Great Lakes Coastal Wetland Ecosystem

State of the Ecosystem

Background

More than 216,000 hectares (534,000 acres) of coastal wetlands are directly influenced by the waters of the Great Lakes. Under the United States *Clean Water Act*, the term wetlands means "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

The functions of Great Lakes coastal wetlands—biological, chemical, and physical processes that occur naturally within a wetland—include the storage and cycling of nutrients and organic materials carried by rivers and streams to the Lakes; food web production; biological productivity; groundwater recharge; stream base flow maintenance; and, habitats for a wide range of Great Lakes species. Many fish species, for example, depend upon coastal wetlands for some portion of their life cycles. Coastal wetlands have functions and values including water quality improvement, flood storage, water supply, erosion protection, and fish spawning habitats.

Water fluctuations are necessary to maintain this highly productive system. Temporary water fluctuations are caused by wind and "tides" known as seiches. Seasonal fluctuations reflect the yearly hydrologic cycle of the Great Lakes. Multi-year fluctuations are caused by basinwide, continental or global changes in climate. Coastal wetland plant life is most affected by water fluctuations. Low water levels expose bottom sediments which allow seeds to germinate. High water levels may flood out vegetation and dilute nutrient concentrations. In many areas where the natural systems have been highly modified, vegetated coastal wetlands persist only because of intensive management that may include water level controls.

There are three major categories of coastal wetlands. Lacustrine wetlands are controlled directly by the waters of the Great Lakes. They are affected by lake level fluctuations, nearshore currents, seiches and ice scour. Riverine wetlands occur in rivers, tributaries and connecting channels that flow into or between the Great Lakes. Barrier protected wetlands have become separated from the Great Lakes by a barrier beach or other barrier feature. The barriers protect the wetland from the waves.

Five different types of vegetation can be found in Great Lakes coastal wetlands. Floating plants may be rooted under water but have leaves that float on the surface. Submerged plants are rooted under water and grow entirely underwater. Emergent plants have roots that might be underwater but grow and flower above the surface of the water. Wet meadow vegetation is less tolerant of flooding and represents a transition from wetland to terrestrial. The shrub zone contains woody plants that grow above the water line but is influenced by periodic flooding.

A diversity of animals inhabits coastal wetlands. Phytoplankton is at the base of the food chain. Macroinvertebrates such as insects, snails, mollusks and worms cycle nutrients through the system by breaking down course vegetation; they are also food for fish and birds. Ninety percent of the more than 200 species of Great Lakes fish spend some part of their life cycle in Great Lakes coastal wetlands. Fish such as Northern Pike (*Esox lucius)*, Yellow Perch (*Perca flavescens*) and Bowfin (*Amia calva*) spawn in coastal marshes. Birds, reptiles and amphibians use coastal wetlands as resting, feeding and nesting habitat.

This report summarizes the environmental status and trend of Great Lakes coastal wetlands. It provides details of coastal wetland indicator reports and outlines current and probable future pressures on coastal wetland resources. It outlines possible management actions needed to monitor, protect and restore, and manage Great Lakes coastal wetlands. And it describes how assessing the status and trend of coastal wetlands has changed since the paper presented at SOLEC 1996.

<u>Status and trend summary</u>
The status of the Great Lakes coastal wetland system is *mixed* and the trend *deteriorating* due to habitat loss and deterioration, invasive species, water level stabilization, and contaminants. Declines in populations of species that use wetlands almost exclusively for breeding, combined with an increase in some wetland edge and generalist species, suggest changes in wetland habitat conditions may be occurring. The status and trend are based on observations or best professional judgment and on indicator reports.

- Over the past decade, statistically significant declining trends were detected for American Toad (*Bufo americanus*), Bullfrog (*Rana catesbeiana)*, Chorus Frog (*Pseudacris triseriata)*, Green Frog (*Rana clamitans*), and Northern Leopard Frog (*Rana pipiens*). Wetland bird species with significant basinwide declines were American Coot (*Fulica americana*), Black Tern (*Chlidonias niger*), Blue-winged Teal (*Anas discors*), Common Grackle (*Quiscalus quiscula)*, Common Moorhen (*Gallinula chloropus*), Least Bittern (*Ixobrychus exilis*), Undifferentiated Common Moorhen/American Coot (*Fulica americana)*, Northern Harrier (*Circus cyaneus*), Pied-Billed Grebe (*Podilymbus podiceps*), Red-winged Blackbird (*Agelaius phoeniceus*), Sora (*Porzana Carolina*), Tree Swallow (*Tachycineta bicolor*), and Virginia Rail (*Rallus limicola*).
- Mechanical disturbance of coastal sediments appears to be one of the primary vectors for introduction of non-native invasive species to coastal wetlands. Intact wetlands, on the other hand, may be a refuge for native fishes, at least with respect to the influence of Round Gobies (*Neogobius melanostomus*).
- A disturbing trend is the expansion of Frog-Bit (*Hydrocharis morsus-ranae*); it is a floating plant that forms dense mats capable of eliminating submergent plants. Frog-Bit is found from the St. Lawrence River and Lake Ontario westward into Lake Erie.
- With diet the primary source of exposure, contaminants such as polychlorinated dioxins, furans, polychlorinated biphenyls (PCBs) in snapping turtles measured is persistent and bioaccumulative. This indicates that contamination still persists throughout the aquatic food web.
- In 2007, low Lake Superior water levels resulted in devastation of Kakagon Sloughs (Wisconsin) Wild Rice (*Zizania palustris*) beds. Bad River Tribe natural resource personnel reported that many Wild Rice beds resembled mud flats. Low water levels

could lead to an influx of non-native species such as Purple Loosestrife (*Lythrum salicaria*).

- The status of Georgian Bay and the North Channel coastal wetlands of Lake Huron are good based on McMaster University researchers' evaluation of more than 100 wetlands. Some degradation was noted in southeastern Georgian Bay due to anthropogenic disturbances.
- Water level control in Lake Ontario has resulted in a decrease in plant and animal diversity in coastal wetlands. The International Joint Commission has completed a five-year study on the impacts of water level controls on shoreline habitats and properties, shipping, and small boat use. A decision on a new water level control plan is expected in 2008.

<u>Status and trend by indicator</u>

The SOLEC 2004 paper "The Great Lakes Indicator Suite: Changes and Progress 2004," contains descriptions of 13 indicators deemed relevant to determine the status and trend of Great Lakes coastal wetlands. Based on the work of the Durham coastal wetland managers and other Great Lakes coastal wetland scientists, previous SOLEC authors, the Coastal Wetland Consortium, and the Great Lakes Environmental Indicators (GLEI) collaborators, the following six coastal wetland indicators are now recommended to effectively and efficiently monitor Great Lakes coastal wetlands. In addition, other chemical and physical coastal wetland information such as turbidity, conductivity, phosphorus, and nitrogen, will be collected to help interpret indicator data.

Three indicators suggested in the 2004 report are not considered specific to the coastal wetland indicator suite. Contaminants in Snapping Turtle Eggs (4506), Phosphorus and Nitrogen Levels (4860), and Effect of Water Levels Fluctuations (4861) are associated with coastal wetlands, however are broader in the context of overall ecosystem health and should therefore not be included in the coastal wetland suite. Four indicators—Coastal Wetland Restored Area by Type (4511), Sediment Flowing into Coastal Wetlands (4516), Human Impact Measures (4864), and Land Cover Adjacent to Wetlands (4963)—are not feasible to monitor at this time. The recommendation is to eliminate these indicators. One other indicator, Sediment Available for Coastal Nourishment (8142), was suggested after the 2004 report and is applicable to the entire Great Lakes shoreline so should not be considered solely a coastal wetland indicator.

The names for the six indicators below have changed since the *State of the Great Lakes 2007* report (Environment Canada and U.S. Environmental Protection Agency 2007). More detailed information is found in each indicator's status and trend report.

<u>*Extent and composition of coastal wetlands (SOLEC indicator 4510): mixed, deteriorating*</u>

The status of this indicator has not been updated since the *2005 State of the Lakes* report. One conclusion of the 2005 report was that wetlands continue to be lost and degraded, yet the ability to track and determine the extent and rate of this loss in a standardized way is not yet feasible. A GIS database providing the first spatially explicit seamless binational summary of coastal wetland distribution in the Great lakes system was completed in 2004. Coastal wetlands totaling 216,743 hectares were identified up to Cornwall, Ontario. However, due to existing data limitations, estimates of coastal wetland extent, particularly for the upper Great Lakes are acknowledged to be incomplete. Despite significant losses in some regions, the Lakes and rivers still support a diversity of wetland types. Stressors to coastal wetlands continue to contribute to the loss and degradation of coastal wetland area including filling, dredging, draining for conversion to other uses, shoreline modification, water level regulation, and sediment and nutrient loading from watersheds.

The 2005 report also concluded that many of the pressures result from direct human actions and therefore, with proper consideration of the impacts, can be reduced. Because of growing concerns around water quality and supply, which are key Great Lakes conservation issues and the role of wetlands in flood attenuation, nutrient cycling and sediment trapping, wetland changes need to be monitored closely.

Coastal wetland invertebrate communities (SOLEC indicator 4501): not assessed
Development of this indicator is still in progress. In 2002 the Great Lakes Coastal Wetlands Consortium conducted extensive surveys of wetland invertebrates of the four lower Lakes. The data are not entirely analyzed to date. However, the Consortium adopted an Index of Biotic Integrity that was applied in wetlands of northern Lake Ontario. Physical alteration and eutrophication continue to be a threat to coastal wetland invertebrates due to promotion of non-native vegetation and destruction of plant communities as well as changes to the natural hydrology.

Coastal wetland fish communities (SOLEC indicator 4502): not assessed
Lakes Erie and Ontario tend to have more wetlands containing cattail communities and therefore fish communities of lower richness and diversity. The seven wetlands sampled in Lake Superior contained relatively unique vegetation types so fish communities of these wetlands were not directly compared with those of wetlands of other lakes. There appear to be no wetlands on the US side of Lake Erie that have experienced minimal anthropogenic disturbance. Comparatively, northern Lakes Huron and Michigan wetlands have relatively high quality coastal wetland fish communities.

Bluntnose Minnows (*Pimephales notatus*) and Johnny Darters (*Etheostoma nigrum*) are almost absent from Lakes Michigan lower bay wetland sites. Species associated with plants and clearer water—Rock Bass (*Ambloplites sp.*), Sand Shiners (*Notropis stramineus*), and Golden Shiners (*Notemigonus crysoleucas*)—are present in upper bay samples but absent from lower bay samples. In 2003, there were no Alewives (*Alosa pseudoharengus)* or Gizzard Shad (*Dorosoma cepedianum*) at an upper Green Bay site. Likewise, the fish assemblage structure in Cootes Paradise, a highly degraded wetland in Lake Ontario, is very different from other less degraded wetlands analyzed in one study. Water quality is one factor in determining plant communities and that in turn influences fish community structure. Groups of fish species in reference wetlands tend to have similar water temperature and aquatic productivity preferences.

Based on intensive fish sampling prior to 2003 at more than 60 sites spanning all the Great Lakes, Round Gobies (*Neogobius melanostomus*) (have not been sampled in large numbers at any wetland or been a dominant member of any wetland fish community. Therefore, it seems likely that wetlands may be a refuge for native fishes, at least with respect to the influence of Round Gobies. There is little information on the habitat preferences of the Tubernose Goby

(*Proterorhinus marmoratus*) within the Great Lakes with the exception of studies on the Detroit River. Because this goby shares habitats with fishes from many different habitats, however, it is suggested that the tubernose goby will expand its geographic range within the Great Lakes.

Ruffe (*Gymnocephalus cernuus*) have never been found in high densities in coastal wetlands anywhere in the Great Lakes. In one study it was concluded that coastal wetlands in western Lake Superior provide a refuge for native fishes from competition with ruffe. The mudflat-preferring ruffe avoids wetland habitats due to foraging inefficiency in dense vegetation that characterizes healthy coastal wetland habitats. Therefore, further degradation of coastal wetlands could lead to increased dominance by ruffe in shallow water habitats.

Grasshead carp (*Ctenopharyngodon idellus*), Bighead Carp (*Hypophthalmichthys nobilis*), and Silver Carp (*Hypophthalmichthys molitrix*) have escaped aquaculture operations and are now in the Illinois River and migrating toward the Great Lakes through the Chicago Sanitary Canal. These species represent a substantial threat to food webs in wetlands and nearshore habitats with macrophytes.

Coastal wetland amphibian communities (SOLEC indicator 4504): mixed, deteriorating
Amphibian data has been collected at 548 routes across the Great Lakes basin since 1995. Thirteen species were recorded during the 1995-2007 period. Spring Peeper (*Pseudacris crucifer*) was the most frequently detected species. Spring Peeper populations are increasing. Green Frog (*Rana clamitans*) was detected in more than half of the survey stations. Grey Treefrog (*Hyla versicolor*), American Toad (*Bufo americanus*), and Northern Leopard Frog (*Rana pipiens*) were common. Statistically significant declining trends were detected for American Toad, Bullfrog (*Rana catesbeiana)*, Chorus Frog (*Pseudacris triseriata)*, Green Frog, and Northern Leopard Frog. Anecdotal and research evidence suggests that wide variations in occurrence of many amphibian species at a given site is a natural and ongoing phenomena.

Coastal wetland bird communities (SOLEC indicator 4507): mixed, deteriorating
Since 1995, Marsh Monitoring Program volunteers have collected bird data at 508 discrete routes across the Great Lakes basin. 56 bird species that use marshes for feeding, nesting or both throughout the Great Lakes basin were recorded. The Red-winged Blackbird (*Agelaius phoeniceus*) was the most commonly recorded non-aerial foraging bird observed followed by the Swamp Sparrow (*Melospiza georgiana*), Marsh Wren (*Cistothorus palustris*), and Yellow Warbler (*Dendroica petechia*). Among birds that nest exclusively in marsh habitats, the most commonly recorded species was Marsh Wren followed by Virginia Rail (*Rallus limicola*), Common Moorhen (*Gallinula chloropus*), Pied-billed Grebe (*Podilymbus podiceps*), American Coot (*Fulica Americana)* and Sora (*Porzana Carolina*). Among species that typically forage in the air above marshes, Tree Swallow (*Tachycineta bicolor*) and Barn Swallow (*Hirundo rustica*) were the two most commonly recorded bird species.

Species with significant basinwide declines were American Coot, Black Tern (*Chlidonias niger*), Blue-winged Teal (*Anas discors*), Common Grackle (*Quiscalus quiscula)*, Common Moorhen, Least Bittern ((*Ixobrychus exilis*), undifferentiated Common Moorhen/American Coot (*Fulica americana)*, Northern Harrier (*Circus cyaneus*), Pied-billed Grebe, Red-winged Blackbird, Sora, Tree Swallow (*Tachycineta bicolor*), and Virginia Rail. Statistically significant basinwide population increases were observed for Common Yellowthroat (*Geothlypis trichas*), Mallard (*Anas platyrhynchos*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), Purple Martin (*Progne subis*), Trumpeter Swan (*Cygnus buccinator*), Willow Flycatcher (*Empidonax traillii*), and Yellow Warbler (*Dendroica petechia*). American Bittern (*Botaurus lentiginosus*) and Marsh Wren (*Cistothorus palustris*) populations did not show a significant trend in abundance indices from 1995 through 2005. Differences in habitats, regional population densities, timing of survey visits, annual weather variability and other factors, will likely interplay with water levels to explain variation in wetland dependent bird populations.

Coastal wetland plant communities (SOLEC indicator 4862): mixed, undetermined
The state of the wetland plant community is quite variable, ranging from good to poor across the Great Lakes basin. 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. Trends in wetland health based on plants have not been well established.

Turbidity of the southern Great Lakes has reduced with the expansion of Zebra Mussels (*Dreissena polymorpha*), resulting in improved submergent plant diversity in many wetlands. However, in Saginaw Bay, Green Bay, and Lake Ontario, agricultural sediments have resulted in highly turbid waters which support few or no submergent wetland plants.

In the southern Great Lakes 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 Cattails (*Typha sp.*), reduced submergent diversity and coverage, and prevalence of non-native plants. 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. In most Great Lakes urban settings, almost complete wetland loss has occurred along the shoreline. Shoreline hardening is eliminating wetland vegetation. Mechanical alteration of the shoreline is fostering the introduction of non-native species.

A disturbing trend is the expansion of Frog Bit (*Hydrocharis morsus-ranae*), a floating plant that forms dense mats capable of eliminating submergent plants, found from the St. Lawrence River and Lake Ontario westward into Lake Erie. This expansion will probably continue into all or many of the Lakes. It appears that undisturbed marshes are not easily colonized by non-native species such as Purple Loosestrife ((*Lythrum salicaria*) and Reed Canary Grass (*Phalaris arundinacea*). As these species become locally established, seeds or fragments of plant may be able to establish when water level changes create appropriate sediment conditions. The worst wetland invasive species is the Asian Carp, whose mating and feeding result in loss of submergent vegetation in shallow marsh waters.

Pressures

Future pressures on the coastal zone will likely include continuing loss and degradation of important coastal wetlands, water level decrease or stabilization, sedimentation, contaminant and nutrient inputs, and continued invasion of non-native plants and animals. Human-induced global climate change has the potential to result in severe changes in coastal wetland habitats. The following summary of pressures on the coastal wetland system is based on an analysis by indicator report authors.

<u>Agriculture</u>
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 such as Reed Canary Grass (*Phalaris arundinacea*), and 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.

<u>Urban development</u>
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.

<u>Residential shoreline development</u>
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 is usually less intense than local physical alteration which often results in the introduction of non-native species. Shoreline hardening can completely eliminate wetland vegetation.

<u>Mechanical alteration of shoreline</u>
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.

<u>Introduction of non-native species</u>
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, whose mating and feeding result in loss of submergent vegetation in shallow marsh waters.

<u>Coastal wetlands actions needed:</u>
Authors of the indicator papers have recommended the following actions to monitor, protect and restore, and manage Great Lakes coastal wetlands.

Monitor:
- Continue to monitor coastal wetland in order to determine impacts from water level stabilization, sedimentation, contaminant and nutrient inputs, climate change and invasion of exotic species.
- Maintain high quality wetland habitat as well as associated upland areas adjacent to coastal wetlands.
- Monitor amphibians according to a five-year rotational cycle in order to sufficiently monitor noteworthy changes in population indices and to trends in species occurrence or relative abundance to environmental factors.
- Monitor the contaminant status of Snapping Turtles (*Macrochelys temminckii*) on a regular basis across the Great Lakes basin where appropriate. Once the usefulness of the indicator is confirmed, a complementary US program is required to interpret basinwide trends.
- Monitor the response of Reed Canary Grass (*Phalaris arundinacea*) to rising water levels.
- Monitor following disturbance of coastal sediments to reduce new introductions of non-native plants.

Protect and restore:
- Address impacts detrimental to wetland health such as water level stabilization, invasive species and inputs of toxic chemicals, nutrients and sediments.
- Conserve and restore wetland habitats to ensure their functioning.
- Incorporate buffer strips along steams and drains to mitigate the effects of agriculture and urban sediments on coastal wetlands.
- Reduce algal blooms by more effectively applying fertilizer.

Manage:
- Establish regional goals and acceptable thresholds for species-specific abundance indices and species community compositions.
- Thoroughly clean equipment to eliminate non-native seed sources.
- Verify the relationships between wetland-adjacent land cover and the functions of coastal wetlands.
- Uniformly measure adjacent land cover field parameters across the region to determine accurate information.

<u>1996 – 2008: Changes in assessing coastal wetlands</u>
The SOLEC 1996 paper, "Coastal Wetlands of the Great Lakes" (Wilcox and Maynard, December 1997), presented an overview of coastal wetland ecology, ecological functions and values, and stressors. The authors suggested the development of coastal wetland indicators in the following categories: physical and chemical, individual and population level, wetland community, landscape, and social and economic. The status of coastal wetlands based on expert information was given for each of the Great Lakes, the St. Mary's River, St. Clair River, Lake St. Clair, Detroit River, Niagara River, and St. Lawrence River. Among the authors' conclusions were the following management challenges:

- "There is no comprehensive inventory and evaluation of Great Lakes coastal or even inland wetlands."

- In the US, "Individual states have also completed wetland inventories and evaluations, however methodologies are not consistent and the level of detail and amount of field-based data varies."
- "Work has been initiated to develop indicators for wetland degradation and to choose monitoring sites and appropriate monitoring strategies. However, there is no international consensus on these matters."

The background paper for SOLEC 1998, "Biodiversity Investment Areas, Coastal Wetland Ecosystems" (Chow-Fraser and Albert, October 1998), identified and described a multitude of wetland inventory databases and classification systems in use throughout the basin. The Great Lakes shoreline was divided into eco-reaches based on fish and avi-faunal uses and diverse coastal wetlands identified. The authors concluded: "We recognize that the value of the eco-reach must reflect the distribution of wetlands as well as size, distribution and quality…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."

Although coastal wetlands have critically important ecological values and functions, coastal wetland data is not available bi-nationally or basinwide; no one entity has the responsibility to oversee the coordination of coastal wetland data. The conclusion: a binational monitoring program is needed to assess the health of Great Lakes coastal wetlands, an integral part of the Great Lakes basin ecosystem.

In 2000, the U.S. EPA Great Lakes National Program Office funded the creation of the Great Lakes Coastal Wetland Consortium to expand the coastal wetland monitoring and reporting capabilities of the U.S. and Canada under the Great Lakes Water Quality Agreement. The Consortium was coordinated by Great Lakes Commission staff and consisted of scientific and policy experts drawn from key U.S. and Canadian federal agencies, state and provincial agencies, non-governmental organizations, and other interest groups with responsibility for coastal wetlands monitoring. Approximately two dozen agencies, organizations and institutions were brought into the Consortium as Project Management Team members. In addition, other members were brought in as small project teams formed to address discrete project elements and pilot studies.

The purpose of the Consortium was to design a long term, binational coastal wetland monitoring program. Indicators suggested in the SOLEC papers were evaluated and protocols tested. In early 2008, a final report detailed indicators, protocols for monitoring, and costs. Major accomplishments include:

- A map of the 217,000 hectares of known coastal wetlands;
- A new classification system consisting of three major categories: lacustrine, riverine, and barrier-protected that was then applied to the mapped coastal wetlands;
- Field-tested sampling protocols;
- A statistical sampling design; and,
- A database that will house future data.

In 2002 and 2003, the initial work of the Consortium was field tested at 15 sites in the Regional Municipality of Durham on the north shore of Lake Ontario. The project was designed to improve coordination among stakeholders, standardize monitoring methods in order to compare results among wetlands and watersheds, and improve the condition of wetlands in this highly urbanized region through support of meaningful management decisions. In turn, the Durham Region Coastal Wetland Monitoring Project provides a blueprint for implementing a basinwide coastal wetland monitoring program.

A U.S. project, Great Lakes Environmental Indicators (GLEI), researched developing an integrated set of environmental indicators to assess the condition of the shoreline, including coastal wetlands. This project combined field and existing data to link stressors with environmental indicators and recommended a suite of hierarchically-structured indicators. Consortium and GLEI project partners worked together to determine coastal wetland monitoring protocols that are feasible and cost effective yet result in useful data.

Management Implications

Over the past seven years, a group of dedicated Great Lakes coastal wetlands experts mapped the extent of Great Lakes coastal wetlands; created a coastal wetland classification system and applied it to the mapped wetlands; developed an indicator sampling design and process; and, built a database. The pieces are in place to implement a long term coastal wetland monitoring program. Data from this program will, over time, improve coastal wetland system assessment and allow management agencies to better target protection and restoration of coastal wetland resources. The management challenge is to provide the resources needed to monitor Great Lakes coastal wetlands over the long term.

Comments from the Authors

Acknowledgments
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Numerous scientists and managers have had input to the development of coastal wetland indicators. For a list of Great Lakes Coastal Wetlands Consortium contributors, please see the "Acknowledgments" section in the "Great Lakes Coastal Wetlands Monitoring Plan" report at http://www.glc.org/wetlands/final-report.html.

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Last updated
September 2008