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A description of the nearshore fish communities in the Huron–Erie Corridor using multiple gear types

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ABSTRACT

Great Lakes coastal wetlands provide a critical habitat for many fish species throughout their life cycles. Once home to one of the largest wetland complexes in the Great Lakes, coastal wetlands in the Huron–Erie Corridor (HEC) have decreased dramatically since the early 1900s. We characterized the nearshore fish communities at three different wetland complexes in the HEC using electrofishing, seines, and fyke nets. Species richness was highest in the Detroit River (63), followed by the St. Clair Delta (56), and Western Lake Erie (47). The nearshore fish communities in the Detroit River and St. Clair Delta consisted primarily of shiners, bluntnose minnow, centrarchids, and brook silverside, while the Western Lake Erie sites consisted of high proportions of non-native taxa including common carp, gizzard shad, goldfish, and white perch. Species richness estimates using individual-based rarefaction curves were higher when using electrofishing data compared to fyke nets or seine hauls at each wetland. Twelve fish species were captured exclusively during electrofishing assessments, while one species was captured exclusively in fyke nets, and none exclusively during seine hauls. Western Lake Erie wetlands were more indicative of degraded systems with lower species richness, lower proportion of turbidity intolerant species, and increased abundance of non-native taxa. This work highlights the importance of coastal wetlands in the HEC by capturing 69 different fish species utilizing these wetlands to fulfill life history requirements and provides insight when selecting gears to sample nearshore littoral areas.

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Introduction

Coastal marshes are an important component of Great Lakes fisheries habitat. Extensive use of wetlands by fishes and wildlife is related to a wetland's diverse structural habitat and high primary productivity (Jude and Pappas, 1992). Coastal marshes are generally shallow, protected from wave energy, and have a diversity of emergent and submerged vegetation. The aquatic macrophytes provide structural heterogeneity that is particularly important for providing refugia for small fishes, as well as providing substrate for large populations of invertebrate species, a source of food for fishes. Because these areas are shallow and protected, they warm more quickly in spring than open water. Also, tributaries transfer invertebrates and nutrients to nearshore waters. These factors promote increased productivity in marshes versus open water habitat (Herdendorf, 1987).

Coastal marshes typically have a high number of fish species associated with them. Jude and Pappas (1992) evaluated open water and coastal wetland habitats from all five Great Lakes and documented 113 species of fishes. Of this total, 82 species were either resident or migrated seasonally into coastal wetlands for nursery, spawning, and shelter. An additional 30 species may be occasional visitors to coastal wetlands based on occurrence in adjacent habitats (Jude and Pappas, 1992). Similarly, the Nature Conservancy estimated that about 80% of the approximately 200 fish species found in the Great Lakes use the nearshore areas at least part of the year and directly depend on coastal wetlands for some part of their life cycles (Chow-Fraser and Albert, 1999; Wei et al., 2004).

Coastal marshes provide important habitat for fishes and wildlife, however the wetlands that remain today represent a small remnant of the very extensive wetland system that was present along the shorelines of the Great Lakes prior to European settlement. For example, only about 20–25% of the original wetland area of Western Lake Ontario remains, with almost complete loss of wetlands in major urban areas (Whillans, 1982). Wetland losses along the highly industrialized Lake Erie shore are particularly important because Lake Erie had the smallest

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number and area of wetlands relative to the other Great Lakes. In Lake Erie, only 10% of original coastal marshes are estimated to be remaining today (Herdendorf, 1987).

In addition to direct loss of coastal wetlands, some functions of remaining wetlands have been degraded. Wetland degradation in the Great Lakes basin has been attributed to a variety of human disturbances including increased loading of nutrients and sediment from agricultural and urban development (Chow-Fraser, 1998; Crosbie and Chow-Fraser, 1999), introduction of invasive species (Lougheed et al., 1998), and shoreline development (Chow-Fraser, 2006). Regardless of the source, the resulting eutrophic and turbid conditions generally lead to a higher-biomass of benthic algae, which can reduce species richness of submerged plants, and affect species richness, species composition, and size structure of higher trophic levels (Chow-Fraser, 2006).

Given the importance of nearshore waters and coastal wetlands to fish populations, coupled with the loss and degradation of what remains, the primary objective of this study was to describe the nearshore fish communities in the Detroit River, St. Clair Delta, and Western Lake Erie. The second objective was to evaluate the use of several different gear types in sampling the nearshore fish community and determine sampling effort required to characterize the fish community. The high diversity of fish species associated with these sites provided an opportunity to make comparisons among sampling gear.

Material and methods

Study area

The area of study included the lower section of the St. Clair River to the western shore of Lake Erie within the Huron–Erie Corridor (HEC) (Fig. 1). The HEC encompasses southern Lake Huron, St. Clair River, Lake St. Clair, Detroit River, and Western Lake Erie.

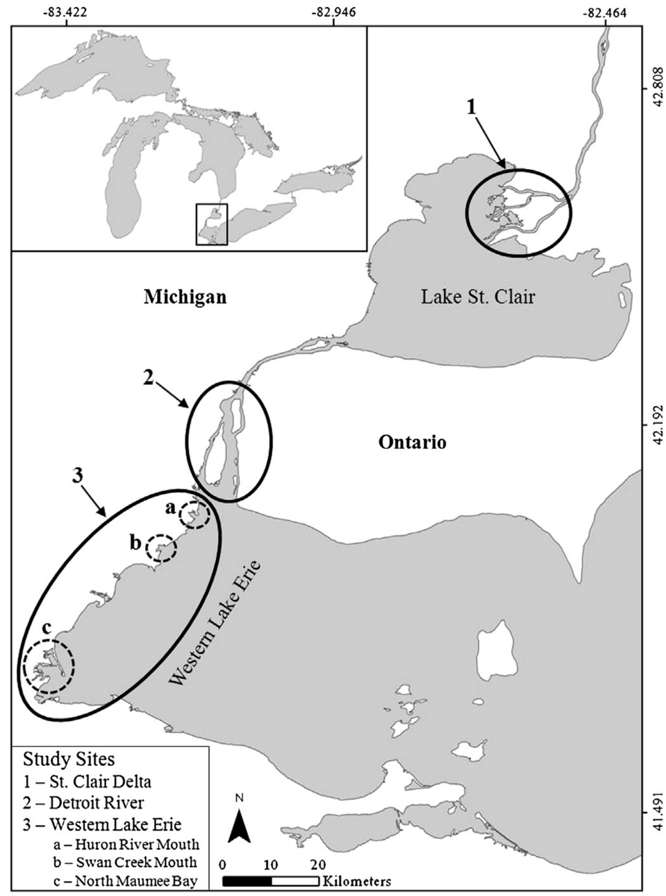

Fig. 1. Locations where fish sampling was conducted in the Huron–Erie Corridor 2004–2008.

Detroit River

The Detroit River is a 51 km connecting channel between Lake St. Clair and Lake Erie. About 95% of the total flow of the Detroit River enters from Lake Huron via the St. Clair River and Lake St. Clair (Derecki, 1984). The discharge of the river is relatively constant (averaging 5200 m^3/s) compared to other large rivers that fluctuate widely from spring floods to summer low flows (Manny et al., 1988). The total fall of the river from Lake St. Clair to Lake Erie is 0.9 m and the average travel time for water to pass through the Detroit River is 20 h (Derecki, 1984).

Coastal wetlands and large submersed macrophyte beds along the Detroit River were nearly continuous in colonial times, but now exist as 31 small isolated remnants that cover a total of only 1382 ha. Nearly 55% of the coastal wetlands in lower Detroit River were lost from 1916 to 1973 (Jaworski and Raphael, 1976). Wetlands have been lost to backfilling and bulk heading for development, especially on the American side. Other wetlands have been rendered largely unsuitable for use by fishes and wildlife by chemical pollution, poor substrate quality, or diking (Manny et al., 1988). Manny et al. (1988) concluded that loss of shallow wetland areas has been the most significant ecological impact resulting from channel modifications.

Western Lake Erie

The Michigan shoreline of Western Lake Erie consists of low-lying marshes and sand beaches. In this study, three different wetlands were sampled in Western Lake Erie. Sampling was done at the mouth of both the Huron River and Swan Creek. The lower courses of these tributaries contain flooded flats at the mouth and are classified as drowned-river mouths (Herdendorf, 1987). The third site, North Maumee Bay, is considered a lacustrine protected embayment because it is protected from direct wave energy by a long sand spit called Woodtick Peninsula (Albert et al., 2003). Jaworski and Raphael (1976) estimated 2498 ha of coastal wetlands in Michigan waters of Western Lake Erie in 1916. By 1973, only 956 ha remained; a loss of 62%. Nearly 56% of the coastal wetlands in Swan Creek and 58% in North Maumee Bay were lost from 1916 to 1973 (Jaworski and Raphael, 1976).

St. Clair Delta

The St. Clair River is a 64 km connecting channel between Lake Huron and Lake St. Clair. The flow velocities in the St. Clair River range from 6.0 km/h at the Blue Water Bridge to 1.1 km/h at Lake St. Clair and averages 3.5 km/h. Generally, water velocity is highest north of the town of St. Clair, MI and decreases downstream. The flow time from Lake Huron to Lake St. Clair is 21.1 h (Edsall et al., 1988). The total average fall from Lake Huron to Lake St. Clair is 1.5 m (Edsall et al., 1988) and the shore line of the St. Clair River and its main distributary channels is 192 km (Edsall et al., 1988; Herdendorf et al., 1986).

The shoreline of the St. Clair River has been extensively developed for residential, commercial, and recreational uses and the only extensive natural areas are on the St. Clair Delta. The St. Clair Delta is the largest delta in the Great Lakes and is found where the St. Clair River enters Lake St. Clair (Herdendorf et al., 1986). No other significant deltas occur in the Great Lakes; the St. Clair Delta is a unique coastal feature supporting abundant and diverse wetland communities not found on other Great Lakes shorelines (Herdendorf et al., 1986).

The Delta is made up of a suite of landforms that support a diversity of wetland types. The bays and wetlands in the St. Clair Delta are important spawning and nursery areas for many fish species that support major fisheries in Lake St. Clair as well as Lake Huron and Lake Erie (Goodyear et al., 1982). More than 70 species of fishes have been recorded as residents or migrants in Lake St. Clair; 48 of these species are dependent on or use marshes and shallow areas of the lake (Herdendorf et al., 1986). From 1868-1873, there were 5473 ha of wetlands in the St. Clair Delta, but only 1779 ha remained by 1973 (a loss of

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