



Biological Inventory For Conservation of Great Lakes Islands: 1999 Progress Report



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Executive Summary

In 1998, Michigan Natural Features Inventory (MNFI) initiated a multi-year project to conduct biological inventories for the conservation of Great Lakes islands. The fundamental goal of this project is to systematically examine selected Great Lakes islands, compile comprehensive information on natural features and significant biodiversity areas, and then convey this information in the most useful form for landowner education and conservation planning purposes. The first year of the project focused on biological inventories in the Beaver Island archipelago (Beaver and Garden islands in Charlevoix County) and a selective floristic survey of several islands within the Garden Peninsula group (Poverty, Summer, and Little Summer islands in Delta County). In year two, we continued inventories within the Beaver Island archipelago and also conducted inventory work in northern Lake Huron, focusing on Bois Blanc Island (Mackinac County), Marquette and La Salle islands within the Les Cheneaux chain (Mackinac County), and Drummond Island (Chippewa County). In addition, a prototype conservation planning workshop was held on Beaver Island for residents and other island stakeholders.

In 1999, animal surveys were conducted on Beaver, Garden, and Bois Blanc islands, focusing on migratory and breeding birds, rare insects, and selected reptiles. Overall, 133 different bird species were observed; 108 species were observed during spring migration and 109 species were observed during summer breeding season. Fifty-one species were classified as long-distance migrants, 55 species were classified as short-distance migrants, and 27 species were classified as resident taxa. Mean bird abundance during spring migration was greater on Bois Blanc Island when compared to Beaver and Garden islands; species richness was greater on Beaver and Bois Blanc islands than on Garden Island. Mean bird abundance during the summer breeding season was greater on Bois Blanc Island when compared with Beaver and Garden islands; species richness during the summer breeding season was slightly higher on Bois

Blanc Island than on the other two islands. A quantitative assessment of habitat use by migratory birds was conducted via selected point count censusing stations. During spring migration, a greater number of individuals and bird species were recorded near cobble shorelines bordered by coniferous forest, or near an inland lake or wetland.

With regard to rare bird species, no piping plovers were observed on Beaver Island at a previously known site near McCauley Point. Common loon was recorded at several locations on Beaver Island and at one Bois Blanc Island site. Red-shouldered hawks responded to taped calls and were observed or otherwise heard at several sites on Bois Blanc Island. Additional rare bird observations include bald eagle (Beaver and Bois Blanc islands), American bittern (Bois Blanc and Beaver islands), caspian tern (Bois Blanc and Beaver islands), common tern (Bois Blanc Island), osprey (Beaver and Garden islands), Northern harrier (Beaver Island), Forster's tern (Beaver Island), common moorhen (Beaver island), and merlin (Beaver and Garden islands).

In other animal surveys, no aweme borer moths were found on Beaver Island at McCauley Point, site of the only known observation for this extremely rare taxon in Michigan. New populations of the endemic Lake Huron locust were found at all three sites surveyed on Beaver island; no sites were identified on Bois Blanc Island, where little suitable habitat was found. Suitable habitat for the federal endangered Hine's emerald dragonfly was identified on Bois Blanc Island, where it was subsequently learned that a researcher had documented new locations for this species just prior to the MNFI inventory. No Eastern massasauga rattlesnakes were observed during limited meander surveys on Bois Blanc Island, although a resident population likely remains extant, based on recent observations of island residents.

Aquatic surveys focused on four inland lakes and two streams on Beaver Island, and included dedicated surveys to determine the status of the deepwater pondsnail. No extant locations of the pondsnail were observed. SCUBA survey of Fox

Lake concluded that reports of this species there are likely in error, based on the apparent absence of suitable habitat. No rare or sensitive taxa were identified during these brief aquatic surveys. It was concluded that the aquatic systems of Beaver Island are notably unique; there is striking ecological diversity among the lakes for the relatively small geographic area represented.

Plant and natural community surveys were conducted on all of the 1999 island study sites. Numerous new plant and community occurrences were documented, and many previously known occurrences were located and updated with current status information. For Beaver Island, four new natural community occurrences (one of open bog, two of mesic northern forest, one of dry-mesic northern forest) were documented. Fourteen previously known occurrences of plant species were located and updated (two of dwarf lake iris, one of Pumpelly's brome grass, three of Pitcher's thistle, three of Lake Huron tansy, one of ram's head ladyslipper orchid, two of butterwort, one of beauty sedge, and one of Michigan monkey-flower). On Garden Island, eight new occurrences were documented (one of northern wet meadow, two of Great Lakes marsh, one of Houghton's goldenrod, two of northern fen, and two of beauty sedge). Five previously documented occurrences were relocated and updated (one of boreal forest, one of butterwort, two of Pitcher's thistle, one of mesic northern forest). On Hog Island, five new occurrences were documented (one of northern fen, one of forest-dune swale complex, one of Great Lakes marsh, one of dwarf lake iris, and one of hardwood swamp). Two previously known occurrences were relocated and updated (one of Pitcher's thistle, one of dry-mesic northern forest). On Marquette and La Salle islands in the Les Cheneaux chain, nine new occurrences were documented (three of beauty sedge, one of northern fen, two of boreal forest, one of dwarf lake iris, one of yellow pitcher-plant, and one of open dunes). Two previously known occurrences were relocated and updated (one of dwarf lake iris, one of Great Lakes marsh). Lastly, on Drummond Island, two new occurrences were documented (one of slender

cliff-brake, one of dry non-acid cliff), and one previously known occurrence was relocated and updated (wall-rue).

As part of this project, all natural features occurrences within the Beaver Island archipelago were digitized for spatial representation within a Geographic Information System (GIS) following transcription, updating, and data processing for the statewide Biological and Conservation Database (BCD). Sites included known locations on all significant islands within the archipelago, including Beaver, Garden, High, Hog, Squaw, Whiskey, and Trout islands as necessary.

A prototype conservation planning workshop was designed and conducted for Beaver Island. A community-based approach was selected, in order to allow residents and other important stakeholders to determine what types and levels of MNFI data they would like, what form or forms it might take, and how to use the available information most effectively. Ultimately, instead of one conservation planning workshop, MNFI developed and organized one presentation as part of an annual meeting and then conducted an interactive workshop, the latter open to all Beaver Island residents and interested parties. A presentation was given during the 1999 annual meeting of the Beaver Island Property Owners Association (BIPOA), the most active group within the community. Approximately 100 people attended the annual meeting. The interactive workshop, open to all residents and stakeholders and held in August, was entitled "Preserving the Natural Resources and Community Character of Beaver Island". The latter workshop was prepared and conducted with the assistance of the Land Information and Access Association (LIAA). Fundamental findings and recommendations of the workshop included developing an arrival guide to inform new residents and visitors about the unique natural and cultural features on Beaver Island and surrounding area, and how to be good land stewards. It was also suggested that a user-friendly electronic kiosk be installed, along with instructive brochures for dissemination. Lastly, and perhaps more importantly, a suggestion was made to integrate natural features information collected by MNFI and others with the current

values of islanders into the comprehensive master planning process for each of the island's two townships.

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Introduction

This progress report presents the results of year two of a multi-year project to conduct systematic inventories of selected Great Lakes island groups, followed by conservation planning efforts. As noted previously (Penskar et al. 1998), a considerable portion of the biological diversity unique to the Great Lakes region is found on islands. Soule (1993) stated that “nowhere else does the combination of vast, interconnected, mid-continental bodies of freshwater and such a number of variety of islands occur.” Thus, the nearly 600 islands contained within Michigan’s borders comprise a critically important part of this freshwater landscape, owing to their richness in variety of geography, geological origin, indigenous and non-indigenous human history, and biodiversity.

Over the past two decades Michigan Natural Features Inventory (MNFI) has surveyed numerous natural communities and rare species found on or allied with Great Lakes islands. This extensive work was described in part by Soule (1993) and was detailed in last year’s progress report (Penskar et al. 1998), and therefore will not be repeated here. Conducting comprehensive biological inventories on Great Lakes islands is both timely and crucial to future conservation planning, as reflected in the findings and recommendations of The State of the Great Lakes Island Report (Vigmostad 1999). Vigmostad reports the proceedings of a 1996 U.S-Canada Great Lakes islands workshop

convened by the Great Lakes Island Project (Department of Resource Development, Michigan State University) to determine the state of Great Lakes islands and elucidate potential conservation strategies. Among the three fundamental findings of the workshop was a recommendation for governments and other entities to support island and archipelago conservation, and to that end, to base conservation planning on “good” (i.e. sound) scientific information. Comprehensive inventories are thus critical to building the strong base of scientific knowledge upon which conservation strategies are dependent.

In this compilation of our second-year efforts, we provide the results of the completion of biological inventories for the principal islands of the Beaver archipelago selected for surveys, consisting of Beaver, Garden, and Hog islands. We also provide a description and summary of a prototype island conservation planning workshop given on Beaver Island to key island stakeholders. Included within this report are also the results of biological inventories conducted variously by zoologists, botanists, and ecologists in northern Lake Huron, where we initiated surveys on Bois Blanc Island, selected islands within the Les Cheneaux archipelago, and the eastern shoreline of Drummond Island. As in the first year progress report, a preliminary identification of important biodiversity areas is presented in the conclusions section.

Organization of Report

This report has been organized according to the various inventory efforts within the aforementioned sites, followed by a summary of the conservation planning activities completed for Beaver Island. Biological inventories in 1999 consisted of the following types: animal surveys, with an emphasis on migratory birds and rare invertebrates; plant inventories, focusing on Great Lakes shoreline endemics and the identification of intact coastal and interior habitats; natural community surveys, emphasizing the delineation and assessment of

high quality natural communities; and lastly, aquatic ecology surveys, with a focus on the inland lakes and streams on Beaver Island and an emphasis on verifying historic occurrences of rare snails, in addition to general aquatic surveys to determine biodiversity potential. Methods, results, and discussion are provided separately for each of the aforementioned components. The report concludes with an assessment of significant biodiversity areas and a brief description of the projected and ongoing work for year 2000 surveys.

The Study Areas

In northern Lake Michigan, the study sites for the second year of island inventory included Beaver, Garden, and Hog islands, three of principal islands within the Beaver Island group in northeast Lake Michigan (Figure 1). Located approximately 19 miles west of its nearest point in Emmet County on the Lower Peninsula mainland, Beaver is the largest of these islands, covering approximately 37,000 acres. Several thousand acres of the southern half of the island occur within the Mackinac and Jordan River State Forests. Public land thus comprises the majority of this region of the island. To the north, about 1.25 miles at its closest point, lies Garden Island, the second largest of the group, covering approximately 4,400 acres and occurring entirely within the Beaver Islands State Wildlife Research Area (WRA). Hog Island, which lies approximately 3 miles east of Garden Island, also occurs within the WRA, and is more than 2000 acres in size. The remaining islands of the Beaver archipelago, which were not visited during this inventory, are Gull, Hat, High, Squaw, Trout, and Whiskey islands, variously located to the east, west and south of Beaver and Garden islands. These islands range in size from about 11 to more than 3,500 acres.

In northern Lake Huron, the study sites consisted of Bois Blanc Island, Marquette and La Salle islands in the Les Cheneaux group, and Drummond Island (Figure 2). Bois Blanc Island is the largest island within the Straits region, located immediately east of the Straits of Mackinac and covering approximately 24,000 acres. A significant portion of Bois Blanc consists of state land within Mackinaw State Forest. The Les Cheneaux islands lie in the vicinity of Hessel and Cedarville, approximately 20 miles northeast of the Straits. The islands are largely private with the exception of Government Island, which is within the Hiawatha National Forest. Marquette Island is the largest island within the Les Cheneaux group, covering approximately 4000 acres in the western portion of the island group. La Salle Island, which lies immediately east of Little La Salle Island and Marquette Island, covers approximately 1200 acres. Drummond Island, exceeded only by Isle Royale in size, is the easternmost point of Michigan's Upper Peninsula and covers more than 83,000 acres. A significant portion of Drummond Island lies within Lake Superior State Forest.

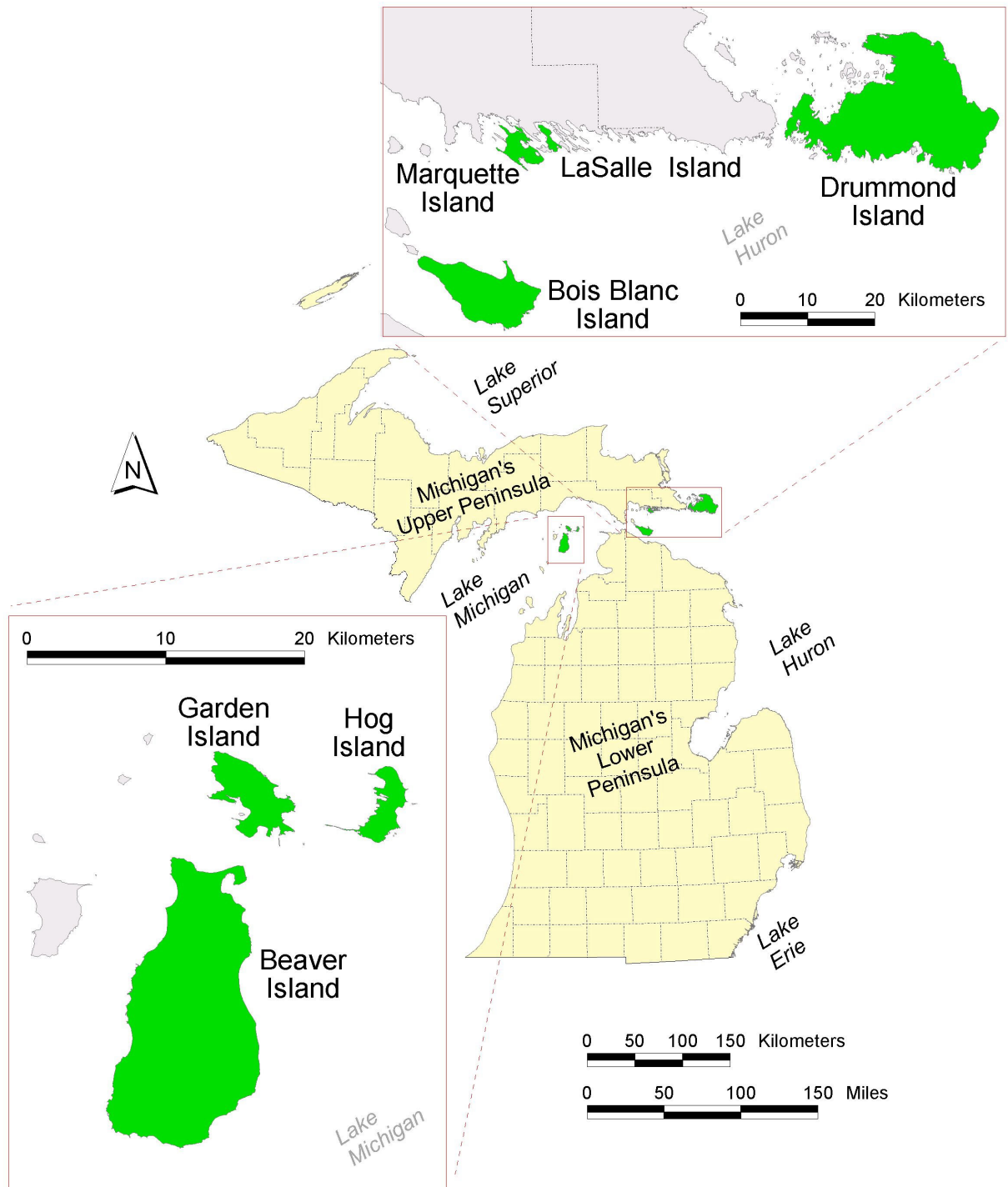


Figure 1. Location of study sites in Lake Michigan and Lake Huron.

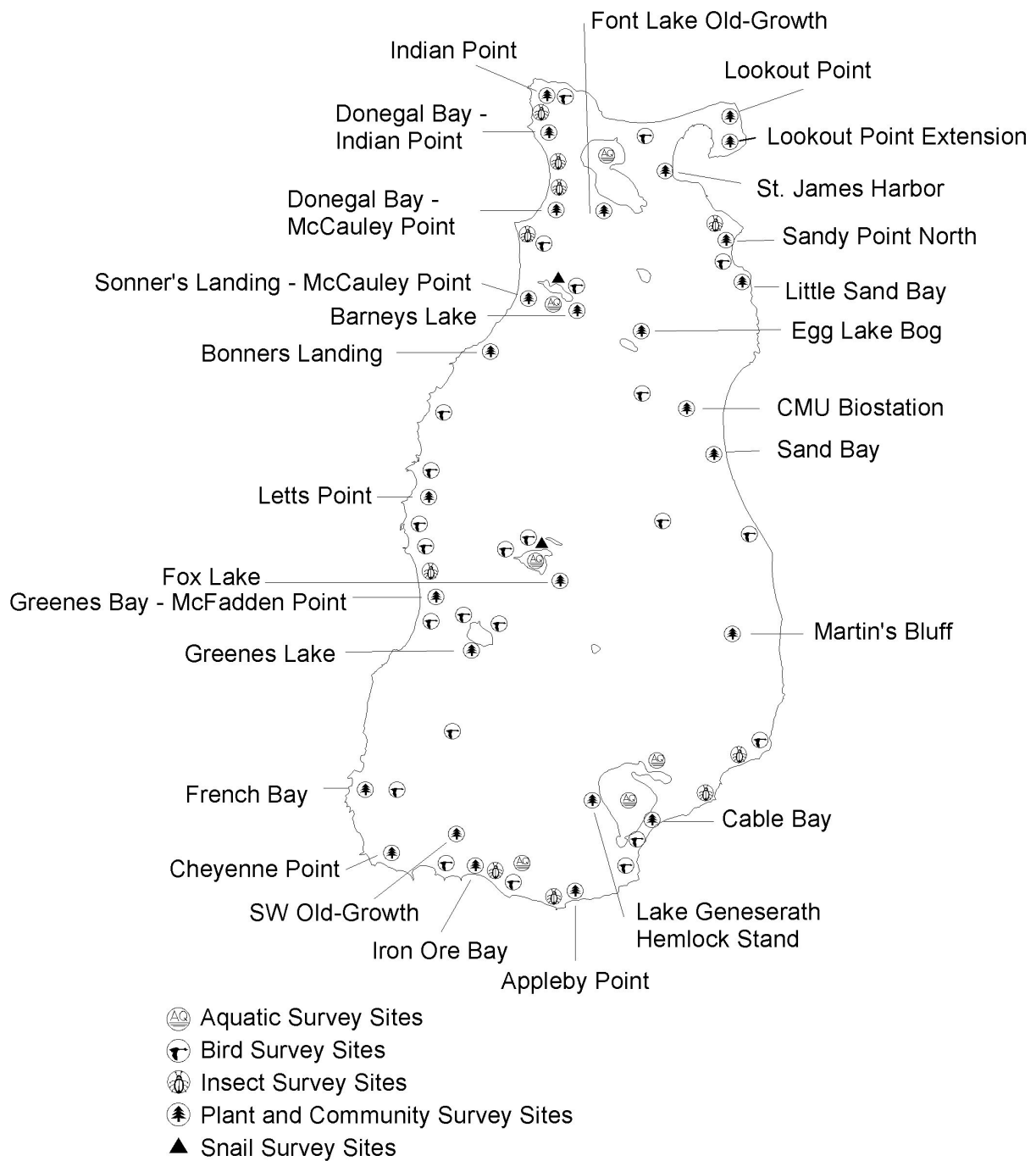


Figure 2. Beaver Island survey sites.

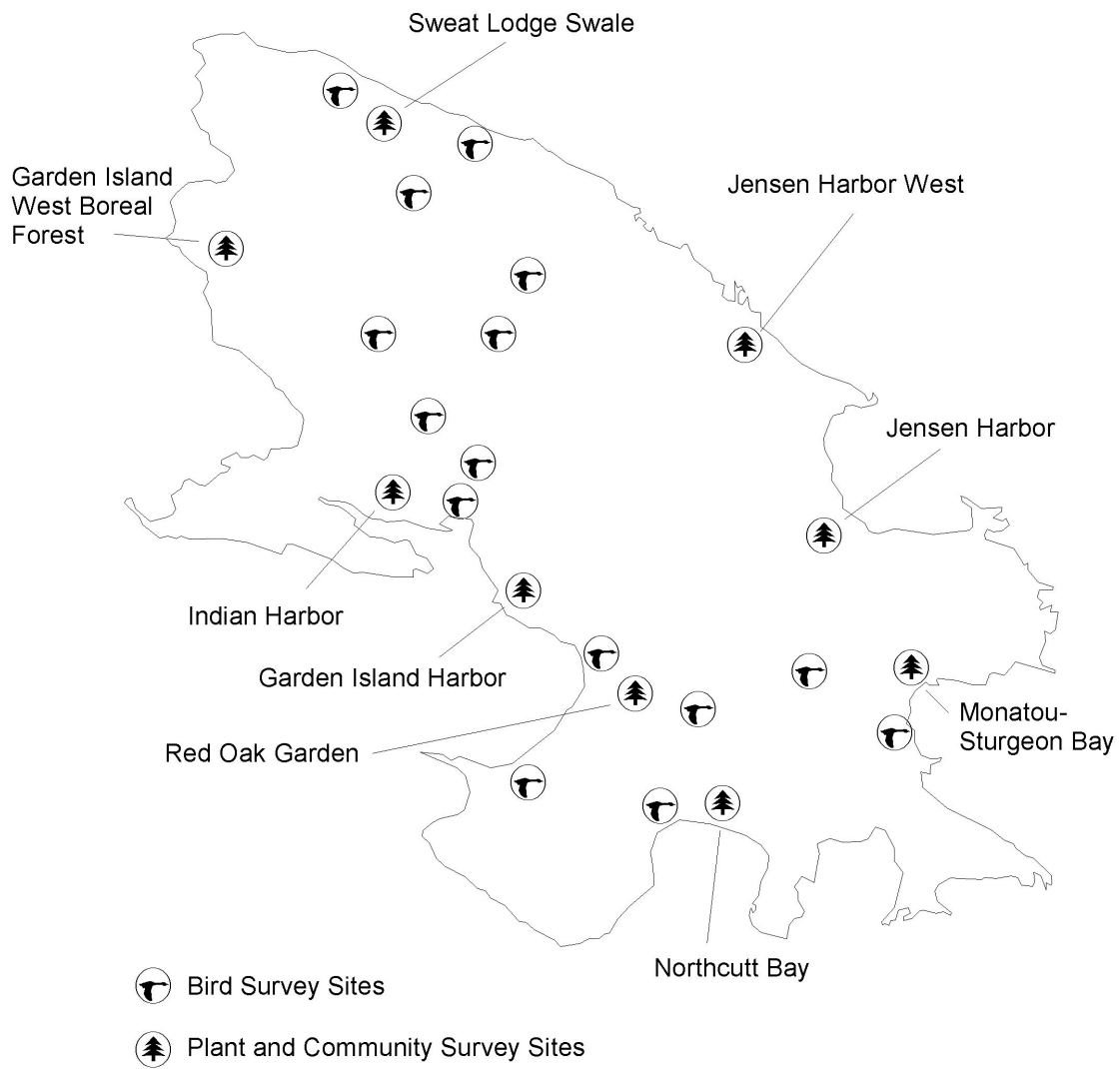


Figure 3. Garden Island survey sites

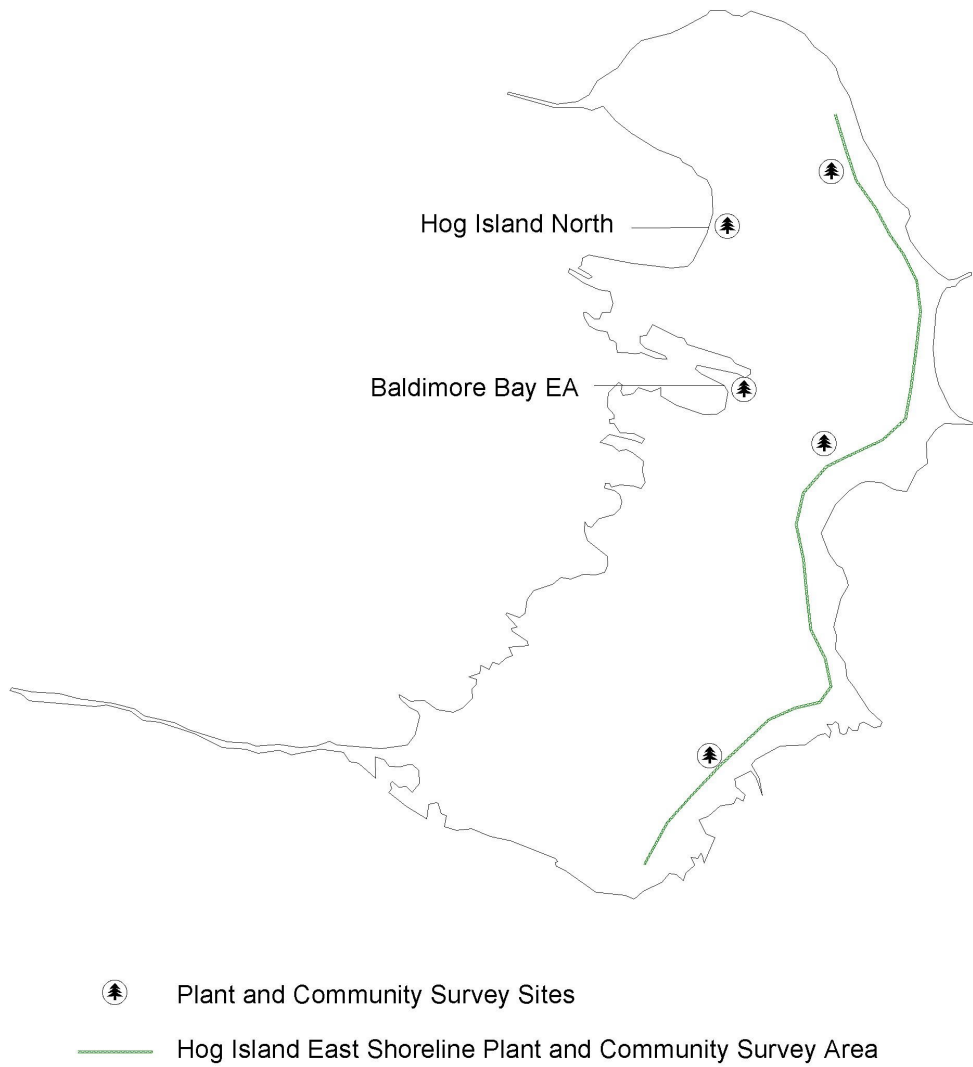
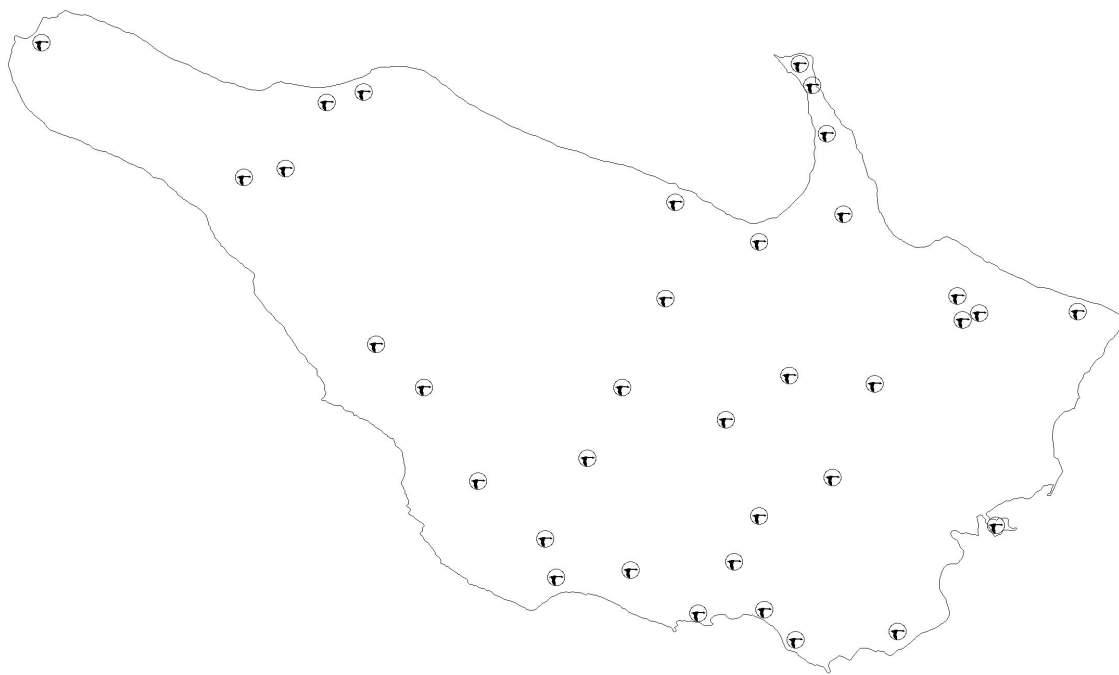


Figure 4. Hog Island survey sites.



☉ Bird Survey Sites

Figure 5. Bois Blanc Island survey sites.

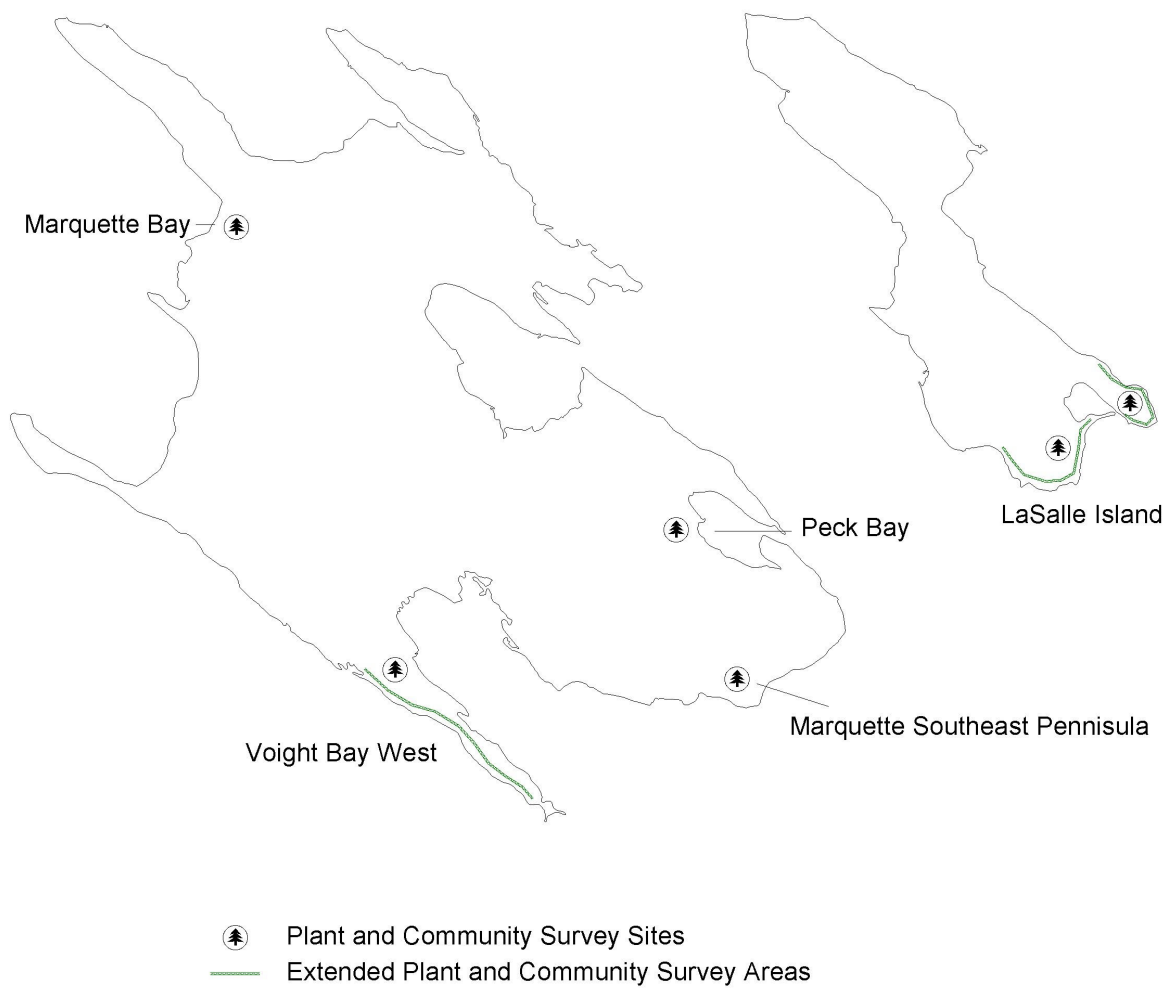


Figure 6. Marquette Island and La Salle Island survey sites.

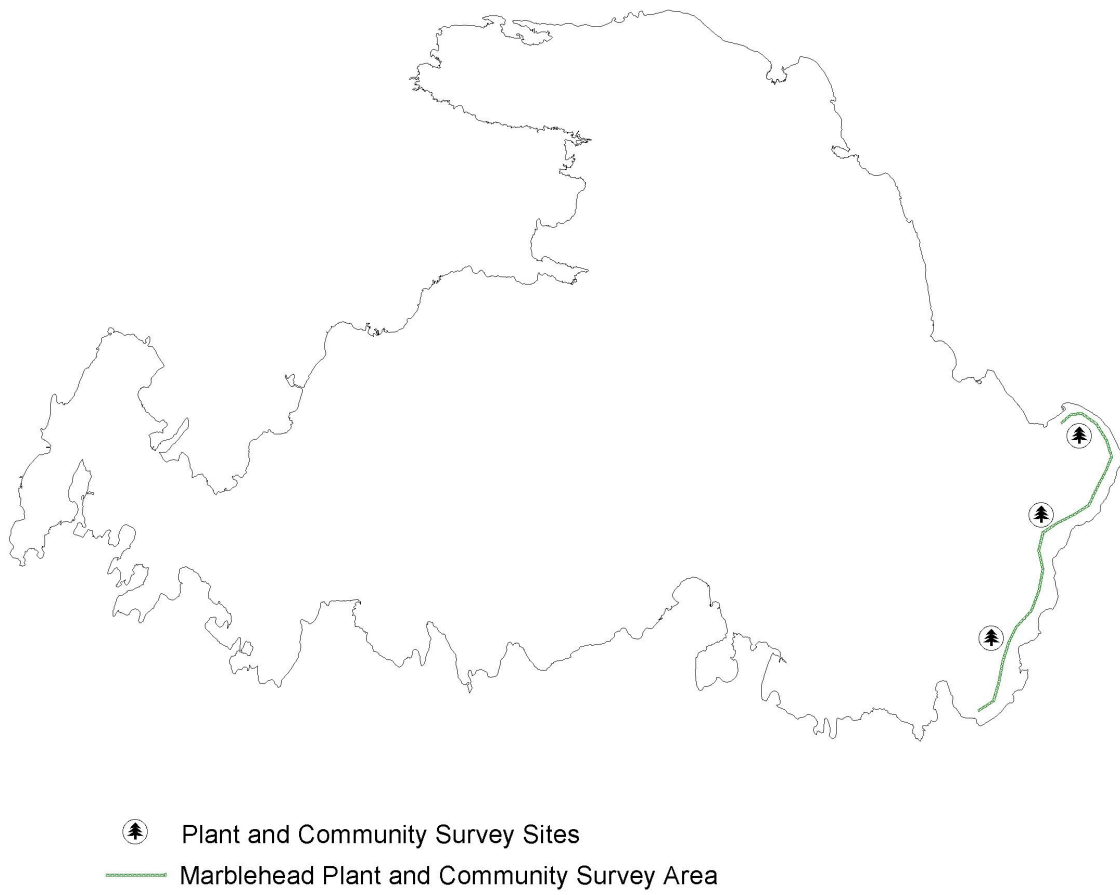


Figure 7. Drummond Island survey sites.

Methods for Animal Surveys

Neotropical migratory birds and rare invertebrates endemic or largely restricted to the Great Lakes region were the primary targets of animal surveys on Beaver, Garden and Bois Blanc Islands (Figures 1,2,3,5). In addition, surveys for the Eastern massasauga rattlesnake and red-shouldered hawk were conducted on Bois Blanc Island. The Natural Heritage Biological and Conservation Database (BCD) was consulted for known occurrences of rare animal species associated with these islands. Information on various species was gathered by consulting expert zoologists and wildlife biologists, pertinent unpublished reports, and a variety of published sources. Survey sites for each target species or group were selected based upon historical occurrence records, air photo interpretation, current landcover maps, and by consulting with individuals knowledgeable about the islands' flora and fauna. MNFI ecologists

and botanists also identified potential survey sites. A field schedule was developed based on prior Michigan observation and collection dates for each animal group or species and the extent of suitable habitat. Survey techniques varied according to species groups and are described in the following sections. Incidental observations of listed species, which have been designated under the federal and/or state Endangered Species Acts as endangered, threatened, or special concern status, were noted by all project staff when they occurred. Data from all sightings of listed animal species were recorded on MNFI field forms, including numbers of individuals observed and the extent and quality of occupied habitat. These data were then entered into the statewide BCD. All birds species observed during spring and summer island visits were also recorded.

Birds

The Great Lakes shorelines serve as important migration corridors for large concentrations of migrant landbirds (Beebe 1933, Perkins 1964, Hessel et al. 1992). Great Lakes islands may act as focal points for migratory birds which tend to accumulate near ecological barriers (Moore and Simons 1992). Scharf (1996) suggested three possible reasons that Great Lakes islands are attractive to Nearctic-Neotropical birds as well as short distance migrants including:

- 1) Nocturnal migrants that find themselves over open water at dawn seek the nearest land.
- 2) Islands often represent northward extensions of the mainland and are included in the flight-path north by internal orientation mechanisms of birds and stochastic events of weather patterns.
- 3) Islands are the intended destination of migratory species that regularly nest on the islands.

Scharf (1973) documents large numbers of passerines moving along the shorelines of North and South Manitou and South Fox Islands as part of a very large and important flyway. He remarks that it is surprising that Beaver Island

has not been documented as an important migration area. Although previous studies have recorded the avifauna of Beaver Island (Hatt et al. 1948, Drew and Phillips 1964, Mahan 1969, Grudzien 1979), this survey further elucidates the role that Beaver Island and other islands in the Beaver archipelago may play in providing critical stopover habitat to migratory birds.

Ewert and Hamas (unpubl. data) in their 1993 study, document the importance of the immediate shoreline along the northern shore of Lake Huron as critical stopover habitat for Neotropical migratory birds. They found that this cobble shoreline habitat provides an important food source, in the form of aquatic midges, to spring migrants that arrive before terrestrial insects are abundant. It would thus seem logical that Bois Blanc Island, located just south of this study area, would also provide important stopover habitat to migratory songbirds.

Bird counts using the point count method were conducted using standard methodology as outlined by Ralph et al. (1993, 1995). All birds seen or heard within a 50-meter radius were

tallied for 5 minutes during spring migration and for 10 minutes during the breeding season. Birds seen or heard outside the 50-meter radius circle were noted also. Point counts were conducted at thirty-four different sites on Beaver Island, fifteen sites on Garden Island, and thirty-four sites on Bois Blanc Island in a variety of habitats (Figure 2,3,5).

Spring bird counts were conducted between sunrise and 1200 hr on 11-12 May 1999 on Garden Island, 13-15 May 1999 on Beaver Island, and 11-14 May 1999 on Bois Blanc Island. Breeding bird counts were conducted between sunrise and 1000 hr on 13-15 June 1999 on Beaver Island, 16-17 June 1999 on Garden Island, and 15-18 June 1999 on Bois Blanc Island. All counts were conducted when there was no precipitation and little or no wind. Surveys began immediately after the observer arrived at the location. Field staff conducting the point counts were able to identify Michigan birds by sight and sound. Point counts were conducted at least 250 m apart to ensure that each bird was counted only once. Standard field forms for point counts were used.

Overall mean bird abundance was calculated by dividing the total number of birds observed within 50 m at each of the point count stations by the total number of stations censused on each island. Species richness was calculated by dividing the total number of species recorded at each of the point count stations by the total number of stations censused on each island.

Insects

The Hine's emerald dragonfly (*Somatochlora hineana*) is an extremely rare dragonfly listed as federally endangered in January 1995. This species is currently known to persist in seven populations at a variety of sites in Illinois, Wisconsin, and Michigan (Cuthrell pers. comm). Hine's emerald was first documented in Michigan in 1997. Since this time, three distinct populations at a number of sites have been found in Michigan in the Upper Peninsula, Bois Blanc Island, and the Northern Lower Peninsula. The Hine's emerald dragonfly is thought to be restricted to wetland habitats characterized by thin soils over dolomite bedrock

Dominant species were identified by calculating the total number of observations for each species at each of the point count stations by the total number of stations censused on each island.

The federally endangered piping plover (*Charadrius melodus*) is known to occur on Beaver Island. Areas of cobble beach habitat along Donegal Bay at McCauley Point and at McFadden Point where piping plovers have a history of occurrence were surveyed between 13-15 May 1999 and again between 13-15 June 1999. Other historical piping plover sites on the island were not surveyed.

The state threatened common loon (*Gavia immer*) is known from Beaver and Bois Blanc Islands. Observations were made at inland lakes on these islands to determine if loons were feeding or nesting at these locations.

On Beaver, Garden and Bois Blanc islands, surveys for the state threatened red-shouldered hawk (*Buteo lineatus*) were conducted in areas of appropriate habitat. Standard methodology outlined by Kennedy and Stahlecker (1993) was used. Taped conspecific red-shouldered hawk calls were broadcast with a predator caller 3 times: at 60 degrees for 10 seconds, 180 degrees for 10 seconds, and 300 degrees for 10 seconds. This was followed by 30 seconds of listening. This calling sequence was repeated 3 times at each calling station. When hawks responded to the taped calls, observers intensively searched for birds and/or a nest in the direction the call was initially heard.

with marshes, seeps, and sedge meadows (U.S. Fish and Wildlife Service 1999). Meander surveys were conducted for this species by walking through suitable habitat during the appropriate time of year on Bois Blanc Island on 27-28 July 1999 along the northern shore, eastern shore, and along the edges of Twin Lake East and Thompson Lake.

The aweme borer (*Papaipema aweme*) is an extremely rare noctuid moth known from only four sites globally. It was collected in 1925 on Beaver Island (Moore 1930), and has not been documented since, despite a survey in 1987 and 1988 (Profant 1991), and an MNFI survey on

Beaver Island in 1998 (Penskar et al. 1998). No rangewide surveys have been conducted for this species and this is the only known Michigan record. Virtually nothing is known about the life history of this taxon. Based on collection locations it is believed to be associated with the dune formations of lakes (present day or glacial) or adjacent wetlands (Profant 1991).

Blacklighting for *Papaipema aweme* was conducted using standard light trapping methods at McCauley Point on Beaver Island on 11 August 1999 located on the west side of the island. This site is located adjacent to dune formations and a variety of microhabitats located within these dune communities were targeted. Light trapping was conducted with a standard 1500-watt mercury-vapor light and a 15-watt UV blacklight powered by portable Honda generator. A 2 x 2 meter metal conduit frame supporting a large white sheet was used as a collecting surface.

The collection period started at sunset (about 2000 hr) and lasted for 4 - 6 hr. Insects collected from the sheet were transferred to an ethyl acetate-charged killing jar and later transferred to a zip-lock plastic bag and placed into a cooler. Bagged samples were then frozen until they could be processed. At a later date, insects were

identified and prepared following standard insect collection techniques. Prepared specimens were identified to genus or species using published references.

The Lake Huron locust (*Trimerotropis huroniana*) is a Great Lakes endemic known only from high quality, sparsely vegetated coastal sand dunes of Michigan, Wisconsin, and Ontario. It is presently listed as state threatened and has been recommended to the U.S. Fish and Wildlife service for consideration as a federally listed species. Populations of the Lake Huron locust were documented at eight locations on Beaver Island in 1998. This year inventories were expanded to include additional sites on Beaver Island not previously surveyed as well as surveys in suitable habitat on Bois Blanc Island. Surveys were conducted on 12 August 1999 on Beaver Island at Lookout Point, Bonner's Landing, and Little Iron Ore Bay and on 27 July 1999 on Bois Blanc Island along the north shore between Pt. Catoosh and Pt. Detachee. Surveys were conducted by walking through areas of suitable habitat and searching for adults. At new locations, voucher specimens were collected with an aerial net.

Reptiles

The Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is currently listed as a species of special concern in Michigan due to loss of its preferred habitat and human persecution. These snakes occupy shrubby or marshy lowlands that are immediately adjacent to open uplands and use both habitats at different times of the year (Harding 1997). In the past, massasauga rattlesnakes were reportedly common on Bois Blanc Island. They are disjunct

from Lower Peninsula populations, are at the northern limit of their range, and achieve a larger size on the island than anywhere within their range. The Snake Island wetland complex, a small peninsula that is a designated State Natural Area, is thought to provide the most important habitat for massasaugas on the island (Taylor 1995). Meander surveys were conducted in appropriate habitat on 11-14 May 1999 and 15-18 June 1999 on Bois Blanc Island.

Results of Animal Surveys

Birds

One hundred thirty-three different bird species were observed as part of this study during spring migration and the summer breeding season (Table 1). One hundred eight different species were observed during spring migration and one hundred nine species were observed during the summer breeding season. Fifty-one species can be classified as long distance migrants (birds that winter south and breed north of the Tropic of Cancer). Fifty-five species are short distance migrants (birds that winter in the southern U.S. and northern Mexico and breed in the U.S. and Canada). Twenty-seven

species can be considered residents (birds that winter and breed in the same region).

During spring migration surveys seventy-six bird species were observed on Beaver Island, sixty-three bird species were observed on Garden Island and seventy-eight bird species were observed on Bois Blanc Island. During the summer breeding season surveys, eighty-nine bird species were observed on Beaver Island, fifty-eight bird species were observed on Garden Island and seventy-four bird species were observed on Bois Blanc Island (Table 1).

Table 1. Bird Species Recorded During Migration and Breeding Seasons on Beaver Island, Garden Island, and Bois Blanc Island, Charlevoix County, and Mackinac County Michigan, 1999.

Common Name	Scientific Name	Beaver	Garden	Bois Blanc
Long Distance Migrants:				
Pied-billed Grebe	<i>Podilymbus podiceps</i>		B	
Osprey (T)	<i>Pandion haliaetus</i>	B	B	
Merlin (T)	<i>Falco columbarius</i>	B	M	
Spotted Sandpiper	<i>Actitis macularia</i>			B
Caspian Tern (T)	<i>Sterna caspia</i>	MB		B
Common Tern (T)	<i>Sterna hirundo</i>			B
Forster's Tern (SC)	<i>Sterna forsteri</i>	B		
Common Nighthawk	<i>Chordeiles minor</i>			M
Whip-poor-will	<i>Caprimulgus vociferus</i>	B		
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	B	B	B
Eastern Wood Peewee	<i>Contopus virens</i>	B	B	B
Willow Flycatcher	<i>Empidonax traillii</i>			MB
Least Flycatcher	<i>Empidonax minimus</i>	M	MB	MB
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	B	B	
Eastern Kingbird	<i>Tyrannus tyrannus</i>	B	M	MB
Bank Swallow	<i>Riparia riparia</i>	M		
Barn Swallow	<i>Hirundo rustica</i>	MB		
Veery	<i>Catharus fuscescens</i>	B	MB	B
Swainson's Thrush	<i>Catharus ustulatus</i>	B	M	B
Wood Thrush	<i>Hylocichla mustelina</i>	B		
Gray Catbird	<i>Dumatella carolinensis</i>	MB	M	MB
Blue-headed Vireo	<i>Vireo solitarius</i>		M	MB
Philadelphia Vireo	<i>Vireo philadelphicus</i>			M
Red-eyed Vireo	<i>Vireo olivaceus</i>	MB	B	MB
Tennessee Warbler	<i>Vermivora peregrina</i>	M		
Orange-crowned Warbler	<i>Vermivora celata</i>			M
Nashville Warbler	<i>Vermivora ruficapilla</i>	MB	MB	MB

Common Name	Scientific Name	Beaver	Garden	Bois Blanc
Northern Parula	<i>Parula americana</i>	MB	B	MB
Yellow Warbler	<i>Dendroica petechia</i>	B	B	MB
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	M	M	B
Magnolia Warbler	<i>Dendroica magnolia</i>	MB	M	MB
Cape May Warbler	<i>Dendroica tigrina</i>	M	M	B
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	MB		MB
Black-throated Green Warbler	<i>Dendroica virens</i>	MB	MB	MB
Blackburnian Warbler	<i>Dendroica fusca</i>	B	M	MB
Palm Warbler	<i>Dendroica palmarum</i>			M
Bay-breasted Warbler	<i>Dendroica castanea</i>	M	M	
Black-and-white Warbler	<i>Mniotilta varia</i>	MB	MB	MB
American Redstart	<i>Setophaga ruticilla</i>	MB	B	MB
Ovenbird	<i>Seiurus aurocapillus</i>	MB	MB	MB
Northern Waterthrush	<i>Seiurus noveboracensis</i>	M	M	MB
Mourning Warbler	<i>Oporornis philadelphia</i>	M		M
Common Yellowthroat	<i>Geothlypis trichas</i>	MB		B
Wilson's Warbler	<i>Wilsonia pusilla</i>			M
Canada Warbler	<i>Wilsonia canadensis</i>			B
Scarlet Tanager	<i>Piranga olivacea</i>	B	B	B
Chipping Sparrow	<i>Spizella passerina</i>	MB	MB	MB
Clay-colored Sparrow	<i>Spizella pallida</i>			B
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	MB	B	MB
Indigo Bunting	<i>Passerina cyanea</i>	B		B
Bobolink	<i>Dolichonyx oryzivorus</i>	B		
Short Distance Migrants:				
Common Loon (T)	<i>Gavia immer</i>	MB	B	B
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	MB	MB	MB
American Bittern (SC)	<i>Botaurus lentiginosus</i>	B		M
Great Blue Heron	<i>Ardea herodias</i>	MB	MB	MB
Green Heron	<i>Butorides virescens</i>			B
Turkey Vulture	<i>Cathartes aura</i>	MB	MB	M
Canada Goose	<i>Branta canadensis</i>	MB		MB
Northern Pintail	<i>Anas acuta</i>		M	
Ring-necked Duck	<i>Aythya collaris</i>		B	
Hooded Merganser	<i>Lophodytes cucullatus</i>			M
Common Merganser	<i>Mergus merganser</i>	M	M	MB
Red-breasted Merganser	<i>Mergus serrator</i>	B	MB	
Northern Harrier (SC)	<i>Circus cyaneus</i>	M		
Red-shouldered Hawk (T)	<i>Buteo lineatus</i>			MB
Red-tailed Hawk	<i>Buteo jamaicensis</i>	B	MB	
Virginia Rail	<i>Rallus limicola</i>	M		
Sora	<i>Porzana carolina</i>	MB	B	
Common Moorhen (SC)	<i>Gallinula chloropus</i>	B		
Sandhill Crane	<i>Grus canadensis</i>	MB		M
Killdeer	<i>Charadrius vociferus</i>	MB	MB	MB
Greater Yellowlegs	<i>Tringa melanoleuca</i>		M	
Lesser Yellowlegs	<i>Tringa flavipes</i>	M	M	
Common Snipe	<i>Gallinago gallinago</i>	MB	MB	MB
American Woodcock	<i>Scolopax minor</i>	MB	MB	M
Mourning Dove	<i>Zenaida macroura</i>	MB	M	MB
Belted Kingfisher	<i>Ceryle alcyon</i>	MB	M	
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	MB	MB	MB
Northern Flicker	<i>Colaptes auratus</i>	MB	MB	MB

Common Name	Scientific Name	Beaver	Garden	Bois Blanc
Eastern Phoebe	<i>Sayornis phoebe</i>	B		M
Tree Swallow	<i>Tachycineta bicolor</i>	MB	MB	MB
Brown Creeper	<i>Certhia americana</i>	MB	B	MB
House Wren	<i>Troglodytes aedon</i>	B		
Winter Wren	<i>Troglodytes troglodytes</i>	MB	MB	MB
Ruby-crowned Kinglet	<i>Regulus calendula</i>		M	M
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>			M
Eastern Bluebird	<i>Sialia sialis</i>	MB		
Hermit Thrush	<i>Catharus guttatus</i>	MB	B	B
American Robin	<i>Turdus migratorius</i>	MB	MB	MB
Brown Thrasher	<i>Toxostoma rufum</i>	MB	MB	
Yellow-rumped Warbler	<i>Dendroica coronata</i>	MB	MB	MB
Pine Warbler	<i>Dendroica pinus</i>	MB		MB
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	M		MB
Clay-colored Sparrow	<i>Spizella pallida</i>	M		
Savannah Sparrow	<i>Passerculus sandwichensis</i>	MB		
Song Sparrow	<i>Melospiza melodia</i>	MB	MB	MB
Swamp Sparrow	<i>Melospiza georgiana</i>	B		M
White-throated Sparrow	<i>Zonotrichia albicollis</i>	MB	M	MB
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	M	M	M
Red-winged Blackbird	<i>Abelais phoeniceus</i>	MB	MB	MB
Eastern Meadowlark	<i>Sturnella magna</i>	MB	M	
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>			B
Common Grackle	<i>Quiscalus quiscula</i>	B	B	M
Brown-headed Cowbird	<i>Moluthrus ater</i>	MB	MB	M
Pine Siskin	<i>Carduelis pinus</i>		M	
American Goldfinch	<i>Carduelis tristis</i>	MB	M	MB
Residents:				
Mute Swan	<i>Cygnus olos</i>	B	B	MB
Mallard	<i>Anas platyrhynchos</i>	MB	MB	MB
Common Goldeneye	<i>Bucepahla clangula</i>		MB	MB
Bald Eagle (T)	<i>Haliaeetus leucocephalus</i>	M	M	MB
Ruffed Grouse	<i>Bonasa umbellus</i>	MB	MB	
Wild Turkey	<i>Meleagris gallopavo</i>	MB		M
Ring-billed Gull	<i>Larus delawarensis</i>	MB	MB	MB
Herring Gull	<i>Larus argentatus</i>	MB	MB	MB
Great Horned Owl	<i>Bubo virginianus</i>	B		
Barred Owl	<i>Strix varia</i>			M
Downy Woodpecker	<i>Picoides pubescens</i>	MB	MB	MB
Hairy Woodpecker	<i>Picoides villosus</i>	B	MB	MB
Pileated Woodpecker	<i>Dryocopus pileatus</i>			M
Blue Jay	<i>Cyanocitta cristata</i>	MB	MB	MB
American Crow	<i>Corvus brachyrhynchos</i>	MB	MB	MB
Common Raven	<i>Corvus corax</i>	MB	MB	M
Black-capped Chickadee	<i>Poecile atricappilus</i>	MB	MB	MB
Red-breasted Nuthatch	<i>Sitta canadensis</i>	MB	MB	MB
White-breasted Nuthatch	<i>Sitta carolinensis</i>	M	M	M
Golden-crowned Kinglet	<i>Regulus satrapa</i>	MB	MB	M
European Starling	<i>Sturnus vulgaris</i>	MB		M
Cedar Waxwing	<i>Bombycilla cedrorum</i>	B	B	B
Dark-eyed Junco	<i>Junco hyemalis</i>	B		B
Northern Cardinal	<i>Cardinalis cardinalis</i>			B
Purple Finch	<i>Carpodacus purpureus</i>	B	B	MB

Common Name	Scientific Name	Beaver	Garden	Bois Blanc
House Finch	<i>Carpodacus mexicanus</i>	M		
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	B		
TOTAL		108 species	83 species	98 species
M=MIGRATION		76	63	78
B=BREEDING		89	58	74
MB=BOTH		58	38	52
(SC)=State Special Concern				
(T)=State Threatened				

Mean bird abundance during spring migration was greater on Bois Blanc Island when compared with Beaver and Garden Islands (Table 2). Species richness during spring migration was greater on Beaver and Bois Blanc Islands than on Garden Island. During spring migration, the black-throated green warbler and the yellow-rumped warbler were identified as dominant species on each of the three islands censused.

Other dominant species represented on the islands censused during spring migration include: black and white warbler, American redstart, American robin, ovenbird, and Nashville warbler.

Mean bird abundance during the summer breeding season was greater on Bois Blanc Island when compared with Beaver and Garden Island (Table 3). Species richness during the summer breeding season was slightly higher on Bois Blanc Island than on the other two islands. During the summer breeding season the red-eyed vireo, black-throated green warbler, and the American redstart were identified as dominant species on each of the three islands censused. Other dominant species recorded during the summer breeding season include yellow-rumped warbler, American robin, and ovenbird.

Table 2. Mean bird abundance, species richness and dominant species recorded during spring migration in 1999 on Beaver, Garden and Bois Blanc Islands.

	Beaver Island-'99	Garden Island-'99	Bois Blanc Island-'99
Mean Bird Abundance (Mean No. birds per point count station)	3.79 ± 0.91	4.13 ± 1.80	7.53 ± 1.78
Mean Species Richness (Mean No. species per point count station)	6.44 ± 0.94	3.53 ± 1.18	6.26 ± 0.87
Dominant Species	Black-throated Green Warbler Yellow-rumped Warbler Black and white warbler	Myrtle Warbler American Robin Black-throated Green Warbler Ovenbird Nashville Warbler	Black-throated Green Warbler Yellow Warbler Yellow-rumped Warbler Am. Redstart Ovenbird

Table 3. Mean bird abundance, species richness and dominant species recorded during summer breeding season in 1999 on Beaver, Garden and Bois Blanc Islands.

	Beaver Island-'99	Garden Island-'99	Bois Blanc Island-'99
Mean Bird Abundance (Mean No. birds per point count station)	6.50 ± 1.30	7.60 ± 3.28	9.41 ± 1.19
Mean Species Richness (Mean No. species per point count station)	7.18 ± 0.78	7.00 ± 1.08	8.09 ± 1.05
Dominant Species (In order of abundance)	Red-eyed Vireo Black-throated Green Warbler American Redstart Yellow-rumped Warbler American Robin	Black-throated Green Warbler American Redstart American Robin Ovenbird Red-eyed Vireo	Black-throated Green Warbler Red-eyed Vireo Ovenbird American Redstart Black and white Warbler

A qualitative assessment of habitat use by migratory birds on the islands was conducted. Habitats associated with point count stations that had high numbers of individual birds as well as high numbers of bird species were identified. During spring migration on Bois Blanc Island, a greater number of individual birds and a greater number of bird species were recorded near cobble shoreline bordered by coniferous forest, or near an inland lake or wetland. Fewer numbers and species of birds were seen or heard in upland deciduous forests at interior locations on the island. The only interior sites on the island where high bird counts were recorded were upland habitats characterized by early successional vegetation such as old fields and orchards containing ground juniper and low growing shrubs. This same pattern of bird distribution also occurred during point counts on Beaver and Garden Islands. During the breeding bird counts on the three islands this distribution pattern was also noted but the differences were less significant.

No piping plovers were observed on Beaver Island at McCauley point, located at the southern end of Donegal Bay, or at McFadden Point, located to the north of Greenes Bay.

The common loon was recorded at a number of locations on Beaver Island including: Font Lake (a pair with a chick); Barney's Lake (one pair in May and 5 individuals in June); Lake Geneserath (one pair); Greene's Lake (one pair); and an individual flying over McCauley Point.

Loons were also recorded on Bois Blanc Island at Twin Lake East (one individual), Twin Lake West (one individual) and on Thompson Lake (one individual). No loons were recorded on Garden Island.

Red-shouldered hawks responded to taped calls at five different locations on Bois Blanc Island and were seen and heard in a number of locations during spring and summer bird counts. Because of limited time, minimal effort was directed toward locating their nests, although it is almost certain that numerous pairs are breeding on the island. An inactive hawk nest, presumably used the previous year by a red-shouldered hawk, was discovered in an area where a red-shouldered hawk responded to the taped call. This is probably an active territory.

State threatened and special concern birds were observed on all of the islands. On Bois Blanc Island observations include: a pair of bald eagles with two nearly fledged young at Sucker Creek Swamp, an American bittern in a sedge wetland north of Twin Lake Creek and two Caspian terns and a small colony of nesting common terns on a spit off the southeast shore of the island. On Beaver Island rare birds include; a Caspian tern and an Osprey fishing at Barney's Lake, an American bittern heard calling at Font Lake, an immature eagle seen at Iron Ore Bay, a common moorhen heard calling at Greene's Lake, a northern harrier observed flying over the orchard at Barney's Lake, a Forster's tern seen in St. James harbor, and a merlin observed

patrolling the open fields at Wilke Airport. On Garden Island, a merlin was seen in flight at

Northcutt Bay and an osprey was observed at Indian Harbor.

Insects

Surveys conducted for the Hine's emerald dragonfly on Bois Blanc Island were inconclusive, although suitable habitat was identified on the northern and eastern shores of the island. Extensive observations in suitable habitat on the northern shore resulted in the identification of dragonflies belonging to the *Somatochlora* genus. There are three species in this genus, one of which is the federally endangered Hine's emerald dragonfly. The only way to conclusively identify this dragonfly to species is upon close examination of its genitalia. This was not possible since the effort to net one of these individuals was not successful.

After our searches for Hine's emerald dragonfly were completed, MNFI learned that this species had been identified on the island just days prior to our surveys (Steffans 1999) in

habitat that we had inventoried and found suitable.

No aweme borer moths were found at McCauley Point on Beaver Island where blacklighting was conducted. With so few specimens known for this species it is difficult to predict with great accuracy the flight period for adult moths. The flight period is suspected to occur in the last two weeks of August, which is why our surveys were conducted at this time.

In 1999, populations of the Lake Huron locust were found at all three of the sites surveyed on Beaver Island including Bonner's Landing, Lookout Point, and Little Iron Ore Bay. Very little suitable habitat was identified during surveys on Bois Blanc Island and no new occurrences of this species were identified.

Reptiles

No Eastern massasauga rattlesnakes were observed during meander surveys in appropriate habitat during the spring and summer on Bois Blanc Island. A number of island residents reported encountering massasauga rattlesnakes

over the years in various places on the island, although they mentioned that they do not see them as frequently as they did in the past. Unfortunately, many of the recent observations were of snakes killed on the road.

Discussion of Animal Surveys

The diversity and abundance of birds documented on Beaver, Garden, and Bois Blanc Islands is impressive and illustrates the important role that these islands play in providing critical stopover and breeding habitat for birds. Factors that likely contribute to the distribution of migratory birds using these islands as stopover sites include weather conditions, human use patterns, abundance of potential prey, predation pressure, and the composition, structure, and successional stage of the vegetation. In their 1993 research (unpubl.) Ewert and Hamas note that spring migrants often arrive in Michigan before the leaves on trees have fully emerged.

Consequently, lepidopterous larvae, which are a primary source of food for migrants in areas south of Michigan, are not yet abundant. Migratory birds instead take advantage of the swarms of emerging aquatic insects, such as chironomid midges (Family: *Chironomidae*), that are concentrated along Great Lakes cobble beaches, and along inland streams, lakes and wetlands. It is noteworthy that swarming insects were observed in these areas on the islands during point counts. Trees and shrubs in close proximity to the shoreline and interior riparian and wetland areas provide an excellent foraging substrate for migratory birds feeding on these

insects. The habitat assessment conducted from data collected from 1999 surveys supports this hypothesis. The greatest diversity and abundance of migrating birds were found near the shoreline or adjacent to wetlands rather than in deciduous forests located in the interior of the islands. This pattern of distribution was less marked during the breeding season since after the trees have leafed out, lepidopterous larvae are present and available to birds as a valuable food source.

There were fourteen bird species that were only recorded during migration and not during the breeding season (Table 1). These are birds that breed primarily in the Upper Peninsula of Michigan and in Canada or were not detected during the breeding bird surveys even though they are known to nest in the area.

There are two Neotropical bird species that were recorded during breeding bird surveys that are worth noting, since there is evidence that they are declining in all or part of their ranges. The black-throated blue warbler (*Dendroica caerulescens*), which was observed on Beaver and Bois Blanc Islands, has been ranked by the bird conservation organization, Partners in Flight (PIF), as a species of moderately high priority for conservation action due to its very restricted wintering range. The PIF watch list includes those birds of the continental United States not already listed under the Endangered Species Act that warrant conservation attention.

The black-throated blue warbler breeds most commonly in mesic deciduous forest, prefers the interior of mature forests and avoids young second growth. Although previously considered one of Michigan's most abundant migrants it has declined in numbers over the years. The protection of mature hardwood forests is critical for the conservation of this species (Bindford 1991). Beaver and Bois Blanc Islands currently contain large tracts of this desirable forest type and consequently provide critical nesting habitat for this species. The wood thrush (*Hylocichla mustelina*) was recorded during breeding bird surveys on Beaver Island and has been ranked by Partners in Flight (PIF), as a species of moderately high priority for conservation action. This species generally prefers dense mesic woodlands with small streams and springs associated with a dense understory. The wood

thrush has undergone a decline in the Midwest due to forest thinning and fragmentation, loss of wetlands on the wintering grounds and heavy cowbird parasitism in some areas (Pinkowski 1991). Beaver Island provides suitable habitat for the wood thrush and its forests should continue to support breeding pairs, as long as they are managed to minimize fragmentation and to enhance forest maturity.

Observations of the state threatened merlin (*Falco columbaris*) on Garden Island during the migratory period and on Beaver Island during the breeding season indicate that the Beaver Island archipelago provides both migratory and breeding habitat for this species. Merlin's prefer to nest in forest edges adjacent to extensive openings and are more commonly found close to the shores of the Great Lakes. The island chain offers the merlin an abundant source of avian prey in the form of trans-lake migrants both during the spring prior to nesting and in the fall when the juvenile birds are becoming independent (Binford 1991). Although a nest was not found, the sighting of the merlin hunting over the airport field on Beaver Island suggests that it was nesting nearby.

Surveys for the state threatened red-shouldered hawk (*Buteo lineatus*) on Bois Blanc Island were quite successful in documenting at least five active breeding territories. Red-shouldered hawks nest in mature deciduous or mixed forest complexes that are located near wetland habitats. Although nests were not found, this hawk was heard and observed on numerous occasions all over the island. It is clear that Bois Blanc Island provides an abundance of good quality nesting habitat for this species. Unlike Beaver and Garden islands, which also have suitable habitat, Bois Blanc Island is located in close proximity to the mainland. Thus the hawks do not have to cross long distances over open water. Perhaps this is why during our surveys the red-shouldered hawk has only been found on Bois Blanc Island.

Breeding records for the state threatened common loon (*Gavia immer*) on all three of the islands is not surprising due to the habitat provided by the Great Lakes and the large inland lakes on each of the islands. In addition, these birds enjoy less disturbance by recreational

boaters and jet skiers due to the absence of extensive development on these islands.

The state threatened bald eagle (*Haliaeetus leucocephalus*) nest observed on Bois Blanc Island was found on a territory that has been active for several years. It was found in an area that receives little disturbance except for the occasional use of snowmobiles in the winter.

The observations of the state threatened osprey (*Pandion haliaetus*) fishing at Barney's Lake on Beaver Island and flying at Indian Harbor on Garden Island during the breeding season strongly suggests that they have nesting territories on these islands. There is an abundance of suitable habitat for this bird although surprisingly there are no previous records for this species on either island.

The small colony of state threatened common terns (*Sterna hirundo*) observed nesting on Gull Island off the southern shore of Bois Blanc Island is not expected to achieve reproductive success. This colony shares the small island with hundreds of ring-billed gulls (*Larus delawarensis*) and herring gulls (*Larus argentatus*) which will likely prey on their eggs or young. Because the Great Lakes levels are declining the terns will likely find more suitable habitat elsewhere.

The observations of the state threatened Caspian tern (*Sterna caspia*), during the breeding season on Beaver and Bois Blanc island were probably not of breeding pairs. No nests were noted and they were not a part of a nesting colony. Although this species has apparently nested continuously in the Beaver Island group since at least early settlement times (Barrows 1912), no colonies were documented during the past two years of surveys.

The observation of the common moorhen (*Gallinula chloropus*), a species of special concern, during the breeding season on Beaver Island is surprising since they have not been documented nesting this far north and they are not common in the Northern Lower Peninsula of Michigan. It is assumed that this observation represents a breeding individual since it was heard calling in suitable habitat during the breeding season. Surveys for this species should be conducted on the island to further substantiate this record.

Nesting American bitterns (*Botaurus lentiginosus*), a species of special concern, have been documented in wetlands on Beaver and Bois Blanc Islands previously. Preserving these wetlands and protecting them from human alteration and disturbance will be important if they are to remain a part of the island's fauna.

One of the most important discoveries this year was that of the federally endangered Hine's emerald dragonfly (*Somatochlora hineana*) on Bois Blanc Island. Since this species has only been known from Michigan since 1997, this population on Bois Blanc Island is significant. Future surveys are targeted for 2000 in the areas where they were documented as well as in other locations with suitable habitat.

In the past two years, eleven new sites for the state threatened Lake Huron locust (*Trimerotropis huroniana*) were documented. Eight of the eleven new sites are located on the western or southern sides of Beaver Island. The western shoreline of the island has greater vertical structure, higher dune ridges, and more dune blowouts than the eastern side of the island, which is lacking this vertical structure. The western and southern coasts of the island are subject to the prevailing winds from the southwest. This may result in shifting sands, which helps to keep the dunes open, thus maintaining habitat for the locust.

Although it is uncertain how long these populations can persist in small isolated pockets, remnant dune areas located in the midst of development can still provide critical habitat for this species. It would be informative to map locations of Lake Huron locust populations and determine the degree to which occupied sites are interconnected. This may help to determine whether the various locations should be considered one site or whether they should be viewed as a metapopulation. This analysis is essential in developing management and conservation strategies for the species.

Surveys for the aweme borer moth, (*Papaipema aweme*), a special concern species, are inconclusive due to the limited sampling effort in 1998 and 1999. Although this species has not been reported in seventy-three years and may well be extinct on Beaver Island, more intensive surveys are needed to more

conclusively determine its status on the island. Additional surveys of high quality dune habitats on other islands and along the eastern shoreline of Lake Michigan would further clarify this species' status in Michigan.

It is disappointing that the Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), a special concern species, was not found on Bois Blanc Island in 1999. The weather was cool and dry during the spring and summer that the surveys were conducted. In

addition, this was the second year that the island experienced lower than average snowfall. Many of the wetlands where these snakes had been documented previously were dried up or had receded significantly. Since these snakes are quite cryptic and difficult to detect even during the most optimal conditions, it is not surprising then that our surveys were unsuccessful in finding any massasauga rattlesnakes. Further surveys are targeted for year 2000 studies.

Methods for Aquatic Ecology Surveys

Beaver Island has several inland water bodies that have potential for supporting significant biodiversity. Historical records indicate that the state threatened deepwater pondsnail, *Stagnicola contracta*, has been observed in Fox and Barney Lakes, and aquatic surveys were conducted to verify these historical occurrences. A wide diversity of aquatic habitats exist that may support additional sensitive species. Qualitative reconnaissance surveys of additional aquatic resources were therefore conducted to determine whether additional rare aquatic taxa may exist on the island. Lakes were surveyed using SCUBA visual surveys conducted over a range of habitats, including shallow water littoral (<2m water depth with abundant aquatic macrophytes), deeper water littoral (3-5m water depth with some aquatic macrophytes) and deep water pelagic (>5m water depth with no aquatic macrophytes present) habitats. Lake shorelines were also searched for spent mollusk shells and other evidence of the occurrence of aquatic biota. Mollusk shells collected during the SCUBA and shoreline visual surveys were identified to genus and species where possible.

Lake habitats that could not be adequately surveyed using visual techniques were sampled

using a Petite Ponar® bottom dredge. The dredge was lowered over the side of the boat with a hand line and allowed to sink to the bottom. Upon contact with the lake bottom, the sampler automatically closed over a small area (0.234m²) and retained a volume of lake substrate (≈ 2.4l) that was hoisted back into the boat. The sample was washed in a sieve bucket (mesh size 0.5mm) to remove excess fine sediments and water. The samples were then placed in 70% isopropyl alcohol for later processing. Stream and seep habitats were also sampled as part of the aquatic surveys. Benthic kick nets were used to collect samples of macroinvertebrates from representative stream and seep habitats, including leaf packs, woody debris and cobbles over a range of current velocities in the stream. Samples were preserved in 70% isopropyl alcohol for later processing. In the laboratory, fauna present in the lake and stream substrate samples were culled from the sediments and identified to genus where possible.

Results of Aquatic Ecology Surveys

Four lakes and two streams were visited and surveyed on Beaver Island, including Font Lake, Fox Lake, Barney Lake, Lake Geneserath, a small tributary on the northeast side of Lake Geneserath, and Iron Ore Creek (Figure 2). Font Lake is a shallow lake (<2m in most areas visited) with an extensive flocculent organic mat >1m thick covering much of the lake bottom. Sparse sandy areas support aquatic macrophytes and associated fauna as well as one unionid species, *Anodonta grandis*. Fox Lake is a deeper lake (>6m in some areas) with water that is darkly stained with tannins (tannic acid), suggesting that it is an acidic system. The darkly stained water prevents light penetration beyond a few meters from the surface, making SCUBA visual surveys in deeper areas impossible. Dredge surveys indicated that organic-rich sands and sediments generally characterize the lake bottom, with some sandy-gravel areas in nearshore areas that support macrophytes. Only one mollusk was observed in Fox Lake, *Campeloma decisum*, a species that was common in all of the lakes visited on Beaver Island. Barney Lake is shallow over much of its area, although one end of the lake is up to 5m deep. The substrates of Barney Lake are principally sandy marl that is populated with several **calciphilous** aquatic plant species (e.g. *Potamogeton* spp., *Sparganium* spp., *Utricularia* spp.), including the alga *Chara*. Mollusks, especially gastropods, were very abundant in Barney Lake, and at least six species were collected at the time of the visit.

Lake Geneserath is the largest of the lakes visited on Beaver Island. It is characterized by extensive shallow littoral areas that support abundant aquatic macrophytes. Substrates range from sandy areas to organic-rich sands and fine sediments where the water is <4m deep. Limestone cobbles are present in some areas on the lake. The unionid *Lampsilis siliquoidea* was common in the lake, especially in the shallow, sandy substrates along the shoreline. The middle of Lake Geneserath is deep (\approx 6m) and is

characterized by a flocculent organic mat in these deeper areas that is similar to the extensive organic mat in Font Lake. The small tributary stream that feeds into Lake Geneserath is a first order stream characterized by some cobble and gravel riffles separating clay, sand, and gravel-lined pools. Low water conditions during the site visit had reduced flow significantly, and much of the streambed was dry. Leaf packs and woody debris were common along the length of the stream as well as occasional beaver dams. Iron Ore Creek is a sand-based stream system with very little rocky substrate. The principal instream structure consists of woody debris and tree roots. The water is stained by tannins, and the system is assumed to be acidic.

Few fish were observed during the SCUBA visual surveys, and dense macrophyte beds hampered efforts to seine shallow areas. However, a wide diversity of invertebrates was observed among the six study sites (Tables 4 and 5). Both Font and Barney Lakes were characterized by high mollusk diversity compared to Fox Lake and Lake Geneserath (Table 4). However, weather conditions prevented surveyors from thoroughly searching Lake Geneserath, and additional taxa may be present at the site which are not reported here. Regardless, the mollusk communities were relatively distinct among the lakes (Table 4). No currently listed taxa were observed during the surveys, including *S. contracta*. No particularly sensitive macroinvertebrates were observed in any of the lake bottom dredge samples or the stream kick net samples. Some differences in species composition occurred between the Font and Fox Lakes and between the Lake Geneserath tributary and Iron Ore Creek, although the qualitative nature of the surveys preclude a statistical analysis to detect significant differences in community structure among the water bodies.

Table 4. Occurrences of aquatic mollusks in four Beaver Island inland lakes. Spent shells were collected during SCUBA visual surveys and in lake substrate dredge samples.

Taxonomic Group	Species	Font Lake	Fox Lake	Barney's Lake	Lake Geneserath
Gastropoda	<i>Campeloma decisum</i>	X	X	X	X
	<i>Physella gyrina</i>	X			
	<i>Planorbella campanulata</i>	X			
	<i>Lymnaea stagnalis</i>			X	
	<i>Valvata tricarinata</i>	X	X	X	
	<i>Elimia livescens</i>			X	
	<i>Helisoma anceps</i>			X	
	<i>Bythynia spp.</i>	X			
	<i>Stagnicola elodes</i>			X	
Bivalvia	<i>Spaerium simile</i>	X		X	
	<i>Lampsilis siliquoidea</i>				X
	<i>Anodonta grandis</i>	X			

Table 5. Occurrences of aquatic macroinvertebrates obtained in samples from inland lakes and streams on Beaver Island. Lake samples were collected using a bottom dredge and stream samples were collected using a benthic kick net.

Order	Family	Genus	Font Lake	Fox Lake	Tributary to Lake Geneserath	Iron Ore Creek
Trichoptera (Caddisflies)	Brachycentridae	<i>Brachycentrus</i>				X
	Hydropsychidae	<i>Hydropsyche</i>		X		
	Hydroptiliidae	<i>Oxyethira</i>		X		
	Leptoceridae	<i>Oecetis</i>	X	X		
	Leptoceridae	<i>Trianodes</i>	X			
	Molannidae	<i>Molanna</i>				X
	Phryganeidae				X	
	Polycentropodidae	<i>Cyrnellus</i>	X			X
	Sericostomatidae	<i>Agarodes</i>	X			
Uenoidae	<i>Neophylax</i>			X		
Ephemeroptera (Mayflies)	Caenidae	<i>Caenis</i>	X	X		
Coleoptera (Beetles)	Dytiscidae	<i>Dytiscus</i>				X
	Elmidae	<i>Optioservus</i>				X

Odonata (Damselflies and Dragonflies)	Aeshnidae	<i>Aeshna</i>			X	X
	Coenagrionidae	<i>Argia</i>		X		
	Cordulagastridae	<i>Cordulagaster</i>			X	X
	Corduliidae	<i>Somatochlora</i>		X		
	Gomphidae	<i>Gomphus</i>		X		
Hemiptera (True Bugs)	Notonectidae	<i>Notonecta</i>			X	
Diptera (True Flies)	Chironomidae		X	X	X	X
	Ptychopteridae				X	
	Simuliidae	<i>Simulium</i>				X
	Tipulidae	<i>Tipula</i>				X
	Ceratopogonidae		X	X		
	Chaoboridae	<i>Chaoborus</i>	X	X		
Lepidoptera (Butterflies and Moths)	Pyralidae	<i>Petrophila</i>	X			X
	Pyralidae	<i>Acentria</i>	X			
Hirudinea (Leeches)	Glossiphoniidae		X	X	X	
Oligochaeta			X	X	X	X
Amphipoda	Hyaletellidae	<i>Hyaletella</i>	X			
	Gammaridae	<i>Gammarus</i>			X	
Isopoda					X	
Gastropoda	Physidae	<i>Physa</i>			X	

Discussion of Aquatic Ecology Surveys

Historical records for the deepwater pondsnail, *S. contracta*, could not be verified from the lake surveys conducted on Beaver Island. This species has been described as occurring in *Chara* beds at 10m depths in only a few locations in Michigan (Burch 1994). No habitat fitting both of these criteria were identified during the site visits. If *S. contracta* does occur on Beaver Island, the most likely site for supporting this species is Barney Lake, one of the historical occurrence sites. Barney Lake does have extensive *Chara* beds, but is only \approx 5m deep at its deepest point. A similar species, *Stagnicola elodes*, was abundant in Barney Lake, and may have been misidentified as *S. contracta* during the historical survey. Fox Lake is an acidic system approximately 5-6m deep with very few gastropod species present. No *Chara* was identified from dredge samples, and the extremely low light penetration beyond a few meters from the surface makes the presence of deepwater plants unlikely. It is therefore likely that the historical reports of *S. contracta* in Fox Lake are in error unless drastic ecological changes have occurred in this system since the original observation. Font Lake was far too

shallow to support *S. contracta*, and no *Chara* beds were observed in Lake Geneserath that would provide suitable habitat for this species.

No additional sensitive or rare taxa were identified from the reconnaissance surveys of Beaver Island lakes and streams. The surveys conducted were brief and designed to provide an overview of aquatic resources on the island. More detailed surveys could potentially yield additional observations of rare taxa. Despite the absence of rare taxa during these surveys, the aquatic systems of Beaver Island are notably unique. There is striking ecological diversity among the lakes for such a small geographic area. No two lakes on the island are even superficially similar and differences in community structure and composition are readily apparent based on this reconnaissance survey. Also, the low to non-existent residential development along the shorelines of these lakes qualifies these site as unique compared to many if not most inland lakes in Michigan. The ecological diversity and significance of these lakes should be recognized as important elements to be conserved and protected.

Methods for Plant Surveys

Islands selected for plant field inventories were identified following examination of the Natural Heritage Biological and Conservation Database (BCD) and consultation with MNFI staff ecologists and other scientists. As in previous studies (Penskar et al. 1999, Penskar et al. 1997, Penskar et al. 1993), our high priority targets were Great Lakes endemic plant species, most of which are associated with shoreline areas and natural communities such as open dunes, coastal rich conifer swamps, bedrock beaches, alvar, cedar glades, northern fens, and forest dune and swale complexes. However, emphasis was also placed on delineating notable natural communities. This was done both to identify significant potential rare plant habitats as well as to conduct a preliminary assessment for high

quality community remnants for subsequent evaluation and possible transcription by MNFI ecologists.

The islands identified for 1999 botanical surveys consisted of Beaver and Garden islands, Marquette and La Salle islands in the Les Cheneaux group, and a specific area, the eastern shoreline, of Drummond Island. Both Beaver Island and Garden Island were targeted primarily to assess delineated areas that had not been covered during the 1998 inventory, as well as to review sites that had strong merit for more comprehensive survey, particularly to focus on early blooming species. Marquette and La Salle islands were selected based on their large size and *a priori* knowledge that significant survey gaps existed for rare plants and other elements,

and also because these important islands lie within The Nature Conservancy's Northern Lake Huron Bioserve. Lastly, Drummond Island was selected for an inventory of its extreme eastern shore in the vicinity of Marblehead, an area of extensive limestone cliff outcrops that has been poorly inventoried – largely due to its relative inaccessibility – despite several surveys of the island during other studies.

Beaver, Garden, and Hog Islands

Both early and late season surveys were conducted to complete botanical inventories initiated in 1998. All early and late season surveys were conducted by P. Higman from May 20-25 and August 16-20. For Beaver Island, targeted areas included the upper west shoreline, which had not been fully assessed and walked, and several additional shoreline areas, such as French Bay and the east shore in the vicinity of the Central Michigan University Biological Station. The latter two sites required early season surveys in order to assess known historical records and potentially find additional sites for such early blooming species as calypso orchid (*Calypso bulbosa*), ram's head orchid (*Cypripedium arietinum*), and early fruiting sedges such as beauty sedge (*Carex concinna*) and Richardson's sedge (*C. richardsonii*). Several interior sites, including significant bog habitat around Egg Lake, and areas with reports of mature mesic northern forest, were also targeted and assessed.

Les Cheneaux Islands

The Les Cheneaux group constitutes a prominent chain of islands in northern Lake Huron. These islands have been identified by Soule (1993) as a high priority for inventory, and are also known to contain numerous areas with a high potential for additional rare elements. Both Marquette Island, the largest in the chain, and La Salle Island were identified by Soule as having a high priority for both plant and natural community surveys, and thus these were targeted for our initial inventories. Surveys for plants and high quality natural communities were conducted

The botanical survey methods closely follow those used during the first year of island inventory. These have been thoroughly detailed by Penskar et al. (1999) and thus will not be presented again here. The results compiled below include several rare plant occurrences identified by an ecologist during natural community surveys on Garden and Hog islands.

Garden Island was similarly identified to detect early blooming species, including the orchids noted above and rare sedges such as *Carex concinna* that had been tentatively identified in limestone glade areas. In addition, several areas of apparent northern fen on the southern shore of the island were highlighted for inventory based on the potential for such rare species as Houghton's goldenrod (*Solidago houghtonii*), butterwort (*Pinguicula vulgaris*), and dwarf lake iris (*Iris lacustris*). In the case of Houghton's goldenrod, northern fen areas were identified in spring for the late season inventory.

Hog Island was targeted only for natural community surveys, but rare plant occurrences were documented when encountered on this island by a staff ecologist experienced with these species. Additional rare plant occurrences were similarly identified by this ecologist on Garden Island.

by M. Penskar and P. Higman from June 9-11. This time period was selected in order to more optimally survey for both spring and early summer species via a single visit. A large portion of the eastern shore of Marquette Island was accessed by kayak and significant areas were walked; whereas other portions, such as on the southern end and southwestern shore, were accessed by powerboat and then walked and meander-searched.

Drummond Island

As noted above, the eastern shore of Drummond Island at Marblehead was identified as a survey site based on the paucity of previous inventory work. Although the site is well known, it is difficult to access directly via inland roads and is distant from adjacent shoreline access points. The Marblehead limestone cliffs were there accessed via kayak from Glen Cove to the east, and the entire eastern shore was assessed

from the Marblehead peninsula south and around to Bass Cove. M. Penskar and P. Higman conducted surveys on July 15. Several areas of the Marblehead outcrops were examined inland to the forest border, as well as areas of lower bedrock outcrops, gravel shores, and rocky beaches.

Results of Plant Surveys

Because rare plant and natural community surveys were conducted by both botanists and ecologists, the results of these surveys are combined. Natural community results are discussed below in the community section. All Hog Island surveys, which resulted in several rare plant discoveries, were conducted by MNFI ecologist D. Albert.

For the collective group of islands inventoried in 1999, a total of 10 new rare plant occurrences were documented. These consisted of one occurrence of Pitcher's thistle (*Cirsium pitcheri*, federal and state threatened), one occurrence of Lake Huron tansy (*Tanacetum huronense*, state threatened), four occurrences of beauty sedge (*Carex concinna*, state special concern), one occurrence of Houghton's goldenrod (*Solidago houghtonii*, federal and state threatened), one occurrence of dwarf lake iris (*Iris lacustris*, federal and state threatened), one occurrence of yellow pitcher-plant (*Sarracenia purpurea* f. *heterophylla*, state threatened), and one new occurrence of purple cliff-brake (*Pellaea atropurpurea*, state

threatened) Tables 6-10. Most notably, the new occurrences include discoveries of three of Michigan's four federally listed Great Lakes endemics, including dwarf lake iris, Houghton's goldenrod, and Pitcher's thistle.

Twenty-one occurrences of known occurrences were relocated for obtaining current status information, consisting of one occurrence of beauty sedge, four occurrences of dwarf lake iris, five occurrences of Pitcher's thistle, one occurrence of Michigan monkey-flower (*Mimulus glabratus* var. *michiganensis*, federal and state endangered), three occurrences of butterwort (*Pinguicula vulgaris*, state special concern), three occurrences of Lake Huron tansy, one occurrence of ram's head orchid (*Cypripedium arietinum*, state special concern), one occurrence of Pumpelly's brome grass (*Bromus pumpellianus*, state threatened), and one occurrence of wall-rue (*Asplenium ruta-muraria*, state endangered). Some of these occurrences include those found in 1998 that we identified for further survey in order to obtain more comprehensive status data.

Table 6. Rare plant and natural community sites inventoried during 1999 surveys of Beaver Island.

Site name	Known occurrences relocated and updated	New occurrences documented
Appleby Point	<i>Iris lacustris</i>	
Bonnars to McCauley Point	<i>Bromus pumpellianus</i> <i>Cirsium pitcheri</i> <i>Tanacetum huronense</i>	
CMU Biostation	<i>Cypripedium arietinum</i>	
Donegal Bay to Indian Point	<i>Cirsium pitcheri</i> <i>Pinguicula vulgaris</i> <i>Tanacetum huronense</i>	
Egg Lake Bog		Bog
Font Lake Old-Growth		Mesic northern forest
French bay	<i>Carex concinna</i> <i>Iris lacustris</i>	
Little Sand Bay Preserve	<i>Cirsium pitcheri</i> <i>Mimulus glabratus</i> var. <i>michiganensis</i> <i>Pinguicula vulgaris</i> <i>Tanacetum huronense</i>	
Lookout Point Extension		<i>Cirsium pitcheri</i> <i>Tanacetum huronense</i>
Martin's Bluff		Mesic northern forest
Point La Par		Dry-mesic northern forest

Table 7. Rare plant and natural community occurrences identified during 1999 surveys of Garden Island.

Site name	Known occurrences relocated and updated	New occurrences documented
Garden Island Harbor		Northern wet meadow
Garden Island West Boreal Forest	Boreal forest	
Indian Harbor		Great Lakes marsh
Jensen Harbor	<i>Pinguicula vulgaris</i>	<i>Solidago houghtonii</i> Northern fen
Jensen Harbor West	<i>Cirsium pitcheri</i>	<i>Carex concinna</i>
Monatou Bay to Sturgeon Bay		Great Lakes marsh
Northcutt Bay	<i>Cirsium pitcheri</i>	Northern fen
Red Oak Garden	Mesic northern forest	
Sweat Lodge Swale		<i>Carex concinna</i>

Table 8. Rare plant and natural community occurrences identified during 1999 surveys of Hog Island.

Site name	Known occurrences relocated and updated	New occurrences documented
Baldimore Bay EA		Northern fen
Hog Island East Shoreline	<i>Cirsium pitcheri</i> <i>Trimerotropis huroniana</i>	Forest dune and swale complex Great Lakes marsh <i>Iris lacustris</i>
Hog Island North	Dry mesic northern forest	Hardwood swamp

Table 9. Rare plant and natural community occurrences identified during 1999 surveys of Marquette and La Salle islands, Les Cheneaux group.

Site name	Known occurrences relocated and updated	New occurrences documented
Marquette Bay		<i>Carex concinna</i> Northern fen Boreal forest
Marquette Bay Southeast Peninsula	<i>Iris lacustris</i>	<i>Carex concinna</i>
Peck Bay	Great Lakes marsh	<i>Iris lacustris</i>
Voight Bay West		<i>Carex concinna</i> <i>Sarracenia purpurea</i> f. <i>heterophylla</i> Boreal forest Open dunes

Table 10. Rare plant and natural community occurrences identified during 1999 surveys of Drummond island.

Site name	Known occurrences relocated and updated	New occurrences documented
Marblehead Cliffs	<i>Asplenium ruta-muraria</i>	<i>Pellaea atropurpurea</i> Dry non-acid cliff

Discussion of Plant Surveys

As in the previous year, systematic inventories of the targeted Great Lakes islands resulted in several new rare plant occurrences derived from a total of seven plant species. All of these species were found along the immediate shoreline or within near-shore natural communities, once again demonstrating the richness of the shoreline ecosystem. The majority of discoveries were from Beaver, Garden, and Hog islands, perhaps due in part to the extent of habitat exposed during a low water year, as well as the attention of surveyors at optimal times. Two years of dedicated survey within this archipelago has also enabled surveyors to learn to focus on habitat of the highest potential, such as bedrock exposures near the shore, cedar glades, northern fens, gravelly storm beaches, interdunal wetlands, spring-fed seeps and streams, and sand dunes of any significant extent. In addition to significant new occurrences, a large number of older records were relocated and important information on the status, condition, and extent of several rare taxa

was obtained. These new data will greatly assist in conservation planning, owing to the rare of development along shorelines where the vast majority of rare plants occur.

In northern Lake Huron, only an initial effort could be made in the large Les Cheneaux island chain, yet our surveys resulted in three new plant occurrences and also several significant natural community occurrences (discussed below). The most notable discovery was documented on the west side of Marquette Island in Marquette Bay, where the first Upper Peninsula record of yellow-pitcher plant was found (see photo on report cover). Prior to this discovery the species was known in Michigan only in a few bogs in the northern Lower Peninsula near Lewiston. On Marquette Island yellow-pitcher plant was discovered within a fen-like interdunal wetland, a markedly different habitat than the southern Michigan sites. Substantial portions of Marquette Island, which is quite large, and La Salle Island remain to be more thoroughly surveyed, and it is expected that additional

rarities and natural community occurrences will be recorded during future efforts.

On Drummond Island, we succeeded in accessing a portion of the extensive limestone cliffs bordering the shore of the Marblehead “peninsula”. These impressive outcrops resulted in a large new occurrence of purple cliff-brake, a species known elsewhere on the island. Marblehead is also well-known for supporting the only state occurrence of the state endangered

wall-rue, a species that remains extant and secure along the impressive outcrops. Because of the extent of this exposed bedrock, and the difficulty of traversing many of the vertical faces, Marblehead is a site that cannot be considered as having been comprehensively inventoried, and it is likely that additional discoveries, especially ferns, will be documented at this site.

Methods for Natural Community Surveys

Similar to the 1998 inventories, a portion of natural community surveys was based upon the preliminary identification of potentially high quality sites by botanical surveyors and others. Examination of the MNFI statewide database (BCD) and other information, such as knowledge of existing dedicated state natural areas based on old-growth tracts, was used to help delineate areas to serve as the foci for aerial photo

interpretation and potential field inventories. While a variety of natural communities are known to occur within the Beaver island archipelago, inventory priorities focused on locating, describing, and mapping high quality examples of mesic northern forest, boreal forest, northern fen, and open dunes.

Beaver, Garden, and Hog Islands

Beaver, Garden, and Hog islands were identified for late season surveys to focus principally on mature (i.e old-growth) and high quality tracts of mesic northern forest and shoreline related natural communities. Anticipated shoreline communities included such types as northern fens, open dunes/interdunal wetlands, forest dune and swale complexes, and Great Lakes marsh. Natural community inventories were conducted by D. Albert from August 16-20. Prior to field surveys the islands were briefly examined via 1978 CIR photos to delineate potential survey sites. Surveys were conducted by traversing habitats via meander

searches and recording appropriate community data (e.g. tree dbhs, microtopography, soils information, disturbance features, evidence of Native American management, etc.) for high quality examples of sufficient merit for recognition for the statewide database.

Several old-growth tracts reported previously by other staff for Beaver and Garden islands were highlighted for survey (e.g. the red oak tract on Garden Island). A Great Lakes marsh site was known for Hog Island, and was a targeted of particular interest owing to the current low water conditions.

Bois Blanc Island

Bois Blanc Island was selected for a brief late season survey to assess the regions of two to three dedicated state natural areas; these were sites based on old-growth tracts of mesic northern forest. Because of a mature red oak component, it was suspected that the structure

and composition of these tracts was due to former Native American management. Several sites were inspected in mid-November, including tracts where recent red oak timber harvesting was taking place in order to obtain tree ages. Soil litter and duff samples were obtained for

subsequent examination for charcoal and a possible indication of Native American burn

management.

Les Cheneaux Islands

Natural community surveys for the Les Cheneaux islands were conducted during the course of botanical inventories, with an emphasis on boreal forest, northern fen, open dunes, and other potential shoreline communities. Inventories took place from June 9-11 and were

performed by M. Penskar and P. Higman. Species lists for potentially high quality examples were compiled as well as appropriate natural community field forms and photographs for evaluation by staff ecologists.

Drummond Island

Natural community surveys for Drummond Island were conducted during rare plant inventories, as it was suspected that this extensive outcrop habitat was a high quality natural community with strong merit for

recognition within the statewide database. A species list was compiled by botanists in addition to a description of the vertical cliff faces, disturbance features, and the general extent and condition of the community.

Results of Natural Community Surveys

A diverse assemblage of new natural community occurrences was documented during 1999 island surveys, as indicated in Tables 6-10. Eighteen new occurrences of communities were documented and entered into the statewide database (BCD). These were comprised of one occurrence of bog, two occurrences of mesic northern forest, one occurrence of dry mesic northern forest, four occurrences of northern fen, three occurrences of Great Lakes marsh, one occurrence of northern wet meadow, one occurrence of forest dune/swale complex, one hardwood swamp occurrence, two occurrences of

boreal forest, one occurrence of open dune, and one occurrence of dry non-acid cliff. In contrast, only one existing community occurrence was encountered and updated, a dry mesic northern forest example.

The majority of new natural community occurrences is attributable to the Beaver Island archipelago, where 13 occurrences deriving from 8 different community types were documented, including several occurrences of northern fen, Great Lakes marsh, and mesic northern forest.

Discussion of Natural Community Surveys

Natural community inventories resulted in a remarkable number of new occurrences, particularly within the Beaver Island archipelago. In one sense this is not surprising, owing to the fact this group is where the staff ecologists concentrated their efforts. A relatively large number of community occurrences are also not unexpected in many natural features inventories,

based on the fact that little previous work of this type has often not been conducted in an area. However, natural community occurrences must still be of sufficient condition and extent from a statewide standpoint to qualify for the database, and thus this large number of new occurrences is highly noteworthy. The community diversity parallels that reflected in the plant and animal

findings, corroborating the richness and high biodiversity of the Beaver islands assemblage. The current low water year has led to the enhancement and definition of several shoreline communities, such as notable northern fens and Great Lakes marshes, which comprise several of the occurrences within the Beaver archipelago.

Elsewhere, a small number of significant new occurrences were documented for the Les Cheneaux islands and Drummond Island. Further surveys by staff ecologists in more comprehensive efforts in the Les Cheneaux

island chain will undoubtedly lead to the recognition of additional occurrences and likely other community types. Lastly, the outcrops identified at Marblehead on Drummond Island are perhaps exemplary for dry non-acid cliffs in the eastern Upper Peninsula, and appear to be unique in their marked structure. Because of their apparent uniqueness and difficulty in surveying, this bedrock exposure may yet harbor other plant and perhaps animal rarities such as snails that are associated with alvar communities.

Digitization of Island Data and Spatial Representation of Natural Features

Overview of 1999 Work and Results

As an effort of the island project, and a task ultimately critical for conservation planning, MNFI has initiated preparation of island natural features data for use within a Geographic Information System (GIS). To that end, natural features data for areas where inventory is considered more or less complete will be processed, digitized, and prepared for spatial representation. During the 1999 island project, the Beaver Island archipelago was identified as the first island assemblage to be digitized, and following the compilation of 1999 surveys, all occurrence information was subsequently processed in this manner. Here we present an explanation of how these data are spatially represented, followed by a description of the conceptual basis for mapping and representing these data, using Hog Island as an example.

Following two years of systematic inventory in the Beaver islands, a total of 161 natural features were processed and digitized. Approximately 25% of this total number originated via MNFI's surveys in 1998 and 1999. An example of how natural features data are depicted spatially is presented in Figure 8, which displays the digitization of occurrences on Hog Island. The gray shaded areas are polygons that represent the aerial extent of natural features, whereas the circular area in the southwest part of the island demonstrates how more vague information, usually that which derives from older records, is displayed within a buffer of relational uncertainty, the concept of which is described below.

Conceptual Basis for Element Occurrences and Mapping

When returning from the field the scientist transcribes any information for element occurrences to be submitted to the information management staff. The known extent of an **Observed Feature** is mapped on a 1:24,000 USGS topographic map as a point, line or polygon. These **Conceptual Feature** types are determined by the scientist and are based on the minimum mapping unit of 12.5 meters. In order for boundaries, resulting in a polygon, to be mapped, the extent of an element must exceed

12.5 meters in both length and width. When an EO is less than 12.5 meters in one of these dimensions, it is mapped as a line. In cases where the EO is less than the minimal mapping unit in both dimensions, it is conceptually represented by a point (Figure 8).

It is at this stage that the scientist incorporates locational uncertainty. Since the actual location may vary from the recorded location represented on the topographic map, procedural buffers are generated around the

digitized feature in order to avoid misrepresentation of the occurrence's location. The scientist sets the distances of these procedural buffers.

With information clearly mapped and locational uncertainty classes set, the scientist then passes the transcription forms along to information management staff to be entered into the database. The Biodiversity Tracking and Conservation System (Biotics) is then used to digitize and record spatial information on element occurrences.

After receiving transcription information from staff scientists, information management staff then digitize the **Conceptual Features** displayed on the topographic maps. These conceptual features become points, lines or polygons within the Biotics program and are then

known as **Source Features**. The locational uncertainty specified by the scientist is then applied resulting in the creation of a procedural buffer. This source feature combined with the procedural buffer becomes what is known as a **Procedural Feature**. It is this resulting polygon that is used to calculate spatial information for the element occurrence.

Once the spatial information is calculated in the Biotics program, it is stored in the database and becomes an **Element Occurrence Representation Polygon**. It is these representation polygons that are used in conservation planning efforts. These concepts and the flow of information resulting in a natural features occurrence record are depicted in Figure 9.

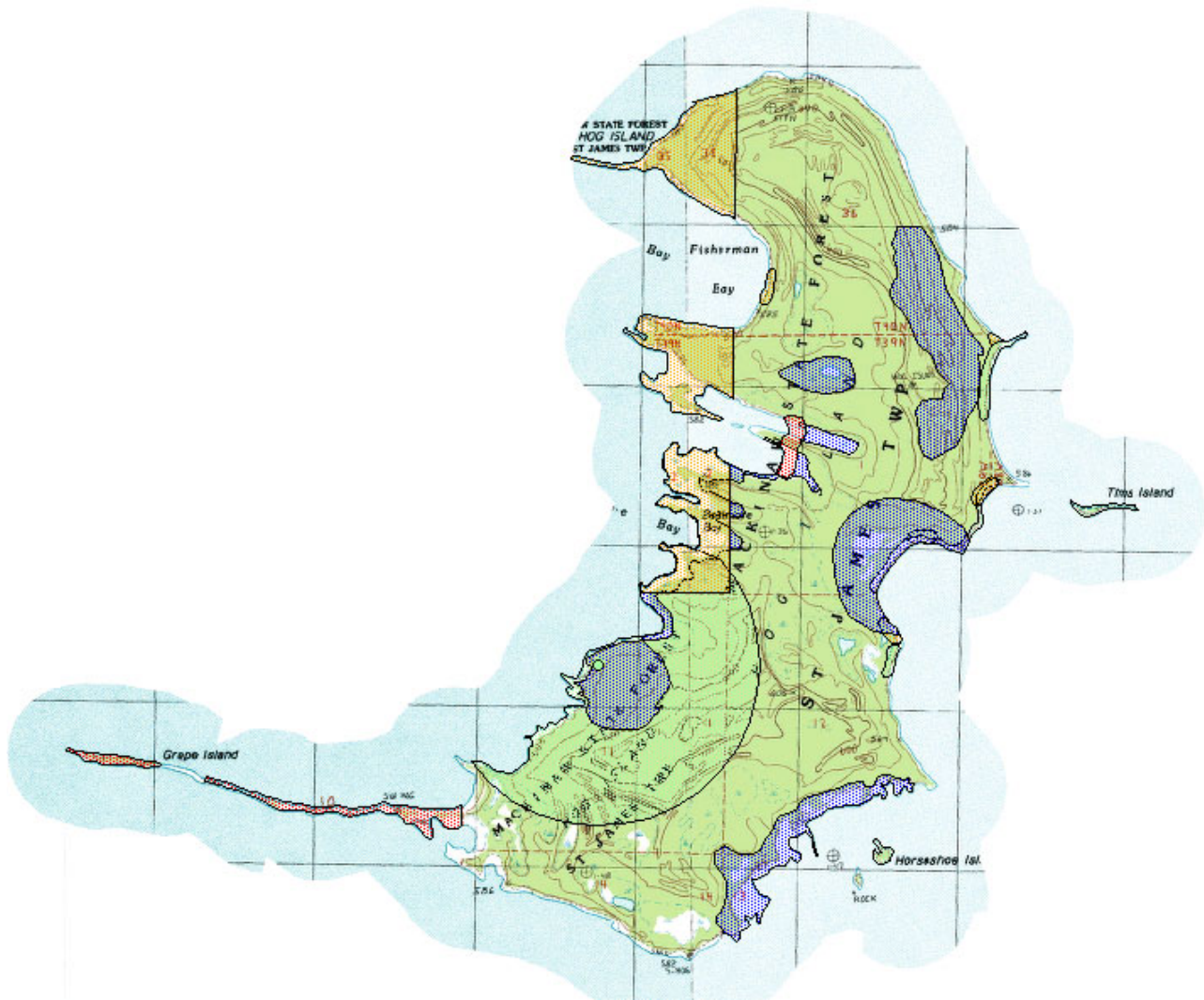


Figure 8. Hog Island with digitized and mapped natural features occurrences, demonstrating the spatial extent of elements recently determined in the field (irregular polygons) versus the relational uncertainty of older occurrence information (spherical area in southern region) based on less site-specific data.

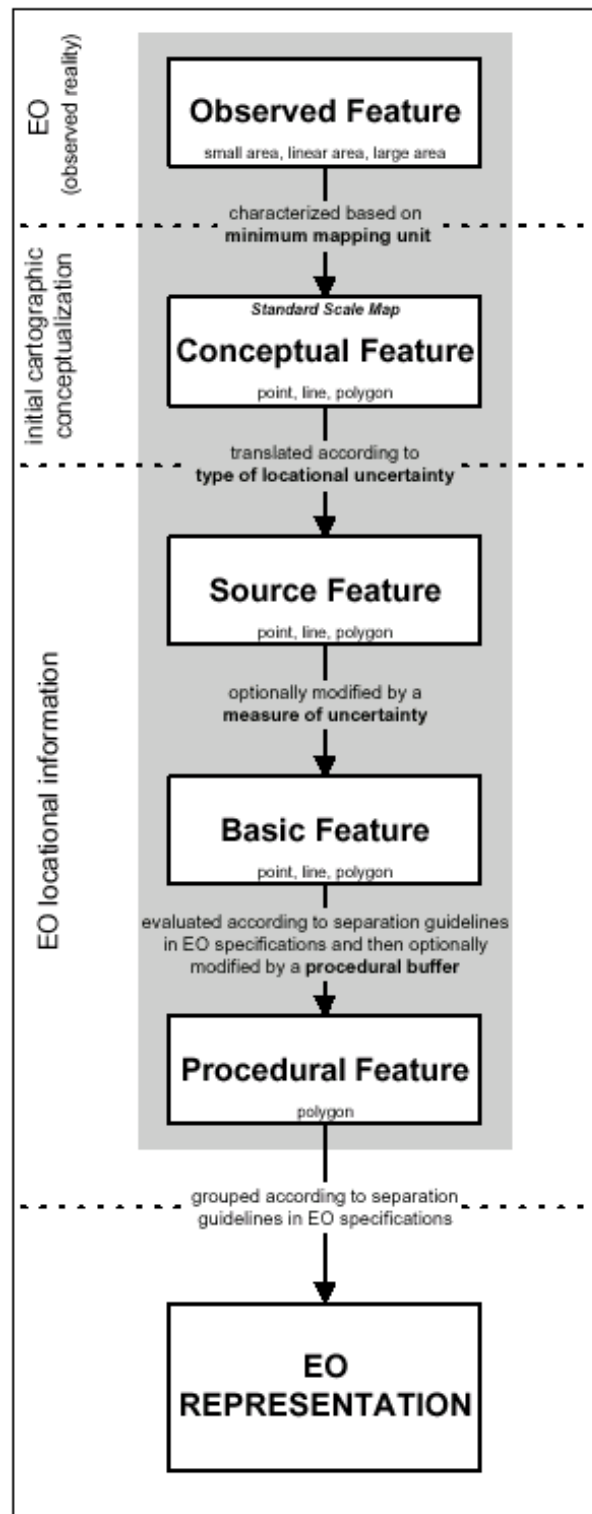


Figure 9. Essential stages in developing an element occurrence representation.

Conservation Planning for Beaver Island

Background

During the first and second years of this project, MNFI scientific staff collected information on unique, rare, and sensitive natural features. Priority areas on Beaver Island were identified and inventoried, and these data were analyzed and summarized. One of the primary goals of this project, however, was not just to collect and analyze data, but also to assist island community and local decision makers with future land-based decision making efforts by providing

meaningful ecological information. The purpose of the conservation planning portion of the project was two fold. The first objective was to determine what types and levels of natural resource information were desirable to the Beaver Island community. The second objective was to determine the most effective ways to convey this information to the Beaver Island community, including significant stakeholders and other interested parties.

Methodology

In order to achieve these goals we needed to develop a methodology or process to communicate with the Island community. The original model was essentially an expert-based model in which MNFI would present ecological information, systematically gather input from select members of the community, and summarize results. As development of the process proceeded, we decided to take a more community-based approach. In this model, the community would develop their own decision-making process for determining what types and levels of MNFI data they would like, what form or forms it might take, and how to use the information most effectively. The plan was to hold one community wide meeting and invite key community stakeholders and leaders.

The meeting was going to be broken into two segments. In the first segment, MNFI would present 1) description of MNFI, 2) significance of the Great Lakes shoreline and Islands, 3) threats to significant natural features along the shoreline, and 4) ecological data of Beaver Island. The second segment would focus on engaging the community in a discussion about the information we presented. Techniques such as breakout groups, steering committees, focus groups, and/or task forces could then be used to reach the two objectives mentioned earlier.

The method chosen to communicate with the public was a slight modification of the community-based model described above. A number of key community leaders and

stakeholders were consulted to develop a system that was best suited for Beaver Island. These included, 1) Tom Bailey, Director of the Little Traverse Conservancy, 2) Marilyn Damstra, chairperson of Little Traverse Conservancy's Beaver Island Steering Committee, and planning commissioner of St. James Township, 3) E.B. Lange, acting president of the Beaver Island Property Owners Association, and 4) Bill Paladino, planning commissioner of Peaine Township. Instead of one workshop, John Paskus, Conservation Planning Specialist, MNFI, in cooperation with community leaders, developed and organized one presentation as part of an annual meeting and one interactive workshop, which was open to all Island residents.

The presentation was given during the Beaver Island Property Owners Association (BIPOA) annual meeting. According to several key people in the community, the BIPOA is currently the most active group on the Island. Approximately 100 people attended the meeting. The presentation was coordinated with Tom Bailey, Director of the Little Traverse Conservancy (LTC). Bailey presented information about the LTC, past and present activities on the Island, and conservation tools. He ended his talk by discussing the significance of MNFI's work to the LTC. John Paskus followed Bailey's presentation. Paskus developed a powerpoint presentation which contained information about MNFI, the

ecological significance of the Great Lakes' Islands, results from previous and recent biological inventory work on the Island, identification of significant ecological sites on Beaver Island, and an interactive workshop planned for August that would be open to the entire community. Maps of the natural features, circa 1800 vegetation, and 1978 landcover of Beaver Island were on display during the entire meeting. (Please refer to Appendix A for a copy of the slide presentation).

The workshop that followed was organized and advertised as an interactive workshop. The goals of the workshop were to: 1) initiate a community discussion about the natural resources and community character of the Island, and 2) determine the natural features that Island residents value most. All Island residents were welcome, and key community stakeholders were identified and specifically invited. Advertisements for the workshop were displayed at key locations throughout the Island. The

workshop was entitled, Preserving the Natural Resources and Community Character of Beaver Island. MNFI contracted with the Land Information Access Association (LIAA) to assist with the design and implementation of the workshop. The agenda for the workshop included: 1) introductions and greetings, 2) technology demonstration showing how computerized mapping and multimedia can be used to document and understand community resources, 3) an interactive exercise (break-out groups) entitled 'crayon your community', 4) an overview of significant natural features on the Island and threats to those features (powerpoint presentation), and finally 5) a discussion about the next steps to consider. A total of 23 residents attended the workshop, and relationships were developed with several key people in the community. (Please refer to Appendix B for a copy of the agenda, notes taken during the workshop, and the follow up letter sent out to workshop participants).

Summary of Results

As part of the introduction for the workshop, participants were asked to list some of the things they appreciated about Beaver Island. Items ranged from 'dark night sky' (low light pollution), to specific sites such as Little Sand Bay and Barney's lake. Of the 18 items mentioned, 15 were related to natural resources. The remaining three items were cultural history, opportunity for seclusion, and the planning process.

The purpose of the interactive exercise entitled 'crayon your community' was to generate mental maps of the participant's community and list things that define Beaver Island as a special place. At the end of the exercise, all items were broken into four categories: 1) commercial, 2) historic features, 3) natural features, and 4) cultural features. By far the category with the most items was natural features that contained 22 different items, two of which were mentioned several times.

A list of recommendations was provided in the discussion on improvements and preservation efforts. Recommendations were quite broad and included such things as building a cultural

center, protecting natural features, maintaining public access to lakes, and road improvements. A group discussion on next steps followed. The purpose of this last step was to: 1) determine what types and levels of natural resource information were desired by the community, and 2) determine the most effective ways to present this information. Recommendations were broken into two major categories: 1) information/communication, and 2) planning.

Strong interest was expressed for developing an arrival guide to inform new residents and visitors about the unique natural and cultural features on Beaver Island and surrounding area, as well as how to be good stewards. It was also suggested that a user-friendly electronic kiosk be installed on the ferryboat or in one of the Boat Company's offices, along with a brochure they can take with them. The kiosk would contain information about special natural and cultural sites, unique and/or exemplary natural communities, and rare and declining plants and animals found in the Beaver Archipelago. Emphasis would be placed on informing users about the impacts of human

activities on natural features, beneficial stewardship activities, environmental education opportunities, and conservation programs. Another interesting suggestion came from two planning commissioners (one from each township). The commissioners expressed interest in integrating new biological information (collected by MNFI and others) and current

values of Islanders into the comprehensive master planning process of each township, and future outreach efforts. Several hard copy maps of natural features, circa 1800 vegetation, and 1978 landcover were provided to the township planning commissioners to temporarily address their needs.

Site Summaries

As established in the format of several previous MNFI reports concerning coastal zone inventories, we provide here a summary description of the significant inventory sites. These descriptions are provided primarily for inventory sites covered by MNFI botanists, community ecologists, and aquatic ecologists. We have not attempted to catalogue this level of information for all sites assessed and inventoried during animal surveys; many of these consisted of bird census stations where it was not necessary to obtain detailed habitat data. However, animal inventories did coincide in several of the following sites, and where useful, relevant information is incorporated below. Sites where bird point counts were conducted are appropriately noted. While a complete analysis

requires multi-year data, areas rich in bird species are highlighted.

The intention of this section is to provide a summary of each site in a relatively brief commentary format that can be used for meaningful future reference and consultation. Lastly, because several surveys consisted of re-visits to sites inventoried in 1998, we have updated the site summary descriptions where necessary, and to avoid confusion, we are including all of the last two years' site summaries within this section. To avoid additional confusion with last year's work, we have eliminated sequentially numbering each site, and instead provide each island's inventory sites in alphabetical order.

Beaver Island Sites

Appleby Point

Appleby Point is located at the southernmost tip of the Island and was visited to assess the status of a dwarf lake iris (*Iris lacustris*) population documented in 1989, and a reported ram's head orchid (*Cypripedium arietinum*) population. The iris population was found thriving at the edge of a cedar-spruce-sugar maple forest that is abruptly terminated by the bordering road, from where we observed the population. It extends into the forest along areas of sparse canopy cover canopy openings and out along the edge of a barrier dunes complex bordering Lake Michigan. A proposed cable route was changed to avoid this population in 1992 and likely had a significant role in the preservation of this colony.

Although sought, the Ram's-head orchid population was not observed. This species is notoriously difficult to find due to its small size and short, weather dependent flowering period. Reported from this site for several years by Central Michigan University staff and students, there is no reason to suspect it's extirpation.

This site appears slated for development, as evidenced by construction stakes on the property. It will be important to educate those involved of the significance of this site, harboring one of only two Beaver Island occurrences of the Great Lakes endemic, dwarf-lake iris. Knowledge and implementation of appropriate stewardship actions, could preserve the integrity of the forest and dune communities and associated species.

Barney's Lake

The north shore of this lake was surveyed briefly to detect the presence of any shells of deepwater pondsnail (*Stagnicola contractus*), which was documented and last observed here in 1940. A small portion of the northern shore was inventoried by MNFI botany staff, who collected several snail shells for assessment by staff

zoologists and other experts. Numerous snail shells were found, and this lake was observed to be markedly different from Fox Lake, with its mucky-peaty substrate and several indications of more alkaline conditions. No specimens of deepwater pondsnail were confirmed from the snail shells obtained. Portions of the northern

shore supported fen species, such as Indian paintbrush (*Castilleja coccinea*), and groundwater seeps and springs were observed. The shoreline was also unsuccessfully surveyed for a rare buttercup (*Ranunculus cymbalaria*) last observed here when it was first documented in 1957. Because of the brief nature of the aforementioned surveys, further inventories are warranted for both the deepwater pondsnail and the rare buttercup in 1999 to determine their status. During an early evening survey of the

Barneys Lake Nature Preserve along the shore, in old field habitat and in an orchard, zoologists recorded thirteen bird species including the state threatened caspian tern (*Sterna caspia*) which was observed fishing in the lake. In 1999, thirty-one bird species were recorded at Barney's Lake Nature Preserve along the lake and in the orchard during spring and summer bird surveys. The state threatened Caspian tern (*Sterna caspia*) and osprey (*Pandion halieetus*) were observed fishing in Barney's Lake.

Bonner's Landing

This site extends along several miles of the west shore of Beaver Island just south of Barneys Lake. It continues from Left's point to the south as a narrow shoreline band consisting primarily of cobble and sand beach, interspersed with occasional emergent marsh and northern fen communities. In this region, it encompasses numerous small coves and rocky spits that extend out into the lake and is dotted with well set-back private cottages. Species typical of open dunes dominate the sandy portions of the site including such species as ground juniper and horizontal juniper (*Juniperus communis* and *J. horizontalis*), marram grass (*Ammophila breviligulata*), Canada rye grass (*Elymus canadensis*), agropyron (*Agropyron dasystachyum*), wormwood (*Artemisia campestris*), and goldenrod (*Solidago simplex* var. *gillmanii*). Several clusters of Pitcher's thistle (*Cirsium pitcheri*) and a single cluster of Lake Huron tansy (*Tanacetum huronense*) were found scattered in the sandier coves, thus increasing the southward extent of previously known occurrences from this site. However, along much of the more rocky and narrower regions, exotic species such as soapwort (*Saponaria officinalis*), yarrow (*Achillea millefolium*), and bluejoint (*Poa compressa*) have a significant presence. The wetter portions of the shoreline included species typical of

northern fens and interdunal wetlands, such as purple gerardia (*Agalinis purpurea*), silverweed (*Potentilla anserina*), rush (*Juncus balticus*), gentian (*Gentianopsis procera*), Kalm's lobelia (*Lobelia kalmii*), and grass-leaved goldenrod (*Euthamia graminifolia*). To the north, the site gradually widens to a broad sandy foredune just west of Slop Town Road, where it is popularly known as Bonners Landing, a relatively secluded beach and picnic site. Only the southern portion of the sandy foredune area was explored and Pitcher's thistle was found to be fairly abundant while Lake Huron tansy, although not abundant, was more common than further south. The open dune continues northward eventually merging with an extensive forested dune complex. The Lake Huron locust (*Trimerotropis huroniana*) was documented in the sand dunes along the shoreline during 1999 surveys. Ninety-four adults were seen during a fifteen-minute search of shoreline. Although not considered a large population, the habitat in this area is considered good for this species. This area will be a priority for 1999 survey work. In addition to assessing the status of the thistle and tansy populations, attempts will be made to relocate and assess an occurrence of Pumpell's brome grass that was documented in 1958.

Bonner's Landing to McCauley Point

This site is accessed from the end of Sloptown Rd., where a small parking area has been designated for visitors. One climbs down the steep, Nippising dune beach ridge and follows a pathway that opens into a broad sand beach vegetated with typical dune species such as marram grass (*Ammophila breviligulata*), wheat grass (*Agropyron dasystachyum*), wormwood (*Artemisia campestris*), sand cherry (*Prunus pumila*) creeping juniper (*Juniperis communis*), and bearberry (*Arctostaphylos uva-ursi*). A low foredune spans the entire site, broadening into moderate blowout areas in two places, and a broad sand beach at McCauley Point. The

northern two thirds of the shoreline is backed by a complex topography of mostly forested dune ridges and valleys. The entire site is dotted with cottages or marked for future home sites, however the open dune regions are not as disturbed as some of the more heavily used regions of the shoreline, such as Donnegal Bay. Local colonies of Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*) are scattered throughout and several colonies of Pumpell's brome grass (*Bromus pumpellianus*) were observed in the blowout areas.

Cable Bay

This site was identified primarily to gather status information for known populations of Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*). The dunes were found to be of good quality and extensive enough to merit documentation. In the upper, or northeast portion of Cable Bay, where public land provides access to the upper part of the bay, the dunes grade relatively high in topography, with one parabolic-like blowout area. Moderately-sized populations of Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*) were observed, as well as a standard assemblage of dune species, including marram grass and dune grass (*Ammophila breviligulata*, *Calamovilfa longifolia*), beach pea (*Lathyrus japonicus*), sea rocket (*Cakile edentula*), horizontal juniper (*Juniperus horizontalis*), hairy puccoon (*Lithospermum caroliniense*), milkweed

(*Asclepias syriaca*), ground juniper (*J. communis*), poison ivy (*Toxicodendron radicans*), little bluestem (*Andropogon scoparius*), dune willows (*Salix exigua*, *S. cordata*), jack pine (*Pinus banksiana*), northern white cedar (*Thuja occidentalis*), euphorbia (*Euphorbia polygonifolia*), and starry false Solomon's seal (*Smilacina stellata*). No particularly invasive exotics were observed. Animal surveys resulted in the documentation of a large population of Lake Huron locust (*Trimerotropis huroniana*) in the open sandy dunes and blowouts. Two point counts were conducted for migratory birds, one in the open dunes and the other in the adjacent interior forest. Both areas contain a fairly complex vegetational structure and were rich in bird species. The state threatened merlin (*Falco columbarius*) was observed hunting prey along the forested edge of the open dune area.

Cheyenne Point

This site spans several coves and sand spits along the southwest shoreline of Beaver Island just west of Iron Ore Bay. It is comprised of a narrow fringe of mostly cobble beach with numerous emergent/northern fen wetlands. Emergent grass and sedge species such as hardstem bulrush (*Scirpus acutus*), three-square bulrush (*S. americanus*), twig-rush (*Cladium*

mariscoides), rush (*Juncus brachycephalus*) and bluejoint grass (*Calamagrostis inexpansa*) in standing water characterize the wetlands. Clusters of colorful herbs such as Kalm's lobelia (*Lobelia kalmii*), Arkansas mint (*Calamintha arkansana*), purple gerardia (*Agalinis purpurea*), and Indian paintbrush (*Castilleja coccinea*) occur along the edges of the larger wetlands and

in shallow depressions along the cobble beach. Four small clusters of Pitcher's thistle (*Cirsium pitcheri*), consisting of only a few individuals each were noted in sandy pockets along this stretch of shoreline. Associates included typical dune species such as creeping and ground juniper (*Juniperis horizontalis*, *J. communis*), balsam poplar (*Populus balsamifera*), marram grass (*Ammophila breviligulata*), wild rye (*Elymus*

glaucus), and wheat grass (*Agropyron dasystachyum*).

A large population of Lake Huron locust (*Trimerotropis huroniana*) was observed during surveys conducted in 1999. Thousands of adults were seen and heard at this site and they are locally abundant here. This species occurs from Iron Ore Bay to the dunes west of Cheyenne Point in Section 23.

CMU Biostation

A population of Ram's-head orchid was discovered at the CMU Biostation in 1986, occurring under pines on a sand dune ridge topped by a layer of pine needle duff, a very typical habitat for this species. A survey was conducted to assess the status of this population,

which has persisted for several years, despite significant amount of traffic through the area. Only one sterile plant was observed in 1999. This population should be monitored periodically to determine its viability.

Donegal Bay to McCauley Point

The Donegal Bay area has one of the island's largest dune complexes, yet the site is highly fragmented with numerous homes and cottages scattered throughout. Little of the accessible areas were inventoried, although several of the site's well known rare species were observed, including Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*). These species appear to persist well in the intact local stretches of dunes, which are known to support several other rarities, including Pumpell's brome grass (*Bromus pumpellianus*), fascicled broom-rape (*Orobanche fasciculata*), butterwort (*Pinguicula vulgaris*), and Houghton's goldenrod (*Solidago houghtonii*). Several interdunal depressions and low flats were investigated for Houghton's goldenrod. Although good habitat was present, only the related, common Ohio goldenrod (*Solidago ohioensis*) was observed. A large vigorous colony of

butterwort was observed in an interdunal area. Animal surveys at McCauley Point resulted in the documentation of a new occurrence of the Lake Huron locust (*Trimerotropis huroniana*). Large patches of little bluestem were swept for red-legged spittlebug (*Prosapia ignipectus*), which was not found, and blacklighting was conducted in this same area in an unsuccessful attempt to detect the aweme borer moth (*Papaipema aweme*), a very rare moth previously documented in sand dunes on Beaver Island. Two migratory bird counts were conducted just inland from McCauley Point in mature beech-maple habitat. A new occurrence of the Lake Huron locust was also documented in the Mt. Pisgah and Donegal Bay Park areas, which both contain back dunes that finger up and grade into mixed northern forest. Blacklighting surveys did not detect the rare aweme borer moth in the vicinity of Mt. Pisgah.

Donegal Bay to Indian Point

This survey was initiated directly west of Donegal Bay Rd. to complete coverage of the shoreline from north Donegal Bay northward to Indian Bay. Although similar to the site directly south (Donegal Bay - McCauley Point), surveyed in 1998, this region lacks the extensive

dune complex immediately adjacent to the shore, consisting of a mostly narrow band of sand beach with one or two low foredune ridges in several regions. This is a heavy use residential area with fairly well set-back homes spanning the entire length of the site. Although vegetated with

the typical complement of dune species, several exotics were fairly abundant including spotted knapweed (*Centaurea maculosa*), yarrow (*Achillea millifolium*), bladder campion (*Silene vulgaris*), and Canada bluegrass (*Poa compressa*). Local clusters of Pitcher's thistle and Lake Huron tansy were observed throughout the site, however they are vulnerable to continued disturbance by human activity.

A careful survey was conducted to relocate and assess the status of a previously identified Houghton's goldenrod (*Solidago houghtonii*) population; the only reported location for this species on the Island. The small, but apparently healthy population was located immediately north of the start point, in a linear interdunal

depression behind a low foredune ridge. Although the number of flowering stalks was not as high as noted in 1993, the population appeared to be undisturbed and non-flowering shoots were abundant. Dominant associates included shrubby cinquefoil (*Potentilla fruticosa*), Kalm's St. John's-wort (*Hypericum kalmianum*), rush (*Juncus balticus*), bulrush (*Scirpus atrovirens*), Ohio goldenrod (*Solidago ohioensis*), grass-leaved goldenrod (*Euthamia graminifolia*), false asphodel (*Tofieldia glutinosa*), and Kalm's lobelia (*Lobelia kalmia*). A small population of state threatened butterwort (*Pinguicula vulgaris*) was also relocated at the edge of this interdunal wetland.

Egg Lake Bog

Egg Lake Bog lies in the north-central portion of the Island approximately two miles south of Font Lake. It is a well known site and was targeted for survey to assess its quality and to look for English sundew (*Drosera Xanglica*), a special concern species documented there in 1970. The high diversity bog is fairly intact with a moderate to marginal forest buffer. Scattered black spruce (*Picea mariana*), tamarack (*Larix laricina*), and white cedar (*Thuja occidentalis*) are the dominant canopy and understory tree species, while sweet gale (*Myrica gale*), leatherleaf (*Chamydaphne calyculata*), and blueberry (*Vaccinium* spp.) form the dominant shrub matrix. Interspersed throughout is a rich

assortment of bog species such as bog-rosemary (*Andromeda glaucophylla*), bog-laurel (*Kalmia polifolia*), bog buckbean (*Menyanthes trifoliata*), marsh cinquefoil (*Potentilla palustris*), three square (*Dulichium arundinacea*), yellow-eyed-grass (*Xyris torta*), bog sedge (*Carex limosa*), round-leaved sundew (*Drosera rotundifolia*), and pitcher plant (*Sarracenea purpurea*). The bog appears little disturbed, with most traffic evidenced by foot trails on the north side, where there is an access road. English sundew was not observed, however further dedicated survey for this species is recommended.

Font Lake

This is the second largest inland lake on Beaver Island. An American bittern (*Botaurus lentiginosus*) was heard calling during breeding bird surveys at the southeast end of the lake. This lake edge is characterized by bog and marsh vegetation including tamarack (*Larix laricina*), bog birch (*Betula pumilla*), sweet gale (*Myrica gale*), sedge (*Carex* spp), and common reed

(*Phragmites australis*). The American bittern is currently listed as a species of special concern due to habitat loss and resulting population declines. It is usually found in Michigan's bigger marshes, along lake and pond edges where cattails, sedges, or bulrushes are plentiful, as well as in bogs and wet meadows.

Font Lake Old-Growth

A small remnant of old growth mesic hardwoods occurs along the west side of Font Lake, where the steep slopes of a back dune complex extends inland from Donnegal Bay on the northwest shoreline of Beaver Island. The canopy is dominated by hemlock (*Tsuga canadensis*), American beech (*Fagus grandifolius*), sugar maple (*Acer saccharum*), and occasional paper birch, with diameters reaching 26-30 inches. White pine is rare. The understory is dominated by these same species, with the addition of moosewood (*Carpinus caroliniana*), and balsam fir (*Abies balsamea*). Ground cover is sparse consisting primarily of localized patches of partridge berry (*Mitchella repens*), wild sarsaparilla (*Aralia nudicaulis*),

starflower (*Trientalis borealis*), various clubmosses, and tree seedlings. Numerous paths crisscross the area and high levels of disturbance surround the remnant. Due to these factors and its small size, this remnant is not considered a high quality, functional old growth community with the ability to harbor significant biodiversity. However should adjacent land-use practices become more compatible with biodiversity conservation, there is potential for a larger, more functional community to be restored. This would require that the second growth mesic forest community covering the remainder of the back dune complex be allowed to mature, with minimal disturbance or fragmentation.

Fox Lake

With the exception of a small public access site for boat launching, this site is contained within private land. This pothole lake is relatively shallow, sandy-bottomed, and ringed with a mostly narrow sandy beach whose width fluctuates markedly with changes in lake level. The entire western and southern shores were searched for a known population of water plantain (*Littorella uniflora*) last observed when it was collected in 1980. This species was readily relocated just south of the public boat access, where the receding sandy shoreline revealed locally dense colonies of plants. Associated plants included those typical of softwater lake habitats, such as water-milfoil (*Myriophyllum tenellum*), rush (*Juncus pelocarpus*), lance-leaved violet (*Viola lanceolata*), arrowhead (*Sagittaria* sp.), bulrush (*Scirpus americanus*),

and creeping spearwort (*Ranunculus reptans*). In addition, approximately one-half of the shoreline of the lake was searched for snail shells to determine the possible presence of the deepwater pondsnail (*Stagnicola contractus*), a species documented at this site in 1939. Although surveys of the shoreline failed to detect any snail shells whatsoever, this limited inventory is inconclusive at best, and further work with the appropriate deepwater sampling will be required to ascertain the status of this rare invertebrate. A large open bog occurrence contiguous with the northeast shore of the lake was not prioritized for survey and thus not covered, although this community may be scheduled for assessment in 1999. One point count for migratory birds was conducted along the northern shore of the lake.

French Bay

Accessed by foot trail, this site consists of a small distinct bay on the lower southwest shore of the island. Most of the immediate bay area is contained within state forest land, and the site is well-known locally for its scenic aspect and relatively secluded shoreline location. The bay forms the leading edge of a former post-glacial embayment. Approximately 0.25 east is a

marked, post-glacial ridge. Between this Algonquin-age ridge and the shore, the land slopes downward over a series of successively lower beach ridges, grading from northern hardwood forest to mixed hardwood conifer forest and ultimately to a coastal conifer forest consisting of northern white cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), and

white spruce (*Picea glauca*). The cobbly-sandy beach within the bay is relatively narrow and backed abruptly by the coastal forest. Status information was obtained for previously documented populations of Pitcher's thistle (*Cirsium pitcheri*), Lake Huron tansy (*Tanacetum huronense*), and dwarf lake iris (*Iris lacustris*). Pitcher's thistle and tansy occurred in modest numbers along the limited habitat on the shore, whereas dwarf lake iris was restricted to the shaded, moist coastal conifer forest, where it occurred in small to moderately-sized patches primarily in close proximity to the shore. Additional areas beyond those previously known were recorded for dwarf lake iris, extending the range of the occurrence slightly to the north. One point count for migratory birds was conducted near French Bay Road, approximately 0.5 miles east of the immediate shore.

French bay was revisited briefly in 1999 targeting a previously documented occurrence of

fairly slipper orchid (*Calypso bulbosa*) and to confirm the identity of beauty sedge (*Carex concinna*). The sedge was noted in 1998, however the characteristic fruits required for identification were absent at the time of the survey. It was found in 1999 scattered widely throughout the site, occurring in rocky substrate where canopy coverage was incomplete. Its distribution paralleled that of dwarf lake iris, which was found in great abundance in a band approximately 10-15 meters wide between the tree line and rocky beach, as well as inland between the old beach lines separated by rows of boreal trees. The iris was in peak flower at the time of survey, proclaiming the scenic essence of this site. *Calypso bulbosa* was not relocated, however due to the inherent difficulty of locating this diminutive and ephemeral orchid, it could well be present.

Greenes Bay to McFadden Point

This site contains one of the highest quality sand dune systems occurring on Beaver Island, comprising perhaps the most intact and least fragmented example of open dunes. The site includes large blowout areas, well-developed topography and relatively high dune hills, and areas that are also densely forested. This site is rivaled somewhat by the large dunes associated with Donegal Bay. However, the latter site is highly fragmented with numerous residences and lacks the broad expanse of dune fields and blowouts that remain in this site. The broadest expanse of open dunes occurs in the middle of section 25 just below McFadden Point. The shoreline is fronted by a relatively high, well-developed foredune and broad beach strand. The foredune is dominated by marram grass (*Ammophila breviligulata*), and includes such species as sea rocket (*Cakile edentula*), milkweed (*Asclepias syriaca*), dune willows (*Salix cordata*, *Salix myricoides*), agropyron (*Agropyron dasystachyum*), beach pea (*Lathyrus japonicus*), sand cherry (*Prunus pumila*), and occasional clones of Lake Huron tansy (*Tanacetum huronense*). Pitcher's thistle (*Cirsium pitcheri*) was observed on the foredune but also was found

frequently throughout the open dunes, whereas Lake Huron tansy tended to occur along the foredune and in general closer to the shore. A previously documented population of fascicled broom-rape (*Orobanche fasciculata*) last observed in 1958 was sought but not relocated, although this obscure species likely persists in this large dune complex.

Landward the dunes form a broad, open, slightly undulating dune field, with many portions having a considerable amount of cobble strewn in the sand. The northern portion of the dunes near the point are platted for sale by real estate companies, and there is local disturbance in this area by vehicles straying from the current entry road, possibly including off-road-vehicle (ORV) use. This is the most disturbed portion of the open dunes, as evidenced by the presence of such exotics as spotted knapweed (*Centaurea maculosa*) and bladder campion (*Silene vulgaris*). The backdune areas are typified by a standard assemblage of dune plants such as little bluestem (*Andropogon scoparius*), which forms large patches, horizontal juniper (*Juniperus horizontalis*), ground juniper (*Juniperus communis*), wormwood (*Artemisia campestris*),

hairy puccoon (*Lithospermum caroliniense*), white camas (*Zigadenus glaucus*), bearberry (*Arctostaphylos uva-ursi*), jack pine (*Pinus banksiana*), northern white cedar (*Thuja occidentalis*) and numerous other typical species. The dune field grades to relatively high dune hills with parabolic blowouts, and the adjoining forest forms an abrupt boundary along the border. In the southern portion of Greenes Bay in section 36, the dunes narrow markedly to a broad beach strand and foredune, backed by a limited area of open dunes bordered by forest and interspersed with seasonal homes. The intactness of this high quality dune system is threatened by what appears to be imminent development near McFadden Point. As noted above, much of the private portion has been platted for sale and eventual residential development, and this will undoubtedly lead to further degradation of this dune landscape, both through the direct effects of habitat modification and indirect effects caused by the further introduction of exotic species.

During animal surveys, a large population of Lake Huron locust (*Trimerotropis huroniana*) was documented on the open dunes near McFadden Point. Large patches of little bluestem were swept for red-legged spittlebug (*Prosapia ignipectus*), which was not found, and blacklighting was conducted in this same area in an unsuccessful attempt to detect the aweme borer moth (*Papaipema aweme*), a very rare moth previously documented in dunes on Beaver Island. During late August surveys, merlins (*Falco columbarius*) were observed near McFadden Point, although it was not known if they represented nesting birds or merely fall migrants. Greenes Bay is a documented site for the federal and state endangered piping plover (*Charadrius melodus*), and although suitable habitat appears to exist, the species has not been observed at this site since 1988. Lastly, three point counts for migratory birds were conducted in the general vicinity of Greenes Bay, one just north of McFadden Point and the others in section 36 and the adjoining section 31.

Greene's Lake - Common moorhen area

This lake is located on the southwestern side of the island and is contiguous with the extensive Greene's Lake Bog to the southeast. A common moorhen was heard calling at the north side of the lake during breeding bird surveys in marsh habitat with abundant emergent aquatic vegetation. White pond lily (*Nymphaea odorata*)

and spatterdock (*Nuphar variegata*) are abundant in this area of the lake with patches of sedge (*Carex* spp.) and leatherleaf (*Chamaedaphne calyculata*). The common moorhen is listed as a species of special concern due to habitat loss and resulting population declines.

Indian Point

From the north end of Donegal Bay, the shoreline contains locally extensive interdunal wetlands and flats, which are dominated primarily by herbaceous plants, including several rush (*Juncus*) and sedge (*Carex*, *Scirpus*) species. The wet sand flats include such species as Ohio goldenrod (*Solidago ohioensis*), grass-leaved goldenrod (*Euthamia graminifolia*), sedge (*Carex viridula*), three-square (*Scirpus americanus*), butterwort (*Pinguicula vulgaris*), and nodding ladies'-tress orchid (*Spiranthes cernua*). Further north the shoreline grades into broad areas of cobble shore with marshy flats.

There were occasional short stretches of sand dune, that despite their limited extent and occasionally weedy nature were observed to support small colonies of Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*). Tansy was also observed occasionally growing on cobble shores, which is not atypical. Just south of Indian Point there are small openings with Great Lakes barrens vegetation, with such species as ground juniper (*Juniperus communis*), bearberry (*Arctostaphylos uva-ursi*), horizontal juniper (*J. horizontalis*), and various conifer species. The

sandy openings near the Point were also found to be relatively weedy, with most invaded by spotted knapweed (*Centaurea maculosa*). East of the Point, the shoreline becomes very narrow and limited, consisting of a cobbly-sandy shore backed abruptly by forest. Animal surveys for

the Lake Huron locust (*Trimerotropis huroniana*) were unsuccessful in documenting the species in this area. Further surveys are needed to determine whether they occur here. Two point counts for migratory birds were conducted in the vicinity of the point.

Iron Ore Bay

A relatively extensive region of shoreline dunes occurs in the vicinity of the mouth of Iron Ore Creek, ranging from about 0.5 miles west of the creek mouth to more than one mile east. The gated, private portion in section 20, west of Iron Ore Bay proper, was not surveyed. The dunes near Iron Ore Creek are of good quality, consisting of a well-developed, relatively high foredune grading back into moderately steep dune hills, where there is some fragmentation due to the development of private residences on the higher areas. Behind the public beach and foredune the coastal road runs through the lower portion of the dunes, where it is signed as a Public Beauty Road. The site is scenic but the road clearly fragments the dunes. The foredune is dominated by the pioneering marram grass (*Ammophila breviligulata*), with dune grass (*Calamovilfa longifolia*), as is typical, occurring primarily throughout the backdunes. Known populations of Lake Huron tansy (*Tanacetum huronense*) and Pitcher's thistle (*Cirsium pitcheri*) were surveyed to obtain status and population information; both species were scattered through the dunes, with tansy occurring principally along the foredune areas. Virtually no status information was known for these rarities prior to our survey. An exemplary assemblage of

dune species was present, including wormwood (*Artemisia campestris*), milkweed (*Asclepias syriaca*), horizontal juniper (*Juniperus horizontalis*), bearberry (*Arctostaphylos uva-ursi*), jack pine (*Pinus banksiana*), white cedar (*Thuja occidentalis*), white camas (*Zigadenus glaucus*), dune willows (*Salix cordata*, *S. myricoides*), and hairy puccoon (*Lithospermum carolinense*). A known population of the rare fascicled broom-rape (*Orobanche fasciculata*), an obscure species last observed at this site in 1958, was sought during early and late summer field surveys but could not be relocated. However, wormwood, the obligate host plant of the parasitic broom-rape, is common in the Iron Ore Bay dunes, and thus it is likely that *Orobanche* persists within this still intact dune community. During animal surveys, a population of Lake Huron locust (*Trimerotropis huroniana*) was documented in Iron Ore Bay and in section 20 to the east. In addition, point counts for birds were conducted in forested habitat along Iron Ore Bay Creek and in the open dune community north of Iron Ore Bay. A pair of merlins (*Falco columbarius*) were observed perched in pine trees just 100 meters from the shore on two different occasions.

Lake Geneserath Hemlock Stand

A small stand of old-growth Eastern hemlock (*Tsuga canadensis*) was found along the southwest shore of Lake Geneserath. The one acre stand is located on gently sloping terrain with exaggerated pit-and-mound topography. The forest canopy is dominated by hemlock with lesser amounts of yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), and American beech (*Fagus grandifolia*). Sugar maple dominates the sub-canopy, shrub layer,

and groundlayer. Other common shrub and ground layer species included balsam fir (*Abies balsamea*), striped maple (*Acer pensylvanicum*), ground-pine (*Lycopodium* sp.) and wild sarsaparilla (*Aralia nudicaulis*). Canada yew (*Taxa canadensis*) was found growing well protected under a large blowdown tangle within the thin band of cedar which separates the hemlock stand from Lake Geneserath. Both Eastern hemlock and Canada yew are heavily browsed by white-

tailed deer, which is likely the cause of their scarcity in the forest understory. No hemlock seedlings or saplings were observed within the stand or elsewhere on the island. Because the site is privately owned and borders Lake Geneserath, it is a prime development site. Within this general area, a point count for migratory birds

was conducted along the south shore of the lake, in a different habitat dominated by cedar, birch and maple. This site is notable in that ten different bird species were recorded during the short interval of the point count.

Lefts Point

North of the high quality dune complex at McFadden Point, the foredune constricts to a narrow shoreline band consisting of a mixture of cobble and sand beach with occasional pockets of northern fen. This mile or so stretch of shoreline that extends approximately ½ mile north and south of Left's Point contains three clusters each of Pitcher's thistle and Lake Huron tansy. For the most part these clusters are rather sparsely populated, reaching their greatest density of 50 or so individuals just south of Left's point where the greatest extent of sandy foredune occurs. Common associates include typical dune species such as marram grass (*Ammophila breviligulata*), wheat grass (*Agropyron dasystachyum*), and wormwood (*Artemisia campestris*). Exotic species such as soapwort (*Saponaria officinalis*), bluegrass (*Poa compressa*), spotted knapweed (*Centaurea*

maculosa) and yarrow (*Achillea millefolium*) were common in several areas along this stretch. A northern fen occurs on Left's Point itself, dominated by grass and sedge species such as twig-rush (*Cladium mariscoides*), sedge (*Carex aquatilis*), bluejoint grass (*Calamagrostis inexpectans*), hardstem bulrush (*Scirpus acutus*), and rushes (*Juncus balticus* and *J. brachycephalus*). Illustrative of the diversity of this community were the numerous herbaceous species in flower during the time of survey. These included small fringed gentian, (*Gentianopsis procera*), cardinal flower (*Lobelia cardinalis*), Kalm's lobelia (*L. kalmii*), ladies'-tress orchids (*Spiranthes* sp.) and grass-of-Parnassus (*Parnassia glauca*). One point count for migratory birds was conducted along the road just inland from the point.

Little Sand Bay Preserve

A well-known area encompassing a nature preserve owned and managed by the Little Traverse Conservancy, this entire bay was surveyed to document the status of the numerous rare plant populations known there, including, most importantly, the sole remaining population of Michigan monkey flower on the Island. A nicely constructed pathway winds through the preserve through a boreal forest-cedar swamp complex into the sandy, dune shoreline at the heart of the Bay. A network of creek tributaries converge at the edge of the forest forming a large creek of cold flowing water that empties into the Bay. It is in this portion of the creek, at the ecotone of forest and open dune that the still thriving population of monkey flower occurs. Covering approximately 8 square meters, scattered along the edges of the main creek and

several tributaries, about 30% of the population was in full bloom on August 19.

The dune beach is characterised by shallow foredune backed by several long linear interdunal wetlands which are in turn backed by a wide flat dune in the northern half of the bay. It retains a full complement of native dune species, including healthy populations of both Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*), which are found along most of the Bay. A flourishing population of butterwort (*Pinguicula vulgaris*) consisting of hundreds of plants was found to persist in one of the linear dune swales. Local clusters of exotic species, such as spotted knapweed (*Centaurea maculosa*), yarrow (*Achillea millefolium*), hawkweeds (*Hieracium* spp.), and Kentucky blue-grass (*Poa compressa*) also occur along the

entire Bay, but are most frequent near the preserve where the pathway opens onto the

beach. ORV tracks were also seen along portions of the dunes.

Lookout Point

Lookout Point comprises a stretch of shoreline on the northeast shore harboring a somewhat small but locally significant area of open dunes. These dunes, which also include well-developed interdunal wetlands, were identified as a significant survey gap and subsequently covered during early as well as late season surveys. East of Lookout Point, the dunes consist of a narrow foredune abruptly backed by forest, expanding to a much broader open dune community with interdunal wetlands near the Point. West of the Point, the foredunes are higher, backed by broad, flat, sandy-gravelly dune fields and a few interdunal wetland pockets. In one area the dunes grade up to a modest blowout below the forested bluff, where Pumpell's brome grass (*Bromus pumpellianus*) was discovered. Dominant and common species include such typical dune plants as dune grasses (*Ammophila breviligulata*, *Calamovilfa longifolia*), milkweed (*Asclepias syriaca*), sea rocket (*Cakile edentula*), rock-cress (*Arabis lyrata*), bearberry (*Arctostaphylos uva-ursi*), beach pea (*Lathyrus japonicus*), and horizontal juniper (*Juniperus horizontalis*), as well occasional exotic species such as spotted knapweed (*Centaurea maculosa*), soapwort (*Saponaria officinalis*), and bluegrass (*Poa compressa*). Most exotic species did not appear to be a problem, with the exception of spotted knapweed, which was relatively invasive in the sandy-gravelly flats behind and near the Point. Significant populations of Pitcher's thistle (*Cirsium pitcheri*), Lake Huron tansy (*Tanace-*

tum huronense), and Pumpell's brome grass, in addition to the open dunes community, were catalogued as new occurrences for the statewide database.

To complete the survey of the northeastern shore of the Island, the island was surveyed from just east of the lighthouse at the easternmost point of St. James Harbor, around Sucker Point and north to Lookout Point. Gull Harbor, a small preserve located east of St. James Bay, consists primarily of a large calcareous, emergent wetland along a rocky shoreline, backed by boreal forest. Although targeted, no rare sedges, grasses, or orchids were found in the Preserve. A road runs along the shoreline from the lighthouse to Sucker Point which has long been noted as the Island "car wash" due to the disappearance of the road into the Lake during times of high water. Homes are scattered along most of the shoreline fronted by rocky sand beach. Localized colonies of Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*) were noted along the beach frontage from Sucker Point north to Lookout Point where they merge into the extensive populations of the northern shore of the Island, noted in 1998.

In 1999, despite poor survey conditions, a small population of the Lake Huron locust (*Trimerotropis huroniana*) was found along the narrow sandy shoreline west of Lookout Point.

Martin's Bluff

This mesic northern hardwood forest, roughly 60 acres in size, is located on a low ridge between two large wetlands. Large, old-growth trees include American beech (*Fagus grandifolia*), hemlock (*Tsuga canadensis*), yellow birch (*Betula alleghaniensis*), and sugar maple (*Acer saccharum*). Within the old-growth forest there is a small area where cutting

followed by fire appears to have occurred. In this section there were white pine (*Pinus strobus*) stumps and mature paper birch (*Betula papyrifera*), which established following the fire. Local island residents, as well as students and faculty at CMU know the site. Many of the trees have been marked during student studies.

Point La Par

This forest, with trees from 100 to 150 years old, consisted of two portions. A low sand ridge supported a forest of red oak and white pine, which may have been the result of fire management for agriculture by Native Americans. No food storage pits were encountered to substantiate this type of management. The other portion of the forest is a moister, broad swale that supported green ash

(*Fraxinus pennsylvanica*), northern white-cedar (*Thuja occidentalis*), and trembling aspen (*Populus tremuloides*). A large cedar from this swale was between 150 and 175 years old. This tract is relatively large (approximately 300 acres) and should be pursued for acquisition or other forms of protection.

Sand Bay

Sand Bay consists of an approximately three-mile stretch of shoreline forming a gently curving, shallow bay from Conns Point south to about Point La Par. This area includes the well-known Central Michigan University Biological Station and a long string of residences, many of which are fairly large seasonal homes. This site was identified for inventory based on a nearly complete lack of status information for previously documented rare plant populations. As we surveyed this shoreline and tallied population numbers for Pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*), we realized the open dunes community was contiguous and intact for a considerable portion of the shore, thus warranting recognition as a natural community occurrence. The dunes were found to consist of a relatively broad, well-developed foredune backed by a band of mostly flat backdunes between the foredunes and most homes. Although there is extensive development in this area, artificial disturbance by landowners in many cases was minimal, with the alteration of dune frontage consisting of little more than modest paths to the beach. Several had day use areas, but the general level of disturbance in many areas was fairly

limited. South of the Jordan River mouth, the dunes grade upward to a few low-sloping dune rises, where a few open lots were undeveloped.

Several thousand plants were estimated for both Pitcher's thistle and Lake Huron tansy, indicative in part of the collectively extensive and functional nature of the open dunes community. As is typical, marram or dune grass (*Ammophila breviligulata*) dominated on the foredune, with dune grass (*Calamovilfa longifolia*) occurring landward. Typical species included beach pea (*Lathyrus japonicus*), sea rocket (*Cakile edentula*), milkweed (*Asclepias syriaca*), rock-cress (*Arabis lyrata*), euphorbia (*Euphorbia polygonifolia*), poison ivy (*Toxicodendron radicans*), starry false Solomon's seal (*Smilacina stellata*), horizontal juniper (*Juniperus horizontalis*), and ground juniper (*Juniper communis*). Exotics included soapwort (*Saponaria officinalis*), smooth brome (*Bromus inermis*), bluegrass (*Poa compressa*), and spotted knapweed (*Centaurea maculosa*), with the latter observed to be somewhat invasive in backdune areas. One point count for migratory birds was conducted at the south edge of Sand Bay near the state forest campground just north of Point La Par.

Sandy Point North

This site comprises an approximately one-mile portion of shoreline south of Little Sand Bay, the latter a well-known area including a nature preserve owned and managed by the Little Traverse Conservancy. The shoreline was briefly inventoried from Sandy Point to the southern edge of Little Sand Bay, primarily to determine the presence of rare plant species likely to continue from the north. In this site, the shoreline consisted of discontinuous and very limited stretches of beach and foredune, backed by abrupt lowland cedar and mixed conifer-hardwood forest. The dune stretches were interspersed with cobble shore and occasional limestone bedrock outcrops and small boulders. Small, low-diversity wetlands were found toward the south edge of Little Sand Bay. Modest numbers of Pitcher's thistle (*Cirsium pitcheri*)

and Lake Huron tansy (*Tanacetum huronense*) were documented as extensions to the well-documented populations in Little Sand Bay. Three point counts for migratory birds were conducted just to the north at the Little Traverse Conservancy Nature Preserve. Counts were conducted in old field, lowland cedar, and shoreline habitats. It is noteworthy that swarming insects were observed along the beach during the point counts. Emerging aquatic insects along the shoreline may provide migratory birds a significant food resource in the spring when terrestrial insects may be scarce. The cedar, spruce and tamarack trees as well as various shrubs lining the shoreline may provide an excellent foraging substrate for neotropical migratory birds feeding on these insects.

Southwest Old-Growth

When MNFI botanists conducted reconnaissance in late June for potential natural community occurrences, this interior mesic forest stand was identified as having old-growth characteristics. Several individual trees were observed as rather large in both stature and diameter at breast height (DBH), and the forest contained a significant Eastern hemlock (*Tsuga canadensis*) component. The occurrence of large hemlocks is particularly noteworthy, as this species was once common throughout northern Michigan but because of high deer densities often fails to regenerate. The site was more thoroughly assessed with MNFI staff ecologists during late season surveys, resulting in the identification of an approximately 20-30 acre stand of high quality northern mesic forest

distinct from the surrounding matrix forest community. The stand is dominated by sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*), and contains several large Eastern hemlocks. One sugar maple measured 99 cm in DBH, with several other trees approaching this size. Additional species included American beech (*Fagus grandifolia*), paper birch (*Betula papyrifera*), and several examples of large red maple (*Acer rubrum*). The several large paper birch trees present are indicative of a disturbance regime that results in canopy gaps due to blowdowns, creating not only marked canopy gaps but also a structure of pit-and-mound microtopography on the forest floor, a typical feature of mesic northern forests.

St. James Harbor

Within this largely developed bay, some open dune habitat occurs from approximately the public beach to Harbor Point. Portions with low foredune and a limited backdune area, mostly comprising the frontage of residences and seasonal homes, still provide habitat for modest populations of Pitcher's thistle (*Cirsium pitcheri*)

and Lake Huron tansy (*Tanacetum huronense*). Typical dune species predominate on the foredune, including dune grasses (*Ammophila breviligulata*, *Calamovilfa longifolia*), beach pea (*Lathyrus japonicus*), starry false Solomon's seal (*Smilacina stellata*), and dune willows (*Salix* spp.), although owing to human activities and

artificial disturbance the shoreline is somewhat weedy in areas, particularly near the public beach. Exotic species include soapwort (*Saponaria officinalis*), spotted knapweed (*Centaurea maculosa*), and smooth brome (*Bromus inermis*). A well-known population of the federal and state endangered Michigan monkey-flower (*Mimulus glabratus* var. *michiganensis*) was sought in the south part of the harbor. This species occurred in cold, spring-fed pools at the base of a low hillside, and was

observed to be extant in 1989 by M. Penskar. The shoreline hydrology was found to be drastically modified during the construction of a residential home, and as reported previously (J. Paskus, pers. comm.), the colony could not be located. Permission should be obtained to do a more thorough survey of this private parcel, although it does seem likely that one of the 15 known global populations of this Michigan endemic has been extirpated.

Garden Island sites

Garden Island Harbor

A northern wet meadow occurs inland from Garden Island Harbor in an old, abandoned embayment of Lake Michigan. This bay is now separated from the lake by a dune ridge. The edges of the bay support cedar swamp, while the center of the bay contains a small lake with a

thick organic bottom. Between the lake and the cedar swamp there is a broad band of wet meadow, which supports many plants characteristic of northern fens.

Garden Island West Boreal Forest

An extensive, approximately 600-acre tract of boreal forest was located along the western shore of Garden Island on shallow organic soil over limestone cobble (Figure 3). The natural community was characterized by well developed pit-and-mound microtopography and single and group tree windthrow; characteristics indicative of mature forest with the natural disturbance regime intact. Overstory species were predominantly northern white cedar (*Thuja occidentalis*) and white spruce (*Picea glauca*) with lesser but significant amounts of balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and balsam poplar (*Populus balsamifera*). The forest sub-canopy, generally sparse but dense locally, was dominated by balsam fir with lesser amounts of white cedar and white ash (*Fraxinus americana*). Shrub layer species included mountain maple (*Acer spicatum*), beaked hazelnut (*Corylus cornuta*), round-leaved dogwood

(*Cornus rugosa*), and American fly honeysuckle (*Lonicera canadensis*). The understory, sparse with extensive areas of exposed soil and duff, included creeping rattlesnake plantain (*Good-ya repens*), Menzies' rattlesnake plantain (*G. oblongifolia*), twin flower (*Linnaea borealis*), goldthread (*Coptis trifolia*), large round-leaved orchid (*Platanthera orbiculata*), blue-bead lily (*Clintonia borealis*), and various species of Violets (*Viola* sp.) and sedges (*Carex* sp.). No human disturbance, e.g. timber harvests, stumps, trails, or other clearings, was noted within the forest. This site is among the largest and highest quality tracts of boreal forest described in Michigan to date. Further, there is some chance that several rare orchids, including ram's head lady's slipper (*Cypripedium arietinum*) and calypso orchid (*Calypso bulbosa*), may occur within this natural community.

Indian Harbor

A large Great Lakes marsh occurs in the narrow bay at Indian Harbor. Typical of many of the marshes along Beaver, Garden, and Hog Islands, and of the Mackinac Straits area in general, there are typical emergent marsh plants like threesquare (*Scirpus americanus*) in the deeper portions of the marsh, but along the shallower edges, northern fen species are

dominant. The northern fen gradually becomes drier and changes to open cedar swamp along its inland margin. While no plants of Houghton's goldenrod (*Solidago houghtonii*) were encountered, the habitat seemed appropriate for this Great Lakes endemic, and thus the site may merit inventories again to seek this rare species.

Jensen Harbor

A large population of butterwort (*Pinguicula vulgaris*) was found growing in the northern fen at Jensen Harbor. While butterwort often occupies moist, marly habitat, it was growing on the moist sand of the low beach ridges, along with dried up *Nostoc*, an algae. It appears that the seeds of butterwort were deposited on the moist sand when the water levels were high, in 1997 and 1998. None of these plants were flowering; all appeared to be juvenile plants. Houghton's goldenrod (*Solidago houghtonii*) was found locally growing within

the northern fen, occupying the moist swales. Butterwort was growing nearby. A large northern fen occurred along the margin of the bay, with open marsh extending into the shallow waters of the bay, and the fen extending up to the cedar forest, which grew both on low beach ridges along the shoreline and in shallow swales. There was no sign of past logging of the cedar. The cedar were relatively small diameter, probably due to periodic wind storms along the shoreline.

Jensen Harbor West

The entire shoreline was traversed southeast from sweat lodge swale to Jensen's Harbor to assess the status of previously documented occurrences of Pitcher's thistle and Lake Huron tansy, and to determine if other listed shoreline species may be present. The shoreline is mostly rocky with a shallow, steep bluff topped with boreal forest. For the most part it lacks the sandy dune features typical of thistle and tansy habitat. Just west of the harbor, however, lies a narrow

strip of sandy beach, the presumed location of earlier records for these species. Several hundred clumps of tansy were found scattered throughout, but no Pitcher's thistle plants were observed. No additional rarities were discovered along this sandy strip, however beauty sedge was discovered in several pockets northwestward, growing sparsely in crevices of the rocky substrate forming the top lakeward edge of the bluff.

Monatou Bay to Sturgeon Bay

Surveys were conducted along the shoreline from the east edge of Northcutt bay to Sturgeon Bay. Due to the extreme low water year, significant areas of marly, rocky, sand lake bottom with little vegetation was exposed along each of the bays. Occasional islands of vegetation are scattered throughout these flats. At the edge of the normal waterline, Great Lakes

Marsh vegetation with a northern fen component dominates, similar to that described in the Northcutt Bay site description above. Occasional swales occur, often with a marly crust, dominated by calciphiles such as twig-rush (*Cladium mariscoides*), spike-rush (*Eleocharis rostellata*), and Buxbaum's sedge (*Carex buxbaumii*). Marly pockets with species such as

grass-of-Parnassus (*Parnassia glauca*), pitcher-plant (*Sarracenia purpurea*), false asphodel (*Tofieldia glutinosa*), bird's-eye primrose

(*Primula mistassinica*), Indian paint brush (*Castilleja coccinea*), and (*Carex flava*) can also be found here.

Northcutt Bay

Surveys were conducted along the shoreline from Indian Harbor to Northcutt Bay, targeting a previously documented Pitcher's thistle record and any additional shoreline rarities. The shoreline is characterized by a band of Great Lakes Marsh and northern fen species including blue joint (*Calamagrostis canadensis*), tickle grass (*Agrostis hyemalis*), hardstem bulrush (*Scirpus acutis*), spike-rush (*Eleocharis elliptica*), arrow-grass (*Triglochin maritimum*), rushes (*Juncus balticus*, *J. brevicaudatus*), Calamint (*Calamintha arkansana*), silvery cinquefoil (*Potentilla anserina*), Kalm's lobelia (*Lobelia kalmii*), and fringed gentian (*Gentianopsis procera*). Further inland, it typically grades into a shrub-graminoid zone with the addition of shrubby cinquefoil (*Potentilla fruticosa*), red-osier dogwood (*Cornus stolonifera*), ninebark (*Physocarpus opulifolius*), and sweet gale (*Myrica gale*). This, in turn, is backed by white cedar, white birch, spruce dominated boreal forest. Most of the immediate shoreline along this stretch contains a fair number of exotic species including bouncing bet (*Sapponaria officinalis*), ox-eye daisy (*Chrysanthemum leucanthemum*), spotted knapweed (*Centaurea maculosa*), and yarrow (*Achillea millefolia*).

Northcutt Bay was the only region with any significant sandy shoreline, consisting of a narrow strip along the inner northwest corner of

the Bay. A population of Pitcher's thistle persists here, consisting of 50-100 clumps scattered sparsely in only a small region of the inner Bay. The sandy shore backs up immediately to boreal forest where sparse amounts of beauty sedge (*Carex concinna*) were found along the forest-dune ecotone. The site was quite weedy and there was evidence of human activity such as boat launching, picnic sites, and hiking.

A northern fen occurs a little further eastward of the sandy portion of the Bay. White cedar (*Thuja occidentalis*) and tamarack (*Larix laricina*) are scattered throughout a marly, hummocky, matrix of shrubby cinquefoil, (*Potentilla fruticosa*), twig-rush (*Cladium mariscoides*), bulrush (*Scirpus cespitosus*), and little bluestem (*Andropogon scoparius*). Additional species include grass-of-parnassus (*Parnassia glauca*), false asphodel (*Tofieldia glutinosa*), Kalm's lobelia (*Lobelia kalmii*), Indian paintbrush (*Castilleja coccinea*), sundew (*Drosera linearis*), and Pitcher plant (*Sarracenia purpurea*). The fen extends inland, forming a "bouncy" peat-mat surrounding a large pool of open water.

The state threatened merlin was seen flying at Northcutt Bay and the state threatened osprey was observed at Indian Harbor. No nests were observed although it is likely that they nest on the island.

Red Oak Garden

A forested track of mature red oak (*Quercus rubra*) occurs within southern portions of the islands interior forest. The site is included here because of its significance as a possible artifact of presettlement Native American land use. The General Land Office surveyors of the mid-1800's noted this area as having been "cleared by fire" and "burned". Today the site is completely dominated by large red oaks with few sugar maples (*Acer saccharum*) and white ash (*Fraxinus*

americana) reaching the canopy. It is likely that the native people inhabiting Garden Island in presettlement times regularly burned this area to keep it open for agriculture, berry picking, and hunting. Because of its ability to persist in a shrub-like condition where fires are common, red oak rapidly assumed dominance at this site once Native American land use patterns changed. However, sugar maple, the dominant species throughout the islands' mesic forests will soon

regain its place in this sites canopy as it currently dominates the forest's understory. Other common understory species include ironwood (*Ostrya virginiana*), and hazelnut (*Corylus americana*), a fire-adapted shrub. Common groundlayer species include wild sarsaparilla (*Aralia nudicaulis*), sedges (*Carex pensylvanica* and *C. pedunculata*), and sugar maple. In 1999,

this site was surveyed again. No white pine (*Pinus strobus*) was found, unlike many other Native American former agricultural sites. Based on trees cut near the trail, individuals of red oak were found to be at least 120-125 years old.

Sweat Lodge Swale

A small, high quality northern fen occurs approximately 30 meters inland from the islands northwest shore. The swale is bordered by an extensive boreal forest to the south and a thin band of cedar glade separating the northern fen from Lake Michigan. The long, narrow fen is distinctly different at each end. The marly, eastern portion of the fen contains a diverse array of calcium loving species including English sundew (*Drosera anglica*) and butterwort (*Pinguicula vulgaris*), both species of special concern, Ohio goldenrod (*Solidago ohioensis*) Kalm's lobelia (*Lobelia kalmii*), grass-of-Parnassus (*Parnassia glauca*), sedges (*Carex viridula* & *C. flava*) and false asphodel (*Tofieldia glutinosa*). In contrast the western portion of the fen was dominated by sedge (principally *Carex lasiocarpa*) and contained little plant species diversity. Within the limestone rich cedar glade to the north of the swale several Native American, traditional sweat lodges have been erected and although empty, were in good repair. The sandy and limestone cobble shoreline bordering the cedar glade contained several dozen, scattered Pitcher's thistle (*Cirsium*

pitcheri), constituting a small new occurrence for the island.

A return trip was made to sweat lodge swale in 1999 to survey for beauty sedge (*Carex concinna*) and ram's head orchid (*Cypripedium arietinum*) during their prime. We were unable to confirm the identity of the small, early fruiting sedge or early flowering orchid with certainty during our 1998 visit, due to the late date of the survey, which targeted other species. In 1999, beauty sedge was found flourishing in the rich cedar glade bordering Lake Michigan. The species was growing in abundance, widely scattered in crevices in the flat bedrock substrate at the edge of the cobble beach terraces and boreal forest further inland. It's most common associates included bearberry (*Arctostaphylos uva-ursi*), sedges (*Carex pedunculata*, *Carex eburnea*), gay wings (*Polygala pauciflora*), twinflower (*Linnaea borealis*), and various mosses and lichens. Ram's head orchid was not observed, however, a dozen or so yellow lady's-slipper orchids were found there.

Hog Island Sites

Baldimore Bay EA

This state environmental area consists of a couple of very narrow embayments that support Great Lakes marsh, northern fen, and at their inland edge, interdunal wetlands. During 1999, due to the low water levels in the Great Lakes, these bays were almost completely dry. Emergent marsh vegetation dominates the outer portion of the wetland, while northern fen vegetation occurs near the swamp forest border

that is dominated by northern white cedar (*Thuja occidentalis*). The marsh is dominated by hardstem bulrush (*Scirpus acutus*), and includes such species as rush (*Juncus balticus*). Common and dominant plants of the northern fen include Kalm's lobelia (*Lobelia kalmii*), Arkanasa mint (*Calamintha arkansana*), sedge (*Carex viridula*), twig-rush (*Cladium mariscoides*), and rush (*Juncus balticus*)

In addition to the natural community occurrences, common terns (*Sterna hirundo*) were encountered along the narrow embayments of Baltimore Bay. Four adult terns were observed, and were quite aggressive, appearing

to be defending nests. This was the only place where common terns were encountered, but the previously known nesting site on the point near Grape Island was not visited.

Hog Island East Shoreline

The eastern shoreline of Hog Island consists of several small dune and swale complexes, areas of open dune, cobble beach, and coastal wetland. There is very little sign of human disturbance along this entire shoreline. Along the southeastern shoreline there is a relatively large stretch of Great Lakes marsh. The substrate is generally cobbly, with marl and northern fen plants near the upland edge of the wetland complex. This section of shoreline has a record for Pitcher's thistle (*Cirsium pitcheri*), but there was very little sand substrate, so it is likely that the collections were made from further north along the eastern shoreline. Populations were ultimately found in the northern portion of this site. The populations of Pitcher's thistle are relatively small, located west and north of Tim's Island. The smaller area of habitat supported approximately 60 plants, while the larger northern area had only four plants. The cobbly nature of much of the shoreline does not provide optimal habitat for this plant, although this species has been observed to form moderately large colonies on cobbly-sandy beaches (Penskar et al. 1997).

The dune and swale complex present is not well developed, with one large swale and two well developed dune ridges. The foredune provided habitat for both Pitcher's thistle and Lake Huron locust (*Trimerotropis huroniana*). Lake Huron locust is found along the narrow foredune of the eastern shoreline in several places. Most of these populations are small, a result of the small area of habitat, but one large stretch of beach is over a half mile long and contains the largest population of the locust, with 38 locusts counted. A dwarf lake iris (*Iris lacustris*) population occurs on the southern edge of this site. This population of dwarf lake iris is the first occurrence documented from the island. The population occupies a small open beach ridge, with many ant mounds interspersed throughout. Portions of the beach ridge and adjacent swale support small northern white cedars (*Thuja occidentalis*), under which scattered clumps of sterile dwarf lake iris are also found. The northern white cedars within this complex were not large, but there were no stumps. Storms may cause blowdowns to occur commonly in these shoreline cedars .

Hog Island North

Both of the natural community occurrences in the northern part of the island are inland sites. Most of the upland forest has been cut in the past, probably around the turn of the century for fueling steam ships. The old-growth forest areas are probably the result of Native American agricultural activities. An old-growth black ash (*Fraxinus nigra*) swamp was found east of Fisherman Bay. The black ash trees, which ranged from 26 to 40 cm in diameter, were highly buttressed, indicating that the water levels were typically high. In 1999 the swamps were completely dry; these areas were probably considered to be of poor productivity and thus

were not harvested during the cutting of adjacent upland sites. West of the swamp there was almost impassible shrub swamp, with a large beaver pond, also completely dry in 1999

An area that is a remnant of Native American occupation occurs on a small ridge. The top of this low sand ridge, probably a beach ridge created several thousand years ago, supports a forest of white pine (*Pinus strobus*) and red oak (*Quercus rubra*). This site was referenced as an Indian field in the presettlement surveys. Former MNIF ecologist Gary Reese cored trees in 1986, and identified trees that dated from 1830s to 1840s, which provides

potential evidence that the area was farmed by Native Americans using fire as a tool for agriculture. Plot data were compiled during 1999 surveys of the site and soil samples were collected for future charcoal analyses; these data

can assist in reconstructing the successional and Native American management history of the site, as has been done elsewhere in northern Michigan (Minc and Albert 1987).

Bois Blanc Island sites

No detailed botanical or natural community surveys were conducted on Bois Blanc Island, as this site has been extensively surveyed for those elements in much previous work. Other than the numerous sampling points for bird surveys, a brief late-season survey was conducted to examine known old-growth remnants within and around two dedicated state natural areas. Mature red oak (*Quercus rubra*) was found to be an important component in these mesic northern forests, in addition to scattered large individuals

of white pine (*Pinus strobus*). Adjacent to and within mapped old-growth areas, extensive cutting is occurring, resulting in the removal of numerous red oaks. Although charcoal analyses are beyond the scope of this study, several litter samples were obtained in old-growth areas for possible future analysis; this will assist in reconstructing the successional history of these areas and possibly determine the role of Native American occupation and site use.

Marquette Island Sites (Les Cheneaux Islands)

Marquette Bay

The shoreline of Marquette Bay was accessed via kayak. The majority of the shoreline was accessed and selected interior areas were inventoried. A narrow cobble and sand beach borders Marquette Bay, which was somewhat more extensive in 1999 due to the low water levels. The shoreline is backed abruptly by a good quality boreal forest in the northern portion of the bay; the forest occurs within a small embayment that forms a small dune and swale complex with moderate ridge and swale topography. Northern white cedar (*Thuja occidentalis*) is a dominant component, with many tall mature individuals ranging up to about 14" or more in dbh. Co-dominating are balsam fir (*Abies balsamea*) and occasional white spruces (*Picea glauca*). Relatively large, single-

stemmed individuals of paper birch (*Betula papyrifera*) occur in disturbance (blowdown) gaps.

A small, localized but distinct open swale depression harbors a good quality northern fen remnant, around and within which are individuals of beauty sedge (*Carex concinna*). The fen is small but of good quality; characteristic species in the fen include shrubby cinquefoil (*Potentilla fruticosa*), northern white cedar, creeping juniper (*Juniperus horizontalis*), bird's eye primrose (*Primula mistassinica*), sphagnum, round-leaved sundew (*Drosera rotundifolia*), false ashpodel (*Tofieldia glutinosa*), yellow lady's slipper (*Cypripedium calceolus*), and arrow-grass (*Triglochin maritimum*).

Marquette Southeast Peninsula

On the extreme southeast portion of Marquette Island, west of Voight Bay and south of Peck Bay, a relatively small bay with northern fen was explored. This small cove, which in location straddles the state meridian line, contains a complex of northern fen bordered by a

fringe of boreal forest. Although neither community was of sufficient size and extent to constitute an element occurrence, both were of good quality. A vigorous population of dwarf lake iris, part of which is an extension of a previously known occurrence, extends into the

'boreal' islands of the fen and continues eastward at along the ecotonal edge of rocky shoreline and inland boreal forest. This occurrence appears to be thriving amongst the human dwellings and activities that occur there, and extends for approximately one mile along the forested edge of the shoreline and well into the forest interior where natural and human made openings are common. Common associates include such typical species as northern white

cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), larch (*Larix laricina*), bearberry (*Arctostaphylos uva-ursi*), and creeping juniper (*Juniperus horizontalis*). Beauty sedge (*Carex concinna*) was also observed here, scattered along a very narrow edge of the ecotone. Several clumps were also found eastward around the bend of the island.

Peck Bay

Peck Bay consists of an extensive high quality Great Lakes Marsh with three dominant vegetation zones. A narrow band of submergent marsh occurs at the lake edge and grades into an extensive band of emergent marsh, which, in the southeast end, extends all the way across the Bay. Lying furthest inland, is an extensive northern fen, dominated by calciphiles such as shrubby cinquefoil (*Potentilla fruticosa*), grass-of-parnassus (*Parnassia glauca*), sedge (*Carex flava*), Indian paintbrush (*Castilleja coccinea*) and bird's-eye primrose (*Primula mistassinca*).

Islands of small cedar (*Thuja occidentalis*), tamarack (*Larix laricina*), and black spruce (*Picea mariana*) are scattered throughout the fen, along with numerous marly pools. A thriving population of dwarf-lake iris (*Iris lacustris*) was discovered in the middle of the south side of the Bay, extending for about a quarter mile stretch. The iris occurs primarily along the ecotonal edge of the fen and boreal forest further inland, extending into the forest along openings in the canopy.

Voight Bay West

West of Voight Bay proper, where an extensive and well known, high quality Great Lakes marsh occurs, lies a section of shoreline of high ecological diversity. Immediately west of Voight Bay, across a thin peninsula, a small region of shoreline occurs supporting a narrow but significant strip of open dunes. The dunes are comprised principally of a single low foredune backed by a narrow, linear interdunal wetland. Because of the paucity of open dunes habitat within the Les Cheneaux islands, this community was considered to be significant. Although the dunes were slightly weedy where human use was apparent, they were dominated by such typical species as dune grass (*Ammophila breviligulata*), creeping juniper (*Juniperus horizontalis*), bearberry (*Arctostaphylos uva-ursi*), narrow-leaved tickseed (*Coreopsis lanceolata*), rock-cress (*Arabis lyrata*), white spruce (*Picea glauca*), and bastard toadflax (*Comandra umbellata*). A few plants of beauty sedge (*Carex concinna*) were

found along the forest edge along the interdunal wetland. The interdunal wetland, which was not distinguished as a separate natural community because of its small extent, was found to be quite diverse, supporting a large assemblage of wetland species. Locally this is a spectacular region of the island containing a rich diversity of plant species, including a strikingly abundant population of the common pitcher-plant (*Sarracenia purpurea*).

Located amongst the hundreds of purple tinged plants, was a small group of bright lime-green specimens that could be spotted from a long distance away. This rare variation of pitcher-plant, a state threatened taxon known as forma *heterophylla*, contains no purple pigment in the flowers or vegetative portions of the plant. Flowers lacking pigment are critical in order to confirm the identity. The discovery of this taxon on Marquette Island brings the total known population clusters in the state to three. This taxon was previously known for many years only

from a small group of acid bogs in Montmorency County in northern Lower Michigan, until this year when it was found in a bog near the city of Newberry in the Upper Peninsula and simultaneously on Marquette Island during our surveys.

Along the northern portion of this site, a series of high quality, diverse northern fen openings were systematically surveyed. The openings occur immediately adjacent to the shore, forming a series of more or less circular areas, one of which is quite large. These northern fen areas extend for approximately one-half mile. The fens are extremely marly, with many open pools and small rivulets of running water; within the fens are small islands of white

cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), larch (*Larix laricina*), and black spruce (*Picea mariana*). Common and dominant species include such bog and fen taxa as spikerush (*Eleocharis rostellata*), twig-rush (*Cladium mariscoides*), Labrador tea (*Ledum groenlandicum*), spikemoss (*Selaginella eclipses*), bulrush (*Scirpus cespitosus*), grass-of-Parnassus (*Parnassia glauca*), sedges (*Carex livida*, *C. garberi*), and numerous other species. *Sphagnum* hummocks were common within the fens. Our surveys were too early to detect the presence of Houghton's goldenrod, which is known from this region of the island.

La Salle Island (Les Cheneaux Islands)

A small portion of La Salle Island was inventoried, consisting of a brief assessment of the southeast and southern shore; this area was selected based on aerial photo interpretation. On the small peninsula adjacent to the narrow channel by Government Island, a boreal forest was documented, comprised of a reasonably good quality second growth community with good structure as evidenced by numerous snags, blowdowns, natural gaps, and relatively large trees. Large white pines (*Pinus strobus*) ranging to 24" or more in dbh were noted, as well as large, single-stemmed paper birches (*Betula papyrifera*) found in former blowdown gaps. Co-dominant trees included balsam fir (*Abies balsamea*), balsam poplar (*Populus balsamifera*), northern white cedar (*Thuja*

occidentalis) ranging to about 18" dbh, and white spruce (*Picea glauca*). Several clumps of beauty sedge (*Carex concinna*) were documented adjacent to Bass Cove Lake, where this species extended well inland along a bordering slope into the boreal forest.

Along the southern shore of the island, ranging around toward Bosely Channel, cobble beach grading into small localized areas of northern fen was observed, with a typical complement of fen and cedar glade species, including Indian paintbrush (*Castilleja coccinea*), shrubby St. John's-wort (*Hypericum kalmianum*), Arkansas mint (*Calamintha arkansana*), and characteristic sedges of alkaline sites (*Carex flava*, *C. viridula*).

Drummond Island Sites

Marblehead Cliffs

An extensive, striking series of limestone/dolomite cliffs occur along the periphery of the Marblehead peninsula. Drummond Island has been surveyed numerous times to assess the status and condition of its well known, globally rare alvar examples, which are found over much of its area. However, very little inventory has been directed toward assessing the Marblehead cliffs along the

northeastern shore, owing in part to the difficulty in surveying this relatively remote, inaccessible terrain. The cliffs, which are primarily along the northern two-thirds of this blunt peninsula, occur abruptly behind the narrow cobble shore. These cliffs rise approximately 30 meters (ca. 100 ft) or more above lake level, stepping back in a series of two to three major terraces. There is a good deal of woody vegetation within and around the

cliffs, the overstory dominated by northern white cedar (*Thuja occidentalis*), trembling aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*). Shrubs and vines are also dominant in places, comprised of native honeysuckle (*Diervilla lonicera*), prickly gooseberry (*Ribes cynosbati*), buffalo-berry (*Shepherdia canadensis*), and especially poison ivy (*Toxicodendron radicans*), that latter a well known lime-loving species extremely abundant throughout the site, which impeded close inspection in many areas. The cliffs were traversed to the top terrace, which was dominated by a thin, dry mesic, mixed forest with trembling aspen and paper birch (*Betula papyrifera*).

The east facing, exposed cliff faces support numerous clumps on ferns in a variety of crevices, concavities, and other surfaces where several species are able to establish. Common ferns include fragile fern (*Cystopteris fragilis*), rusty woodsia (*Woodsia ilvensis*), common

polypody (*Polypodium virginianum*), and maidenhair spleenwort (*Asplenium trichomanes*). This site is the only known extant Michigan occurrence for the state endangered wall rue (*Asplenium ruta-muraria*), and this species was present in good numbers. A new occurrence for the state threatened slender cliff brake (*Pellaea atropurpurea*) was discovered during the inventory, and a large number of plants were catalogued.

In addition to the survey of the cliffs, the entire eastern shore from the Marblehead peninsula south to Bass Cove was examined via kayak, including stops to conduct brief surveys of potentially significant shorelines. No additional significant areas were identified along the remainder of the shoreline, which is comprised of relatively narrow cobble beaches, with the exception of one open area in section 24 that was determined to be unremarkable

Identification of Significant Biodiversity Areas

The following is not intended to be a comprehensive summary, which will be compiled in a subsequent report, but rather a simple elaboration of the most notable and significant sites and natural features identified during 1999 surveys. As in 1998, surveys resulted in relatively large number of finds. This was the result of conducting surveys in several new areas, as well as revisiting sites inventoried previously. With regard to the latter, this was true particularly where there was an emphasis on new targets, such as focusing on early blooming versus late-blooming rare plant species, or surveying breeding birds in addition to censusing migratory species. Occurrences also resulted from extending surveys from the periphery of known sites, when it was recognized that additional habitat was present and accessible. Lastly, new data were also obtained via the addition of selected surveys by MNFI aquatic ecologists, who focused on an assessment of potentially significant aquatic sites on Beaver Island.

Beaver, Garden, and Hog islands. On Beaver Island, significant new sites identified include Egg Lake bog, Font Lake old-growth, an additional area near Lookout Point (i.e. Lookout Point extension), Martin's Bluff, and Point La Par. The majority of these newly identified areas comprise natural community occurrences, including notable interior areas that support examples of mesic northern forest (Font Lake old-growth and Martin's Bluff) and open bog (Egg Lake bog). Inventory of additional shoreline areas resulted in several new plant and insect occurrences, including Great Lakes endemics, further demonstrating the importance of the shoreline and its richness in biodiversity.

Aquatic reconnaissance of Beaver Island concluded that the interior lakes and tributaries examined are areas of potentially high biodiversity; these include Barney's Lake, Fox Lake, Font Lake, Lake Geneserath and a tributary, and Iron Ore Creek.

With regard to bird surveys, Beaver Island collectively supports a large number of migratory as well as breeding birds, including several state listed species that occur at such sites as Barney's

Lake, Font Lake, Iron Ore Bay, Greene's Lake, St. James Harbor, and open fields near Wilke Airport.

Several significant new sites were identified through further survey of Garden and Hog islands, which are rich in biodiversity despite their more modest sizes. These islands, all of which are owned and managed by the State of Michigan, occur within the Beaver Islands Wildlife Research Area, and are collectively very important biodiversity sites.

Bois Blanc Island. Bois Blanc is large island well known for its many natural features, most of which have been assessed in several previous surveys. Migratory and breeding surveys demonstrated the high bird abundance in comparison to that recorded for Beaver and Garden islands, which were studied during the same year, with relatively high bird richness as well. Several listed bird species, including bald eagle, American bittern, Caspian tern, and common tern were observed during 1999 surveys. Overall, Bois Blanc Island is a significant site for avian biodiversity in addition to the numerous occurrences of several rare plants, including all of Michigan's Great Lakes endemics. In addition, the newly listed federal endangered Hine's emerald dragonfly, (*Somatochlora hineana*), was subsequently confirmed on the island in habitat identified during surveys as being suitable. This is one of the relatively few known sites within the currently known global range of this species, which is largely restricted to the Great Lakes. The island is also the northernmost state site for the Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), a species currently under consideration for federal listing. Bois Blanc also supports several state dedicated natural areas, including interior sites with mesic northern forest containing old-growth. The occurrence of large red oaks in these old-growth areas is suggestive of a Native American cultural history, providing an additional reason to conserve and study these sites.

Les Cheneaux islands. The Les Cheneaux islands have long been identified as a significant

biological and cultural region of the northern Lake Huron shoreline, as evidenced by their inclusion with The Nature Conservancy's Northern Lake Huron Bioserve. Despite this *a priori* knowledge, it was also known that more thorough and detailed field inventory was necessary. Portions of two of the largest islands in the chain were surveyed, resulting in new occurrences for boreal forest, northern fen, open dunes, and shoreline plant species on Marquette Island and La Salle Island. The most notable occurrence was the discovery of the rare yellow pitcher-plant (*Sarracenia purpurea* f. *heterophylla*), a state threatened species known previously only in a few local bogs in the northern Lower Peninsula north of Lewiston (see report cover). These initial inventories indicate the need to conduct further survey work for plants, natural communities, and selected animal species, such as Hine's emerald dragonfly, for which suitable habitat is likely present.

Drummond Island. Much of Drummond Island, which is well known for its extensive and high quality alvar grassland habitat, has undergone intensive surveys. Previous inventories have focused on core areas of known alvar sites and on systematic inventories of bedrock shorelines. Our somewhat brief but more systematic inventory of the limestone/dolomite outcrop that forms the Marblehead cliffs resulted in the identification of another rare fern species, the state threatened slender cliff brake (*Pellaea atropurpurea*), and more importantly, the documentation of the cliffs as a significant natural community type (dry non-acid cliff). The cliffs are extremely difficult to traverse and inventory completely, they still require further survey for additional rare plant taxa, and have merit for snail surveys and perhaps other invertebrates as well.

Projected Island Work for Year 2000

Natural community surveys. Field work for natural communities will be directed toward selected, accessible islands within Potagannissing Bay near Drummond Island, with an emphasis on assessment of the largest islands. Harbor Island, a public island within the Seney Refuge management region, is the largest island in the bay, and one to two days of field surveys are planned. Access to one or more of the remaining significant islands, such as Burnt Island, Wilson Island, and Macomb Island, will be contingent on obtaining permission from private landowners, including at least one family limited partnership (e.g. the Plym Foundation for Burnt, Wilson, Cedar, and associated smaller islands within the group).

Botanical surveys. Botanical surveys, in collaboration with the aforementioned natural community work, are scheduled for one or more of the islands, contingent on the provisions noted above. In addition, the MNFI Botany Program leader will conduct a brief analysis of this island inventory and conservation planning project for

the purpose of providing guidance to future efforts and proposals.

Animal surveys. Bois Blanc Island and Drummond Island are scheduled for both migratory and breeding bird surveys, and potentially additional follow-up surveys for selected insects and reptiles on Bois Blanc Island.

Landowner contact. A comprehensive landowner contact and conservation planning effort for Drummond Island will be delayed until 2001, such that significant inventory work can be completed in 2000. However, MNFI's conservation planning specialist will initiate preparatory work for this effort by analyzing the results of the 1999 Beaver Island workshop. This will result in an improved perception of specific information needs, island stakeholders, and the most meaningful workshop format.

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APPENDIX A
PowerPoint Presentation Given to Beaver Island
Conservation Planning Workshop

Agenda

- Who is the Michigan Natural Features Inventory?
- Significance of Great Lakes shoreline and Islands
- Results of biological surveys



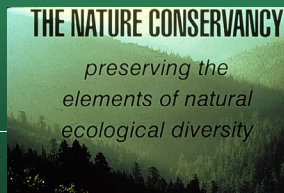
The Natural Heritage Network

- A network of agencies whose charge is to collect sound scientific information
- 85 primary data centers;
 - all states
 - 6 Canadian provinces
 - 13 Latin American and Caribbean countries



Public-Private Partnership

- MNFI was cooperatively formed between The Nature Conservancy and the state of Michigan.

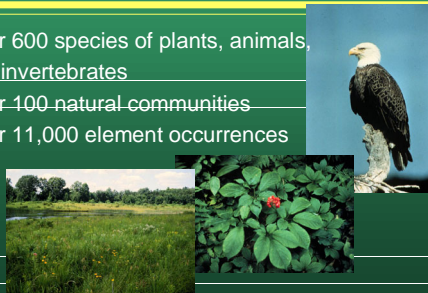


Information Flow

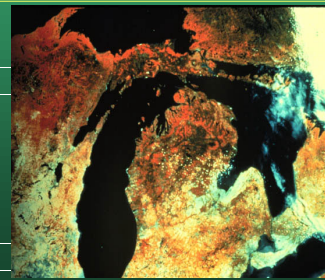
- Gather
- Track
- Analyze
- Disseminate
 -information on endangered, threatened and special concern species, rare or exemplary natural communities, and other unique natural features.

Tracking Data

- Over 600 species of plants, animals, and invertebrates
- Over 100 natural communities
- Over 11,000 element occurrences



Significance of Great Lakes Shorelines



Biodiversity Significance

- Stopover points for migratory waterfowl
- Nesting sites for Colonial waterbirds
- Stopover sites for Neotropical migrants, and raptors
- Important fish spawning habitat
- Harbor a large number of rare species
- Many of Michigan's most unique natural communities are only found on shoreline

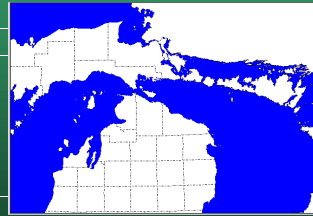
Unique Natural Communities



Unique Natural Communities

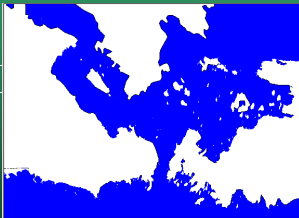


Significance of Islands



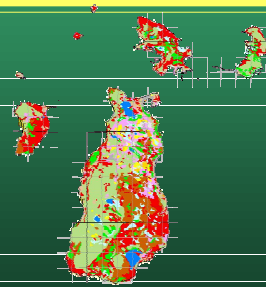
Nowhere else in the world does the combination of vast interconnected bodies of freshwater and such a number and variety of Islands occur.

Close-up of St. Mary's River Area



- Nearly 600 islands within Michigan's borders
- Harbor Approximately 10% of states total known E.O.'s

Beaver Island Archipelago



Natural Community Surveys

- Open Dunes
 - no occurrences in database
- Old growth Forest
 - large tracts of forest in southern portion of the Island



Plant Surveys

- Great Lakes Shoreline
- Great Lakes endemics
 - update old information
 - provide more detail
 - explore unsurveyed areas



Animal Surveys

- Migratory Birds
 - Evaluate importance as a stopover site
- Breeding birds
 - Which birds are nesting and where
- Insects
 - Rare species in Open dunes



Results of Surveys

- Significant Areas Include:
 - Entire Great Lakes Shoreline
 - Inland Lakes
 - Pockets of Old Growth Forest

Great Lakes Shoreline

- Open Dunes
 - 5 new occurrences documented
 - primarily along southern and western shorelines



Great Lakes Shoreline

- Plants
 - 21 occurrences updated
 - 7 new occurrences
 - 1 species listed as Federally and State Endangered
 - 3 species listed as Federally and State Threatened

Great Lakes Shoreline



Pitcher's thistle

- Great Lakes endemic
- State Threatened
- Federally Threatened
- Open dunes
- found all along shoreline

Great Lakes Shoreline



- Lake Huron Tansy
 - State Threatened
 - Open dunes
 - Limited distribution
 - Found all along shoreline

Great Lakes Shoreline



- Houghton's goldenrod
 - State Threatened
 - Federally Threatened
 - Great Lakes endemic
 - interdunal wetlands
 - Limited distribution
 - 1 known site on Beaver

Great Lakes Shoreline



- Dwarf Lake Iris
 - Great Lakes endemic
 - State Threatened
 - Federal Threatened
 - Found in two sites

Great Lakes Shoreline



Fascicled broom rape

- State Threatened
- Previously found
- Not found during recent surveys
- parasitic plant of wormwood (common on dunes)

Great Lakes Shoreline

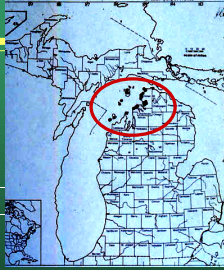


Michigan Monkey Flower

- State Endangered
- Federally Endangered
- Harbor site extirpated
- LTC site harbors one of only 13 populations in world

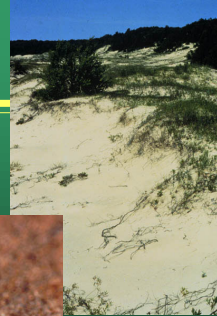
Great Lakes Shoreline

- Pompelly's bromegrass
 - State Threatened
 - Open dunes
 - Very limited distribution
 - one site on Island



Great Lakes Shoreline

- Lake Huron Locust
 - State Threatened
 - 8 new sites documented
 - Open Dunes



Great Lakes Shoreline

Bird Highlights

- Migratory Shorebirds (gulls, cormorant, terns, plovers, rails)
- Neotropical Migratory songbirds
- Merlin - southern shoreline (state threatened)
- American bittern - Font Lake (state special concern)
- Loons - Inland Lakes (state threatened)
- Common moorhen Greenes' Lake (state special concern)

Great Lakes Shoreline



- Piping Plover
 - Federally Endangered
 - Historically nested along Western shoreline
 - No successful nests since 1991 (Donnegal Bay)
 - Pair observed in 1998 - McCauley Pt.
 - Flushed by local dog

Great Lakes Shoreline

Neotropical Migrants

- Breed in N. America
- Winter in tropics
- Long distance migration
- Serious decline due to habitat loss
- Stopover sites are very important



Great Lakes Shoreline

Migratory Birds

- Total # of Birds 1999 = 106
- Total # of migrants 1999 (spring) = 65
- Total # of migrants 1999 (summer) = 78



• Beaver Island is an important stopover and breeding site for long and short distance migrants

- Black throated blue warbler is a species observed that is experiencing a serious decline

Great Lakes Shoreline

Neotropical Migrants



- Other notable neotropical migratory songbirds found on Beaver Island include:
 - [Image of a yellow throat black and white bird]
 - [Image of a yellow throat black and white bird]

Great Lakes Shoreline

Neotropical Migrants

- Hotspots on Beaver Island for migratory songbirds include:
 - Southern and eastern Lake Michigan shorelines with protected bays and coniferous vegetation.
 - Little Sand Bay
 - French Bay
 - Along Mrs. Redding's Trail
 - Inland Lakes such as Barney's Lake

Inland Lakes

- Neotropical migratory songbirds
 - protection from wind
 - good food source
- Loons
 - Historically documented on all lakes
- Deepwater pondsnail
 - (state listed threatened)
 - only 4 known sites in MI
 - 2 historical sites on Beaver

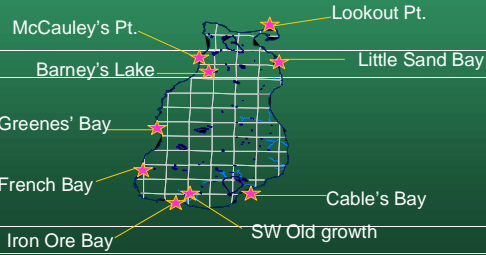


Old Growth Forest



- Although mesic northern hardwoods is a common natural community, very little exists in a mature, old growth condition.
- Three sites were documented, all in southern portion of Island

Most Significant Sites



Map labels:

- McCauley's Pt.
- Barney's Lake
- Greenes' Bay
- French Bay
- Iron Ore Bay
- Lookout Pt.
- Little Sand Bay
- Cable's Bay
- SW Old growth

APPENDIX B
Interactive Workshop: Beaver Island

The Michigan Natural Features Inventory,
and Land Information Access Association
invite residents to a workshop entitled:

Preserving the Natural Resources and Community Character of Beaver Island



This will be an interactive workshop featuring:

- a multi-media technology presentation
- and results of biological inventory work

Date: August 5, 1999

Time: 9:00 a.m. – 12:30 p.m.

Place: St. James Township Hall

Admission is free.

Refreshments will be served.

August 25, 1999

Mr. & Mrs. Ries
31640 East Side Drive
Beaver Island, MI 49782

Dear Mr. & Mrs. Ries,

Greetings! With this letter, we send our appreciation for sharing your wonderful island with us earlier this month. Clearly, Beaver Island is truly a treasure worth protecting. We also want to thank you for participating in our August 5th workshop concerning the preservation of the cultural and natural features of Beaver Island.

We have enclosed with this letter, copies of the meeting agenda, introductory notes, and the information you provided about Beaver Island's most important resources. As you recall, we began the meeting with individual introductions. Each of you was asked to identify yourselves and name something that you truly love about the Island. We compiled your answers on a flip chart.

During the next part of our meeting, we provided a technology demonstration showing how computerized mapping and multimedia can be used to document and understand community resources. We then asked you to break up into groups and participate in a *crayon your community* exercise. That exercise generated a number of excellent *mental maps* of your Island and lists of things you believe define Beaver Island as a special place, unique in the world.

John Paskus, Michigan Natural Features Inventory (MNFI), then provided a *slide show* and overview of the natural features survey work recently completed on the Island. He noted that MNFI has provided the results of these surveys in a publication titled: *Biological Inventory for Conservation of Great Lakes Islands: 1998 Progress Report*. If you want your own copy, John asked that you write him at MNFI, 530 West Allegan Street, Lansing, MI 48933.

As the last step in the workshop, you made a number of strong suggestions about what improvements and preservation efforts should be undertaken on Beaver Island to maintain your community. Finally, you offered a list of *next steps* - the things you feel should be done next.

Again, we were very pleased to meet you and get to know a little about Beaver Island. We hope the workshop was useful to you in considering the future of the Island and your role in defining that future.

We hope to be of assistance again. Please call if there is anything the Land Information Access Association can do to assist you in the future.

Thank you.

Sincerely,

Joe VanderMeulen, Ph.D.
Executive Director

Beaver Island Community Workshop

Identifying & Preserving the Cultural & Natural Resources of Beaver Island

1. Greetings & Introductions
2. Technology Demonstration – Using Multimedia & Digital Mapping
3. Crayon Your Community - Using Your Mental Map of Beaver Island
4. The Michigan Natural Features Inventory – Beaver Island Surveys
5. Development Concerns on the Island
6. Examples of Habitat Change
7. Defining Some Next Steps

Beaver Island Community Workshop

Things We Love About Beaver Island (Introductory Remarks by participants)

- Dark at night
- Fox Lake Bog
- Barney's Lake
- Public Access to Lake Michigan
- 40 Acres next to French Bay
- Lack of Pollution of all kinds
- Clean water and beaches
- Controlled Public Access to Lake Michigan
- Egg Lake Bog
- Optional contact with humans
- History of the island
- (above board master planning)
- Waterfront (harborscape) across from Shamrock
- Limited use of turf grass
- Four different kinds of beach grass – no herbicide
- Beach at McFadden's Point
- Dwarf Lake Iris
- Little Sand Bay

Beaver Island Community Workshop

Crayon Your Community Exercise

- Step 1.** Please mark on your map all the important cultural and natural features you remember.
- Step 2.** Please mark on your map what you think should be preserved.
- Step 3.** Please identify what “improvements” you would like to see.
- Step 4.** Let’s talk about it.

Beaver Island Community Workshop

Elements Mapped During The Crayon Your Community Exercise:

Commercial

1. Beaver Island Lodge
2. Township Airport
3. Harbor Business
4. Transfer Station

Historic Features

1. Indian Point
2. Community House
3. Old Rectory, Holy Cross
4. Font Lake
5. Light Houses – Beaver head tw??
6. Mrs. Reddings Trail
7. Keebler Trail
8. Library
9. Marine Museum
10. Mormon Printshop
11. Protar Home and Tomb
12. Toy Museum
13. Christian Brother's Retreat King Strang Mittel??

Natural Features

1. Lakes Interior
2. Clean Water
3. Endangered species along shore (Dwarf Lake Iris)
4. Build Awareness of endangered species along shore
5. Little Sand Bay Preserve ***
6. Iron Ore Bay
7. French Bay and 40 acres

8. Miller's Marsh *
9. Cranberry Bogs – all
10. Old Growth State Forest
11. Big Sand Bay
12. Barney's Lake
13. McFadden's Point
14. Bull harbor
15. Donegal Bay
16. Green Bay
17. Birch Trees (Fox Lake Road)
18. Big Rock
19. Paradise Bay
20. Mt. Pisgah
21. Appleby's Point
22. Outer Islands

Cultural Features

1. Projected Theater/Meeting Area (to be determined)
2. Pocket Park
3. Scenic Roads
4. Iron Ore Access
5. St. James Public Campground
6. Bill Wagners's Campground
7. Cable's Bay/Foot bridge (Public Access)
8. Galati Boardwalk
9. The Library
10. Marine Museum
11. Mormon Print Shop
12. Toy Museum
13. Tennis Courts
14. Churches
15. Whiskey Point Memorial

Beaver Island Community Workshop

Improvements and Preservation Efforts Recommended

- Limitation on light pollution
- Preserve night dark sky
- Preserve smaller dirt roads
- Pave main roads
- Maintain natural features
- Control/eliminate jet skis
- Open access and primitive camping on West coast state land (relieve pressure on other beaches)
- Cultural Center
- Maintain trail systems
- Public access to lakes (keep)
- Speed Limits
- Scenic Roads
- Dust Control
- Information provided to new comers as to the nature of our island
- More viable leadership from Historical Society and other island organizations
- Clear Trails
- Trash cans at parks
- Public access to lake
- Public policy at state level – no privatization purchases isolating and privatizing public land
- St. James Property around harbor (Pocket Parks)
- Improve St. James T Property around harbor (Harborscape)
- Road improvement around harbor
- Expand library and health center
- Protect and maintain Gull Harbor
- Protect and maintain all wet lands and bogs
- General Education to the public about value of Island features
- Preserve historic shuffle board court
- Preserve Indian history of island
- Preserve Brothe's place
- Need more boat access to Lake Michigan

Beaver Island Community Workshop

The Next Steps List

- Code of Conduct
- New Arrival Guide
- More Information Meetings (Transfer Station)
- Understanding of Interdependence between permanent and seasonal residents
 - Town meetings
- Serious evaluation of combining 2 townships
 - Very difficult to pull off
- Problem with old power base
- Update island values for master planning process
 - Integrate bio information - *GTS database*