Coastal Wetland Plant Communities
Indicator #4862

Overall Assessment
Status: **Mixed**
Trend: **Undetermined**
Rationale**: The status of the coastal wetland plant community in the Great Lakes is mixed because Lake Superior and Lake Ontario have individual wetlands plant communities that have a good status. Lake Michigan, Lake Huron, and Lake Erie are all listed with a fair status of their coastal wetland plant community health.**

Lake-by-Lake Assessment
Lake Superior
Status: Mixed
Trend: Undetermined
Rationale: Degradation around major urban areas. Coastal wetlands plants in Lake Superior generally have a good status.

Lake Michigan
Status: Fair
Trend: Undetermined
Rationale: High quality wetlands in the northern part of the lake. Lakes Michigan's northern open embayments and protected embayment are higher quality compared to the coastal wetlands in the drowned river mouth.

Lake Huron
Status: Fair
Trend: Undetermined
Rationale: Plowing, raking and mowing on Saginaw Bay wetland during low water causing degradation. Northern wetlands are higher quality. Lake Huron's northern protected embayments and open embayments generally have fair to good status with individual wetlands having good status. However, in Saginaw Bay the open embayment have poor to fair status.

Lake Erie
Status: Fair
Trend: Deteriorating
Rationale: Generally poor on U.S. shore with some restoration at Metzger Marsh Ohio. Presque Isle, Pennsylvania and Long Point, Ontario have high quality wetlands. Lake Erie's open and sand-spit embayments have a fair status. The lake is also classified as deteriorating based on historically data from 1975 in Lake Erie.

Lake Ontario
Status: Poor
Trend: Unchanging

Rationale: Degraded by nutrient loading and water level control. Some scattered Canadian wetlands of higher quality. Lake Ontario's barrier beach lagoons have higher quality than the drowned river mouths and the protected embayments. However, individual coastal wetlands in the protected embayments have good status.

Purpose

- To assess the level of native vegetative diversity and cover for use as a surrogate measure of quality of coastal wetlands which are impacted by coastal manipulation or input of sediments.

Ecosystem Objective

Coastal wetlands throughout the Great Lakes basin should be dominated by native vegetation, with low numbers of invasive and non-native plants species that have low levels of coverage. Significant wetland areas in the Great Lakes System that are threatened by urban and agricultural development and waste disposal activities should be identified, preserved and, where necessary, rehabilitated (Annex 13 GLWQA). This indicator supports the restoration and maintenance of the chemical, physical and biological integrity of the Great Lakes basin and beneficial uses dependent on healthy wetlands (Annex 2 GLWQA).

State of the Ecosystem

The conditions of the plant community in coastal wetlands naturally differ across the Great Lakes basin, due to differences in geomorphic and climatic conditions. The characteristic size and plant diversity of coastal wetlands vary by wetland type, lake, and latitude; in this document these differences will be described broadly as "regional wetland types."

Regional Wetland Types

Coastal wetlands are divided into three main categories based on the hydrology of the area. Lacustrine wetlands are connected to the Great Lakes, and they are largely impacted by fluctuations in lake levels. Riverine wetlands occur near rivers that are found in the Great Lakes basin. Typically, the quality of riverine wetlands are dominated by the river drainage system, however coastal process can cause lakes to flood back into these wetlands. The last type of coastal wetlands is barrier protected. Barrier protected wetlands are derived from coastal processes that separate the wetland from the Great Lakes by barrier beaches. All coastal wetlands contain different zones (swamp, meadow, emergent, submergent), some of which may be absent in certain types of wetlands. Great Lakes wetlands were classified and mapped in 2004 (see http://glc.org/wetlands/inventory.html). United States coastal wetlands inventory map (see http://glc.org/wetlands/us_mapping.html) and Canada coastal wetland inventory map (see http://glc.org/wetlands/can_mapping.html).

Lake Variations

Physical properties such as the type of shoreline and chemical and physical water quality parameters vary between great lakes. The variation of nutrient levels creates a north to south gradient, and nutrient levels also increase in lake basins further to the east. This includes Lake Erie, Lake Ontario, and in the upper St. Lawrence River. Lake Superior is the most distinct great lake due to its low alkalinity and prevalence of bedrock shoreline.

Differences in Latitude

Latitudinal variations result in different climatic conditions based on the location of the coastal wetlands. Temperature differences between the north and south lead to differences in the species of plants found in coastal wetlands. The southern portion of the Great Lakes also has increased agricultural activity along the shorelines, resulting in increased nutrient loads, sedimentation and non-native species introductions.

There are characteristics of coastal wetlands that make usage of plants as indicators difficult in certain conditions. Among these are:

Water level fluctuation

Great Lakes water levels fluctuate greatly from year to year. Either an increase or decrease in water level can result in changes in numbers of species or overall species composition in the entire wetland or in specific zones. Such a change makes it difficult to monitor change over time. Changes are great in two zones: the wet meadow, 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.

Lake-wide alterations

For the southern lakes, most wetlands have been dramatically altered by both intensive agriculture and urban development of the shoreline. Alterations of coastal wetland especially in the wet meadow and upper emergent zone will lead to drier conditions which may allow invasive species to establish.

There are several hundred species of plants that occur within coastal wetlands. To evaluate the status of wetlands using plants as indicators, several different plant metrics have been suggested. These are discussed briefly here.

Invasive Plant Cover

The invasive plant cover for an entire site and all coastal wetlands zones including wet meadows, dry emergent, flooded emergent and submergent zones that are considered high quality should not have any invasive plants present. For low quality coastal wetlands all zones are expected to have 25 to 50% cover of invasive plants. Invasive plant cover that is more than 50% is considered to be very low quality (Albert, 2008). Invasive plant cover includes both native and non-native invasive plants.

Invasive Frequency

The invasive frequency is measured similar to invasive plant cover. Invasive plants are expected to be absent in all coastal wetland zones to be considered a high quality coastal wetlands. When invasive frequency is consider low to very low quality invasive plants are present in 25 to more than 50% of the coastal wetland (Albert, 2008). Invasive frequency includes both native and non-native invasive plants.

Mean Conservatism (Native Species)

Conservatism indices were developed using the Floristic Quality Assessment (FQA) program. The mean conservatism is an index that measures the specificity of a particular species of plant to a specific habitat (Albert, 2008). The mean conservatism index also evaluates the intactness of coastal wetlands, which is based on all of the plant species in the wetlands. A species is considered conservative if it only grows in a specific, high quality environment. Plant species that are ubiquitous receive a low conservatism score (0) however plant species that are rare and only found in specific habitats are assigned a high conservatism score (10) (Swink, and Wilhelm, 1994). The mean conservatism index includes all of the species found in a habitat.

Mean conservatism ratios may also be calculated. The ratio is derived by taking the mean conservatism index for all species present divided by the mean conservatism index for native species. Mean conservatism ratios that are less than 0.79 are expected to represent large numbers of exotic species present with degraded conditions. Mean conservatism ratios that are 0.8 and above represent medium to high quality conservatism with many native species present (Albert, 2008).

Table 1. Mean Conservatism Scores for the Great Lakes Coastal Wetlands Plant Communities in Meadow, and Emergent zones, and the Total Marsh

* For Lake Ontario and Georgian Bay protected wetlands the mean scores for each zone are based on the score of several wetlands rather on a mean coverage value for all of the marshes studies. The maximum score of a single wetland for each zone is shown in parenthesis when the data is available ( ).
**For Lake Erie, mean C scores from historic data collected in high quality wetland at Perry's Victory Monument (Stuckey 1975) is show in brackets [ ].

Lake Assessment Scale for Mean Conservatism Scores

Good	6.0 and above
Fair	3.0 - 5.9
Poor	0.0 - 2.9
Mixed	Combination of two categories

Data was collected and interpreted from Table 3-4 written by Albert, D.A., March 2008. Great Lakes Coastal Wetlands Monitoring Plan, Chapter Three Vegetation Community Indicators. Developed by the Great Lakes Coastal Wetlands Consortium, A project of the Great Lakes Commission

The total marsh in Lake Superior appears to have the highest quality wetlands when compared to the other lakes with a 6.4 conservatism index. Lake Michigan and Lake Huron have very similar total marsh conservatism indices ranging from 4.5 to 5.6. Lake Erie has a fair conservatism index ranging from 3.1 to 4.5. However, compared to historic ratings the coastal wetlands are deteriorating. Lastly, Lake Ontario has a fair conservatism index with a range consisting of 3.9 to 5.7. Overall, a majority of the lake fall into the fair quality of coastal wetland based on the conservatism index.

The state of the wetland plant community is quite variable, ranging from good to poor across the Great Lakes basin. The wetlands in individual lake basins are often similar in their characteristics because of water level controls and lake-wide near-shore management practices. There is evidence that the plant component in some wetlands is deteriorating in response to extremely low water levels in some of the Great Lakes, but this deterioration is not seen in all wetlands within these lakes. In general, there is slow deterioration in many wetlands as shoreline alterations introduce non-native species. However, the turbidity of the southern Great Lakes has reduced with expansion of zebra mussels, resulting in improved submergent plant diversity in many wetlands.

Trends in wetland health based on plants have not been well established. In the southern Great Lakes (Lake Erie, Lake Ontario, and the Upper St. Lawrence River), almost all wetlands are degraded by either water level control, nutrient enrichment, sedimentation, or a combination of these factors. Probably the strongest demonstration of this is the prevalence of broad zones of cat-tails, reduced submergent diversity and coverage, and prevalence of non-native plants, including reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), curly pondweed (*Potamogeton crispus*), Eurasian milfoil (*Myriophyllum spicatum*), and frog bit (*Hydrocharis morsus-ranae*). In the remaining Great Lakes (Lake St. Clair, Lake Huron, Lake Michigan, Georgian Bay, Lake Superior, and their connecting rivers), intact, diverse wetlands can be found for most geomorphic wetland types. However, low water conditions have resulted in the almost explosive expansion of reed in many wetlands, especially in Lake St. Clair and southern Lake Huron, including Saginaw Bay. As water levels rise, the response of reed should be monitored.

One of the disturbing trends is the expansion of frog bit, a floating plant that forms dense mats capable of eliminating submergent plants, from the St. Lawrence River and Lake Ontario westward into Lake Erie. This expansion will probably continue into all or many of the remaining Great Lakes.

Studies in the northern Great Lakes have demonstrated that non-native species like reed, reed canary grass, and purple loosestrife have become established throughout the Great Lakes, but that the abundance of these species is low, often restricted to only local disturbances such as docks and boat channels. It appears that undisturbed marshes are not easily colonized by these species. However, as these species become locally established, seeds or fragments of plants may be able to establish themselves when water level changes create appropriate sediment conditions.

Pressures

Agriculture

Agriculture degrades wetlands in several ways, including nutrient enrichment from fertilizers, increased sediments from erosion, increased rapid runoff from drainage ditches, introduction of agricultural non-native species (reed canary grass), destruction of inland wet meadow zone by plowing and diking, and addition of herbicides. In the southern lakes, Saginaw Bay, and Green Bay, agricultural sediments have resulted in highly turbid waters which support few or no submergent plants.

Urban development

Urban development degrades wetlands by hardening shoreline, filling wetland, adding a broad diversity of chemical pollutants, increasing stream runoff, adding sediments, and increased nutrient loading from sewage treatment plants. In most urban settings, almost complete wetland loss has occurred along the shoreline.

Residential shoreline development

Along many coastal wetlands, residential development has altered wetlands by nutrient enrichment from fertilizers and septic systems, shoreline alterations for docks and boat slips, filling, and shoreline hardening. Agriculture and urban development are usually less intense than local physical alteration which often results in the introduction of non-native species. Shoreline hardening can completely eliminate wetland vegetation.

Mechanical alteration of shoreline

Mechanical alteration takes a diversity of forms, including diking, ditching, dredging, filling, and shoreline hardening. With all of these alterations, non-native species are introduced by construction equipment or in introduced sediments. Changes in shoreline gradients and sediment conditions are often adequate to allow non-native species to become established.

Introduction of non-native species

Non-native species are introduced in many ways. Some were purposefully introduced as agricultural crops or ornamentals, later colonizing in native landscapes. Others came in as weeds in agricultural seed. Increased sediment and nutrient enrichment allow many of the worst aquatic weeds to out-compete native species. Most of the worst non-native species are either prolific seed producers or reproduce from fragments of root or rhizome. Non-native animals have also been responsible for increased degradation of coastal wetlands. One of the worst invasive species has been Asian carp, who's mating and feeding result in loss of submergent vegetation in shallow marsh waters.

Pressures were described by Dennis Albert in the Coastal Wetland Plant Communities Indicator # 4862

Management Implications

Although monitoring protocols have been developed for this indicator by the Great Lakes Coastal Wetlands Consortium, monitoring on basin wide scale has net yet occurred. Implementations of a long term coastal wetland monitoring program is pending, however support for this program is need4ed by resource managers throughout the basin.

While plants are currently being evaluated as indicators of specific types of degradation, there are limited examples of the effects of changing management on plant composition. Restoration efforts at Cootes Paradise, Oshawa Second, and Metzger Marsh have recently evaluated a number of restoration approaches to restore submergent and emergent marsh vegetation, including carp elimination, hydrologic restoration, sediment control, and plant introduction. The effect of agriculture and urban sediments may be reduced by incorporating buffer strips along streams and drains. Nutrient enrichment could be reduced by more effective fertilizer application, thereby reducing algal blooms. However, even slight levels of nutrient enrichment cause dramatic increases in submergent plant coverage. For most urban areas it may prove impossible to reduce nutrient loads adequately to restore native aquatic vegetation. Mechanical disturbance of coastal sediments appears to be one of the primary vectors for introduction of non-native species. Thorough cleaning of equipment to eliminate seed source and monitoring following disturbances might reduce new introductions of non-native plants.

Assessing Data Quality

Insert "x" under the statement that best corresponds with each data characteristic

Data Characteristics	Strongly Agree	Agree	Neutral or Unknown	Disagree	Strongly Disagree	Not Applicable
1. Data are documented, validated, or quality-assured by a recognized agency or organization		X				
2. Data are traceable to original sources		X				
3. The source of the data is a known, reliable and respected generator of data		X				
4. Geographic coverage and scale of data are appropriate to the Great Lakes basin		X				
5. Data obtained from sources within the U.S. are comparable to those from Canada			X			
6. Uncertainty and variability in the data are documented and within acceptable limits for this indicator report			X			
Clarifying Notes: Data was collected by the Great Lakes Coastal Wetlands Consortium using the Great Lakes Coastal Wetland Monitoring Plan. There has been a lot of sampling, with most of the larger marshes in all of the Great Lakes being sampled. The only exception is Georgian Bay, where the sampling has been spottier and the overall development of indicators less detailed.						

Acknowledgments

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Dennis Albert, Michigan Natural Features Inventory, Michigan State University Extension. (2006-2008)

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List of Tables

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Last Updated

State of the Lakes Ecosystem Conference (SOLEC) 2008

Lake or Region Name	Regional Wetland Type	Mean Conservatism Score by Zone			Lake Assessment Scale
		Meadow Zone	Emergent Zone	Total Marsh	
Lake Superior	Barrier Enclosed - Barrier Beach & Riverine	6.3	3.7	6.4	Mixed
Lake Superior	Barrier Enclosed - Swale Complex	-	-	5.9 (6.9)	Fair, (Good)
Saint Marys River	Riverine - Connecting Channel	5.1	5.6	5.6	Fair
Lake Michigan	Riverine - Drowned River Mouth	4.0	4.9	4.5	Fair
Lake Michigan	Lacustrine - Open Embayments	5.5	4.5	5.1	Fair
Lake Michigan	Lacustrine - Protected Embayment	5.1	5.6	5.6	Fair
Lake Michigan	Barrier Enclosed - Swale Complex	-	-	5.3 (6.3)	Fair, (Good)
Lake Huron	Lacustrine - Protected Embayments	5.1	5.6	5.6	Fair
Lake Huron	Lacustrine - Open Embayments	5.5	4.5	5.1	Fair
Lake Huron	Barrier Enclosed - Swale Complex	-	-	4.9 (6.4)	Fair, (Good)
Georgian Bay	Lacustrine - Protected Embayment*	5.1 (6.5)	6.4 (7.2)	5.8 (6.8)	Mixed, (Good)
Saginaw Bay	Lacustrine - Open Embayment	3.2	4.5	3.9	Fair
Saint Clair River	Riverine - Delta	4.2	5.5	4.7	Fair
Lake Saint Clair	Lacustrine - Open Embayments**	3.1	3.8	3.7	Fair
Lake Erie	Lacustrine - Open Embayments**	3.1 [4.6]	3.8 [5.3]	3.7 [5.3]	Fair, [Fair]
Lake Erie	Lacustrine - Sand-Spit Embayments**	4.3 [4.5]	4.4 [6.1]	4.5 [4.8]	Fair, [Mixed]
Lake Ontario	Barrier Enclosed - Barrier Beach Lagoons	5.0	5.7	5.3	Fair
Lake Ontario	Riverine - Drowned River Mouth	4.2	4.3	4.2	Fair
Lake Ontario	Lacustrine - Protected Embayments*	4.7 (6.4)	3.9 (5.8)	4.5 (6.3)	Fair, (Mixed)
Saint Lawrence River	Riverine - Drowned River Mouth	4.4	5.5	5.0	Fair

Table 1. Mean Conservatism Scores for the Great Lakes Coastal Wetlands Plant Communities in Meadow, and Emergent zones, and the Total Marsh

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