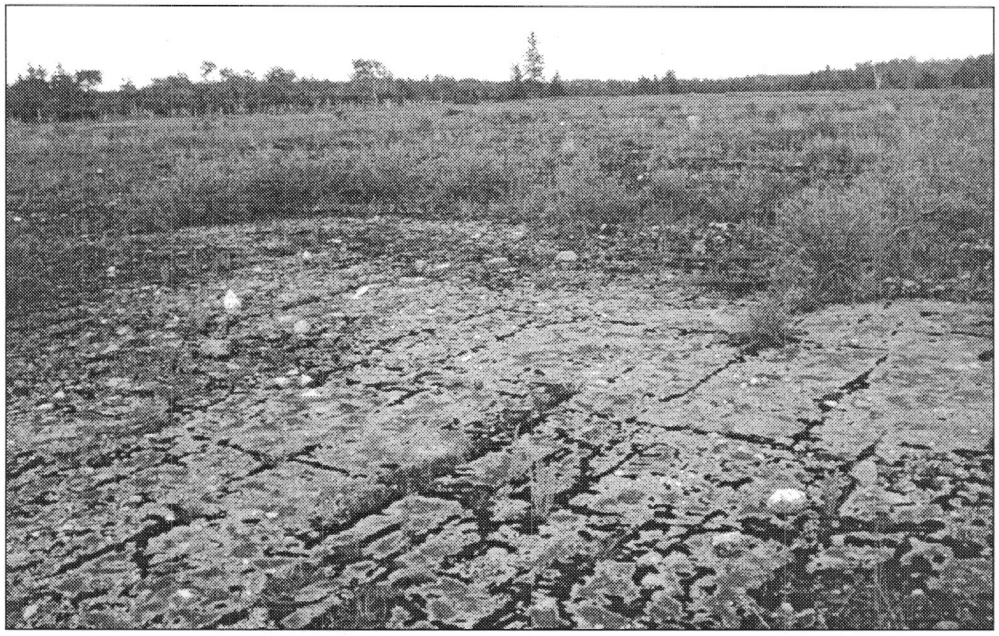
# ALVARS OF MICHIGAN

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**Abstract**

Alvars are known to occur in three areas of the world, in the Baltic region of northern Europe, in County Clare of northwest Ireland, and in the Great Lakes region south of the Canadian shield in North America. Although alvar communities vary considerably in structure and species composition, they all share several key characteristics. They occur on relatively flat limestone or dolomite bedrock pavements where soils are very shallow or absent. Alvars are typically subjected to seasonal environmental extremes of spring flooding and summer drought. The combination of thin soils and extreme fluctuations in available moisture play a significant role in controlling the establishment of trees. Hence, they are all naturally open landscapes with little or no tree cover. Alvar communities generally support distinctive flora and fauna including several rare and interesting species.

Recent work on alvars in the Great Lakes basin calls attention to the ecological rarity and importance of these communities. Many species that occur in alvars are disjuncts occurring outside their primary range but are able to survive in the shallow soils and harsh conditions. Alvars and surrounding woodlands have been disturbed or modified by their use for agriculture, timber production, recreation, residential development, and other human activities. Alvar communities may provide information useful for improvement to cultivated crops, such as drought adaptation in cultivated relatives of alvar plants. Alvar habitats are also important for researching and understanding the impacts of climatic change and environmental extremes as well as the evolution, taxonomy, biogeography, biology, and ecology of rare and/or unique species that occur in these systems.

This report is a product of a collaborative effort by over 50 researchers from Michigan, New York, Ohio, Ontario, and the International Alvar Conservation Initiative. The principal objectives of this initiative included conducting a rangewide assessment of alvars in the Great Lakes basin, documenting and identifying high-quality alvar sites for protection, developing a working knowledge of alvar ecosystems, developing conservation monitoring strategies, and increasing awareness of alvar ecosystems. This report provides a general background to alvars in Michigan; a summary of known alvar sites in the state in terms of their condition, status, and threats; a list of high priority sites and site-specific strategies for conservation; and recommendations for future work on alvars in the state. This report is intended for use by land managers, researchers, private landowners, and local conservation groups.

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## INTRODUCTION

Alvar is a Swedish term used to describe a group of ecological communities characterized by their occurrence on limestone or dolomite bedrock. (Dolomite is a magnesium rich limestone that it is generally quite resistant to erosion.) Although alvar communities vary considerably in structure and species composition, they all share several key characteristics. Alvar communities are all naturally open landscapes with little or no tree cover. They occur on relatively flat limestone or dolomite bedrock pavements where soils are very shallow or absent. Alvars are typically subjected to seasonal environmental extremes of spring flooding and summer drought (Stephenson and Herendeen 1986). The combination of thin soils and extreme fluctuations in available moisture play a significant role in controlling the establishment of trees. Alvar communities generally support distinctive flora and fauna including several rare and interesting species.

Alvars are known to occur in three areas of the world, in the Baltic region of northern Europe, in County Clare of northwest Ireland (D'Arcy 1997), and in North America. In North America, alvars are concentrated in the Great Lakes region south of the Canadian shield. Approximately 64% of the current total acreage of alvar in the Great Lakes region is found in Ontario, with most of the remaining alvar divided about equally between Michigan and New York (Reschke et al. 1998). Small pockets of alvar also occur in Ohio, Wisconsin, Quebec, and along Lake Champlain in Vermont (Catling and Brownell 1995, Reschke et al. 1998).

Thirteen different types of alvar communities and 4 related communities have been recognized by ecologists studying alvar in the Great Lakes region (Reschke et al. 1998) (Table 1). These community types can be categorized into three main groups based on vegetative structure: 1) open grasslands and pavements, 2) shrublands, and 3) savannas and woodlands (Reschke et al. 1998). Open alvar grasslands and pavements are characterized by very little tree and shrub cover (less than 10% cover by trees over 5 meters tall and less than 25% shrub cover). Open grasslands are dominated by grasses and sedges, while alvar pavements are dominated by mosses, lichens, and exposed rock. Alvar shrublands are characterized by very few trees (less than 10% cover by trees over 5 meters tall), moderate to high shrub cover (at least 25% cover), and varying amounts of herbaceous and non-vascular plants. Alvar savannas and woodlands are characterized by higher percentages of tree canopy cover, with savannas having 10 to 25% cover by trees over 5 meters tall, and woodlands with 25 to 60% tree cover. In addition, three other community types have been recognized as related to, but distinct from alvar communities. These are Great Lakes limestone bedrock lakeshores, bur oak limestone savannas, and Midwest wet-mesic dolomite prairies. A more detailed discussion of all these community types is provided in Reschke et al. 1998.

Recent work on alvars in the Great Lakes basin calls attention to the ecological rarity and importance of these communities. Alvars are characterized by an unusual blend of boreal, southern, and prairie species (Reschke et al. 1998). Many species that occur in alvars are disjuncts occurring outside their primary range but are able to survive in the shallow soils and harsh conditions. Some species are primarily confined to alvar habitats, such as the Great Lakes endemic lakeside daisy (*Hymenoxis acaulis* var. *glabra*, federal and state threatened). Alvar communities also provide habitat for a number of rare plant and animal species. For example, in Ontario, 43 rare plant species occur on alvar (Catling and Brownell 1995). In addition, new species of insects (Brunton 1986) and snails (Grimm 1995), and a new plant species (Catling et al. 1993) have been discovered from alvars. Finally, at the community level, all alvar communities are globally and regionally rare and imperiled. Within the Great Lakes basin, 108 alvar and alvar-related sites have been documented comprising approximately 27,000 acres total (Reschke et al. 1998). To a great extent alvars and surrounding woodlands have been disturbed or modified by their use for agriculture, timber production, recreation, residential development, and other human activities.

Catling and Brownell (1995) cite several other reasons alvar communities are important. Alvar communities may provide information potentially useful for improvement to cultivated crops, such as

drought adaptation in cultivated relatives of alvar plants (e.g., wild strawberries, cherries, and plums). Alvar habitats also are important for researching and understanding past vegetation and the impacts of climatic change and environmental extremes as well as the evolution, taxonomy, biogeography, biology, and ecology of rare and/or unique species that occur in these systems. Finally, alvars can provide economic benefits to local communities through ecotourism.

This report is a product of a collaborative effort by over 50 researchers from Michigan, New York, Ohio, Ontario, and the International Alvar Conservation Initiative. The initiative was formed in 1995 to "provide a unified, consistent approach to understanding and evaluating alvar ecosystems and developing basinwide strategies to ensure their protection and stewardship" (Reschke et al. 1998). The principal objectives of this initiative included conducting a rangewide assessment of alvars in the Great Lakes basin, documenting and identifying high-quality alvar sites for protection, developing a working knowledge of alvar ecosystems, developing conservation monitoring strategies, and increasing awareness of alvar ecosystems. One of the first major accomplishments of this initiative was the establishment of the Alvar Working Group, a network of over 50 collaborators sharing information, setting priorities, and coordinating basin-wide activities. Other products from this project include an overview of alvar ecosystems in the Great Lakes as well as individual state summaries from Michigan, New York , Ohio, and Ontario.

The following report provides a summary of work conducted on alvars in Michigan as part of the International Alvar Conservation Initiative. This report represents our current understanding of alvars in Michigan. Specifically, this report provides a general background to alvars in Michigan, a summary of known alvar sites in the state in terms of their condition, status, and threats; a list of high priority sites and site-specific strategies for conservation, and recommendations for future work on alvars in the state. This report is intended for use by land managers, researchers, private landowners, and local conservation groups.

## MICHIGAN ALVARS

In Michigan, alvar and alvar-related communities have been documented at 32 sites. These sites represent 21 occurrences of 7 different alvar community types. They are primarily open grasslands and shrublands. There are also 14 occurrences of Great Lakes limestone bedrock lakeshores. (Some sites contained more than one community type.) Most of the sites occur in the Upper Peninsula along the shorelines of Lake Huron and Lake Michigan, in a band from Drummond Island to Cedarville, west to Seul Choix Point and along the Garden Peninsula. Alvars also occur further west and inland along the Escanaba River. In the Lower Peninsula, alvars occur on Thunder Bay Island along Lake Huron and inland near Rogers City, Alpena, and Thompson's Harbor (Figure1).

The alvar and limestone bedrock lakeshore

Figure 1. Distribution of alvar communities in Michigan. (For more detail see map section in appendix.)

sites in Michigan coincide with areas of exposed limestone and dolomite bedrock found predominantly along the northern shorelines of Lake Michigan and Lake Huron. These bedrock deposits in the eastern Upper Peninsula date back to the Ordovician and Silurian periods, about 400 to 500 million years ago, when shallow inland seas covered the Michigan Basin. The Michigan Basin included all of the Lower Peninsula and the eastern

half of the Upper Peninsula, but the limestone bedrock of the Lower Peninsula is not typically exposed along the shoreline. These areas of exposed limestone and dolomite bedrock are part of the Niagaran Cuesta, a gently sloping bedrock plain that extends along the margins of the Great Lakes from approximately Milwaukee, Wisconsin to Rochester, New York (Dorr and Eschman 1977). A steep escarpment, known as the Niagaran Escarpment, forms the northern margin of the cuesta. The most extensively exposed shoreline bedrock in the Lower Peninsula occurs on Thunder Bay Island along Lake Huron and dates to the more recent Devonian period.

Exposed bedrock associated with the Niagaran limestone and dolomite is found in two characteristic forms: broad expanses of pavement or as cliffs. Limestone pavements are flat, horizontally deposited layers of limestone or dolomite. Pavements are most often exposed along or near a shoreline, but are occasionally found inland where they may be extensive, as on Drummond Island. Michigan's alvars and Great Lakes limestone bedrock lakeshores occur on these limestone pavements. Limestone pavement or bedrock lakeshores are characterized by a zonal gradation of plant communities based on distance from the lake. The width of the zones varies with Great Lakes water level fluctuations. The splash/scrape zone, which averages 10 m (32 feet) in width, is closest to the lake, and is greatly impacted by wave action and ice scrape. As a result, this zone is very sparsely vegetated. Common plant species occurring in the bedrock cracks in this zone include rush (*Juncus balticus*), silverweed (*Potentilla anserina*), and Balm-of-Gilead (*Populus balsamifera*). Vegetation density increases further inland as soil is able to accumulate in and adjacent to bedrock cracks. The vegetated zone, which averages 23 m (75 feet) in width, is characterized by patches of vegetation interspersed with areas of exposed bedrock. In addition to the species found in the splash/scrape zone, common shrub and herbaceous species in this zone include Arkansas mint (*Calamintha arkansana*), shrubby cinquefoil (*Potentilla fruticosa*), panic grass (*Panicum lindheimeri*), hair grass (*Deschampsia cespitosa*), and several moss taxa. Further inland, sand accumulations or cobble ridges on the pavement allow for the establishment of woody plants and denser assemblages of herbaceous plants. Scattered trees and shrubs dominated by northern white-cedar (*Thuja occidentalis*), white spruce (*Picea glauca*), Balm-of-Gilead, and balsam fir (*Abies balsamea*) are common on these cobble ridges.

Limestone glade is another coastal bedrock natural community that is considered a form of alvar. Glades occur in the inland portions of the shoreline, and are typically quite small, usually only a few acres in extent. These exposed pavements are dominated by small, stunted conifers, low evergreen shrubs, and dense herbaceous plants and mosses. These glades are usually described as a form of open alvar grassland or alvar shrubland. Characteristic shrub and herbaceous species include shrubby cinquefoil, common juniper (*Juniperus communis*), bearberry (*Arctostaphylos uva-ursi*), buffalo-berry (*Shepherdia canadensis*), hair grass, ebony sedge (*Carex eburnea*), white camass (*Zigadenus glaucus*), and ragwort (*Senecio pauperculus*). Scattered trees, typically northern white-cedar and white spruce, form a sparse overstory canopy. Rare plant species found in glades include such taxa as dwarf lake iris, beauty sedge (*Carex concinna*), Richardson's sedge (*C. richardsonii*), bulrush sedge, (*C. scirpoidea*), Hill's thistle (*Cirsium hillii*), Cooper's milk-vetch (*Astragalus neglectus*) and Ram's head orchid (*Cypripedium arietinum*).

Inland alvar sites such as those on Drummond Island and the Garden Peninsula, support most of the same plant species found along the shoreline. Additional species, like prairie smoke (*Geum triflorum*) and flattened spike-rush (*Eleocharis compressa*), are found only at inland sites. Drummond Island has several areas of inland alvar, including an exemplary region known as the Maxton Plains. This extensive expanse of limestone pavement is dominated by flattened spike-rush and prairie dropseed (*Sporobolus heterolepis*), the latter species forming large colonies and narrow bands of dense turf in long bedrock cracks. The plains are notable for their dramatic display of prairie smoke. Maxton Plains also supports many of the island's known plant and animal rarities.

A number of rare vascular plants occur in or are associated with alvars or limestone bedrock

lakeshores in Michigan. Rare plant species associated with alvars in Michigan include the dwarf lake iris (*Iris lacustris*) which is a Great Lakes endemic and federally and state threatened. Some species characteristic of arctic-alpine flora common on the volcanic bedrock of the Keweenaw Peninsula also occur on limestone bedrock lakeshores and alvars. These include bulrush sedge (*Carex scirpoidea*, state threatened), downy oatgrass (*Trisetum spicatum*, special concern), wild chives (*Allium schoenoprasum*, state threatened), and butterwort (*Pinguicula vulgaris*, state threatened). Other rare plant species commonly found on alvar and limestone bedrock lakeshores in Michigan and elsewhere in the Great Lakes region include calypso orchid (*Calypso bulbosa*, state threatened), Richardson's sedge (*Carex richardsonii*, special concern), Hill's thistle (*Cirsium hillii*, special concern), Cooper's milk-vetch (*Astragalus neglectus*, special concern), prairie-smoke (*Geum triflorum*, state threatened), and prairie dropseed (*Sporobolus heterolepis*, state threatened).

Insects and land snails appear to be the two animal groups most closely associated with alvar communities. In Michigan, leafhoppers are the insects most commonly found on the studied alvar sites. Sixteen leafhopper species, mostly characteristic of Canadian or Great Plains prairies, have been identified as being associated with alvar grasslands (Hamilton 1994). A special concern leafhopper (*Flexamia delongi*), a prairie species, has been documented from five alvar or limestone bedrock lakeshore sites. New taxa are also being discovered from alvars including a new leafhopper species (*Auridius*) which has been found on Drummond Island and from the Garden Peninsula. Two ground beetle species, *Pterostichus novus* and *Chlaenius purpuricollis*, are only recorded from prairie or alvar habitats, and five rare land snail species are found on alvars including *Vertigo hubrichti, V. ventricosa, V. morsei, V. elatior,* and *Catinella exile.*

## METHODS

### Community Surveys and Classification

Several alvar sites were known from Michigan prior to the surveys conducted for the International Alvar Conservation Initiative. Most of these sites were resurveyed between 1995 and 1997 using standard survey methodology developed by the Alvar Working Group to gather basic inventory data and data to further evaluate ecological processes. During this time period, several new inland alvar sites were identified based on aerial photograph interpretation, field reconnaissance, and/or site leads from other individuals. New sites were surveyed using the same methodology. A total of 27 sites were surveyed in Michigan.

The standard community survey methodology consisted of three different types of surveys: 1) Observation points along a transect were used to briefly document the different community types present at a site and the most abundant plant species in each vegetation layer. 2) Species lists by community type documented all plant species observed within the six general alvar community types based on vegetative structure (e.g., pavement, grassland, and shrubland) present at each alvar site surveyed. 3) Finally, quantitative data on each vegetation layer present and percent cover of each layer within 10 meters by 10 meters square sample plots were recorded. Data from the sample plots and species lists by community type were analyzed to develop the alvar community classification scheme (Table 1) and to assign alvar community types to the sites.

### Rare Plant Surveys

A group of 14 plant species were identified as targets for the alvar project (Table 2). These species are characteristic or restricted alvar species that are globally rare, rare in the Great Lakes basin, and/or rare in Michigan. Surveys for these target species as well as other rare plant species were largely conducted during natural community inventories and vegetation sampling. Standard rare plant survey forms were completed when rare plants were found at an alvar site. Rare plant occurrences were ranked according to their quality and viability.

### Rare Animal Surveys

Rare animal surveys for this project focused on land snails, leafhoppers, and butterflies and noctuid moths. Several alvar and limestone lakeshore sites on Drummond Island and in the Garden Peninsula were surveyed for land snails in 1995. In addition, Wayne Grimm, snail researcher from Ontario, Canada conducted surveys during late summer 1996 at several sites in Chippewa and Delta counties. During 1998 researchers from the University of Wisconsin-Green Bay collected land snails from several sites across the Upper Peninsula including four alvar sites (Nekola 1998). Snails were located by visually searching the shoreline in appropriate microhabitats, turning over rocks and woody debris, and sifting through debris such as leaves, pine needles, and soil. Specimens were collected and placed into 70% ethyl alcohol, and identified; or collected, placed into containers, and reared to adulthood in the laboratory for positive identification.

Insect surveys were conducted at alvar sites and limestone bedrock lakeshores on Drummond Island, the Garden Peninsula, Poverty Island, Summer Island, and at East Lake. Leafhoppers were collected with aerial nets. Noctuid or nocturnal moths were surveyed with light trapping, a method used to document the occurrence of nocturnal insects. Species that could be identified in the field were recorded and released. For species that required further study for accurate identification, individuals were collected and prepared following standard insect collection techniques. Insects were keyed to the genus or species level using published references, or were sent to experts for verification.

## SITE SUMMARIES

The following sites were delineated on the basis of recognizable natural boundaries, changes in ownership or management pattern, or historic site boundaries. The sites are grouped by location, those along the Garden Peninsula and Lake Michigan, those along northern Lake Huron in the Upper and Lower Peninsulas, and inland alvar sites. Within each group, sites are arranged in order of ecological importance or significance. Information on location, alvar community type, size, occurrence rank, number of special plants and animals, and ownership is provided on each of these sites in a summary table (Table 3). The following brief site descriptions provide information on each site's general ecological condition including special plants and animals, status, threats, and conservation or management recommendations. More detailed information on these sites is provided in Albert et al. (1997) and Michigan Natural Features Inventory's Biological and Conservation Data System.

### Alvar Sites of the Garden Peninsula and Lake Michigan.

#### *1. Poverty Island.*

Poverty Island is Great Lakes limestone bedrock lakeshore alvar type. It is nearly all limestone pavement sloping gently to the east. As a result, the island contains low cliff along most of the west shore, pavement lakeshore along the east shore, and dense cedar-birch boreal forest throughout the island's interior. The limestone pavement or bedrock lakeshore, averaging 50 m (160 ft) wide, extends for approximately 1 km (0.6 mile) along the eastern shoreline. Rare plant species associated with this pavement lakeshore are dwarf lake iris (*Iris lacustris*), beauty sedge (*Carex concinna*), and Richardson's sedge (*C. richardsonii*). The boreal forest that dominates the entire interior portion of the island is a very high quality example of its type for Michigan. Although

the forests of this island are frequently blown down by gusts off the lake, there are a number of groves of mature northern white-cedar, balsam fir, and paper birch. The lack of deer on the island has allowed extensive thickets of Canada yew (*Taxus canadensis*) to develop throughout the island's interior. The dry limestone/dolomite cliff, varying from 2 to 8 m (6-25 ft) high, is among the more picturesque of the low cliffs in this part of Lake Michigan. Poverty Island is entirely federally owned.

***2. Summer Island.***

Summer Island contains a diversity of forests and Great Lakes shoreline. Two alvar types are represented, Great Lakes limestone bedrock lakeshore and creeping juniper - shrubby cinquefoil alvar pavement. As with Poverty Island to the southwest, Summer Island is underlain by limestone-dolomite pavement that dips gently to the east. However, there is much deeper soil throughout Summer Island, and as a result, it supports both boreal forests and northern hardwoods throughout the island's interior. The limestone pavement extends for 2.5 km (1.6 miles) along the eastern shoreline, and ranges from 20 to 35 m (60-100 ft). Rare plant species found along the inland edge of the pavement lakeshore were dwarf lake iris, beauty sedge, and Richardson's sedge. Near the south end of the island, a small area of limestone/dolomite glade extends another 5 m (16 ft) inland from the shoreline. There is an active hunt camp and several access roads located adjacent to the glade, so it is possible that the glade may be, at least in part, the result of past land use. Much of Summer Island is within the Lake Superior State Forest and owned by the state. Although there are several homes located on the north end of the island, there are currently no permanent island residents.

***3. Point Detour.***

Point Detour extends southeast from the southern tip of the Garden Peninsula. Similar to Summer Island, this site is characterized by Great Lakes limestone bedrock lakeshore and creeping juniper - shrubby cinquefoil alvar pavement. Pavement lakeshore is found in four distinct segments totaling 1.2 miles (2 km) in length along the east side of the point. Between the segments of pavement lakeshore there are low cliffs and cobble lakeshores. The width of the pavement lakeshore varies from 16 to 100 m (50 to 325 ft), with the widest portion found at the south end. A small portion of limestone/dolomite glade is found along the inland margin of the southern-most segment of pavement lakeshore. This area is dominated by northern white-cedar, white spruce, shrubby cinquefoil, hair grass, Ohio goldenrod, and Canada bluegrass. Along most of this shoreline there is a low cobble ridge on the inland margin of the lakeshore that supports a dense boreal forest of white spruce, northern white-cedar, balsam fir, and quaking aspen (*Populus tremuloides*). Dwarf lake iris is found at this site. Two rare land snails are found here, *Vertigo elatior* and *V. ventricosa.* All but the southern tip of Point Detour falls on state forest land. However, there is easy access to this stretch of shoreline, so there is potential for habitat destruction from illegal use of off-road vehicles.

***4. Garden Peninsula Southeast.***

Just inland from the lakeshore along the east side of the Garden Peninsula are three unusual forms of alvar. These sites, known here as Garden Peninsula Southeast, Sucker Lake, and one inclusion near Kregg Bay Northeast, are located on what was Lake Michigan lakeshore approximately 4,000 years ago. These areas include very shallow, sandy soils over limestone pavement. Somewhat poorly drained portions, best seen at Garden Peninsula Southeast, contain a scattered canopy of northern white-cedar and white spruce over a carpet of dwarf lake iris. Garden Peninsula Southeast is of the alvar type called scrub conifer/dwarf lake iris alvar shrubland. Slightly better drained examples (Sucker Lake and Kregg Bay Northeast) are less dominated by northern white-cedar and with less dwarf lake iris, mostly replaced by a turf of ebony sedge.

The Garden Peninsula Southeast site also includes rare plant species such as beauty sedge, Richardson's sedge, dwarf lake iris, and limestone oak fern (*Gymnocarpium robertianum*). This alvar, extending over 121 hectares (300 acres), is the largest and least disturbed of any known example. The area is partially owned by the State of Michigan, with four private owners retaining the rest. A long-term strategy for public acquisition, and perhaps state Natural Area dedication, should be developed for this site.

***5. Sucker Lake.***

Approximately one half mile (.8 km) inland from the lakeshore of Kregg Bay, a series of alvar glades/ shrublands extends from Sucker Lake to the north. These glades are located on moderately drained sands over limestone pavement. Widely scattered white spruce and common juniper (*Juniperus communis*) are common, along with a dense turf of ebony sedge and scattered patches of dwarf lake iris. Sucker Lake is of the alvar type called scrub conifer/dwarf lake iris alvar shrubland.

Most of this area falls on state forest land, but portions are located on private land. This stretch of shoreline includes several private cabins. Potential for additional development in this area is high. Public acquisition and/or conservation easement should be pursued in the private portions of Section 12.

***6. Kregg Bay Northeast.***

This is a one mile-long stretch of pavement lakeshore along a bay and two small points that extend southeast into Lake Michigan. It is located just south of Charboneau Lake and the Portage Bay State forest campground. The width of the pavement lakeshore varies from 55 to 90 ft (18 to 30 m) and is quite irregular in rock structure and composition. The southernmost portions are similar in structure to the pavement lakeshore at Point Detour, with bleached dolomite containing cracks several inches wide. There are also several large broken rocks and extensive inter-rock pools in this area. Kregg Bay Northeast is of the Great Lakes limestone bedrock lakeshore alvar type.

Along the south side of Charboneau Point, the dolomite is not bleached and contains very fine cracks. Much of this exposed pavement lakeshore is probably inundated during high Great Lakes water levels. Sand has washed down from the inland margins over the surface of portions of this pavement, providing habitat for many plant species. Common plant species along this stretch of shoreline are grass-leaved goldenrod (*Euthamia graminifolia*), sedges (*Carex viridula, C. hystericina*), Dudley's rush (*Juncus dudleyi*), silverweed (*Potentilla anserina*), and hair grass. The inland margin of this entire shoreline is a 2-5 m (5-16 ft) high cobble ridge. Nearly all of the ridge supports dense boreal forest of white spruce, northern white-cedar, quaking aspen, and white pine. The rare snails *Vertigo morsei*, *V. elatior*, and *Catinella exile* were found here. Dwarf lake iris is also found at this site. The central portion of this shoreline is included within state forest land. Private tracts containing vacation homes are found on both Charboneau Point and Kregg Bay. Recent tree removal and trail development has taken place inland along the west end of the this pavement lakeshore. There is much potential for habitat destruction along this stretch of shoreline.

***7. Kregg Bay Glade.***

A disturbed example of scrub conifer - dwarf lake iris alvar shrubland is known from public land near Charboneau Lake, which is just inland from the Kregg Bay lakeshore site. This disturbed glade is located on either side of the access road to the state forest campground. Dwarf lake iris is common throughout these openings, and the rare snail *Vertigo elatior* has been found there. Some experimental treatments, including prescribed burning, have been proposed for state forest land adjacent to these openings.

***8. Stony Point.***

This 0.75 mile-long stretch of shoreline contains exposed limestone pavement similar in structure and composition to that mentioned along Charboneau Point. Like Kregg Bay, it is the Great Lakes limestone bedrock lakeshore alvar type. It contains fine cracks in mostly unbleached dolomite. This portion of pavement lakeshore is clearly inundated during high Great Lakes water levels. There is a considerable amount of sand washed down onto this pavement, most of which is saturated with water flowing down from further inland. There is also a low cobble ridge located just inland of the pavement lakeshore which is backed by interdunal wetland and boreal forest of white spruce, tamarack, balsam fir, and northern white-cedar. Most vegetation occurs where 2-5 cm (1-2 inches) of sand have accumulated on the pavement surface. No rare plants or animals were located along this stretch of shoreline, although dwarf lake iris, Pitcher's thistle, and Lake Huron tansy are all known from near here.

Stony Point is privately owned. It was offered to the state and rejected as a Natural Resources Trust nomination in 1995. There is easy access to the site from US-2, which passes nearby along the Lake Michigan shoreline.

### *9. Goudreau's Harbor.*

This is among the most extensive and scenic stretches of pavement lakeshore in the state. The pavement lakeshore of Goudreau's Harbor extends for over two miles along the west side of Seul Choix Point. It is broken into a number of distinct segments that are probably connected at the lowest Great Lakes water levels, but otherwise form distinct islands. Past rare plant surveys have been conducted the length of this shoreline. Site visits for plant community characterization were conducted at the east end near Seul Choix Point.

Although the width of pavement lakeshore is quite variable, it averages 35 m (110 ft) wide at the east end. Inland of the pavement lakeshore, there is dense boreal forest mostly dominated by northern white-cedar. A number of rare plant species occur along this portion of shoreline, including dwarf lake iris, Lake Huron tansy (*Tanacetum huronense*, state threatened), Pitcher's thistle (*Cirsium pitcheri*), oat grass (*Danthonia intermedia*, special concern), veiny meadowrue (*Thalictrum venulosum* var. *confine*, state threatened), Houghton's goldenrod (*Solidago houghtonii*, state and federal threatened), and green spleenwort (*Asplenium viride*, state threatened). Piping plovers (*Charadrius melodus*, federal and state endangered) are known to nest along this stretch of shoreline. A rare land snail, *Vertigo hubrichtii*, was recorded from this section of the lakeshore by Wayne Grimm during 1996 surveys. This represents a new state record.

The Goudreau family owns nearly all of this shoreline. There are several homes built along the edge of the pavement lakeshore. The lighthouse at Seul Choix Point is located just inland of the pavement lakeshore, and lawns extend to the pavement lakeshore in several places.

## Alvar Sites of Northern Lake Huron.

### *1. Maxton Plains West.*

Maxton Plains is the largest and best known area of alvar grassland and pavement in Michigan. Traditionally, the site has been divided into the West, Middle, and East Maxton Plains. Four alvar types are represented here: tufted hairgrass wet alvar grassland, little bluestem alvar grassland, annual alvar pavement-grassland, and creeping juniper – shrubby cinquefoil alvar pavement. Vernal pools, typically dominated by two moss species, *Pseudocalliergon turgescens* and *Bryum pseudotriquetrum*, occur throughout the former two natural communities, and are a distinctive feature of these alvar types. Detailed information on the non-vascular plants of the Maxton Plains is provided in a study by Marr (1997). Rare plants include prairie smoke (*Geum triflorum*) and prairie dropseed.

Although the alvar grassland at this site is quite extensive and of high quality, the pavement lakeshore is narrow, disturbed by vehicle traffic, and covered by cobbles in much of the area. Most of the site is owned and managed by the State of Michigan and/or The Nature Conservancy. There is possibility of acquiring some of the small ownership.

Ninety-nine species of insects from the target groups have been recorded from Maxton Plains West including 31 species of leafhoppers. Some of the typical prairie species found here include

*Ceratagallia* n. sp. (being described by K.G.A. Hamilton), *Flexamia delongi* (special concern), and *Chlorotettix unicolor*. The adjacent inland grassland, owned by The Nature Conservancy, contains one of the richest leafhopper faunas in the state.

***2. Maxton Plains Middle.***

There is no exposed bedrock shoreline south of Maxton Plains Middle; the shoreline consists of a marly cobble beach. This portion of Maxton Plains supports high quality alvar. Small inclusions of bedrock glade occur throughout, but these are too small to map or rank. Seven special plants are known from this alvar, Calypso orchid (*Calypso bulbosa*, state threatened), Richardson's sedge, bulrush sedge, flattened spike-rush (*Eleocharis compressa*, state threatened), small skullcap (*Scutellaria parvula*, state threatened), Hill's thistle, prairie dropseed, and false pennyroyal (*Trichostema brachiatum*, state threatened).

Almost the entire Middle Plains is owned and managed by the State of Michigan, but there are a few small private parcels at the southern edge of the alvar. Acquisition of these parcels should be pursued to limit residential and recreational development of the Maxton Plains.

***3. Maxton Plains East.***

Maxton Plains East contains one of the most disturbed alvar areas. In 1995, the site was sampled for insects with sweep net samples to compare with the more pristine alvar sites such as Maxton Plains Middle or Maxton Plains West. Only nine species of leafhoppers were taken at Maxton Plains East, but this did include the state-listed *Flexamia delongi*.

***4. Chippewa Point.***

The Chippewa Point site is the smallest site recognized on Drummond Island, yet it is comprised of three alvar types: tufted hairgrass wet alvar grassland, annual alvar pavement-grassland, and creeping juniper – shrubby cinquefoil alvar pavement. It has a short exposure of limestone/dolomite pavement lakeshore backed by approximately 20 hectares (50 acres) of alvar grassland. The openings consist of additional alvar habitat with species similar to those found in the more extensive openings and plains to the east and southeast. The alvar openings are like those in the immediate proximity, such as near Grand Marais Lake, consisting of a thin turf of sedges and grasses over bedrock, with many alvar and fen species. Rare species include Richardson's sedge, beauty sedge, and bulrush sedge. The openings vary from seasonally moist, thin turfs over bedrock to rocky, fen-like meadows near the shore. Low shelves of bedrock above cobble beach occur on the north side of the point. Acquisition of this site was recently completed by The Nature Conservancy to augment the Maxton Plains preserve and protect additional alvar habitat.

***5. Grand Marais Lake (Maxton Plains North).***

This site contains some of the least degraded bedrock shoreline and alvar grassland in the state. It includes the alvar types: tufted hairgrass wet alvar grassland, little bluestem alvar grassland, annual alvar pavement-grassland, and creeping juniper – shrubby cinquefoil alvar pavement. The bedrock is exposed along the shores of Grand Marais Lake, and gradually grades into alvar farther from the shoreline. Along the shore, dolomite is exposed, and vegetation occupies the cracks and some of the moist pavement. Spike-rush (*Eleocharis rostellata*) is the common dominant on the moist pavement, and this species is often surrounded by a thin film of precipitated calcium carbonate. Farther inland vegetation cover becomes complete, forming a scant turf dominated by sedges and grasses. Shallow pools dominated by mosses are common. Limestone/dolomite glade occurs near the North Channel shoreline and is scattered throughout the alvar. Seven special plant species are known from the site, including Calypso orchid, beauty sedge, bulrush sedge, Hill's thistle, flattened spike-rush, Alaska orchid (*Piperia unalascensis*, special concern), and prairie dropseed. Animal surveys in 1995 revealed the presence of a special concern leafhopper, *Flexamia delongi*. Most of this site is owned by either the State of Michigan and The Nature Conservancy, including a recent purchase by The Nature Conservancy.

***6. Bass Cove-Little Shelter Bay.***

This seven-mile (12 km) stretch of shoreline consists primarily of pristine dolomite pavement along the west shore of Bass Cove and along the east shore of Little Shelter Bay; it is one of the highest quality dolomite lakeshores in the state. The dolomite pavement is locally 250 feet (80 m) wide. On Bass Cove, the pavement gradually grades into high-quality bedrock glade, dominated

by small northern white-cedar, balsam fir, and tamarack. The glade totals approximately 200 acres (80 hectares) in area. Rare plant species include Hill's thistle, Richardson's sedge, bulrush sedge, flattened spike-rush, and Alaska orchid.

The highest quality dolomite pavement and all of the bedrock glade is located on State of Michigan property. The remaining shoreline on both Drummond Island and Shelter Island is mostly cobble lakeshore under large private ownership. The private ownerships should be pursued for acquisition, either by the state or a conservation organization, but these acquisitions are of lower priority than the private ownerships at Seamans Point and Huron Bay.

***7. Big Shoal Cove.***

This is one of the shorter expanses of high quality bedrock beach along the south shore of Drummond Island, and is comprised of Great Lakes limestone bedrock lakeshore and tufted hairgrass wet alvar grassland alvar types. There are three distinct sections of dolomite pavement; the largest has been acquired by the Michigan Nature Association (MNA). Although the MNA preserve is relatively small, it contains nine special plants, making it one of the richest sites on Drummond Island for special plants. These include Cooper's milk-vetch (*Astragalus neglectus*, special concern), beauty sedge, Richardson's sedge, bulrush sedge, Hill's thistle, ram's head lady's-slipper (*Cypripedium arietinum*, special concern), dwarf lake iris, Alaska orchid, and prairie dropseed. Insect surveys were conducted during the summer and early autumn of 1994. Residential development and road building have degraded the remaining dolomite pavement. There are no other tracts on the bay to recommend for acquisition.

***8. Seamans Point.***

This site contains four distinct segments of broad, high-quality dolomite pavement separated by cobble lakeshore. There are also 20 hectares (50 acres) of alvar pavement that extends from the shoreline inland for nearly quarter mile (.4 km). The pavement lakeshore averages approximately 30 m (100 feet) in width. The open pavement gradually grades into a narrow limestone/dolomite glade, which contains Hill's thistle, dwarf lake iris, and Alaska orchid. Special plants common on the pavement are the Richardson's sedge and bulrush sedge. Houghton's goldenrod also was found at this site.

The State of Michigan owns the shoreline in the eastern quarter of Section 21 and the western half of Section 15, where considerable dolomite pavement and the alvar are located. The western three quarters of Section 21, formerly owned by George and Eleanor Seaman, was acquired in 1996 by a developer. This lakeshore requires a concerted effort by the conservation community to work with the developer and ensure that the ecological integrity of this lakeshore is maintained.

***9. Warners Cove.***

Exposed pavement along the shoreline is limited to less than a quarter mile, with no known special plants associated with the site. It is of the Great Lakes limestone bedrock lakeshore type. A prairie leafhopper (*Flexamia delongi*) is the lone special animal recorded from the site. Large portions of this shoreline are owned by the State of Michigan. Remaining private parcels are large.

***10. Huron Bay.***

Huron Bay has the largest expanse of broad limestone/dolomite pavement lakeshore in the entire state. The site also has more special plants (10 species) than any other site on Drummond Island. These include Calypso orchid, Richardson's sedge, bulrush sedge, Hill's thistle, limestone oak fern, purple cliff-brake (*Pellaea atropurpurea*, state threatened), alpine bluegrass (*Poa alpina*, state threatened), small skullcap, and downy oat grass. The pavement extends as far as 325 m (1000 feet) inland and averages 65 to 100 m (200 to 300 feet) wide along the eastern side of the bay. The dolomite along portions of the shoreline are much steeper than is typical on Drummond Island, but on most of the shoreline the pavement is quite flat, with less than one percent slope. Insect sampling at Huron Bay occurred along the shoreline north of Helen's Lake and in the small glade farther inland. Black lighting at this site occurred in 1994, 1995, and 1996. A total of 54 species from the target orders have been recorded from the inland glade. This site also contains the leafhopper, *Flexamia delongi*, a species associated with prairie.

The mix of state and private ownership of this shoreline should be consolidated through acquisition and/or conservation easement. Because of easy vehicle access to the area, long-term monitoring and possibly signage should be

considered to prevent degradation of the site by ORVs. This site is categorized as Great Lakes limestone bedrock lakeshore.

***11. Prentiss Bay/Whitefish Point.***

This one acre site of as Great Lakes limestone bedrock lakeshore is located at the southern tip of Whitefish Point in eastern Mackinac County. It is estimated that, during low water level years for Lake Huron, the limestone/dolomite pavement lakeshore is exposed for a 0.8 km (0.5 mile) stretch. When last surveyed in 1980, the pavement was observed to contain dense vegetation in the cracks, and the exposed pavement was backed by a cedar and tamarack-dominated forest. Common plant species in the cracks included silverweed (*Potentilla anserina*), bird's eye primrose (*Primula mistassinica*), bluejoint (*Calamagrostis canadensis*), and red-osier dogwood (*Cornus stolonifera*).

This area is accessed through the Cedar Campus facility owned by the Inter-varsity Christian Camps, and does not appear to be under any threat of development.

***12. Thunder Bay Island.***

Thunder Bay Island is a 70 hectares (175 acre) island just off North Point east of Alpena. Great Lakes limestone bedrock lakeshore, alvar nonvascular pavement, and little bluestem alvar grassland make up this site. Along the eastern side of the island is one of the most extensive limestone/dolomite pavement lakeshores in the state. The pavement extends for over 1.6 km (one mile) and averages nearly 65 m (200 ft) in width. Along with bulrush sedge, butterwort (*Pinguicula vulgaris*) is another rare plant associated with this pavement. This island contains significant nesting sites for both Caspian terns and common terns (*Sterna caspia* and *S. hirundo*, both state threatened). A major rookery for ring-billed gulls (*Larus delawarensis*) is located throughout the south end of the island. Adjacent to the pavement lakeshore, a high quality cedar-dominated boreal forest occupies the northern half of the island. Much of the inland forest is well drained upland, but portions of cedar-tamarack swamp are also present. The interior of the island is densely vegetated with Canada yew, forming a nearly impenetrable thicket. Other rare plant species known from the island include: Calypso orchid (*Calypso bulbosa*), ram's head ladyslipper (*Cypripedium arietinum*), dwarf lake iris (*Iris lacustris*), and Douglas's hawthorn (*Crataegus douglasii*). There is a historical record for false pennyroyal (*Trichostema brachiatum*), but this species has not been re-located on the island in recent years.

Thunder Bay Island is entirely under federal ownership; currently with the Bureau of Land Management, and is scheduled for transfer to the U.S. Fish and Wildlife Service in 1997 (Doug Spencer USFWS pers. comm.). The USFWS has been monitoring bird use of the island for a number of years. Plans for maintenance and utilization of the lighthouse in conjunction with developing access sites for the adjacent underwater sanctuary have considered limited development of the lighthouse portion of the island.

## Inland Alvar Sites

***1. Escanaba River South.***

This site with Escanaba River North represent the only sites from which river ledge alvar grasslands, an extremely rare alvar community, are known to occur. This is a very long, narrow, linear stretch of alvar that rarely exceeds 30 m in width from the river's edge and covers approximately a 6-mile stretch along the sloping banks of the river. This grass-dominated, herbaceous community contains high plant diversity and a number of rare

plant species which include prairie dropseed, Richardson's sedge, wild chives, Cooper's milk-vetch, bulrush sedge, butterwort, dwarf lake iris, New England violet, veiny meadow-rue (*Thalictrum venulosum*), and mat muhly (*Muhlenbergia richardsonis*, state threatened). Shrubs are primarily tag alder (*Alnus rugosa*) and ninebark (*Physocarpus opulifolius*). Zonation in plant communities parallels the river with limestone pavement or *Leersia/Spartina* at or near the water's edge, followed by a zone of big bluestem and mat muhly, with prairie dropseed and little bluestem at the top of the slope.

Active farms, forest, and homes surround the alvar on all sides. A portion of the site is contained within the Escanaba River Shorelands Preserve. The rest is under mixed private ownership. The site has been disturbed by grazing, off-road vehicle use, and bridge construction to the north. Land acquisition or registry is needed to provide further protection of this unique site. ORV access also needs to be controlled.

***2. Escanaba River North.***

Alvar pavement with vegetation only in the cracks covers the first 10 to 20 m from the river's edge. The next 5 m is predominantly grassland dominated by *Spartina pectinata*, *Carex stricta*, *Calamagrostis*, and *Andropogon*. This is followed by 10 m of shrubland with sparse tree cover. A low, seepy limestone cliff (3-6' high) occurs on the opposite side of the river along a significant stretch.

Past land uses of this site were grazing and probably timber harvesting at the turn of the century. Active farms and state forest make up the patchwork surrounding this portion of the river. Most of the site is owned by the state with the rest under mixed private ownership. The site currently has good integrity; however, exotic plants occur at this site in high numbers and diversity. The spread of exotic plants needs to be monitored at this site.

***3. Grand Lake Glade.***

This long, narrow pocket of scrubby alvar is uniquely nested within a patchy mosaic of open bedrock-associated upland forests of spruce, fir, white pine, and aspen, and poorly drained cedar and tamarack swamp. This site contains high percentages of shrub and herbaceous cover, and is of the scrub conifer – dwarf lake iris category. Rare plants at this site include large populations of dwarf lake iris and Cooper's milk-vetch. Two grizzled skipper (*Pyrgus wyandot*, special concern) butterflies were observed in 1997 in a disturbed alvar glade located about 0.25 mi. southeast of Grand Lake glade. Although this species has not observed within the Grand Lake glade, there is potential for grizzled skippers at this site since the host plant, wild strawberry (*Fragaria virginiana*) is present.

This site is located within the Mackinaw State Forest, and much of it is in state ownership. Aspen clearcuts recently occurred just down slope within 0.5 mi. of the site. The state needs to be made aware of the site, and management or protection guidelines need to be established.

***4. East Lake Glade.***

Approximately 30 acres in size, this relatively pristine alvar glade is unique in that it contains well-developed grykes (10-25 cm wide and up to 2 m deep) which clearly help drain the site. Scattered white pine tower over more abundant white spruce and balsam poplar. Balsam fir is common as scattered shrubs. Most of the limestone bedrock surface is exposed and dry. Small patches throughout undoubtedly collect water and retain moisture in organic material. Ragwort is the most common herb. Poverty grass (*Danthonia spicata*) is scattered throughout the area. The site occurs on a south facing high plateau surrounded by northern hardwoods on deeper soils. It is possible that this formed where grykes allowed soils to wash away. Most other similar plateaus in this area have closed-canopy spruce-fir forest grading into northern hardwoods.

This site is contained within the Hiawatha National Forest. Hardwoods bordering the north side of the alvar have been clearcut recently. Site is also accessible to ORV's from the roads. Owner needs to be made aware of the site, and protection guidelines need to be established.

***5. Jones Lake – Drummond Island.***

This site consists of two patches of scrubby alvar grassland at the upper slope portions overlooking Jones Lake. The open alvar is probably expanded somewhat by logging activity in the past. Numerous boulders are scattered across the surface of the slope. Widely scattered white spruce, aspen, cedar, and paper birch form tree and shrub layers. Ebony sedge and poverty grass dominate this dense

herbaceous layer. Hill's thistle is common throughout the area. Alaska orchid also has been documented at this site. No flooding likely takes place here. The site is currently owned by the state as state forest land subject to timber management.

***6. The Rock.***

This site consists of two pockets of shrub-dominated dolomite pavement. Scattered white spruce as both trees and shrubs. Common juniper (*Juniperus communis*) is dominant with a great deal of exposed pavement. It is classified as juniper alvar shrubland. Most of the grykes are entirely filled and moss-covered. This site is somewhat floristically depauperate, but does have a large population of Hill's thistle. This site is entirely state owned. A road currently serves as the site's western boundary and provides access to both openings for forest management and ORV's. The state needs to be made aware of this site, and guidelines for management and protection of this site needs to be established.

***7. Thompson's Harbor.***

This is a small broken canopy alvar glade very similar to the glades of the Garden Peninsula. It is a scrub conifer – dwarf lake iris alvar shrubland. Scattered red pine and paper birch form an overstory above more dense white spruce and balsam fir. Balsam fir, balsam poplar, and cedar are common shrubs. Dwarf lake iris forms a virtual carpet. No pavement or bedrock is exposed, but soils are very shallow over cobble. The flat topography suggest limestone bedrock below the cobble surface. The site grades into cedar swamp to the northeast. A road passes through the middle of the glade. Grizzled skippers were observed from 1994 to 1998 just outside this alvar site in the state park along a powerline corridor. There is potential for this species to occur within the alvar site because of the presence of the host plant (i.e., wild strawberry) and connectivity to powerline corridor. Further survey is needed to establish the extent of this alvar community.

The portion of this site north of the road is owned by the state, located within Thompson's Harbor State Park. The southern half of the site is under mixed private ownership. Land south of the road needs to be acquired.

***8. Thompson's Harbor Observatory Point.***

The site is located not far from the northern Lake Huron shoreline just northwest of Grand Lake. This site consists of a mosaic of open, wet alvar glades and shrub swamps, probably resulting from historic logging and burning. Dwarf lake iris is scattered throughout the site. The site, a combination of state and private ownership, should be revisited.

***9. Charboneau Lake.***

This site is located only 0.25 to 0.75 mi. from the shoreline, and was probably a coastal alvar approximately 3,000 to 4,000 years ago. The site consists of patchy sedge openings in a matrix of spruce, cedar, and dwarf lake iris glade. Pockets of dense forest of spruce, fir, cedar, and aspen over shallow soils surround the site. Small pockets of seasonally wet swamps are scattered throughout. Some stumps found in the alvar indicate limited past logging, and a road passed through the center of the alvar. There also is evidence of deer browsing. A road currently passes along the northern edge of the site.

This alvar glade is under state ownership as part of the Lake Superior State Forest. Recent clearcutting of the area to the north scraped off the surface layer of the glade and devastated the majority of the alvar at this site, decreasing 90% of the intact glade acreage. The clearcut area is now a wasteland. The state forest needs to be notified of this site for future timber management or planning. Increased ORV use as a result of coastal development in the area is another potential threat, and needs to be monitored.

***10. Huron Bay Road.***

This is a small alvar opening on exposed dolomite pavement surrounded by closed forest of white spruce, fir, aspen, and white pine. Large boulders and moderate to large crevices are common throughout the opening. A healthy population of Hill's thistle occurs here. Road access to Huron Bay is through this opening, and past activity along this road has certainly contributed to keeping it open. A horse-feeding station is found along the road. The site is currently owned by Drummond Dolomite, Inc., who needs to be notified of its significance. For long-term protection, this site should be acquired, and access to Huron Bay redirected away from site. Also, use of horses and ORV's in the area, and spread of

exotic plants at the site are potential threats and need to be monitored.

***11. Big Knob Campground.***

This site consists of a moderately-sized block of exposed bedrock with grykes (20 – 50 cm wide) and is mostly forested. Sugar maple, white ash, and balsam fir make up a broken forest canopy with several exposed pockets of bedrock. Abandoned weedy fields on either side of site. The site is owned by the state.

## SUMMARY AND RECOMMENDATIONS

Over three-quarters of the alvar and limestone bedrock lakeshore sites in Michigan are owned and managed entirely or partially by state government through the Michigan Department of Natural Resources, federal government, or conservation groups. The most ecologically significant sites are either owned and managed by The Nature Conservancy or under a mix of state and private ownership. While the Michigan Department of Natural Resources recognizes the importance of alvar communities, problems with ORV access and timber management activities need to be resolved. State forest areas should be made aware of alvar sites and the rare species of this community on lands that they manage, and appropriate management or protection guidelines should be established. Residential development of the Lake Michigan and Lake Huron shorelines in Michigan's Upper and Lower Peninsulas continues, emphasizing the need for pursuing acquisition of the more important private tracts associated with the state's alvar and bedrock lakeshore sites.

Although protection of all alvar sites in the state would be ideal, limited resources emphasize the need for prioritization. Thirteen sites have been identified as high priority sites for conservation based on their ecological significance and/or level of threat. These include seven shoreline sites and six inland sites. The following is a list of the high priority sites:

<u>Lake Michigan Sites</u>
Garden Peninsula Southeast
Goudreau's Harbor
Point Detour
Summer Island

<u>Lake Huron Sites</u>
Huron Bay
Bass Cove-Little Shelter Bay
Seaman's Point
(Maxton Plains Middle??)

<u>Inland Sites</u>
Grand Lake
Escanaba River South
Escanaba River North
East Lake Glade
The Rock
Jones Lake

In general, conservation of these sites will require some land acquisition. Private landowners should be made aware of the presence of alvar on their property, the ecological significance of these communities, and the many rare plants and animals that they support. Specific conservation recommendations are provided in the individual site summaries. If land acquisition is not feasible, conservation easements and other conservation measures could be pursued.

This project provided an excellent opportunity to develop a better understanding of the distribution and status of alvar and alvar-related communities in the state and in the Great Lakes basin. However, more work needs to be done on these ecosystems to gain a better understanding of their ecological components and sustaining processes in order to develop effective protection and management techniques.

Scrub conifer – dwarf lake iris alvar type at Garden Peninsula Southeast. Much of the ground cover here is dwarf lake iris.

Scrub conifer – dwarf lake iris alvar type at Sucker Lake.

Dwarf lake iris (*Iris lacustris*) on alvar.

Poverty Island, an example of the Great Lakes limestone bedrock lakeshore alvar type.

Summer Island, where two alvar types are represented, Great Lakes limestone bedrock lakeshore and creeping juniper – shrubby cinquefoil alvar pavement.

Richardson's sedge (*Carex richardsonii*), on alvar at Huron Bay.

Maxton Plains, tufted hairgrass wet alvar grassland and little bluestem alvar grassland, in the spring.

Maxton Plains, little bluestem alvar grassland, in the summer.

Huron Bay, a combination of Great Lakes limestone bedrock lakeshore and alvar non-vascular pavement.

Escanaba River North, the extremely rare river ledge alvar grassland community type. The distinct edges of the pavement a result of ice scouring.

The pavement at Escanaba River North with prairie dropseed growing from the grykes.

Escanaba River South, a combination of the rare river ledge alvar grassland and little bluestem alvar grassland.

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## APPENDIX

Tables:

Table 1. List and general description of alvar and related communities

Table 2. List of target plant species during alvar surveys

Table 3. Alvar and Great Lakes Limestone Bedrock Lakeshore Sites in Michigan

Maps:

Garden Peninsula and Lake Michigan Sites

Northern Lake Huron Sites

Inland Sites

**Table 1. List and general description of alvar and related communities as recognized by the International Alvar Conservation Initiative (Reschke et al. 1998).**

| Main Category | Alvar Community Type | General Description and Characteristic Plants |
|---|---|---|
| Open alvar grasslands and pavements (< 10% tree cover, < 25% shrub cover) | River ledge alvar grassland* | Located on limestone or dolomite bedrock ledges along a river, usually occurring in small patches (<50 acres); usually <2% shrub cover. Prairie cordgrass (*Spartina pectinata*), mat muhly grass (*Muhlenbergia richardsonis*), prairie dropseed (*sporobolus heterolepis*), upland white aster (*Solidago ptarmicoides*), and flat-topped goldenrod (*Euthamia graminifolia*). |
| | Tufted hairgrass wet alvar grassland* | Typically low, wet community; <1% shrub cover. Tufted hairgrass (*Deschampsia cespitosa*), Crawe's sedge (*Carex crawei*), prairie dropseed, and flat-topped spikerush (*Eleocharis compressa*). |
| | Little bluestem alvar grassland* | ≥50% grass/sedge cover and as much as 50% dwarf shrub (<0.5 m tall) cover. Prairie dropseed, little bluestem (*Schizachyrium scoparium*), creeping juniper (*Juniperus horizontalis*), northern singlespike sedge (*Carex scirpoidea*), tufted hairgrass, balsam ragwort (*Senecio pauperculus*), and Crawe's sedge. |
| | Annual alvar pavement-grassland | Mosaic of pavement and grassland areas dominated by small rush grass (*Sporobolus neglectus*), sheathed rush grass (*S. vaginiflorus*), Philadelphia panic grass (*Panicum philadelphicum*), wiry panic grass (*P. flexile*), and false pennyroyal (*Trichostema brachiatum*). |
| | Annual nonvascular pavement* | Rock outcrop community throughout the Great Lakes basin; exposed pavement sparsely vegetated with lichens and mosses, Virginia saxifrage (*Saxifraga virginiensis*), hairy beardtongue (*Penstemon hirsutus*), Norwegian cinquefoil (*Potentilla norvegica*), and false pennyroyal. |
| | Poverty grass dry alvar grassland | Poverty grass (*Danthonia spicata*), Canada bluegrass (*Poa compressa*), and sometimes little bluestem. |
| Alvar shrublands (<10% tree cover, ≥25% shrub cover, and variable herbaceous and non-vascular plant cover) | Creeping juniper-shrubby cinquefoil alvar pavement* | ≥25% dwarf shrub cover with creeping juniper and/or shrubby cinquefoil (*Potentilla fruticosa*). Other characteristic species include little bluestem, Richardson's sedge (*Carex richardsonii*), and northern singlespike sedge. Closely related to little bluestem alvar grassland. |
| | Shrub conifer / dwarf lake iris alvar shrubland* | >25% cover of tall (2-5 m) and short (0.5-2 m) shrubs, and >50% herbaceous cover. Dwarf lake iris (*Iris lacustris*), ebony sedge (*Carex eburnea*), and scrub forms (i.e., tall shrubs) of white spruce (*Picea glauca*), northern white cedar (*Thuja* |

**Table 1. Continued**

| | | |
|---|---|---|
| | | *occidentalis*), tamarack (*Larix laricina*), and balsam fir (*Abies balsamea*). |
| | Juniper alvar shrubland* | >25% cover of tall, short, and dwarf shrubs. Eastern red cedar (*Juniperus virginiana*), northern white cedar (*Thuja occidentalis*), bur oak (*Quercus macrocarpa*), common juniper (*Juniperus communis*), fragrant sumac (*Rhus aromatica*), downy arrow-*wood (Viburnum rafinesquianum*), poverty grass, and upland white aster. |
| | Shagbark hickory / prickly ash alvar savanna | Shagbark hickory (*Carya ovata*) is dominant tree, and prickly ash (*zanthoxylum americanum*) is dominant shrub. Herbs include poverty grass, Philadelphia panic grass, and Pennsylvania sedge (*Carex pensylvanica).* |
| | Chinquapin oak / nodding onion alvar savanna | Chinquapin oak (*Quercus muhlenbergii*) is most abundant, but swamp white oak (*Q. bicolor*) blue ash (*Fraxinus quadrangulata*), and eastern red cedar are also characteristic. Most abundant shrubs include rough-leaved dogwood (*Cornus drummondii*), downy arrow-wood, fragrant sumac, and prickly ash. Canada bluegrass is dominant. |
| | White cedar - jack pine / shrubby cinquefoil alvar savanna | Dominant trees are northern white cedar, jack *pine (Pinus banksiana*), and tamarack. Shrubby cinquefoil and creeping juniper are dominant shrubs, and characteristic herbs include little bluestem, prairie dropseed, northern singlespike sedge, limestone calamint (*Calamintha arkansana*), Richardson's sedge, and ebony sedge. |
| | Mixed conifer / common juniper alvar woodland | Characteristic species include white spruce, northern white cedar, jack pine, white pin (*Pinus strobus*), common juniper, false pennyroyal, and ebony sedge. |
| | Red cedar / early buttercup alvar woodland | Red cedar, white cedar, poverty grass, Canada bluegrass, early buttercup (*Ranunculus fascicularis*), Philadelphia panic grass, wiry panic grass, and upland white aster. |
| Alvar-related communities | Great Lakes limestone bedrock lakeshore* | Found along Great Lakes shores where flat limestone or dolomite is exposed. Exposed bedrock slopes gently into the lake. Numerous cracks and crevices, where plants are rooted. Up to three vegetative zones. |
| | Bur oak limestone savanna | 10-25% tree cover, and open, grassy groundlayer.. Dominant tree is bur oak, and ground flora include many species characteristic of alvar. |
| | Midwest wet-mesic dolomite prairie | Occurs on shallow, temporarily flooded or frequently saturated soils overlying dolomite bedrock. Dense herbaceous vegetation, and little woody vegetation. |

*Community occurs in Michigan.

**Table 2. List of target plant species during alvar surveys as agreed upon by collaborators of the International Alvar Conservation Initiative (Reschke et al. 1998).**

| Common Name | Scientific Name | Global Rank[1] | Status in Michigan |
|---|---|---|---|
| Wild chives | *Allium schoenoprasum* var. *sibiricum* | G5 | Threatened |
| Cooper's milk vetch | *Astragalus neglectus* | G3G4 | Special concern |
| Sideoats grama grass | *Bouteloua curtipendula* | G5 | Threatened |
| Juniper sedge | *Carex juniperorum* | G2 | - |
| Shortstalk chickweed | *Cerastium brachypodum* | G? | - |
| Hill's thistle | *Cirsium hillii* | G3 | Special concern |
| Pitcher's thistle | *Cirsium pitcheri* | G3 | Threatened |
| Ram's-head lady's slipper | *Cypripedium aretinum* | G3 | Special concern |
| Lakeside daisy | *Hymenoxys herbacea* | G2 | - |
| Dwarf lake iris | *Iris lacustris* | G3 | Threatened |
| Mat muhly | *Muhlenbergia richardsonis* | G5 | Threatened |
| Tiny mousetail | *Mysosorus minimus* | G3 | - |
| Houghton's goldenrod | *Solidago houghtonii* | G3 | Threatened |
| Prairie dropseed | *Sporobolus heterolepis* | G5 | Threatened |

[1] Global ranks are assigned by The Nature Conservancy using the following designations:
G1 = Critically imperiled globally
G2 = Imperiled globally
G3 = Very rare and local throughout its range
G4 = Apparently secure globally
G5 = Demonstrably secure globally

**Table 3. Alvar and Great Lakes Limestone Bedrock Lakeshore Sites in Michigan.**

| Site | Location (T, R, S) | Alvar community type | Size in acres | Quality rank | No. of special plants/ animals | Ownership |
|---|---|---|---|---|---|---|
| **Garden Peninsula and Lake Michigan Sites** | | | | | | |
| Poverty Island | T36N R19W S9 | GLLBL | 15 | A | 3/- | State of MI |
| Summer Island | T37N R19W S26,33 | GLLBL, CJSCAP | 29 | A | 3/- | State of MI, Private |
| Point Detour | T37N R19W S11,14 | GLLBL, CJSCAP | 25 | A | 1/2 | State of MI, Private |
| Garden Peninsula Southeast | T37N R19W S2,27 (3?) | SCDLIAS | 300 | A | 4/- | State of MI, Private |
| Sucker Lake | T38N R19W S13, 14, 23-24 | SCDLIAS | 140 | A | 1/- | State of MI, Private |
| Kregg Bay Northeast | T38N R18W S4 | GLLBL | 7 | B | 1/2 | State of MI, Private |
| Kregg Bay Glade | T38N R19W S1, 12 | SCDLIAS | 75 | B | 1/1 | State of MI, Private |
| Stony Point | T41N R16W S22, 23 | GLLBL | 5 | B | -/- | Private |
| Goudreau's Harbor | T41N R13W S20, 21 | GLLBL, ANP | 22 | A | 8/2 | Private |
| **Lake Huron Sites** | | | | | | |
| Maxton Plains West | T43N R6E S28, 29,32,33 | THWAG, LBAG, AAPG, CJSCAP | 260 | A | 2/1 | State of MI, Nature Conservancy |
| Maxton Plains Middle | T43N R6E S34, 35 | THWAG, LBAG, AAPG, CJSCAP | 2600 | A | 7/- | State of MI, Private |
| Maxton Plains East | T43N R6E S31, 36 | THWAG | 140 | B | -/1 | State of MI, Private |
| Chippewa Point | | THWAG, AAPG, CJSCAP | | | 3/- | |
| Grand Marais Lake | T43N R6E S20,27-30 | GLLBL, THWAG, LBAG, AAPG, CJSCAP | 160 | A | 7/1 | State of MI, Nature Conservancy |
| Bass Cove-Little Shelter Bay | T41N R7E S27,28-29 | GLLBL, ANP | 100 | B | 5/- | State of MI, Private |
| Big Shoal Cove | T41N R6E S24 | GLLBL, THWAG | 2 | B | 9/- | Private |

| Site | Location (T, R, S) | Alvar community type | Size in acres | Quality rank | No. of special plants/ animals | Ownership |
|---|---|---|---|---|---|---|
| Seaman's Point | T41N R6E S15,16,21,22 | GLLBL | 50 | B | 6/- | State of MI, Private |
| Warner's Cove | T41N R6E S18 | GLLBL | 32 | C | -/1 | State of MI, Private |
| Huron Bay | T41N R5E S13, 19,24 | GLLBL, ANP, WCJPSCAS | 120 | A | 8/1 | State of MI, Private |
| Prentiss Bay/Whiteish Point | T41N R2E s5,6,8 | GLLBL | 1 | C | -/- | Private |
| Thunder Bay Island | T31N R10E S34 | GLLBL, ANP, LBAG | 18 | A | 4/2 | Federal-Fish and Wildlife Service |
| **Inland Sites** | | | | | | |
| Escanaba River South | T40N R23W S1,6,32,33-36 | RLLP, LBAG | 20? | A | 9/1 | Private |
| Escanaba River North | T42N R24W S22,23,26 | RLLP, LBAG | 30 | B | -/- | State of MI, Private |
| Grand Lake Glade | T34N R7E S33, 34 | SCDLIAS | 160 | B | -/- | State of MI |
| East Lake Glade | T43N R5W S12 | JAS | 30 | B | -/- | Federal- Hiawatha National Forest |
| The Rock | T42N R6E S22,23 | JAS | 60 | B | 1/- | State of MI |
| Jones Lake | T41N R5E S6,31, 32 | PGDAG | 40 | B | 2/- | State of MI |
| Thompson's Harbor | T34N R7E S15, 22 | SCDLIAS | 10 | C | 1/- | State of MI, Private |
| Thompson's Harbor Observatory Point | T34N R6E S1,2,7,9,11-12, 16-18 | SCDLIAS, THWAG | 1000 (300?) | A | 1/- | |
| Charboneau Lake | T38N R18W S4,5,32, 33 | SCDLIAS | 90 | C (B?) | 1/- | State of MI |
| Huron Bay Road | T41N R5E S12 | JAS | 15 | C | 1/1 | Private |
| Big Knob Campground | T43N R10W S30 | JAS | 8 | C | -/- | State of MI |

AAPG – Annual Alvar Pavement-Grassland
ANP – Alvar Non-vascular Pavement
CJSCAP – Creeping Juniper – Shrubby Cinquefoil Alvar Pavement
GLLBL – Great Lakes Limestone Bedrock Lakeshore
JAS – Juniper Alvar Shrubland
LBAG – Little Bluestem Alvar Grassland
PGDAG – Poverty Grass Dry Alvar Grassland
RLAG – River Ledge Alvar Grassland
SCDLIAS – Scrub Conifer – Dwarf Lake Iris Alvar Shrubland
THWAG – Tufted Hairgrass Wet Alvar Grassland

**Table 4. Rare species found at alvar sites in Michigan.**

| | Bass Cove | Big Knob Camp. | Big Shoal Cove | Charboneau Lake | Chippewa Point | East Lake Glade | Escanaba River | Escanaba River S. | Garden Pen. SE | Goudreau's | Grand Lake Glade | Grand Marais | Huron Bay | Huron Bay Road | Jones Lake | Kregg Bay Glade | Kregg Bay NE | Maxton Plains W. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Allium schoenoprasum v. sibiricum* | | | | | | | | X | | | | | | | | | | |
| *Aspelium viride* | | | | | | | | | | X | | | | | | | | |
| *Astragalus neglectus* | | | X | | | | | X | | | | | | | | | | |
| *C. pitcheri* | | | | | | | | | | X | | | | | | | | |
| *Calypso bulbosa* | | | X | | | | | | | | | X | X | | | | | |
| *Carex concinna* | | | X | | X | | | | X | | | X | | | | | | |
| *Carex richardsonii* | X | | X | | X | | | X | X | | | | X | | | | | |
| *Carex scirpoidea* | X | | X | | X | | | X | | | | X | X | | | | | |
| *Catinella exile* | | | | | | | | | | | | | | | | | X | |
| *Charadrius melodus* | | | | | | | | | | X | | | | | | | | |
| *Cirsium hillii* | X | | X | | | | | | | | | X | X | X | X | | | |
| *Cryptogramma stelleri* | | | | | | | | | | | | | X | | | | | |
| *Danthonia intermedia* | | | | | | | | | | X | | | | | | | | |
| *Eleocharis compressa* | X | | | | | | | | | | | X | | | | | | |
| *Flexamia delongi* | | | | | | | | | | | | X | | X | | | | X |
| *Geum triflorum* | | | | | | | | | | | | | | | | | | X |
| *Gymnocarpium robertianum* | | | | | | | | | X | | | | | | | | | |
| *Iris lacustris* | | | X | X | | | | | X | X | | | | | | X | X | |
| *Muhlenbergia richardsonis* | | | | | | | | X | | | | | | | | | | |
| *Pellaea atropurpurea* | | | | | | | | | | | | | X | | | | | |
| *Pinguicula vulgaris* | | | | | | | | X | | | | | | | | | | |
| *Piperia unalascensis* | X | | X | | | | | | | | | X | | | X | | | |
| *Poa alpina* | | | | | | | | | | | | | X | | | | | |
| *Scutellaria parvula* | | | | | | | | | | | | | X | | | | | |
| *Senecio indecorus* | | | | | | | | | | X | | | | | | | | |
| *Solidago houghtonii* | | | | | | | | | | X | | | | | | | | |
| *Sporobolus heterolepis* | | | X | | | | | X | | | | X | | | | | | X |
| *Sterna caspia* | | | | | | | | | | | | | | | | | | |
| *Sterna hirundo* | | | | | | | | | | | | | | | | | | |
| *Tanacetum huronense* | | | | | | | | | | X | | | | | | | | |
| *Thalictrum venulosum* | | | | | | | | X | | X | | | | | | | | |
| *Trichostema brachiatum* | | | | | | | | | | | | | | | | | | |
| *Trisetum spicatum* | | | | | | | | | | | | | X | | | | | |
| *Vertigo hubrichtii* | | | | | | | | | | X | | | | | | | | |
| *V. elatior* | | | | | | | | | | | | | | | | X | | |
| *V. morsei* | | | | | | | | | | | | | | | | | X | |
| *V. ventricosa* | | | | | | | | | | | | | | | | | | |
| *Viola novae-angliae* | | | | | | | | X | | | | | | | | | | |

| | Maxton Plains | Maxton Plains | Point Detour | Poverty Island | Prentiss Bay | Seamans Point | Stony Point | Sucker Lake | Summer Island | The Rock | Thompson's | Thompson's Harbor | Thunder Bay | Warner's Cove |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Allium schoenoprasum v. sibiricum* | | | | | | | | | | | | | | |
| *Aspelium viride* | | | | | | | | | | | | | | |
| *Astragalus neglectus* | | | | | | | | | | | | | | |
| *C. pitcheri* | | | | | | | | | | | | | | |
| *Calypso bulbosa* | X | | | | | | | | | | | | | |
| *Carex concinna* | | | | X | | | | | X | | | | | |
| *Carex richardsonii* | X | | | X | | X | | | X | | | | | |
| *Carex scirpoidea* | X | | | | | X | | | | | | | X | |
| *Catinella exile* | | | | | | | | | | | | | | |
| *Charadrius melodus* | | | | | | | | | | | | | | |
| *Cirsium hillii* | X | | | | | X | | | | X | | | | |
| *Cryptogramma stelleri* | | | | | | | | | | | | | | |
| *Danthonia intermedia* | | | | | | | | | | | | | | |
| *Eleocharis compressa* | X | | | | | | | | | | | | | |
| *Flexamia delongi* | | X | | | | | | | | | | | | X |
| *Geum triflorum* | | | | | | | | | | | | | | |
| *Gymnocarpium robertianum* | | | | | | | | | | | | | | |
| *Iris lacustris* | | | X | X | | X | | X | X | | X | X | X | |
| *Muhlenbergia richardsonis* | | | | | | | | | | | | | | |
| *Pellaea atropurpurea* | | | | | | | | | | | | | | |
| *Pinguicula vulgaris* | | | | | | | | | | | | | X | |
| *Piperia unalascensis* | | | | | | X | | | | | | | | |
| *Poa alpina* | | | | | | | | | | | | | | |
| *Scutellaria parvula* | X | | | | | | | | | | | | | |
| *Senecio indecorus* | | | | | | | | | | | | | | |
| *Solidago houghtonii* | | | | | | X | | | | | | | | |
| *Sporobolus heterolepis* | | | | | | | | | | | | | | |
| *Sterna caspia* | | | | | | | | | | | | | X | |
| *Sterna hirundo* | | | | | | | | | | | | | X | |
| *Tanacetum huronense* | | | | | | | | | | | | | | |
| *Thalictrum venulosum* | | | | | | | | | | | | | | |
| *Trichostema brachiatum* | X | | | | | | | | | | | | X | |
| *Trisetum spicatum* | | | | | | | | | | | | | | |
| *Vertigo hubrichtii* | | | | | | | | | | | | | | |
| *V. elatior* | | | X | | | | | | | | | | | |
| *V. morsei* | | | | | | | | | | | | | | |
| *V. ventricosa* | | | X | | | | | | | | | | | |
| *Viola novae-angliae* | | | | | | | | | | | | | | |

**Garden Peninsula and Lake Michigan Sites**


1. Poverty Island
2. Summer Island
3. Point Detour
4. Garden Peninsula SE
5. Sucker Lake
6. Kregg Bay NE
7. Kregg Bay Glade
8. Stony Point
9. Goudreau's Harbor

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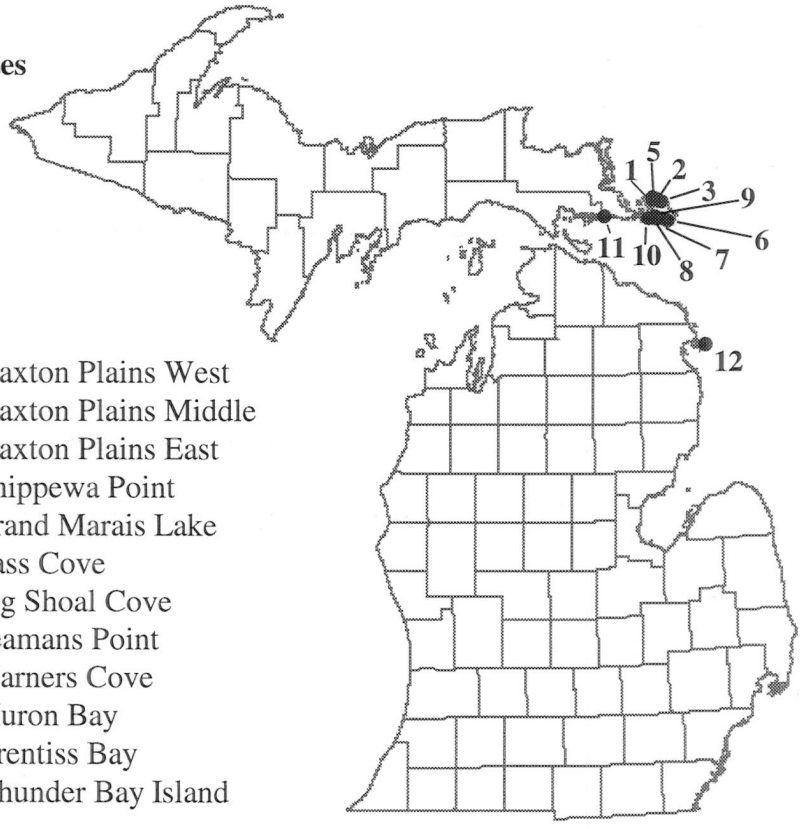
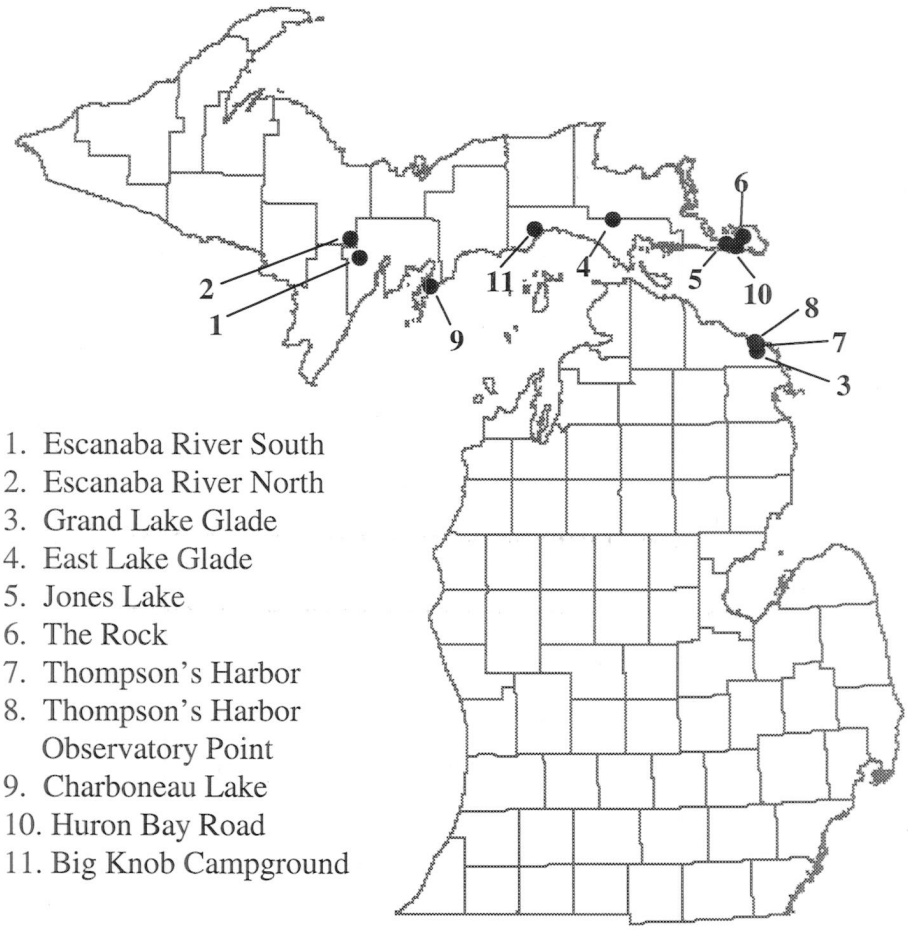
**Northern Lake Huron Sites**




1. Maxton Plains West
2. Maxton Plains Middle
3. Maxton Plains East
4. Chippewa Point
5. Grand Marais Lake
6. Bass Cove
7. Big Shoal Cove
8. Seamans Point
9. Warners Cove
10. Huron Bay
11. Prentiss Bay
12. Thunder Bay Island

**Inland Sites**




1. Escanaba River South
2. Escanaba River North
3. Grand Lake Glade
4. East Lake Glade
5. Jones Lake
6. The Rock
7. Thompson's Harbor
8. Thompson's Harbor Observatory Point
9. Charboneau Lake
10. Huron Bay Road
11. Big Knob Campground

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