# Coastal Wetland Fish Community Health

Formerly Indicator #4502

**Overall Assessment**

Status: **Not Assessed**

Trend: **Not Assessed**

Rationale: **This indicator will be evaluated as part of an overall analysis of biological communities of Great Lakes coastal wetlands and nearshore aquatic systems.**

*Note: This is a progress report towards implementation of this indicator. The indicator is currently being used throughout the entire Great Lakes basin, but data will not be available until 2012. The following evaluation was constructed using input from investigators collecting fish community composition data from Great Lakes coastal wetlands over the last several years. Regarding the following, neither experimental design nor statistical rigor has been used to specifically address the status and trends of fish communities of coastal wetlands of the five Great Lakes. However, in the spring of 2011, an effort was put forth by a consortium of universities that established a statistically sound basin-wide coastal wetland monitoring program. This indicator will be used, along with others, at the majority of coastal wetlands with a surface water connection to the Great Lakes that are greater than 4 hectares in size. The effort is bi-national and basin wide and will produce scientifically-defensible information on the status and trends of Great Lakes coastal wetlands.*

**Lake-by-Lake Assessment**

**Each lake was categorized with a not assessed status and an undetermined trend, indicating that data were not available yet.**

**Purpose**

- To assess the fish community composition, and to infer suitability of habitat and water quality for Great Lakes coastal wetland fish communities.

**Ecosystem Objective**

Restore and maintain the diversity of the fish community of Great Lakes coastal wetlands while indicating overall ecosystem health. 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**

Development of this indicator is complete and the indicator is currently be implemented. However, data are not available at this time. Several different fish metrics developed by the Great Lakes Coastal Wetlands Consortium are being utilized.

Mean abundance and richness per (fyke) net-night of resident fish species within dominant inundated vegetation zones; primarily bulrush (*Schoenoplectus*) and cattail (*Typha*); across survey stations specific to a vegetation zone; percent non-native richness; mean Shannon Diversity index; mean evenness; and, mean abundance and richness of Omnivores, insectivores, piscivores, and carnivores (insectivores+ piscivore+zooplanktivore).

In order to properly manage the Great Lakes coastal wetland fish community health there must be consistent sampling methods. Sampling is being conducted no earlier than mid June and no later than August due to migration patterns of the fish communities. Dominant vegetation zones are being identified because different zones support different types of fish. Two main vegetation zones are *Schoenoplectus*-Bulrush and *Typha*-cattail, but all are being included. When sampling fish using fyke netting it is recommended to use a minimum of three replicate fyke nets with 4.8mm mesh for each dominate vegetation zone. There are two sizes of fyke nets that can be used 0.5-m x 1-m opening and 1-m x 1-m opening. The smaller nets are placed in water that is 0.25-0.5 m deep and the larger fyke nets are placed in water that is greater than 0.50 m deep. The leads are 7.3 m long with 1.8 m long wings . Nets are randomly placed a minimum of 20 m apart in each vegetation zone. The fyke nets are placed perpendicular to the vegetation zone, therefore, fish swimming along the edge of the vegetation zone are captured.

Any fish collected that is greater than 25mm should be identified down to species. The number of the fish caught per fyke net should be recorded. Also 10 to 20 specimens of each species, life stage and size at age should be chosen randomly to record.

Using the methods stated above, scientists have determined the composition of fish communities is related to plant community type within wetlands (Uzarski *et al*. 2005, Wei *et al*. 2004). Uzarski *et al*. (2005) found no relationship between wetland fish composition and a specific Great Lake, suggesting that fish communities of any single Great Lake were no more impacted than those from any other Great Lake. However, of the 61 wetlands sampled in 2002 from all five lakes, Lake Erie and Lake Ontario tended to have more wetlands containing cattail communities (a plant community type that correlates with nutrient enrichment), and the fish communities found in cattails tended to have lower richness and diversity than fish communities found in other vegetation types. Wetlands found in northern Lake Michigan and Lake Huron tended to have relatively high quality coastal wetland fish communities. 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.

When the fish communities of reference wetlands are compared across the entire Great Lakes, the most similar sites come from the same ecological province rather than from any single Great Lake or specific wetland types. Data from several GLEI project studies indicate that the characteristic groups of fish species in reference wetlands from each ecological province tend to have similar water temperature and aquatic productivity preferences.

John Brazner and co-workers from the U.S. EPA Laboratory in Duluth, MN, sampled fishes of Green Bay (Lake Michigan) wetlands in 1990, 1991, 1995, 2002, and 2003. They sampled three lower bay and one middle bay wetland in 2002 and 2003. Their data suggested that these sites were improving in water clarity and plant cover, and that they supported a greater diversity of both macrophyte and fish species, especially more centrarchid species, than they had in previous years. They also noted that the 2002, and especially 2003, year classes of yellow perch were very large. Brazner's observations suggest that the lower Green Bay wetlands are improving slowly and the middle bay site seems to be remaining relatively stable in moderately good condition (J. Brazner, personal observation). The most turbid wetlands in the lower bay were characterized by mostly warm-water, turbidity-tolerant species such as gizzard shad (*Dorosoma cepedianum)*, white bass (*Morone chrysops*), freshwater drum (*Aplodinotus grunniens)*, common shiners (*Luxilus cornutus),* and common carp (*Cyprinus carpio).* Meanwhile the least turbid wetlands in the upper bay were characterized by several centrarchid species, golden shiner (*Notemigonus chrysoleucas*), logperch (*Percina caprodes)*, smallmouth bass (*Micropterus dolomieu)* and northern pike (*Esox lucius).* Green sunfish (*Lepomis cyanellus)* was the only important centrarchid in the lower bay in 1991, while in 1995, bluegill and pumpkinseed sunfishes (*L. macrochirus* and *L. gibbosus)* had become much more prevalent, and a few largemouth bass (*M. salmoides)* were also present. There were more banded killifish (*Fundulus diaphanous)* in 1995 and 2003 compared with 1991, and white perch (*Morone americana)* were very abundant in 1995 as this non-native species became dominant in the bay. The upper bay wetlands were in relatively good condition based on the fish and macrophyte communities that were observed. Although mean fish species richness was significantly lower in developed wetlands across the whole bay, differences between less developed and more developed wetlands were most pronounced in the upper bay where the highest quality wetlands in Green Bay are found (Brazner 1997).

Round gobies (*Neogobius melanostomus)* were introduced to the St. Clair River in 1990 (Jude and Pappas 1992), and they have since spread to all of the Great Lakes. Jude studied them in many tributaries of the Lake Huron-St. Clair River-Lake Erie corridor and found that both round and tubenose gobies (*Proterorhinus marmoratus*) were very abundant at river mouths and had colonized far upstream. They were also found at the mouth of Old Woman Creek in Lake Erie, but not within the wetland proper. Jude and Janssen's work in Green Bay wetlands showed that round gobies had not invaded three of the five sites sampled, but a few were found in lower Green Bay along the sandy and rocky shoreline west of Little Tail Point.

Uzarski and Burton (unpublished) consistently collected a few round gobies from a fringing wetland near Escanaba, MI, where cobbles were present. In the Muskegon River-Muskegon Lake wetland complex on the eastern shoreline, round gobies are abundant in the heavily rip-rapped harbor entrance to Lake Michigan, and they have just begun to enter the river/wetland complex on the east side of Muskegon Lake (Cooper *et* al. 2007; D. Jude, personal observations). Based on intensive fish sampling prior to 2003 at more than 60 sites spanning all of the Great Lakes, round gobies have not been sampled in large numbers at any wetland or been a dominant member of any wetland fish community (Jude *et al*. 2005). Round gobies were collected at 11 of 80 wetlands sampled by the GLEI project (Johnson *et al*. unpublished data). Lapointe (2005) assessed fish-habitat associations in the shallow (less than 3 m) Canadian waters of the Detroit River in 2004 and 2005 using boat-mounted electrofishing and boat seining techniques. The round goby avoided complex macrophytes in all seasons at upper, mid-, and downstream segments of the Detroit River. However, in 2006, beach seining surveys at shoreline sites in Canadian waters of Lake St. Clair, the Detroit River, and western Lake Erie, both tubenose and round gobies were collected in areas with aquatic vegetation (Corkum, Univ. of Windsor, unpublished data). It seems likely that wetlands may be a refuge for native fishes, at least with respect to the influence of round gobies (Jude *et al*. 2005), however, small gobies seem to be increasing in abundance in many Great Lakes coastal wetlands.

There is little information on the habitat preferences of the tubenose goby within the Great Lakes with the exception of studies on the Detroit River (Lapointe 2005), Lake St. Clair and the St. Clair River (Jude and DeBoe 1996, Pronin *et al*. 1997, Leslie *et al*. 2002). Within the Great Lakes, tubenose goby that were studied at a limited number of sites along the St. Clair River and on the south shore of Lake St. Clair occurred in turbid water associated with rooted submersed vegetation (*Vallisneria americana*, *Myriophyllum spicatum*, *Potamogeton richardsonii* and *Chara* sp.;Leslie *et al*. 2002). Few specimens were found on sandy substrates devoid of vegetation, supporting similar findings by Jude and DeBoe (1996). Leslie *et al*. (2002) collected tubenose goby in water with no or slow flow on clay or alluvium substrates, where turbidity varies and where rooted vegetation was sparse, patchy or abundant. Lapointe (2005) found that the association between tubenose goby and aquatic macrophytes differed seasonally in the Detroit River. For example, tubenose goby was strongly negatively associated with complex macrophytes in the spring and summer, but positively associated with complex macrophytes in the fall (Lapointe 2005). Because tubenose goby shared habitats with fishes representing most ecoethological guilds, Leslie *et al*. (2002) suggested that the tubenose goby would 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 their investigation of the distribution and potential impact of ruffe on the fish community of a Lake Superior coastal wetland, Brazner *et al*. (1998) concluded that coastal wetlands in western Lake Superior provide a refuge for native fishes from competition with ruffe. The mudflat-preferring ruffe actually avoids wetland habitats due to foraging inefficiency in dense vegetation that characterizes healthy coastal wetland habitats. This suggests that further degradation of coastal wetlands or heavily vegetated littoral habitats could lead to increased dominance of ruffe in shallow water habitats elsewhere in the Great Lakes.

There are a number of carp introductions that have the potential for substantial impact on Great Lakes fish communities, including coastal wetlands. Goldfish (*Carassius auratus*) are common in some shallow habitats, and they occurred along with common carp young-of-the-year in many of the wetlands sampled along Green Bay. In addition, there are several other carp species, e.g., grass carp (*Ctenopharyngodon idella),* bighead carp (*Hypophthalmichthys nobilis)* and silver carp (*Hypophthalmichthys molitrix)* that escaped aquaculture operations and are now in the Illinois River and migrating toward the Great Lakes through the Chicago Sanitary and Ship Canal. Most of these species attain large sizes. Some are planktivorous, but also eat phytoplankton, snails, and mussels, while the grass carp eats vegetation. These species represent yet another substantial threat to food webs in wetlands and nearshore habitats with macrophytes (U.S. Fish and Wildlife Service (USFWS) 2002).

In 2003, Jude and Janssen (unpublished data) determined that bluntnose minnows (*Pimephales notatus)* and johnny darters (*Etheostoma nigrum)* were almost absent from lower Green Bay wetland sites, but they comprised 22% and 6%, respectively, of upper bay catches. In addition, other species, usually associated with plants and/or clearer water, such as rock bass, sand shiners (*Notropis stramineus*) and golden shiners (*Notemigonus crysoleucus),* were also present in upper bay samples, but not in lower bay samples. In 2003, Jude and Janssen found that there were no alewife (*Alosa pseudoharengus)* or gizzard shad in upper Green Bay site catches, but in lower bay wetland sites, they composed 2.7% and 34%, respectively, of the catches by number.

Jude and Pappas (1992) found that fish assemblage structure in Cootes Paradise, a highly degraded wetland area in Lake Ontario, was very different from other less degraded wetlands analyzed. They used ordination analyses to detect fish-community changes associated with degradation.

According to a study completed by Seilheimer and Chow-Fraser northern coastal wetlands had higher water quality indices than southern lakes coastal wetlands. Lake Superior had a good status while Lake Huron and Georgian Bay were classified with a very good status. Southern coastal wetlands in Lake Ontario, Erie and Michigan were classified as moderately degraded (Seilheimer and Chow-Fraser, 2007).

During this study pumpkinseed (*Lepomis gibbosus*) occurred in 94 out of 100 wetlands studied, and over 6,000 pumpkinseed individuals were captured. Brown bullhead (*Ameiurus nebulosus*) was the second most abundant fish captured and it was found in 80 wetlands. Another abundant species was the Spottail shiner (*Notropis hudsonius*) which was found in 39 coastal wetlands with a little less than 3,800 individual captured. Other abundant species found in the Great Lakes coastal wetlands are the Largemouth bass (*Micropterus salmoides*), Bluntnose minnow (*Pimephales notatus*), and the Bluegill (*Lepomis macrochirus*).

**Pressures**

<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 (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. Thoma (1999) and Johnson *et al*. (2006) were unable to find coastal wetlands on the U.S. side of Lake Erie that experienced minimal anthropogenic disturbances.   According to Seilheimer and Chow-Fraser there has been accelerated loss of wetland fish habitat in Lake Ontario, Lake Erie and Lake Michigan near urban areas and agriculture.

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, which results in degradation of fish habitat. It appears that when a wetland becomes affected by human development, the fish community changes to that typical of a warmer, richer, more southerly wetland. This finding may help researchers anticipate the likely effects of regional climate change on the fish communities of Great Lakes coastal wetlands.

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 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 not 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.

**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 |
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|---|---|---|---|---|---|---|
| 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: | | | | | | |

**Acknowledgments**
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**Last Updated**

*State of the Great Lakes 2009* report.
An editor's note was added for the 2011 reporting cycle.