

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

CRITICAL COASTAL WETLAND PROBLEM AREAS ALONG THE MICHIGAN-WISCONSIN
SHORELINE OF LAKE MICHIGAN, AND THEIR PRIORITIZATION FOR FURTHER STUDY

by

Gerald L. Shideler
U.S. Geological Survey
P.O. Box 25046, MS 913
Denver, CO 80225

(Open-File Report)
92-22

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1992

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General Strategy

As part of the Coastal Wetlands element of the National Coastal Geology Program, this project constitutes a new initiative for regional studies of coastal wetland systems associated with the Great Lakes Drainage Basin. This phased project will be conducted over approximately a 5-year period, and it is initially focusing on wetlands along the Michigan-Wisconsin shoreline of Lake Michigan. The rationale for initiating wetland studies along Lake Michigan is to interface with ongoing erosion studies along southern Lake Michigan, and to conform with the schedule of the NOAA/USGS "Great Lakes Shoreline Mapping Program," which will also initially focus on Lake Michigan. Subsequent coastal wetland studies will be conducted in Lakes Huron, Erie, Ontario, and Superior.

The first completed task of this project, as presented in this report, was to identify and prioritize the most critical wetland problem areas along the Michigan-Wisconsin shoreline. These areas are recommended as potential target sites for conducting future detailed geologic studies. The studies will be designed to quantify the amount of wetland losses in the target areas, to establish the geologic framework and Holocene evolution of the areas, and to evaluate both natural and anthropogenic local processes affecting the stability/degradation of these wetland habitats. The identification of the most critical wetland problem areas for further study was accomplished by consultations with appropriate Federal, State, and academic organizations, as well as with individual researchers who have first-hand knowledge of specific local wetland-problem areas. The prioritization of these identified wetland target sites was then accomplished by a ranking process based on a combination of several criteria. In general, these prioritization criteria pertain to an individual wetland's ecological significance, its importance to man, and the probability that conducting further geological studies at the site would significantly improve our understanding of the factors contributing to the wetland problems.

Site Prioritization Criteria

Specific criteria that were used for prioritizing the coastal wetland target sites along the Michigan-Wisconsin shoreline of Lake Michigan are the following:

1. State Department of Natural Resources (DNR) Concerns--In general, the DNR concerns and priorities expressed by the States of Michigan and Wisconsin constituted the most influential criterion in the prioritization process.
2. Other Organizational/Individual Concerns--Excluding the State DNR's, the concerns expressed by other organizations and individuals (e.g., U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Environmental Protection Agency, State Geological Surveys, university researchers) were an important criterion.
3. Ecological Factor I (Productivity)--The specific wetland habitat is a particularly important breeding and spawning ground, a site of unusually high fish and wildlife productivity.
4. Ecological Factor II (Uniqueness)--The wetland is an ecosystem that has some unique aspect, such as being a habitat for endangered, threatened, transitional, or displaced plant

or animal species. Alternatively, it is a wetland where extensive past ecological studies have been conducted, thus providing a good database for analogue studies.

5. Ecological Factor III (Migration Corridor)--The wetland is located within a primary spring/fall migration corridor for migratory waterfowl (diving and dabbling ducks, Canada geese), thus serving as an important short-term feeding and resting area during migration.

6. Ecological Factor IV (Concentration Area)--The wetland habitat is a fall concentration area for migratory waterfowl, thus serving as a longer term feeding and resting area.

7. Wetland Processes I (Pristine Conditions)--The wetland area is essentially free of man-induced effects; it constitutes an ideal control area for studying natural wetland processes and establishing baseline conditions for comparative studies of other wetlands.

8. Wetland Processes II (Natural Geologic)--The wetland area has been somewhat impacted by man-induced effects, but is still generally a good area for studying natural geologic processes (e.g., erosion and littoral transport, sedimentation, lake-level fluctuations) that affect wetland stability.

9. Wetland Processes III (Anthropogenic)--The wetland area has experienced major adverse effects from man-induced processes (e.g., industrial/agricultural/municipal pollution, wetland draining and infilling from urban development and recreational activities, etc.), resulting in either substantial wetland acreage loss or functional degradation of wetland quality.

10. Wetland Processes IV (Comparative)--The wetland area is substantially impacted by both natural and man-induced processes, thus providing a good geologic setting to evaluate their relative effects on wetland stability or degradation.

11. Wetland System Archetype--The wetland area's geologic/geomorphic framework renders it a good system model (archetype) for a specific type of coastal wetland (e.g., open-coast, ridge-and-swale or interdunal, estuarine, riverine); a system archetype can be used as a baseline control area for comparative evaluations of degradation or restoration effects on wetland systems of the same type throughout the Great Lakes region.

The foregoing eleven criteria were used to prioritize wetland target sites for further study in both the States of Michigan and Wisconsin; each state was evaluated independently. Priority target sites for each state were ranked in their order of importance (#1 = most important and highest priority), with the ranking based mainly on the number of prioritization criteria that applied to an individual site. The following prioritized listing for each state provides a brief summary statement of each identified wetland target site recommended for further study.

Michigan Wetland Target Sites

Refer to Figure 1 for the locations of these prioritized wetland target sites along the Lake Michigan shoreline.

1. Little Bay de Noc/Big Bay de Noc Area (Delta Co.)--Located near the City of Escanaba in Michigan's Upper Peninsula, this area is ranked by the State DNR as its highest priority

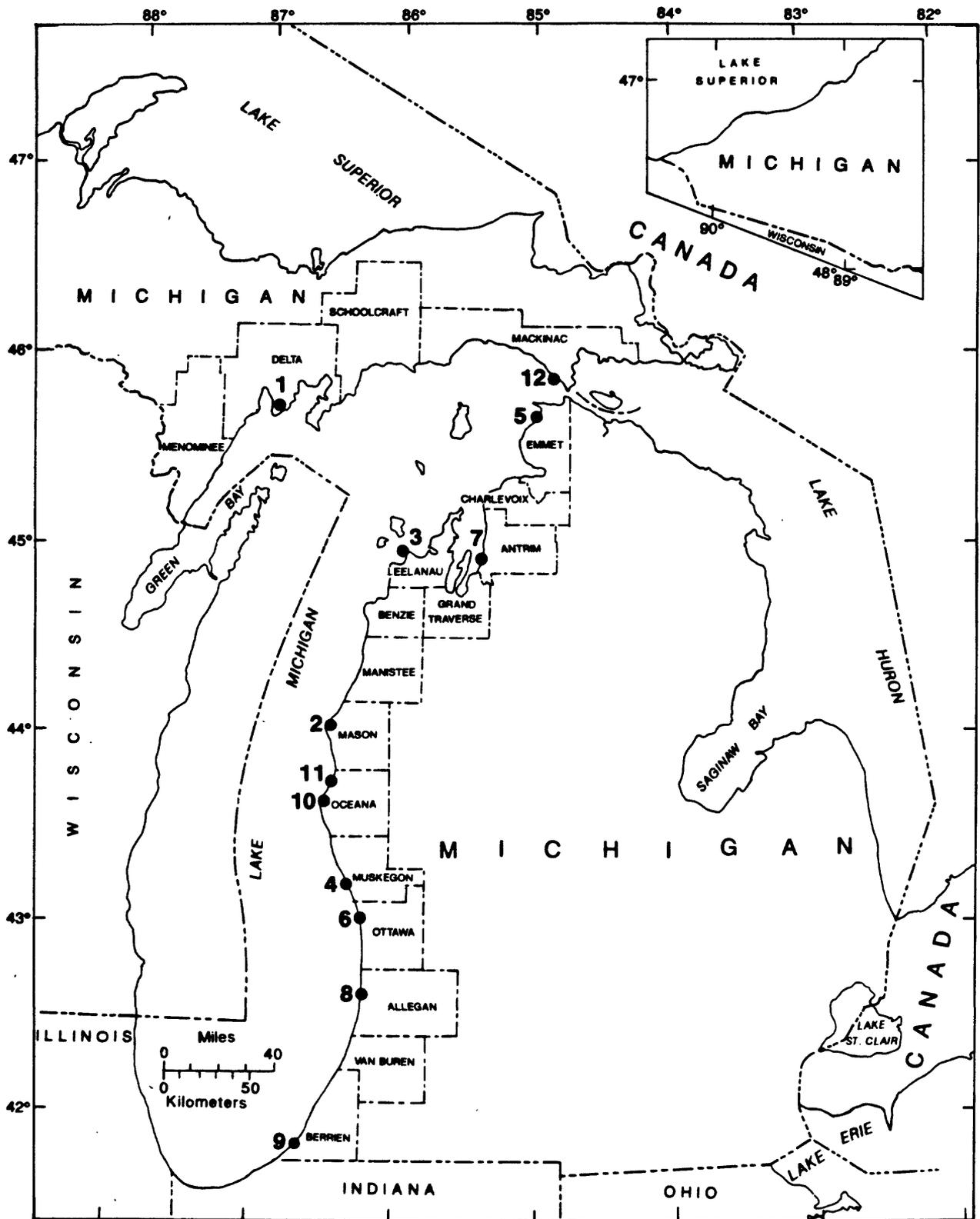


Figure 1. Location map of prioritized State of Michigan coastal wetland target sites along the Lake Michigan shoreline (number 1 = highest priority).

"open-coast" wetland problem area. It is situated in a primary migration corridor for waterfowl and serves as their fall concentration area; it is also a habitat with some threatened plant species and exceptional muskrat productivity. Little Bay de Noc has experienced major man-induced effects from pollution, industrial development, and agriculture, thus destroying high-productivity wetlands. In contrast, adjacent Big Bay de Noc is essentially pristine and an excellent site for evaluating natural processes.

The two-bay area constitutes an excellent archetype of an open-coast wetland system, and it provides an unusually good opportunity to conduct side-by-side comparative studies to evaluate natural vs man-induced effects on wetland stability.

2. Big Sable Point/Hamlin Lake Area (Mason Co.)--Located between the cities of Manistee and Ludington on the central coastal sector of Michigan's Lower Peninsula, this area is ranked by the State DNR as one of its highest priority wetland-problem areas. It is a fall concentration area for waterfowl, and is an extensive and highly productive habitat. It is also a unique habitat, being an ecological hinge point that contains regionally transitional species. Big Sable Point is located in a littoral drift reversal area, where longshore currents flow northward to the north of the point and flow southward to the south of the point. This point is one of the most highly eroded coastal sectors along Lake Michigan; consequently, the area offers an excellent opportunity to study natural coastal processes (erosion/littoral transport) effecting wetlands. The wetlands in the area are of two different types. Landward of Big Sable Point are interdunal wetlands, which are being impacted both by coastal dune erosion, and by man-induced effects resulting from previous sand-mining operations. The second wetland type is estuarine wetlands located adjacent to Hamlin Lake, which is the drowned mouth of the Big Sable River. These estuarine wetlands are relatively pristine, and would be a good archetype site to provide baseline control for studying other estuarine wetlands that are presently experiencing severe developmental/recreational impacts. Such adverse impacts on estuarine wetlands are presently one of the State DNR's major concerns.

3. Sleeping Bear Dune National Lakeshore (Leelanau Co.)--Located northwest of Traverse City along the northwest coast of the Lower Peninsula. The area occurs within a primary migration corridor for waterfowl, and it contains highly productive wetland habitats. Being Federal land, the State DNR has no particular concerns about the area. However, the area is a pristine complex of interdunal wetlands that is presently undergoing severe erosion. Scientifically, it is an excellent site to study natural-process effects on wetlands without any significant interference from man-induced effects. Consequently, it is a good archetype for an interdunal wetland system, and could provide control data for comparative studies of other interdunal wetlands.

4. Muskegan Lake Area (Muskegan Co.)--Located near the City of Muskegan along the central coastal sector of the Lower Peninsula. The wetlands in this area are mainly of the estuarine-riverine type, located adjacent to the drowned mouth of the Muskegan River. This wetland area is situated within two primary migration corridors for waterfowl, and serves as a fall concentration area; it is also an exceptionally productive muskrat habitat. The State DNR is very concerned about the severe adverse man-induced impacts on these wetlands, resulting from both industrial pollution and substantial developmental/recreational pressures. Parts of this area were proposed by the DNR as unique natural coastal sites (unique biological, geological, or scenic interest) for preservation and enhancement efforts.

5. Waugoshance Wilderness State Park Area (Emmet Co.)--Located west of Mackinaw City near the northern tip of the Lower Peninsula. Local wetlands are mainly of the ridge-and-swale type (along Sturgeon Bay), and the area is a highly productive bird habitat that

also contains some threatened plant species. It is a pristine and dynamic coastal area, and constitutes a good archetype site for studying natural-process effects (erosion, littoral transport, lake-level fluctuations) on a ridge-and-swale wetland system. The area is not a major concern of the State DNR at the present time.

6. Grand Haven Area (Ottawa Co.)--Located near the City of Grand Haven on the central coast of the Lower Peninsula, the local wetlands are mainly of the estuarine-riverine type and are associated with the drowned mouth of the Grand River drainage system. The wetlands are located within two primary migration corridors for waterfowl and serve as a fall concentration area. It is a highly productive habitat that is experiencing severe adverse man-induced impacts resulting from developmental/recreational pressures, and the area is an important concern of the State DNR.

7. East Arm of Grand Traverse Bay Area (Antrim Co.)--Located northeast of Traverse City on the northwest coast of the Lower Peninsula, the area occurs within a primary migration corridor for waterfowl and serves as a fall concentration area. The local wetlands consist of both open-coast and ridge-and-swale types, and the area between the east arm of the bay and Torch Lake to the east is experiencing severe adverse man-induced impacts, due mainly to extensive developmental/recreational activities. The site is an important concern of the State DNR.

8. Kalamazoo Lake Area (Allegan Co.)--Located near the town of Saugatuck along the southern coastal sector of the Lower Peninsula. Local wetlands are of the estuarine-riverine type, and are associated with the drowned mouth and flood plain of the Kalamazoo River. The wetlands are located within two primary migration corridors for waterfowl, and are being severely degraded by industrial contaminants in the Kalamazoo River effluent; this area is a designated EPA Superfund site. The wetlands are also experiencing severe adverse effects from developmental/recreational activities. The area is an important concern of the State DNR, which is conducting ongoing ecological studies of the local habitat.

9. Galien River Area (Berrien Co.)--Located near the town of New Buffalo on the southernmost coast of the Lower Peninsula. Local wetlands are mainly of the riverine type associated with the Galien River, but also includes some ridge-and-swale wetlands. The area was relatively pristine prior to the 1970's. However, during the past two decades, there have been substantial adverse impacts on local wetlands from developmental activities. This area could offer the potential for evaluating short-term, man-induced effects on local wetlands. This is an area of concern to the State DNR, which has completed various local ecological studies. The DNR proposed this area as a unique natural coastal site for preservation and enhancement.

10. Little Sable Point/Silver Lake Area (Oceana Co.)--Located between the cities of Ludington and Muskegan on the central coastal sector of the Lower Peninsula. The area occurs within a primary migration corridor for waterfowl, and the local wetlands are of the interdunal type and relatively small in area. This site is of no major concern to the State DNR, but it is a favorable location for studying natural coastal processes that effect wetlands. Similar to the Big Sable Point site further north, this site occurs within the same littoral drift reversal area, and the coastal sector is undergoing severe erosion; consequently, this would be a favorable site for studying erosion and littoral transport processes. In addition, these natural-process effects are being accelerated by adverse man-induced impacts from recreational activities (mainly from dune buggies), which are resulting in substantial dune destruction.

11. Pentwater Lake Area (Oceana Co.)--The area is located south of the City of Ludington on the central coastal sector of the Lower Peninsula. The site occurs near the intersection of two primary migration corridors for waterfowl, and it serves as a fall concentration area. Local wetlands are mainly of the estuarine type, and are associated with the drowned mouth of the Pentwater River. The area presently is not a major concern to the State DNR; however, there have been substantial man-induced impacts on wetlands from developmental/recreational activities. The main significance of the area is that extensive local ecological studies have been completed by university researchers; these could serve as a good database for analogue ecological studies of similar wetlands associated with drowned river mouths.

12. Point aux Chenes Area (Mackinac Co.)--Located northwest of the City of St. Ignace on the Upper Peninsula near the Straits of Mackinac. Local wetlands are of the interdunal and open-coast types, and are the habitat for a few endangered plant species. The wetlands have experienced some adverse man-induced impacts, as a result of developmental activities; however, the area presently is not a major concern to the State DNR. The area would be a favorable site for studying an interdunal wetland system.

The foregoing twelve prioritized wetland areas along the State of Michigan shoreline are recommended as potential target sites that warrant further detailed and focused investigations. It is recommended that work be initiated at these sites in their order of ranking (#1 initiated first), which reflects their relative importance, as determined by the prioritization criteria.

Wisconsin Wetlands Target Sites

Refer to Figure 2 for the locations of these prioritized wetland target sites along the Lake Michigan shoreline.

1. Green Bay West Shore Area (Oconto & Marinette Counties)--Located between the cities of Green Bay and Marinette, this coastal section is composed predominantly of open-coast type wetlands, and the area has been ranked by the State DNR as it's highest priority wetlands problem area. The wetlands along this entire coastal sector lie within a migration corridor for waterfowl (Canada geese). These wetlands are a highly productive waterfowl habitat, which also contains several endangered or threatened plant and animal species. The west shore wetlands are impacted by both natural and man-induced processes. This coastal sector is a relatively flat, low-lying area that is highly impacted by lake-level fluctuations and associated erosion. An historical assessment (Wisconsin DNR wetland inventory mapping) illustrated that a 6-ft rise in lake level during the 1964-74 period resulted in a 83% net loss in wetland acreage along the Green Bay shore. This area also experiences large annual variations in wetland acreage, and would constitute a good archetype site for studying the effects of lake-level fluctuation, erosion, and littoral transport on the stability of an open-coast type of wetland.

The bay's west shore also is impacted by developmental activities, and by industrial/municipal pollution that is being dispersed northward from the lower Green Bay/Fox River area, which has been identified as a major "area of concern" by the Great Lakes International Joint Commission. The lower bay area adjacent to the City of Green Bay is highly polluted from a large variety of contaminants (e.g., PCB, dioxin, Mg, Pb, and other heavy metals) emanating from the highly industrialized Fox River. This has resulted

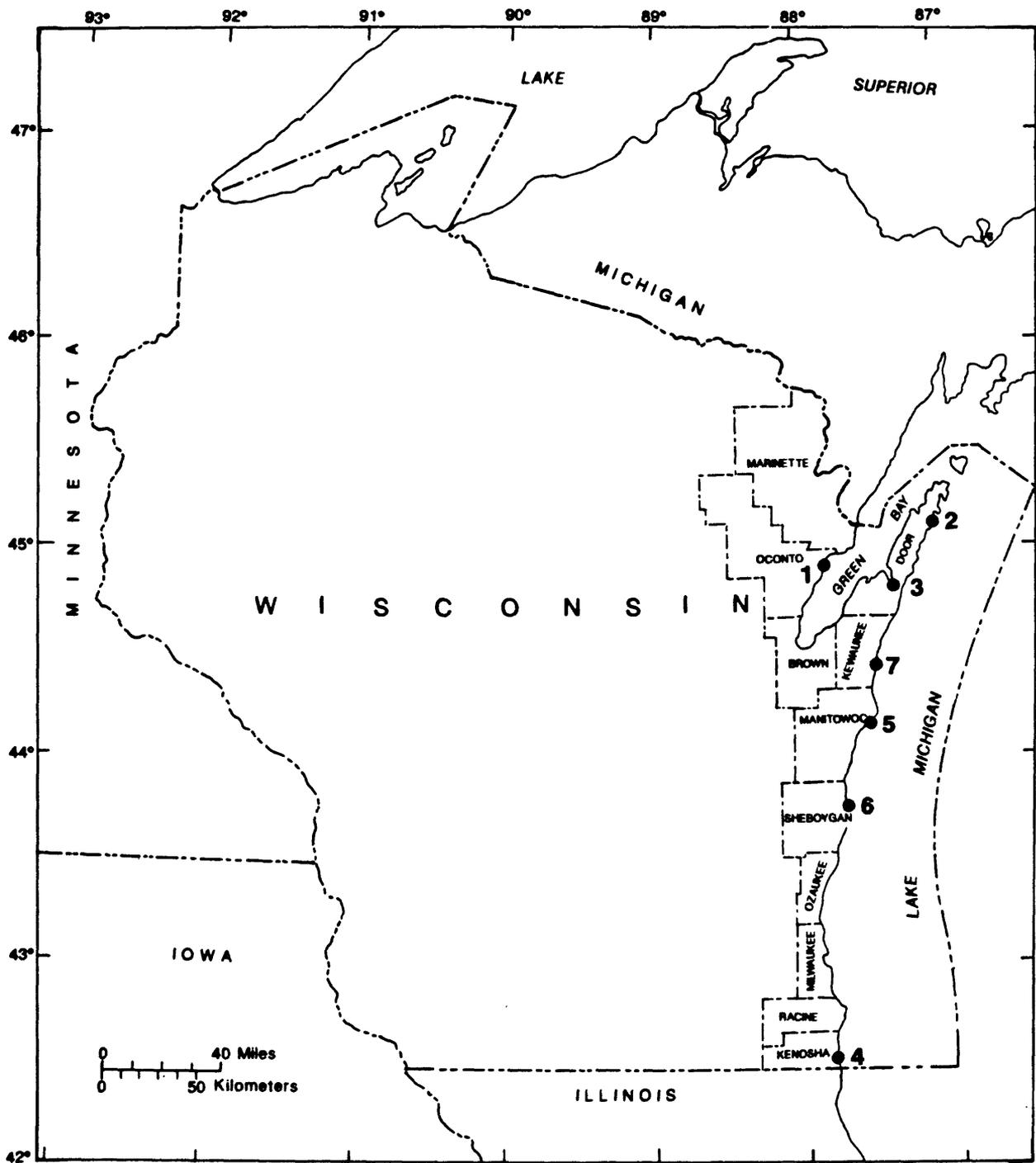


Figure 2. Location map of prioritized State of Wisconsin coastal wetland target sites along the Lake Michigan shoreline (number 1 = highest priority).

in a major functional degradation of wetland habitat in the lower Green Bay ecosystem, which has had severe adverse effects on local fish and wildlife populations. Approximately 90% of the original wetlands in the lower Green Bay ecosystem has been lost between 1834 and 1975. The lower bay area is presently the site of a Wisconsin DNR Remedial Action Plan (1988), which includes provisions for the preservation and more effective management of the few remaining wetlands on Green Bay, most of which are located along the bay's west shore. As one provision of this Remedial Action Plan, the State has an ongoing land acquisition program for wetlands along the west shore; consequently, studies of wetland stability at this site would be timely and highly valuable to the State DNR's Green Bay wetland-management program. The Green Bay area is also presently a very active site for ongoing studies by several other Federal agencies, thus providing opportunities for interactive and complementary research efforts.

2. Mink River Area (Door Co.)--Located near the northern end of the Door Peninsula that separates Green Bay from Lake Michigan. The State DNR ranks this site as one of its highest priority wetland areas, and is concerned about its continued preservation. The wetlands associated with the Mink River area are mainly of the estuarine-riverine type, but also include some ridge-and-swale wetlands. Ecologically, this is a very important wetland complex. It is located within a primary migration corridor for waterfowl, and is a highly productive breeding and spawning ground. As a result of microclimatic conditions, it is a rather unique habitat that contains an unusual displaced boreal forest that normally occurs further north; it also contains a large concentration of endangered plant species. Another important attribute is that these wetlands are highly pristine without any significant man-induced effects. Consequently, this is an outstanding control area to serve as an estuarine-wetland archetype for studying natural wetland processes; this would provide valuable baseline information for comparative evaluations of man-induced effects on other similar types of wetlands. Parts of the area are presently being eroded, and a chronology of lake-level fluctuations is discernable in a system of nearby beach ridges (Johnson and others, 1990). The area is largely dedicated to ongoing wetland research. The surrounding land is partially owned by the University of Wisconsin, and is used for ecological research. Other parts of the land are owned by a private wetlands preservation organization that is also using the land for research purposes; consequently, geological studies of local wetland processes would be a valuable addition to other ongoing research efforts.

3. Sturgeon Bay Area (Door Co.)--The area is located in the central sector of the Door Peninsula. Local wetlands occur along both shores of the peninsula but are more extensive on the Lake Michigan shore. The wetlands are mainly of the estuarine type, but also include some ridge-and-swale wetlands. The area occurs within a primary waterfowl migration corridor, and the wetlands are a habitat for some endangered plant species. The wetlands have experienced some adverse man-induced impacts from developmental/recreational activities. In addition, the area is also being impacted by high-energy natural processes. The area is experiencing localized erosion, strong littoral drift, and channel siltation. Consequently, it is a good dynamic area to study natural coastal processes that are effecting wetland stability, as well as man's influence on those processes. This site is an important concern of the State DNR.

4. Kenosha Area (Kenosha Co.)--The area of interest is located in southernmost Wisconsin, extending from just south of the City of Kenosha to the Wisconsin-Illinois state line. Local wetlands are of the ridge-and-swale type, and are associated with a beach-ridge complex that extends southward to Waukegan, Illinois. A chronology of late Holocene lake-level fluctuations reflected by this beach-ridge complex, as well as their paleoclimatic implications, have been established (e.g., Larson, 1974; Fraser and others, 1990), and would provide a good foundation for further studies of local wetland evolution. The local wetlands are situated within two primary migration corridors for waterfowl, and they

constitute a rather unique ecosystem. The ecosystem is a wet prairie complex ("Chiwaukee Prairie Complex") that is relatively scarce, and which includes some endangered plant species. These wetlands are experiencing severe adverse impacts from urbanization and developmental activities. The area is an important concern to both the State DNR and to other wetland preservationists.

5. Two Rivers/Manitowoc Area (Manitowoc Co.)--Located along the central coastal sector north of the City of Manitowoc, the area occurs within a primary waterfowl migration corridor. The local wetlands are mainly of the ridge-and-swale type, and occur largely along a promontory (Rawley Point) north of the town of Two Rivers. This is a high-energy area experiencing erosion and strong littoral drift; it would be a good archetype area for studying natural littoral processes effecting the ridge-and-swale type of wetlands. This wetland area is also being impacted by man, as a result of both developmental activities and industrial pollution of the local river system.

6. Sheboygan Area (Sheboygan Co.)--Located just south of the City of Sheboygan along the central coastal sector, this area occurs within two waterfowl primary migration corridors. The local wetlands are of the ridge-and-swale type. They are being adversely impacted by man-induced effects from developmental activities and industrial pollution of the local rivers. This area is an important concern of the State DNR.

7. Kewaunee River Area (Kewaunee Co.)--Located north of the City of Manitowoc near the base of the Door Peninsula, the area lies within a primary migration corridor for waterfowl. The local wetlands are of the estuarine-riverine type, and are associated with the Kewaunee River estuary. These wetlands are being impacted by developmental activities, and the area is of concern to the State DNR.

The foregoing seven prioritized wetland areas along the State of Wisconsin shoreline are recommended as potential target sites for further detailed investigations. The sites should be studied in their order of ranked-importance, as determined by the aforementioned site prioritization criteria.

Recommendations

The initial reconnaissance phase of this project described in this report has identified and prioritized the most critical wetland problem areas along the Michigan-Wisconsin shoreline of Lake Michigan as potential target sites for further detailed investigations. Further studies should be designed and implemented in both the States of Michigan and Wisconsin to accomplish the following three sequential objectives: 1. To conduct site historical assessments and quantify changes in wetland areas and the rates of change over specified time intervals. This can be accomplished using existing time-series maps, aerial photography, and GIS databases; 2. To conduct field investigations for establishing the surface and shallow subsurface geologic framework of the wetland target sites and documenting their evolution during the Holocene. This can be accomplished using a combination of coring, high-resolution seismic surveys, and surficial sediment sampling to establish the site's stratigraphic/sedimentological and geomorphic characteristics; 3. To conduct multidisciplinary field investigations to evaluate present local wetland processes at the target sites. Both natural and man-induced processes should be investigated, and their relative effects on the stability and quality of specific wetland systems evaluated. Some specific natural processes that can be evaluated, are the following: a) Long-term and

short-term lake-level fluctuations and forcing agents; b) Coastal erosion and littoral-transport processes; c) Fine-grained sediment transport processes and sedimentation rates; and d) Geochemical properties of the wetland waters and fine-grained sediments to assess the wetland's contaminant-retention capability for neutralizing man-induced pollution effects.

Accomplishing the foregoing study objectives at the prioritized wetland target sites will result in the following three essential scientific contributions to wetland management programs: 1. Provide a generic understanding of the evolution and predictive responses of the various types of wetland systems (archetypes) associated with the Great Lakes Basin; 2. Provide an assessment of the relative impact effects of natural vs man-induced processes on wetland stability and functional quality; 3. Provide site-specific information on critical local wetland problem areas, which are of concern to the State DNR's and other organizations involved in coastal-wetland management and preservation efforts.

It is recommended that the general strategy described in this report be used to implement similar coastal wetland studies of the remaining Lakes Huron, Erie, Ontario, and Superior.

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