Floristic Quality Assessment for Fisher Family Nature Preserve, Emmet County, Michigan

EEB 556: Field Botany of Northern Michigan

August 17, 2007

Elena Doucet-Bëer, Elizabeth Haber, Matt Koski, Carly Kratz,

Denise Nemeth, and Phong Van Nguyen

Abstract

A considerable portion of the native habitat of Michigan has been destroyed by development. Disturbances such as agriculture, logging, and urban sprawl have played a key role in the modification of Michigan's landscape over the last two centuries. This process of land alteration has greatly reduced the number of ecologically diverse habitats within the state, and the protection of these areas is crucial to the survival of many native species. Given the constraints of conserving all remaining native habitats, protected areas must be thoughtfully managed such that they represent a diversity of flora and fauna. One area of interest is the Fisher Family Nature Preserve in Emmet County, Michigan. The Fisher preserve contains upland forest, a steep beach bluff, and a sandy low beach ridge/shoreline. In order to assess the floristic quality of the preserve, we used the Floristic Quality Assessment methodology, proposed by the Michigan Department of Natural Resources. Using this calculation, the Floristic Quality Index (FQI) of the Fisher Family Preserve is 43.28 without adventive species and 40.72 including such species. This FQI value designates the Fisher Family Preserve as a site that hosts high quality native plants. This information is important for the continued management and protection of the Fisher Preserve, given that it is one of a small number of protected sites along the Lake Michigan shoreline.

Introduction

With the advent of agriculture, logging, and human settlement, the natural vegetation cover of nearly every continent has been extensively modified. A cycle of land use change has been repeated throughout recorded history, and the current North American landscape is vastly different from that seen by the first European settlers. Our landscape today is made up of a patchwork of altered areas and fragmented vegetative communities. These patches are located within different soil and community types, and vary in their size and juxtaposition relative to other land uses, and type of ownership. Throughout the world, biodiversity conservation is largely dependent on the preservation and management of these remaining fragments. Careful consideration must be given not only to how these areas are managed but also to whether they should be conserved at all, given their relative ecological integrity.

A simple and reliable tool to assess the quality of the native plant communities of the Chicago region was developed in 1979 by Floyd Swink and Gerould Wilhelm (Mushet et al. 2002). Since then, this tool has been replicated and applied to the plants of other regions. The Floristic Quality Assessment (FQA) is based on the concept of species conservatism, the degree to which a species can tolerate disturbance and its fidelity to unaltered conditions (Mushet et al. 2002). The method requires that all native vascular plant species in a region be assigned coefficients of conservatism, which range from 0 – 10 and represent the estimated probability that a plant is likely to occur in an undisturbed landscape (Herman et al. 2001). The FQA requires a thorough inventory of the vascular flora of a given site. Each plant is assigned the appropriate coefficient of conservatism, and an average coefficient of conservatism (mean C) can be calculated for the entire site by summing the C values for each native species present and dividing this total by the

number of species present (n) (Herman et al. 2001). The Floristic Quality Index (FQI) is an additional variable that can be valuable within the context of a Floristic Quality Assessment. The coefficient of conservatism is multiplied by the square root of the total number of plants (n). The FQI transforms the mean coefficient of conservatism which can allow for better comparison between large sites with many species and small sites with fewer species, providing a way to compare various sites in Michigan of differing sizes (Herman et al. 2001). Higher mean C and FQI values are an indication of higher floristic integrity and a low level of disturbance to a given site. FQA is an important component to any conservation monitoring and management program and should be used in conjunction with other evaluative methods of site integrity.

The FQA methodology has been modified and applied for use in Michigan by the Department of Natural Resources as well as by conservation organizations. Intensive logging of the forests of Michigan in the late 1800s, followed by the failure to log selectively and to replant trees, created empty fields across northern Michigan and small remnant patches of native vegetation. During the early part of the 20th Century, the state created forest preserves and began restoring forests under public ownership. Private organizations have also played a large role in land conservation throughout the state, particularly in recent years, as housing development pressures have increased. One such organization, the Little Traverse Conservancy, owns and manages 164 nature preserves in a five-county region in northern Michigan. As part of EEB 556 Field Botany of Northern Michigan at the University of Michigan Biological Station, we conducted a Floristic Quality Assessment of the Fisher Family Preserve, owned by the Little Traverse Conservancy. The Fisher preserve, acquired in 1994, is a 41-acre site located along M-119 north of Cross Village (Figure 1). The preserve is nearly all wooded upland, but

Fisher Family Preserve, Emmet County Michigan

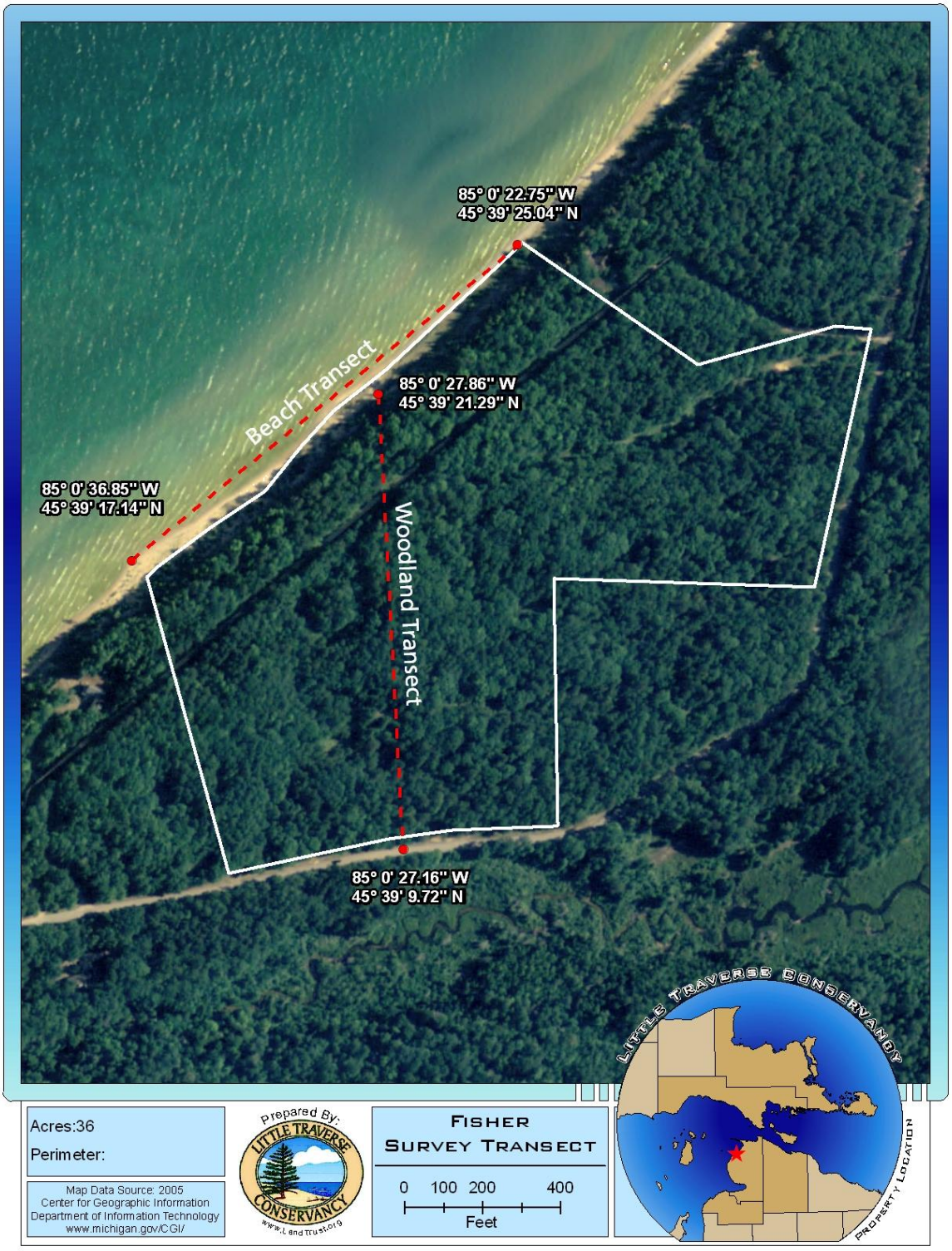

Figure 1. The Fisher Family Preserve, Emmet County, Michigan. The preserve is delineated by solid white lines and the two transects used for the FQA are delineated by dashed lines in red.

continues to the Lake Michigan shoreline, where it is bordered on either side by property with privately owned homes. The preserve is located in the Northern Michigan District II, (Subdistrict 12.2) Regional Landscape Ecosystem, as characterized by Albert and Barnes (1986) (Figure 2). Before the preserve was designated there were plans to develop the land for housing and a road was cut through the center of the preserve to provide access for this development. Additionally, there is a power line cut through the preserve.

Regional Landscape Ecosystems of Lower Michigan, Regions I and II.

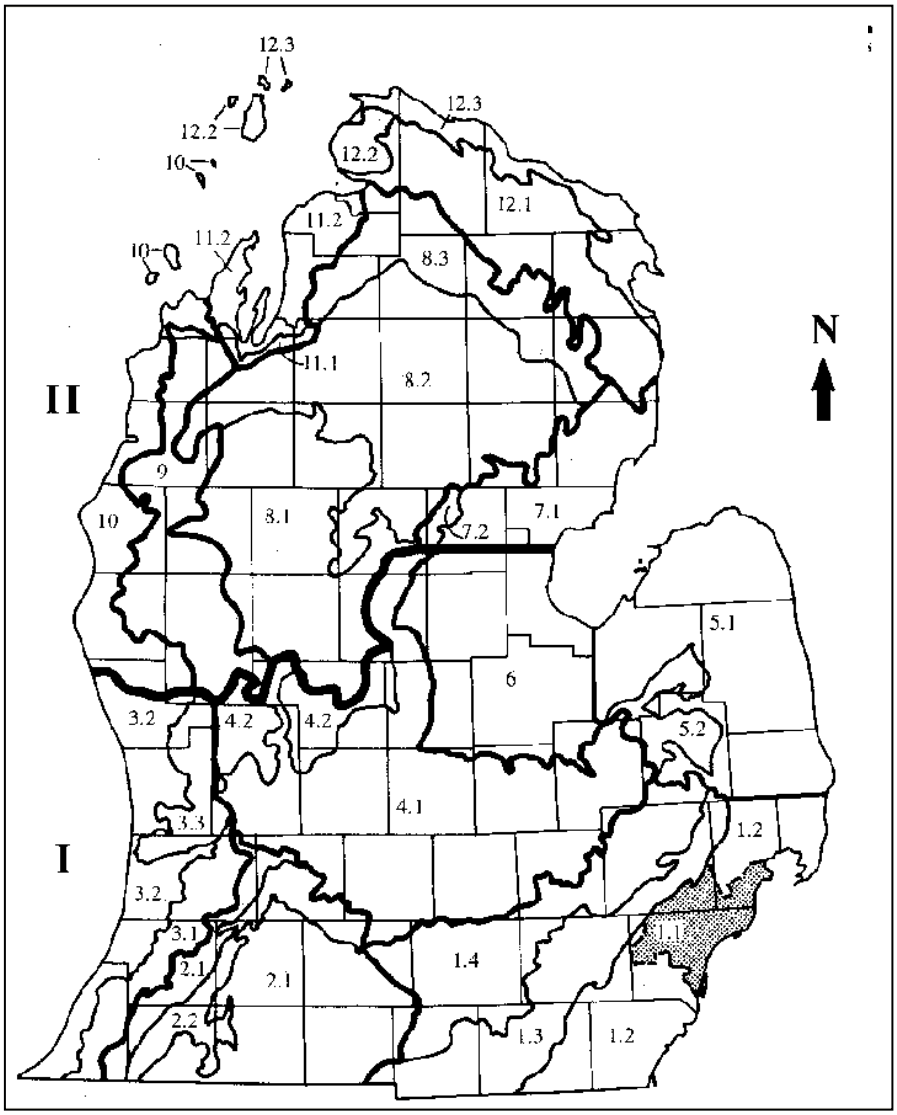

Figure 2. Regional Landscape Ecosystems of Lower Michigan, Regions I and II.

Methods

There are four soil types located within the Fisher Family Preserve. These include Deer Park sand, Stony Lake Beaches, Sandy Lake Beaches and East Port sand. Deer Park sand covers about 90% of the preserve, which is composed of wooded dunes near the shoreline of Lake Michigan. Stony Lake Beaches covers the northern portion of the shoreline, only a few feet above the present level of Lake Michigan. Stony Lake Beaches are made up of sand and gravel and are prone to drought. Sandy Lake Beaches make up the southern half of the shoreline. Sandy Lake Beaches are characterized by the movement of soil (typically sand) from the force of the wind. East Port sand also covers a small area in the northwest corner of the preserve. This section is more wooded than other areas along the shoreline, but is still prone to drought. (National Cooperative Soil Survey 1994).

Our class was divided into two groups of three, and each group was responsible for identifying all plant species from one transect within the preserve. Two transects were examined, one from the edge of M119 to the bluff just before the shoreline (referred to as the woodland transect) and the other along the shoreline (referred to as the shoreline transect) (Figure 1). These transects were chosen in order to best capture the diversity present at the preserve. Although there was some overlap in species between the two transects, the species composition on the shoreline and woodland transects were different because they represent two different ecosystems. By using these two transects we were better able to capture the species diversity of the entire preserve. All plant species were recorded within a meter of each side of the woodland transect, including through the road cut. On the shoreline transect, all species were identified and recorded from the edge of the water to the bluff. Unknown species from both transects were collected and taken

back to the laboratory at the University of Michigan Biological Station (UMBS) for further study. Unknown species were identified using *Michigan Flora* volumes I, II, III (Voss, 1972, 1985, 1996) and the *Illustrated Companion to Gleason and Cronquist's Manual of Vascular Plants of Northeastern United States and Adjacent Canada* (Holmgren et al. 1998), as well as the UMBS Herbarium.

A Floristic Quality Assessment (FQA) was performed using coefficients of conservatism from the Michigan Department of Natural Resources (Herman et al. 2001). The FQA was performed for each transect separately, so that they could be compared, and then both transects together. The FQA is made up of three primary components; the Floristic Quality Index (FQI), Average of the coefficients of conservatism (average C) and the Wetness Index (averageW). The average of the coefficients of conservatism is calculated by adding the coefficients of conservatism for each species in the transect, and then dividing by the total number of species (n); average $C = (\Sigma C)/n$. The FQI is the average of the coefficients of conservatism multiplied by the square root of the total number of species; FQI = (Average C)($\sqrt{n}$). The FQI was calculated both with and without adventive (non-native) species to better assess their impact to the site. The average wetness (Wetness Index) of the site was also calculated (average $W = (\Sigma W)/n$). If this value is less than or equal to zero then the plant community is predominately composed of wetland species.

Results

Forest

The wooded upland area of the Fisher Family Nature Preserve hosted a variety of vascular plants from the groundcover to the canopy. Throughout the forest, common groundcover species were *Gaultheria procumbens*, *Mitchella repens*, and *Lycopodium*

annotinum. Species such as *Vaccinium angustifolium, Gaylussacia baccata, Maianthemum canadense,* and *Pteridium aquilinum* dominated the forest groundcover from the road to power-line cut. The cleared land was dominated by *Pteridium aquilinum* and grass species such as *Bromus inermus* and *Deschampsia flexuosa,* and did not contain any understory or overstory plants. After the power-line cut to the edge of the forest before the bluff, *Polygonatum pubescens, Aralia nudicaulis,* and *Lycopodium dendroideum* dominated the groundcover. *Acer pensylcanicum* and *Pinus strobus* were in the understory, while the dominant overstory species included *Acer rubrum, Quercus rubra, Thuja occidentalis,* and *Pinus resinosa*.

The bluff could be considered a microhabitat along the woodland transect. Groundcover species included *Achillea millefolium*, *Fragaria virginiana, Arctostaphylos uva-ursi,* and *Hieracium caespitosum*. Only one species, *Solidago simplex,* with a coefficient of conservatism of ten occurred on the bluff. The understory within this section of the preserve was dominated by *Thuja occidentalis, Abies balsamea*, *Betula papyrifera,* and *Populus tremuloides*.

Overall, 56 native species and 6 non-native species were identified along the forest and bluff transects. The mean coefficient of conservatism (mean C) was 4.3 for native species and 3.9 for all species. The Floristic Quality Index (FQI) was 30.7 (native species only) and 29.3 (including adventives). The mean coefficient of wetness (mean W) was 2.1 (native species only) and 2.0 (adventives). Based on the value for mean W, the bluff and forest were placed within the facultative upland category, indicating that the given species mainly occur in non-wetland areas.

Shoreline

The shoreline of the Fisher Family Nature Preserve was dominated by graminoids, shrubs, and forbs. The area was divided into the northern shoreline covered with rocks and the southern shoreline covered with sand. The species in the understory of the rocky area were *Populus tremuloides*, *Thuja occidentalis*, *Acer pensylvanicum*, and *Ostrya virginiana*. The groundcover there included *Rubus hispidus* and *Impatiens capensis*. Species occurring at the sandier area of the beach were *Agropyron dasystachyum*, *Ammophila breviligulata*, and *Elymus canadensis*. Species that grew closer to the waterline were *Cakile edentula* and several species of *Juncus*.

Along the shore there was a total of 59 species with 7 adventives. The mean C was 4.6 (native species) and 4.1 (including adventives). The FQI for native species along the shoreline was 33.4. When including adventives, the FQI decreased to 31.4. The mean W including only native species was -0.3. The mean W for all species was 0.4. Plants along the shoreline of the preserve can be categorized as facultative, meaning that they are equally likely to occur in either wetlands or non-wetland areas.

Floristic Quality Assessment for collective preserve

The Floristic Quality Assessment for the entire preserve (87 native species) resulted in a mean C of 4.6, FQI of 43.2, and mean W of 0.7. When including the 11 adventives into the assessment, the mean C and FQI decreased to 4.1 and 40.7, respectively. Mean W increased to 1.1. According to the wetness value, the preserve falls between facultative and facultative upland, indicating that the existing plant species are likely to occur in either wetlands or non-wetlands. Overall composition of the flora

included mostly forbs (46.9%), trees (15.3%), and shrubs (15.3%). The lesser occurring physiognomical categories were fern ally (10.2%), grass (6.1%), sedge (3.1%), vine (2.0%), and fern (1.0%).

Discussion

Shoreline/Low Beach Ridge

The shoreline of Fisher Family Nature Preserve is continuously changing, due not only to wind and wave action and fluctuating lake levels, but also to the soil medium itself. Two types of soils constitute the shoreline: Sandy Lake Beach soil and Stony Lake Beach soil (Alfred, Hyde, and Larson 1973). The southern half of the shoreline, the Sandy Lake Beach soil, experiences constant shifting sand due to the mobility of the small sized soil particles. The excessive movement of sand creates an uncommon ecosystem, populated by specialized plant species. A subset of these species is the dune-stabilizing grasses. Three main species of grasses are present: *Agropyron dasystachyum*, *Ammophila breviligulata*, and *Elymus canadensis*. Of these three grasses, *Ammophila breviligulata* makes the most significant contribution to sand stabilization, with fast-growing rhizomes that can reach lengths of eight feet in one year (Voss 1972). Although these grasses trap moving sand in their root masses, building mounds of relatively stable habitat for later-successional shrubs to establish, such shrubs only occur at the face of the beach ridge near the water.

The habitat just beyond the reach of the waves may be too extreme for the following beach shrubs located on the ridge: *Prunus pumila*, *Salix cordata*, *Salix exigua*, and *Salix myricoides*. A possible justification for this phenomenon is that the beach ridge sand is still too mobile for shrub establishment due to sun and wind drying factors. The shoreline soil is moister, and this moisture gives it stability and a more solid medium for

root establishment. Two tree species grow in the Sandy Lake Beach soil: *Populus baslamifera* and *Quercus rubra*. *Populus balsamifera* has established itself on the same beach ridge as the shrubs, while only one *Quercus rubra* grew in middle of the grasses. Due to such an unstable habitat, no overstory trees (trees with a diameter of 9 cm or more at a height of 1.37m) were present on the beach transect; all species censused are found in the understory (trees with a diameter of less than 9 cm and greater than 1.5 cm at a height of 1.37m) or groundcover (specimens with a diameter of less than 1.5 cm at a height of 1.37 m, or those that do not reach such a height).

The Stony Lake Beach soil provides a habitat separate from the shifting Sandy Lake Beach soil, which is observable by both the presence of a separate set of plant species and the increased amount of biomass. There is also a groundwater stream, originating from the side of the bluff, which flows through this soil type and undoubtedly affects species distribution. The greater stabilization, provided by larger, less mobile soil particles and small rocks, allows for the establishment of semi-permanent shrubs and small trees such as *Rubus hispidus* and *Populus tremuloides*. Additionally, trees and shrubs already found growing on the Sandy Beach soil, such as *Salix myricoides* and *Populus balsamifera*, are more common and robust on the Stony Beach soil. Many *Salix myricoides* plants here surpass a height of six feet, while the same species only reached a height of three feet on the sand. Besides increased stabilization, the Stony Lake Beach soil provides greater moisture retention. This facilitates the growth of species with a negative wetland coefficient, such as *Triglochin palustre, Solidago ohioensis* and *Equisetum fluviatale*. Species with a negative wetland coefficient are more likely to grow in moist areas than in drier uplands. The calcium-rich groundwater stream creates a microhabitat within the Stony Lake Beach ecosystem that hosts a variety of species not

seen anywhere else on the shoreline. Such species include *Carex hystericina, Juncus nodosus, Epilobium coloratum* and a dense mat of *Equisetum variegatum*.

The mean C-value at this site, 4.03 with all species and 4.60 without adventives, being slightly higher than that of the upland forest, may suggest that the beach community has retained its floristic quality slightly better than its upland counterpart. This could be due to the lack of human disturbance on the shoreline. The FQI for the Shoreline/Beach Ridge transect, 30.46 including all species and 32.53 without adventives, although not above 35, still reveals that this habitat is of higher quality than most undisturbed land in Michigan and therefore is valuable. The overall average value for the Wetness Coefficient was 0.39 including all plants and -0.16 excluding adventives, categorizing the shoreline/beach ridge transect as facultative. This means that the average plant specimen in this transect is as equally likely to occur in wetlands as in non-wetlands. However, the calculation of a single wetland coefficient for the entire transect proved problematic. Many of the plants with low wetland coefficients converged on the Stony Beach soil. It may be interesting to look at the areas with two soil types separately to determine if either of the areas has a higher component of wetland plants.

Seven adventive species were found in the shore/beach ridge transect. The main concern with adventives on this transect comes from *Centaurea maculosa*. This species has vigorous growth and seed dispersal and is a serious threat to native flora (Voss 1996). Although less than ten specimens of this plant were found along the shoreline, considerable spread is likely to occur if these individuals are not removed.

Forest

Prior to European settlement, the upland forested area of the Fisher Family Preserve was dominated by *Pinus strobus* and *Pinus resinosa* (Comer et al. 1998). *Pinus*

strobus-Pinus resinosa stands are interspersed on drier, rockier sites within a larger forest community type known as a Northern Hardwoods Community (Barnes 2004). *Pinus resinosa* remains a dominant overstory tree today; however other dominant species now include *Populus grandidentata* and *Quercus rubra*. *Pinus strobus* is present mainly as an understory tree, most likely due to selective logging. The dominant overstory species are characteristic of sandy, well drained soils (Barnes & Wagner 2004), which is consistent with the characteristics of the dominant soil type at the site, Deer Park sand. This soil type is characteristic of wooded dunes, is dry and susceptible to blowing.

Most of the forest transect understory was comprised of *Gaultheria procumbens, Vaccinium angustifolium and Gaylussacia baccata*. *Vaccinium angustifolium* and *Gaultheria procumbens* occur in dry situations and thrive after fire (Voss 1996). *Gaylussacia baccata* thrives in acid situations and can be found in wet or dry areas (Voss 1996). Overall, the understory and overstory vegetation along the forest transect are indicative of dry, sandy soils found in the Preserve and the soil is most likely moderately acid.

The species composition of the forested area near the bluff differs greatly from the *Pinus resinosa*-dominated forest. Dominant overstory trees include *Tsuga canadensis, Abies balsamea* and *Thuja occidentalis. Tsuga canadensis* and *Thuja occidentalis* are indicators of wet, calcareous conditions. The understory is rather sparse, probably due to limited light in the understory, but does include *Mitchella repens* and *Polygonatum pubescens.* These understory species are common in beech-maple forests (Voss 1996) which often have more mesic conditions, higher soil moisture and a more neutral pH than pine-dominated forests. Adventive species in this area are *Epipactus helleborine* and *Veronica officinalis,* most likely introduced through adjacent road development. This drastic change in forest composition is due to the close proximity to Lake Michigan.

Lake effects create a cooler, moister microclimate which supports different vegetation types compared to areas further from the shore.

The end of the forest transect includes a steep sand-rock bluff adjacent to the beach. This area is highly exposed to heavy winds and sunlight. The bluff is less vegetated than the forest due to difficulty of establishment in an unstable substrate and harsh environmental conditions. We identified adventive species on the bluff including *Arenaria serpyllifolia* and *Hieracium caespitosum*. Their ability to thrive here may be due to an abundance of open substrate and light availability. However, species with high C-values are also found on the bluff; *Solidago simplex* with a C-value of 10 and *Arabis lyrata* with a C-value of 7.

The mean C-value of the forest transect was 4.29 including only native species, and 3.91 including adventives. The FQI was 30.67 without adventives, and 19.27 with adventives. These values are only slightly lower than the beach transect. The wetness coefficient of the forest transect was 2 (native species) and 2.31 (including adventives), placing it in the facultative upland wetland category. The forest community of the Preserve occasionally occurs in wetlands but most often in non-wetlands (Herman et al. 2001).

Collective Preserve

The average C value for both transects of the Fisher Family Nature Preserve, 4.16 and 4.69 without adventives, combined with the relatively high FQI value of 40.72 with all species and 42.28 without adventives, reveals that this preserve has maintained its floristic quality much more so than most undeveloped land areas in the state. The average FQI is less than 20 for Michigan's undeveloped areas. Areas with FQI values above 35 are floristically important in a state wide perspective as they possess sufficient

conservatism and species richness. Although not above 50, the Preserve's FQI value indicates that it encompasses a large fragment of pre-European settlement biodiversity.

A large portion of the high FQI is likely due to the relatively large number of high quality native species. Roughly 6.25% of the species we found at the Preserve had a C-value of 10. These species are extremely likely to be found in the pre-European settlement environment. Interestingly, these species; *Agropyron dasystachyum, Ammophila breviligulata, Lathyrus japonicus, Salix cordata, Solidago simplex,* and *Tanacetum huronense,* are present only on the beach, with exception of *Solidago simplex,* which occurs on face of the bluff. Particularly important of these plants is *Tanacetum huronense,* a state listed threatened species. This species is threatened by anthropogenic impact on shorelines, dune stabilization and invasive species, however is not actively managed (Michigan Natural Features Inventory 2004). Protection of shoreline habitat where *Tanacetum huronense* is found is currently the best way to preserve this species. The continued protection and management of the Fisher Preserve will be critical to the long-term survival of *Tanacetum huronense*.

Moreover, 18.7% of the plant species in the Preserve had a C-value of over 7. Upland forest species, such as *Arcostaphyllos uva-ursi,* and *Chimaphila umbellata,* fall into this category, indicating that remnants of the native biodiversity are still present in this ecosystem. The shoreline transect also contained several species in this category, such as *Elymus canadensis, Equisetum variegatum, Arabis lyrata* and *Prunus pumila*.

The mean Wetland Coefficient for the entire Preserve, 1.09 with adventives and 0.71 without adventives, categorizes the Fisher Family Preserve as a facultative site. This means that the average plant in the preserve can be found in both uplands and wetlands, with a slight tendency toward uplands. This calculation is somewhat misleading because the presence of the two (or more) distinct ecosystems with different hydrological

properties. When distinguishing the extent of wetlands at this preserve, it is more advantageous to look at each transect separately. Although there is a difference between Wetness Coefficients of the two transects, neither is low enough to be protected under Part 303 (Wetland protection) of Michigan's 1994 Public act 451 (Herman et al. 2001). One would more appropriately label the Fisher Family Preserve as a diverse upland habitat than a wetland.

A total of twelve non-native species were found within the preserve. Most concerning among these species are *Centaurea maculosa,* and *Epipactis helleborine*. These plants pose a serious threat to the Fisher preserve because each has the ability to spread throughout their respective habitats by wind dispersed seeds. The other invasives are constrained to only a small area and therefore do not pose a great threat. In order to preserve the existing biodiversity of Fisher Family Preserve, we strongly suggest the removal of *Centaurea maculosa* and *Epipactis helleborine*.

In Michigan, the Great Lakes shoreline is threatened by increased rates of development relative to inland areas (Environmental Protection Agency 2001). The Nature Conservancy describes coastal dunes as the most diverse of any ecosystem in the Great Lakes, however they are increasingly fragmented (Cabala et al. 2006). The Fisher Family Preserve, abundant with high-quality native shore species, protects a portion of Michigan's diminishing pristine shoreline. Collectively, the preserve's significantly high FQI value, more than two times that of the average undeveloped area justify its protection. The values of ecological integrity found through this analysis can be used by the Little Traverse Conservancy to compare the floristic integrity of the Fisher Family Preserve to that of other preserves or areas under consideration for protection. The FQA may also be useful in policy and management decisions when rare or threatened species and unique habitats are being assessed for protected status.

Appendix A

Composite list of all species found on the Fisher Family Nature Preserve, Emmet County, Michigan.

Floristic Quality Data		Native	87	88.8%	Adventive	11	11.2%
Total native species	87	Tree	15	15.3%	Tree	0	0.0%
Total species	98	Shrub	15	15.3%	Shrub	0	0.0%
Native mean C	4.6	W-Vine	2	2.0%	W-Vine	0	0.0%
Mean C with adventives	4.1	P-Forb	30	30.6%	P-Forb	7	7.1%
Native FQI	43.2	B-Forb	4	4.1%	B-Forb	1	1.0%
FQI with adventives	40.7	A-Forb	3	3.1%	A-Forb	1	1.0%
Native mean W	0.7	P-Grass	4	4.1%	P-Grass	2	2.0%
Mean W with adventives	1.1	P-Sedge	3	3.1%	P-Sedge	0	0.0%
Average Wetland Classification	FAC-	Fern	1	1.0%	Fern	0	0.0%
		Fern ally	10	10.2%	Fern ally	0	0.0%

ACRONYM	C	SCIENTIFIC NAME	ST	W	WET	PHYS	COMMON NAME
ABIBAL	**3**	Abies balsamea		-3	FACW	Nt Tree	BALSAM FIR
ACEPEN	**5**	Acer pensylvanicum		3	FACU	Nt Tree	STRIPED MAPLE
ACERUB	**1**	Acer rubrum		0	FAC	Nt Tree	RED MAPLE
ACESAU	**5**	Acer saccharum		3	FACU	Nt Tree	SUGAR MAPLE
ACHMIL	**1**	Achillea millefolium		3	FACU	Nt P-Forb	YARROW
AGRDAS	**10**	Agropyron dasystachyum		4	FACU-	Nt P-Grass	WHEAT GRASS
AMEARB	**4**	Amelanchier arborea		3	FACU	Nt Tree	JUNEBERRY
AMELAE	**4**	Amelanchier laevis		5	[UPL]	Nt Tree	SMOOTH SHADBU
AMMBRE	**10**	Ammophila breviligulata		5	[UPL]	Nt P-Grass	MARRAM GRASS
ANAMAR	**3**	Anaphalis margaritacea		5	[UPL]	Nt P-Forb	PEARLY EVERLASTING
APOAND	**3**	Apocynum androsaemifolium		5	[UPL]	Nt P-Forb	SPREADING DOGBANE
ARALYR	**7**	Arabis lyrata		4	FACU-	Nt B-Forb	SAND CRESS
ARANUD	**5**	Aralia nudicaulis		3	FACU	Nt P-Forb	WILD SARSAPARILLA
ARCUVA	**8**	Arctostaphylos uva-ursi		5	[UPL]	Nt Shrub	BEARBERRY
ARESER	*****	ARENARIA SERPYLLIFOLIA		0	FAC	Ad A-Forb	THYME-LEAVED SANDWORT
ARTCAM	**5**	Artemisia campestris		0	[FAC]	Nt B-Forb	WORMWOOD
ASCSYR	**1**	Asclepias syriaca		5	[UPL]	Nt P-Forb	COMMON MILKWEED
ASTLAE	**5**	Aster laevis		5	[UPL]	Nt P-Forb	SMOOTH ASTER
ASTLAN	**2**	Aster lanceolatus		-3	[FACW]	Nt P-Forb	EASTERN LINED ASTER
BETPAP	**2**	Betula papyrifera		2	FACU+	Nt Tree	PAPER BIRCH
BROINE	*****	BROMUS INERMIS		5	[UPL]	Ad P-Grass	SMOOTH BROME
CAKEDE	**5**	Cakile edentula		3	FACU	Nt A-Forb	SEA ROCKET
CENMAU	*****	CENTAUREA MACULOSA		5	[UPL]	Ad B-Forb	SPOTTED BLUET
CHIUMB	**8**	Chimaphila umbellata		5	[UPL]	Nt Shrub	PIPSISSEWA
CXARTA	**3**	Carex arctata		5	[OBL]	Nt P-Sedge	SEDGE
CXHYST	**2**	Carex hystericina		-5	OBL	Nt P-Sedge	SEDGE
CXPENS	**4**	Carex pensylvanica		5	[UPL]	Nt P-Sedge	SEDGE
DESFLE	**6**	Deschampsia flexuosa		5	[UPL]	Nt P-Grass	HAIR GRASS
DIELON	**4**	Diervilla lonicera		5	[UPL]	Nt Shrub	BUSH HONEYSUCKLE
ELYCAN	**7**	Elymus canadensis		1	FAC-	Nt P-Grass	CANADA WILD-RYE
EPICOL	**3**	Epilobium coloratum		-5	OBL	Nt P-Forb	CINNAMON WILLOW-HERB

ACRONYM	C	SCIENTIFIC NAME	ST	W	WET	PHYS	COMMON NAME
EPIHEL	*	EPIPACTIS HELLEBORINE		5	[UPL]	Ad P-Forb	HELLEBORINE
EPIREP	7	Epigaea repens		5	[UPL]	Nt Shrub	TRAILING ARBUTUS
EQUARV	0	Equisetum arvense		0	FAC	Nt Fern Ally	COMMON HORSETAIL
EQUFLU	7	Equisetum fluviatile		-5	OBL	Nt Fern Ally	WATER HORSETAIL
EQUHYE	2	Equisetum hyemale		-2	FACW-	Nt Fern Ally	SCOURING RUSH
EQULAE	2	Equisetum laevigatum		-3	FACW	Nt Fern Ally	SMOOTH SCOURING RUSH
EQUSCI	7	Equisetum scirpoides		-1	FAC+	Nt Fern Ally	DWARF SCOURING RUSH
EQUSYL	5	Equisetum sylvaticum		-3	FACW	Nt Fern Ally	WOODLAND HORSETAIL
EQUVAR	8	Equisetum variegatum		-3	FACW	Nt Fern Ally	VARIEGATED SCOURING RUSH
FAGGRA	6	Fagus grandifolia		3	FACU	Nt Tree	AMERICAN BEECH
FRAVIR	2	Fragaria virginiana		1	FAC-	Nt P-Forb	WILD STRAWBERRY
GALTRR	4	Galium triflorum		2	FACU+	Nt P-Forb	FRAGRANT BEDSTRAW
GAUPRO	5	Gaultheria procumbens		3	FACU	Nt Shrub	WINTERGREEN
GAYBAC	7	Gaylussacia baccata		3	FACU	Nt Shrub	HUCKLEBERRY
HIECAE	*	HIERACIUM CAESPITOSUM (H. PRATENSE)		5	[UPL]	Ad P-Forb	KING-DEVIL
HIEKAL	3	Hieracium kalmii		5	[UPL]	Nt P-Forb	KALM'S HAWKWEED
HIEPIS	*	HIERACIUM PILOSELLOIDES		5	[UPL]	Ad P-Forb	GLAUCOUS KING-DEVIL
HUPLUC	5	Huperzia lucidula (Lycopodium lucidulum)		-1	[FAC+]	Nt Fern Ally	SHINING CLUBMOSS
IMPCAP	2	Impatiens capensis		-3	FACW	Nt A-Forb	SPOTTED TOUCH-ME-NOT
JUNALP	5	Juncus alpinus		-5	OBL	Nt P-Forb	RUSH
JUNBAL	4	Juncus balticus		-5	OBL	Nt P-Forb	RUSH
JUNCOI	4	Juniperus communis		3	[FACU]	Nt Shrub	COMMON or GROUND JUNIPER
JUNNOD	5	Juncus nodosus		-5	OBL	Nt P-Forb	JOINT RUSH
LATJAP	10	Lathyrus japonicus		4	FACU-	Nt P-Forb	BEACH PEA
LONDIO	5	Lonicera dioica		3	FACU	Nt W-Vine	RED HONEYSUCKLE
LYCAME	2	Lycopus americanus		-5	OBL	Nt P-Forb	COMMON WATER HOREHOUND
LYCANN	5	Lycopodium annotinum		0	FAC	Nt Fern Ally	STIFF CLUBMOSS
LYCDEN	5	Lycopodium dendroideum		0	FAC	Nt Fern Ally	TREE CLUBMO
MAICAC	4	Maianthemum canadense		0	FAC	Nt P-Forb	CANADA MAYFLOWER
MELLIN	6	Melampyrum lineare		1	FAC-	Nt A-Forb	COW-WHEAT
MITREP	5	Mitchella repens		2	[FACU+]	Nt P-Forb	PARTRIDGE BERRY
OENBIE	2	Oenothera biennis		3	FACU	Nt B-Forb	COMMON EVENING-PRIMROSE
OSTVIR	5	Ostrya virginiana		4	FACU-	Nt Tree	IRONWOOD; HOP HORNBEAM
PINRES	6	Pinus resinosa		3	FACU	Nt Tree	RED PINE
PINSTR	3	Pinus strobus		3	FACU	Nt Tree	WHITE PINE
POACOM	*	POA COMPRESSA		2	FACU+	Ad P-Grass	CANADA BLUEGRASS
POLPUB	5	Polygonatum pubescens		5	[UPL]	Nt P-Forb	DOWNY SOLOMON SEAL
POPBAL	2	Populus balsamifera		-3	FACW	Nt Tree	BALSAM POPLAR
POPTRE	1	Populus tremuloides		0	FAC	Nt Tree	QUAKING ASPEN
POTANS	5	Potentilla anserina		-4	FACW+	Nt P-Forb	SILVERWEED
PRUPUM	8	Prunus pumila		5	UPL	Nt Shrub	SAND CHERRY
PRUVIR	2	Prunus virginiana		1	FAC-	Nt Shrub	CHOKE CHERRY
PTEAQU	0	Pteridium aquilinum		3	FACU	Nt Fern	BRACKEN FERN
QUERUB	5	Quercus rubra		3	FACU	Nt Tree	RED OAK
RUBHIS	4	Rubus hispidus		-3	FACW	Nt Shrub	SWAMP DEWBERRY
RUBPUB	4	Rubus pubescens		-4	FACW+	Nt P-Forb	DWARF RASPBERRY
RUBSTR	2	Rubus strigosus (R. idaeus)		-2	FACW-	Nt Shrub	WILD RED RASPBERRY
RUMTRI	1	Rumex triangulivalvis		-3	FACW	Nt P-Forb	DOCK
SALCOR	10	Salix cordata		-1	FAC+	Nt Shrub	SAND-DUNE WILLOW

ACRONYM	C	SCIENTIFIC NAME	ST	W	WET	PHYS	COMMON NAME
SALEXI	**1**	Salix exigua (S. interior)		-5	OBL	Nt Shrub	SANDBAR WILLOW
SALMYR	**9**	Salix myricoides (S. glaucophylloides)		-3	FACW	Nt Shrub	BLUELEAF WILLOW
SCULAT	**5**	Scutellaria lateriflora		-5	OBL	Nt P-Forb	MAD-DOG SKULLCAP
SEDACR	*****	SEDUM ACRE		5	[UPL]	Ad P-Forb	MOSSY STONECROP
SILVUL	*****	SILENE VULGARIS (S. CUCUBALUS)		5	[UPL]	Ad P-Forb	BLADDER CAMPION
SMISTE	**5**	Smilacina stellata		1	FAC-	Nt P-Forb	STARRY FALSE SOLOMON-SEAL
SOLOHI	**8**	Solidago ohioensis		-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLSIM	**10**	Solidago simplex		3	[FACU]	Nt P-Forb	GILLMAN'S GOLDENROD
TANHUR	**10**	Tanacetum huronense	**T**	4	[FACU-]	Nt P-Forb	LAKE HURON TANSY
TAROFF	*****	TARAXACUM OFFICINALE		3	FACU	Ad P-Forb	COMMON DANDELION
THUOCC	**4**	Thuja occidentalis		-3	FACW	Nt Tree	ARBOR VITAE
TOXRAR	**2**	Toxicodendron radicans		-1	FAC+	Nt W-Vine	POISON-IVY
TRIBOR	**5**	Trientalis borealis		-1	FAC+	Nt P-Forb	STARFLOWER
TRIGRA	**5**	Trillium grandiflorum		5	[UPL]	Nt P-Forb	COMMON TRILLIUM
TRIPAL	**8**	Triglochin palustre		-5	OBL	Nt P-Forb	SLENDER BOG ARROW-GRASS
VACANG	**4**	Vaccinium angustifolium		3	FACU	Nt Shrub	BLUEBERRY
VERANA	**4**	Veronica anagallis-aquatica		-5	[OBL]	Nt B-Forb	WATER SPEEDWEL
VEROFF	*****	VERONICA OFFICINALIS		5	[UPL]	Ad P-Forb	COMMON SPEEDWELL

Literature Cited

Albert, D., S.R. Denton and B.V. Barnes. 1986. Regional Landscape Ecosystems of Michigan. School of Natural Resources, University of Michigan, Ann Arbor. pp. 1-32.

Alfred, S.D., Hyde, A.G., Larson, R.L. 1973. Soil Survey of Emmet County, Michigan. United States Department of Agriculture Soil Conservation Service. U.S. Government Printing Office. Washington D.C. pp. 32-33.

Barnes, B.V. and H.W. Wagner. 2004. Michigan trees: a guide to the trees of the Great Lakes Region, revised and updated. The University of Michigan Press, Ann Arbor, MI. pp. 1-446.

Cabala, T.,B. Garman, and H. McDiarmid. Michigan Environmental Council. Developing Our Coastlines: Michigan Communities Take Stock of Their Great Lakes Assets. August 2007.

Comer, P. J., D. A. Albert, with M. B. Austin (cartographer). 1998. Vegetation of Michigan circa 1800: An interpretation of the General Land Office Surveys. Michigan Natural Features Inventory, Michigan Dept. Nat. Res., Wildlife Div. 2 maps.

Environmental Protection Agency (EPA). National Coastal Conditions Report 2001. September 2001. <http://www.epa.gov/owow/oceans/ncrr/downloads.html.>

Herman, K.D., L.A. Masters, M.R. Penskar, A.A. Reznicek, G.S. Wilhelm, W.W. Brodovvich, 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, Mich. 19 pp. + Appendices.

Holmgren, N.H., P.K. Holmgren and H.A. Gleason. 1998. Illustrated Companion to Gleason and Cronquist's Manual of Vascular Plants of Northeastern United States and Adjacent Canada. New York Botanical Garden. pp. 1-937.

Mushet, D.M., N.H. Euliss, Jr., and T. Shaffer. 2002. Floristic Quality Assessment of One Natural and Three Restored Wetland Complexes in North Dakota, USA. Wetlands 22: 126-138. pp. 126-138.

National Cooperative Soil Survey, USDA.1994.
<http://www2.ftw.nrcs.usda.gov/osd/dat/E/EASTPORT.html>

Penskar, M.R., A.A. Reznicek, W.W. Brodovich, G.S. Wilhelm, L.A. Masters, K.D. Herman, 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 Division, Natural Heritage Program. Lansing, MI. 19 pp. + Appendices.

Voss, E.G. 1972. Michigan Flora, Part I: Gymnosperms and Monocots. Cranbrook Institute of Science and the University of Michigan Herbarium. Bloomfield Hills and Ann Arbor. pp. 1-488.

Voss, E.G. 1972. Michigan Flora, Part II: Dicots. Cranbrook Institute of Science and the University of Michigan Herbarium. Bloomfield Hills and Ann Arbor. pp. 1-724.

Voss, E.G. 1996. Michigan Flora, part III: Dicots Concluded. Cranbrook Institute of Science and the University of Michigan Herbarium. Bloomfield Hills and Ann Arbor. pp. 1-622.