An Evaluation of the Ichthyofauna of Old Woman Creek Estuary, a Unique Aquatic Resource

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ABSTRACT

Old Woman Creek (OWC) National Estuarine Research Reserve and State Nature Preserve is one of only a handful of protected freshwater estuaries in the nation and is one of the few undisturbed natural areas found along the Ohio shore of Lake Erie. Located at the mouth of Old Woman Creek, about 5 km east of the city of Huron, OWC estuary represents a remnant of a once extensive costal marsh ecosystem that provides spawning and nursery habitat for many Lake Erie fishes. Fishes were collected nine times from four sites during a two year time period extending from late July 2002 to early August 2004. A total of 34 species of fish representing 11 different families was collected. Two species never observed in the OWC system were collected including the invasive *Apollonia melanostomus* (round goby). The absence of larger piscivorous fish previously reported as common in the estuary, such as *Esox lucius* (northern pike) and *Amia calva* (bowfin), may be a result of the cumulative effects of years of siltation and the resulting habitat alteration. Spawning *Oncorhynchus mykiss* (rainbow trout) were observed in the estuary in April followed by the collection of juveniles the following spring and fall, providing the first documentation of successful rainbow trout reproduction in this system. This work provides current data concerning fish present in OWC estuary and contrasts this with historical data, providing a benchmark by which the effects of future environmental impacts may be assessed.

INTRODUCTION

Old Woman Creek (OWC) National Estuarine Research Reserve and State Nature Preserve (NERR/SNP) is one of the few undisturbed natural areas found along the Ohio shore of Lake Erie and is one of only a handful of protected freshwater estuaries in the nation. Located at the mouth of Old Woman Creek, about 5 km east of the city of Huron, OWC estuary represents a remnant of a once extensive coastal estuarine system. This system covered 4,000 km^2 of Lake Erie's southern shore from Vermillion, Ohio to the Detroit River and provided spawning and nursery habitat for many Lake Erie fish (Rotenberry et al. 1989). Rotenberry et al. (1989) reported that only 100 km^2 of this habitat, including OWC estuary remains, greatly enhancing the importance of this remaining estuarine habitat. The importance of OWC estuary to the greater Lake Erie ecosystem is well documented. OWC estuary provides spawning habitat for many of the nearly 40 species of Lake Erie fishes that require marsh-like habitat to spawn (Hoffman 1985). In addition to extensive habitat loss, water quality problems have been common in the recent history of Lake Erie, and fish populations are known to have changed dramatically in response to these issues (Trautman 1981). Changes in fish population composition within OWC estuary have also been reported (Hoffman 1985), and whether these changes are simply a reflection of changes in the Lake Erie fish community or a result of reported habitat alteration in the estuary (Rotenberry et al. 1987) remains unclear.

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This work is also the first study on fish populations in the estuary since the decline in Lake Erie water levels in 1999 and 2000 (Herdendorf et al. 2004). Historically Lake Erie levels have cycled through highs and lows over approximate 30 year periods. The last low water period occurred during 1964 to 1966, meaning previous detailed studies of the fish populations of this system were all conducted during a period of high water levels (Lenters 2001). This study is intended to serve as a benchmark survey of the ichthyofauna in this unique ecosystem.

METHODS AND MATERIALS

Old Woman Creek estuary drains into Lake Erie about 3 km east of the town of Huron, Ohio in Erie County and is surrounded by the 230 hectare Old Woman Creek State Nature Preserve and National Estuarine Research Reserve (Fig. 1). The estuary mouth is approximately 174 m above sea level and has a beach that, depending on rainfall received in the drainage basin, may prevent fish migration both into and out of the estuary. Aside from a stream channel that averages slightly less then 1.5 m in depth the estuary is relatively shallow, often less than 1.0 m (Hoffman 1985). The estuary covers approximately 40 ha (Rotenberry et al. 1987), and emergent aquatic vegetation covers about 70% of the estuary, and *Nelumbo lutea* (American lotus) was the most common aquatic macrophyte.

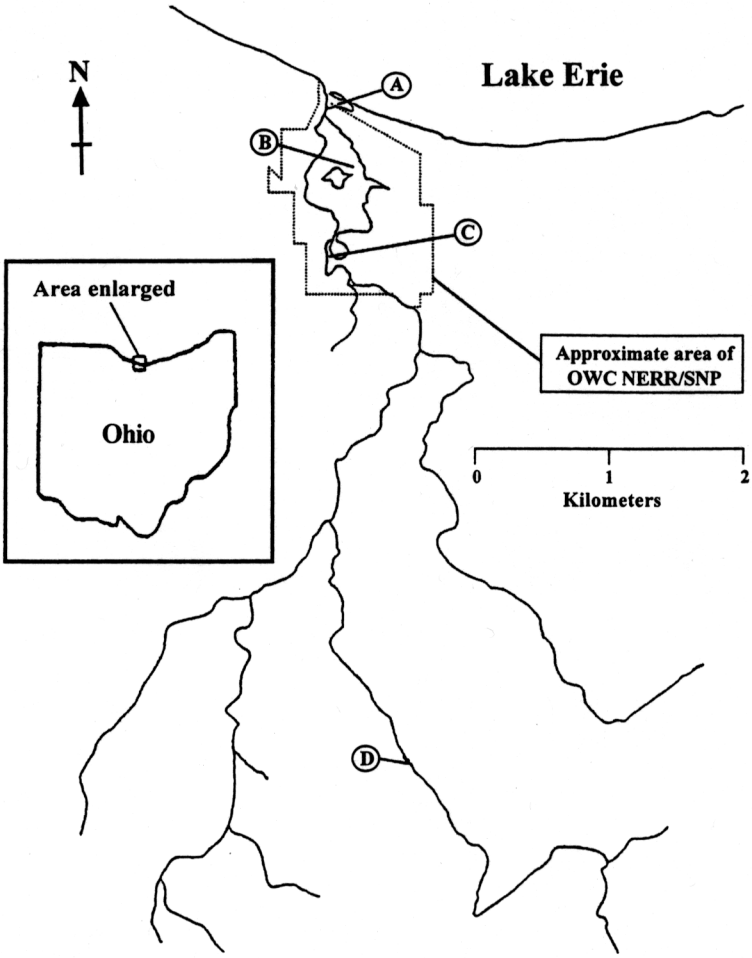

Figure 1. Location of sampling sites A, B, C and D in the OWC system.

Fish were collected from four sites in the OWC system between July 2002 and August 2004. Sampling occurred in July and October 2002, April, June, August and October 2003, and May, June, and August 2004. Sites were located near the mouth of OWC estuary (Site A: N 41 22 963; W 082 30 823), near the center of OWC estuary (Site B: N 41 22 650; W 082 30 644), the upstream portion of OWC estuary (Site C: N 41 22 243; W 082 30 848), and in OWC proper (Site D: N 41 19 842; W 082 30 439) (Fig. 1).

Fish were collected from sites A, B, and C using boat electrofishing equipment (Price et al. 2003). The barrier beach at the mouth of OWC estuary was open from 15 October 2001 until it closed on 3 July 2002. The barrier beach was intact or closed during both the July and October 2002 samplings but was washed open on 11 November 2002 and, with the exception of a 47 day period from 11 August 2003 to 27 September 2003, remained open for the duration of this study. After the August 2003 sampling, the water level in Site B was below the required 0.5 m depth to allow sampling. A federally protected *Haliaeetus leucocephalus* (bald eagle) nest prevented sampling of Site C in April 2003. Site D was sampled utilizing one-pass backpack electrofishing. Site D required access via private property and permission was only granted from April 2003 through May 2004.

For all sites, fish were collected and held until the electrofishing ceased. Most fishes were identified in the field and released, but some individuals were collected for further identification. *Lepomis* spp. (sunfish) individuals <2.4 cm in length were classified as juvenile sunfish and were not identified to species. Trautman (1981) and Page and Burr (1991) were utilized for fish identifications.

RESULTS

A total of 34 species representing 11 families was collected at all sites in the OWC system during the course of this study and 24 fish species that had been previously observed in the OWC system were not observed (Table 1). Scientific and common names of all fishes are given in Table 1. Fish assemblages at the various collecting sites differed in composition. Site A contained quillback and high numbers of freshwater drum and largemouth bass - fish that were likely residents of Lake Erie temporarily residing in the estuary (Table 2). Sites B and C contained fish assemblages most similar to that found in site A. Large numbers of juvenile (<2.4 cm) sunfish were present in all estuary sites throughout most of the collection periods. Site D, located well above the estuary in the lotic portion of OWC, contained fish representative of a typical northern Ohio small stream. Central stonerollers, striped shiners, blacknose dace and bluntnose minnow were all found in this stream section in abundance while the only Lake Erie fish observed in site D was rainbow trout.

Two species were collected that had never before been collected in the estuary - round goby and rock bass (Table 1). Many of the fish previously observed in the estuary that were absent from this study only appeared sporadically in previous studies. However, some of the fish absent in this study, such as black crappie and white crappie, had been reported as abundant for a number of years. Piscivores were relatively rare throughout the estuary, with largemouth bass and white bass appearing occasionally along with rare collections of smallmouth bass, white perch and yellow perch.

DISCUSSION

Perhaps the most noteworthy species observed in this survey was the round goby. This invasive fish is now widespread in Lake Erie, and its presence in the OWC system could have been considered inevitable. Round gobies were collected from both site A (estuary mouth) and site C (upstream portion of the estuary) providing the first recorded collection of this species within the OWC estuary system. Gobies were only observed in the final collections and in very limited numbers.

Table 1. Fish species collected in the OWC system during this survey (2002 to 2004) and historically (Hoffman 1985, Rotenberry et al. 1987, Rotenberry et al. 1989, Herdendorf et al. 2001).

Family	Scientific name	Common name	This study	Historical
Amiidae	*Amia calva*	Bowfin		X
Atherinopsidae	*Labidesthes sicculus*	Brook silverside		X
Catostomidae	*Carpiodes cyprinus*	Quillback	X	X
	Catostomus commersoni	White sucker	X	X
	Ictiobus bubalus	Smallmouth buffalo		X
	Minytrema melanops	Spotted sucker		X
	Moxostoma duquesnei	Black redhorse		X
	Moxostoma erythrurum	Golden redhorse		X
	Mosostoma macrolepidotum	Shorthead redhorse		X
Centrarchidae	*Ambloplites rupestris*	Rock bass	X	
	Lepomis cyanellus	Green sunfish	X	X
	Lepomis gibbosus	Pumpkinseed	X	X
	Lepomis humilis	Orangespotted sunfish	X	X
	Lepomis macrochirus	Bluegill sunfish	X	X
	Micropterus dolomieu	Smallmouth bass	X	X
	Micropterus salmoides	Largemouth bass	X	X
	Pomoxis annularis	White crappie		X
	Pomoxis nigromaculatus	Black crappie		X
Clupeidae	*Alosa pseudoharengus*	Alewife		X
	Dorosoma cepedianum	Gizzard shad	X	X
Cyprinidae	*Campostoma anomalum*	Central stoneroller	X	X
	Carassius auratus	Goldfish	X	X
	Cyprinella spiloptera	Spotfin shiner	X	X
	Cyprinius carpio	Common carp	X	X
	Ericymba buccata	Silverjaw minnow	X	X
	Luxilus chrysocephalus	Striped shiner	X	X
	Macrhybopsis storeriana	Silver chub		X
	Notemigonus crysoleucas	Golden shiner	X	X
	Notropis atherinoides	Emerald shiner	X	X
	Notropis cornutus	Common shiner		X
	Notropis hudsonius	Spottail shiner	X	X
	Notropis rubellus	Rosy faced shiner		X
	Notropis stramineus	Sand shiner		X
	Pimephales notatus	Bluntnose minnow	X	X
	Pimephales promelas	Fathead minnow	X	X
	Rhinichthys atratulus	Blacknose dace	X	X
	Semotilus atromaculatus	Creek chub	X	X
Esocidae	*Esox lucius*	Northern pike		X
Gobiidae	*Apollonia melanostomus*	Round goby	X	
Ictaluridae	*Ameiurus natalis*	Yellow bullhead	X	X
	Ameiurus nebulosus	Brown bullhead	X	X
	Ictalurus melas	Black bullhead		X
	Ictalurus punctatus	Channel catfish	X	X
	Noturus flavus	Stonecat madtom		X
	Noturus gyrinus	Tadpole madtom		X
Lepisosteidae	*Lepisosteus osseus*	Longnose gar	X	X
Moronidae	*Morone americana*	White perch	X	X
	Morone chrysops	White bass	X	X
Percidae	*Etheostoma caeruleum*	Rainbow darter	X	X
	Etheostoma nigrum	Johnny darter		X
	Perca flavescens	Yellow perch	X	X
	Percina caprodes	Logperch		X
	Sander vitreus	Walleye		X
Salmonidae	*Oncorhynchus kisutch*	Coho salmon		X
	Oncorhynchus mykiss	Rainbow trout	X	X
	Osmerus mordax	Rainbow smelt		X
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum	X	X
Umbridae	*Umbra limi*	Central mud minnow		X

The appearance of rock bass in the estuary is a novel, but not an unexpected, observation. The rock bass is common in nearshore areas of Lake Erie and in most of the surrounding streams (Trautman 1981, Page and Burr 1991). Although the rock bass has not previously been reported in the stream portion of OWC, it has been observed in nearby tributaries (Herdendorf et al. 2001), and it seems likely that rock bass may also be present in the stream portion of OWC in low numbers.

Both spawning adult and young-of-year (YOY) rainbow trout were observed in the OWC system in 2003, providing the first indication of successful natural rainbow trout reproduction in this system. Rainbow trout is not native to the Great Lakes but is introduced to enhance sport fishing opportunities. While rainbow trout populations in all the Great Lakes, including Lake Erie, are primarily maintained through an annual stocking program, limited natural reproduction is known to occur. In our study, actively spawning rainbow trout were observed in the upstream portion of OWC in early April 2003. YOY rainbow trout were collected on subsequent 2003 collecting trips in both

Table 2. Total individuals of various species collected during this study (2002 to 2004) from the four sampling sites (A-D).

			Site			
Family	Scientific name	Common name	A	B	C	D
Catostomidae	*Carpiodes cyprinus*	Quillback	1			
	Catostomus commersoni	White sucker	24	19	47	10
Centrarchidae	*Ambloplites rupestris*	Rock bass			1	
	Lepomis cyanellus	Green sunfish	71	5	220	27
	Lepomis gibbosus	Pumpkinseed	38	4	21	
	Lepomis humilis	Orangespotted sunfish	5	1	6	6
	Lepomis macrochirus	Bluegill sunfish	106	6	106	
	Lepomis spp.	Juvenile sunfish	123	19	197	16
	Micropterus dolomieu	Smallmouth bass			1	
	Micropterus salmoides	Largemouth bass	19	2	16	1
Clupeidae	*Dorosoma cepedianum*	Gizzard shad	364	1,246	416	
Cyprinidae	*Campostoma anomalum*	Central stoneroller	2		25	213
	Carassius auratus	Goldfish	224	301	51	
	Cyprinella spiloptera	Spotfin shiner	8	1	6	
	Cyprinius carpio	Common carp	70	33	76	
	Ericymba buccata	Silverjaw minnow				2
	Luxilus chrysocephalus	Striped shiner				10
	Notemigonus crysoleucas	Golden shiner			1	
	Notropis atherinoides	Emerald shiner	4		10	10
	Notropis hudsonius	Spottail shiner				31
	Pimephales notatus	Bluntnose minnow	10		54	97
	Pimephales promelas	Fathead minnow		2	1	
	Rhinichthys atratulus	Blacknose dace				15
	Semotilus atromaculatus	Creek chub	11		25	123
Gobiidae	*Apollonia melanostomus*	Round goby	3		3	
Ictaluridae	*Ameiurus natalis*	Yellow bullhead	17	30	10	
	Ameiurus nebulosus	Brown bullhead	17		3	
	Ictalurus punctatus	Channel catfish	24	5		
Lepisosteidae	*Lepisosteus osseus*	Longnose gar			1	
Moronidae	*Morone americana*	White perch	2		1	
	Morone chrysops	White bass	10			
Percidae	*Etheostoma caeruleum*	Rainbow darter				24
	Perca flavescens	Yellow perch	22		9	
Salmonidae	*Oncorhynchus mykiss*	Rainbow trout				10
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum	5		3	

June and October. The presence of YOY rainbow trout in the creek in October indicates successful summer survival, an oddity in Lake Erie tributaries. While spring 2004 sampling was likely too late to detect spawning adults, the absence of YOY in summer and fall sampling may indicate that spawning and YOY survival in the creek is sporadic, depending on summer water levels and temperatures.

Perhaps the largest shift in abundance of any one species in OWC estuary occurred in northern pike. Before 1885, northern pike was so common in OWC estuary that it, along with muskellunge, was captured in large numbers and stacked on wagons for transport to nearby cities (Trautman 1981). Despite a decline that began in 1885, northern pike populations in the 1950's were still large enough to permit the Ohio Department of Natural Resources to remove them from OWC estuary for stocking in other areas of Ohio (Miller 1957). Today pike are relatively rare in Lake Erie and were not observed at all in the OWC estuary system in the present study. The primary factor believed to be responsible for the overall decline in pike numbers in Lake Erie is loss of appropriate spawning habitat (Trautman 1981). Pike require heavily vegetated areas to spawn (Wallus et al. 1990), and OWC estuary previously supplied such habitat. It seems reasonable to assume that estuaries like OWC might play a pivotal role in the survival of remaining Lake Erie pike.

Both white and black crappies are relatively common in waters of northern Ohio, are known to occur in Lake Erie, and were abundant in previous OWC estuary fish surveys. The previous abundance of crappies in OWC estuary, particularly the white crappie, may be due in part to their numbers in Lake Erie during this period. In the late 1970s and 1980s, catches of centrarchids in near shore trawls conducted in Lake Erie western basin were dominated by white crappie (Tyson and Ciborowski 2007). In contrast, centrarchid catches from 2002 to 2004 had high numbers of pumpkinseed, bluegill and other sunfish with very few white or black crappies, similar to our observations within OWC during the same time period. In addition, the cyclical nature of crappie populations may provide at least a partial explanation for their complete absence in the present study. Crappie, particularly black crappie, populations tend to fluctuate greatly (Trautman 1981), which is reflected in the OWC estuary historical data. Both black and white crappies were absent in 1970, abundant in 1974, absent in 1977, and then abundant in the 1980s (Hoffman 1985, Rotenberry et al. 1987, Rotenberry et al. 1989, Herdendorf et al. 2001).

Assessing the overall health of the OWC ecosystem based on the fish assemblage is difficult, although several observations noted in this study may be indicative of greater trends. Deegan et al. (1997) developed a preliminary index of biotic integrity for saltwater estuaries. In this work several responses to degraded estuarine conditions are predicted including: 1) a reduction in the number of species utilizing the estuary as a spawning ground and nursery; 2) a loss of higher trophic level species (piscivores); and 3) an increase in abundance of a few tolerant species who would dominate year round as the sensitive species disappeared. The low numbers of piscivores observed in the present study and the complete absence of previously observed piscivores such as bowfin and pike seem to be indicative of a long-term decline in the numbers of these fish. These observations are consistent with the conclusions of Rotenberry et al. (1987) who tentatively concluded the lack of large piscivores in the estuary was a result of turbidity combined with high temperature and low dissolved oxygen observed in the spring and fall. In addition, the abundance of the notoriously tolerant common carp, along with gizzard shad, in the OWC estuary during the course of this study seems to represent an ecosystem dominated by a few tolerant species. Although the changing fish community in Lake Erie certainly has a tremendous impact on the fishes found in the estuary, the long term fish abundance data from OWC estuary suggest ecological degradation is impacting the fish fauna.

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