State of the Lakes Ecosystem Conference 1998

BIODIVERSITY INVESTMENT AREAS
Coastal Wetland Ecosystems

Identification of “Eco-Reaches” of Great Lakes Coastal Wetlands that have high biodiversity value

Version 3

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Notice to Readers

This paper on Biodiversity Investment Areas is one of three such papers that were prepared for discussion at SOLEC 98 and have been modified based on comments received at the conference. The idea of Biodiversity Investment Areas originated at SOLEC 96 for the Nearshore Terrestrial Ecosystem. This work has continued and been expanded to include Aquatic Ecosystems and Coastal Wetland Ecosystems. The authors of these papers have drawn information from many experts.

1. Background

Coastal wetlands of the Great Lakes perform a number of economically important functions for human communities of the Great Lakes basin. They also play a vital ecological role in maintaining biodiversity and providing habitat for plants, birds, mammals, fish and invertebrates (Maynard and Wilcox 1997). For example, about 80% of the approximately 200 fish species found in the Great Lakes use nearshore areas for at least part of the year (Lane 1996), and directly depend on coastal wetlands for some part of their life cycle (SOLEC 1996). The Nature Conservancy's Great Lakes Program (1994) estimated that nearly a third of globally significant biodiversity features [within the Great Lakes states] were strongly associated with wetlands and shoreline features of the Great Lakes.

In SOLEC '96, Maynard and Wilcox (1997) gave an overview of the distribution and status of coastal wetlands in the entire Great Lakes basin, summarizing the extent of wetland loss sustained by each lake or connecting river system, the types of natural and human-induced stressors that affect these wetlands, and their significant biotic features (Appendix 1). However, they were not able to conduct a comprehensive evaluation because there was no binational inventory. Although most of the data for such an inventory exist for both the Canadian and U.S. shorelines, the information have not been standardized and centralized into a Geographic Information System (GIS) that would permit rapid retrieval and spatial analyses (Leger and Greenwood 1997). Another problem was that wetlands were classified according to different schemes and no study has as yet classified all of the coastal wetlands using the same criteria. In the absence of a comprehensive inventory and consistent classification scheme, it is not surprising that an overall state of coastal wetlands in the Great Lakes ecosystem could not be given in the SOLEC '96 summary report (SOGL 1997).

2. Objective and Rationale

This paper builds on the work begun in SOLEC '96. The ultimate objective is to identify areas of the Great Lakes shoreline that contain high quality faunal habitat that could be identified as "Biodiveristy Investment Areas" (Holland and Reid 1996) . To achieve this objective, we attempted the following:

- To create a GIS-based inventory of all coastal Great Lakes wetlands.
- To develop a consistent terminology for classifying and describing coastal Great Lakes wetland types, based on both geomorphic context and floristic relationships, for both Canadian and U.S. wetlands.
- To utilize existing U.S. and Canadian data to describe the wetland types for each shoreline reach.
- To delineate coastal reaches of the Great Lakes that support significant wetland types that are ecologically distinctive. (We have called these "**eco-reaches"**).
- To summarize and compare avi-faunal use of littoral and nearshore areas within all Great Lakes eco-reaches.
- To identify eco-reaches that are known to be exceptionally important habitat for a large number of fish and bird species.

There are several reasons for utilizing a wetland inventory and delineating eco-reaches as first steps in the identification of BIAs. First of all, we wanted to ensure that all coastal wetlands were included for consideration. There is, understandably, a tendency for investigators to focus more on familiar and well-studied wetlands at the expense of sites that have not yet been studied or which have not yet been targeted for protection by advocacy groups. Yet, those that have not yet been studied may be some of the most important wetlands in terms of habitat. An additional benefit is that sentinel sites from each of the eco-reaches could be chosen for monitoring and more detailed study to ensure that a representative cross-section of all the Great Lakes eco-reaches could be assessed on a routine basis.

3. Description of Databases

3.1 Existing Wetland Inventories

The largest inventory of Canadian wetlands are those evaluated by the Ontario Ministry of Natural Resources (OMNR) according to their "Evaluation System for Wetlands of Ontario South of the Precambrian Shield" during the 1980s and 1990s (OMNR 1984, 1993); information from evaluation sheets for these wetlands have been compiled and made available on the internet by the Natural Heritage Information Centre, NHIC; web site address entered here). The most comprehensive inventory of U.S. wetlands was prepared by Herdendorf et al. (1981a-3). Herdendorf's study included all wetlands within 1000 feet of the Great Lakes, a significant number of which were not directly under the hydrologic influence of the Great Lakes. A more recent study of over 100 Great Lakes coastal wetlands, all under the direct influence of the Great Lakes, was conducted between 1987 and 1994 (Minc 1997, Albert and Minc 1998). This study, which explored the controlling abiotic factors, regional distribution and plant species composition for U.S. coastal wetlands, also incorporated the information from the previously mentioned Herdendorf studies, as well as other studies of Great Lakes coastal wetlands.

3.2 Wetland Polygons and Shoreline Classification

The greatest challenge in assembling a GIS-based inventory of coastal wetlands was locating digitized data sources that were easily accessible and available without charge, and that would contain information for shorelines of both countries. We were able to locate digitized information for Canadian wetlands from two main sources: Environmental Sensitivity Atlases (ESA; Environment Canada 1976, 1993a, 1993b, 1994a-e; U.S. Coast Guard,1994) and the NHIC (see details below). Corresponding data for the U.S. wetlands are available from the U.S. Fish and Wildlife Services' National Wetland Inventory (NWI) but we were not able to incorporate these into the present study due to time constraints. Locational information were also obtained from the Michigan Natural Features Inventory for approximately 100 wetlands. Shoreline characterization of sediments and geomorphology were obtained from the ESA database and the Great Lakes Environmental Research Laboratory web site (GLERL; www.glerl.noaa.gov/gis/glerl-gis.html) for the Canadian and U.S. portions, respectively.

3.2.1 ESA Database

The GIS-based version of Environment Canada's ESA (Environment Canada 1993a, 1993b, 1994a-e) cover seven main Great Lakes/River systems that include shoreline of all 4 Canadian Great Lakes as well as the St. Lawrence Seaway, Niagara River and Welland Canal, Detroit River, Lake St. Clair, St. Clair River and St. Marys River These atlases, which were designed for use in response to spills of oil and other hazardous materials, include a detailed shoreline classification of nineteen different shoreline

habitats, spill countermeasure resources, as well as data on biological and human-use resources. The bulk of the coastal wetlands in the atlases were classified under "Areas of Ecological Significance", a subset of "Special Status Areas". Some of the wetlands appeared under other category names such as "provincial park and nature reserve". This source provided wetland polygons for most of the Canadian wetlands listed in this study.

3.2.2 Natural Heritage Information Centre (NHIC) Database

All available information relating to coastal wetlands in the NHIC database were obtained and this represented roughly a third of the entire Canadian inventory. The information consisted of the geographic location of the wetland centroid but not the wetland polygon. Depending on the wetland, there were also sometimes accompanying information on wetland area, substrate type, site type and dominant vegetation derived from OMNR Wetland Evaluation Sheets. The boundaries of all provincially significant wetlands in Ontario have been or are presently being digitized by the OMNR.

3.2.3 U.S. Fish and Wildlife Services' National Wetland Inventory (NWI)

Many of the U.S. coastal wetlands have been digitized by the USFWS' National Wetland Inventory (NWI), but only a small portion have been incorporated into the WIRE Net database to date.

3.2.4 Michigan Natural Features Inventory Database

Michigan Natural Features Inventory (MNFI) contains information on over 100 marshes along the Great Lakes coastline that were sampled between 1987 and 1994. Data on marsh size, type, substrate, water depth, and aquatic macrophyte distribution and coverage values were obtained along transects.

3.3 Limitations of Databases

- There is incomplete coverage of U.S. coastal wetlands in the GIS database
- Non-standardized sampling methods were used to collect vegetational and substrate information for wetlands
- There is missing information for wetland size, quality and faunal use
- Other databases exist (e.g. Canadian Wildlife Services' and OMNR's coastal wetland atlas database, Nature Conservancy's databases on significant areas of biodiversity in the Great Lakes basin) but they have not yet been incorporated into a comprehensive database such as WIRE Net for analysis and easy retrieval

4. Classification, Vegetation Analyses and Inventory of Coastal Wetlands

4.1 Types of Classification Schemes

Various schemes have been developed to classify Great Lakes coastal wetlands by different agencies and researchers for different purposes. For example, OMNR classified their coastal wetlands according to "**Site Types**" in the Ontario Wetland Evaluation System Southern Manual (1993; revised in 1994); "Site Types" in this classification include four categories: **riverine**, **lacustrine**, **palustrine**, and **isolated**. Smith et al. (1991) used a similar treatment of wetlands on the Canadian Great Lakes and connecting rivers, excluding Lake Superior; they included riverine, lacustrine, and palustrine wetlands, and added two additional Site Types, **rivermouth** and **protected bay**. In the Environmental Sensitivity Atlases (ESA), Environment Canada separated Great Lakes coastal wetlands into much broader classes: **fringing**, and **broad** wetlands.

The Michigan Natural Features Inventory (MNFI) classifies US coastal wetlands according to **aquatic systems** (after Sly and Busch, 1992): **lacustrine**, **connecting channel**, **riverine**, and **lacustrine** or **freshwater estuary**. They further divide the aquatic systems into "**Site Types"** based on geomorphic features, or shoreline configuration, which are listed and described in **Table 4.1**. Many of these "Site Types" are actually discussed in Smith et al. (1991) as types of coastal geomorphology that supports wetlands, but these geomorphic types are not developed into a classification scheme. One of the problems is clearly the different uses of "Site Types" by Canadian and U.S. researchers when describing coastal wetlands.

OMNR also describes wetlands in terms of **Wetland Types**; these are defined in terms of vegetation and include **marsh, swamp, bog and fen** (OMNR 1993). Smith et al. (1991) use identical terminology in their study of 160 coastal Great Lakes wetlands, while a similar classification scheme has been developed for the wetlands of northwestern Ontario (Harris et al. 1996). This classification, which includes but is not limited to Great Lakes coastal wetlands, refers to marsh, swamp, bog, and fen, and **open water marsh** for wetlands with a greater component of floating and submergent aquatic macrophytes.

4.2 MNFI Classification Scheme

The MNFI inventory was based on detailed sampling of 100 coastal herbaceous (i.e., the marshes, bogs, and fens) wetlands. It included rich fen, probably the equivalent of Ontario's fen category, and poor fen, likely the equivalent of Ontario's bog category. It broke marsh classification into finer associations that were primarily geographically and geomorphicaly restricted. The subset of U.S. coastal wetlands were classified into **aquatic systems**, **site types**, and vegetation types and ecologically distinctive shoreline reaches were identified (Minc 1997, Albert and Minc 1998).

4.2.1 Aquatic System

Four major **aquatic systems**, defined largely on water flow characteristics and residence time (Sly and Busch 1992) are applicable to the Great Lakes Basin (both Canadian and U.S. wetlands, see Section 5.0) and each has different potential influences on associated coastal wetlands.

Lacustrine systems are controlled directly by waters of the Great Lakes, and involve wetlands of the Great Lakes shoreline strongly affected by littoral (longshore) currents and storm-driven wave action. Lacustrine habitats generally experience the greatest exposure to wind and wave action and to ice scour, the primary agents responsible for shore erosion and redeposition of sediments.

Connecting channels refer to the major rivers linking the Great Lakes, including the St. Marys, Detroit, St. Clair, Niagara, and St. Lawrence rivers. Connecting channels are characterized by a large flow, but seasonally stable hydrology; their shallowness and current result in earlier spring warming and better oxygenation than in other aquatic systems. All the connecting channels have been modified, primarily to accommodate shipping.

Riverine aquatic systems refer to smaller rivers tributary to the Great Lakes whose water quality, flow rate, and sediment load are controlled in large part by their individual drainages. Tributary rivers have a much lower volume, but seasonally more variable flow than connecting channels, and are influenced by the Great Lakes near their mouth.

Lacustrine or freshwater estuaries, formed where some tributary rivers enter the lakes, are aquatic systems distinctive to the Great Lakes, and represent a zone of transition from stream to lake within which water level, sedimentation, erosion, and biological processes are controlled by fluctuations in lake level.

4.2.2 Glacial Landform (Site Types)

Today, glacial landforms, in combination with recent longshore transport processes, create the prevalent physiographic features along much of the Great Lakes shoreline. Their characteristic differences in substrate, soils, slope, and drainage conditions largely determine both natural shoreline configuration and sediment composition. These, in turn, generate distinctive contexts for wetland development that vary in their exposure and resilience to lake stresses, and in their floristic composition.

The major morphometric or site types represented in the wetland systems inventoried for the MNFI study are presented in Table 4.1. Among freshwater systems, many of these geomorphic features are unique to the Great Lakes coasts, and are typically overlooked in national wetland classification schemes. However, the importance of these features for classifying Great Lakes coastal wetlands is clear. As Herdendorf et al. (1981a:110) state it, "the occurrence, distribution, and diversity of [Great Lakes] coastal wetlands is, in part, determined by the morphology of the coast. Perhaps in no other geographic environment is the relationship between landforms and vegetation so evident".

Several of these morphometric types can co-occur; other types are gradational. The site types are not mutually exclusive categories but are rather illustrative of how the convergence of landform and lake create and influence wetland and aquatic habitats. Further, since the floristic diversity of a wetland is dependent on the diversity of wetland habitats, the variety of morphometric types represented is significant for understanding the vegetational characteristics of a site.

4.3 Classification Scheme Used in this Study

The scope of this study did not permit us to create a new classification scheme based on both U.S. and Canadian wetlands. Instead, we have chosen to use the MNFI scheme (Minc 1997, Albert and Minc 1998; Table 4.1) since all of the U.S. wetlands available for this study have already been classified using this scheme. However, since the MNFI scheme was originally developed for U.S. wetlands, we expanded it to include other categories that were encountered in the Canadian databases (Table 4.2).

Table 4.1 Classification Scheme used in the Minnesota Natural Features Inventory's study (Minc 1997), describing aquatic systems and site types.

Aquatic System	Site Type	Description	Landform Context	*WETLAND DEVELOPMENT*
Lacustrine	**Open Embayment** ***Plates 1a & 1b***	Embayment open to the lake, but in areas where shallow water depth and gently sloping bottom topography reduce wave height and energy.	Sand lakeplain.	Shifting sediments and wave energy limit wetland development to a narrow fringe.
			Clay lakeplain.	Fine-textured substrates are ideal for aquatic macrophytes, resulting in continuous wet meadow and emergent marsh.
	Protected Embayment ***Plate 1c***	Deep indentation or embayment in upland shoreline that provides protection from wind and wave energy.	Bedrock, moraine ridges, or clay lakeplain.	Extensive emergent wetland development.
	Barrier Beach Lagoon ***Plate 2***	Sand and gravel deposition create a barrier bar across the mouth of an embayment resulting in the formation of a shallow pond or lagoon.	Accumulation of sand, gravel, and/or cobbles over bedrock till or lakeplain.	Extensive shallow water emergent vegetation; composition reflects degree of connectivity with Great Lakes.
	Sand-spit embayment and Sand-spit swale ***Plate 3a***	Sand spits projecting along the coast create and protect shallow embayments on their landward side. Large, compound sand spits may also completely enclose small swales.	Gently sloping and curving sections of shoreline where sand transport is not impeded.	Sheltered embayments allow for sediment accumulation and wetland development; sand spits are exposed shallow water sites with unstable sediments.
	Dune and swale complex ***Plate 3b***	Low sand dunes or beach ridges alternate with swales.	Sand lakeplain.	Swales adjacent to lake may contain herbaceous wetlands and/or open water.

Aquatic System	Site Type	Description	Landform Context	*WETLAND DEVELOPMENT*
	Tombolo *Plate 3c*	Island connected to the mainland by a series of beach ridges.	Sand accumulation over bedrock.	Enclosed lagoons can contain a dense growth of aquatic vegetation; embayment leeward of tombolo may contain a fringe of emergent and submergent vegetation.
Connecting Channel and Riverine	**Channel-side wetland**	Stream-side site fronting the main channels of connecting river and exposed to current and wave action.	Diverse contexts, including glacial lakeplain and till plain.	Vegetation is frequently limited to a thin fringe paralleling the shore.
	Channel embayment	Embayment along connecting river channels which provide some protection from erosive elements.		Extensive monotypic wetland development can occur.
	Delta *Plate 4a*	Stream sediments are deposited and accumulate at the mouth of a river creating multiple shallow channels, low islands, and abandoned meanders.	Areas of low gradient flow with weak nearshore currents; glacial lakeplain.	Extensive diverse wetland development can occur.
Estuarine	**Open estuary** *Plate 4b*	Drowned river mouth displaying open, branching inlet form.	Sand lakeplain or till plain.	Protected, fertile wetland habitat that may extend inland for several miles.
	Barred estuary *Plate 4c*	Drowned river mouth with partial barrier bar or dune across the mouth.		

Plate 1. Wetland Site Types of the Great Lakes Shoreline

Plate 1a. **Open embayment at Search Bay, northern Lake Huron.** Curving sections of shoreline open to the lake typically provide minimal protection for coastal wetland development. Wetlands may establish in areas where shallow water depth and gently sloping bottom topography reduce wave height and energy, or in areas where nearshore bars and small sand spits block the waves, as at Search Bay. Even in more protected portions of the embayment, shifting sandy sediments can limit emergent wetlands to a narrow fringe; in contrast, fine-textured (clayey) substrates are ideal for aquatic macrophyte establishment and persistence, resulting in a continuous ring of emergent marsh. (Photo by Ted Cline, 1996).

Plate 1b. **Open embayment at Voight Bay, Marquette Island, northern Lake Huron**. Oriented toward the south, this bay is exposed to wave energies that develop across the full length of Lake Huron. Exposure to storm waves limits the development of emergent marsh and submergent marsh vegetation. Here, the rhizomes of hardstem bulrush attest to a narrow zone of emergent marsh that was destroyed by high water levels (1985-1986); recovery of this marsh has been very slow. A fringe of herbaceous vegetation rims the marly shoreline. (Photo by Ted Cline, 1996).

Plate 1c. **Protected embayment at Duck Bay, Marquette Island, northern Lake Huron.** Indentations or embayments cut into resistant materials of the upland shoreline provide protection from wind and wave energy; tributary streams may flow into the basin, and organic and mineral sediments derived from adjacent uplands may accumulate, allowing development of diverse wetlands. Glacial deposition and subsequent modification of till created the protected embayments along the complex shoreline of the Les Cheneaux Islands, which are drumlinized ground-moraine features. (Photo by Ted Cline, 1996).

Plate 2. Wetland Site Types Created by Sand-transport Features

Barrier-beach lagoons are formed when nearshore currents deposit a sand or gravel barrier bar across the mouth of an embayment. The resulting shallow pond or lagoon is sheltered from the lake's wave energy; sediments accumulate in the lagoon basin and vegetation can become rooted. Although water levels in the lagoon may be augmented by tributary streams and groundwater seepage, coastal lagoon wetlands are also partially controlled by the Great Lakes, through permanent or intermittent connecting channels, wave overwash, or cross-bar seepage.

Plate 2a. **Barrier-beach lagoon at Big Bay, Madeline Island, Apostle Islands, WI**. Barrier beach lagoons are frequently bounded by steep, irregular topography in areas down-current from major sand-producing features where deep embayments trap sands moved by longshore currents. The irregular coastline along the till bluffs of the Bayfield Peninsula and Apostle Islands features numerous well-developed lagoons. Here, the two beaches reflect different lake levels and periods of barrier formation. (Photo by Eric Epstein, 1996).

Plate 2b. **Barrier-beach lagoon at Rainbow Shores/Sandy Pond, NY**. Along the eastern end of Lake Ontario, predominant wind and water currents have accumulated sands eroded from glacial moraines to the west, creating a nearly continuous stretch of lagoons and wetlands between the barrier and the irregular moraine upland to the east. (Photo by John Griebsch 1990).

Plate 2c. **Barrier-beach lagoon at Lakeview Pond Wildlife Management Area, Jefferson Co., NY**. The barrier beach reduces wind and wave energies, allowing for the accumulation of fine sediments and the development of submergent and emergent vegetation communities behind the protective barrier. (Photo by D. Klein 1994).

Plate 3. Wetland Site Types Created by Sand-transport Features (cont.)

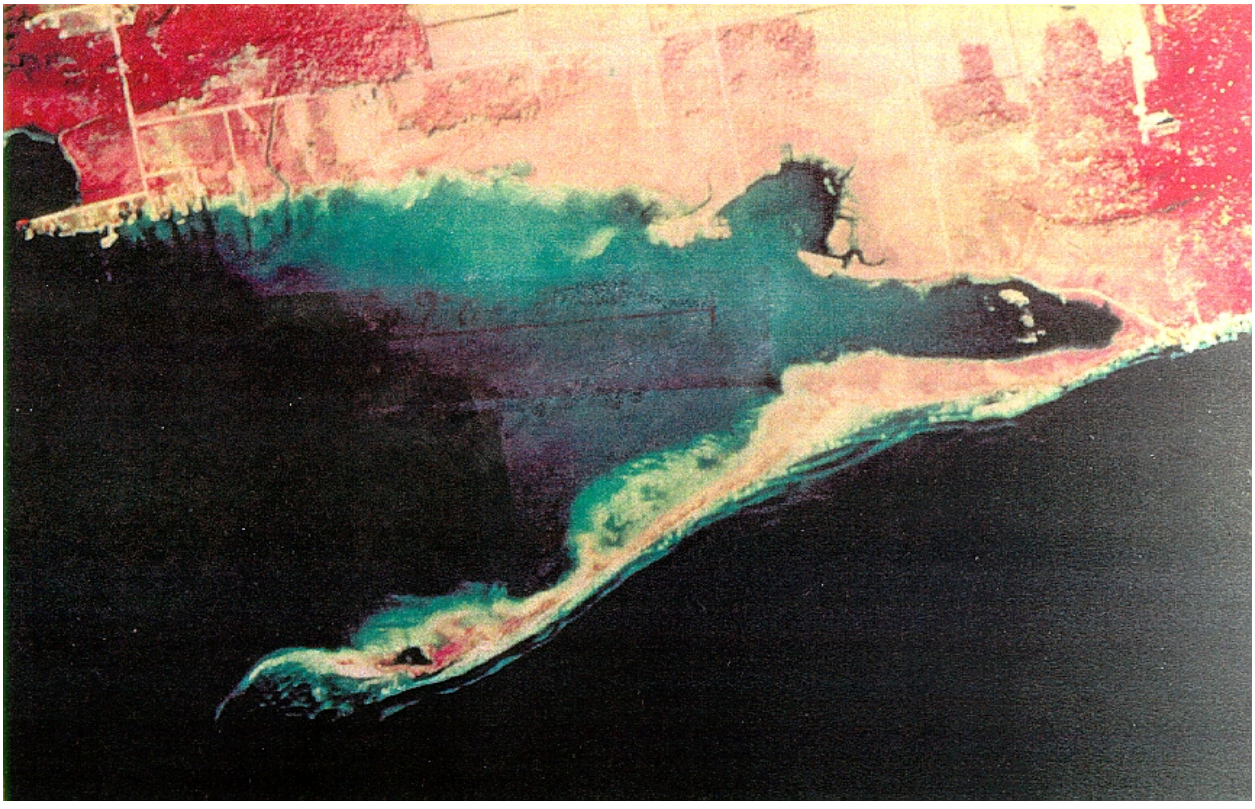


Plate 3a. **Sand-spit embayment at Little Tail Point, Green Bay, WI**. Formed by longshore transport, the sand spit creates and protects a narrow, shallow embayment on its landward side. On their lakeward side, such spits are exposed to wave activity and overwash; on their landward side, however, the spits generally provide good protection from wind and waves, allowing organic and fine mineral sediment accumulation and wetland development in the sheltered embayments. Large, recurved and compound sand spits may also enclose swales or lagoons which offer protected habitat for emergent vegetation. (Color infra-red photography, U.S. Army Corps of Engineers).

Plate 3b. **Dune and swale complex at Stockton Island, Ashland County, Apostle Islands, WI**. Alternating upland and wetland features formed as receding Great Lakes deposited a series of low sandy dunes or beach ridges (0.5 - 4 m high). From the air, these ridges appear as a series of arcs, generally parallel to the present shoreline. The flow of surface and ground water through these complexes can foster wetland development in the swales between beach ridges; water levels in lakeside swales are directly tied to Great Lakes water level fluctuations, while those further inland are not. Swales adjacent to the lake may contain open water and/or herbaceous wetlands; swales further inland, above the level of Great Lakes influence, more often support swamp forest or shrub swamp, although open water and herbaceous wetlands also occur. (Photo by Eric Epstein, 1996).

Plate 3c. **Tombolo at Stockton Island, Ashland County, Apostle Islands, WI**. Tombolos are islands connected to the mainland by current-deposited sands, which frequently form a series of parallel beach ridges. The bars or ridges may enclose a series of shallow interdunal swales, or larger lagoons within which thick organic soils and a dense growth of aquatic vegetation develop. The embayment created on the leeward side of the tombolo may receive sufficient protection from wave action that a fringe of emergent and submergent vegetation persists. (Photo by Eric Epstein, 1996).

Plate 4. Wetland Site Types of Riverine and Estuarine Systems

Deltas form when stream sediments are deposited and accumulate at the mouth of a river creating multiple shallow channels, low islands, and abandoned meanders that can allow for extensive wetland development. Wetland habitats within the delta range from the generally sandy or gravel substrates and swift current of the main channel, to the more protected secondary channels, where the slow to non-existent current permits thick accumulations of organics. Delta formation is best developed in areas of low gradient flow, where nearshore currents are relatively weak and thus do not rapidly remove deposited material.

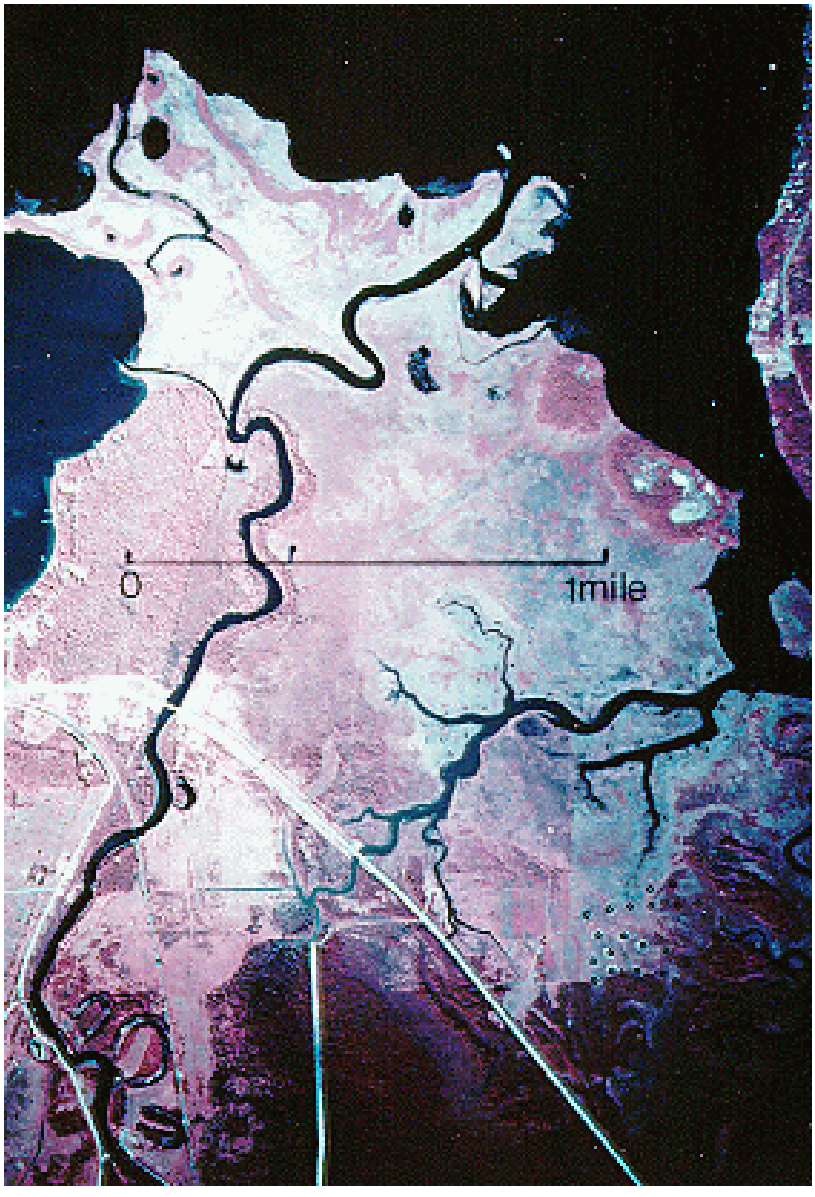


Plate 4a. **Delta of the Sturgeon River in Portage Lake, Upper Peninsula, MI.** The Sturgeon River drops its sediment load as it enters Portage Lake, creating a well-developed delta. Several old meanders and oxbow ponds are clearly visible within the delta. (1978 color infra-red photography, Michigan Department of Natural Resources).

Lacustrine or freshwater estuaries, formed where some tributary rivers enter the lakes, represent a zone of transition from stream to lake within which water level, sedimentation, erosion, and biological processes are controlled by fluctuations in lake level. Most Great Lakes estuaries were formed as buried river mouths, when stream channels cut during an earlier time were drowned or buried by the subsequent rise in the Great Lakes to present water levels. Fairly steep upland slopes help shield the estuary, while reduced water velocities lead to deep accumulations of organics; the result is a protected, fertile (but topographically circumscribed) wetland. Longshore transport and infilling may modify the submerged river mouth, leading to distinct estuarine forms with different wetland characteristics.

Plate 4b. **Open estuary at Sand River, Bayfield County, WI**. Estuaries that are open to the lake typically display a branching inlet pattern that clearly reveals their origin as a drowned river mouth. Sand bars have formed at the mouth of this estuary, but do not appear to seriously impede water flow. (Photo by Eric Epstein, 1996).

***Plate 4c*. Barred estuary at Salmon River, NY.** Longshore transport has nearly barred this estuary by depositing a barrier dune across its mouth, slowing river discharge into Lake Ontario and forcing the river to meander broadly. The opening at the river mouth is now maintained by jetties. (Photo by John Griebsch 1990).

Table 4.2 Classification scheme used in this study

Code	Aquatic System	Site Type	Description
ST1	Lacustrine	Open embayment - fringe	Relatively narrow fringe wetlands exposed to the wave and wind action of the lake. Found on all Great Lakes shorelines.
ST2	Lacustrine	Open embayment - broad	Relatively broad wetlands exposed to the wave and wind action of the lake. Found on all Great Lakes shorelines.
ST3	Lacustrine	Protected embayment - fringe	Narrow, fringing wetlands found in embayments or coves along the shoreline of the four Great Lakes. Common in Georgian Bay and the North Channel.
ST4	Lacustrine	Protected embayment - broad	Broad wetlands found in embayments or coves along the shoreline of the Great Lakes. These would extend inland for several hundred meters.
ST5	Lacustrine	Barrier beach lagoon	Embayments that have been closed off due to accumulation of sand materials at the mouth of the embayment creating a lagoon sheltered from the elements of the lakes.
ST6	Lacustrine	Sand-spit embayment and sand-spit swale	Sand spits projecting along the coast create and protect shallow embayments on their landward sides. eg, Long Point.
ST7	Lacustrine	Dune and swale complex	Low sand dunes or beach ridges alternate with swales. Only used as a type when specifically indicated in wetland reports.
ST8	Lacustrine	Tombolo	Island connected to the mainland by a series of beach ridges.
ST9	Riverine	Channel-side wetland	Wetlands found on the shores of connecting channels - St. Lawrence, Niagara, Detroit, St. Clair, and St. Marys Rivers and the North Channel. These wetlands would be exposed to the wave, wind and current action of the channels. Most are fringe wetlands, but some are more broad.
ST10	Riverine	Channel embayment	Wetlands found on the shores of the connecting channels listed above. These wetlands would be located in protected embayments or coves along the rivers and channels. Most are broad wetlands.
ST11	Riverine or Lacustrine	Delta	Wetlands found at the mouths of small creeks that empty into the Great Lakes (lacustrine) or connecting channels (riverine)
ST12	Riverine or Lacustrine	Riverine - inland	Wetlands found inland along the shores of small rivers that empty into the Great Lakes (lacustrine) and connecting channels (riverine).
ST13	Riverine or Lacustrine	Island wetland	Wetlands found covering (entirely or partially) small islands in the lakes and connecting channels.
ST14	Estuarine	Open estuary	Wetlands found at the mouths of larger rivers emptying into the Great Lakes. eg, Grand River.
ST15	Estuarine	Barred estuary	Wetlands found at the barred mouths of larger rivers emptying into the Great Lakes. eg, Cedar Creek.
ST16	Isolated		Wetlands isolated hydrologically from the Great Lakes.
ST17	Palustrine		Wetlands located close to the shores of the Great Lakes but not connected hydrologically
ST18	Dyked		Wetlands that have been enclosed by man-made dykes.

4.3 Vegetation Analyses

Several abiotic variables (including aquatic system, water level fluctuations, surficial bedrock, glacial landform, climate, and land use) combine to determine the distribution, as well as the morphology, species composition, and quality, of Great Lakes coastal wetlands. In the MNFI study (Minc 1997), a synthetic classification of Great Lakes coastal wetlands (based on both abiotic and vegetation analyses) identified nine groups, each with distinctive floral characteristics and a restricted geographic distribution. Here, we present the vegetation zonation and key species (i.e. species showing a preferential distribution relative to each group) for each group identified in the MNFI study, and modify it where possible to include the Canadian marshes.

4.3.1 Lake Superior Poor Fen

This group contains most of the wetlands sampled along the Lake Superior shoreline. These wetlands occupy sheltered sites, including barrier-beach lagoons, estuaries, and tributary river deltas, since marshes cannot develop along unprotected stretches of Lake Superior's harsh shoreline. These sites are characterized by fairly acidic, sandy soils and an extreme cold northern climate. As a result, organic decomposition is retarded and deep organic soils develop. Most of the marshes found along the Canadian shoreline of Lake Superior, as in Nipigon, Thunder, and Whitefish Bays, probably fall within this wetland type. It is possible that wetlands on the granitic bedrock of the North Channel and Georgian Bay also fall into this class, but almost no detailed plant data were found by the authors for these wetlands. Poor fens, as recognized for northwestern Ontario (Harris et al. 1996), are similar to those found along the Great Lakes shoreline of the U.S.

Characteristic vegetation includes northern poor fen in the herbaceous zone grading into poor shrub fen at the inland wetland periphery; the poor fen is typically the most extensive zone within Lake Superior wetlands. Species showing strong preferences for this habitat include *Sphagna* spp., the forbs *Sarracenia purpurea* (pitcher-plant), *Menyanthes trifoliata* (buckbean), *Rhynchospora alba* (beak-rush), *Triadenum fraseri* (marsh St. John's-wort), *Pogonia ophioglossoides* (rose pogonia), and the shrubs *Chamaedaphne calyculata* (leatherleaf), *Andromeda glaucophylla* (bog rosemary), *Myrica gale* (sweet gale), *Vaccinium macrocarpon* (large cranberry) and *V. oxycoccus* (small cranberry). Continuity in species composition for northern poor fen is strong across a considerable range of lake levels (Minc 1997b), although extreme high lake levels reduce the abundance of some characteristic species, including *Sphagnum* spp. and *Chamaedaphne calyculata*.

The emergent zone, typically only a narrow fringe, contains species associated with clear, well-aerated waters, including a low-density mix of *Eleocharis smallii* (spike-rush), *Sparganium fluctuans* (bur-reed), and the bulrush *Scirpus subterminalis*. Common floating-leaved species include *Nuphar variegata* (yellow pond-lily), *Brasenia schreberi* (water shield), and *Megalodonta beckii* (water-marigold), while the pondweed *Potamageton gramineus* is the most frequently encountered submergent species.

4.3.2 Northern Rich Fen

This group comprises coastal sites concentrated near the Straits of Mackinac and located on marly substrates. In Ontario, many of the wetlands found on Cockburn and Manitoulin Islands, as well as the Bruce Peninsula can probably be classed as rich fens (Fahselt & Maun 1980; Smith et al. 1991). Most of these sites occupy embayments of the open, sandy shoreline where limestone bedrock or cobble is at or near the surface. These sites have calcareous soils (with a pH as high as 8.2), resulting either from

calcareous substrates, water flow off adjacent limestone bedrock or limestone-rich till, or algal precipitation of calcium carbonate in the relatively warm, carbonate saturated waters. The result is the formation of distinctive "marly flats" and an associated complex of calciphile plant species. Several of the species recognized from rich fens in northwestern Ontario are characteristic of the rich fens located along the U.S. shorelines of northern Lakes Huron and Michigan (Harris et al. 1996).

The calciphiles *Chara* sp. (muskgrass) and *Eleocharis rostellata* (spike-rush) frequently dominate the emergent zones, along with *Scirpus acutus* (hardstem bulrush); overall species diversity is low. The herbaceous zone -- the most distinctive and diagnostic zone -- is consistently a northern rich fen. *Calamagrostis canadensis* (blue-joint grass) can dominate, but the calciphiles *Carex viridula* (sedge) and *Lobelia kalmii* (Kalm's lobelia) are key species for this group. Other species indicative of rich fen along the Great Lakes shoreline include *Cladium mariscoides* (twig-rush), *Potentilla anserina* (silverweed), *Panicum lindheimeri* (panic grass), *Triglochin maritimum* (common bog arrow-grass), and *Hypericum kalmianum* (Kalm's St. John's-wort). Common woody species of the associated rich shrub fen include *Myrica gale* and *Potentilla fruticosa* (shrubby cinquefoil), while *Larix laricina* (larch) and *Salix pedicellaris* (bog willow) are consistently present, but in low numbers. This characteristic suite of calciphiles make the Northern Rich Fen type readily recognizable across a range of lake-level fluctuations (Minc 1997b).

4.3.3 Northern Great Lakes Marsh

This group includes all marshes along the St. Marys River, as well as circumneutral sites of Lake Superior and northern Lakes Michigan-Huron; it is the largest group of Great Lakes wetlands sampled. Marshes of this type occur on a diversity of glacial landforms and substrates, including clay lakeplain, sand lakeplain, and sandy ground moraine. Site types vary: Lake Superior northern marshes typically inhabit open water and stream margins within estuarine sites, often within a much larger poor fen; those of northern Lakes Michigan-Huron are typically found occupying the entirety of relatively protected embayments. The largest group of sites, however, is the channel-side wetlands and embayments along the St. Marys River. For Ontario, this type is expected to occur abundantly in the flowing portion of major Lake Superior estuaries, and possibye those of the North Channel and Georgian Bay, and the Canadian portion of the St. Marys River, including the eastern site of St. Joseph Island, which includes the far western edge of the North Channel. This marsh type includes both the marsh and open water marsh described for northwestern Ontario (Harris et al. 1996).

The open emergent zone features low densities of *Scirpus acutus* (hardstem bulrush) and *Eleocharis smallii* (spike-rush), along with *Scirpus subterminalis* (bulrush), *Equisetum fluviatile* (water horsetail), *Najas flexilis* (slender naiad), and *Sparganium eurycarpum* (common bur-reed). The submergent pondweeds *Potamageton gramineus* and *P. natans* are common occurrences in this zone as well. The herbaceous zone is consistently a northern wet meadow dominated by *Calamagrostis canadensis* (blue-joint grass), and the sedges *Carex stricta* and *C. lacustris*; key forbs include *Campanula aparinoides* (marsh bell-flower) and *Potentilla palustris* (marsh cinquefoil).

A narrow band of northern shrub meadow, often only 10-20 meters wide, borders many of these wetlands. Shrubby species strongly preferential to this zone include *Spiraea alba* (meadowsweet) and *Salix petiolaris* (meadow willow), but other wide-spread woody species are found here as well, primarily *Alnus rugosa* (speckled alder) and *Myrica gale*; *Calamagrostis canadensis*, *Carex stricta*, *C. lacustris*, and *Potentilla palustris* remain dominant as in the adjacent wet meadow zone.

4.3.4 Green Bay Disturbed Marsh

This Lake Michigan group contains a small number of relatively well-protected sites, including deltaic channels, estuarine channels, and sheltered sand-spit embayments, primarily within Green Bay, WI. These sites are located near the **tension zone** and display both northern and southern vegetation characteristics. In general, the emergent zones of these sites contain a more southern flora high in floating species, while their wet meadow zones span the north-south division. These sites also share a highly disturbed habitat. The adjacent flat, poorly drained clay lakeplain has been intensively farmed with row crops, and waters of Green Bay are generally characterized as quite turbid, owing both to erosion from agricultural activities and to industrial and urban pollution. This marsh type may not exist along the Ontario coastline.

Emergent zone dominants are species associated with quiet, nutrient-rich waters, and typically more abundant in the southern Great Lakes. Key species include *Ceratophyllum demersum* (coontail), *Elodea canadensis* (common waterweed), *Lemna minor* (small duckweed), and *Spirodela polyrhiza* (great duckweed), along with the widespread *Nymphaea odorata* (sweet-scented waterlily) and *Sagittaria latifolia* (common arrowhead). The herbaceous zone is a wet meadow in which *Calamagrostis canadensis* is clearly the dominant, while both *Carex stricta* and *C. lacustris* are present in low levels. Wet meadow species more characteristic of the south include *Impatiens capensis* (spotted touch-me-not) and *Typha angustifolia* (narrow-leaved cat-tail), as well as the exotics *Lythrum salicaria* (purple loosestrife), *Phragmites australis* (giant bulrush), and *Phalaris arundinacea* (reed canary grass). A distinct shrub zone was seldom encountered in sampling transects, due to heavy disturbance in the upland portion of the landscape.

Owing to the relatively flat topography, fluctuations in Lake Michigan's water level considerably alter the size of these coastal wetlands as well as their species composition (Harris et al. 1977). Receding high waters expose substantial portions of sandy beach and open mud flats, which are quickly colonized by dense stands of *Scirpus validus* (softstem bulrush), *Bidens cernuus* (nodding bur-marigold), and one or more species of *Polygonum* (smartweed). Over a period of several years, these colonizing species decline and are replaced by a sedge meadow consisting primarily of *Carex* spp. and *Calamagrostis canadensis* (Harris et al. 1981).

4.3.5 Lake Michigan Lacustrine Estuaries

This group consists of barred lacustrine estuaries of western Lower Michigan, generally south of the tension zone. All of the major rivers along this stretch have lacustrine estuaries at their mouths. Most are partially to largely barred by longshore sand transport, and many have artificially maintained channels to Lake Michigan. These estuarine systems can extend for a considerable distance inland, where the rivers occupy linear floodplains cut into surrounding glacial moraines and sand lakeplain. Sites of this group are well protected from wind and wave action, owing to their long, narrow configuration and partial separation from Lake Michigan. This protection results in deep accumulations of organic deposits (mucks and peats) throughout the emergent and herbaceous vegetation zones; open stream channels are generally shallow and nutrient rich, owing to the input of fine sediments and the presence of deep underlying organic substrates. While the site type (barred lacustrine estuary) occurs on Ontario portions of Lakes Ontario and Erie, the characteristic assemblage of plants may not occur.

In the emergent zone, *Nuphar advena* (yellow pond-lily) and *Peltandra virginica* (arrow-arum) are characteristic of these muck soils, while the large cover values for the floating species *Ceratophyllum demersum* and the duckweeds *Spirodela polyrhiza*, *Lemna trisulca*, and *L. minor* reflect relatively

protected waters with a high nutrient content. *Nymphaea odorata* has a wide-spread distribution, but can form particularly dense beds in these protected sites.

The herbaceous zone conforms to the southern wet meadow type. *Calamagrostis canadensis* is a frequent dominant, but key southern species include *Impatiens capensis*, *Rorippa palustris* (yellow cress), *Polygonum lapathifolium* (nodding smartweed), and *Leersia oryzoides* (cut grass). The southern shrub swamp is characterized by a mix of *Alnus rugosa*, *Cornus stolonifera* (red-osier dogwood), and *Fraxinus pennsylvanica* (red ash), but many of the above-mentioned herbaceous species occur throughout. In addition, *Osmunda regalis* (royal fern) is common here.

Vegetative response to changing lake levels in these estuarine sites appears to be largely a function of site morphometry (Minc 1997b). Steep confining banks appear to limit shallow water habitats during high water periods such that shallow water vegetation is largely eliminated. As a result, high-water years are marked by a decrease in edge communities and shallow water emergents, and a concomitant increase in floating-leaved communities and associated duckweeds.

4.3.6 Saginaw Bay Lakeplain Marsh

This group contains most sites from Saginaw Bay. Formed by a flat glacial lakeplain that slopes gently into Lake Huron, Saginaw Bay is very shallow with a thin veneer of sand over clay; the Wildfowl Bay Islands are extensive sand spits formed over local exposures of limestone bedrock. Wetland site types range from protected sand-spit embayments to open coastal embayments.

Wetlands in this group contain a mix of northern and southern species; this dual affinity may reflect the location of the climatic tension zone across Saginaw Bay. In addition, most sites contain ample floristic evidence of surrounding intensive agricultural land-use.

This vegetation assemblage may not be found on Ontario's Great Lakes shoreline, as the equivalent, large, protected embayment does not occur along the Canadian Great Lakes shoreline this far south.

The emergent zone is generally a northern emergent marsh containing the key northern species *Scirpus acutus* and *Eleocharis smallii*, although not in great densities. However, excessive sedimentation appears to have excluded many submergent species typically found within a northern emergent marsh, including most pondweeds, which are generally intolerant of turbidity. Both *Scirpus americanus* (three-square bulrush) and the more southerly *S. validus* are frequently present as well, while *Typha angustifolia* and *Najas flexilis* are common co-dominants; floating species (such as the duckweeds) are only minimally present. Along more open stretches of the bay, *Scirpus americanus* can form a narrow, but dense fringe, apparently due to its greater tolerance of extreme wave action.

The herbaceous zone is typically a southern wet meadow with a high percentage of early successional and disturbance species. Typical colonizing species include *Bidens cernuus*, *Impatiens capensis*, *Rorippa palustris*, *Scirpus validus*, and *Polygonum lapathifolium*; common exotics include *Lythrum salicaria*, *Phragmites australis*, *Phalaris arundinacea*, and *Polygonum persicaria* (lady's thumb). The absence of a distinct shrub swamp zone for this group may reflect the intensity of land-use in this area, in which fertile lacustrine soils are farmed as close to Great Lakes coastal wetlands as possible.

In contrast to most other wetland types, the marshes of the Saginaw Bay lakeplain experience significant changes in the abundance and ubiquity of dominant species relative to lake-level fluctuations, particularly in the herbaceous zone (Minc 1997b). The gentle slope of the lakeplain, combined with the heavy deposition of fine sediments, creates the potential for extensive, fertile mud flats following dry-

down and favors colonizing species adapted to the cyclical exposure of this habitat (including *Rorippa palustris*, *Bidens cernuus*, *Polygonum lapathifolium*, and *Scirpus validus*). In contrast, when lake levels remain at or below the mean, succession to a more typical wet meadow takes place, with an increased dominance of *Calamagrostis canadensis* and *Carex stricta* and a dramatic drop in the cover values of the colonizing species.

4.3.7 Lake Erie-St. Clair Lakeplain Marsh

This group includes all marsh sites from the glacial lakeplain of Lake St. Clair and western Lake Erie. Although the lakeplain formerly supported extensive marsh and wet prairie communities, the predominant remaining wetlands are the lacustrine estuaries formed at the mouths of rivers drowned by the post-glacial rise in lake level. However, even the remaining marshes reflect high levels of agricultural disturbance characteristic of the fertile, flat lakeplain soils, along with heavy manipulation of the shoreline through diking and rip-rap. This marsh type likely occurs along the Canadian shoreline of both Lake Ontario (western) and Lake Erie. As in the U.S., many of these wetlands are highly degraded. The Long Point, Ontario and Presque Isle, Pennsylvania sandspits appear to share many habitats and species.

All of the wetlands occupy fairly protected sites (estuaries, barrier-beach lagoons, or sand-spit swales); in addition, the Lake Erie sites enjoy the most moderate climate of the Great Lakes region. As a result, their emergent marshes feature a relatively southern flora, while herbaceous zones are typically a southern wet meadow with a high proportion of disturbance species.

Common species of the emergent zone include the floating duckweeds (*Lemna minor* and *Spirodela polyrhiza*), and the canopy-forming submergents *Ceratophyllum demersum* and *Elodea canadensis*, characteristic of quiet, turbid waters. The southern species *Nuphar advena* is common, while *Nelumbo lutea* (American lotus) attains very high densities at selected sites. *Sagittaria latifolia*, *Scirpus validus*, *Typha angustifolia*, and *T.* x *glauca* (hybrid cat-tail) are common edge species.

Herbaceous zones are a southern wet meadow dominated by *Calamagrostis canadensis*, along with *Phalaris arundinacea*, *Typha angustifolia*, and *Polygonum lapathifolium*. The standard suite of early successional species (*Bidens cernuus*, *Impatiens capensis*, *Rorippa palustris*) and common exotics (*Lythrum salicaria* and *Phragmites australis*) are present as well. As in the case for Saginaw Bay, the absence of a distinct shrub swamp zone often reflects the intensity of land-use in this area, in which fertile lacustrine soils are farmed as close to coastal wetlands as possible.

The St. Clair River delta is loosely joined with the St. Clair-Erie lakeplain group; however, the St. Clair "flats" is a unique site in the Great Lakes, and its vegetation differs significantly from sites of Saginaw Bay to the north and Lake Erie to the south. Emergent zone vegetation is more typical of northern, open marshes, perhaps owing to the flow of the river. Common early successional and exotic species were only minimally present in large portions of the wet meadow.

4.3.8 Lake Ontario Lagoon Marshes

U.S. wetland sites in eastern Lake Ontario make up this group; all but one are barrier-beach lagoons. In Ontario, several of the marshes in the more exposed coastal Bay of Quinte sites may share similar vegetation. These sites share a similar protected site type, a lake-level regime characterized by a dampening of natural extreme fluctuations, and an associated set of distinctive species in the emergent, herbaceous, and shrubby zones.

Two distinct shoreline areas contain barrier-beach lagoons. Along the southern shore of Lake Ontario, the lake truncates a field of N-S oriented drumlins; here, low barrier beaches (generally less than 3 m high) across intervening embayments have created a series of shallow lagoons, including the East Bay, Black Creek, and Sterling Creek sites. These may share conditions and species with more protected wetlands of the Bay of Quinte portion of Ontario. Along the eastern end of Lake Ontario, predominant wind and water currents have led to the accumulation of sands, creating a low shoreline characterized by numerous embayments with barrier beaches and sand dunes rising up to 30 m above the lake. The barrier beaches create a string of shallow lagoons and wetlands, including Deer Creek, Cranberry Pond, South Colwell Pond, and Lakeview Pond. In the Bay of Quinte area and on nearby islands, the more exposed embayments may share both species and wetland configuration.

The emergent zones of this type feature very high densities of the canopy-forming submergent species, *Ceratophyllum demersum* and *Elodea canadensis*, along with the duckweeds *Spirodela polyrhiza* and *Lemna trisulca*. *Nuphar advena* and *Nymphaea odorata* are also common. All of these reflect the well-protected and nutrient-rich waters of the lagoons, although *Lemna trisulca* may be associated with cold, spring-fed streams. High densities of this last species are distinctive to the Lake Ontario and St. Lawrence sites, as is the prevalence of *Potamogeton zosteriformis* (flat-stemmed pondweed).

The herbaceous zone is a wet meadow in which *Typha angustifolia* typically dominates, along with *Calamagrostis canadensis* and *Thelypteris palustris* (marsh fern). Cat-tail is particularly sensitive to flooding; its dominance in Lake Ontario corresponds historically to the recent period of lake-level regulation. In contrast, species adapted to the cyclical exposure of shoreline mud flats are poorly represented in these sites.

The shrubby zones divide into two distinct types. Buttonbush thicket features a mix of *Decodon verticillata* (swamp loosestrife) and *Cephalanthus occidentalis* (buttonbush), along with *Alnus rugosa*; *Thelypteris palustris* and *Peltandra virginica* dominate mucky openings within the thickets. In contrast, poor shrub fen was encountered in areas of low water flow behind barriers, typically distant from the active stream channel. Here, poor fen shrubs (*Chamaedaphne calyculata*, *Myrica gale*, *Vaccinium macrocarpon*, and *Andromeda glaucophylla*) dominate, while *Sphagna* spp. and *Sarracenia purpurea* attain high cover values in the groundcover.

4.3.9 St. Lawrence River Estuaries

This group contains wetland sites along the upper reaches of the St. Lawrence River where the river is strongly influenced by Lake Ontario. This stretch features numerous islands and bedrock knobs on the adjacent mainland shore which are the surface expression of the Frontenac Arch, where overlying limestone and sandstone formations have been removed by glacial scouring to reveal the irregular surface of the underlying Precambrian rock. The exposed bedrock is mostly pink, massive rock of granitic composition; most of the exposures are smoothly rounded by scouring ice.

The St. Lawrence wetland sites are typically estuarine. Small streams or rivers occupy apparent pre-glacial valleys cut through the rounded bedrock knobs and ridges which have been partially filled in by outwash and alluvial deposits to form fairly broad, flat basins. Extensive wetlands (up to 1 km wide) line the lower reaches of the streams for several kilometers inland as they flow through the basins; a narrow delta has formed at the mouth of some basins. The valley of Crooked Creek is one of the best examples of wetland development along this stretch of the St. Lawrence River (Herdendorf et al. 1981a:53), while those of nearby Chippewa and Cranberry creeks are also of considerable importance to fish and wildlife (Geis and Kee 1977). It is expected that the protected estuaries and embayments on the nearby Canadian islands and mainland share both similar wetland configuration and species composition.

As in the preceding group, the emergent zone is characterized by high densities of floating species, including *Utricularia vulgaris* (great bladderwort) and the duckweeds *Lemna trisulca* and *Spirodela polyrhiza*, along with the canopy-forming submergent species, *Ceratophyllum demersum* and *Elodea canadensis*. Other submergents preferential to this group include *Potamogeton zosteriformis, P. friesii* (Fries's pondweed), and *Zizania aquatica* (wild rice). The exotic *Hydrocharis morsus-ranae* (frog's bit) is abundant. The herbaceous zone is a broad wet meadow zone with deep organic soils (often > 4 m), featuring *Typha angustifolia* along with *Calamagrostis canadensis* and *Thelypteris palustris*. Again, the dominance of cat-tail may reflect the reduction of natural lake-level fluctuations. However, *Impatiens capensis*, a species adapted to the cyclical exposure of shoreline mud flats is well represented in this group of sites.

4.4 Inventory of Coastal Wetlands

The entire list of available Canadian and U.S. coastal wetlands and corresponding “Site Types” are presented in Appendices 2a and b, respectively (Table 4.2 was used to assign Site Types for the Canadian wetlands). Distribution of these coastal wetland complexes and fringe wetlands can be found on a series of maps prepared for this study: maps for the entire Great Lakes basin (Fig. 4.1), the St. Lawrence River (Fig. 4.2), Lake Ontario (Fig. 4.3), Lake Erie (Fig. 4.4), Lake Huron-Georgian Bay (Fig. 4.5), Lake Superior (Fig. 4.6) and Lake Michigan (Fig. 4.7). Although the Canadian database is fairly complete, only the 100 or so wetlands in the MNFI inventory hav been made available for inclusion in this study and are included in the maps.

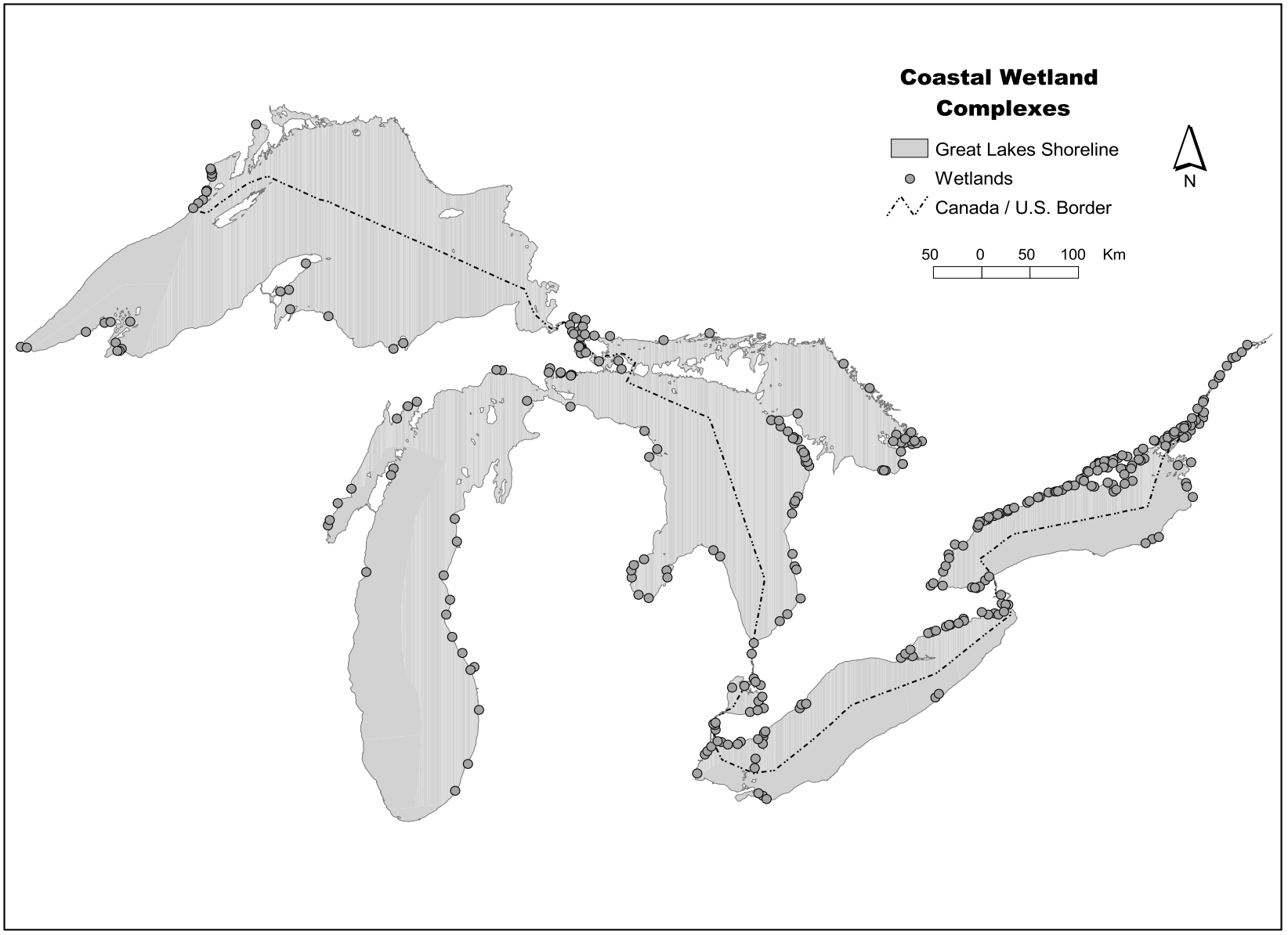


Figure 4.1 Coastal wetland complexes and fringe wetlands occurring on the shoreline of the Great Lakes

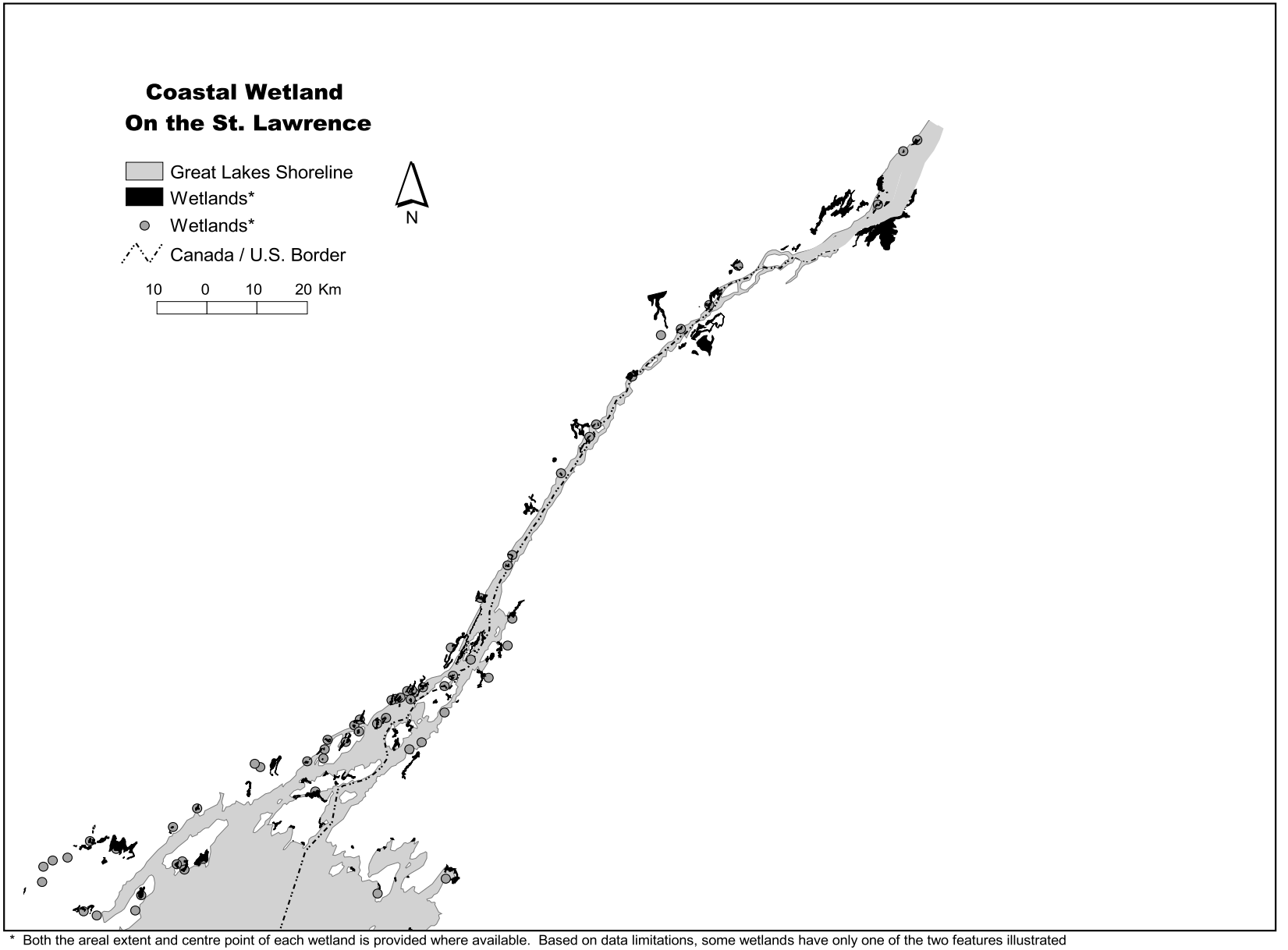


Figure 4.2 Coastal wetland complexes and fringe wetlands occurring on the shoreline of the St. Lawrence River

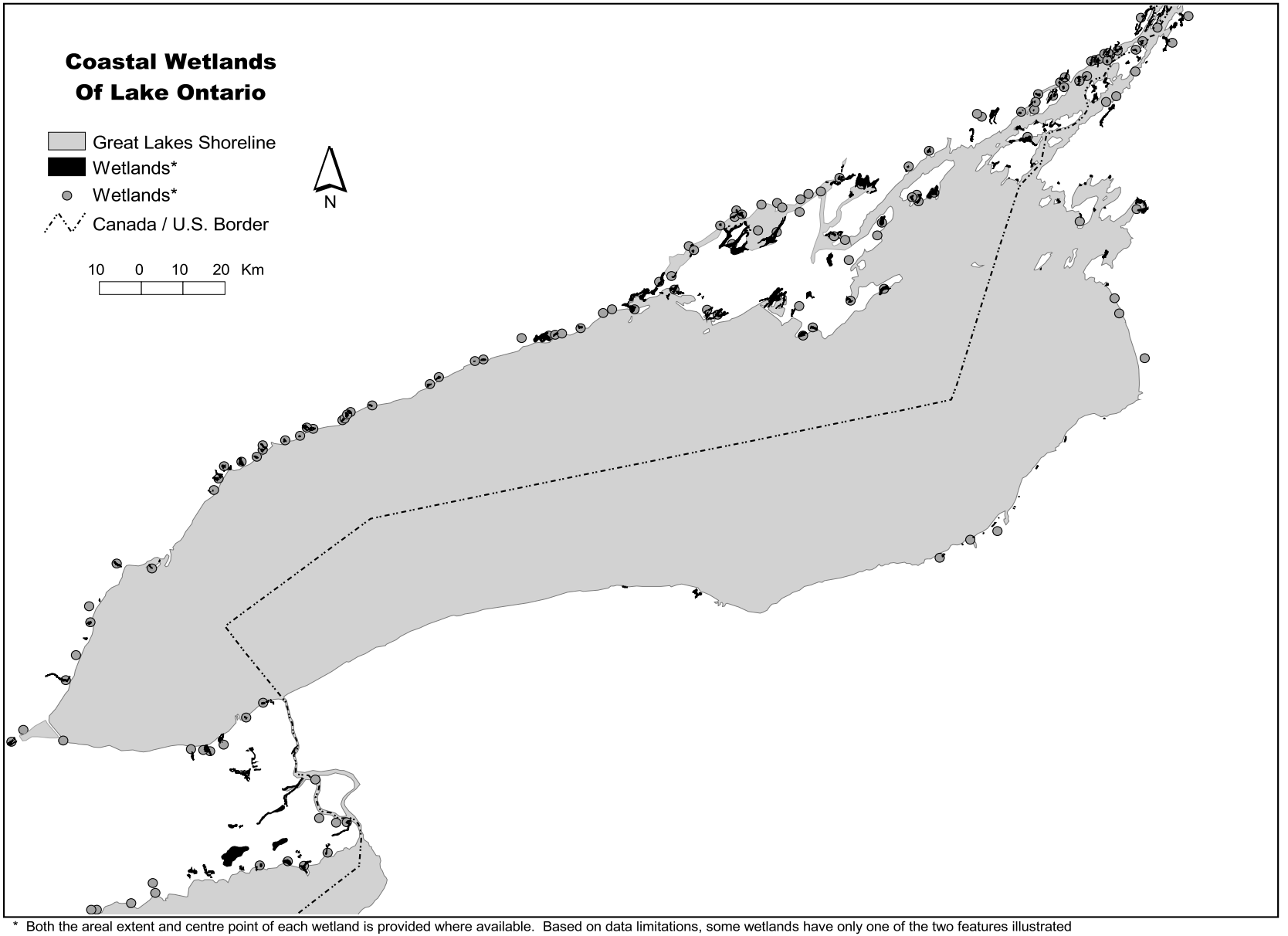
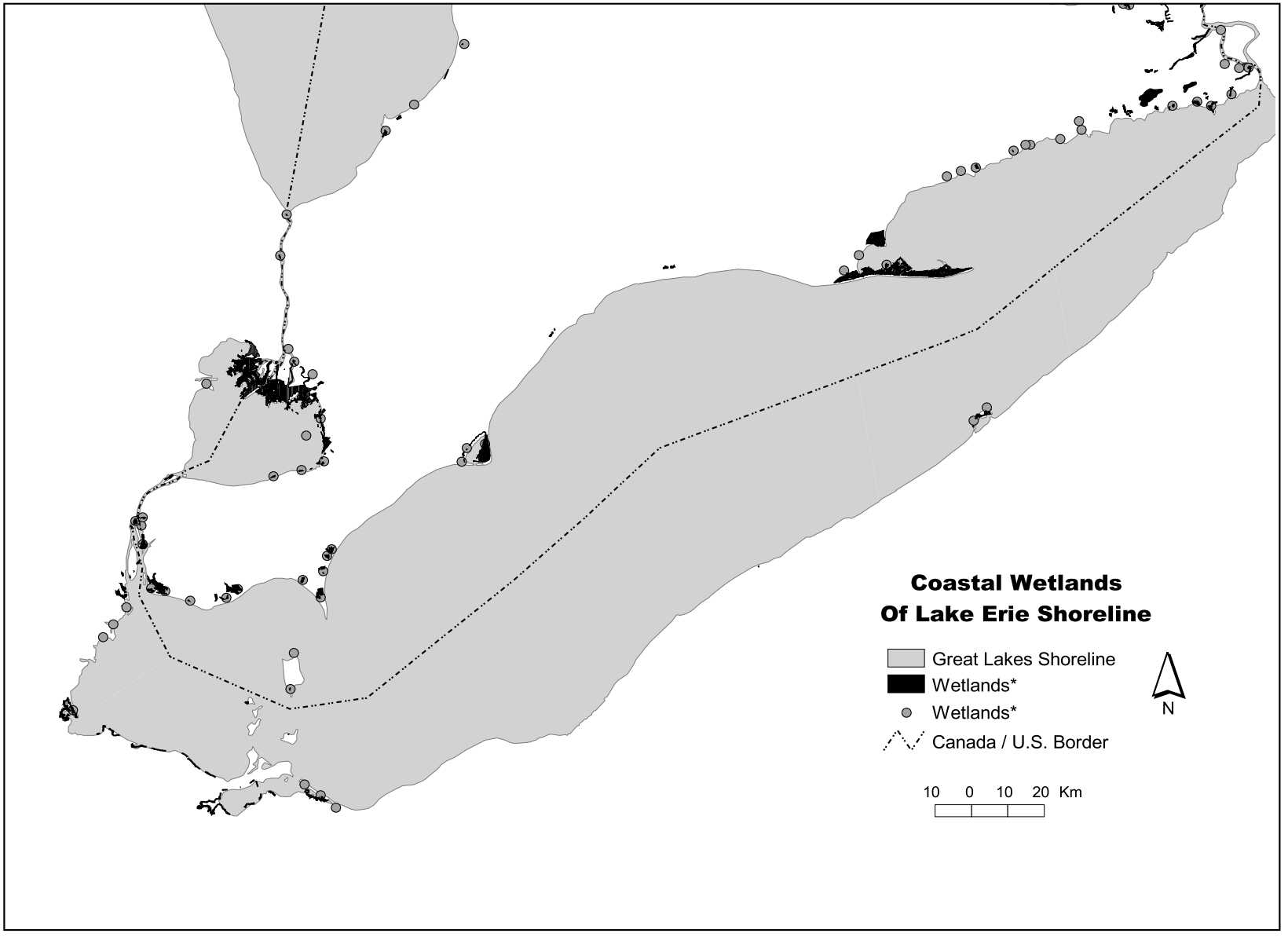
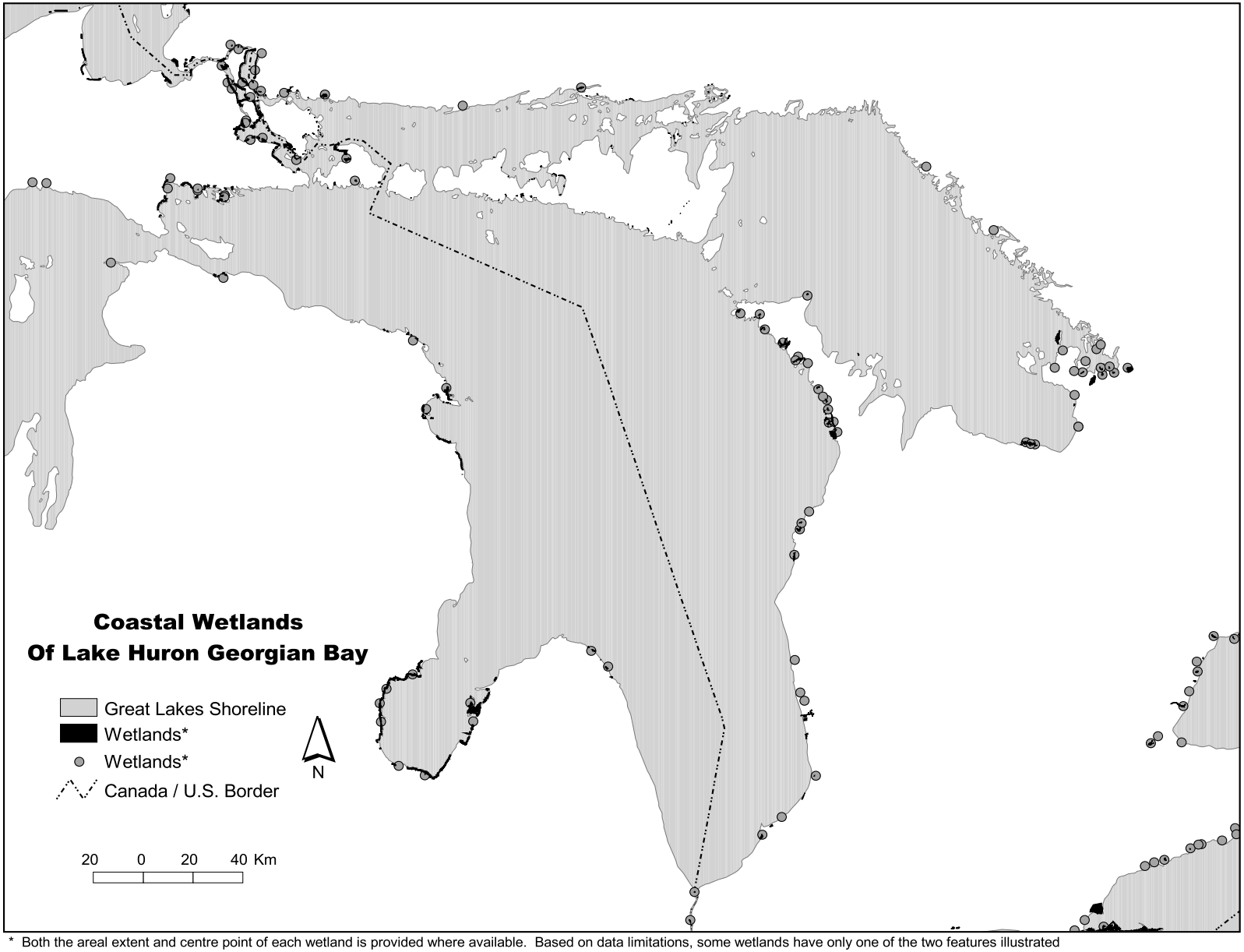


Figure 4.3 Coastal wetland complexes and fringe wetlands occurring on the shoreline of Lake Ontario



* Both the areal extent and centre point of each wetland is provided where available. Based on data limitations, some wetlands have only one of the two features illustrated

Figure 4.4 Coastal wetland complexes and fringe wetlands occurring on the shoreline of Lake Erie



* Both the areal extent and centre point of each wetland is provided where available. Based on data limitations, some wetlands have only one of the two features illustrated

Figure 4.5 Coastal wetland complexes and fringe wetlands occurring on the shoreline of Lake Huron-Georgian Bay

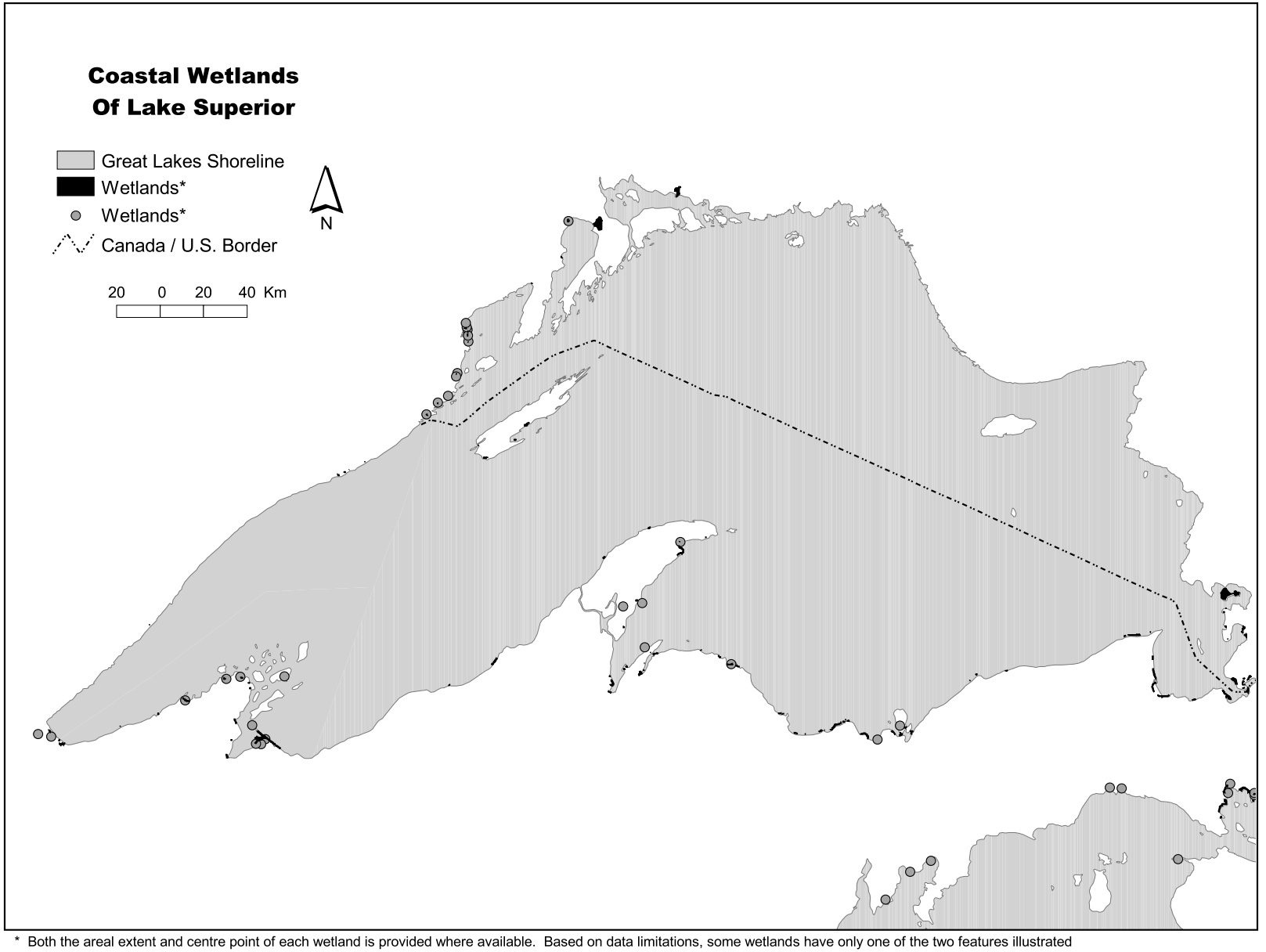
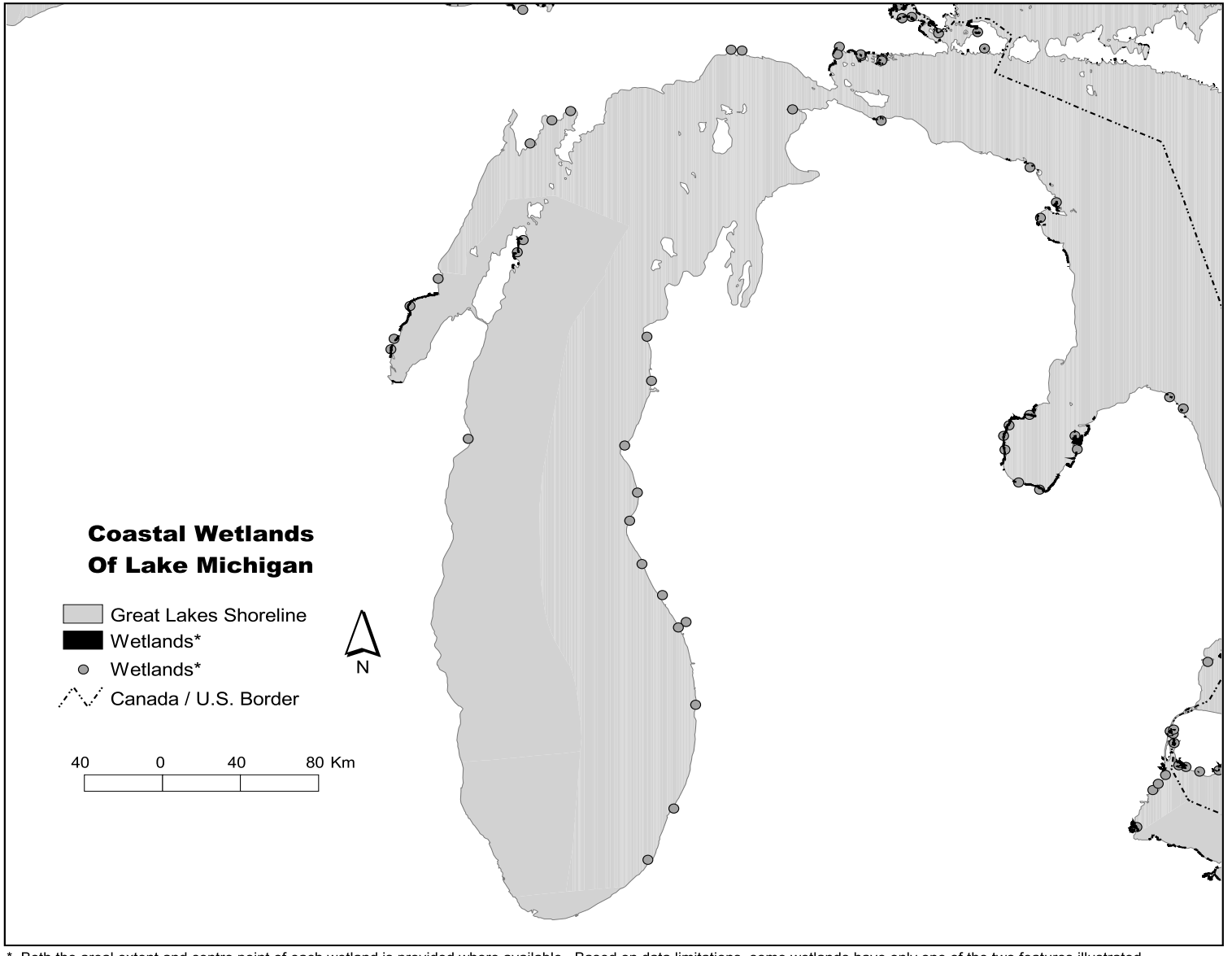


Figure 4.6 Coastal wetland complexes and fringe wetlands occurring on the shoreline of Lake Superior



* Both the areal extent and centre point of each wetland is provided where available. Based on data limitations, some wetlands have only one of the two features illustrated

Figure 4.7 Coastal wetland complexes and fringe wetlands occurring on the shoreline of Lake Michigan

5. Identification of Coastal "Eco-Reaches"

In this study, we adopt the use of "**eco-reaches**" to represent stretches of the Great Lakes shoreline that support significant concentrations of coastal wetlands, and which are characterized by distinctive conditions for coastal wetland development based on differences in climate, bedrock, geology, glacial geomorphology, shoreline configuration, and sills, as well as land use and disturbance factors (Minc 1997). Delineations of many of these eco-reaches do not match existing natural division maps of the Great Lakes area (Carpenter et al. 1995, Albert 1995) based on upland characteristics because coastline conditions reflect a combination of upland and nearshore characteristics. That is, the location of a reach relative to prevailing winds and persistent littoral currents, and to areas of erosion (sources of sediment moved along the coast) are of equal importance to the shoreline configuration as are topography and substrates of immediately adjacent uplands.

The definition and description of reaches was based on the following sources:

1. **published natural divisions maps and descriptions** for Minnesota, Wisconsin, and Michigan (Albert 1995; Hole and Germain 1994), Illinois (Schwegman 1973), Indiana (Homoya 1997), and New York (Reschke 1990);

2. **bedrock geology maps and texts** for the Lake Superior region of Minnesota, Wisconsin, and Michigan (Morey et al. 1982), Minnesota (Olsen and Mossler 1982), Michigan (Dorr and Eschman 1981), and New York (Van Diver 1985);

3. **glacial geomorphology** of the Lake Superior region (Clayton 1984; Farrand et al. 1984), Minnesota (Hobbs and Goebel 1982), Northern and Southern Michigan (Farrand and Bell 1982a, 1982b), the Illinois-Indiana coast (Chrzastowski et al. 1994), and Lake Erie (Herdendorf 1989);

4. **soils maps** for Minnesota (Dept. of Soil Science 1977, 1981; Anderson and Grigal 1984), Wisconsin (Hole 1968, 1976), and county soil surveys for Michigan;

5. **topographic maps**, including the USGS 7.5" series for all of the U.S. Great Lakes shoreline;

6. **shoreline descriptions**, including (a) detailed, reach-by-reach shoreline descriptions of lower Michigan and part of the Lake Superior shoreline (Humphrys et al. 1958; Humphrys 1958), the Illinois-Indiana coast (Chrzastowski et al. 1994), and Lakes Erie and Ontario (Herdendorf 1975); (b) reach-by-reach maps generated under the U.S. Army Corps of Engineers (n.d.) Great Lakes/St. Lawrence River shoreline classification; and (c) more generalized characterizations provided by the Great Lake Basin Commission (1975) and the IJC Levels Reference Study (1993);

7. **ecological profiles** (including descriptions of land use and water quality) for St. Marys River (Duffy et al. 1987; Liston et al. 1986); the Detroit River (Manny et al. 1988), Lake St. Clair (Herdendorf et al. 1986; Edsall et al. 1988), the St. Clair River (Edsall et al. 1988), and western Lake Erie (Herdendorf 1987);

8. **natural vegetation maps** for the Michigan shoreline (Veatch 1953; Raphael 1987; Comer and Albert 1997) and Lake Erie (Gordon 1966);

9. **inventories of natural communities of the Great Lakes shoreline**, including coastal marshes (Albert et al. 1987, 1988, 1989; Geis and Key 1977), Lake Erie estuaries (Herdendorf 1987,

1990, 1992), dune-and-swale complexes (Comer and Albert 1991, 1993), and bedrock communities of Michigan (Albert et al. 1997);

10. **field visits by Heritage Program personnel**, including MNFI, the Minnesota Natural Heritage Program, the Wisconsin Natural Heritage Program, and New York Natural Heritage Program; and

11. **(Environment Canada 1993), Lake Huron's Canadian Shoreline (Environment Canada 1994), Lake Ontario's Canadian Shoreline (Environment Canada 199?), Lake Erie's Canadian Shoreline (Environment Canada 199?), and St. Marys River Shorelines (Environment Canada 1994).**

Finally, characteristic wetland sites are listed for each reach, which are included within the MNFI data base. Descriptions of individual sites along Michigan's shores can be found in Albert et al. (1987, 1988, 1989). Descriptions of non-Michigan U.S. marsh sites sampled by MNFI are included in Minc (1997c). Detailed descriptions of Ontario wetland sites can be found at the Natural Heritage Information Centre web site for each wetland (www.mnr.gov.on.ca/MNR/nhic/nhic.html).

In total, we delineated 44 eco-reaches for shorelines of all the Great Lakes and their connecting channels. Detailed descriptions of landform and shoreline characteristics, dominant site types, soil substrates and names of wetlands that are characteristic of each eco-reach are presented in Table 5.1 to 5.6. Delineations of eco-reaches for all lakes and connecting channel are presented in Fig. 5.1 to 5.6. Wetlands on the shoreline of St. Lawrence River and Lake Ontario were categorized into eight distinct reaches: OS1, OS2, OS3a and OS3b, OS4, OS5, OS6 and OS7; those on the shores of Niagara River and Lake Erie were categorized into eight reaches: E1, E2, E3, E4, E5, E6a and E6b, and E7; those in the Detroit River, Lake St. Clair, and St. Clair River were grouped into 3 ecoreaches: SC1, SC2, and SC3; those in the Georgian Bay and Lake Huron shoreline have been categorized into ten reaches: HG1, HG2, HG3, HG4 (same as M8), HG5, HG6, HG7, HG8a, HG9, and HG10; those on the shoreline of Lake Superior and the St. Marys Channel were grouped into 7 eco-reaches: S1 (same as HG8b), S2, S3, S4, S5, S6, and S7A; and those on the shores of Lake Michigan were separated into 8 eco-reaches: M1, M2, M3, M4, M5, M6a and M6b, and M7.

The eco-reach boundaries identified in this study are not intended to be static, but should be altered to reflect new information on land use and wetland status. For example, the boundary between eco-reaches may be moved (e.g. boundary between E6a and E7 may be moved westward), and in some cases, existing eco-reaches (e.g. S7 and E4) may be further subdivided to better reflect the uniqueness of wetland complexes there. We would also consider it useful to develop an over-arching classification that could integrate the terrestrial BIAs and these coastal wetland eco-reaches.

5.1 St. Lawrence River and Lake Ontario

Table 5.1 Lake Ontario and St. Lawrence River shoreline reaches and their characteristic wetlands

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
OS1. LOWER ST. LAWRENCE R.	Till plain and limestone bedrock border river. Poorly-drained glacial till overlies limestone bedrock. Wetlands are small, at the mouths of slightly entrenched streams and in small embayments along the St. Lawrence River. Also small wetlands above influence of St. Lawrence River.	a. Isolated. b. Tributary estuaries.	a. Organic. b. Organic.	a. b.	Wetlands are quite small compared to those of Upper St. Lawrence River.
OS2. UPPER ST. LAWRENCE R., N.Y. AND ONTARIO.	Shoreline of glacially smoothed sandstone and granitic (gneiss) bedrock. Contains numerous islands, extensive bays, and numerous shoals. Influenced by Lake Ontario and essentially an extension of the lake.	a. Estuary b. Protected embayment.	a. Deep organic soils, bedrock and fine-textured substrate near marsh edges. b. Ditto above.	a. Crooked Creek. b. Goose Bay (Cranberry Creek).	Protected embayments near mouths of several estuaries. Water-level regulation has reduced marsh diversity, creating broad cattail beds.
OS3a and **OS3b**. STONY PT., N.Y. - PRESQU'ILE BAY (BRIGHTON), ONTARIO. **OS3a** is the Canadian portion, while **OS3b** is the U.S. portion.	Till plain and numerous low, glacially scoured islands of limestone. Bay of Quinte and Trent R., with uplands of till, provide extensive protected habitat for wetland development. The Canadian Islands (Amherst, Howe, Simcoe) and the U.S. shoreline (including Galloo and Stony islands) have a shoreline with more exposed bedrock, cobble, gravel, or sand beach, with barrier beach lagoons behind either sand or gravel bars. Wetland habitat in lagoons and estuaries.	a. Barrier beach lagoon. b. Barred estuary. c. Lacustrine estuary. d. Protected embayment. e. Delta.	a. Wellers Bay, Ont., Peninsula Pt., N.Y. b. Huych Bay, Ont. c. Sawguin Creek, Ont. d. Presqu'ile Bay, Ont. e. Presqu'ile Bay.	a. Organic and sand. b. Deep organic soils. c. Deep organic soils. d. Organic and mineral e. Organic and mineral	Bay of Quinte and Trent River channel provide protected habitat for most extensive wetlands. Marshes less extensive on more exposed U.S. shoreline of this map unit.
OS4. BRIGHTON, ONTARIO TO NIAGARA RIVER, ONTARIO	Bluffs of glacial till and lacustrine clays with wetland habitat generally restricted to the mouths of streams entering Lake Ontario. Large sand spits at Hamilton, Ont. enclose large, protected embayment and estuary.	a. Barred estuary. b. Estuary. c. Barrier beach lagoon.	a. Originally organic, now typically mineral b. Ditto a. c. Ditto a.	a. Duffin Creek b. Cootes Paradise c. Port Britain	Intensive agricultural use of uplands has resulted in replacement of original organic soils in estuaries with fine-textured mineral soil.

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
OS5. NIAGARA RIVER TO BRADDOCK PT., N.Y.	Till plain deposits over shale bedrock reult in narrow shingle beaches backed by low bluffs, 3-20 m high. Shallow streams, deeply incised into bluffs, flow directly over bedrock near lake Ontario shoreline. Almost no areas of coastal wetland development.				
OS6. BRADDOCK PT., N.Y. TO SAGE CREEK, N.Y.	Drumlin fields, broken by small stretches of steep till bluffs, characterize most of this stretch of shoreline. Extensive estuarine wetlands occupy the low plain between the drumlins; small sandspits or barrier beaches create shallow lagoons at mouth of many estuaries.	a. Barred estuary. b. Barrier beach lagoon.	a. Deep organic soils. b. Deep organic soils.	a. East Bay, Black Creek. b. Butterfly Swamp.	Water-level controls of Lake Ontario has reduced amount of open, submergent marsh, with increased, dense emergent marsh, primarily cattails.
OS7. SAGE CREEK, N.Y. TO STONY POINT, N.Y.	Sand dunes and barrier beach lagoons, resulting from accumulation of sands at eastern end of Lake Ontario. Embayments have been separated from the lake by barrier beaches and dunes reaching 30 m in height, creating lagoons up to 3 km wide. Drumlins and ground moraine features further inland.	a. Barrier beach lagoon. b. Barred estuary.	a. Sand near lake, deep organics in protected lagoon. b. Deep organics and mineral.	a. Deer Creek, Lakeview Pond. b. Salmon River.	Small streams enter into most of the lagoons. Sand starvation occurring due to shoreline armoring.

5.2 Lake Erie - Niagara River

Table 5.2 Lake Erie and Niagara River shoreline reaches and their characteristic wetlands

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
E1. NIAGARA R.	The river flows over hard dolomitic limestone of Silurian age underlain by softer shales and sandstone. Shoreline typically low and marshy, with thin glacial drift over bedrock.	a. Estuary (tributary). b. Connecting riverine. c. Isolated.	a. Deep organic. b. Mineral or bedrock substrate. c. Organic.	a. Lyon's Creek, Ontario. b. Buckthorn Island. c. Welland Swamp, Ontario.	Extensive submergent beds are also associated with the Niagara River itself.
E2. NIAGARA R. TO TURKEY POINT, ONTARIO	Low limestone bluffs backed by fine-textured lacustrine deposits characterize much of this shoreline. Sand and gravel is deposited between areas of rock headland. Most wetlands are found at stream mouths, but there are some in small protected embayments.	a. Estuary. b. Barred Estuary.	a. Organic soils. b. Organic soils, mineral near mouth.	a. Hickory Creek. b. Nanticoke Creek.	The soils of most of the small estuaries along this stretch of shoreline are now mineral, the result of upland agricultural mgmt.
E3. TURKEY POINT TO PORT ROWAN (LONG POINT)	Long Point is a 30 km long sand spit that partially encloses Long Point Bay and smaller Inner Bay, which supports extensive wetlands. Long Point consists of a large complex of sand spits, dunes, and barrier beach lagoons.	a. Sand spit embayment. b. Barrier beach lagoon. c. Barred estuary.	a-c. Organic soils are found in all of these wetland types, with sand soils included in sand spit embayment and b.b. lagoons.	a. Turkey Point. b. Long Point. c. Big Creek.	This is the most extensive wetland complex on Lake Erie.
E4. PORT ROWAN TO WHEATLEY	Most of this shoreline stretch consists of eroded till bluffs, with localized sand deposition at Pt. aux Pins (alias Rondeau). Bluffs reach 60 meters in height and shoreline erosion is severe, providing few sites for wetland development, except at Pte. aux Pins, where littoral drift provides sand for a large barrier beach, with an enclosed lagoon.	a. Barrier beach lagoon. b. Open embayment	a. Organic soils. b. Mineral soils.	a. Rondeau Bay. b. Rondeau Provincial Park.	

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
E5. POINT PELEE: WHEATLEY TO DETROIT RIVER	From Wheatley, just east of Point Pelee, the Detroit River, low, poorly drained clay lake plain occurs along the lakeshore, with a large sand spit, Point Pelee, extending over 10 km south into Lake Erie. Extensive wetlands form behind barrier beaches at Point Pelee and within small barred estuaries on the lake plain.	a. Barrier beach lagoons. b. Barred estuaries. c. Open embayment.	a. Organic and mineral soils. b. Organic soils. c. Mineral soils.	a. Pte. Pelee. b. Fox Creek. c. Lypp's Beach.	Agricultural sediments have covered the organic sediments of many estuaries.
E6a and **E6b**. DETROIT RIVER TO OLD WOMAN CREEK	E6a. Most of this shoreline is low, poorly drained, clay lakeplain (Maumee Lakeplain), which once contained some of the most extensive wetland areas of the Great Lakes, but many of these have been degraded or lost. E6b. On the Ohio, U.S. mainland, between Port Clinton and Marble Head, and on several small islands (Catawba, Kelleys, N. Bass, S. Bass, Middle Bass in Ohio and Pelee Island, Ont.), limestone is near the surface or exposed. The islands contained several smaller wetlands, especially in protected embayments.	a. Open lacustrine marsh. b. Estuary. c. Barred estuary. d. Delta. e. Barrier beach lagoon.	a. Fine-textured mineral soils. b. Organic. c. Organic. d. Organic and mineral. e. Organic and mineral.	a. Largely eliminated or highly degraded. b. Swan Creek, MI. c. Old Woman Creek, OH. d. Pt. Mouillee. e. Sheldon Marsh.	E3a. Most of these wetlands have been highly degraded because of agricultural sediments and urban development of lakeshore. Most of remaining marshes are diked. Sheldon Marsh is presently being restored. E3b. Most of the marshes in protected embayments have been destroyed, but few small persist.
E7. EAST OF OLD WOMAN CREEK, OH. TO NIAGARA RIVER, N.Y.	Much of the shoreline along the south shore of Lake Erie consists of 3-30 meter high eroded till bluffs. Bluffs consist of till and lacustrine sediments, with some shale exposures. A 25 km-long sand spit, Presque Isle, encloses Erie Bay in Pennsylvania. Extensive lagoons and embayments enclose wetlands on Presque Isle.	a. Sand spit embayment. b. Barrier beach lagoon. c. Open lacustrine. d. Barred estuary.	a. Organic and sandy mineral substrate. b. Organic and sandy mineral substrate. c. Mineral soil. d. Organic substrate.	a. Presque Isle, PA. b. Presque Isle, PA. c. Presque Isle and Erie Bay, PA. d. Mentor Marsh, OH.	Many of the embayments and lagoons at Presque Isle support high quality, natural marsh. Much of Mentor Marsh has been dredged.

5.3 Lake St. Clair - St. Clair and Detroit Rivers

Table 5.3 Lake St. Clair and St. Clair and Detroit Rivers shoreline reaches and their characteristic wetlands

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
SC1. DETROIT RIVER	The Detroit River, a 51 km-long connecting channel, is bordered by poorly drained clay lake plain. The shoreline is now characterized by heavy industrial development. The rapidly flowing river is underlain by limestone bedrock, but large portions of its bottom had finer mineral substrates that supported extensive submergent plant beds, as well as emergent marsh along much of the shoreline.	a. Channel-side (fringing) wetland. b. Submergent beds.	a. Mineral and organic soil. b. Mineral soil, cobble, and locally limestone bedrock	The submergent beds once characterized large portions of the river, have been degraded, and the fringing emergent marsh has been almost completely destroyed.	Extensive wild celery (*Vallisneria americana*) beds were important for diving ducks. Celery bed decline was followed by decline in diving duck use.
SC2. LAKE ST. CLAIR	Poorly drained clay lake plain surrounds the lake. The lake is shallow and at one time was almost completely vegetated with submergent wetland vegetation, while the entire shoreline was bordered by emergent marsh and swamp forest. The St. Clair River Delta is one of the largest fresh water deltas in the world.	a. Delta. b. Protected embayment. c. Submergent beds. d. Tributary estuaries and deltas.	The soils of the delta are shallow organics over fine sand, silt, and clay. The soils of the lake and its margins are silts and clays. Smaller tributary estuaries have deep organic soils.	a. St. Clair River Delta. b. St. Johns Marsh. c. Lake St. Clair. d. Marshy Creek and Snye River Marshes.	Extensive wild celery (*Vallisneria americana*) beds, important for diving ducks, once characterized much of Lake St. Clair's bottom, but much of these beds has been degraded by human land use. Residential development has eliminated shoreline marshes.
SC3. ST. CLAIR RIVER	The St. Clair River, a major connecting river, with high flow velocity, flows through both loamy till (ground moraine) and clay lake plain. At the base of the river is the St. Clair River Delta, which is treated above with Lake St. Clair. Extensive marshes are not characteristic of the river, although the adjacent clay plain supported large swamp forests.	a. Tributary estuaries. b. Open riverine.	a-b. The substrate of the river bottom consists primarily of erosion resistant glacial drift, with a bedrock sill controlling the down-ward erosion rate of the river.	a. b. Stag Island	The rapid flow and resistant substrate do not provide good, extensive habitat for wetland development along the river, except where it joins Lake St. Clair.

5.4 Lake Huron - Georgian Bay

Table 5.4. Lake Huron and Georgian Bay shoreline reaches and their characteristic wetlands

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
HG1. LAKE HURON: PORT AUSTIN, MI. TO CHIEFS PT., ONTARIO	Straight, eroded shoreline of both ground moraine and clay lake plain, with many areas of low, exposed shale (and locally sandstone) cliffs. Locally sand dunes and swales occur.	a. Dune and swale complex. b. Estuary. c. Open embayment (Fringing wetland).	a-b. Organic soils originally in dune and swale and estuaries. c. Mineral soil in fringing wetlands.	a. Ipperwash Provincial Park, Ontario. b. Goderich (Maitland River), Ontario. c. Kettle Point, Ontario and Whiskey Bay, MI.	Agricultural sediments (fine-textured mineral soil) have degraded most estuaries. Map units 2 and 3 in the Environmental Sensitivity Atlas for Lake Huron (Environment Canada 1994) are combined in this map unit.
HG2. LAKE HURON: CHIEFS PT, ONTARIO TO ST. VITAL PT., MI	Resistant dolomite (limestone) bedrock, which dips gently into Lake Huron, forms the lake bottom along the shoreline of the Bruce Peninsula and Manitoulin, Cockburn, and Drummond islands. Cobble and pebble beach are also common sediments.	a. Open embayment.	a. Marl, marly sand, and occasionally clay, locally provide calcareous substrate.	a. Walkhouse, East Belander, and Carroll Wood Bays, Manitoulin Island (Ontario), and Big Shoal Cove, Drummond Island (MI).	Fens, which typically form only a narrow fringing wetland, occur in only the most protected embayments along this stretch of shore.
HG3. LAKE HURON: ST VITAL PT., MI TO POUPARD BAY, MI.	This stretch of the Lake Huron shoreline consists of dolomite bedrock overlain by thin deposits of either fine-textured till or a thin veneer of sand. Many islands and embayments provide diverse and abundant habitat for wetland development.	a. Protected embayments. b. Open embayments, sandy. c. Open embayments, marly. d. Dune & swale complex.	a. Clay with thin organic soils. b. Sand or sand over clay. c. Marly sand or clay substrate. d. Organic over sand.	a. Mackinac and Duck bays. b. St. Martin Bay. c. Peck and Voight bays. d. Albany Bay.	This section of shoreline has some of the highest wetland density on northern Lake Huron. Many of its wetlands are similar to those on the south shore of the Straits of Mackinac (next section).

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
HG4. LAKE HURON: CROSS VILLAGE (LK MI) TO SQUAW BAY (LK HURON), MI. (same as **M8**)	This stretch of the Lake Huron shoreline is similar to the St. Vital Pt. - Poupard Bay segment, with dolomite bedrock overlain by a thin veneer of lacustrine sands or clays and also locally exposed, as near Alpena and Rogers City. Cobble and pebble beach are common.	a. Protected embayments. b. Open embayments. c. Dune and swale complex.	a. Marly sands or clay. b. Sand and/or gravel over clay. c. Sand and shallow organic soils.	a. Cheboygan State Park, El Cajon and Misery bays. b. Squaw Bay. c. Hammond Bay.	Dune and swale complexes are more common in the northwest due to greater amounts of sand deposition. Fen vegetation grows on marly sands or clays.
HG5. LAKE HURON: SQUAW BAY TO POINT LOOKOUT, MI.	A narrow band of flat, sandy lake plain extends along this stretch of shoreline. The shoreline topography consists of numerous dune and swale complexes.	a. Dune and swale complexes.	a. sand dune features, with organic soils in swales.	a. Tawas and Au Sable points and Black River.	In this stretch, most streams miander through dune and swale complexes before entering Lake Huron.
HG6. LAKE HURON: SAGINAW BAY: (POINT LOOKOUT TO PORT AUSTIN) .	Poorly drained lacustrine clays with a thin veneer of sand characterize most of the Saginaw Bay shoreline, producing expansive habitat for coastal wetlands. Bedrock is near the surface, but only very locally exposed.	a. Protected embayments. b. Open embayments. c. Estuaries. d. Dune and swale complexes. e. Sand spit embayments. f. Barrier beach lagoons.	a. Sand over clay. b. Sand over clay or clay. c. Organic soils. d. Sand ridges, organic in swales. e. Sand and thin organics. f. Organic soils over sand.	a. Wildfowl Bay Islands. b. Fish Point. c. Quanicassee River (degraded). d. Sleeper State Park. e. Pinconning S.G.A. f. Tobico S.G.A.	Intensive agricultural management of the clay plain and industrial and urban development have degraded most of the Saginaw Bay wetlands, but they remain important for fishery and wildlife values.
HG7. GEORGIAN BAY/NORTH CHANNEL: YARWOOD PT (NOTTAWASAGA BAY), ONTARIO TO POTAGANNISING BAY, DRUMMOND ISLAND, MI.	Resistant dolomite bedrock forms either steep cliffs or low cobble or bedrock outcrops along shorelines. Relief varies from low to 150 meters. Wetlands are restricted to protected embayments, or in some cases, lagoons separated from lake by pebble or cobble barrier beaches.	a. Protected embayments. b. Barrier beach lagoons.	a. Mineral soils; coarse to fine textured. b. Cobble, marl.	a. Strawberry Channel, Manitoulin Island. b. Grand Marais Lake, Drummond Island.	Wetlands, when present, are often dominated by the same calciphiles (calcium-loving plants) found along the southern shoreline on these islands (Cockburn, Manitoulin, and Drummond) and the Bruce Peninsula. Wetlands are not common.

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
HG8a and HG8b. NORTH SHORE OF NORTH CHANNEL: THESSALON POINT TO BADGELEY POINT, ONTARIO. (**HG8b** Same as S1)	The entire north shore of the North Channel, with the exception of the protected western end (treated as a part of the St. Marys River, map unit S1b), is characterized by rough, igneous and metamorphic bedrock, with very little fine sediments. The number of protected embayments and islands increases to the east, but provides only limited opportunity for wetland development. Large deltaic deposits are located at the mouths of both the Mississagi and Spanish rivers.	a. Isolated palustrine wetlands. b. Fringing lacustrine wetlands. c. Delta/Estuary. d. Protected embayment.	a. Organic soils. b. Mineral soils. c. Sand, organic soils? d. Organic soils?	a. Hay Bay, Marsh Bay Island. b. Clapperton Island c. Mississagi and Spanish rivers. d. Serpent River/Harbour.	Very few wetlands have had data collected, but large sections of shoreline are shown as having fringing wetlands. Based on data collected on similar shorelines in U.S., the fringing wetlands probably have sandy, mineral soils, with open vegetation, while the protected embayments and estuaries probably have deep organics, with both submergent and emergent veg.
HG9. GEORGIAN BAY: BADGELEY POINT TO MATCHEDASH BAY, ONTARIO	Most of the north and east shore of Georgian Bay is extremely complex bedrock (Precambrian Shield), with numerous islands and protected embayments, with sediments restricted to river mouths. The protected embayments and river mouths provide the primary protected environment for wetland development.	a. Protected embayments. b. Fringing wetlands. c. Estuaries.	a. Organic soils. b. Mineral sediment? c. Organic soils.	a.Beaverstone, Moose, and Deer islands; Matchedash Bay. b. Sturgeon Bay. c. Naiscoot and French rivers.	While the Environmental Sensitivity Atlas (Environment Canada 1994) shows large stretches of fringing wetland for Georgian Bay, environmental data appears to have been collected for few of these.
HG10. GEORGIAN BAY: MATCHEDASH BAY TO YARWOOD PT (NOTTAWASAGA BAY), ONTARIO	The underlying bedrock is less resistant sedimentary rock, which is exposed in low cliffs along the shore, along with broad expanses of cobble, pebble, and sand beach. Wetlands are primarily fringing wetlands in protected embayments, but also include palustrine wetlands behind coastal barrier beaches.	a. Open embayment, fringing wetland. b. Wooded dune and swale. c. Estuary .	a. Mineral soil, sands to silts? b. Sand and shallow organic soils. c. Organic soils.	a. Hog and Tobies bays. b. Sturgeon Bay (check quad). c. Wye Marsh.	

5.5 St. Marys River - Lake Superior

Table 5.5. St. Marys River and Lake Superior shoreline reaches and their characteristic wetlands

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
S1. ST. MARYS RIVER. NORTH SHORE OF NORTH CHANNEL: SOUTH SHORE OF ST. JOSEPH ISLAND (OLD FORT ST. JOE PT) TO THESSALON POINT, ONTARIO	The St. Marys , a major connecting river between Lake Superior and Lake Huron, flows across poorly drained lacustrine clay plain. Where the river is narrow, there is typically a narrow fringe of emergent marsh backed by swamp. Broad embayments along the river support large emergent marshes. Shrub and swamp forests can extend several kilometers inland on the poorly drained clay plain. The east side of St. Joseph Island, at the western edge of the North Channel, which supports broad marshes environmentally similar to those of the St. Marys River; is being treated as S1b.	a. channel-side wetland. b. Channel embayment. c. Protected embayment.	a. Sand to loam; mineral soils with thin organic soils beneath wet meadow zone. b. Sand to loam; mineral soils with thin organic soils beneath wet meadow zone. c. Mineral soil in emergent marsh, shallow organic in wet meadow.	a. Hursley Creek and Whipple Point (St. Marys River, MI.). b. Shingle Bay and Munuscong River (St. Marys River, MI.). c. Hay Bay (North Channel), Lake George (St. Marys River, Ont.).	The St. Marys River contains some of the most extensive marshes in the Great Lakes.
S2. PANCAKE BAY, ONTARIO TO WHITEFISH PT., MI	Littoral currents cause sand accumulation in the form of sand spits, dunes, and barrier lagoons on both the U.S. and Canadian shoreline.	a. Barrier beach lagoon. b. Dune and swale complex. c. Delta.	a. Sand and shallow organic soil. b. Sand and shallow organic soil. c. Mineral and organic.	a. Whitefish Point, MI. b. Whitefish Bay and Tahquamenon River, MI. c. Goulais River, Ont.	
S3. PANCAKE BAY TO SCHREIBER, ONTARIO	Rugged granitic bedrock shoreline, with almost no protected embayments or wetlands.				
S4. SCHREIBER, ONTARIO TO GRAND PORTAGE, MN. [1, north end of 2]	Protected embayments of Thunder, Black, and Nipigon Bays. Shoreline of granitic and volcanic bedrock. Unit includes Isle Royale, MI. Cobble beaches and barrier beaches of cobble are common features.	a. Protected embayment. b. Estuary. c. Barrier beach lagoon.	a. Both mineral and organic soils. b. Organic soils. c. Organic soils. Cobble barriers common.	a.Cloud Bay, Ont. b. Whiskeyjack Creek, Gravel River, Ont. c. Neebing Bay, Ont.	Almost all wetlands associated with this stretch of shoreline have a predominance of organic soils. Similar pattern for all of Lake. Superior.

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
S5. GRAND PORTAGE, MN. TO DULUTH, MN. [2-3]	Smooth, steep shoreline, with volcanic bedrock to the north of Split Rock Point and lacustrine clays and bedrock to the south. Wetlands are found only behind sand beach ridges north of Split Rock Point, and these are small, less than 10 hectares.				
S6. DULUTH, MN. TO MARBLE POINT, WI.	This relatively short stretch of shoreline is relatively protected and supports numerous wetlands. Duluth to Superior, WI is highly dissected clay plain containing steep ravines of the St. Louis River, which support barred estuaries and a large barrier beach lagoon. From Superior to Washburn, WI, are till bluffs and low sandstone cliffs, with several small barrier beach lagoons and barred estuaries. From Washburn to Marble Point, there is relatively flat clay lakeplain near the shore and large barrier beach lagoon and barred estuary complexes in Chequamegon Bay.	a. Barred estuary (buried river-mouth). b. Barrier beach lagoon. c. Lacustrine estuary.	a-b. Both of these wetlands consist largely of organic soils. Sand is concentrated near the barrier beach or bar. c. Only examples are disturbed, with both mineral and shallow organic.	a. St. Louis, Allouez, and Superior Bays. b. Kakagon Sloughs and Honest John Lake. c. Pokegama River.	The estuaries at or near Duluth have been heavily altered, with lagoons modified for ship traffic and harbor with residences on sand spits. The smaller wetlands of the Apostle Islands and the extensive Bad River and Kakagon Sloughs wetlands are largely intact.

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
S7. MARBLE PT., WI TO WHITEFISH PT., MI	This large stretch of shoreline, covering most of the south shore, is relatively diverse, but supports few large wetlands. The majority of the shore consists of steep till bluffs, sandstone cliffs, volcanic and granitic bedrock shoreline. From Marble Point to the Lac La Belle, on the northeastern shore of the Keweenaw Peninsula, almost no wetlands because of the steep bedrock shore. There are a few small dune and swale complexes in Ontonagon Bay, as well as further south on the east side of the Keweenaw. Wetlands are scattered along the remaining shoreline, primarily where barrier beaches protect a lagoon or a series of swales (dune and swale complex). There are also large deltaic and estuarine wetlands along the Portage Lake Ship Channel, near Houghton/Hancock..	a. Barrier beach lagoon/tombolo. b. Barred estuary. c. Delta. d. Dune and swale complex.	a-d. Primarily organic soils.	a. Pequaming. b. Au Train River, Lac La Belle. c. Sturgeon River. d. Grand Traverse Bay.	

5.6 Lake Michigan

Table 5.6 Lake Michigan shoreline reaches and their characteristic wetlands

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
M1. POUPARD BAY/GROS CAP TO THOMPSON, MI.	This stretch features open, exposed sandy shoreline brobken by areas of sand beach and low coastal dune. Limestone bedrock or cobble are locally exposed or near the surface at many of the points, including Pt. Epoufette, Seul Choix, Stony and Manistique Points. Small, marly coastal wetlands are associated with the bedrock points, while dune and swale complexes, extending several kilometers inland, characterize the sandy shores of many of the large embayments.	a. Dune and swale complex. b. Open embayment.	a. Sand beach ridges with shallow organic soils in swales. b. Marly sands and sand over clay.	a. Pte. aux Chenes, Gulliver Lake dunes. b. Epoufette Bay.	Most of the marshes in the open embayments support calciphiles characteristic of northern fens, including spikerush and Kalm's lobelia.
M2. THOMPSON, MI TO EASTERN GREEN BAY, WI.	This map unit contains most of the Door Peninsula, WI. and Garden and Stonington peninsulas, MI., where limestone [dolostone] bedrock is exposed over large stretches of shoreline. On the western shorelines of the Garden and Stonington are steep cliffs and bluffs, precluding wetland developement, while on the western shore of the Door Peninsula, small dune and swale complexes occur in small embayments, as do a few barred estuaries. On the eastern shore of these peninsulas, there are both shallow, marly wetlands on bedrock and several barrier beach lagoons, as well as occasional dune and swale complexes, as at the mouth of the Sturgeon, Ogontz, and Little Fishday rivers.	a. Barrier beach lagoons. b. Dune and swale complexes. c. Barred estuaries. d. Estuary.	a. Marl and marly sands, organic soils. b. Sand on uplands and shallow organics in swales. c. Organic soils. d. Organic soils except at river mouth, where both fine- & course-textured mineral soils occur.	a. Kangaroo and Mud lakes, WI. b. Portage Bay, MI. c. d. Mink River, WI.	Calciphiles, (lime-loving plants) predominate in the marly fens of this eco-reach. In deeper water of many lagoons, dense beds of chara and nitella often grow.

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
M3. SQUAW POINT, MI TO GREEN BAY, WI.	Outwash and lacustrine sands characterize the shoreline of most of this stretch. In the north, between Squaw Point and Rapid River, the outwash sands are dry, but along much of the remaining MI and WI shoreline, poorly drained conditions are prevalent, accounting for extensive coastal wetlands at river mouths and behind protective sand spits, as well as large swamp forests just inland from the Great Lakes.	a. Delta. b. Barred estuary. c. Sand spit embayment.	a. Organic and mineral soils. b. Organic soils. c. Sandy mineral soils.	a. Peshtigo River, WI. b. Ford River, MI. c. Little Tail Point and Dead Horse Bay, WI.	Several marshes in sand spit embayments and protected embayments near Green Bay and the mouth of the Fox River have been destroyed by combination of agricultural sediments and shoreline armoring and filling.
M4. ALGOMA TO KENOSHA, WI.	High bluffs of clayey reddish till occur along this stretch, with localized narrow sand and gravel beaches, and few wetlands along the shorelines. While most of the streams entering Lake Michigan have narrow, steep ravines, a few of the larger streams have broad estuaries near there mouth, often extending several kilometers inland.	a. Estuary.	a. Deep organic soils.	a. Kewaunee and Twin rivers, WI.	The lower reaches of many of these estuaries have been filled or modified for either industrial or marina use.
M5. KENOSHA, WI TO GARY, IND.	Most of this stretch originally consisted of poorly drained lacustrine plain, but also includes 25 km of eroding moraine bluff in northern IL, and a low lacustrine plain continuing to near Gary, IN. In southern WI, dune and swale topography predominates.	a. Barred estuary (largely destroyed). b. Open embayment (destroyed).	a. Originally organic soils. b. Originally mineral and shallow organic soils.		The estuaries, coastal wet prairies, and marshes of the Chicago to Gary area have been drained and filled, with shoreline armored, resulting in almost complete wetland loss.

Shoreline Segment Number and Name	Landform and Shoreline Characteristics	Wetland Site Type	Soil Substrate	Wetland Examples	Comments
M6. GARY, IN TO GOOD HARBOR BAY, MI.	Littoral sand deposition has created large sand dunes, which alternate with steep till bluffs along this entire stretch of shoreline. Strong currents, wave activity, and heavy sediment transport do not allow marsh development in the open lake. Marshes are confined to barred estuaries that form near the mouths of most of the large rivers flowing into Lake Michigan. Wooded dune and swale complexes occur along the entire south end of Lake Michigan, from Gary to Michigan City, but wetlands are quite small.	a. Barred estuaries. b. Barrier beach lagoons. c. Wooded dune & swale.	a. Deep, poorly consolidated organic soils. b. Deep, poorly consolidated organic soils. c. Sand on ridges and organic soils in swales.	a. Kalamazoo, Muskegon, and Grand rivers, MI. b. Bar Lake. c. Indiana Dunes National Lakeshore.	The extensive barred estuaries, often called "buried river mouths', typically have a lake or lagoon at their mouth. These lagoons were originally bays of Lake Michigan before being separated from the lake by a sand bar. Marina development has destroyed many of the estuaries, especially the portions in the lagoons.
M7. EAST OF GOOD HARBOR BAY, MI TO CROSS VILLAGE, MI.	The coastline is diverse, ranging from drumlin fields, moraine bluffs, and low bedrock cliffs to sand lakeplain. The shoreline of the lakeplain is sand or gravel beach, with no significant wetlands. The moraines and bluffs likewise have no wetland; the shoreline is often cobble or pebble beach.	a. Dune and swale wetland, destroyed.	a. Sand on dune ridges, with organic soils in the swales.	a. Traverse City State Park (degraded wetland).	
M8/HG4. CROSS VILLAGE, MI TO SQUAW BAY, MI.	Only a small portion of this unit occurs on Lake Michigan; the majority is on Lake Huron. See **HG4** on Lake Huron.				

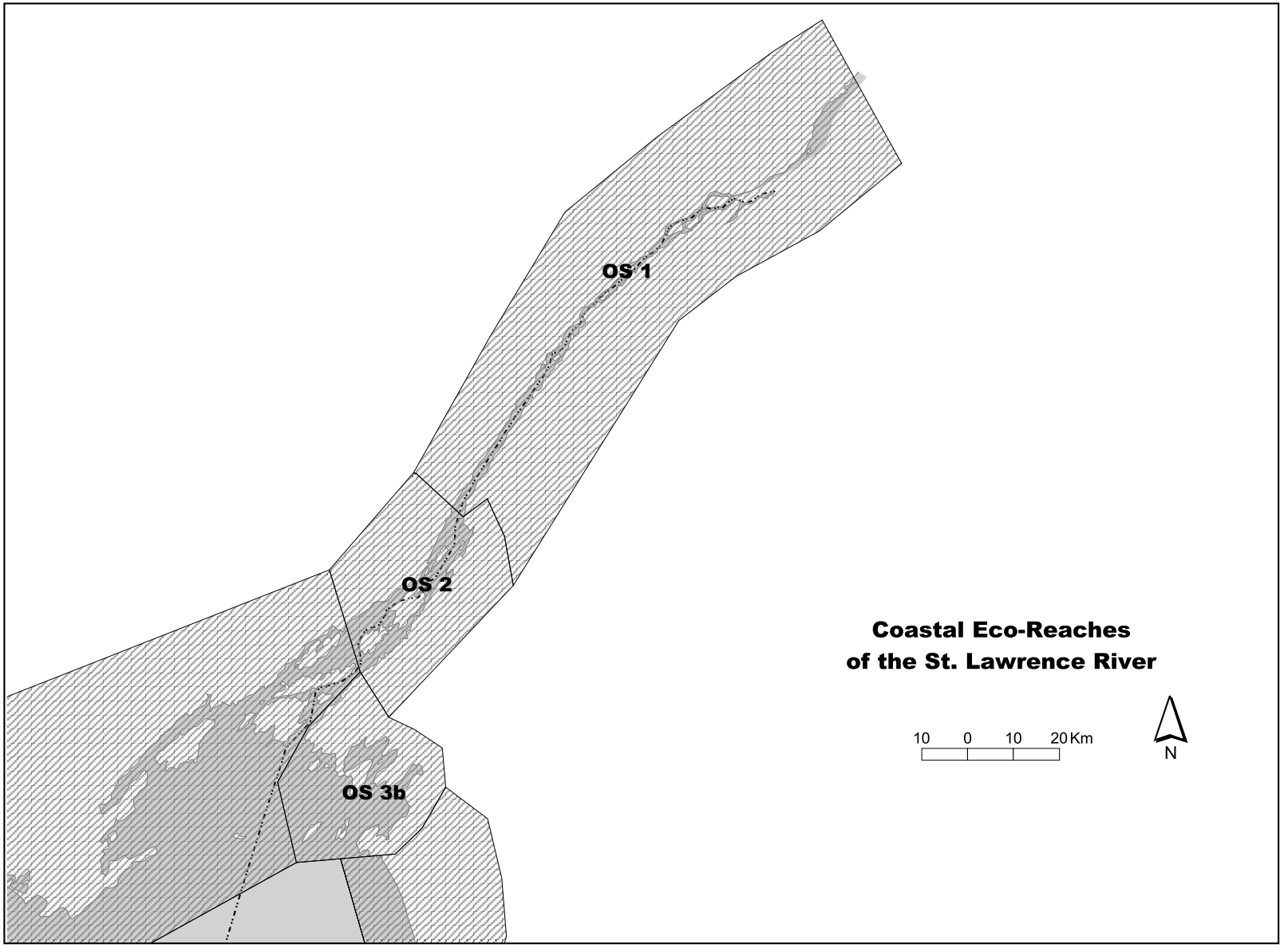


Figure 5.1 Eco-reaches of the St. Lawrence River

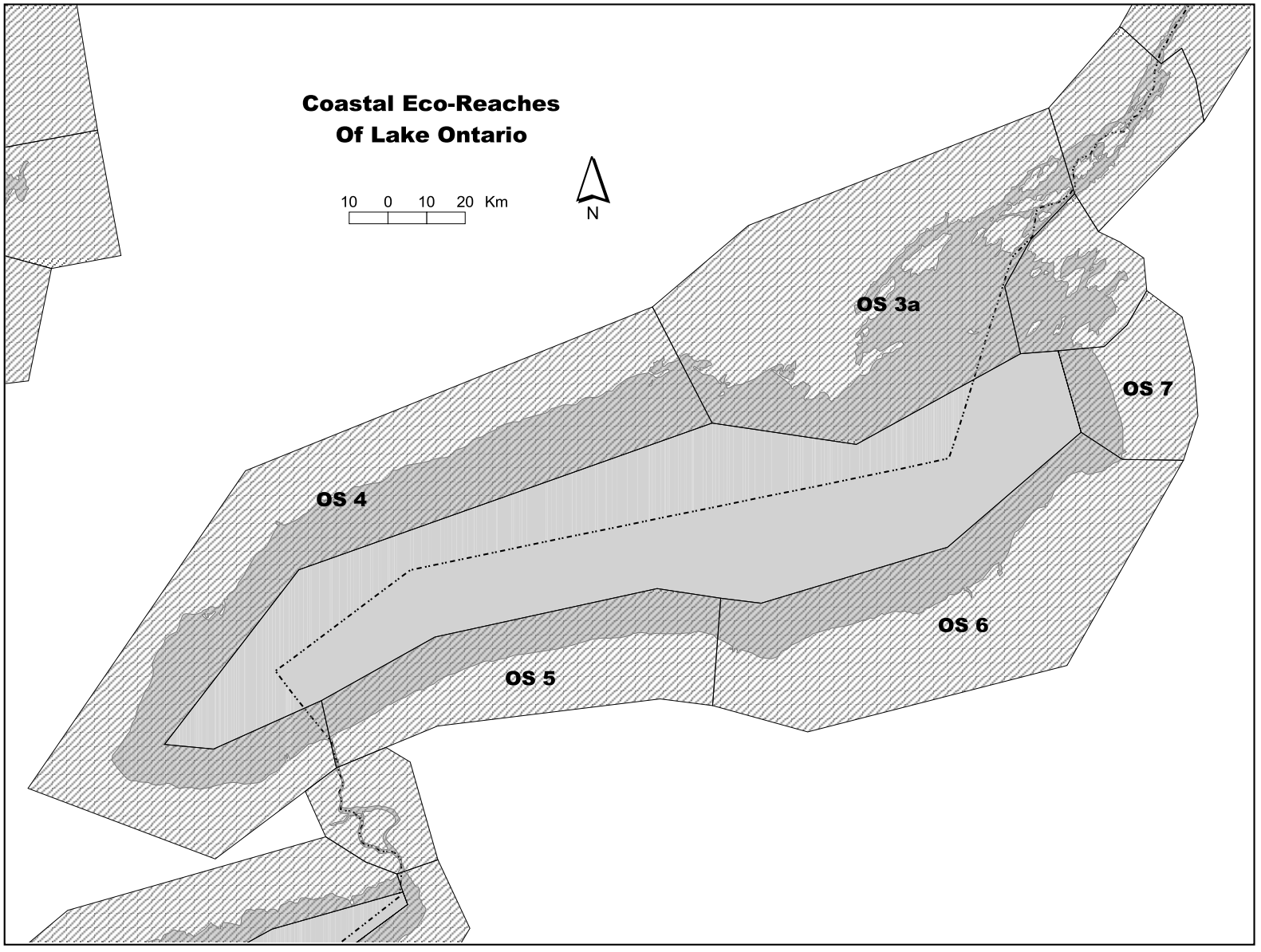


Figure 5.2 Eco-reaches of Lake Ontario

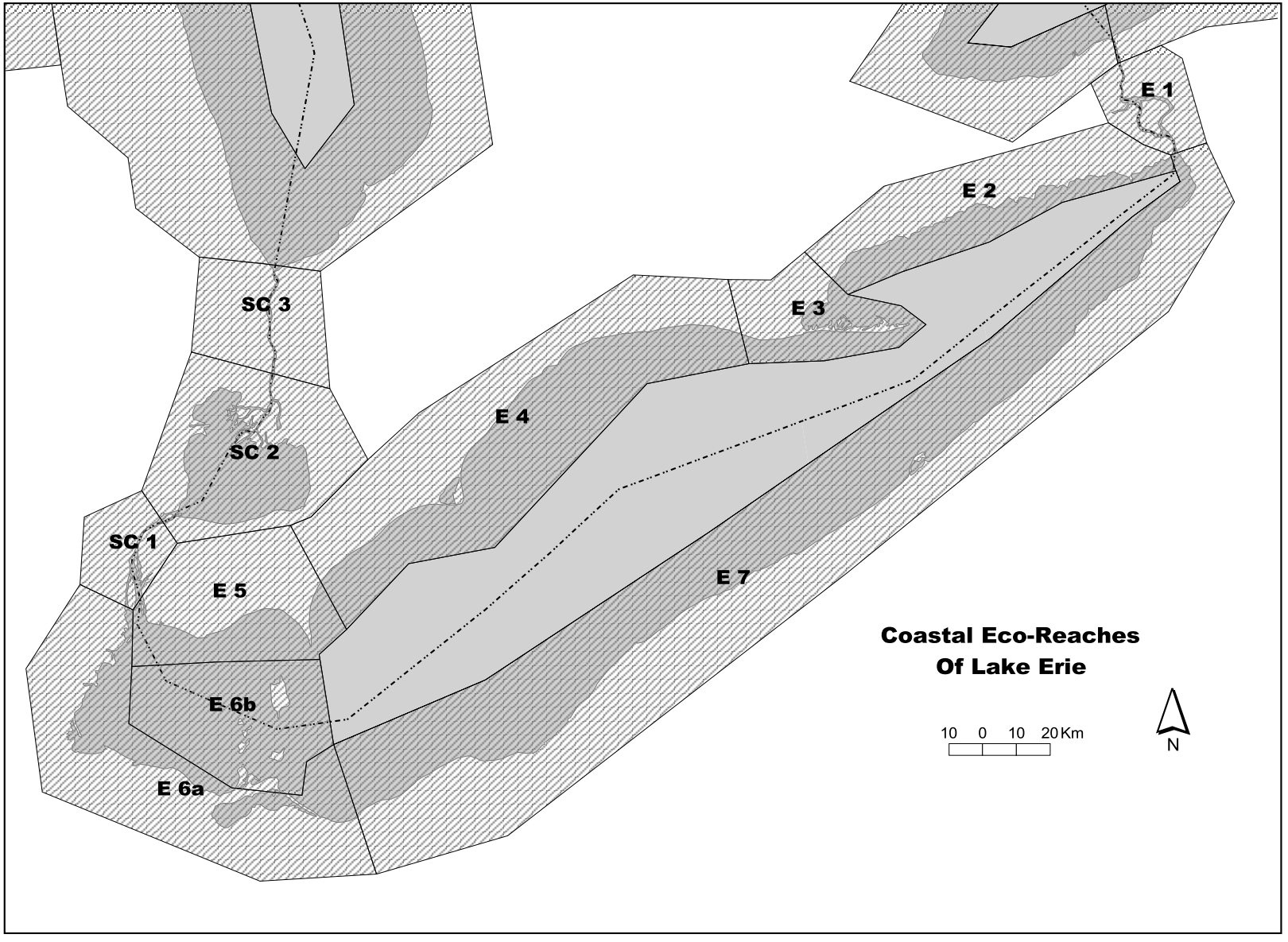


Figure 5.3 Eco-reaches of Lake Erie and Lake St. Clair Area

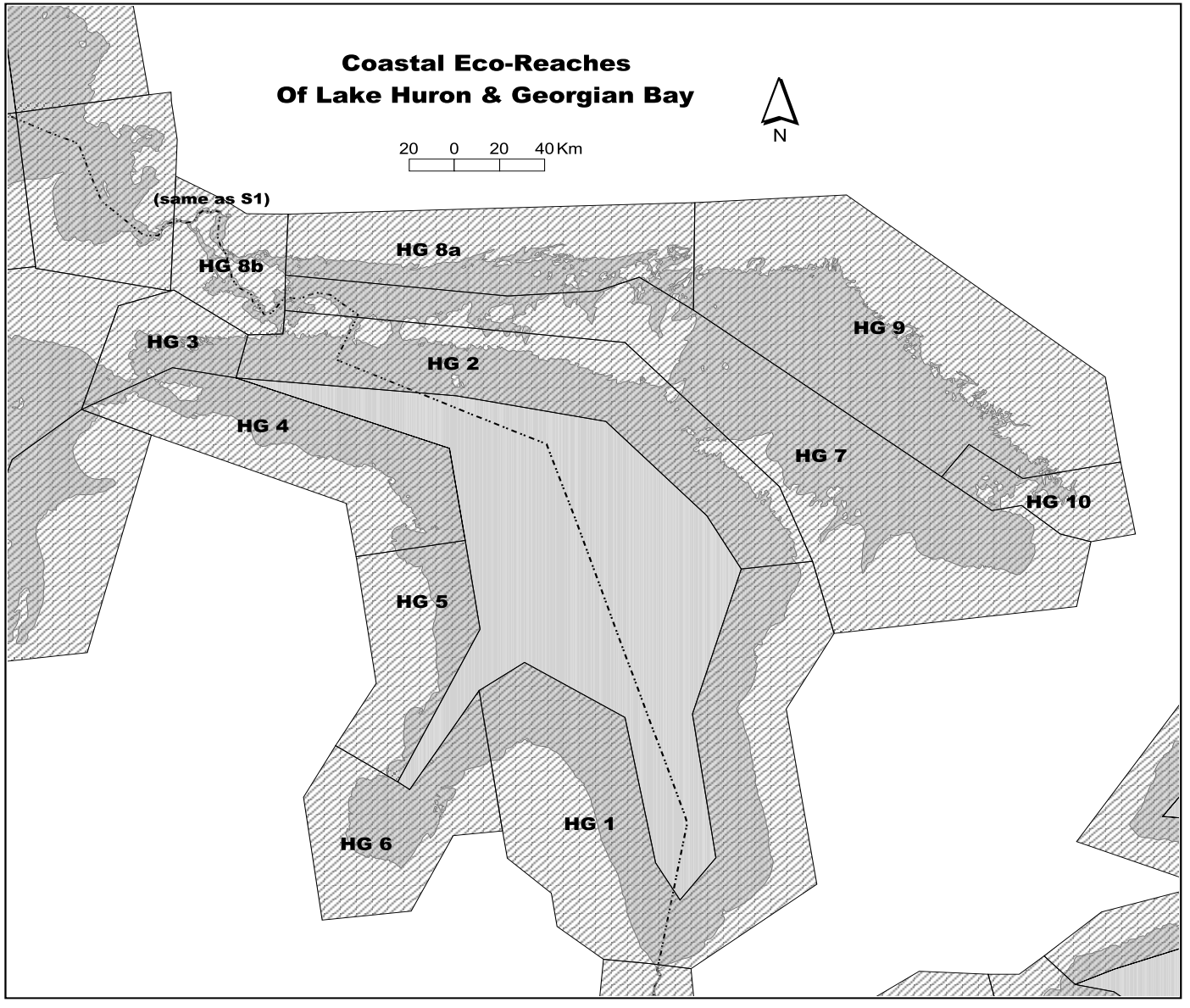


Figure 5.4 Eco-reaches of Lake Huron and Georgian Bay

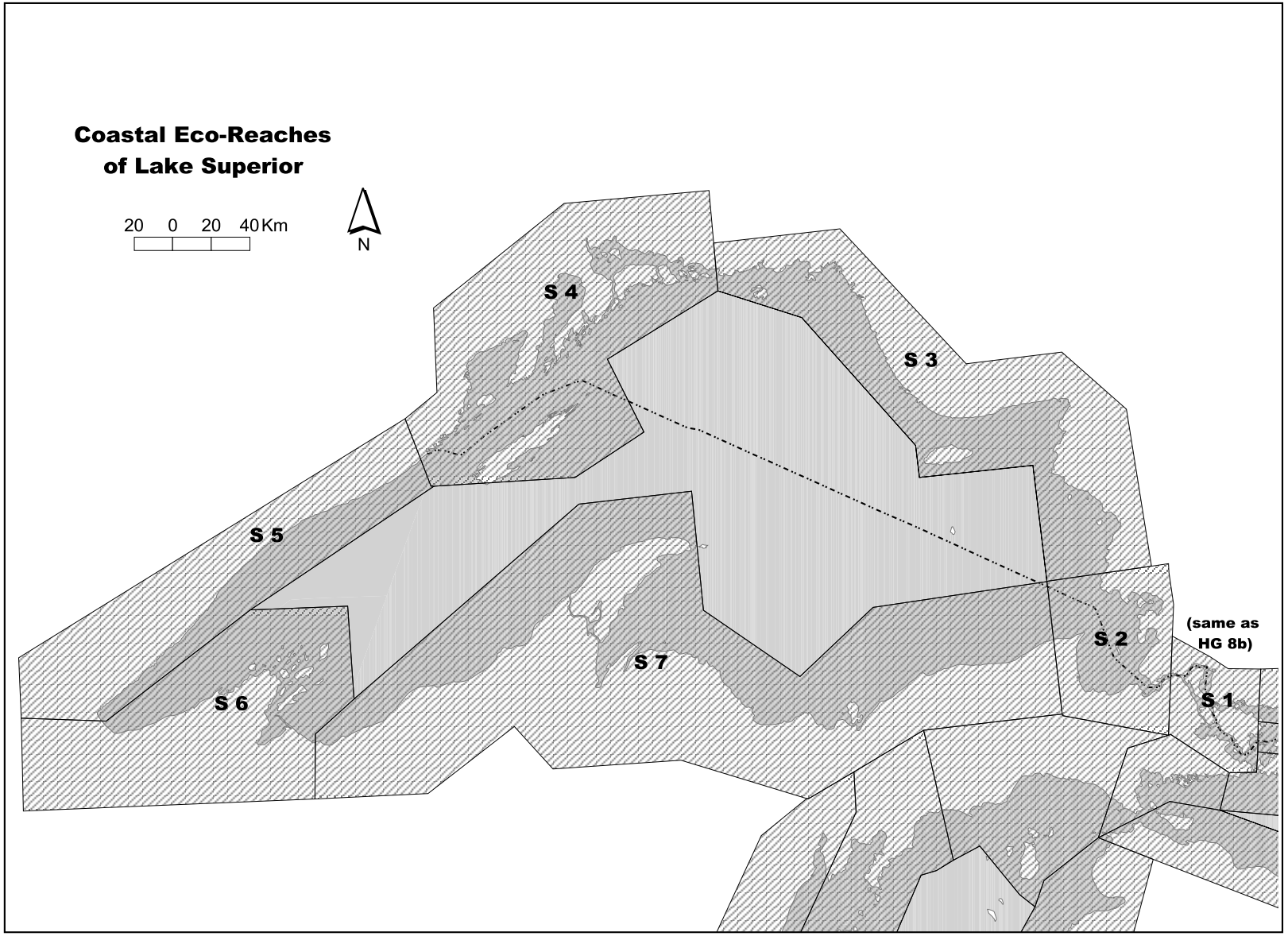


Figure 5.5 Eco-reaches of St. Marys River and Lake Superior

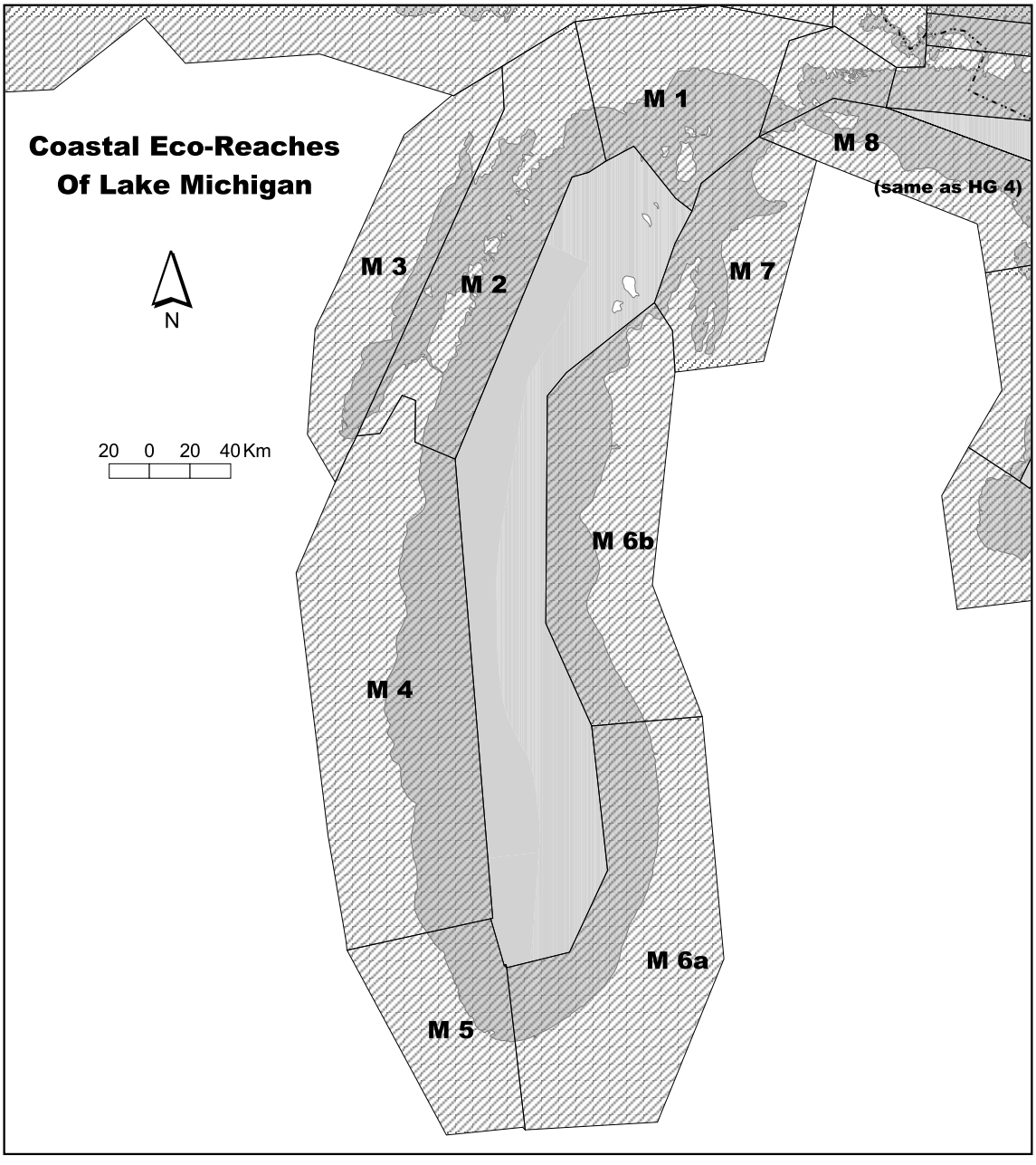


Figure 5.6 Eco-reaches of Lake Michigan

6. Fish and Avi-faunal Use of Eco-Reaches

Once we completed the delineations, we wanted to come up with an objective, quantifiable measure of the biodiversity value of the 44 eco-reaches. This would further our goal in identifying eco-reaches that have exceptionally important habitat for a large number of fish and bird species. Given sufficient time and money, the best approach to take would be to conduct a comprehensive survey of the important fauna and flora in all eco-reaches so that a current assessment of the biodiversity values of different eco-reaches can be compared. Unfortunately, there was neither the time nor the money available to accomplish this task. Consequently, we had to rely on historic databases that documented faunal use of coastal wetlands and nearshore areas of the Great Lakes in a comprehensive manner.

To ensure unbiased treatment of all eco-reaches, the criteria we chose to screen the databases were as follows:

- Databases had to have national or bi-national coverage
- Method used in the surveys had to be standardized and systematically applied to all Great Lakes
- Methods used in the surveys had to be clearly documented and scientifically supportable
- Data from these studies had to be geo-referenced so that they could be added to the existing GIS database

The Environmental Sensitivity Atlas database contained information on faunal use but the method used to obtain the information was not clearly documented and hence not scientifically supportable. Moreover, the database only covered the Canadian portion of the Great Lakes shoreline, and was therefore incomplete. The "Atlas of the Spawning and Nursery Areas of Great Lakes Fishes" (Goodyear et al. 1982) was a binational database that provided information for the entire Great Lakes community although the data were only current to the early 1980s. We decided to use the database in this study despite its dated nature, because 1) it is the only binational and comprehensive treatment of fish use, 2) the methods used were clearly documented, 3) the database included 139 species and 4) there were geographic coordinates associated with each entry. The "Atlas of Breeding Birds of Ontario" (Cadman et al. 1988) provided information regarding the breeding birds for the Canadian portion of the Great Lakes but did not cover the U.S. portion. Despite this deficiency, we incorporated information on bird use because wetlands are important habitat for the avian community. The bird atlas did not provide geographic coordinates but did provide distributional maps for 236 species.

We want to emphasize that there exist other excellent databases that document the habitat range of other birds, fishes or amphibians, but they could not be made available for incorporation within the time frame of this study, and most of these had restricted geographic coverage (i.e. either for only one lake or for one country), and therefore did not meet the above stated criteria. In this study, we simply wanted to use a few comprehensive data sources to demonstrate how a comparison of the eco-reaches could be made.

6.1 Use by Great Lakes Fish Community

Use of each eco-reach by fish for spawning and nursery areas has been summarized in Appendix 3a and 3b respectively. To construct the matrices in Appendix 3, we first superimposed our eco-reach delineations on the fish atlas maps, and recorded the fish species that used the associated tributaries (T) or littoral areas (L; within the 9-ft depth contour, which presumably included all of the coastal wetlands) for spawning (Appendix 3a) or nursery (Appendix 3b) habitat. For the purpose of this study, we have calculated the percent of all Great Lakes fishes that utilize either habitat for spawning and/or nursery areas. As a preliminary analysis, we have not taken into consideration the type of fish that use these

habitats, and have therefore largely ignored the economic or recreational value associated with certain commercial or sportfish. We recommend that others use the appendices provided to refine the evaluation we have started here.

During the early 1980s, the nearshore areas and tributaries of all eco-reaches identified in this study had been used as spawning habitat by at least 7 different fish species (e.g. **HG10**), and up to the 104 species (e.g. **E7**) (Appendix 3a). The median frequency is about 14% (dotted lines in Fig. 6.1) when all 44 eco-reaches were analyzed together. Those eco-reaches that had equal to or greater than the median frequency are noted in Table 6.1. Specifically, those with frequencies greater than the 50th percentile were denoted with 1 asterisk, those greater than 75th percentil were denoted with 2, and those exceeding 90th percentile were denoted with 3. In a similar fashion, the median frequency (10%; dotted lines in Fig. 6.2) was calculated for nursery habitat data, and those eco-reaches that had exceeded the median frequency are also noted in Table 6.1. There were from 1 (**HG10**) to 66 (**E7**) fish species that used these eco-reaches as nursery habitat during the early 1980s (Appendix 3b).

6.2 Use by Breeding Birds of Ontario

Use of the Canadian eco-reaches by breeding birds has been summarized in Appendix 3c. The percent of all breeding birds that use the various eco-reaches tend to vary from about 45% to 70%, with very extensive use in the Huron-Georgian Bay eco-reaches (Fig. 6.3). The median frequency was about 58% for all 23 Canadian eco-reaches (dotted line in Fig. 6.3). Eco-reaches that corresponded with high use frequency (> 60%) are also indicated in Table 6.1.

Fig. 6.1 Summary of fish spawning habitat in eco-reaches.

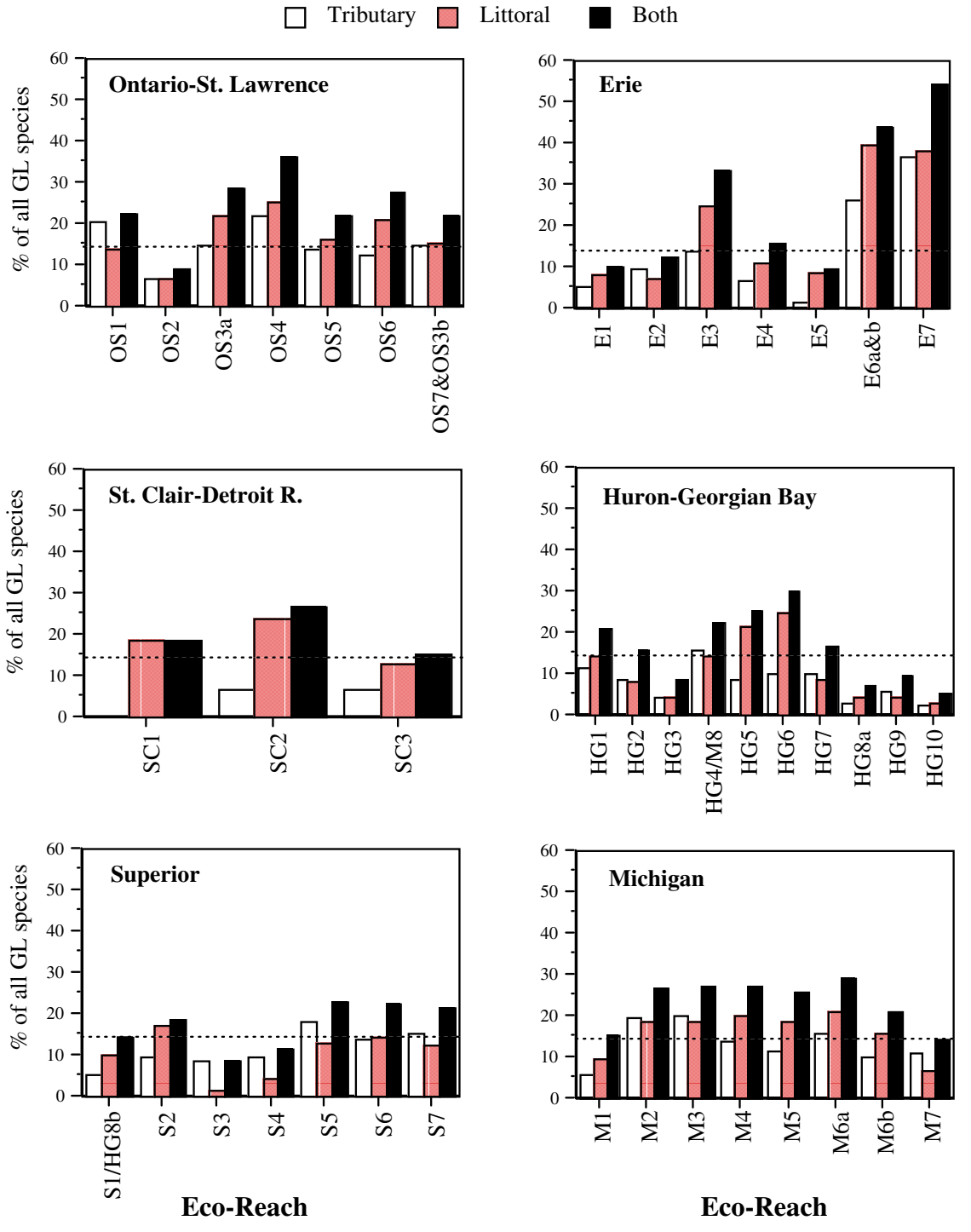


Fig. 6.2 Summary of fish nursery habitat in eco-reaches.

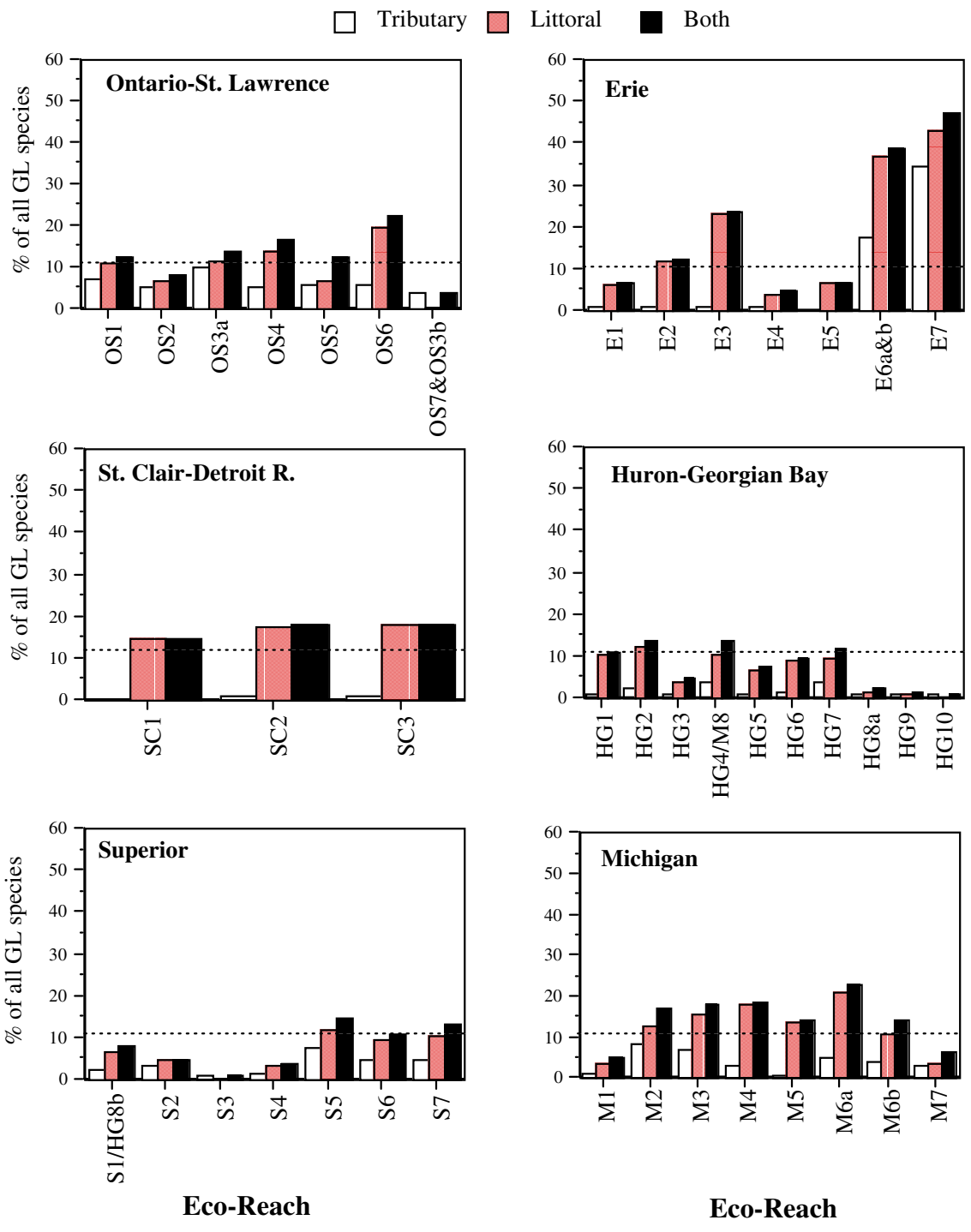


Fig. 6.3 Summary of Eco-reaches used as habitat by breeding birds of Ontario

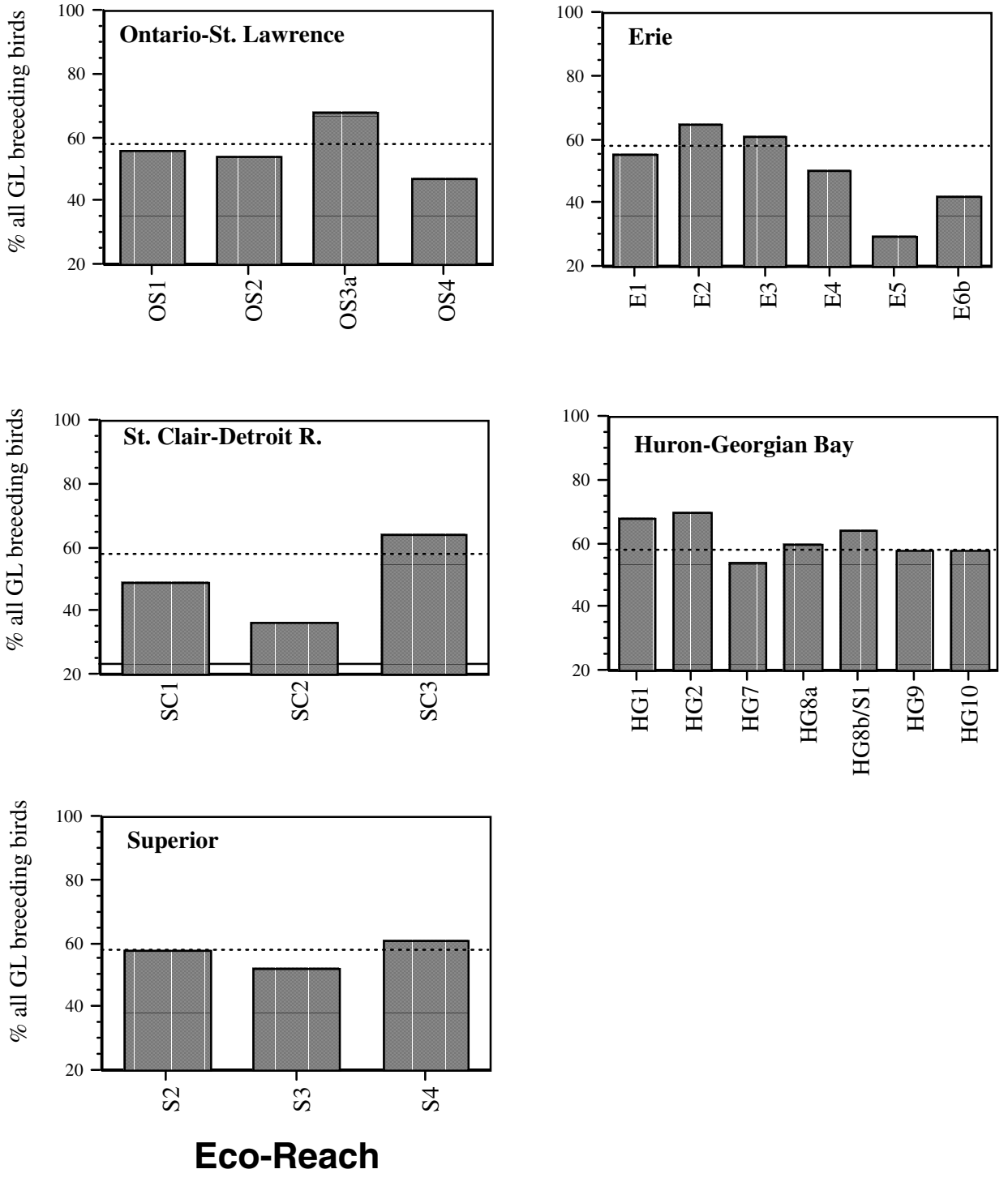


Table 6.1 Comparison of fish and avi-faunal use of eco-reaches

Eco-reach	Number of Wetlands			Number of fish species that spawn in eco-reach		Number of fish species with nursery areas in eco-reach		Number of bird species that use eco-reach
	Cdn	U.S.	Total	Tributary	Littoral	Tributary	Littoral	Entire shoreline
OS1	36	77	113***	28***	19	10**	15*	133
OS2	17	83	100***	9	9	7**	9	127
OS3a	65	---	65*	20**	30**	14***	16*	160***
OS4	50	---	50*	30**	35***	7**	19**	160***
OS5	---	8	8	19*	22*	8**	9	n/a
OS6	---	65	65*	17*	29**	8**	27**	n/a
OS7	---	24	24	20**	21*	5*	0	n/a
OS3b	---	64	64*	20**	21*	5*	0	n/a
E1	12	9	21	7	11	1	8	110
E2	17	---	17	13	10	1	16*	130
E3	6	---	6	19*	34***	1	32***	153**
E4	8	---	8	9	15	1	5	143*
E5	9	---	9	2	12	0	9	118
E6a	---	62	62*	36***	55***	24***	51***	na
E6b	2	9	11	36***	55***	24***	51***	68
E7	---	16	16	51***	53***	48***	60***	n/a
SC1	6	7	13	0	26*	0	20**	100
SC2	29	2	31	9	33**	1	24**	116
SC3	2	5	7	9	18	1	25**	84
HG1	17	17	34*	16*	20*	1	14*	152**
HG2	36	58	94**	12	11	3	17*	161***
HG3	---	52	52*	6	6	1	5	n/a
HG4/M8	---	112	112***	22**	20*	5*	14*	n/a
HG5	---	8	8	12	30**	1	9	n/a
HG6	---	21	21	14*	34***	2	12	n/a
HG7	27	---	27	14*	12	5*	13	166***
HG8a	20	---	20	4	6	1	2	128
HG9	n/a	---	n/a	8	6	1	1	151**
HG10	14	---	14	3	4	1	0	138*
HG8b/S1	50	28	78**	7	14	3	9	141*
S2	7	21	28	13	24*	4*	6	138*
S3	1	---	1	12	2	1	0	123
S4	15	29	44*	13	6	2	4	143*
S5	---	7	7	25**	18	10**	16*	n/a
S6	---	94	94**	19*	20*	6*	13	n/a
S7	---	127	127***	21**	17	6*	14*	n/a
M1	---	62	62*	8	13	2	5	n/a
M2	---	102	102***	27***	26*	12***	18*	n/a
M3	---	55	55*	28***	26*	10**	22**	n/a
M4	---	20	20	19*	28**	4*	25**	n/a
M5	---	36	36*	16*	26*	1	19**	n/a
M6a	---	32	32*	22**	29**	7**	29***	n/a
M6b	---	37	37*	14*	22*	6*	15*	n/a
M7	---	24	24	15*	9	4*	5	n/a

n/a = not available ; data taken from Appendix 3a, b and c. *:>50th percentile; **: >75th percentile; ***: >90th percentile

7. Identification of Biodiversity Investment Areas

In 1996, several areas were identified as "Biodiversity Investment Areas" by Reid and Holland (1996) because of high concentrations of rare species or high quality natural communities. In attempting to use the same approach for the coastal wetlands, we have identified eco-reaches of Great Lakes shoreline that support extensive use by birds for breeding habitat, and by fish for spawning and/or nursery habitat. While wetland habitat is important for a large number of plant and animal species, the number of rare species known from coastal wetlands is very low; the Heritage Program databases for most of the Great Lakes states and the Province of Ontario contains locations for high quality examples of typical Great Lakes wetland types, but few occurrences for rare species. Therefore, we have not based our assessment on the presence of rare species in the respective eco-reaches.

7.1 Distribution of Wetlands

The distribution of wetlands in each eco-reach (Table 6.1) is highly variable for a number of reasons . First, the length of shoreline varies among eco-reaches; some are very long (e.g. **S7**) and some are very short (e.g. **SC3**). In some stretches of shoreline, wetland development is naturally limited (e.g. north shore of Lake Superior), whereas in others, many wetlands have been drained, dredged or filled (e.g. north shore of Lake Erie). Currently, wetlands occur in abundance in **OS1** and **OS2** (Upper St. Lawrence River), and in **OS3** (eastern Lake. Ontario; Stony Pt. To Presqu'ile Bay. Lake Huron and part of Lake Michigan also has richly-developed stretches of wooded dune and swale complexes as well as marshes and open embayments (**HG4/M8**; Cross Village – Squaw Bay. In Lake Superior, **S7** has many poor fens and dune and swale complexes, while Lake Michigan have many barrier-beach lagoons (**M2**). By comparison, relatively few wetlands are found on the southern shore of Lake Ontario (**OS5**), the northern shore of Lake. Erie (**E3**, **E4**), the St. Clair River (**SC3**), western shore of Lake Huron (**HG5**), or the northern shore of Lake Superior (**S3**, **S5**).

Our study confirmed many of the nearshore BIAs first identified by Reid and Holland in 1996. In fact, 6 of the 10 eco-reaches that we identified as having exceptional biodiversity values (> 90th percentile in at least one use category, and indicated in yellow on this map) were a subset of the nearshore BIAs. Our findings diverge only where Lake Superior is concerned, primarily because wetland development in much of the Lake Superior shoreline is naturally limited.

7.2 Value of Eco-reaches

7.2.1 General

We recognize that the value of the eco-reach must reflect both the distribution of wetlands as well as wetland size, uniqueness and quality. A very good example of this is **E3**, a stretch of shoreline on the north shore of Lake Ontario that have only a few wetlands that are relatively large, high-quality coastal marshes (e.g. Long Point Marsh). Unfortunately, information regarding wetland size and quality is incomplete, and we were not able to conduct a systematic comparison of eco-reaches with respect to these parameters.

As background to the discussion of the importance of eco-reaches for biodiversity, we list below some of the more important and generally recognized qualities of some of the eco-reaches delineated in this study.

On Lake Erie, **E3** (Turkey Point - Port Rowan), **E5** (Point Pelee), and **E6** (Detroit River - Old Woman Creek) all support abundant wetland, even though the wetlands of **E6** have been both greatly reduced in area and heavily degraded by human land use. **SC1** (the Detroit River) remains important for its large submergent vegetation beds, functioning as important habitat for waterfowl migration and nursery areas for fish. **SC2** (Lake St. Clair) contains the St. Clair River delta, the largest coastal delta in the Great Lakes. The delta is not only important for waterfowl and the Great Lakes fishery, but also provides habitat for rare coastal prairie types, with many associated rare plant species.

For Lake Huron, **HG6** (Saginaw Bay) support some of the most extensive coastal wetlands in the Great Lakes, even though many areas of coastal marsh and open lacustrine estuary have been eliminated. Other important areas of coastal marsh are found in **HG5** (Squaw Bay to Point Lookout), which has extensive dune and swale complexes, many with large coastal lagoons.

The St. Marys River (**S1/HG8b**), which is a connecting channel between Lakes Superior and Huron, contains very extensive coastal wetlands. These wetlands are recognized as being important for waterfowl migration. Extensive wetlands are also found in **S2** (Pancake Bay - Whitefish Pt.); most of these are dune and swale complexes or barrier beach lagoons. S6 (Duluth - Marble Pt.) contains both large deltas and barred estuaries, with several smaller barrier beach lagoons and dune and swale complexes.

On Lake Michigan, **M1** (Poupard Bay/Gros Cap – Thompson) has extensive dune and swale complexes, while **M3** (Squaw Point - Green Bay) is still associated with numerous wetlands, even though many of the previously important wetlands near Green Bay have been highly degraded because of agricultural and urban/industrial development. **M6** (Gary - Good Harbor Bay) supports extensive barred estuaries along the east side of Lake Michigan, with smaller wetlands associated with large wooded dune and swale complexes at the southern end of the lake.

7.2.1 Importance for Biodiversity

Eco-reaches that support comparatively high use by a large number of fish and bird species have been summarized in Table 7.1. This comparison shows clearly that the eco-reaches of Lake Ontario and the St. Lawrence should be protected for faunal use, especially **OS3a** and **OS4**, which are used extensively by many fish and breeding birds. Wetlands in **E3** (Lake Erie), **SC1** (along the Detroit River), and **SC2** (in Lake St. Clair) also deserve high priority not only because they serve important habitat for a large number of fish and bird species, but especially because there are so few wetlands remaining in these coastal stretches. Like Lake Ontario, Lake Michigan also contains several eco-reaches (**M2**, **M3**, **M4**, **M6a**) that are used as habitat by a large number of Great Lakes fishes, and should therefore be conserved.

Consistent with the list of nearshore BIAs, the Detroit River, Lake St. Clair and the St. Clair River, and the shores of Lake Ontario and Lake Michigan are found to contain exceptionally diverse habitat for fish and breeding birds. Our study also confirmed the importance of the Lake Huron-Georgian Bay eco-reaches as bird habitat for more than 60% of the breeding birds of Ontario. Although the wetlands of L. Superior support a lower diversity of fish and bird use relative to the other lakes, the type of fish and bird community are recreationally and commercially valuable. Future effort should focus on biodiversity values of eco-reaches on a lake-by-lake basis because each Great Lake and connecting channel must be evaluated on their own for conservation and biodiversity investment purposes.

Table 7.1 Important eco-reaches for faunal use

Lake/Connecting Channel	Eco-Reaches		
	Spawning habitat	**Nursery habitat**	**Breeding Bird Habitat**
St. Lawrence-Lake Ontario	OS1, **OS3a**&b, **OS4**,OS5, OS6, OS7	OS1, **OS3a**, **OS4**, OS6	**OS3a**, **OS4**
Lake Erie	**E3**, E6a, E6b, E7	**E3**, E6a, E6b, E7	E3
Detroit River, Lake St. Clair and St. Clair River	**SC1**, **SC2**	**SC1**, **SC2**, SC3	
Lake Huron & Georgian Bay	HG4/M8, HG6		HG1, HG2, HG7, HG9
Lake Superior & St. Marys River		S5	
Lake Michigan	**M2**, **M3**, **M4**, **M6a**	**M2**, **M3**, **M4**, **M6a**	

7.3 Other Considerations

In this study, we have illustrated how ecologically important eco-reaches of coastal wetlands can be identified across the Great Lakes basin, and within a Great Lake. We recognize that the present comparison has been limited by the availability of easily accessible information. The results of any comparison will be entirely dependent on available data and the criteria chosen to screen for importance. For example, because of time constraints, we were only able to compare the total number of fish and bird species that used these eco-reaches. Future studies could also/alternatively focus on the number or relative abundance of economically and recreationally important species that use these stretches of shoreline.

To make this approach a truly objective assessment, we must also complete the U.S. wetland inventory, and locate databases of bird use for U.S. wetlands. We need to conduct vegetation analyses using the same methods for both Canadian and U.S. wetlands. We would also like to incorporate more recent information for at least a subset of these wetlands to determine if conclusions drawn regarding faunal use based on 15-20-y-old databases are still applicable today.

This study should be considered a first small step towards identifying "biodiversity investment areas" for coastal wetlands in the sense of Reid and Holland (1996). Other pertinent information that must be considered in identifying coastal wetland BIAs are the types of stressors applicable to eco-reaches, the type of existing government protection programs, the feasibility of implementing investment strategies, and the recreational/commercial value of different biota in the respective eco-reaches.

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9. Appendices

Appendix 1

Summary of the distribution of coastal wetlands in the Great Lakes basin, associated significant features and their current status gleaned from the report of Maynard and Wilcox (1997). Data for Lake Michigan wetlands were obtained from Minc (1997) and added to the table because they were absent in Maynard and Wilcox's report.

Lake/ River sub-basin	Shoreline Length (km)	Wetland abundances and area (in brackets)		Wetland status and significant features	
		Canadian	U.S.	Canadian	U.S.
Lake Superior [1]	**5,105**	**21** (915 ha) known (10 evaluated by OMNR); 3500 ha remains to be evaluated	**272** (21,357 ha)	· no comprehensive estimate of coastal wetland losses available · wetlands affected by site-specific stressors and water-level regulation (locks at Sault Ste. Marie) · extensive use of marshes by fish for spawning, feeding, shelter and nursery; important migratory habitat for waterfowl, colonial nesting birds, raptors and song birds.	
St. Marys River [1]	**112**	**8** (3705 ha); 130 need to be evaluated	**76** (5384 ha)	· no significant loss due to human influence noted · wetlands affected by site-specific stressors, including dredging, filling, sediment and industrial contamination and commercial shipping · emergent areas serve as spawning, nursery and feeding habitat for sportfish; significant area of waterfowl production, and important for raptors and black tern	
Lake Michigan [2]		not applicable	**389**	Not available	
Lake Huron [1]	**6,373**	**43** (7159 ha) with 100+ not evaluated; 12,600 ha in Georgian Bay		· No comprehensive estimate of loss but probably low, occurring around urban areas · recent losses stem from shoreline modification for cottage development · non-indigenous species have colonized and established in Georgian Bay and Saginaw Bay (includes common carp, purple loosestrife and zebra mussels) · very complex vegetation communities; fens located on Lake Huron and Georgian Bay considered globally imperilled communities by Nature Conservancy · extensive use by fish for feeding, shelter, spawning, nursery, dispersal of young and migration; important habitat for amphibians and reptiles; significant waterfowl production in Georgian Bay and Saginaw Bay; used by nesting colonial waterbirds for breeding, feeding or migration.	

Lake/ River sub-basin	Shoreline Length (km)	Wetland abundances and area (in brackets)		Wetland status and significant features	
		Canadian	U.S.	Canadian	U.S.
St. Clair River [1]		550 ha in entire river (96 ha identified along Ontario shore, only 13 of these evaluated); wetlands are now uncommon above St. Clair River delta.		· no comprehensive estimate of wetland loss, but losses have been attributed to shoreline modification, filling, channelization and dredging along shores of river · other stressors include shipping, shoreline erosion, contaminated sediments and waters. · primarily composed of submersed species · river is not important for breeding or migration of waterfowl; however, fish depend greatly for spawning, nursery and feeding; many species of amphibians and reptiles found here.	
Lake St. Clair [1]	**272** (excluding channels in delta)	**4** complexes (12,769 ha) in delta; **5** (188 ha)	**3** complexes (3,500 ha) in delta; **6** (269+ ha)	34% of coastal wetlands lost in delta and lake between 1873 and 1968, mainly because of conversion to farm land; recent losses due to agricultural drainage (89%) and cottage development (11%). A third of St. Clair Marshes Complex in Mitchell Bay is dyked.	51% lost between 1873 to 1968, mostly due to agriculture, urban and recreational development. Dyked marshes include most of Harsens Island wetlands (dyked for intensive waterfowl management) and all of St. Johns Marsh (dyked for roads and housing)
				· dyking reduces access to fish and diminishes diversity. · support tremendous diversity of plants, fish and wildlife; important habitat for species of fish for feeding, spawning, shelter and nursery; many species of amphibians and reptiles · identified as one of the most significant areas for waterfowl, production, staging and migration in the Great Lakes; also important for raptors, waterbirds, and mammals.	

Lake/ River sub-basin	Shoreline Length (km)	Wetland abundances and area (in brackets)		Wetland status and significant features	
		Canadian	U.S.	Canadian	U.S.
Detroit River [1]	**107** (Cdn); **127** (U.S.)	**5** (1136 ha)	**16** (1,382)	· no comprehensive estimate of wetland loss, but losses have been attributed to dredging, filling and shoreline modification; other stressors include shipping and associated dredging and urban and industrial development · contamination by phosphates, heavy metals, oils and PCBs, especially along the U.S. shoreline; vulnerable to invasive exotic species of plants, fish and invertebrates · many marshes are dyked and have accompanying problems of being isolated from the rest of the lake · mostly riverine and river-mouth marshes, dominated by submergent macrophytes · important for fish spawning, and nursery; many species of reptiles and amphibians found there; used for waterfowl production and migratory birds.	
Lake Erie [1]	**1,402**	**31** (18,866 ha)	**87** (7,937ha)	Up to 70% of the large Point Pelee Marsh was drained between 1880 and mid-1970s; losses have also occurred in vicinity of large sand spits; small portion has been dyked for water-fowl management	Has suffered extensive wetland losses, primarily for agricultural development; most remaining wetlands have been dyked for waterfowl management
				· Stressors include high nutrient and sediment loads, contaminants (herbicides) shoreline modification and introduction of exotic species such as common carp · support the largest diversity of plant and animal species in the Great Lakes · primarily emergent and submergent marshes with diverse habitats for rare plant species · important for fish spawning, nursery and feeding (includes some rare species); habitat for large number of amphibians and reptiles; Long Point is critical habitat for migratory waterfowl, nesting colonial birds, wading birds, shore birds and raptors.	
Niagara River [1]	**60** (Cdn) **112** (U.S.)	**4** (85 ha)	**9** (158 ha)	no comprehensive information of wetland loss but losses have been attributed to urban encroachment and shore-line modification	large portion of shoreline developed, especially near Buffalo; emergent marsh filled for industry and railroad development

Lake/ River sub-basin	Shoreline Length (km)	Wetland abundances and area (in brackets)		Wetland status and significant features	
		Canadian	U.S.	Canadian	U.S.
				· stressors include contamination of water and sediment by toxic wastes and sewage and subsequent bioaccumulation in foodweb, and water withdrawal from the river · significant plant species · submerged vegetation provides important spawning and nursery grounds for many fish species; habitat for wide range of amphibians and reptiles	
Lake Ontario [1]	**1168**	**87** (11,538)	**168** (5,529 ha)	Severe losses of wetlands following European settlement (up to 100% in some stretches of shoreline); due primarily to agricultural drainage, urban encroachment and water-level regu-lation	nearly 60% of wetlands lost, mostly associated with heavily populated areas; some losses due to shoreline modification, dredging, and water-level regulation
				• contamination of water and sediment by toxic wastes, bioaccumulation problems, high sediment loading, and eutrophication further stress wetlands · rare plant species found · critical spawning, nursery, and feeding habitat for large number of fish species; important habitat for amphibians and reptiles; wetlands in eastern Lake Ontario rival those of St. Clair Delta for waterfowl production; also important for waterbirds, colonial nesting birds and migratory birds	
St. Lawrence River [1]	**186** (Wolfe Island to Quebec border)	**38** (7,062 ha)	not available	• Greatly altered by construction of St. Lawrence Seaway, dredging for navigation ,power production, and water-level regulation · shoreline modification of Canadian side resulted in wetland losses · other stressors: nutrient /sediment loading, invasive exotic species, toxic and fecal contamination and bioaccumulation of PCBs in submergents and floating species · significant plant species found; major recreational fisheries supported here; one of the few large self-sustaining populations of muskellunge in North America · primary importance as migration and staging habitat for waterfowl; also important for colonial nesting waterbirds, amphibians and reptiles	

[1]Data source: Maynard and Wilcox (1996) [2]Data source: Minc (1997)

Appendix 2a

Subset of coastal wetlands located on the Canadian shoreline of the Great Lakes. Site Type (ST) according to Table 4.2.

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
1	Bainsville Bay Marsh/Point Mouillee	St. Lawrence River	OS1	Riverine	ST10	407	
2	Westley's Creek Marsh	St. Lawrence River	OS1	Riverine	ST9, ST11	17	
3	South Lancaster Wetland	St. Lawrence River	OS1	Riverine	ST11		Part of Charlottenburg
4	Ile Kit Kit	St. Lawrence River	OS1	Riverine	ST13		
5	IR 59 (Squaw Island)	St. Lawrence River	OS1	Riverine	ST13		
6	Charlottenburgh Marsh (Fraser Pt. Island)	St. Lawrence River	OS1	Riverine	ST11, ST9	851	Includes Fraser Point Island
7	Cameron's Island	St. Lawrence River	OS1	Riverine	ST13		
8	Thick Marsh (Ile St. Regis to Pointe Fraser	St. Lawrence River	OS1	Riverine	ST9, ST11, ST13		
9	IR 59 (Renshaw Island)	St. Lawrence River	OS1	Riverine	ST13		
10	Colquhoun Islands Wetlands	St. Lawrence River	OS1	Riverine	ST13		Pilon Island South
11	Pilon Island Wetland	St. Lawrence River	OS1	Riverine	ST13		
12	Hoople Bay/Creek Marsh	St. Lawrence River	OS1	Riverine	ST10, ST11	169	
13	Upper Canada Migratory Bird Sanctuary/Morrison Island	St. Lawrence River	OS1	Riverine	ST10, ST11	321	
14	Ault Island	St. Lawrence River	OS1	Riverine	ST10		Not in WIRE Net database
15	C.F.B.P. Wetland	St. Lawrence River	OS1	Riverine	ST9		
16	Riverside Marsh Wetland	St. Lawrence River	OS1	Riverine	ST10	134	
17	Hoasic Creek Marsh	St. Lawrence River	OS1	Riverine	ST12		
19	Doran Creek Marsh Complex	St. Lawrence River	OS1	Riverine	ST11	42	
20	McLaughlins Creek Marsh Complex	St. Lawrence River	OS1	Riverine	ST11	22	
21	Edwardsburgh Marsh	St. Lawrence River	OS1	Riverine	ST17		
22	Johnstown Marsh Complex	St. Lawrence River	OS1	Riverine	ST10	232	
24	Bradley's Creek Wetland	St. Lawrence River	OS1	Riverine	ST11	4	
25	South Augusta Wetland Complex	St. Lawrence River	OS1	Riverine	ST17, ST12		
26	Grant's Creek Wetland	St. Lawrence River	OS1	Riverine	ST11, ST10	10	
27	Molly's Gut Wetland Complex	St. Lawrence River	OS1	Riverine	ST11	7	
28	Jones Creek Marsh	St. Lawrence River	OS2	Riverine	ST11	140	
29	Grenardier Island Wetland Complex	St. Lawrence River	OS2	Riverine	ST13, ST9	868	Includes Poverty Island
30	La Rue Mills Creek Wetland Complex	St. Lawrence River	OS2	Riverine	ST12		
31	Hill Island East Wetland	St. Lawrence River	OS2	Riverine	ST10	72	
32	Mulcaster Island Wetlands	St. Lawrence River	OS2	Riverine	ST13		Not in WIRE Net database

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
33	Ivy Lea Wetland Complex	St. Lawrence River	OS2	Riverine	ST11, ST12	64	
34	Collier Island Wetland	St. Lawrence River	OS2	Riverine	ST10	16	
35	Landon's Bay Wetland	St. Lawrence River	OS2	Riverine	ST11, ST10, ST12	46	
36	Stave Island Wetland Complex	St. Lawrence River	OS2	Riverine	ST10	9	
37	Halsteads Creek Marsh	St. Lawrence River	OS2	Riverine	ST12, ST11	8	
38	Halsteads Bay Marsh	St. Lawrence River	OS2	Riverine	ST10, ST9	64	
39	Gray's Creek Wetland	St. Lawrence River	OS2	Riverine	ST11	21	
40	Legges Creek Wetland	St. Lawrence River	OS2	Riverine	ST9, ST12	25	
41	Gordon Island Wetland	St. Lawrence River	OS2	Riverine	ST13		Not in WIRE Net database
42	Hay Island Marsh	St. Lawrence River	OS2	Riverine	ST13, ST10	60	
43	Camelot Island	St. Lawrence River	OS2	Riverine	ST13		Not in WIRE Net database
44	Bostwick Island Wetland Complex	St. Lawrence River	OS2	Riverine	ST13	33	
45	Willowbank Marsh	St. Lawrence River	OS3a	Riverine	ST11, ST12	40	
46	Firman's Creek Wetland	St. Lawrence River	OS3a	Riverine	ST11	10	
47	Seburns Creek Wetland	St. Lawrence River	OS3a	Riverine	ST10	60	
48	Johnson Bay Wetland	St. Lawrence River	OS3a	Riverine	ST10, ST11	265	
49	Grass Creek Wetland	St. Lawrence River	OS3a	Riverine	ST11	40	
50	Pitt's Ferry Wetland	St. Lawrence River	OS3a	Palustrine	ST17		
51	Lawless Wetland	St. Lawrence River	OS3a	Riverine	ST9		
52	Cassidy's Bay Wetland	St. Lawrence River	OS3a	Riverine	ST10	4	
53	Madoma Marsh	St. Lawrence River	OS3a	Riverine	ST11	60	
54	Oak Point Wetland	St. Lawrence River	OS3a	Riverine	ST9	19	
55	Wolfe Island Wetland Complex	St. Lawrence River	OS3a	Riverine	ST10	1398	
56	Button Bay Wetland	St. Lawrence River	OS3a	Riverine	ST10	95	
57	Bayfield Bay Marshes	St. Lawrence River	OS3a	Riverine	ST11	506	
58	McDonnell Bay Wetland/Brown's Bay	St. Lawrence River	OS3a	Riverine	ST10	172	
59	Barrett Bay Wetlands (Wolfe Is.)	Lake Ontario	OS3a	Lacustrine	ST4	65	
60	Sand Bay Marsh (Wolfe Is.)	Lake Ontario	OS3a	Lacustrine	ST11, ST4	65	
61	Reeds Bay	Lake Ontario	OS3a	Lacustrine	ST11, ST4	27	
62	Big Sandy Bay Wetland (Wolfe Is.)	Lake Ontario	OS3a	Lacustrine	ST5	338	
64	Cataraquai River Marsh	Lake Ontario	OS3a	Riverine	ST11	504	
65	Greater Cataraquai Marsh	Lake Ontario	OS3a	Riverine	Not available		Not in WIRE Net database
66	Little Cataraquai Marsh	Lake Ontario	OS3a	Riverine	ST11, ST9	360	
67	Little Cataraquai Creek Complex	Lake Ontario	OS3a	Riverine	Not available		Not in WIRE Net database
68	Parrott's Bay Marsh	Lake Ontario	OS3a	Riverine	ST11, ST4	30	
69	Long Point Marsh	Lake Ontario	OS3a	Lacustrine	ST2, ST11		

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
70	Amherst Island Complex/Long Pt. Bay Wetland	Lake Ontario	OS3a	Lacustrine	ST2, ST11	157	
71	Bath Point Wetland	Lake Ontario	OS3a	Palustrine	ST17, ST13	14	
72	Wemps Bay Marsh Wetland	Lake Ontario	OS3a	Lacustrine	ST11, ST2		
73	Nut Island Duck Club Marsh Wetland	Lake Ontario	OS3a	Lacustrine	Not available		Not in WIRE Net database
74	Cressy Swamp	Lake Ontario	OS3a	Riverine	ST11, ST4	128	
75	Lost Lake Swamp Wetland	Lake Ontario	OS3a	Palustrine	Not available		Not in WIRE Net database
76	Cape Vasey Excarpment	Lake Ontario	OS3a	Palustrine	Not available		Not in WIRE Net database
77	Waupoos Creek Swamp	Lake Ontario	OS3a	Lacustrine	ST11, ST3		
78	Lake on the Mountain Swamp	Lake Ontario	OS3a	Palustrine	ST17	140	
79	South Bay Marsh	Lake Ontario	OS3a	Lacustrine	ST4, ST11	62	
80	Big Sand Bay Wetland (near Picton)	Lake Ontario	OS3a	Lacustrine	ST11, ST2	122	
81	Soup Harbour Wetland	Lake Ontario	OS3a	Lacustrine	ST2	69	
82	Salmon Point Wetland	Lake Ontario	OS3a	Lacustrine	ST2	72	
83	East Lake Marsh	Lake Ontario	OS3a	Lacustrine	ST5	230	
84	West Lake Wetlands	Lake Ontario	OS3a	Lacustrine	ST5, ST11, ST4	706	
85	Adolphustown Marsh	Lake Ontario	OS3a	Lacustrine	ST1, ST11		
86	Carnachan Bay Wetland Complex	Lake Ontario	OS3a	Lacustrine	ST4, ST11	71	
87	Hay Bay Marsh Wetland	Lake Ontario	OS3a	Lacustrine	ST4, ST11	1333	
88	Pike Creek Swamp	Lake Ontario	OS3a	Riverine	ST12		
89	Lower Napanee River Wetland	Lake Ontario	OS3a	Riverine	ST11, ST3	206	
90	Foresters Island Wetland	Lake Ontario	OS3a	Lacustrine	ST13		
91	Airport Creek Marsh	Lake Ontario	OS3a	Lacustrine	ST1		
92	Lower Sucker Creek	Lake Ontario	OS3a	Lacustrine	ST11		
93	North Port Swamp	Lake Ontario	OS3a	Palustrine	ST17		Not in WIRE Net database
94	Bluff Point Wetland	Lake Ontario	OS3a	Lacustrine	ST1		
95	Big Marsh Wetland	Lake Ontario	OS3a	Lacustrine	ST11, ST5		
96	Big Island Marsh	Lake Ontario	OS3a	Lacustrine	ST4, ST11	858	
97	Lower Salmon River Wetland	Lake Ontario	OS3a	Lacustrine	ST11		
98	Robinson Cove Marsh	Lake Ontario	OS3a	Lacustrine	ST3		
99	Blessington Creek Marsh	Lake Ontario	OS3a	Lacustrine	ST5, ST11	75	
100	Bell Creek Swamp Complex	Lake Ontario	OS3a	Riverine	ST12		
101	Belleville Marsh	Lake Ontario	OS3a	Lacustrine	ST2		
102	Sawguin Creek Wetland	Lake Ontario	OS3a	Riverine	ST12, ST11, ST4	2093	
103	Bellville Treatment Plant Wetland	Lake Ontario	OS3a	Lacustrine	ST4	3	
104	Bayside Wetlands	Lake Ontario	OS3a	Lacustrine	ST1	19	

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
105	Pine Point Wetland	Lake Ontario	OS3a	Lacustrine	ST1	26	
106	Carrying Place and 12 O'Clock Point Marsh	Lake Ontario	OS3a	Lacustrine	ST2, ST11	62	
107	Wellers Bay/Barcovan Beach Wetland	Lake Ontario	OS3a	Lacustrine	ST6, ST5, ST8		
108	Consecon Lake Marsh	Lake Ontario	OS3a	Lacustrine	ST17		Not in WIRE Net database
110	Pleasant Bay Wetlands	Lake Ontario	OS3a	Lacustrine	ST4	299	Not in WIRE Net database
111	Huyck's Bay	Lake Ontario	OS3a	Riverine	ST12, ST5	245	Not in WIRE Net database
112	Dead Creek Marsh Complex	Lake Ontario	OS4	Palustrine	ST17, ST12, ST4	359	
113	Presqu'ile Bay Marsh Wetland	Lake Ontario	OS4	Lacustrine	ST8	992	
114	Hunt and Beach Rd. Popham Bay Wetland	Lake Ontario	OS4	Lacustrine	ST5		
115	Spencer Point Wetland	Lake Ontario	OS4	Lacustrine	ST5, ST17		
116	Colbourne Creek Wetland	Lake Ontario	OS4	Lacustrine	ST11, ST4	18	
117	Wicklow Bay Wetland	Lake Ontario	OS4	Lacustrine	ST12	19	
118	Wicklow Gravel Pit Wetland	Lake Ontario	OS4	Lacustrine	ST2		
119	Grafton Swamp	Lake Ontario	OS4	Lacustrine	ST17, ST11	62	
120	Brookside Wetland	Lake Ontario	OS4	Palustrine	ST17		
121	Carr's Marsh	Lake Ontario	OS4	Lacustrine	ST5	61	
122	Peter Rock Marsh	Lake Ontario	OS4	Lacustrine	ST5	2	
123	Port Britain Wetland	Lake Ontario	OS4	Lacustrine	ST11, ST5	18	
124	Crysler Point Wetland	Lake Ontario	OS4	Lacustrine	ST11, ST4	6	
125	Wilmot Rivermouth Wetland	Lake Ontario	OS4	Lacustrine	ST11, ST12	26	Lower Wilmot Cr. Wetland
126	Pawson Marsh	Lake Ontario	OS4	Lacustrine	ST11	24	Port Darlington Marsh
127	Westside Creek Wetland	Lake Ontario	OS4	Lacustrine	ST11	36	West Side Beach Marsh
128	Raby Head Wetland #2	Lake Ontario	OS4	Lacustrine	ST11	3	
129	Raby Head Wetland #1	Lake Ontario	OS4	Lacustrine	ST5	4	
130	McLaughlin Bay Wetland	Lake Ontario	OS4	Lacustrine	ST5, ST4		
131	Second Marsh	Lake Ontario	OS4	Lacustrine	ST5, ST4, ST11	105	
132	Pumphouse Marsh	Lake Ontario	OS4	Lacustrine	ST5	2	
133	Corbett Creek Mouth Marsh	Lake Ontario	OS4	Lacustrine	ST11, ST4	26	Lower Corbett Creek
134	Lynde Creek Marsh	Lake Ontario	OS4	Lacustrine	ST11	110	
135	Cranberry Marsh	Lake Ontario	OS4	Lacustrine	ST5, ST4	33	
136	Carruther's Creek Marsh	Lake Ontario	OS4	Lacustrine	ST5	13	
137	Duffins Creek Wetland	Lake Ontario	OS4	Lacustrine	ST11	61	
138	Frenchman's Bay Tributary (east)	Lake Ontario	OS4	Riverine	ST12		
139	Frenchman's Bay Marshes	Lake Ontario	OS4	Lacustrine	ST5, ST11	45	
140	Petticoat Creek Wetland	Lake Ontario	OS4	Riverine	ST12		

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
141	Rouge River Marshes	Lake Ontario	OS4	Lacustrine	ST11	56	Lower Rouge Marshes
142	Highland Creek Wetlands	Lake Ontario	OS4	Lacustrine	ST11, ST12	8	
143	East Ward's Island Wetland	Lake Ontario	OS4	Lacustrine	ST3		
144	Mugg's Island Wetland	Lake Ontario	OS4	Lacustrine	ST3		
145	Toronto Island Wetland Complex/Forestry Island Wetland	Lake Ontario	OS4	Lacustrine	ST5		East Ward's &Mugg's Island
146	Humber River Marshes	Lake Ontario	OS4	Lacustrine	ST11	26	
147	Lakefront Promenade Park Wetland	Lake Ontario	OS4	Lacustrine	ST3		
148	Credit River Marshes	Lake Ontario	OS4	Lacustrine	ST12		
149	Rattray Marsh	Lake Ontario	OS4	Lacustrine	ST4, ST11	10	
150	Joshua Creek Valley	Lake Ontario	OS4	Lacustrine	ST12	3	
151	Oakville Marsh	Lake Ontario	OS4	Lacustrine	ST11		Not in WIRE Net database
152	Bronte Creek Wetland	Lake Ontario	OS4	Lacustrine	ST12, ST11	6	
153	Hendrie Valley Lambs Hollow Wetland	Lake Ontario	OS4	Lacustrine	ST11, ST12		
154	Cootes Paradise Marsh	Lake Ontario	OS4	Estuarine	ST15	250	Modified drowned rivermouth
155	Van Wagner's Marsh	Lake Ontario	OS4	Palustrine	ST17, ST12		
156	Jordan Station Marsh	Lake Ontario	OS4	Lacustrine	ST15	136	
157	Sixteen and Seventeen Mile Creeks Terrace Valley	Lake Ontario	OS4	Lacustrine	ST5, ST12		
158	Fifteen Mile Creek Wetland	Lake Ontario	OS4	Lacustrine	ST5	31	
159	Martindale Marsh	Lake Ontario	OS4	Lacustrine	ST4, ST12	55	
160	Eight Mile Creek Estuary	Lake Ontario	OS4	Lacustrine	ST11, ST12	5	
161	Four Mile Creek Estuary	Lake Ontario	OS4	Lacustrine	ST11	9	Two mile-Four mile Creek Estuary
162	Lake Gibson & Moodie, Welland C. River and Turn Basin	Niagara River	E1	Lacustrine	ST4, ST17	63	
163	Beaver Dams Creek Marsh	Niagara River	E1	Riverine	ST12	1	Not in WIRE Net database
164	Niagara Glen Wetland	Niagara River	E1	Riverine	ST9		
165	Welland River Marshes	Niagara River	E1	Riverine	ST12, ST11	40	
167	Tea Creek Wetland	Niagara River	E1	Riverine	ST12	16	Not in WIRE Net database
168	Navy Island Wetland	Niagara River	E1	Riverine	ST13		
169	Lyons Creek	Niagara River	E1	Riverine	ST12	151	
170	Lyons Creek Flood Plain Wetlands	Niagara River	E1	Riverine	ST12		
171	Highland Golf Course Woodlot	Niagara River	E1	Riverine	ST12, ST17	20	
172	Black Creek Wetland	Niagara River	E1	Riverine	ST12, ST11		
173	Miller's Creek Wetland	Niagara River	E1	Riverine	ST12, ST11		
174	Frenchman's Creek Wetland	Niagara River	E1	Riverine	ST12, ST11	5	
175	Six Mile Creek Wetland (alt. Wavecrest Bush Wetland)	Lake Erie	E2	Lacustrine	ST12, ST11		Wavecrest Bush Wetland

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
176	Point Albino Wetland Complex	Lake Erie	E2	Palustrine	Not available	153	
179	Empire Beach Backshore Basin Forest Wetland (Shisler Point Woodlot)	Lake Erie	E2	Palustrine	ST17		Shisler Point Woodlot
180	Nickle Beach Woodlot and Marsh	Lake Erie	E2	Palustrine	ST17, ST4	58	
181	Wainfleet Wetlands Conservation Area	Lake Erie	E2	Palustrine	ST17		
182	Wainfleet Bog	Lake Erie	E2	Palustrine	ST17, ST12	100	
183	Emerson Road Woodlots	Lake Erie	E2	Palustrine	ST17	32	
184	Moulton Wetland West	Lake Erie	E2	Palustrine	ST17	201	
185	Dunnville Marshes Wetland	Lake Erie	E2	Estuarine	ST14		
186	Erco Wetland	Lake Erie	E2	Lacustrine	ST11		
187	James N. Allen Park Woodlot Wetland	Lake Erie	E2	Palustrine	ST17		
188	Evan's Creek Mouth Wetland	Lake Erie	E2	Lacustrine	ST11		Not in WIRE Net database
189	Wardell's Creek Mouth	Lake Erie	E2	Lacustrine	ST11		Not in WIRE Net database
190	Gates Creek Mouth Wetland	Lake Erie	E2	Lacustrine	ST11, ST5	8	
191	Selkirk Provincial Park Wetland	Lake Erie	E2	Lacustrine	ST11, ST15?	32	
192	Hickory Creek	Lake Erie	E2	Lacustrine	ST11		Not in WIRE Net database
193	Nanticoke Creek Mouth	Lake Erie	E2	Lacustrine	ST11		Not in WIRE Net database
194	Turkey Point Marsh	Lake Erie	E3	Lacustrine	ST6, ST4		
195	Peripheral Marsh	Lake Erie	E3	Lacustrine	ST1		Not in WIRE Net database
196	Big Creek at Port Royal	Lake Erie	E3	Riverine	ST12, ST11		
197	Big Creek Flood Plain	Lake Erie	E3	Riverine	ST12, ST17		Not in WIRE Net database
198	Hahn/Big Creek Marshes	Lake Erie	E3	Lacustrine	ST6, ST5	111	
199	Long Point Wetland Complex	Lake Erie	E3	Lacustrine	ST6	13465	
200	EY-10 Wetland	Lake Erie	E4	Palustrine	ST17		
201	EY-9 Wetland	Lake Erie	E4	Palustrine	ST17		
202	Keive's Bog Wetland Complex	Lake Erie	E4	Palustrine	ST17		
203	Rondeau Bay NW Shore Wetland	Lake Erie	E4	Lacustrine	ST3, ST11	930	
204	Rondeau Provincial Park Wetland	Lake Erie	E4	Lacustrine	ST6	271	
205	McGeachy Pond	Lake Erie	E4	Lacustrine	ST4		Not in WIRE Net database
206	Wheatley Two Creeks Wetland	Lake Erie	E4	Lacustrine	ST11, ST12	12	
207	Muddy Creek Wetland	Lake Erie	E4	Lacustrine	ST11, ST12	11	
208	Hilman Marsh Wetland	Lake Erie	E5	Lacustrine	ST15	362	
209	Lake Pond Marsh (Point	Lake Erie	E5	Lacustrine	ST7, ST4	1175	Point Pelee Wetland

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
	Pelee Nat. Park)						
210	Sturgeon Creek Wetland	Lake Erie	E5	Lacustrine	ST4, ST11	31	
211	Cedar Creek Wetland	Lake Erie	E5	Estuarine	ST15	250	
212	Fox Creek Wetland (alt. Dolson's Creek)	Lake Erie	E5	Lacustrine	ST11	19	
213	Oxley Poison Sumac Swamp	Lake Erie	E5	Palustrine	ST17		
214	Lypps Beach Wetland Complex	Lake Erie	E5	Lacustrine	ST2	13	
215	Big Creek Marsh Wetland	Lake Erie	E5	Estuarine	ST15	1000	
216	Mann's Marsh	Lake Erie	E5	Lacustrine	ST2	55	
218	Lighthouse Point Wetland	Lake Erie	E6b	Lacustrine	ST7, ST3		
219	Fish Point Wetland (Pelee Island)	Lake Erie	E6b	Lacustrine	ST5, ST2	45	
220	Canard River Mouth Marsh	Detroit River	SC1	Riverine	ST11	416	
221	General Chemical Brine Wells Marshes	Detroit River	SC1	Riverine	ST10		Not in WIRE Net database
222	Detroit River Marshes	Detroit River	SC1	Riverine	ST9	575	
223	Turkey Creek Wetland	Detroit River	SC1	Riverine	ST11, ST12	32	
224	Fighting Island Wetland	Detroit River	SC1	Riverine	ST13, ST18	113	
225	Belle Island Park Wetland	Detroit River	SC1	Riverine	ST13, ST17		
226	Ruscom Shores Marsh	Lake St. Clair	SC2	Lacustrine	ST5, ST1	29	
227	Tremblay Beach Marsh	Lake St. Clair	SC2	Lacustrine	ST5, ST2	24	
228	Paternoster Club Marsh	Lake St. Clair	SC2	Lacustrine	ST4	4	
229	Recess Club Marsh	Lake St. Clair	SC2	Lacustrine	ST11	2335	St. Clair R. Marshes
230	Reaume Marsh	Lake St. Clair	SC2	Lacustrine	ST11	2335	St. Clair R. Marshes
231	Thames River Mouth Wetland	Lake St. Clair	SC2	Lacustrine	ST11	2335	St. Clair R. Marshes
232	Bradley Farms Marshes	Lake St. Clair	SC2	Palustrine	ST17	2335	St. Clair R. Marshes
233	St. Clair National Wildlife Area	Lake St. Clair	SC2	Lacustrine	ST2, ST18	2335	St. Clair R. Marshes
234	Balmoral Club Marsh	Lake St. Clair	SC2	Lacustrine	ST2	2335	St. Clair R. Marshes
235	St. Lukes Club Marsh 1	Lake St. Clair	SC2	Lacustrine	ST4	2335	St. Clair R. Marshes
236	St. Lukes Club Marsh 2	Lake St. Clair	SC2	Palustrine	ST17	2335	St. Clair R. Marshes
237	Mallard Pond Marsh	Lake St. Clair	SC2	Palustrine	ST17	2335	St. Clair R. Marshes
238	Bay Lodge Marshes	Lake St. Clair	SC2	Lacustrine	ST2	2335	St. Clair R. Marshes
240	Big Point Club Marsh	Lake St. Clair	SC2	Lacustrine	ST4	2335	St. Clair R. Marshes
241	St. Clair Marshes Wetland	Lake St. Clair	SC2	Lacustrine	ST4, ST2, ST5, ST17	2335	St. Clair R. Marshes
242	Rex Club Marsh	Lake St. Clair	SC2	Palustrine	ST17	2335	St. Clair R. Marshes
243	Rex/Cadotte Marsh	Lake St. Clair	SC2	Lacustrine	ST11, ST4	2335	St. Clair R. Marshes
244	Griffore Marsh	Lake St. Clair	SC2	Palustrine	ST17	2335	St. Clair R. Marshes
245	Moon Island Marsh	Lake St. Clair	SC2	Lacustrine	ST4	2335	St. Clair R. Marshes
247	Mud Creek Club Marsh	Lake St. Clair	SC2	Lacustrine	ST4	2335	St. Clair R. Marshes
248	Rankin/Sloan Marsh	Lake St. Clair	SC2	Lacustrine	ST4	2335	St. Clair R. Marshes
249	Pintail Marsh	Lake St. Clair	SC2	Lacustrine	ST13	2335	St. Clair R. Marshes
250	Walpole Island First Nation Marshes	Lake St. Clair	SC2	Estuarine	ST14		St. Clair R. Marshes
251	Pigeon Marsh	Lake St. Clair	SC2	Riverine	ST12	2335	St. Clair R. Marshes

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
252	Bear Creek Marsh	Lake St. Clair	SC2	Riverine	ST12	2335	St. Clair R. Marshes
253	Chenal Ecarte Marshes	Lake St. Clair	SC2	Riverine	ST12		
254	Snye River Marshes	Lake St. Clair	SC2	Riverine	ST12	44	
255	Marshy Creek Marsh	Lake St. Clair	SC2	Riverine	ST12, ST11		
256	St. Clair Flats Wetlands	Lake St. Clair	SC2	Estuarine	ST14		
257	Stag Island Wetland	St. Clair River	SC3	Riverine	ST13	10	
258	Point Edward Marsh	St. Clair River	SC3	Riverine	ST10	3	
259	Kettle Point Marsh (alt. Shawhawanda Creek Woodlot and Marsh)	Lake Huron	HG1	Lacustrine	ST2	54	
260	Ipperwash Inner-dunal Wetland Complex	Lake Huron	HG1	Lacustrine	ST7		
261	Port Franks Wetland	Lake Huron	HG1	Lacustrine	ST12		
262	ESA BOS-6-B Wetland	Lake Huron	HG1	Lacustrine	ST12		
263	Datars Miller Swamp	Lake Huron	HG1	Palustrine	ST17		
264	ESA HAY-8-C Wetland	Lake Huron	HG1	Palustrine	ST17		
265	ESA STA-3-A Wetland	Lake Huron	HG1	Lacustrine	ST2, ST11		
269	Gully Creek ESA 60D-10A Wetland	Lake Huron	HG1	Lacustrine	ST12		
270	Goderich 51D Wetland	Lake Huron	HG1	Lacustrine	ST12		Not in WIRE Net database
271	Goderich 51A Wetland	Lake Huron	HG1	Lacustrine	ST12		Not in WIRE Net database
272	Colborne 52D Wetland	Lake Huron	HG1	Palustrine	ST17		Not in WIRE Net database
273	Lorne Beach Swamp	Lake Huron	HG1	Palustrine	ST17		Not in WIRE Net database
274	Baie du Dore Wetland	Lake Huron	HG1	Lacustrine	ST4	95	
275	Scott Point Wetland Complex	Lake Huron	HG1	Lacustrine	ST1, ST17	202	
276	MacGregor Point Wetland Complex	Lake Huron	HG1	Lacustrine	ST4, ST17		
277	Chiefs Point Wetland Complex	Lake Huron	HG1	Lacustrine	ST2, ST17	168	
278	Oliphant Wetland	Lake Huron	HG1	Lacustrine	ST1	173	
279	Red Bay Wetland Complex	Lake Huron	HG2	Lacustrine	ST1, ST17	353	
280	Fishing Islands Wetland Complex	Lake Huron	HG2	Lacustrine	ST13	168	alias Chiefs Point
281	Howendale Bay Wetland	Lake Huron	HG2	Lacustrine	ST3, ST11	36	St. Jean's Pt Nature Reserve
282	Sucker Creek Wetland	Lake Huron	HG2	Lacustrine	ST12, ST11		St. Jean's Pt Nature Reserve
283	Pike Bay Wetlands	Lake Huron	HG2	Lacustrine	ST4	42	
284	Black Creek Swamp Wetland	Lake Huron	HG2	Palustrine	ST17		
285	Stokes Bay Wetland	Lake Huron	HG2	Lacustrine	ST4, ST11, ST17		
286	Gauley Bay Wetland Complex	Lake Huron	HG2	Lacustrine	ST4, ST17		
287	Greenough Harbour Wetland	Lake Huron	HG2	Lacustrine	ST4, ST17	27	

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
288	Sadler Creek Wetland Complex	Lake Huron	HG2	Lacustrine	ST12, ST17		
289	Corsiande Bay Wetlands	Lake Huron	HG2	Lacustrine	ST3, ST17		
290	Dorcas Bay Wetlands	Lake Huron	HG2	Palustrine	ST17	110	
291	Barney Lake Wetland Complex	Lake Huron	HG2	Palustrine	ST17	151	
292	South Bay Wetlands	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST1		Includes Sims Bay
293	Leask Bay	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST1, ST11		Not in WIRE Net database
294	Leason Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST11, ST1		
295	On the Narrows Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST1		
296	Big Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST3		
297	Michael's Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST3, ST11		
298	Rathbun Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST11, ST3		
299	Hughson Bay Wetlands	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST11		
300	Providence Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST3		
301	Dominion Point	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST2		
302	Murphy Harbour Wetlands	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST3		
303	Mac's Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST11, ST3		
304	Misery Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST4, ST17		
305	Misery Point Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST1		
306	Little Huron Lake Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST5		
307	Carroll Wood Bay Wetlands	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST7		Not in WIRE Net database
308	Walkhouse Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST1		
309	Fisher Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST3		
310	Black Point Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST1		
311	Christina Bay Wetland	Manitoulin Isl./Lake Huron	HG2	Lacustrine	ST3		Fen
312	Mud Bay Wetland	North Channel	HG2	Lacustrine	ST1		(Cockburn Is)
313	Hyndman Bay Wetland	North Channel	HG2	Lacustrine	ST5		Not in WIRE Net database (Cockburn Is)
314	Mundy's Bay Wetland	North Channel	HG2	Riverine	ST9		(Cockburn Is)
315	Shigniconing Bay Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
316	Morrisville Bay Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
317	Cooks Bay Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		
318	Haydens Point Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
319	Bayfield Sound Wetlands	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
320	Rozels Bay Wetland (Barrie Island)	Manitoulin Isl./N. Channel	HG7	Riverine	ST12, ST10		
321	Campbell Bay Wetlands	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		
322	Lake Wosley Wetlands	Manitoulin Isl./N. Channel	HG7	Lacustrine	ST1, ST11		Isolated?
323	Gore Bay Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST10, ST11		
324	Rushy Cove Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		wetland by Rushy cove
325	Long Point Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		Not in WIRE Net database
326	Strawberry Channel Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9, ST11		
327	Thompson Point Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
328	White's Cove Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		
329	Gow Point - Castigan Point Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
330	Boswell Cove Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		
331	Chapleau Cove	Manitoulin Isl./N. Channel	HG7	Riverine	ST10		
332	Great La Cloche Island Wetlands	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
333	Little La Cloche Island Wetland	Manitoulin Isl./N. Channel	HG7	Riverine	ST9		
334	Wingfield Basin Wetland	Georgian Bay	HG7	Lacustrine	ST3		
335	Barrier Island ANSI Wetland	Georgian Bay	HG7	Lacustrine	ST1, ST13		Not in WIRE Net database
336	Collingwood Shores Wetland Complex	Georgian Bay	HG7	Lacustrine	ST2, ST16	166	Nottawasaga Isl. Nature Reserve
337	Collingwood Harbour Marsh	Georgian Bay	HG7	Lacustrine	ST1, ST11	96	
338	Cranberry Lake Marsh	Georgian Bay	HG7	Palustrine	ST17		
339	Wasaga Beach Wetland	Georgian Bay	HG7	Palustrine	ST17, ST16		
340	Georgina Beach	Georgian Bay	HG7	Lacustrine	ST1		Not in WIRE Net databse
341	Balm Beach Swamp	Georgian Bay	HG7	Palustrine	ST17, ST12		
342	Thuder Bay Swamp	Georgian Bay	HG10	Palustrine	ST17		Not in WIRE Net database
343	Awenda Shoreline Fen	Georgian Bay	HG10	Lacustrine	ST1		Fen
344	Giants Tomb Island Wetland	Georgian Bay	HG10	Lacustrine	ST13		
345	Penetang Marsh	Georgian Bay	HG10	Lacustrine	ST3		

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
346	Sucker Creek (Huronia) Wetland	Georgian Bay	HG10	Palustrine	ST17, ST12		
347	Midland Swamp Wetland	Georgian Bay	HG10	Palustrine	ST17		
348	Wye Marsh Wetland	Georgian Bay	HG10	Lacustrine	ST12		
349	Georgian Bay Islands National Park	Georgian Bay	HG10	Lacustrine	ST13, ST1		Not in WIRE Net database
350	Port McNicoll	Georgian Bay	HG10	Lacustrine	ST1	77	
351	Hog Bay Wetland	Georgian Bay	HG10	Lacustrine	ST3	71	
352	Victoria Harbour Wetland	Georgian Bay	HG10	Lacustrine	ST1	39	
353	Sturgeon Bay Marsh	Georgian Bay	HG10	Lacustrine	ST4, ST12	192	
354	Matchedash Bay Marsh	Georgian Bay	HG10	Lacustrine	ST12, ST4	807	
355	Methodist Island Wetland	Georgian Bay	HG10	Lacustrine	ST13		
356	Quarry Island Wetland	Georgian Bay	HG9	Lacustrine	ST1, ST13		
357	Tobies Bay Wetland	Georgian Bay	HG9	Lacustrine	ST1, ST17		
358	Partridge Bay Wetland	Georgian Bay	HG9	Lacustrine	ST3, ST17		
359	Naiscoot River Wetland	Georgian Bay	HG9	Lacustrine	ST11		Small, protected, fringing
360	South LaCloche Wetlands	North Channel	HG8a	Lacustrine	ST3		Small, protected, fringing
361	Killarney Provincial Park Wetlands	North Channel	HG8a	Lacustrine	ST3, ST11		Small, protected, fringing
362	East Sampson Island Wetland	North Channel	HG8a	Lacustrine	ST3, ST17		Small, protected, fringing
363	McGregor Island Wetland	North Channel	HG8a	Lacustrine	ST3, ST12	420	Small, protected, fringing
364	Jumbo Island Wetland	North Channel	HG8a	Lacustrine	ST3		Small, protected, fringing
365	Middle Sampson Island Wetlands	North Channel	HG8a	Lacustrine	ST3		Small, protected, fringing
366	Iroquois Island Wetlands	North Channel	HG8a	Lacustrine	ST3, ST17		Small, protected, fringing
367	Iroquois Bay Wetlands	North Channel	HG8a	Lacustrine	ST		Not in WIRE Net database
368	Fort LaCloche Wetland	North Channel	HG8a	Riverine	ST10, ST11		
369	Sagamok Point	North Channel	HG8a	Riverine	ST10		
370	Long Bay Wetland	North Channel	HG8a	Riverine	ST10		
371	Oak Bay	North Channel	HG8a	Riverine	ST10		
372	Spanish River Delta Marsh/Tomlinson Islands	North Channel	HG8a	Riverine	ST12 OR 2T14	305	
373	Marsh Bay Island 9 Wetland	North Channel	HG8a	Palustrine	ST17, ST12		
374	Dayton ESA	North Channel	HG8a	Riverine	ST9		Not in WIRE Net database
375	Thessalon Point Wetland	North Channel	HG8a	Riverine	ST9		Not in WIRE Net database
376	Joe Dollar Bay	North Channel	HG8a	Riverine	ST10		Not in WIRE Net database
377	Palideau Island Wetland	North Channel	HG8a	Riverine	ST10, ST13		Not in WIRE Net database
378	Garden Bay Wetland	North Channel	HG8a	Riverine	ST11		(mouth of Jordan Creek)

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
379	Hay Bay Wetland/Peatland	North Channel	HG8a	Palustrine	ST17, ST10		Peatland
380	McMenomy Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
381	Moffat Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
382	Mosquito Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST11, ST10		
383	Caradoc Point - Garside Bay Wetlands	North Channel/St. Joseph Is.	HG8b	Riverine	ST10, ST17		
384	Richmond Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST10		Not in WIRE Net database
385	Richmond Point Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
386	Wallace Island Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST13, ST9		
388	Milford Haven Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST10, ST11 ST12		
389	Tenby Bay Wetlands	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST11		
390	Whiskey Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST10?		
391	Duncan Island	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST13		
392	Elliot Point	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
393	Rains Point/La Pointe Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
395	Hay Marsh Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9	2275	
396	South West Otter Lake Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
397	Richardson Creek Mouth Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST11		
398	Two Tree River Mouth Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
399	Everens Point Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
400	Sailors Encampment Wetland/St. Joseph Island Marshes	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
401	Coyle Point/Reeds Point	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST11		Not in WIRE Net database
402	Coyle Point North Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
403	Stribling Point Wetlands	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
404	Humbug Point Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		Not in WIRE Net database
405	Desjardins Bay and Bamageseck Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
406	Sucker Creek Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST11, ST10		
407	Campement D'Ours Island	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		Not in WIRE Net database

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
408	Green Island	North Channel/St. Joseph Is.	HG8b	Riverine	ST17, ST9		
409	Dawson Island Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST10		
410	Stobie Creek Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST11		
411	Desbarats River Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST11, ST12, ST17		
412	Kensington Point Wetland/Killaly Point	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST17		Not in WIRE Net database
413	Anderson Creek Wetland	North Channel/St. Joseph Is.	HB8b	Riverine	ST10,ST17, ST11,ST12		
414	Quebec Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
415	Sutton Island North	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
416	Pine Island	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST13		
417	Maskinonge Bay Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST10	63	
418	Long Point Wetland	North Channel/St. Joseph Is.	HG8b	Riverine	ST9		
419	Neebish Island Wetlands	North Channel/St. Joseph Is.	HG8b	Riverine	ST9, ST10		
420	Lake George Wetland	St. Mary's River	S1	Riverine	ST9	262	
421	Echo Bay	St. Mary's River	S1	Riverine	ST11, ST10		
422	Sand Island Wetland	St. Mary's River	S1	Riverine	ST9, ST17		
423	Garden River	St. Mary's River	S1	Riverine	ST9, ST11		
424	Squirrel Island	St. Mary's River	S1	Riverine	ST9		Not in WIRE Net database
425	Little Lake George Wetland	St. Mary's River	S1	Riverine	ST13		
426	Point Charles Wetland	St. Mary's River	S1	Riverine	ST9		
427	Bells Point Wetland Complex	St. Mary's River	S1	Riverine	ST11, ST9		
428	Whitefish Island	St. Mary's River	S1	Riverine	ST13. ST17		Not in WIRE Net database
429	Carpin Beach Wetland/Leigh Bay	St. Mary's River	S1	Riverine	ST11, ST9		
430	Marks Bay Wetland	St. Mary's River	S1	Riverine	ST10		
431	Point Louise Wetland	St. Mary's River	S1	Palustrine	ST17, ST9		
432	Shore Ridges Conservation Area Wetland	Lake Superior	S2	Lacustrine	ST2, ST16		
433	Goulais River Wetland Area	Lake Superior	S2	Lacustrine	ST11, ST1		
434	Horeshoe Harbour Wetland	Lake Superior	S2	Lacustrine	ST1		
435	Sand Bay Wetland	Lake Superior	S2	Lacustrine	ST11		
436	Blue Water Bay Wetland	Lake Superior	S2	Lacustrine	ST2, ST17		
437	Marlette's Bay Wetland	Lake Superior	S2	Lacustrine	ST1		
438	Batchwana Island	Lake Superior	S2	Lacustrine	ST1		
439	Pic River Mouth	Lake Superior	S3	Lacustrine	ST11		Not in WIRE Net database

ID No.	Wetland Name	Lake/Connecting Channel	Eco-Reach	Aquatic System	Site Type	Area (ha)	Notes
440	Gravel River Provincial Park Nature Reserve	Lake Superior	S4	Lacustrine	ST12		
441	Black Bay Peninsula Peatland	Lake Superior	S4	Palustrine	ST17		Peatland
442	Hurkett Cove Wetlands	Lake Superior	S4	Lacustrine	ST4, ST11	55	
443	Moose Bay North Wetland	Lake Superior	S4	Lacustrine	ST1		
444	Blende River Wetland	Lake Superior	S4	Lacustrine	ST11		Not in WIRE Net database
445	Northern Wood Preservers Wetland	Lake Superior	S4	Palustrine	ST17, ST1		Not in WIRE Net database
446	Neebing Marsh	Lake Superior	S4	Lacustrine	ST5, ST11	101	
447	Mission Marsh	Lake Superior	S4	Lacustrine	ST1	160	
448	McKellar Marsh	Lake Superior	S4	Lacustrine	ST1	11	
449	Chippewa Marsh	Lake Superior	S4	Lacustrine	ST11, ST3	23	
450	Sturgeon Bay North Wetland	Lake Superior	S4	Lacustrine	ST5, ST3		
451	Sturgeon Bay Wetlands	Lake Superior	S4	Lacustrine	ST	72	
452	Caldwell Lake Wetland	Lake Superior	S4	Lacustrine	ST1, ST17		
453	Cloud Bay Wetland	Lake Superior	S4	Lacustrine	ST4, ST11	16	
454	Pine Bay Wetlands	Lake Superior	S4	Lacustrine	ST11, ST4, ST12	429	

Notes:

Source: Environment Canada's Environmental Sensitivity Atlases, Ontario Ministry of Natural Resources wetland inventory sheets, and the Natural Heritage Information Centre website

- Often, the OMNR listed wetlands as palustrine even though they appeared in the atlas as being connected to the lakes.

- Wetlands with more than one type listed in this table are often larger, more complex wetlands, that extend inland from a tributary delta or protected embayment and thus are representative of several different site types; when more than one type are listed, the site type listed first is the type that was most dominant for that particular wetland.

- Area of wetland was taken from either Ontario Ministry of Natural Resources data sheets or from the Environmental Sensitivity Atlas database.

Appendix 2b

Subset of coastal wetlands located on the U.S. portion of the Great Lakes shoreline. Site Type (ST) according to Table 4.1.

Wetland Name	Aquatic System	Lake/ Channel	Site Type	Location		Size (ha)
				Latitude	Longitude	
Lake Superior Poor Fen						
Fond du Lac *	Estuarine	Superior	ST15	47.08	91.68	40
Bad River B *	Estuarine	Superior	ST5	46.92	90.34	1600
Bark Bay A&B	Lacustrine	Superior	ST5	47.15	90.68	270
Honest John	Lacustrine	Superior	ST5	46.85	90.22	260
Raspberry Bay A *	Lacustrine	Superior	WI	47.18	90.33	60
Siskewit Bay	Lacustrine	Superior	WI	47.18	90.61	100
Stockton Is.	Lacustrine	Superior	MI	47.14	90.12	90
Au Train	Estuarine	Superior	ST15	46.53	86.71	160
Grand Island	Lacustrine	Superior	MI	46.57	86.48	50
Independence Lake	Lacustrine	Superior	MI	47.00	87.62	130
Lac la Belle	Estuarine	Superior	ST15	47.48	87.72	200
Pequaming	Lacustrine	Superior	ST5, ST8	47.09	88.01	170
Portage River	Estuarine	Superior	ST14	47.15	88.12	275
Sturgeon River	Lacustrine	Superior	ST11	47.17	88.20	445
North Rich Fen						
Big Shoal Cove	Lacustrine	Huron	ST3	45.99	83.64	80
Cheboygan	Lacustrine	Huron	ST4	45.71	84.42	115
El Cajon Bay	Lacustrine	Huron	ST3	45.10	83.32	180
Peck Bay	Lacustrine	Huron	ST3	46.00	84.36	30
Voight Bay	Lacustrine	Huron	ST3	45.99	84.37	50
Epoufette Bay	Lacustrine	Michigan	ST1	46.13	85.25	53
Kenyon Bay	Lacustrine	Michigan	ST3	46.14	85.32	40
Waugoshance Pt.	Lacustrine	Michigan	ST6	45.79	84.95	265
Carp/Pine River **	Lacustrine	Huron	ST1	46.05	84.65	90
False Presque I. **	Estuarine	Huron	ST15	45.31	83.40	140
Mud Lake **	Lacustrine	Michigan	ST5, ST7	45.26	86.96	110
Northern Great Lakes Marsh						
Fond du Lac	Estuarine	Superior	ST15	47.08	91.68	40
Pokegama A & B	Estuarine	Superior	ST14	47.04	91.54	80
Bad River Mouth	Estuarine	Superior	ST15	46.92	90.34	1600
Kakagon Slough	Estuarine	Superior	ST15	46.94	90.36	2500
Long Island	Lacustrine	Superior	ST6	46.90	90.41	80
Raspberry Bay B*	Estuarine	Superior	ST15	47.18	90.33	60
Baie de Wasai	Riverine	St. Mary's River	ST10	46.53	84.26	200
Churchville Pt.	Riverine	St. Mary's River	ST9	46.39	84.12	65
Gogomain River	Riverine	St. Mary's River	ST9, ST10	46.16	84.03	170
Hog Island	Riverine	St. Mary's River	ST9, ST10	46.56	84.18	32
Hursley Creek	Riverine	St. Mary's River	ST9	46.44	84.26	220
Kemps Point	Riverine	St. Mary's River	ST9	46.29	84.17	50

Wetland Name	Aquatic System	Lake/ Channel	Site Type	Location		Size (ha)
				Latitude	Longitude	
Munuscong River	Riverine	St. Mary's River	ST10	46.20	84.10	700
Roach Point	Riverine	St. Mary's River	ST10	46.20	84.10	155
Sand Island	Riverine	St. Mary's River	ST9	46.30	84.17	200
Shingle Bay	Riverine	St. Mary's River	ST10	46.46	84.24	130
Sugar Island	Riverine	St. Mary's River	ST9	46.45	84.16	80
Whipple Point	Riverine	St. Mary's River	ST9	46.54	84.14	120
Duck Bay	Lacustrine	Huron	ST4	46.00	84.36	100
Mackinac Bay	Lacustrine	Huron	ST4	46.06	84.40	125
Mismer Bay	Lacustrine	Huron	ST2	46.05	84.40	67
Scott Point	Lacustrine	Huron	ST2	46.08	83.67	65
Squaw Bay	Lacustrine	Huron	ST1	45.03	83.44	290
St. Martins Bay	Lacustrine	Huron	ST1	46.09	84.63	110
Tobico	Lacustrine	Huron	ST5	43.68	83.79	525
Chippewa Pt.	Lacustrine	Michigan	ST1	45.81	86.74	36
Indian Point	Lacustrine	Michigan	ST1	45.92	86.57	53
Little Fishdam River	Lacustrine	Michigan	ST1	45.96	86.44	73
Mink River	Riverine	Michigan	ST14, ST11	45.32	86.91	260
Green Bay Disturbed Marsh						
Dead Horse Bay	Lacustrine	Michigan	ST6	44.75	87.88	128
Little Tail Pt.	Lacustrine	Michigan	ST6	44.80	87.85	84
Oconto River	Estuarine	Michigan	ST11	45.00	87.71	700
Peshtigo River	Estuarine	Michigan	ST11	45.13	87.50	1100
West Twin River	Estuarine	Michigan	ST15	44.23	87.56	200
W. Lake Michigan Estuaries						
Bar Lake	Lacustrine	Michigan	ST5	44.41	86.23	105
Betsie River	Estuarine	Michigan	ST15	44.74	86.21	40
Big Sable River	Estuarine	Michigan	ST15	44.17	86.43	90
Galien River	Estuarine	Michigan	ST15	41.94	86.73	130
Kalamazoo River	Estuarine	Michigan	ST15	42.70	86.25	425
Muskegon River	Estuarine	Michigan	ST15	43.29	86.31	385
Paw Paw River	Estuarine	Michigan	ST15	42.20	86.52	65
Pentwater River	Estuarine	Michigan	ST15	43.83	86.41	97
Pottawattomi Bayou	Estuarine	Michigan	ST15	43.12	86.25	50
S. Lloyd Is.	Estuarine	Michigan	ST15	43.15	86.19	34
Stoney Creek	Estuarine	Michigan	ST15	43.69	86.50	81
White River	Estuarine	Michigan	ST15	43.45	86.41	485
Saginaw Bay Lakeplain Marsh						
Coryeon Pt.	Lacustrine	Huron	ST2	43.63	83.66	536
Hardwood Pt.	Lacustrine	Huron	ST1	43.92	82.68	60
Pinconning A	Lacustrine	Huron	ST6	43.89	83.91	60
Pinconning B	Lacustrine	Huron	ST2	43.89	83.91	60
Pine River	Lacustrine	Huron	ST1	44.01	83.86	120
Saganing River	Lacustrine	Huron	ST4	43.96	83.91	20
Whiskey Harbor	Lacustrine	Huron	ST1	44.00	82.72	3

Wetland Name	Aquatic System	Lake/ Channel	Site Type	Location		Size (ha)
				Latitude	Longitude	
Wigwam Bay	Lacustrine	Huron	ST11	44.04	83.71	335
Wildfowl Bay	Lacustrine	Huron	ST6	43.78	83.44	165
Wildfowl Islands	Lacustrine	Huron	ST3, ST4	43.86	83.44	1415
Erie/St. Clair Lakeplain Marsh						
Clinton River	Lacustrine	Lake St. Clair	ST11	42.58	82.85	105
St. Clair River Delta	Riverine	St. Clair River	ST11	42.58	82.50	3240
Erie Bay	Lacustrine	Erie	ST6	41.81	83.40	223
Otter Creek	Estuarine	Erie	ST14	41.89	83.33	16
Pt. Mouillee	Lacustrine	Erie	ST11	41.96	83.23	465
Swan Creek	Estuarine	Erie	ST14	41.92	83.29	45
Huron River	Estuarine	Erie	ST15	41.44	82.55	120
Old Woman Creek	Estuarine	Erie	ST15	41.41	82.51	160
Sheldon Marsh	Lacustrine	Erie	ST5	41.48	82.60	200
Thompson Harbor	Lacustrine	Erie	ST6	42.22	80.09	50
Presque Isle	Lacustrine	Erie	ST6	42.19	80.14	260
Lake Ontario Lagoon Marsh						
Black Creek	Lacustrine	Ontario	ST5	43.50	76.92	200
Deer Creek	Lacustrine	Ontario	ST5	43.82	76.35	500
Dexter Marsh	Lacustrine	Ontario	S11	44.13	76.36	800
East Bay	Lacustrine	Ontario	ST5	43.47	77.03	500
Lakeview Marsh	Lacustrine	Ontario	ST5	43.93	76.39	1360
Pt. Peninsula	Lacustrine	Ontario	ST5	44.20	76.48	120
Sterling Creek	Lacustrine	Ontario	ST5	43.50	76.83	360
St. Lawrence Estuaries						
Barnett Marsh	Riverine	St. Lawrence R.	ST14	44.51	76.31	80
Chippewa Creek	Riverine	St. Lawrence R.	ST11, ST14	44.61	76.10	275
Cranberry Creek	Riverine	St. Lawrence R.	ST14	44.56	76.17	175
Crooked Creek	Riverine	St. Lawrence R.	ST14	44.66	76.07	340
Delaney Bay	Riverine	St. Lawrence R.	ST14	44.47	76.38	85
Flynn Bay	Riverine	St. Lawrence R.	ST14	44.46	76.42	95

[a] **Sites marked with *** contain transects classed both as Lake Superior Poor Fen and as Northern Great Lakes Marsh; see discussion in text.

Sites marked with ** are associated with the Rich Fen Group, and have calciphitic vegetation in at least one zone.

[b] **Size estimates** are based on several different sources, including areas from existing detailed reports (Geis and Key 1977; Herdendorf et al. 1981a-1981f; Albert et al. 1987, 1988, 1989). For wetlands where no area computations exist in the literature, areas were computed by MNFI staff.

Appendix 3a. Fish species that spawn in the coastal areas of the Great Lakes

Spawning Evidence Classified as Probable or Confirmed (T=tributaries; L=Littoral)*

Data taken from: Goodyear, C.D., Edsall, T.A.,Ormsby Dempsey, D.M., Moss, G.D. and Polanski, P.E. 1982. Atlas of spawning and nursery areas of Great Lakes Fishes. Vol. 1-A. A summary by geographic area. U.S. Fish and Wildlife Service, Washington, DC FWS/OBS-82/52.

Eco-reaches of the shoreline that support these species

	Species	OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
1	Sea lamprey (*Petromyzon marinus*)	T		T	T	T	T	T		T	T	T		TL	T		T	TL	T	T	T	T	T	T	T	T	T	T	T	TL	T	T	T	T	T	T	T	T	T	T	T	T	T	35	0	3	38	3
2	Lake sturgeon (*Acipenser fulvescens*)	TL		T	T	L		TL	L		TL	L	L	TL	TL	L	T	L					TL	L	T				L	TL	T		T	TL	T		TL	TL		TL	TL	L	T	8	9	12	20	21
3	Spotted gar (*Lepisosteus oculatus*)														L	L																												0	2	0	0	2
4	Longnose gar (*Lepisosteus osseus*)	L		L	L			TL			L			TL	L		L								L																			0	7	2	2	9
5	Gar spp.															L							L	L																				0	3	0	0	3
6	Bowfin (*Amia calva*)			L	L	T					L	L		L	L		L						L	L													TL	TL			L	T		2	10	2	4	12
7	American eel (*Anguilla rostrata*)																																											0	0	0	0	0
8	Alewife (*Alosa pseudoharengus*)	TL	TL	TL	TL	TL	L	L				L		TL	TL		L	TL	TL	T	L	TL	L	L	T					L			L	L		L	TL	TL	TL	TL	TL	L	L	2	13	15	17	28
9	Gizzard Shad (*Dorosoma cepedianum*)			L	TL		L				L			TL	TL	L	L	L				T		L				T									T	T			TL			4	7	4	8	11
10	Clupeid spp.													TL																														0	0	1	1	1
11	Mooneye (*Hiodon tergisus*)	T								T	T																																	3	0	0	3	0
12	Longjaw cisco (*Coregonus alpenae*)									TL																																		0	0	1	1	1
13	Lake Herring (*Coregonus artedii*)			L	TL	L	L	L	L	L	L	L	L	TL	L	L		L	L	L	L	L	L	L	L	L	L	L					TL	L	L	L	L	L	L	L	L	L	L	0	32	3	3	35
14	Lake whitefish (*Coregonus clupeaformis*)			L	L	L	L	L		TL	L	L	L	TL	L	L	L	L	L	L	L	L	L	L	TL	L	T	L	L	L	TL	L	L	L	L	L	TL	TL	L	L	L	L	TL	1	31	6	7	37
15	Bloater (*Coregonus hoyi*)				L																												L											0	2	0	0	2
16	Deepwater cisco (*Coregonus johannae*)																																											0	0	0	0	0
17	Kiyi (*Coregonus kiyi*)																																											0	0	0	0	0
18	Blackfin cisco (*Coregonus nigripinnis*)																																											0	0	0	0	0
19	Shortnose cisco (*Coregonus reighardi*)				L																																							0	1	0	0	1
20	Shortjaw cisco (*Coregonus zenithicus*)																																											0	0	0	0	0
21	Pink salmon (*Oncorhynchus gorbuscha*)				T															T	T	T	T							L	T	T	T	T	T	T	T	T				T	T	15	1	0	15	1
22	Coho salmon (*Onchorynchus kisutch*)			TL	T	T	T	T		T	T	T		T	T				T	T	T	T	T	T	T					TL	T	T	T	T	T	T	T	T	T	T	T	T	T	29	0	2	31	2
23	Rainbow trout (*Onchorynchus mykiss*)																		T	T					T			T																4	0	0	4	0
24	Kokanee (*Onchorynchus nerka*)			T	T	T	T	T		T	T	T			T				T	T		T	T	T	T					TL	T		T	T	T	T	T	T	T	T	T	T	T	27	0	1	28	1
25	Chinook salmon (*Onchorynchus tshawytscha*)																																L											0	1	0	0	1
26	Pygmy whitefish (*Prosopium coulteri*)				L																	TL	L	L		L		L		L	T	TL	L	L	TL	L	L	L	L			L	L	1	14	3	4	17
27	Round whitefish (*Prosopium cylindraceum*)			TL	TL	T	T	T	L	T	T	T		L	T			TL	TL	T		TL	TL	T	T		T		T	TL	T	T	T	T	T	T	T	T	T	T	T	TL	T	24	2	8	32	10
28	Atlantic salmon (*Salmo salar*)	T		T	T	T	T	T	L																																		T	7	1	0	7	1
29	Brown trout (*Salmo trutta*)				TL	TL	T	T		TL	T	T			TL				T		T		L	T	T						T		T	T	TL		TL	TL	T	TL	TL	TL	T	13	1	10	23	11
30	Brook trout (*Salvelinus fontinalis*)																													TL	T	T	T	T	T		T	T	T				T	9	0	1	10	1
31	Lake trout (*Salvelinus namaycush*)			L	L		L	L		TL		L	L		L	L			L	L		L	L	L	L	L	L	L	L	L	TL	L	L	L	TL	L	L	TL	L	L	L	L	TL	0	28	4	4	32
32	Splake (*S. fontinalis x S. namaycush*)																			LL		L													L									0	2	0	0	2
33	Salmonid spp.														T			L																							TL			1	1	1	2	2
34	Salmon spp.			L								T						T																										2	1	0	2	1
35	Coregonid spp.						L																																					0	1	0	0	1

	Species	Eco-reaches of the shoreline that support these species																																													
		OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
36	Cisco spp.																																											0	0	0	0	0
37	*Coregonus* spp.																												L										L					0	2	0	0	2
38	Rainbow smelt (*Osmerus mordax*)	T		TL	TL	TL	TL	TL	L	TL	TL	TL	TL	L	TL	L		L	TL	T	T	TL	TL	TL	T	T	T		T	TL		T	TL	TL	TL	T	T	T	TL	TL	TL	TL	TL	11	4	22	33	26
39	Central mudminnow (*Umbra limi*)														TL																													0	0	1	1	1
40	Grass pickerel (*Esox americanus vermiculatus*)										L				L																													0	2	0	0	2
41	Northern pike (*Esox lucius*)	T	TL	TL	TL	TL	L	TL	TL	TL	TL	L	T	TL	TL	L	TL		L	T	L	TL	L	TL	L				L	L		T	TL	TL	TL		TL	TL	T	T	L	TL	L	6	11	19	25	30
42	Muskellunge (*Esox masquinongy*)	TL	L	L			L	L	TL		L	L		T	TL	L	TL	L				TL			L								TL	TL			TL	L						1	10	8	9	18
43	Stoneroller (*Campostoma anomalum*)														T																													1	0	0	1	0
44	Goldfish (*Carassius auratus*)				L	L	L				L			L	TL	L	L						L	L															TL	L				0	10	2	2	12
45	Lake chub (*Couesius plumbeus*)				T		T															T																	TL		T	L		4	1	1	5	2
46	Common carp (*Cyprinus carpio*)	TL		L	TL	TL	L	L			L	T	L	L	TL		L	L	L	L	L		TL	L	TL	L			L				TL	TL	T	L	TL	TL	TL	TL	TL	TL		2	15	14	16	29
47	Silverjaw minnow (*Ericymba buccata*)														T																													1	0	0	1	0
48	Silver chub (*Hybopsis storeriana*)													L	T																										L			1	2	0	1	2
49	River chub (*Nocomis micropogon*)			L																																								0	1	0	0	1
50	Golden shiner (*Notemigonus crysoleucas*)	T						L			L				T		L																											2	3	0	2	3
51	Pugnose shiner (*Notropis anogenus*)		L	T																																								1	1	0	1	1
52	Emerald shiner (*Notropis atherinoides*)				L	TL	L						L	L	L	L	L		L					L						L				L					L	L	L			0	14	1	1	15
53	Bridle shiner (*Notropis bifrenatus*)			L																																								0	1	0	0	1
54	Common shiner (*Notropis cornutus*)	TL			TL		L								T		L					TL														L								1	3	3	4	6
55	Pugnose minnow (*Notropis emiliae*)													L																														0	1	0	0	1
56	Blackchin shiner (*Notropis heterodon*)																																											0	0	0	0	0
57	Blacknose shiner (*Notropis heterolepsis*)																																											0	0	0	0	0
58	Spottail shiner (*Notropis hudsonius*)	TL		L	L	L	T	L			L			L	TL		L			L		L		L						TL						L	L	L	L	L	L	L	TL	1	17	3	4	20
59	Rosyface shiner (*Notropis rubellus*)																																											0	0	0	0	0
60	Spotfin shiner (*Notropis spilopterus*)													L	L		L																											0	3	0	0	3
61	Sand shiner (*Notropis stramineus*)										L			L	L																													0	3	0	0	3
62	Mimic shiner (*Notropis volucellus*)													L	L															L														0	3	0	0	3
63	Northern redbelly dace (*Phoxinus eos*)																													L														0	1	0	0	1
64	Bluntnose minnow (*Pimephales notatus*)	TL		L	TL						L				T		L																						L	L				1	5	2	3	7
65	Fathead minnow (*Pimephales promelas*)																L																						L	L				0	3	0	0	3
66	Blacknose dace (*Rhinichthys atratulus*)				T																																							1	0	0	1	0
67	Longnose dace (*Rhinichthys cataractae*)			L	T										L							T										TL							L	L		L		2	5	1	3	6
68	Creek chub (*Semotilus atromaculatus*)																																											0	0	0	0	0
69	Fallfish (*Semotilus corporalis*)																																											0	0	0	0	0
70	Cyrpinid spp.														L																							L	L		L			0	4	0	0	4
71	Shiner spp.														L																													0	1	0	0	1
72	Minnow spp.														L	L																												0	2	0	0	2
73	River carpsucker (*Carpiodes carpio*)																																											0	0	0	0	0
74	Quillback (*Carpiodes cyprinus*)										T			L	TL									L																	T			2	2	1	3	3
75	Longnose sucker (*Catostomus catostomus*)													L					T	T		TL	T	T	T					TL		T	TL	TL	T	T	TL	T	TL	L	T	T		11	2	6	17	8
76	White sucker (*Catostomus commersoni*)	T	T	T	TL	T	T	TL			T			L	TL			L	T	T	T	T		T	T	T	T		T	T		T	TL	T	T	T	TL	TL	TL	TL	T	T		22	2	8	30	10
77	Creek chubsucker (*Erimyzon oblongus*)																																											0	0	0	0	0
78	Lake chubsucker (*Erimyzon sucetta*)										TL																																	0	0	1	1	1

	Species	Eco-reaches of the shoreline that support these species																																														
		OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
79	Northern hog sucker (*Hypentelium nigricans*)																																											0	0	0	0	0
80	Bigmouth buffalo (*Ictiobus cyprinellus*)										T			TL																														1	0	1	2	1
81	Silver redhorse (*Moxostoma anisurum*)	TL												TL	T														T				TL	T										3	0	3	6	3
82	Black redhorse (*Moxostoma duquesnei*)													TL	T																													1	0	1	2	1
83	Golden redhorse (*Moxostoma erythrurum*)													TL	T				T			T					T															L		4	1	1	5	2
84	Shorthead redhorse (*Moxostoma macrolepidotu*	T			T						T			TL	T														T				TL	T					T					7	0	2	9	2
85	Greater redhorse (*Moxostoma valenciennesi*)	T	L						T						T																						T	T	T					6	1	0	6	1
86	Catostomid spp.								T	T	T			TL	T								L	L																				4	2	1	5	3
87	Sucker spp.			T	T		L										T	T	TL			L	TL	TL								T	T	L	T	L	T	T	TL	T	TL		T	11	4	5	16	9
88	Redhorse spp.																T	T	T											T											T	L		5	1	0	5	1
89	Buffalo spp.																																							T				1	0	0	1	0
90	Black bullhead (*Ictalurus melas*)													TL	T																		TL	L			L	L	L	L	L			1	6	2	3	8
91	Yellow bullhead (*Ictalurus natalis*)						L							L										L																	L			0	4	0	0	4
92	Brown Bullhead (*Ictalurus nebulosus*)	TL	T	TL	L	TL	TL	TL			L			TL	TL		L							L					L															1	5	7	8	12
93	Channel catfish (*Ictalurus punctatus*)	TL	TL	T	L			T			L			TL	TL	L	TL						L	L													L	L			T			3	7	5	8	12
94	Stonecat (*Noturus flavus*)			L										TL	L																													0	2	1	1	3
95	Tadpole madtom (*Notorus gyrinus*)										L																							L										0	2	0	0	2
96	Brindled madtom (*Noturus miurus*)													TL																														0	0	1	1	1
97	Flathead catfish (*Pylodictus olivaris*)													T																														1	0	0	1	0
98	Bullhead spp.													TL	L	L	L						L	L													L		L					0	7	1	1	8
99	Trout-perch (*Percopsis omiscomaycus*)				L		L				L			TL	TL					L				L						L				L			T	TL		L	L	L	T	2	10	3	5	13
100	Burbot (*Lota lota*)	L			L		L							TL	L				L	L			L	L					L	L			T	TL	TL		TL	T	L		TL			2	11	5	7	16
101	Banded killifish (*Fundulus diaphanus*)			L											L																													0	2	0	0	2
102	Brook silverside (*Labidesthes sicculus*)										L				TL																				T									1	1	1	2	2
103	Brook stickleback (*Culea inconstans*)																																						L					0	1	0	0	1
104	Three-spine stickleback (*Gasterosteus aculeatus*)				L	L	TL																																					0	2	1	1	3
105	Ninespine stickleback (*Pungitius pungitius*)																			L		TL													L				L	L	L	L		0	6	1	1	7
106	White perch (*Morone americana*)			L	L	TL	TL	T						L																														1	3	2	3	5
107	White bass (*Morone chrysops*)				TL						L		L	TL	TL	L	TL							T											L		L	TL		T				2	5	5	7	10
108	Rock bass (*Ambloplites rupestris*)	T		TL	L	TL	TL	L	L		L			L	TL	L	L	L	TL			L	L	L			L						T			L								2	13	5	7	18
109	Green sunfish (*Lepomis cyanellus*)														T																													1	0	0	1	0
110	Pumpkinseed (*Lepomis gibbosus*)	TL	T	TL	L	TL		TL			L			L	TL		L		L				L	TL													L	L			L			1	9	6	7	15
111	Orangespotted sunfish (*Lepomis humilis*)																																											0	0	0	0	0
112	Bluegill (*Lepomis macrochirus*)	L				T					L	L		L	TL	L	L		L				L	L														L		L	TL			1	11	2	3	13
113	Smallmouth bass (*Micropterus dolomieui*)	TL	TL	TL	TL	TL	TL	T	L	L	L	L		TL	TL	L	L	TL	TL	L		TL	L	L	L	L	L		L				T	TL	TL	L	TL	TL			T			3	14	15	18	29
114	Largemouth bass (*Micropterus salmoides*)	T	TL	TL	L	L		TL	TL	L	L	L		L	TL	L	L					L	L	L												L		L	L	L	L			1	16	5	6	21
115	White crappie (*Pomoxis annularis*)													L	TL	L	L																											0	3	1	1	4
116	Black crappie (*Pomoxis nigromaculatus*)	TL	TL	T	TL			TL			L			L	T		L								L								T	L										3	5	4	7	9
117	Centrarchid spp.																																											0	0	0	0	0
118	Bass spp.				T		L		TL		L	L	L	T	L		L	L	L						L		L													T				3	10	1	4	11
119	Sunfish spp.											L	L	T			L																											1	3	0	1	3
120	Crappie spp.						L				L			TL	L	L	L		L				L	L																				0	8	1	1	9
121	Greenside darter (*Etheostoma blennoides*)																L																											0	1	0	0	1

	Species	Eco-reaches of the shoreline that support these species																																														
		OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
122	Rainbow darter (*Etheostoma caeruleum*)														TL																													0	0	1	1	1
123	Iowa darter (*Etheostoma exile*)	TL																																										0	0	1	1	1
124	Fantail darter (*Etheostoma flabellare*)																																											0	0	0	0	0
125	Johnny darter (*Etheostoma nigrum*)			L	L	L	L								L				L			L	L						L	L			L							L	L	L		0	14	0	0	14
126	Yellow perch (*Perca flavescens*)	TL		L	TL	L	L	TL		L	TL		L	TL	TL	L	L	TL	L	L	L	TL	TL	TL			T		L	L		L	TL	L	TL	L	TL	TL	TL	L	L	TL	L	1	18	16	17	34
127	Logperch (*Perca caprodes*)	T													TL														L															1	1	1	2	2
128	Channel darter (*Percina copelandi*)													L	T							T																						2	1	0	2	1
129	Sauger (*Stizostedion canadense*)				T						T			TL		L							L	L													TL	TL						2	3	3	5	6
130	Walleye (*Stizostedion vitreum vitreum*)	TL		TL	T	L	TL	TL	T	T	TL	TL	L	TL	TL	L	TL	TL	TL	TL		T	TL	TL	TL	T	TL		TL	TL	T	TL	T	T	T		TL	TL	T	T	TL	TL		11	3	23	34	26
131	Blue pike (*Stizostedion vitreum glaucum*)				T	L		L			TL			L	L																													1	4	1	2	5
132	Percid spp.						L																																					0	1	0	0	1
133	Darter spp.																																											0	0	0	0	0
134	Freshwater drum (*Aplodinotus grunniens*)						TL							TL	TL	L							L	L													TL	TL		L				0	4	5	5	9
135	Mottled sculpin (*Cottus bairdi*)													T																					L					L				1	2	0	1	2
136	Slimy sculpin (*Cottus cognatus*)														L														L	TL					L				L	L	L	L		0	7	1	1	8
137	Spoonhead sculpin (Cottus ricei*)*																																		L									0	1	0	0	1
138	Fourhorn sculpin (*Myoxocephalus quadricornis*)																								L										L									0	2	0	0	2
139	Sculpin spp.														T			L																			L		L					1	3	0	1	3
	Using **tributaries only**	12	3	9	15	8	9	9	3	7	12	7	1	6	22	0	4	3	9	11	6	11	5	8	11	4	7	3	6	2	10	10	14	11	13	8	11	12	10	10	11	7	11					
	Using **littoral areas only**	3	3	19	20	11	21	10	7	4	27	13	11	25	24	26	28	12	13	10	6	9	23	28	9	6	5	4	13	13	0	3	7	12	9	13	10	10	19	20	18	15	5					
	Using **Both**	16	6	11	15	11	8	11	4	6	7	2	1	30	29	0	5	6	7	1	0	11	7	6	3	0	1	0	1	11	2	3	11	8	8	0	16	16	9	6	11	7	4					
	Using **tributaries**	28	9	20	30	19	17	20	7	13	19	9	2	36	51	0	9	9	16	12	6	22	12	14	14	4	8	3	7	13	12	13	25	19	21	8	27	28	19	16	22	14	15					
	Using **littoral areas**	19	9	30	35	22	29	21	11	10	34	15	12	55	53	26	33	18	20	11	6	20	30	34	12	6	6	4	14	24	2	6	18	20	17	13	26	26	28	26	29	22	9					
	Total species-habitats	47	18	50	65	41	46	41	18	23	53	24	14	91	104	26	42	27	36	23	12	42	42	48	26	10	14	7	21	37	14	19	43	39	38	21	53	54	47	42	51	36	24					
	Total number of species **using either** habitat of eco-reach	31	12	39	50	30	38	30	14	17	46	22	13	61	75	26	37	21	29	22	12	31	35	42	23	10	13	7	20	26	12	16	32	31	30	21	37	38	38	36	40	29	20					
	% all GL fishes that spawn in tributaries of eco-reach	20.1%	6.5%	14.4%	21.6%	13.7%	12.2%	14.4%	5.0%	9.4%	13.7%	6.5%	1.4%	25.9%	36.7%	0.0%	6.5%	6.5%	11.5%	8.6%	4.3%	15.8%	8.6%	10.1%	10.1%	2.9%	5.8%	2.2%	5.0%	9.4%	8.6%	9.4%	18.0%	13.7%	15.1%	5.8%	19.4%	20.1%	13.7%	11.5%	15.8%	10.1%	10.8%					
	% all GL species that spawn in littoral areas of eco-reach	13.7%	6.5%	21.6%	25.2%	15.8%	20.9%	15.1%	7.9%	7.2%	24.5%	10.8%	8.6%	39.6%	38.1%	18.7%	23.7%	12.9%	14.4%	7.9%	4.3%	14.4%	21.6%	24.5%	8.6%	4.3%	4.3%	2.9%	10.1%	17.3%	1.4%	4.3%	12.9%	14.4%	12.2%	9.4%	18.7%	18.7%	20.1%	18.7%	20.9%	15.8%	6.5%					
	% all GL fishes that spawn in both habitats of eco-reach	22.3%	8.6%	28.1%	36.0%	21.6%	27.3%	21.6%	10.1%	12.2%	33.1%	15.8%	9.4%	43.9%	54.0%	18.7%	26.6%	15.1%	20.9%	15.8%	8.6%	22.3%	25.2%	30.2%	16.5%	7.2%	9.4%	5.0%	14.4%	18.7%	8.6%	11.5%	23.0%	22.3%	21.6%	15.1%	26.6%	27.3%	27.3%	25.9%	28.8%	20.9%	14.4%					

Appendix 3b Fish species that have nursery areas in coastal region of the Great Lakes

Evidence for Nursery Areas Classified as Probable or Confirmed (T=tributaries; L=Littoral)*

Data taken from: Goodyear, C.D., Edsall, T.A.,Ormsby Dempsey, D.M., Moss, G.D. and Polanski, P.E. 1982. Atlas of spawning and nursery areas of Great Lakes Fishes. Vol. 1-A. A summary by geographic area. U.S. Fish and Wildlife Service, Washington, DC FWS/OBS-82/52.

	Species	Eco-reaches of the shoreline that support these species																																														
		OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
1	Sea lamprey (*Petromyzon marinus*)			T	T	T	T	T		T	T	T		T	T		T	TL	T	TL	T	T	T	T	T	T	T		TL	TL	T	T	T	T	T	T	T	T	T	T	T	T	T	32	0	4	36	4
2	Lake sturgeon (*Acipenser fulvescens*)																L	L												TL														0	2	1	1	3
3	Spotted gar (*Lepisosteus oculatus*)																																											0	0	0	0	0
4	Longnose gar (*Lepisosteus osseus*)	TL			L				L		L			TL	TL		L																											0	4	3	3	7
5	Gar spp.																																											0	0	0	0	0
6	Bowfin (*Amia calva*)	L									L			L	L		L																				TL	TL			L			0	6	2	2	8
7	American eel (*Anguilla rostrata*)																																											0	0	0	0	0
8	Alewife (*Alosa pseudoharengus*)	TL	TL	TL	L	L	L					L	L	TL	TL	L	L	L	L	L	L	L	L	L	L								TL	L		L	TL	TL	L	L	L	L	L	0	22	8	8	30
9	Gizzard Shad (*Dorosoma cepedianum*)			TL			L			L	L			TL	TL	L	L	L	L					L													TL	TL			TL	L		0	9	6	6	15
10	Clupeid spp.													TL																														0	0	1	1	1
11	Mooneye (*Hiodon tergisus*)													L																														0	1	0	0	1
12	Longjaw cisco (*Coregonus alpenae*)																																											0	0	0	0	0
13	Lake Herring (*Coregonus artedii*)	L		L	TL					L										L			L		L							L	L		L		L		L		L			0	12	1	1	13
14	Lake whitefish (*Coregonus clupeaformis*)	L		TL	L		L				L			L	L	L		L		L	L	L			L								L	L	L		L	L	L	L	L	L		0	21	1	1	22
15	Bloater (*Coregonus hoyi*)																				L	L															L		L	L	L		L	0	7	0	0	7
16	Deepwater cisco (*Coregonus johannae*)																																											0	0	0	0	0
17	Kiyi (*Coregonus kiyi*)																																											0	0	0	0	0
18	Blackfin cisco (*Coregonus nigripinnis*)																																											0	0	0	0	0
19	Shortnose cisco (*Coregonus reighardi*)																																											0	0	0	0	0
20	Shortjaw cisco (*Coregonus zenithicus*)																																											0	0	0	0	0
21	Pink salmon (*Oncorhynchus gorbuscha*)																			T																								1	0	0	1	0
22	Coho salmon (*Onchorynchus kisutch*)						L															T							T				T		T		T				L	T		6	2	0	6	2
23	Rainbow trout (*Onchorynchus mykiss*)																			T																								1	0	0	1	0
24	Kokanee (*Onchorynchus nerka*)						T															T												T	T						T	T	T	7	0	0	7	0
25	Chinook salmon (*Onchorynchus tshawytscha*)																																											0	0	0	0	0
26	Pygmy whitefish (*Prosopium coulteri*)																			L		L										L	L				L					L		0	6	0	0	6
27	Round whitefish (*Prosopium cylindraceum*)					T	TL								T										T					TL					T	T	T					T	T	8	0	2	10	2
28	Atlantic salmon (*Salmo salar*)				T																																						T	2	0	0	2	0
29	Brown trout (*Salmo trutta*)									L																															L	T		1	2	0	1	2
30	Brook trout (*Salvelinus fontinalis*)																												T															1	0	0	1	0
31	Lake trout (*Salvelinus namaycush*)																																L		L						L		L	0	4	0	0	4
32	Splake (*S. fontinalis x S. namaycush*)																																											0	0	0	0	0
33	Salmonid spp.																																											0	0	0	0	0
34	Salmon spp.																																											0	0	0	0	0
35	Coregonid spp.						L																																					0	1	0	0	1
36	Cisco spp.																																											0	0	0	0	0

	Species	Eco-reaches of the shoreline that support these species																																														
		OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
37	*Coregonus* spp.														L																							L	L					0	3	0	0	3
38	Rainbow smelt (*Osmerus mordax*)	L		TL	TL	L	L			L	L	L	L	TL	TL	L	L	L	L	L	L	L	L	L	L							L	TL	TL	L	L	L	L	L	L	L	L	L	0	27	6	6	33
39	Central mudminnow (*Umbra limi*)																																											0	0	0	0	0
40	Grass pickerel (*Esox americanus vermiculatus*)										L				TL																													0	1	1	1	2
41	Northern pike (*Esox lucius*)	TL	TL	TL	TL	L	TL	T			L	L	L	TL	L		L												L				L	L	L		TL	TL						1	10	8	9	18
42	Muskellunge (*Esox masquinongy*)	TL							L					L			L																				L	L						0	5	1	1	6
43	Stoneroller (*Campostoma anomalum*)																																											0	0	0	0	0
44	Goldfish (*Carassius auratus*)				L		L				L			TL	TL																								TL					0	3	3	3	6
45	Lake chub (*Couesius plumbeus*)					T	T																																L					2	1	0	2	1
46	Common carp (*Cyprinus carpio*)	L		L	L		L			L	L			TL	TL	L	L	L	L			L	L	L	L											L	L	L	L	L	L			0	20	2	2	22
47	Silverjaw minnow (*Ericymba buccata*)														TL																													0	0	1	1	1
48	Silver chub (*Hybopsis storeriana*)																	L																										0	1	0	0	1
49	River chub (*Nocomis micropogon*)																																											0	0	0	0	0
50	Golden shiner (*Notemigonus crysoleucas*)										L				TL		L																											0	2	1	1	3
51	Pugnose shiner (*Notropis anogenus*)																																											0	0	0	0	0
52	Emerald shiner (*Notropis atherinoides*)				L	T	L			L			L	TL	TL	L		L						L	L								L	L					L	L	L			1	13	2	3	15
53	Bridle shiner (*Notropis bifrenatus*)																																											0	0	0	0	0
54	Common shiner (*Notropis cornutus*)						L															L														L		L						0	4	0	0	4
55	Pugnose minnow (*Notropis emiliae*)																																											0	0	0	0	0
56	Blackchin shiner (*Notropis heterodon*)																																											0	0	0	0	0
57	Blacknose shiner (*Notropis heterolepsis*)										L																																	0	1	0	0	1
58	Spottail shiner (*Notropis hudsonius*)						L		L	L	L			TL	TL	L	L			L		L	L	L						L						L	L	L	L	L	L	L	L	0	19	2	2	21
59	Rosyface shiner (*Notropis rubellus*)													L																														0	1	0	0	1
60	Spotfin shiner (*Notropis spilopterus*)														TL																													0	0	1	1	1
61	Sand shiner (*Notropis stramineus*)										L		L		TL																													0	2	1	1	3
62	Mimic shiner (*Notropis volucellus*)													L																														0	1	0	0	1
63	Northern redbelly dace (*Phoxinus eos*)																																											0	0	0	0	0
64	Bluntnose minnow (*Pimephales notatus*)										L			L	TL																							L	L	L	L			0	6	1	1	7
65	Fathead minnow (*Pimephales promelas*)														L																													0	1	0	0	1
66	Blacknose dace (*Rhinichthys atratulus*)																																											0	0	0	0	0
67	Longnose dace (*Rhinichthys cataractae*)										L			L	TL																							L	L	L		L		0	6	1	1	7
68	Creek chub (*Semotilus atromaculatus*)				L										T																	TL												1	1	1	2	2
69	Fallfish (*Semotilus corporalis*)																																											0	0	0	0	0
70	Cyrpinid spp.					L								TL	L														L												L			0	4	1	1	5
71	Shiner spp.						L							L	L																													0	3	0	0	3
72	Minnow spp.														TL	L		L																										0	2	1	1	3
73	River carpsucker (*Carpiodes carpio*)														L																													0	1	0	0	1
74	Quillback (*Carpiodes cyprinus*)													L	TL																										T			1	1	1	2	2
75	Longnose sucker (*Catostomus catostomus*)				T																												L	L					TL					1	2	1	2	3
76	White sucker (*Catostomus commersoni*)	TL	T	TL	L		L		L	L				L	TL	L		L	L	L		T							L	TL			TL	TL	TL		TL	TL	TL	L	TL			2	11	11	13	22
77	Creek chubsucker (*Erimyzon oblongus*)														L																													0	1	0	0	1
78	Lake chubsucker (*Erimyzon sucetta*)										L																																	0	1	0	0	1
79	Northern hog sucker (*Hypentelium nigricans*)																	L																										0	1	0	0	1
80	Bigmouth buffalo (*Ictiobus cyprinellus*)																																											0	0	0	0	0

	Species	Eco-reaches of the shoreline that support these species																																														
		OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
81	Silver redhorse (*Moxostoma anisurum*)	T													TL																		L	L										1	2	1	2	3
82	Black redhorse (*Moxostoma duquesnei*)														TL																													0	0	1	1	1
83	Golden redhorse (*Moxostoma erythrurum*)														TL																													0	0	1	1	1
84	Shorthead redhorse (*Moxostoma macrolepidotum*)									L																							L	L										0	3	0	0	3
85	Greater redhorse (*Moxostoma valenciennesi*)		L						T																																			1	1	0	1	1
86	Catostomid spp.													L	TL														L															0	2	1	1	3
87	Sucker spp.																																TL	L			T	T	L		L			2	3	1	3	4
88	Redhorse spp.																																											0	0	0	0	0
89	Buffalo spp.																																											0	0	0	0	0
90	Black bullhead (*Ictalurus melas*)													L	TL																		T											1	1	1	2	2
91	Yellow bullhead (*Ictalurus natalis*)													L																														0	1	0	0	1
92	Brown Bullhead (*Ictalurus nebulosus*)		TL	TL	L		TL	T			L			TL	TL			L		L									L															1	5	5	6	10
93	Channel catfish (*Ictalurus punctatus*)	L	L		L									TL	TL		L							L													L	L			TL			0	7	3	3	10
94	Stonecat (*Noturus flavus*)													T	TL																													1	0	1	2	1
95	Tadpole madtom (*Notorus gyrinus*)										L																																	0	1	0	0	1
96	Brindled madtom (*Noturus miurus*)										L																																	0	1	0	0	1
97	Flathead catfish (*Pylodictus olivaris*)																																											0	0	0	0	0
98	Bullhead spp.																L																											0	1	0	0	1
99	Trout-perch (*Percopsis omiscomaycus*)						L			L	L			TL	L	L		L		L		L	L	L									L					L	L	L	L	L		0	16	1	1	17
100	Burbot (*Lota lota*)	L					L							L	L	L		L	L	L	L	L	L	L									T		L		T	TL	L	L	L	L		2	17	1	3	18
101	Banded killifish (*Fundulus diaphanus*)									L	L																																	0	2	0	0	2
102	Brook silverside (*Labidesthes sicculus*)										L		L	L	TL	L																												0	4	1	1	5
103	Brook stickleback (*Culea inconstans*)														TL				L																									0	1	1	1	2
104	Three-spine stickleback (*Gasterosteus aculeatus*)				L		L																																					0	2	0	0	2
105	Ninespine stickleback (*Pungitius pungitius*)																			L		L													L			L	L	L	L	L		0	8	0	0	8
106	White perch (*Morone americana*)			TL	L	L	L							L																														0	4	1	1	5
107	White bass (*Morone chrysops*)						L			L	L		L	TL	TL	L		L		L					TL	L			L								TL	TL						0	9	5	5	14
108	Rock bass (*Ambloplites rupestris*)			T	L	T			L		L			L	TL		L		L	L																								2	7	1	3	8
109	Green sunfish (*Lepomis cyanellus*)													L	TL																													0	1	1	1	2
110	Pumpkinseed (*Lepomis gibbosus*)		TL	TL	L	T					L				TL		L		L						T	L			L										L	L	L			2	9	3	5	12
111	Orangespotted sunfish (*Lepomis humilis*)														TL																													0	0	1	1	1
112	Bluegill (*Lepomis macrochirus*)			TL	L	T					L			L	T		L			L																					TL			2	5	2	4	7
113	Smallmouth bass (*Micropterus dolomieui*)	TL	L	L		T	TL	T	L	L				L	T		L	L	L	L		T												TL	TL		L	L			L			4	12	4	8	16
114	Largemouth bass (*Micropterus salmoides*)	TL	TL	TL	L		T	T		L	L	L		L	TL		L																						L	L	L			2	9	4	6	13
115	White crappie (*Pomoxis annularis*)				T									L	TL		L																											1	2	1	2	3
116	Black crappie (*Pomoxis nigromaculatus*)		T	T		L					L			L	T		L																											3	4	0	3	4
117	Centrarchid spp.															L																												0	1	0	0	1
118	Bass spp.													T											L																			1	1	0	1	1
119	Sunfish spp.													TL	TL		L																											0	1	2	2	3
120	Crappie spp.													L	TL		L																								L			0	3	1	1	4
121	Greenside darter (*Etheostoma blennoides*)													L																														0	1	0	0	1
122	Rainbow darter (*Etheostoma caeruleum*)														L																													0	1	0	0	1
123	Iowa darter (*Etheostoma exile*)										L																																	0	1	0	0	1
124	Fantail darter (*Etheostoma flabellare*)													L																														0	1	0	0	1

Species	OS1	OS2	OS3a	OS4	OS5	OS6	OS7&OS3b	E1	E2	E3	E4	E5	E6a&b	E7	SC1	SC2	SC3	HG1	HG2	HG3	HG4/M8	HG5	HG6	HG7	HG8a	HG9	HG10	S1/HG8b	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6a	M6b	M7	Tributary Only	Littoral Only	Both	Tributary	Littoral
	Eco-reaches of the shoreline that support these species																																														
125 Johnny darter (*Etheostoma nigrum*)					L	L							L	TL	L			L			L			L															L	L	L		0	10	1	1	11
126 Yellow perch (*Perca flavescens*)	TL	L	L		L	L		L	L	L	L	L	TL	TL	L	L	L	L	L		L	L	L	L		L		L	L			TL	L	L		L	L	L	L	L	TL		0	28	5	5	33
127 Logperch (*Perca caprodes*)									L				TL	TL	L		L																										0	3	2	2	5
128 Channel darter (*Percina copelandi*)													L	L																													0	2	0	0	2
129 Sauger (*Stizostedion canadense*)										L			TL	L																													0	2	1	1	3
130 Walleye (*Stizostedion vitreum vitreum*)	T		L					L				L	TL	L	L	L	L						TL	TL			T					TL	TL			L	L				L		2	10	5	7	15
131 Blue pike (*Stizostedion vitreum glaucum*)																																											0	0	0	0	0
132 Percid spp.																																									L		0	1	0	0	1
133 Darter spp.						L								L			L																										0	3	0	0	3
134 Freshwater drum (*Aplodinotus grunniens*)													TL	TL	L		L							L												T	T						2	3	2	4	5
135 Mottled sculpin (*Cottus bairdi*)						L				L			L	L			L																	L					L				0	7	0	0	7
136 Slimy sculpin (*Cottus cognatus*)														L			L	L																L				L		L	L		0	7	0	0	7
137 Spoonhead sculpin (Cottus ricei)																																		L									0	1	0	0	1
138 Fourhorn sculpin (*Myoxocephalus quadricornis*)															L		L	L			L	L	L	L										L				L	L				0	10	0	0	10
139 Sculpin spp.					L	L								TL																								L					0	3	1	1	4
Using **tributaries only**	2	2	3	4	8	4	5	1	1	1	1	0	3	6	0	1	0	1	2	1	5	1	1	3	1	1	1	2	0	1	1	4	2	4	2	6	3	1	1	3	5	4					
Using **littoral areas only**	7	4	5	16	9	23	0	8	16	32	5	9	30	18	20	24	24	14	16	5	14	9	11	11	2	1	0	8	2	0	3	10	9	12	5	12	15	22	19	25	14	5					
Using **Both**	8	5	11	3	0	4	0	0	0	0	0	0	21	42	0	0	1	0	1	0	0	0	1	2	0	0	0	1	4	0	1	6	4	2	0	6	7	3	0	4	1	0					
Using **tributaries**	10	7	14	7	8	8	5	1	1	1	1	0	24	48	0	1	1	1	3	1	5	1	2	5	1	1	1	3	4	1	2	10	6	6	2	12	10	4	1	7	6	4					
Using **littoral areas**	15	9	16	19	9	27	0	8	16	32	5	9	51	60	20	24	25	14	17	5	14	9	12	13	2	1	0	9	6	0	4	16	13	14	5	18	22	25	19	29	15	5					
Total species-habitats	25	16	30	26	17	35	5	9	17	33	6	9	75	108	20	25	26	15	20	6	19	10	14	18	3	2	1	12	10	1	6	26	19	20	7	30	32	29	20	36	21	9					
Total number of species **using either** habitat of eco-reach	17	11	19	23	17	31	5	9	17	33	6	9	54	66	20	25	25	15	19	6	19	10	13	16	3	2	1	11	6	1	5	20	15	18	7	24	25	26	20	32	20	9					
% all GL fishes that have nursery areas in tributaries of eco-reach	7.2%	5.0%	10.1%	5.0%	5.8%	5.8%	3.6%	0.7%	0.7%	0.7%	0.7%	0.0%	17.3%	34.5%	0.0%	0.7%	0.7%	0.7%	2.2%	0.7%	3.6%	0.7%	1.4%	3.6%	0.7%	0.7%	0.7%	2.2%	2.9%	0.7%	1.4%	7.2%	4.3%	4.3%	1.4%	8.6%	7.2%	2.9%	0.7%	5.0%	4.3%	2.9%					
% all GL species that have nursery areas in littoral areas of eco-reach	10.8%	6.5%	11.5%	13.7%	6.5%	19.4%	0.0%	5.8%	11.5%	23.0%	3.6%	6.5%	36.7%	43.2%	14.4%	17.3%	18.0%	10.1%	12.2%	3.6%	10.1%	6.5%	8.6%	9.4%	1.4%	0.7%	0.0%	6.5%	4.3%	0.0%	2.9%	11.5%	9.4%	10.1%	3.6%	12.9%	15.8%	18.0%	13.7%	20.9%	10.8%	3.6%					
% all GL fishes that have nursery areas in both habitats of eco-reach	12.2%	7.9%	13.7%	16.5%	12.2%	22.3%	3.6%	6.5%	12.2%	23.7%	4.3%	6.5%	38.8%	47.5%	14.4%	18.0%	18.0%	10.8%	13.7%	4.3%	13.7%	7.2%	9.4%	11.5%	2.2%	1.4%	0.7%	7.9%	4.3%	0.7%	3.6%	14.4%	10.8%	12.9%	5.0%	17.3%	18.0%	18.7%	14.4%	23.0%	14.4%	6.5%					

Appendix 3c Breeding birds of Ontario that use the coastal region of the Great Lakes as habitat
(Breeding Evidence Classified as Probable or Confirmed)

Data taken from: Cadman, Michael D., Paul F. J. Eagles, Frederick M. Helleiner. 1988. Atlas of the Breeding Birds of Ontario. Federation of Ontario Naturalists and Long Point Bird Observatory. University of Waterloo Press: Waterloo, Ontario. 617 pp.

Species	Eco-reaches in Canada that support these species																						Total
	OS1	OS2	OS3a	OS4	E1	E2	E3	E4	E5	E6b	SC1	SC2	SC3	HG1	HG2	HG7	HG8a	HG8b/S1	HG9	HG10	S2	S3	S4	
Common Loon	1	1	1	1										1	1	1	1	1	1	1	1	1	1	14
Pied-Billed Grebe	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1	1	1	1	1	21
Horned Grebe																								0
Red-Necked Grebe																1								1
Double Crested Cormorant	1		1	1		1				1				1	1	1	1	1	1	1	1		1	14
American Bittern	1	1	1	1		1	1	1	1		1	1			1	1	1	1	1	1	1	1	1	19
Least Bittern		1	1	1			1	1	1		1	1		1	1	1								11
Great Blue Heron	1	1	1	1	1	1	1			1		1		1	1	1	1	1	1	1	1	1	1	19
Great Egret										1		1				1								3
Cattle Egret																								0
Green-Backed Heron	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1			19
Black-Crowned Night-Heron			1	1	1					1		1			1	1			1					8
Yellow-Crowned Night-Heron																								0
Mute Swan				1			1	1																3
Canada Goose	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1		1	1			19
Wood Duck	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	22
Green-Winged Teal	1		1	1	1	1	1	1	1			1		1	1	1	1	1	1		1	1	1	18
American Black Duck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Mallard	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Northen Pintail	1		1	1				1	1			1		1	1	1	1		1	1			1	13
Blue Winged Teal	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	22
Cinnamon Teal						1					1													2
Northern Shoveler	1		1	1			1	1	1		1			1	1	1				1			1	12
Gadwall	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1		1			1	1	18
American Wigeon	1		1	1			1	1	1			1		1		1	1	1	1		1	1	1	15
Canvasback								1				1												2
Redhead	1		1	1			1		1		1					1								7
Ring-necked Duck			1												1	1	1	1	1		1	1	1	9
Lesser Scaup			1													1	1	1			1			5
Common Goldeneye															1	1	1	1			1	1	1	7
Bufflehead																		1				1		2
Hooded Merganser	1		1			1	1	1						1	1	1	1	1	1		1	1	1	14
Common Mersanger	1		1	1				1						1	1	1	1	1	1	1	1	1	1	14
Red-breasted Mersanger			1	1			1					1		1	1	1	1	1	1	1	1	1	1	14
Ruddy Duck								1	1			1		1										4
Turkey Vulture		1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1		1	19
Osprey	1	1							1						1	1	1	1	1	1	1	1	1	12
Bald Eagle							1	1	1		1							1			1	1		7
Northern Harrier	1	1	1	1	1	1		1	1			1	1	1	1	1	1	1	1	1	1	1	1	20
Sharp-Shinned Hawk			1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	16
Cooper's Hawk		1	1	1					1					1	1				1	1	1			9
Northern Goshawk		1	1	1			1								1		1		1			1		8
Red-Shouldered Hawk	1		1	1			1							1	1				1	1	1			9
Broad-Winged Hawk	1	1	1	1			1				1			1	1	1	1	1	1	1	1	1	1	16
Red-Tailed Hawk	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1		1	1	21
American Kestrel	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Merlin															1	1	1		1		1	1	1	7
Peregrine Falcon																								0

Species	Eco-reaches in Canada that support these species																							
	OS1	OS2	OS3a	OS4	E1	E2	E3	E4	E5	E6b	SC1	SC2	SC3	HG1	HG2	HG7	HG8a	HG8b/S1	HG9	HG10	S2	S3	S4	Total
Gray Partridge	1		1	1		1	1																	5
Ring-Necked Pheasant	1	1	1	1	1	1	1	1	1	1	1	1	1	1										14
Spruce Grouse																		1				1	1	3
Ruffed Grouse	1	1	1	1	1	1	1	1				1		1	1	1	1	1	1	1	1	1	1	19
Sharp-Tailed Grouse															1	1		1			1			4
Wild Turkey		1																						1
Northern Bobwhite			1		1			1			1	1	1	1										7
Yellow Rail				1																				1
King Rail				1			1	1	1			1												5
Virginia Rail	1	1	1	1	1	1	1	1	1		1	1		1	1	1				1		1		16
Sora	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1				1	19
Purple Gallinule												1												1
Common Moorhen	1	1	1	1	1	1	1	1	1		1	1	1	1					1					14
American Coot	1	1	1	1	1	1	1	1	1		1	1	1	1				1	1		1		1	17
Sandhill Crane								1							1	1		1			1	1		6
Piping Plover																1								1
Killdeer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Solitary Sandpiper																								0
Spotted Sandpiper	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Upland Sandpiper	1	1	1	1	1	1	1	1				1		1	1	1	1	1		1			1	16
Common Snipe	1	1	1	1	1	1	1	1				1		1	1	1	1	1	1	1	1	1	1	19
American Woodcock	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	22
Wilson's Phalarope			1				1							1										3
Little Gull							1												1					2
Ring-Billed Gull	1	1	1	1		1	1	1	1		1			1	1	1	1	1	1	1	1	1	1	19
Herring Gull	1	1	1	1		1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	21
Great Black-Backed Gull			1	1										1										3
Caspian Tern			1	1											1		1		1	1				6
Common Tern	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			20
Forster's Tern							1	1				1	1	1										5
Black Tern	1	1	1	1		1	1	1	1		1	1			1	1	1	1	1	1				16
Rock Dove	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Mourning Dove	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Black-Billed Cuckoo	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	20
Yellow-Billed Cuckoo	1		1	1	1	1	1	1	1	1	1	1		1										12
Common Barn-Owl				1																				1
Eastern Screech-Owl	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1		1						16
Great Horned Owl	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	1	1	1	21
Barred Owl	1						1								1	1		1	1	1	1	1	1	10
Great Gray Owl																						1		1
Long-Eared Owl	1		1	1		1		1	1							1						1		8
Short-Eared Owl			1			1																		2
Boreal Owl																						1	1	2
Northern Saw-Whet Owl	1		1	1		1	1		1						1	1		1	1		1		1	12
Common Nighthawk	1	1	1	1	1	1	1	1	1		1			1	1	1		1	1	1	1	1	1	19
Chuck Will's Widow								1																1
Wip-Poor-Will	1	1	1	1		1	1	1	1					1	1	1		1	1	1	1		1	16
Chimney Swift	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Ruby-Throated Hummingbird	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Belted Kingfisher	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Red-Headed Woodpecker		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1				16
Red-Billed Woodpecker			1	1	1		1	1			1	1		1										8
Yellow-Bellied Sapsucker	1	1	1	1		1								1	1	1	1	1	1	1	1	1	1	15
Downy Woodpecker	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Hairy Woodpecker	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22

Species	Eco-reaches in Canada that support these species																							
	OS1	OS2	OS3a	OS4	E1	E2	E3	E4	E5	E6b	SC1	SC2	SC3	HG1	HG2	HG7	HG8a	HG8b/S1	HG9	HG10	S2	S3	S4	Total
Three-Toed Woodpecker																								0
Black-Backed Woodpecker			1												1			1			1	1		5
Northern Flicker	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Pileated Woodpecker	1	1	1	1			1	1							1	1	1	1	1	1	1	1	1	15
Olive-Sided Flycatcher															1	1	1	1	1		1	1	1	8
Eastern Wood-Pewee	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	22
Yellow-Bellied Flycatcher																1		1			1	1	1	5
Acadian Flycatcher						1	1	1	1															4
Alder Flycatcher	1	1	1	1	1	1	1				1			1	1	1	1	1	1	1	1	1	1	18
Willow Flycatcher	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1				17
Least Flycatcher	1	1	1	1	1	1	1	1		1			1	1	1	1	1	1	1	1	1	1	1	20
Eastern Phoebe	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	1	21
Great Crested Flycatcher	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Eastern Kingbird	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Horned Lark	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								16
Purple Martin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Tree Swallow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Northern Rough-Winged Swallow	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1				19
Bank Swallow	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Cliff Swallow	1	1	1	1		1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	20
Barn Swallow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Gray Jay															1		1	1	1		1	1	1	7
Blue Jay	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
American Crow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Common Raven															1	1	1	1	1	1	1	1	1	9
Black-Capped Chickadee	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Boreal Chickadee																						1	1	2
Tufted Titmouse				1	1	1		1																4
Red-Breasted Nuthatch	1	1	1	1		1	1	1						1	1	1	1	1	1	1	1	1	1	17
White-Breasted Nuthatch	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1		21
Brown Creeper	1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1		19
Carolina Wren			1	1	1	1		1	1		1													7
House Wren	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Winter Wren		1	1	1	1	1	1	1						1	1	1		1	1	1	1	1	1	16
Sedge Wren	1		1	1		1	1	1	1		1	1		1	1	1		1	1	1			1	16
Marsh Wren	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1				19
Golden-Crowned Kinglet			1	1			1	1							1	1	1	1	1	1	1	1	1	13
Ruby-Crowned Kinglet				1											1			1	1	1	1	1	1	8
Blue-Gray Gnatcatcher	1		1	1	1	1	1	1	1	1	1	1	1	1						1				14
Eastern Bluebird	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1		1	20
Veery	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1	1	1	1	20
Swainson's Thrush															1	1	1	1	1	1	1	1	1	9
Hermit Thrush	1	1					1								1	1	1	1	1	1	1	1	1	12
Wood Thrush	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1	1		20
American Robin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Gray Catbird	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Northern Mockingbird	1	1	1	1	1	1	1	1	1				1	1	1	1	1				1			15
Brown Thrasher	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	22
Cedar Waxwing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Loggerhead Shrike			1												1	1				1				4
European Starling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
White-Eyed Vireo				1		1	1	1	1		1													6
Solitary Vireo							1							1	1				1		1	1	1	7
Yellow-Throated Vireo	1	1		1	1	1	1	1	1			1	1	1	1	1		1	1	1				16
Warbling Vireo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1				19

Species	Eco-reaches in Canada that support these species																							
	OS1	OS2	OS3a	OS4	E1	E2	E3	E4	E5	E6b	SC1	SC2	SC3	HG1	HG2	HG7	HG8a	HG8b/S1	HG9	HG10	S2	S3	S4	Total
Philadelphia Vireo																1			1		1	1	1	5
Red-Eyed Vireo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Blue-Winged Warbler			1	1		1	1	1	1	1		1		1										9
Golden-Winged Warbler			1	1		1	1					1		1	1	1		1	1	1	1			12
Brewster's Warbler							1												1					2
Lawrence's Warbler																								0
Tennessee Warbler															1		1	1	1		1	1	1	7
Nashville Warbler	1	1	1	1		1	1							1	1	1	1	1	1	1	1	1	1	16
Northern Parula														1	1				1	1	1	1	1	7
Yellow Warbler	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Chestnut-Sided Warbler	1	1	1	1		1	1	1			1		1	1	1	1	1	1	1	1	1	1	1	19
Magnolia Warbler	1						1							1	1	1	1	1	1	1	1	1	1	12
Cape May Warbler															1	1	1	1			1	1	1	7
Black-Throated Blue Warbler		1												1	1	1	1		1	1	1	1	1	10
Yellow-Rumped Warbler	1	1	1	1			1							1	1	1	1	1	1	1	1	1	1	15
Black-Throated Green Warbler		1	1				1	1						1	1	1	1	1	1	1	1	1	1	14
Blackburnian Warbler	1	1	1	1			1	1						1	1	1	1	1	1	1	1	1	1	16
Pine Warbler		1	1	1			1	1						1	1	1	1	1	1	1	1	1	1	15
Kirtland's Warbler																								0
Prairie Warbler							1							1					1	1				4
Palm Warbler																							1	1
Bay-Breasted Warbler																1		1	1		1		1	5
Cerulean Warbler		1		1	1		1	1				1		1						1				8
Black-and-White Warbler	1	1	1	1			1	1						1	1	1	1	1	1	1	1	1	1	16
American Redstart	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	21
Prothonotary Warbler							1	1	1					1										4
Ovenbird	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Northern Waterthrush	1	1	1	1		1	1							1	1	1	1		1	1	1	1	1	15
Louisiana Waterthrush				1			1							1		1								4
Kentucky Warbler		1																						1
Connecticut Warbler																							1	1
Mourning Warbler	1		1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	17
Common Yellowthroat	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Hooded Warbler					1		1																	2
Wilson's Warbler																							1	1
Canada Warbler	1		1	1			1	1						1	1	1	1	1	1	1	1	1	1	15
Yellow-Breasted Chat			1	1	1	1		1	1	1	1	1												9
Summer Tanager								1																1
Scarlet Tanager	1	1	1	1	1	1	1	1	1		1	1		1	1	1		1	1	1	1	1	1	20
Northern Cardinal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1				18
Rose-Breasted Grosbeak	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Indigo Bunting	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Dickcissel																1								1
Rufous-Sided Towhee	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1				18
Chipping Sparrow	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Clay-Colored Sparrow			1	1											1	1		1	1	1			1	8
Field Sparrow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1				18
Vesper Sparrow	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1			20
Savannah Sparrow	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	22
Grasshopper Sparrow		1	1	1	1	1	1	1					1	1	1	1				1				12
Henslow's Sparrow		1	1											1		1								4
Le Conte's Sparrow																							1	1
Song Sparrow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Lincoln's Sparrow			1			1															1	1	1	5
Swamp Sparrow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23

Species	Eco-reaches in Canada that support these species																							
	OS1	OS2	OS3a	OS4	E1	E2	E3	E4	E5	E6b	SC1	SC2	SC3	HG1	HG2	HG7	HG8a	HG8b/S1	HG9	HG10	S2	S3	S4	Total
White-Throated Sparrow	1	1	1	1	1									1	1	1	1	1	1	1	1	1	1	15
Dark-Eyed Junco		1													1	1	1	1	1	1	1	1	1	10
Bobolink	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Red-Winged Blackbird	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Eastern Meadowlark	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1				19
Western Meadowlark				1					1					1	1	1								5
Yellow-Headed Blackbird									1			1												2
Rusty Blackbird																1		1			1	1	1	5
Brewer's Blackbird									1			1		1	1	1	1	1	1		1		1	10
Common Grackle	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Brown-Headed Cowbird	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Orchard Oriole			1	1		1	1	1	1	1	1	1		1										10
Northern Oriole	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Pine Grosbeak																					1		1	2
Purple Finch	1	1	1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	18
House Finch	1	1	1	1	1	1	1	1	1		1	1	1	1		1								14
Red Crossbill				1												1			1				1	4
White-Winged Crossbill			1												1		1					1	1	5
Pine Sisken			1	1										1	1	1	1	1	1		1	1	1	11
American Goldfinch	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23
Evening Grosbeak	1														1	1	1	1	1	1	1	1	1	10
House Sparrow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	22
Lark Sparrow																							1	1
Total number of breeding birds utilizing each eco-reach	133	127	160	160	110	130	153	143	118	68	100	116	84	152	161	166	128	141	151	138	138	123	143	3043
% all breeding birds that use eco-reaches	0.56	0.54	0.68	0.68	0.47	0.55	0.65	0.61	0.50	0.29	0.42	0.49	0.36	0.64	0.68	0.70	0.54	0.60	0.64	0.58	0.58	0.52	0.61	