Coastal Wetland Plant Community Health
Indicator #4862

Overall Assessment

Status:	**Mixed**
Trend:	**Undetermined**

Lake-by-Lake Assessment

Lake Superior
Status: Good
Trend: Unchanging
Rationale: Degradation around major urban areas

Lake Michigan
Status: Mixed
Trend: Unchanging
Rationale: High quality wetlands in north part of lake

Lake Huron
Status: Mixed
Trend: Deteriorating
Rationale: Plowing, raking, and mowing on Saginaw Bay wetlands during low water causing degradation. Northern wetlands are high quality.

Lake Erie
Status: Mixed
Trend: Unchanging
Rationale: Generally poor on U.S. shore with some restoration at Metzger Marsh OH. Presque Isle, PA and Long Point, ON have high quality wetlands.

Lake Ontario
Status: Poor
Trend: Unchanging
Rationale: Degraded by nutrient loading and water level control. Some scattered Canadian wetlands of higher quality.

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 plant species that have low levels of coverage. 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 (United States and Canada 1987).

State of the Ecosystem
Background
To understand the condition of the plant community in coastal wetlands, it is necessary to understand the natural differences that occur in the plant communities across the Great Lakes basin. The characteristic size and plant diversity of coastal wetlands vary by wetland type, lake, and latitude, due to differences in **geomorphic and climatic conditions**. Major **factors** will be described below.

Lake
The water chemistry and shoreline characteristics of each Great Lake differ, with Lake Superior being the most distinct due to its low alkalinity and prevalence of bedrock shoreline. Nutrient levels also increase in the lake basins further to the east, that is, in Lake Erie, Lake Ontario, and in the upper St. Lawrence River.

Geomorphic wetland type
There are several different types of wetlands based on the geomorphology of the shoreline where the wetland forms. Each landform has its characteristic sediment, bottom profile, accumulation of organic material, and exposure to wave activity. These differences result in differences in plant zonation and breadth, as well as species composition. All coastal wetlands contain different zones (swamp, meadow, emergent, submergent), some of which may be typically absent in certain geomorphic wetland types. All Great Lakes wetlands have recently been classified and mapped (see http://glc.org/wetlands/inventory.html).

Latitude
Latitudinal differences in temperature result in floristic differences between the southern and northern Great Lakes. Probably more important is the increased agricultural activity along the shoreline of the southern Great Lakes, resulting in increased 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. For Lake Ontario, water level control has resulted in major changes to the flora. For both of these cases, it is difficult to identify base-line, high quality wetlands for comparison to degraded wetlands.

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

Native plant diversity
The number of native plant species in a wetland is considered by many as a useful indicator of wetland health. The overall diversity of a site tends to decrease from south to north. Different hydrogeomorphic wetland types support vastly different levels of native plant diversity, complicating the use of this metric.

Non-native species
Non-native species are considered signs of wetland degradation, typically responding to increased sediment, nutrients, physical disturbance, and seed source. The amount of non-native species coverage appears to be a more effective measure of degradation than the number of non-native species, except in the most heavily degraded sites.

Submergent species
Submergent plants respond to high levels of sediment, nutrient enrichment, and turbidity. Some specific plant species have been identified that respond more so to each of these changes. Floating species, such as *Lemna* spp., are similarly responsive to nutrient enrichment. While submergent species are valuable indicators whose response to changing environmental conditions is well documented, they also respond dramatically to natural fluctuations in the water level, making them less dependable as indicators in the Great Lakes than in other wetland settings.

Nutrient-responsive species
Several species from all plant zones are known to respond to nutrient enrichment. Cattails (*Typha* spp.) are the best known responders.

Salt tolerance
Many species are not tolerant to salt, which is introduced along major coastal highways. Narrow-leaved cattails are known to be very tolerant to high salt levels.

Floristic Quality Index (FQI)
Many of the states and provinces along the Great Lakes have developed indices based on the "conservatism" of all plants growing there. A species is considered conservative if it only grows in a specific, high quality environment. FQI has proved effective for comparing similar wetland sites. However, FQI of a given wetland can change dramatically in response to a water level change, limiting its usefulness in monitoring the condition of a given wetland from year to year without development of careful sampling protocols. Another problem associated with FQIs is that the conservatism values for a given plant vary between states and provinces.

Status of Wetland Plant Community Health
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
There are several pressures that lead to degradation of coastal wetlands.

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. Although less intensive than either agriculture or urban development, local physical alteration 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.

Management Implications
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.

Acknowledgments
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