Coastal Wetland Fish Community Health

Indicator #4502

Note: This is a progress report towards implementation of this indicator, and it has not yet been put into practice. The following evaluation was constructed using input from investigators collecting fish community composition data from Great Lakes coastal wetlands over the last several years. 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.

Overall Assessment

Status:	**Not Assessed**
Trend:	**Not Assessed**

Lake-by-Lake Assessment

Separate lake assessments were not prepared for this report.

Purpose

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

State of the Ecosystem

Development of this indicator is still in progress. Fish indices of biological integrity have been proposed for selected parts of the ecosystem, e.g., Lake Erie river mouths (Thoma 1999) and Lake Michigan and Lake Ontario coastal wetlands (Uzarski *et al*. 2005), and coordinated basinwide sampling has recently been completed by several groups. Thus, progress on indicator development has been substantial, and assessment of data derived from sampling conducted between 2002 and 2005 to indicate the state of the ecosystem should be possible before the next SOLEC.

Teams of Canadian and American researchers from several research groups (e.g., the Great Lakes Coastal Wetlands Consortium of the Great Lakes Commission (GLCWC); the U.S. Environmental Protection Agency (U.S. EPA) Star Grant-funded Great Lakes Environmental Indicators group in Duluth, MN (GLEI); a group of Great Lakes Fishery Commission researchers led by Patricia Chow-Fraser of McMaster University (GLFC); the U.S. EPA Regional Environmental Monitoring and Assessment Program group of researchers led by Tom Simon; and others) have sampled large numbers of Great Lakes wetlands during the last 5 years using comparable methods. They have reported on an array of fish communities in Great Lakes wetlands in presentations at international meetings and in reports. These data are now beginning to appear in refereed journals as individual studies (Uzarski *et al*. 2005, Seilheimer and Chow- Fraser 2006). Work is also underway to integrate the datasets for true basinwide assessment (e.g., Brazner *et al*. 2007, Bhagat *et al*. in press).

The composition of fish communities is related to plant community type within wetlands and, within plant community type, is related to the amount of certain types of anthropogenic disturbance (Uzarski *et al*. 2005, Wei *et al*. 2004, Seilheimer and Chow-Fraser 2006, Johnson *et al*. 2006), especially water quality as affected by urban and agricultural development (Seilheimer and Chow-Fraser 2006, Bhagat 2005, Bhagat *et al*. in press). 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. In contrast, 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. 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. 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. Brazner *et al*. (2007) looked at how 8 different candidate fish Index of Biotic Integrity (IBI) components varied by lake, wetland type, ecological province and anthropogenic stress at 80 wetlands across the entire U.S. Great Lakes. Overall, each of these 4 features explained approximately equal amounts of variation in those components.

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).

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. The black carp (*Mylopharygodon piceus)* has also probably been released, but it has not been recorded near the Great Lakes yet. 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.

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