Sub-Indicator: Coastal Wetlands: Extent and Composition

Note: New mapping and estimation of areal extent on a binational scale has not been completed for a State of Great Lakes Report since 2005. In the absence of a more recent binational survey, the purpose of this report is to summarize progress made on mapping coastal wetland extent and composition for the Canadian portion of the Great Lakes basin using data from the Canadian Baseline Coastal Habitat Survey. Therefore, this report does not consist of formal assessments of Great Lakes ecosystem conditions, so the status and trends are assessed as Not Assessed for this State of the Great Lakes reporting cycle. This coastal wetland extent indicator will help to address commitments pursuant to the Great Lakes Water Quality Agreement and the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health.

Overall Assessment

Status: Not Assessed

Trends:

10-Year Trend: Not Assessed

Long-term Trend: Not Assessed

Rationale: This report summarizes progress made on mapping coastal wetland extent and composition for the Canadian portion of the Great Lakes basin which was completed as part of a recent Baseline Coastal Habitat Survey (ECCC 2020, 2021, 2022c, 2023a). Despite the many wetland values and functions, new mapping and estimation of areal extent has not been completed for a State of Great Lakes Report since 2005, where the overall status was assessed as Mixed and the trend was assessed as Deteriorating (ECCC and EPA, 2005). This is due to the challenges associated with the dynamic nature of coastal wetlands responding to water level fluctuations, acquiring high-resolution imagery, assembling datasets across large spatial and temporal scales, developing standardized vegetation classification schemes and change-detection algorithms, and defining targets for wetland extent and composition.

Lake-by-Lake Assessment

Lake-by-lake assessments are not available for the same reasons that an overall assessment was not feasible. Each lake is categorized with a Not Assessed status, and the 10-year trend and long-term trend are Not Assessed (2001-2023).

Lake Superior

Status: Not Assessed

10-Year Trend: Not Assessed

Long-term Trend: Not Assessed

Rationale: The current estimated areal extent is 23,200 ha of coastal wetlands, representing 25% of wetlands basin wide along the Canadian portion of the Great Lakes.

Status Assessment definitions need to be determined; Data availability limited to Canada only, with no other sufficient dataset to compare.

Lake Michigan

Status: Not Assessed

10-Year Trend: Not Assessed

Long-term Trend: Not Assessed

Rationale: Status Assessment definitions need to be determined; Data availability limited to Canada only, with no other sufficient dataset to compare.

Lake Huron (including St. Mary's River)

Status: Not Assessed

10-Year Trend: Not Assessed

Long-term Trend: Not Assessed

Rationale: The current estimated areal extent is 23,350 ha of coastal wetlands, representing 26% of wetlands basin wide along the Canadian portion of the Great Lakes.

Status Assessment definitions need to be determined; Data availability limited to Canada only, with no other sufficient dataset to compare.

Lake Erie (including St. Clair-Detroit River Ecosystem)

Status: Not Assessed

10-Year Trend: Not Assessed

Long-term Trend: Not Assessed

Rationale: The current estimated areal extent is 27,605 ha of coastal wetlands, representing 30% of wetlands basin wide along the Canadian portion of the Great Lakes.

Status Assessment definitions need to be determined; Data availability limited to Canada only, with no other sufficient dataset to compare.

Lake Ontario (including Niagara River and International section of the St. Lawrence River)

Status: Not Assessed

10-Year Trend: Not Assessed

Long-term Trend: Not Assessed

Rationale: The current estimated areal extent is 17,178 ha of coastal wetlands, representing 19% of wetlands basin wide along the Canadian portion of the Great Lakes.

Status Assessment definitions need to be determined; Data availability limited to Canada only, with no other sufficient dataset to compare.

Status Assessment Definitions

This update contains Canada only data with improved coverage, resolution, and habitat classifications. As a result, the status assessment requires further discussion with both US and Canada to determine effective definitions that are measurable, achievable, time-bound, and reflect the ability of coastal wetlands to improve in extent, diversity, condition, and function. Therefore, for this State of the Great Lakes reporting cycle, all status assessments are considered Not Assessed.

Trend Assessment Definitions

This update contains Canada only data with improved coverage, resolution, and habitat classifications. As a result, the trend assessment requires further discussion with both US and Canada to determine effective definitions that are measurable, achievable, time-bound, and reflect the ability of coastal wetlands to improve in extent, diversity, condition, and function. Therefore, for this State of the Great Lakes reporting cycle, all trend assessments are considered Not Assessed.

Endpoints and/or Targets

Pursuant to the Great Lakes Water Quality Agreement (2012), Canada and the United States are charged with *"conducting a baseline survey of existing habitat against which to establish a Great Lakes Basin ecosystem target of net habitat gain and measure future progress"*. As mentioned, there are no quantitative targets for coastal wetland extent and composition. However, a habitat and species task team has defined net habitat gain as one or more of the following: ***"an increase or improvement in the extent, diversity, condition, function, protection, and restoration"***. Ideally, a target would be made possible by assembling data from a seamless, standardized, and reproducible binational survey with an agreed-upon wetland classification scheme and indicators. In Canada, future survey results can be compared with the Canadian Baseline Coastal Habitat Survey data to detect spatial and temporal wetland change. Gains can also be estimated using fine-resolution imagery to capture the cumulative benefits of conservation, protection, and restoration.

Sub-Indicator Purpose

The purpose of this sub-indicator is to assess the status of coastal wetlands extent across all hydrogeomorphic types (lacustrine, riverine, and barrier-protected) considering natural water level variations and anthropogenic-related changes.

Ecosystem Objective

It has been more than 40 years since a report to the Great Lakes Fisheries Commission first documented concern about the loss and degradation of Great Lakes coastal wetlands (Francis et al. 1979) and more than 20 years since Great Lakes indicators were developed to focus on coastal wetland habitat and species (Dodge and Kavetsky 1995; Maynard and Wilcox 1997; Ingram, 2004). More recently, this sub-indicator best supports work towards

General Objective #5 of the 2012 Great Lakes Water Quality Agreement, that states "*the waters of the Great Lakes should support healthy and productive wetlands and other habitats to sustain resilient populations of native species".*

Since signing the first Great Lakes Water Quality Agreement in 1972, amendments by protocol have called for *"maintaining the total areal extent of coastal wetlands and ensuring adequate representation of coastal wetland types across their historical range"* (GLWQA, 1987), and a "*net habitat gain" in coastal wetland extent (GLWQA, 2012).* In both respects, conserving, protecting, restoring, and enhancing the resilience of the remaining coastal wetlands, and supporting wetland ecosystem services, are critical management needs.

Methods

This sub-indicator report provides measures of coastal wetland areal extent by hydrogeomorphic type based on the Canadian Great Lakes Baseline Coastal Habitat Survey completed between 2019 and 2023 (https://open.canada.ca/data/en/dataset/5894725f-b674-4896-9e8f-c62101c815dc). This survey was informed by the Great Lakes Shoreline Ecosystem (GLSE) Inventory completed by the Ontario Ministry of Natural Resources and Forestry (2018-2022). The inventory followed the Ontario Ecological Land Classification methodology and was modified specifically for the Canadian portion of the Great Lakes shoreline (Lee et al., 2023 *in prep*). The dataset includes the shoreline from the wetland-to-water interface and extends approximately two kilometres inland at a resolution of 0.5 ha (1:5,000). The GLSE provides a detailed geospatial digital inventory that organizes geology, terrain, soil, moisture, and the associated wetland vegetation (Lee et al 2023, *in prep*). Additionally, ecosite classes were combined into higher-level community series and community classes to summarize prevalent patterns in wetland vegetation composition (Figure 4).

https://www.arcgis.com/home/item.html?id=f1fe178a57504baf8a7f529899210e56.
Spatial data were extracted from the wetland inventory and classified using the hydrogeomorphic coastal wetland classification system (Albert et al., 2005) and by wetland community class based on Ontario Ecological Land Classification (Lee et al., 2023 *in prep*). In some areas, hydrologically connected wetlands that extended beyond the 2 km survey area were mapped and classified to capture finer hydrogeomorphic types based on physical features and shoreline processes (e.g., raised lake beds with recessional beach ridges in Lake Superior). Using Geographic Information System analysis, coastal wetlands were combined into a single database to measure areal extent and composition. The total extent of wetlands was divided into ten reporting units representing four Canadian Great Lakes and their connecting channels (Table 1). An example of the detailed methodology and findings for Lake Erie is available at: 2020 Canadian baseline coastal habitat survey : Lake Erie technical report.: En164-62/1-2020E-PDF - Government of Canada Publications - Canada.ca.

Land cover and land use analysis is conducted in Ontario by the Ontario Ministry of Natural Resources and Forestry on a 5-year reporting cycle through the Southern Ontario Land Resources Information System and the Forest Resource Inventory. Although this product represents a point in time, it serves as a baseline for future mapping of wetland change. The mapping methodology used is reproducible, allowing for the continual development of spatial data and maps for monitoring and detecting change. Additionally, recent binational efforts will support the assessment of the coastal wetland extent and composition for future reporting cycles. A group of binational

wetland scientists and resource managers are currently working through the Great Lakes Coastal Assembly (Great Lakes Coastal Assembly) to develop a Great Lakes Coastal Wetland Decision Support Tool. The National Oceanic and Atmosphere Administration is leading efforts to complete coastal wetland delineation and classification at annual time steps (from 2010 to 2020) using openly available remote sensing data and ancillary datasets for the Lake Erie basin. For each year, the range of total existing wetland areal extent, wetland extent by hydrogeomorphic type and wetland community class, annual variation and change over time, with consideration of water level variation, will be completed. Discussions are underway to apply the methodology to the entire Great Lakes Basin.

Coastal Wetland Extent by Hydrogeomorphic Type

For this sub-indicator, three main hydrogeomorphic coastal wetland systems were surveyed:

- Barrier-Protected wetlands, which are created by coastal or fluvial processes, with natural processes separating them from the Great Lakes by a barrier feature such as a barrier beach. The wetlands are protected from wave action but can be permanently or temporarily connected to the lake via a channel through the barrier.
- Lacustrine wetlands, which are influenced directly by the waters of the Great Lakes and are more likely affected by lake-level fluctuations, nearshore currents, seiches, and ice scour. These wetlands can be protected from coastal nearshore processes by hydrogeomorphic features.
- Riverine wetlands, which occur along and within rivers that flow into or between the Great Lakes (including large connecting channels), with associated drainages influencing water quality, flow, and sediment input. Protection from wave action is provided by bars and channel morphology.

The total extent of all Great Lakes coastal wetland in Canada is 91,333 hectares (Figure 1, Table 1). Lake Superior contains the greatest coastal wetland extent (23,200 ha; 25%), followed by Lake Huron (20,629 ha; 23%), Lake Erie (15,595 ha; 17%), Lake Ontario (11,638 ha; 13%), and Lake St. Clair (2,087 ha; 2%). The remaining 20% are found within the connecting channels, with the majority found in the St. Clair River delta (9,066 ha; 10%) and St. Lawrence River (5,466 ha; 6%) (Figures 2 and 3).

Most coastal wetlands in Canada are barrier-protected (34,603 ha; 38%), followed by riverine (30,525 ha; 33%), and lacustrine systems (26,204 ha; 29%). More than half of all barrier-protected coastal wetlands are found in Lake Superior (19,667 ha), primarily in Black Bay, while most of the lacustrine wetlands are found in Lake Huron (9,735 ha), primarily in Georgian Bay (9,673 ha). Lacustrine wetlands are also abundant in Lake Erie (9,673ha), where many remaining coastal wetlands are found in large globally rare and vulnerable sand spits within Long Point (8,235 ha) and Rondeau Bay (1,436ha). Nearly 30% of all riverine wetlands are found within the St. Clair River delta. The Lake Ontario shoreline contains a relatively even mix of hydrogeomorphic types with the largest and highest quality wetlands found within Prince Edward County and the Bay of Quinte.

Coastal Wetland Extent by Wetland Community Class

Wetland composition was also summarized by community class (i.e., marsh, swamp (treed and shrub), fen, and bog) and community series (i.e., shallow water marsh, emergent marsh, meadow marsh), as they are appropriate scales of classification that can be used throughout the Great Lakes shoreline and for future replication.

The total extent of all Great Lakes coastal wetlands (marsh, swamp (treed and shrub), fen, and bog) in Canada is 91,333 hectares (Figure 1, Table 1). Coastal marshes are found throughout the Great Lakes Basin and occupy roughly 50,544 ha, accounting for more than 50% of the total coastal wetland area within the Canadian portion of the Great Lakes (Table 2). Lake Erie had the greatest extent of marshes (13,610 ha), followed by Lake Huron (9,624 ha), St. Clair River (8,838 ha), and Lake Ontario (8,804 ha). Treed swamps are found basin-wide and total roughly 29,451 ha, or 32% of the total wetland area with most treed swamps found throughout the Lake Superior coastal margin (16,802 ha or 57%). Similarly, shrub swamps are found basin-wide, but in much smaller sizes compared to marshes and treed swamps (6,965 ha). Roughly 77% of the shrub swamps are found in the Upper Great Lakes, with Lake Huron containing 2,012 ha, Lake Superior with 1,212 ha, and the St. Mary's River with 595 ha. Bogs and fens are found mainly from Lake Huron to Lake Superior. Fens cover an area of 6,355 ha, with most fens located in Lake Superior (3,981 ha) and Lake Huron (2,135 ha). There was very minimal coverage of bogs (17 ha) as they are uncommon in coastal regions and more often found inland. Lake Superior contained 11 ha of bogs and Lake Huron contained 6 ha (Table 2; Figures 5, 6).

Discussion

Coastal wetlands are hotspots of ecosystem services (Sierszen et al., 2012), and a systemic loss in wetland extent and composition diminish critically important wetland functions and biological productivity. The ability to assess changes in wetland extent and composition is important for effective management, particularly under the context of biodiversity loss and long-term changes in physical and environmental conditions. After experiencing a prolonged low period in the early 2010s, water levels reached record and near-record highs in the late 2010s. Water level regimes may be shifting (Gronewold and Rood, 2019) and future extreme highs and lows are plausible (ECCC 2022a; Seglenieks and Temgoua, 2022). Studies show that wetlands tend to decrease in size as water levels increase, and that wetland vegetation zones (particularly meadow marsh) are sensitive to this change (Wilcox and Bateman, 2018; ECCC, 2022b; Anderson et al., 2023). European settlement, development, agriculture, and the associated forms of pollution are responsible for the loss and degradation of over 50 percent of historical Great Lakes coastal wetlands (Uzarski et al., 2019). Many of the remaining wetlands are degraded by excessive nutrient and sediment runoff (Harrison et al., 2020), habitat fragmentation, invasive species, and incompatible shoreline development and shoreline hardening (Pearsall et al., 2013), making them especially sensitive to temperature increases and changes in precipitation (Shrestha et al., 2022), extremes in water-level variation (Seglenieks and Temgoua, 2022), reduced ice cover (NOAA, 2018), intense storms, and coastal erosion (Zuzek, 2021; ECCC, 2022b). Information on the status and temporal trends in extent and composition provides valuable information on how wetlands have changed over the recent past and longer and can be used to measure conservation success. The pattern or direction the data follows can be used to visualize gains and losses through maps, identify current and emerging challenges to wetland conservation, and inform management and policy decisions.

For future assessments, the Canadian Baseline Coastal Habitat Survey establishes a baseline measure for the Canadian portion of the Great Lakes shoreline. Additionally, a team of resource managers and wetland scientists working through the Coastal Assembly are developing management-relevant status and trend assessment

definitions to account for the diversity of geology, natural features and process, land uses, historical extent, and wetland responses to water level changes.

Linkages

Linkages to other sub-indicators in the indicator suite include:

- Coastal wetland sub-indicators used to identify coastal wetland health and function.
    - Coastal Wetland Invertebrates
    - Coastal Wetland Fish
    - Coastal Wetland Amphibians
    - Coastal Wetland Birds
    - Coastal Wetland Plants
- Hardened Shorelines – Physical alteration the shoreline have disrupted natural coastal processes, flow, and littoral circulatory patterns, and have altered, or eliminated connectivity to coastal wetlands and other coastal habitats.
- Precipitation Amounts – Change in atmospheric temperature will intensify the Earth's water cycle, resulting in more frequent and intense storms, increases in precipitation, and increased risk of flooding.
- Water Levels –An increase or decrease in water level can result in changes in plant community structure and diversity. Changes tend to be greatest in the wet meadow (meadow marsh), where grasses and sedges may disappear in high water or new annuals may appear in low water, and in shallow emergent or submergent zones, where submergent and floating plants may disappear when water levels drop rapidly (Anderson et al., 2023). High water levels and storms can damage natural barriers and wetland plant communities (ECCC, 2022a). Water levels of Lakes Superior and Ontario are regulated, which has altered plant community dynamics. This is most obvious in Lake Ontario, where cattails have formed dense, homogenous stands (Smith et al., 2020).
- Invasive Species – Many non-native invaders are found in Great Lakes coastal wetlands and can displace native vegetation as they spread.
- Aquatic Habitat Connectivity – Dams and barriers restrict movement of water, nutrients, and aquatic species to and from tributaries, lakes, and the wetlands connected to them. Barriers restrict wetland access for spawning fish. Alternatively, barriers may also prevent invasive species from entering wetlands and outcompeting native fish.
- Changes in Physical Conditions and impacts - The Great Lakes region is experiencing extremes in water levels, storm surges, and air and surface water temperatures that are detrimental to aquatic vegetation communities and the native species they support (Environmental Law and Policy Centre, 2019; ECCCC, 2022a; Lam & Dokoska, 2022). Coastal wetlands, especially wetlands of the Lower Great Lakes characterized by glacial till deposits, are particularly vulnerable (ECCC, 2022b).

Assessing Data Quality

Data Characteristics	Agree	Neutral or Unknown	Disagree	Not Applicable
Data are documented, validated, or quality-assured by a recognized agency or organization	X			
Data are from a known, reliable and respected generator of data and are traceable to original sources	X			
Geographic coverage and scale of data are appropriate to the Great Lakes Basin	X*			
Data obtained from sources within the U.S. are comparable to those from Canada				X
Uncertainty and variability in the data are documented and within acceptable limits for this sub-indicator report	X			
Data used in the assessment are openly available and accessible	Yes	Canadian Baseline Coastal Habitat Survey: https://open.canada.ca/data/en/dataset/5894725f-b674-4896-9e8f-c62101c815dc		

Notes on Accessing Data

*No current data is available for the U.S portion of the Great Lakes basin. Future efforts will work to incorporate comparable data for the U.S for this sub-indicator. Also, the data does not include islands within the Great Lakes. See Data Limitations and Next Steps sections for more information.

The assessment also utilized data from the Ontario Ministry of Natural Resources hydrogeomorphic type layer. The data for this layer are not publicly available. For additional information, visit Ontario Geohub.

Data Limitations

The coastal wetland extent and composition sub-indicator was last updated for the 2005 State of Great Lakes Indicator report using data from the Great Lakes Coastal Wetland Consortium's binational coastal wetland database (Albert et al. 2005). The data were incomplete due to gaps and limitations, especially for the upper Great Lakes (EC & USEPA, 2007; Midwood et al., 2012). Additionally, this data covered a different survey scope that included Great Lakes islands and was much coarser, with a minimum mapping unit of two hectares (Ingram et. al., 2004), an average feature size of 25 hectares, and a total feature count of 8,500 unique wetland features.

While the Canadian Baseline Coastal Habitat Survey represents an improvement in scope (~2 km coastal margin and ~8,790 km) and scale (0.5 ha minimum mapping unit), a significant data gap exists where the survey was unable to spatially map coastal wetlands in parts of Lake Huron, namely the extensive archipelago of Georgian Bay, the North Channel, and on Manitoulin Island - the world's largest freshwater island. At the time of this publication, no comparable survey results were available for the United States portion of the Great Lakes Basin. For future sub-indicator reporting, data assembly with a consistent project scope, image resolution, and methodology across the Great Lakes basin is required to comprehensively inventory and map the extent and composition of wetlands, reduce uncertainty in data, and track spatial and temporal changes.

Daily, seasonal, annual, and decadal fluctuations in water level are phenomena that encourage the maintenance of healthy and diverse wetland plant and animal communities. However, more extreme environmental conditions are becoming more common and coastal wetlands are susceptible to future lake level changes (ECCC, 2022b). Tracking changes in wetland extent and composition to reflect losses due to water level changes, erosion, shoreline development, and other stressors, and gains attributable to restoration programs, will require a means to distinguish between changes driven by these factors and natural variation. Characterizing wetland extent and composition over a range of water levels associated with natural cycles helps to overcome this challenge but does not in itself resolve the issue of quantitatively separating the anthropogenically driven areal gains or losses from those associated with natural variability.

Additional Information

The Ontario Ministry of Natural Resources and Forestry conducts province-wide satellite-based natural resource change monitoring and reporting on a five-year cycle. This process can also be used to track loss and gain events in natural areas such as wetlands. The Ontario Ministry of Natural Resources and Forestry intends to incorporate Sentinel 2 multispectral instrument imagery into its natural resource inventory and change monitoring processes. At ten meters, the resolution of this imagery is three times finer than the imagery currently used by the province (i.e., Landsat thematic mapper) and therefore opportunities to improve on both the spatial and thematic scale. For more information on the Canadian Baseline Coastal habitat Survey and the associated data sources, data, methodology, and results, please refer to the Canadian open data catalogue (https://open.canada.ca/data/en/dataset/5894725f-b674-4896-9e8f-c62101c815dc) and the associated technical reports (reference when all are published).

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List of Tables

Table 1. Coastal wetland extent for the Canadian portion of the Great Lakes and connecting rivers by hydrogeomorphic type. Data source: Ontario Ministry of Natural Resources.

Table 2. Extent and composition of coastal wetlands for the Canadian portion of the Great Lakes and connecting rivers by community class. Data source: Ontario Ministry of Natural Resources.

List of Figures

Figure 1. Distribution of all coastal wetlands (a) and coastal wetlands by hydrogeomorphic type (b) across the Canadian portion of the Great Lakes basin. Data source: Ontario Ministry of Natural Resources.

Figure 2. Coastal wetland extent for the Canadian portion of the Great Lakes by hydrogeomorphic type. Data source: Ontario Ministry of Natural Resources.

Figure 3: Coastal wetland extent for the Canadian portion of connecting channels by hydrogeomorphic type. Data source: Ontario Ministry of Natural Resources.

Figure 4: Coastal wetland community class, community series, and ecosite diversity within Rondeau Bay on the north shores of Lake Erie. Data source: Canadian Baseline Coastal Habitat Survey: Lake Erie (2020).

Figure 5. Coastal wetland extent for Canadian portion of the Great Lakes by community class. Data source: Ontario Ministry of Natural Resources.

Figure 6. Coastal wetland extent for the Canadian portion of connecting rivers by community class. Data source: Ontario Ministry of Natural Resources.

Last Updated

State of the Great Lakes 2025 Report

Table 1. Coastal wetland extent for the Canadian portion of the Great Lakes and connecting rivers by hydrogeomorphic type. Data source: Ontario Ministry of Natural Resources.

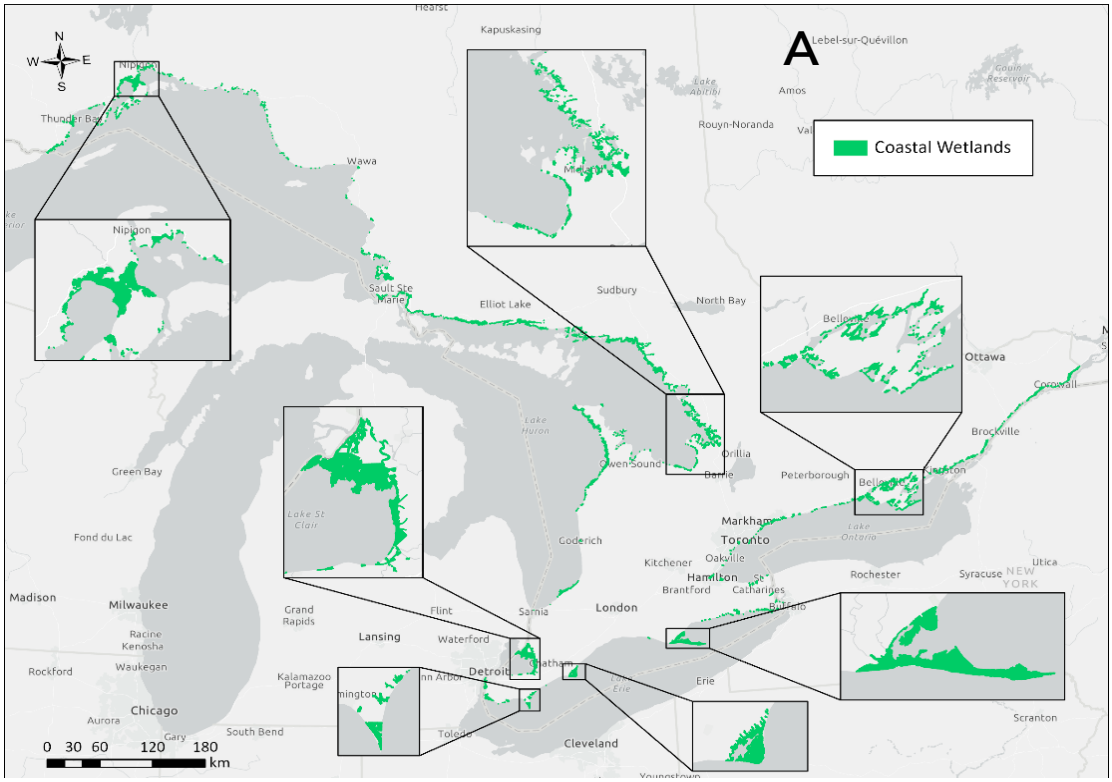
Unit	Unit Name	Unit Type	Hydrohydrogeomorphic Wetland Area (Ha)			Total Area (Ha)	Percent of Total Wetlands Basin-Wide
			Barrier-Protected	Lacustrine	Riverine		
1	Lake Superior	Lake	19,667 (85%)	1,201 (5%)	2,332 (10%)	23,200	25%
2	St. Mary's River	Connecting River	1,305 (48%)	334 (12%)	1,082 (40%)	2,721	3%
3	Lake Huron	Lake	6,362 (31%)	9,735 (47%)	4,532 (22%)	20,629	23%
4	St. Clair River	Connecting River	0 (0%)	6 (<1%)	9,059 (100%)	9,066	10%
5	Lake St. Clair	Lake	851 (41%)	883 (42%)	353 (17%)	2,087	2%
6	Detroit River	Connecting River	0 (0%)	0 (0%)	857 (100%)	857	1%
7	Lake Erie	Lake	3,138 (20%)	9,673 (62%)	2,784 (18%)	15,595	17%
8	Niagara River	Connecting River	0 (0%)	0 (0%)	74 (100%)	74	<1%
9	Lake Ontario	Lake	3,273 (28%)	4,294 (37%)	4,071 (35%)	11,638	13%

10	St. Lawrence River	Connecting River	8 (<1%)	78 (1%)	5,381 (99%)	5,466	6%
Basin - Wide			**34,603 (38%)**	**26,204 (29%)**	**30,525 (33%)**	**91,333**	**100%**

Table 2. Extent and composition of coastal wetlands for the Canadian portion of the Great Lakes and connecting rivers by community class. Data source: Ontario Ministry of Natural Resources.

Unit Number	Unit Name	Unit Type	Community Class	Wetland Area (Ha)
1	Lake Superior	Lake	Bog	11
			Fen	3,981
			Marsh	1,193
			Shrub Swamp	1,212
			Treed Swamp	16,802
2	St. Mary's River	Connecting River	Fen	239
			Marsh	1,178
			Shrub Swamp	595
			Treed Swamp	709
3	Lake Huron	Lake	Bog	6
			Fen	2,135
			Marsh	9,624
			Shrub Swamp	2,012
			Treed Swamp	6,851
4	St. Clair River	Connecting River	Marsh	8,838
			Shrub Swamp	91
			Treed Swamp	138
5	Lake St. Clair	Lake	Marsh	2,059
			Shrub Swamp	1
			Treed Swamp	28
6	Detroit River	Connecting River	Marsh	774

			Shrub Swamp	26
			Treed Swamp	57
7	Lake Erie	Lake	Marsh	13,610
			Shrub Swamp	337
			Treed Swamp	1,648
8	Niagara River	Connecting River	Marsh	31
			Shrub Swamp	6
			Treed Swamp	38
9	Lake Ontario	Lake	Marsh	8,803
			Shrub Swamp	553
			Treed Swamp	2,282
10	St. Lawrence River	Connecting River	Marsh	4,435
			Shrub Swamp	132
			Treed Swamp	899



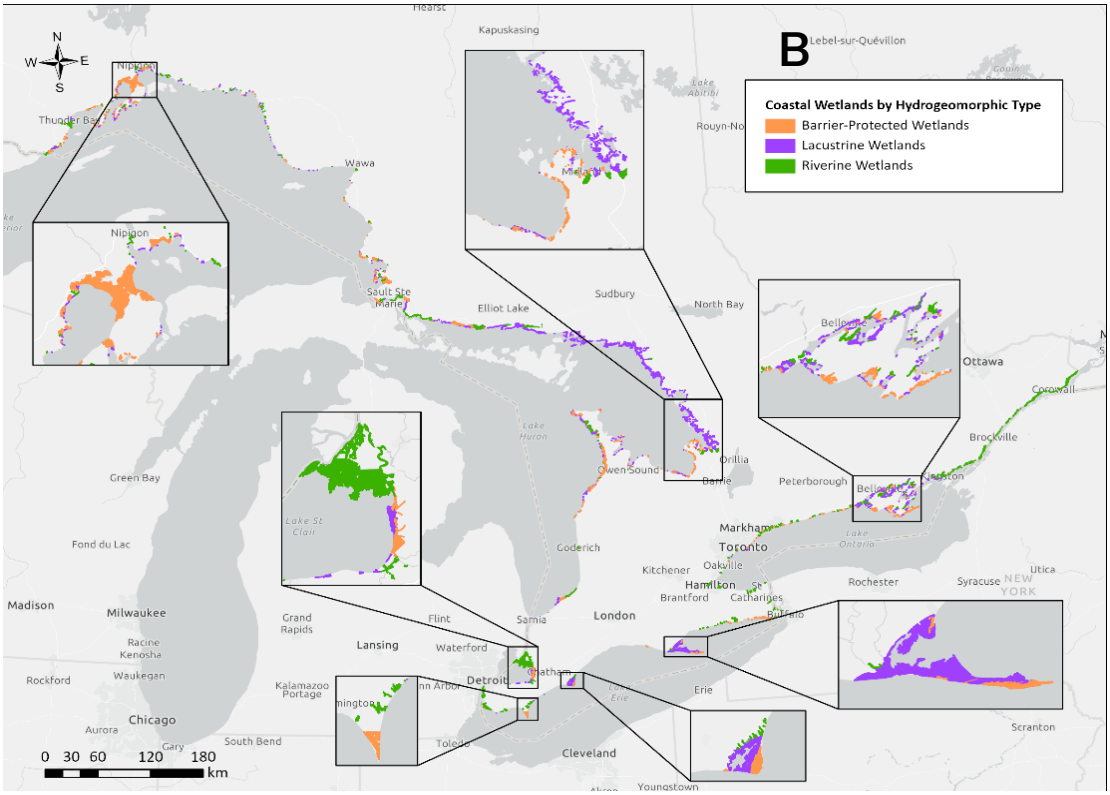


Figure 1. Distribution of all coastal wetlands (a) and coastal wetlands by hydrogeomorphic type (b) across the Canadian portion of the Great Lakes basin. Data source: Ontario Ministry of Natural Resources.

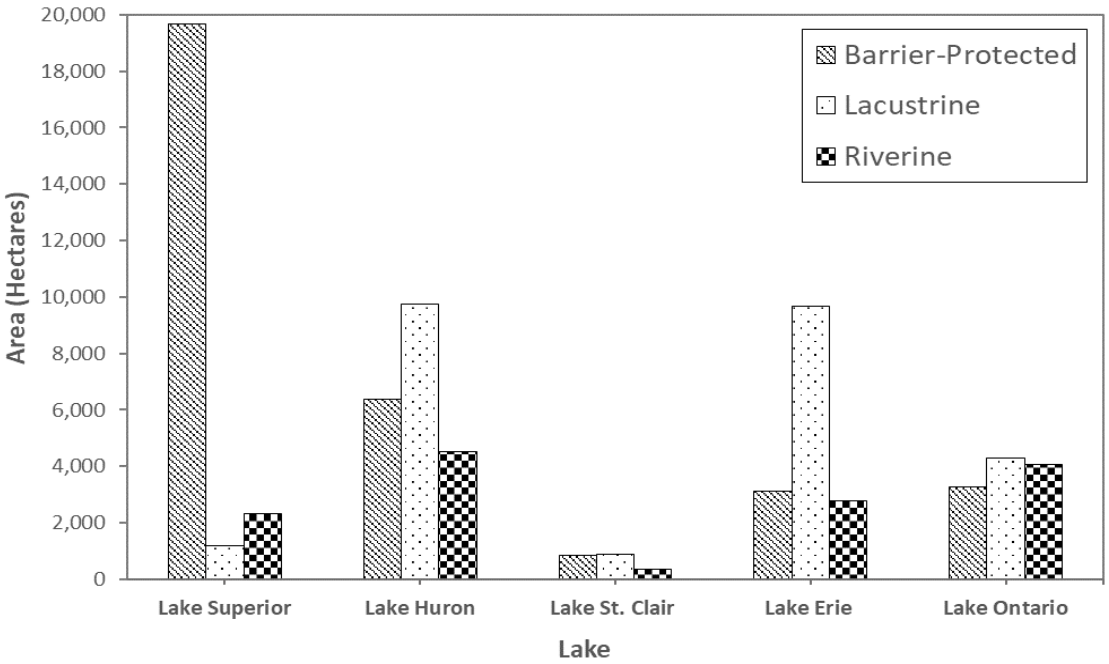


Figure 2. Coastal wetland extent for the Canadian portion of the Great Lakes by hydrogeomorphic type. Data source: Ontario Ministry of Natural Resources.

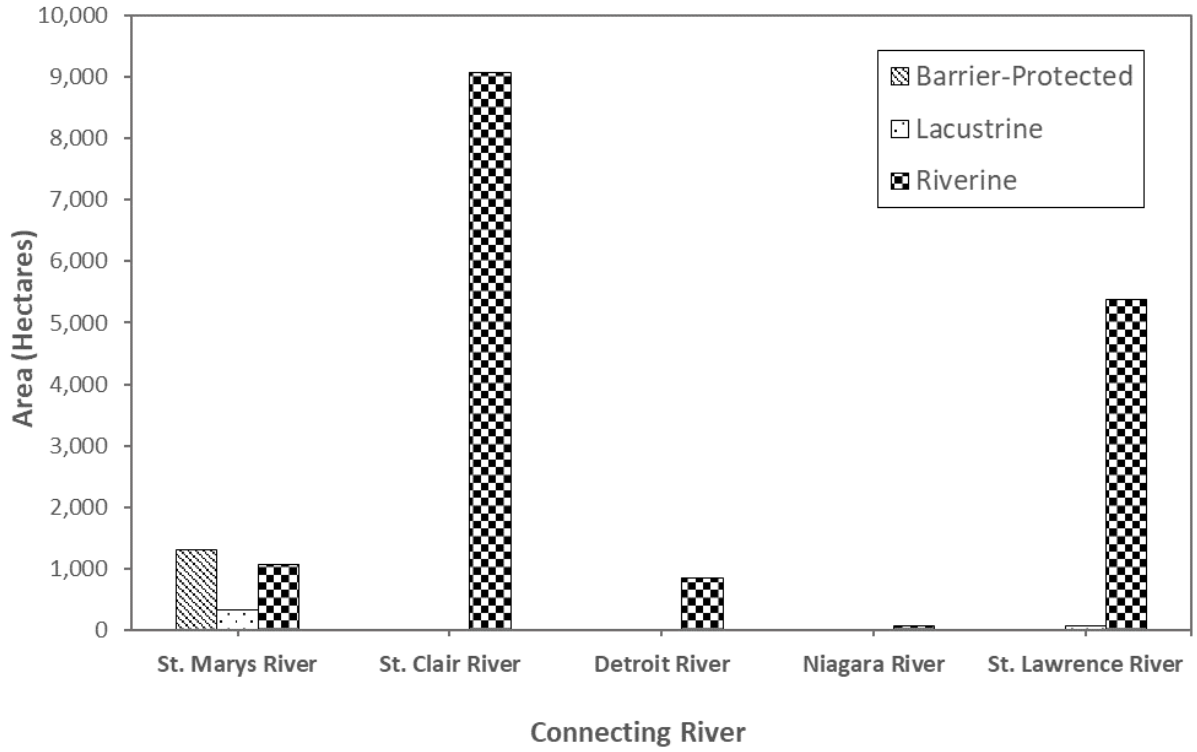


Figure 3. Coastal wetland extent for the Canadian portion of connecting channels by hydrogeomorphic type. Data source: Ontario Ministry of Natural Resources.

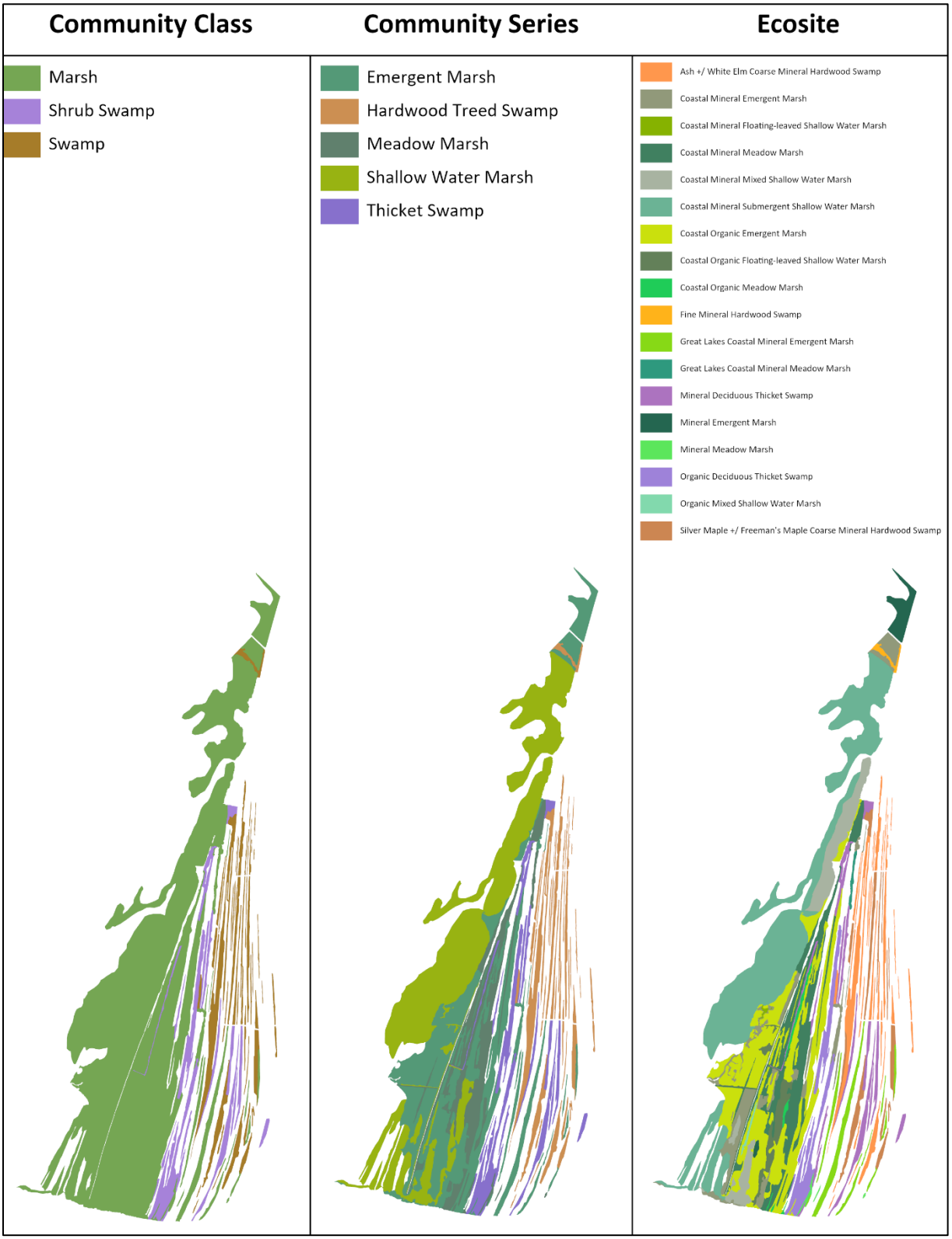


Figure 4. Coastal wetland community class, community series, and ecosite diversity within Rondeau Bay on the north shores of Lake Erie. Data source: Canadian Baseline Coastal Habitat Survey: Lake Erie (2020).

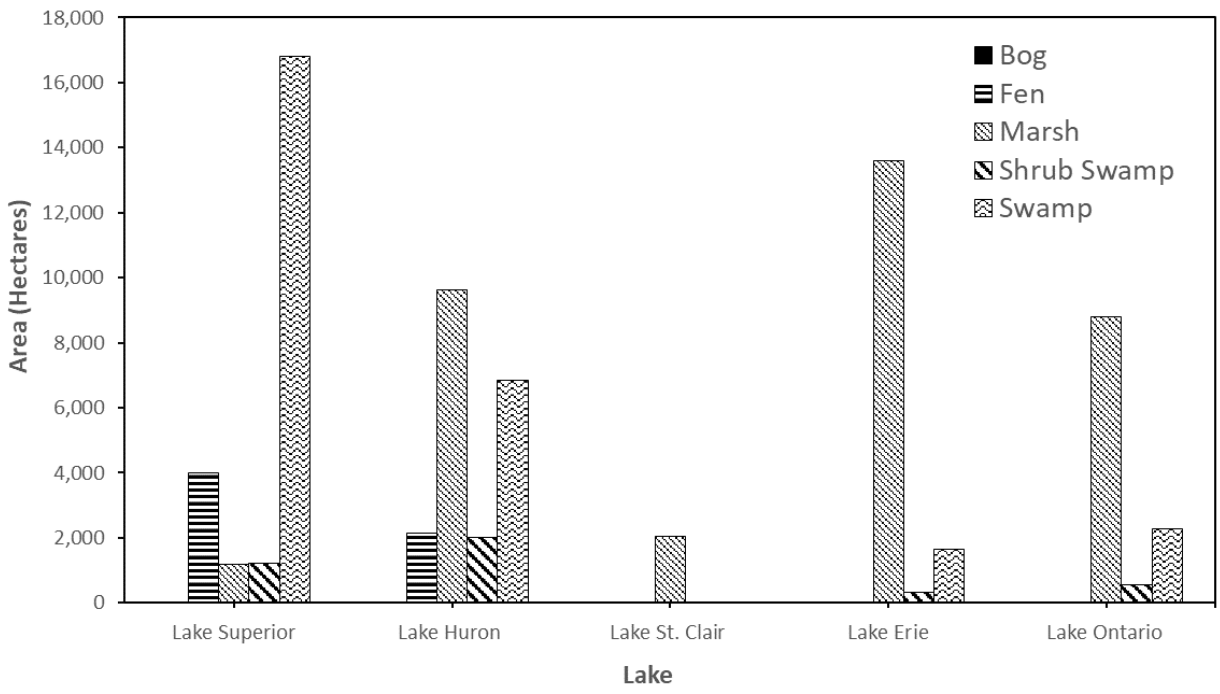


Figure 5. Coastal wetland extent for Canadian portion of the Great Lakes by community class. Data source: Ontario Ministry of Natural Resources.

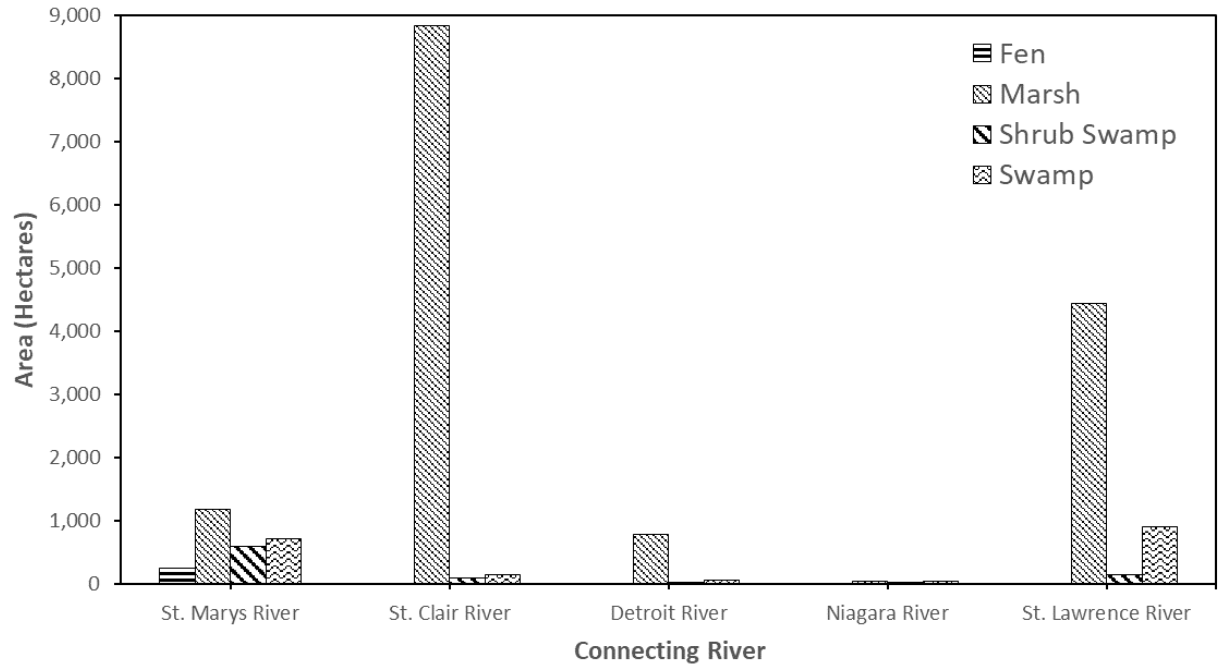


Figure 6. Coastal wetland extent for the Canadian portion of connecting rivers by community class. Data source: Ontario Ministry of Natural Resources.