Indicator: Lake Whitefish Spawning

Background

During the late nineteenth and early twentieth centuries, large numbers of lake whitefish (*Coregonus clupeaformis*) and lake herring (*Coregonus artedii*) entered the Detroit River in the fall to spawn. Natural bedrock (spawning grounds for lake whitefish, cisco, walleye, and trout) was blasted and removed during the construction of the Livingstone Channel from approximately 1907 to 1916. Whitefish prefer to spawn on rock, honeycomb limestone, and gravel or sand substrates (Hart 1930; Ihssen et al. 1981). Historic reports imply that the lower river was a prolific spawning area prior to the construction of the shipping channel (Goodyear et al. 1982). The timing of this construction coincides with the demise of whitefish stock in the river; this alteration in river hydrology represents a major disconnection in the linkage between river spawning and incubation areas, and productive nursery habitats in western Lake Erie. Spawning runs of lake whitefish into the Detroit River almost disappeared by the early 1900s due to overfishing, degradation of habitat and eutrophication (Trautman 1957; Goodyear et al. 1982; Hartman 1972).

*Figure 1. Lake whitefish (*Coregonus clupeaformis*) caught in the Detroit River, November 2005 (Photo credit: U.S. Geological Survey).*

Lake whitefish feed on organisms on the bottom of the lake, primarily *Diporeia* and chironomids, in the Lake Erie basin. They are cold stenotherms (narrow temperature tolerance) requiring cold, adequately oxygenated bottom waters for summer habitat, and relatively silt-free river or lake spawning areas for successful reproduction (Hartman 1973). Lake Erie is the southern edge of the species zoogeographical range. Lake whitefish are recognized as an indicator of ecosystem health and an integral component of the Great Lakes food web.

Status and Trends

By the 1960s and 1970s, lake whitefish were at an all-time low for a variety of reasons: overexploitation, predation by and competition with invasive species, degradation of water quality and habitat, and the loss of *Diporeia*, a major nutrient-rich food source (due to the introduction of zebra and/or quagga mussels). Reduced phosphorus loading to the lake resulted in more favorable conditions for whitefish by the early 1980s, following the implementation of the 1972 Great Lakes Water Quality Agreement (Mohr and Nalepa 2005).

The persistence of remnant self-sustaining lake whitefish stocks in Lakes Huron and Erie, coupled with habitat rehabilitation efforts, allowed the Lake Erie population to begin to

recover in the early 1980s (Lake Erie Coldwater Task Group 2005; Roseman et al. 2006a). Throughout the 1980s and 1990s, the species reached above average catches in Lakes Michigan and Huron (Mohr and Nalepa 2005). For Lake Erie as a whole, growth and condition of whitefish have remained stable and current landings values are within the range of historical means. Whitefish growth rates in Lake Erie after the recovery appear to be similar to rates prior to the period when populations reached all-time lows (Lake Erie Coldwater Task Group 2005).

Harvest in the Detroit River exceeded 227,000 kg (500,000 pounds) in the late 1800s and declined through the early part of the twentieth century (Figure 2). Overharvest and habitat degradation resulted in very low catches after about 1910. The decline of the lake whitefish coincided with the decline of the walleye, blue pike, and lake herring. The Lake Erie whitefish fishery lasted in the east end of the lake until the 1960s. After an absence of approximately 20 years, commercial fishing for lake whitefish in Lake Erie increased to over 454,000 kg (one million pounds) per year during the late 1990s and early 2000s (Figure 3). Even though landings in 2003 and 2004 declined to approximately 272,000 kg (600,000 pounds), this is evidence that lake whitefish populations have rebounded.

In 2005, U.S. Geological Survey researchers, in partnership with the U.S. Fish and Wildlife Service, collected a spermiating male and fertilized eggs from the Detroit River. This was the first fertile lake whitefish found in the river since 1916 (Roseman et al. 2006b). Several dozen fertilized lake whitefish eggs were collected from the river which subsequently hatched in the USGS laboratory in March 2006. On April 5th and 6th, 2006, U.S. Geological Survey found 62 whitefish larvae in the lower Detroit River and most were in the sac-fry stage. Since no larvae were found at sampling locations in the upper Detroit River (indicating spawning in Lake St. Clair or the St. Clair River), researchers concluded that these fry were produced in the Detroit River. This is the first time that there are confirmed native, reproducing lake whitefish in the Detroit River in approximately 100 years.

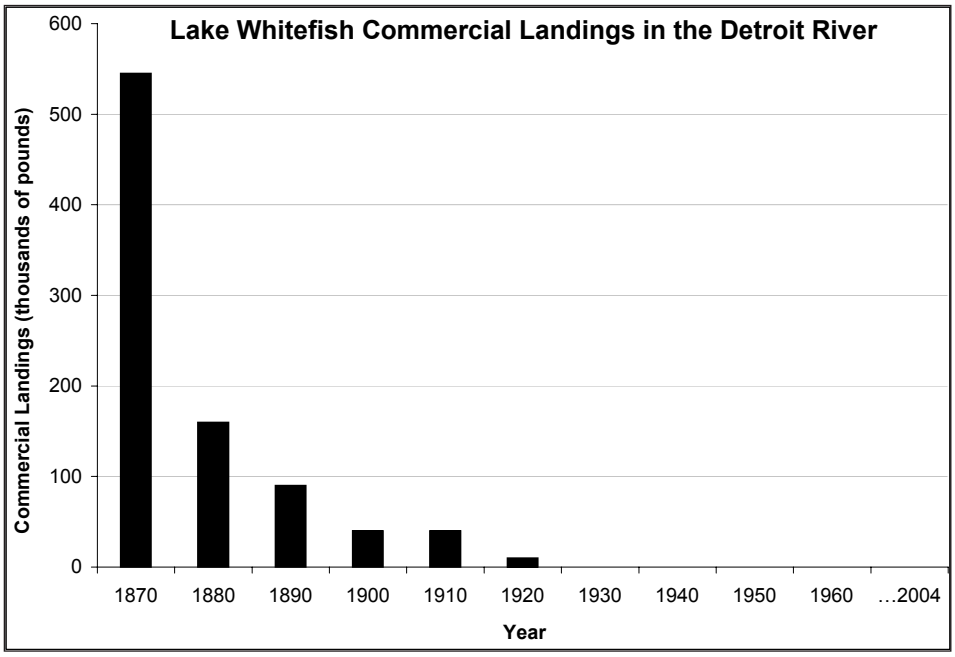

Figure 2. Lake whitefish commercial landings in the Detroit River. Catch is measured in thousands of pounds from 1870-2004 (data from Baldwin et al. 1979 and subsequently collected by U.S. Geological Survey). Note: One pound = 0.45 kg.

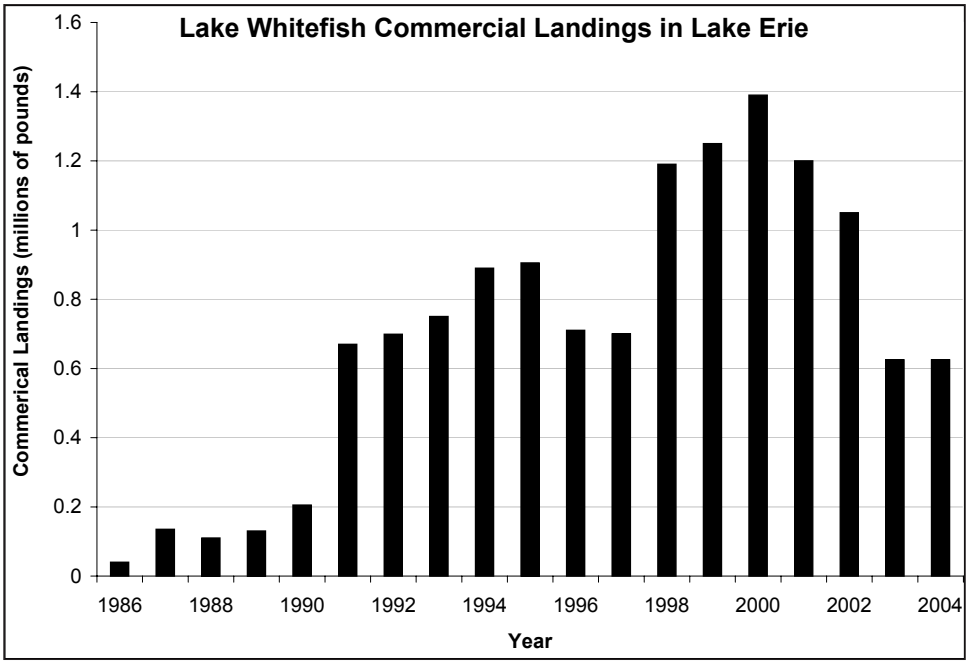

Figure 3. Lake whitefish commercial landings in Lake Erie. Catch is measured in millions of pounds from 1986-2004 (data from Lake Erie Coldwater Task Group 2005).
Note: One pound = 0.45 kg.

Management Next Steps

It is recommended that management agencies continue to monitor lake whitefish populations in the Detroit River and Lake Erie to ensure the continued recovery and the achievement of sustainable stocks. Emphasis should continue to be placed on controlling invasive species, such as dreissenids, which cause food web disruptions that influence whitefish abundance, growth, and condition. Management agencies should consider constructing whitefish spawning habitat in the Detroit River following completion of the fish spawning habitat research conducted in 2006-2008.

Research/Monitoring Needs

Little information exists regarding whitefish life history, habitat requirements, and ecological niche in Lake Erie and its tributaries, including the Detroit River. Data should be collected on the physical and biological characteristics of essential whitefish habitat, and on yield, diet, growth, recruitment, and reproduction rates. These types of information are critical for the successful management of fisheries in the Detroit River and its connecting waters. Further, efforts to rehabilitate fisheries habitat in the Detroit River rely on knowledge of habitat availability and function to use as a benchmark for restoration goals. Research projects should be designed to measure biotic and abiotic factors influencing different life history stages of lake whitefish. Such research should:

- identify spawning sites of multiple fish species;
- describe physical characteristics of spawning areas;
- quantify relative egg abundance and survival;

- assess egg viability and physiological condition;
- assess predation of fish eggs by fishes;
- assess spawning stock characteristics; and
- explore nursery habitat in the river (Roseman et al. 2006b).

Research on fall spawning habitat will continue. Finally, there is a need to further develop models to better predict and evaluate lake whitefish recovery.

References

Baldwin, N.S., R.W. Saalfeld, M.A. Ross, and H.J. Buettner. 1979. Commercial fish production in the Great Lakes 1867-1977. Great Lakes Fishery Commission Technical Report no. 3, Ann Arbor, MI.

Goodyear, C.D., T.A. Edsall, D.M. Ormsby-Dempsey, G.D. Moss, and P.E. Polanski. 1982. *Atlas of Spawning and Nursery Areas of Great Lakes Fishes*. FWS/OBS-82/52. Volumes 1-14. Washington, DC: U.S. Fish and Wildlife Service.

Hart, J.L. 1930. Spawning and early life history of whitefish (*Coregonus clupeaformis*) in the Bay of Quinte, Ontario. *Contributions to Canadian Biology and Fisheries* 40:165-214.

Hartman, W.L. 1972. Lake Erie: Effects of exploitation, environmental changes, and new species on the fishery resources. *Journal of the Fisheries Research Board of Canada* 29:931-936.

Hartman, W.L. 1973. Effects of exploitation, environmental changes, and new species on the fish habitats and resources of Lake Erie. Technical Report no. 22. Great Lakes Fishery Commission. Ann Arbor, MI.

Ihssen, P.E., D.O. Evans, W.J. Christie, J.A. Rechahn, and D.L. DesJardine. 1981. Life history, morphology, and electrophoretic characteristics of five allopatric stocks of lake whitefish (*Coregonus clupeaformis*) in the Great Lakes region. *Canadian Journal of Fisheries and Aquatic Sciences* 38:1790-1807.

Lake Erie Coldwater Task Group. 2005. *Report of the Lake Erie Coldwater Task Group.* Lake Erie Committee, Great Lakes Fishery Commission, Ann Arbor, MI.

Mohr, L.C., and T.F. Nalepa (eds). 2005. Proceedings of a workshop on the dynamics of lake whitefish (*Coregonus clupeaformis*) and the amphipod *Diporeia* spp. in the Great Lakes. Great Lakes Fishery Commission Technical Report 66.

Roseman, E., B.A. Manny, G. Kennedy, and J. Boase. 2006a. Assessment of lake whitefish spawning in the Detroit River. Draft Proposal, U.S. Geological Survey Great Lakes Science Center, Ann Arbor, MI.

Roseman, E., G. Kennedy, B.A. Manny, J. Nichols, and J. Boase. 2006b. Assessing lake whitefish spawning and nursery habitat in the Detroit River International Wildlife Refuge. Presentation.

Trautman, M.B. 1957. *The Fishes of Ohio*. Columbus, OH: Ohio State University Press.

Links for More Information

Michigan Department of Natural Resources, Lake Whitefish: http://www.michigan.gov/dnr/0,1607,7-153-10364_18958-45680--,00.html

Michigan Interactive, Lake Whitefish: http://www.fishweb.com/recreation/fishing/fishfacts/fish/lake_whitefish/lake_whitefish.html

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