

FISHES OF THE INLAND WATERS OF BEAVER ISLAND, CHARLEVOIX COUNTY, MICHIGAN

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ABSTRACT: The shallow water fishes of eleven inland water bodies on Beaver Island, Charlevoix County, Michigan, were surveyed during the summer of 1994 using seines, traps, and standard fishing techniques. This information was supplemented with historic data and reports by the Michigan Department of Natural Resources, other unpublished studies, reports by residents of the island, and specimens housed in the Natural History Museum of the Central Michigan University Biological Station. The result is the first comprehensive list of the fish fauna of Beaver Island. A total of 33 species and one subspecies, representing 11 families, was noted for the island. Seven of these reports are new records. The collection of *Gasterosteus aculeatus* suggests that the range of this species in the Great Lakes drainage is expanding westward, as its western limit had been previously reported as Lake Ontario. Notes on the history as well as habitat descriptions of each collection site on the island are included.

KEYWORDS: Beaver Island, fish, *Gasterosteus aculeatus*, Lake Michigan.

INTRODUCTION

The first known settlement on Beaver Island (French explorers) pre-dated the arrival of the Pilgrims in North America. In 1847, the island was controlled by a Mormon monarchy with 2,000 inhabitants, and in 1856, the assassination of the king of the island triggered a hostile takeover by mainland Irish immigrants. Currently, about 400 permanent residents live on the island, and their main sources of income are fishing, logging, and tourism. Unlike some of the other islands in the Great Lakes (e.g., Mackinac and Drummond Islands), Beaver Island has maintained its natural character. However, in recent years, increased tourism, the development of second homes in previously undeveloped areas, sport fishing pressure, and the potential threats of introduced and exotic species have justified efforts to document the island's pre-disturbance biota and ecology.

Since the establishment of the Central Michigan University Biological Station on Beaver Island in 1964, faculty, students, and visiting scientists have worked hard to inventory and study the island's native flora and fauna. However, most of these studies have focused on the herpetofauna and aquatic vascular plants (J.C. Gillingham and D.E. Wujek, pers. comm.).

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The first survey of the fishes of Beaver Island's inland waters was conducted by the Michigan Department of Natural Resources (unpubl. rep., 1960). Additional unpublished accounts were prepared in the late 1960s (e.g., F. Menapace, 1966; R.D. Simpson, 1967; R. Mellon, 1968; B. Foster, 1969). Most of these reports are restricted to the larger lakes. Few investigators have surveyed the smaller bog lakes, and none have reported on the lotic systems or beach ponds and pools. The objective of this study, then, was to provide baseline information about the diversity and history of the fishes of Beaver Island for use by future investigators.

STUDY AREA

Beaver Island is located in Lake Michigan, 48 km northwest of Charlevoix, Michigan (Figure 1). It is the largest of seven islands in the archipelago, having an area of approximately 137 square kilometers. The islands are of glacial origin, having a substrate made up almost exclusively of till or outwash. The dominant natural forest cover is beech-maple with red and white pine as subdominants. The southern portion of the island is covered with dense cedar swamps and bogs. Much of this area occurs within the Pigeon River State Forest.

Seven lakes or ponds occur on the island (Figure 1): Barney's Lake (20 ha), Egg Lake (14 ha), Font Lake (173 ha), Fox Lake (34 ha), Green's Lake (30 ha), Lake Geneserath (222 ha), and Miller's Marsh (5 ha). An eighth, Round Lake (4 ha), is ephemeral and, in recent years, mostly dry. Egg, Fox, and Green's Lakes are *Sphagnum*-bog lakes, while Barney's Lake is surrounded by a circumneutral fen (Fitzgerald and Bailey, 1975). Font Lake also harbors minerotrophic peat communities. Limnological data for five of the island's lakes are presented in Table 1 (K. Ginn, unpubl. student rep., 1994).

Two lotic systems, Iron Ore Creek and Jordan River, occur on the island (Figure 1). Jordan River is relatively permanent, while Iron Ore Creek is usually seasonal. Both support gravel as well as muck substrata.

MATERIALS AND METHODS

The shallow waters of eleven water bodies on Beaver Island (Figure 1) were surveyed; seven were lakes or large ponds (Barney's, Egg, Font, Fox, Geneserath, and Green's Lakes and Miller's Marsh), two were lotic systems (Jordan River and Iron Ore Creek), and two sites included beach pools and ponds (Sucker Point and Big Sandy Bay). A 4-meter long seine was used to survey fishes in each of the sampling areas. Seining was conducted several times during the morning and evening hours in the littoral benches of each lake and along entire stretches of the creek and river. In addition to seining, small traps, baited with liver, were placed in various habitats at each site and checked daily for a period of one week. Standard sport fishing techniques (involving approximately 30 hours) were used to capture species of deeper waters. Collections were conducted throughout the summer of 1994, and voucher specimens are held in the Natural History Museum of the Central Michigan University Biological Station.

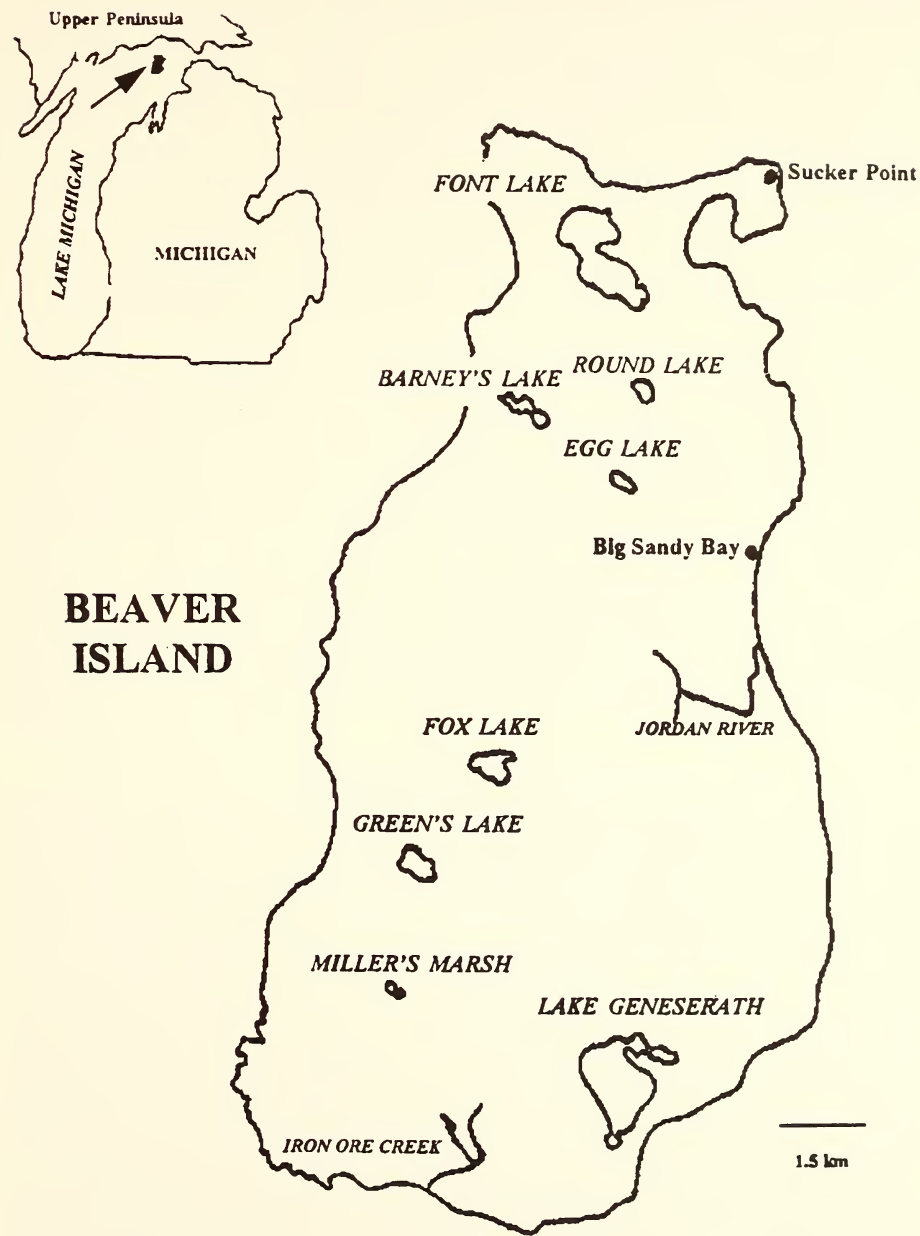


Figure 1.

Table 1. Limnological variables from several lakes on Beaver Island.

	Barney's Lake	Egg Lake	Font Lake	Fox Lake	Lake Geneserath
Maximum depth (m)	3.7	—	2.5	5.3	15.6
O ₂ (mg/l)	9.02	—	8.61	8.58	8.28
CaCO ₃ (mg/l)	110	—	62.4	5.70	86.6
pH	8.88	9.0	8.5	6.74	8.38
Temp (° C on August 2)	24.5	—	24.0	21.4	21.6

The species list resulting from collections conducted during 1994 was supplemented with reports from other sources. The archives and natural history collection of the Central Michigan University Biological Station were checked, and all relevant material (including unpublished student papers as well as reports by the Michigan Department of Natural Resources) were reviewed. These sources are available upon request from J.C. Gillingham at the Department of Biology, Central Michigan University.

Age determination of the perch taken from Green's Lake was conducted by removing and analyzing several non-regenerated scales from the area just behind the pectoral fin of each fish. The age for each specimen was recorded as the number of annual "plates" per scale.

RESULTS AND DISCUSSION

A total of 33 species and one subspecies of fish, representing 11 families, were documented as occurring or having occurred on the island since 1942 (Table 2). Two species (*Onchorhynchus mykiss* and *Salvelinus fontinalis*) no longer occur on the island, one (*Esox masquinongy x lucius*) is an introduced hybrid, and one (*Cyprinus carpio*) is an introduced exotic. Reports of *Ammocrypta pellucida* and *Etheostoma caeruleum* (F. Menapace, unpubl. student rep., 1966) were not recognized due to range limitations, the absence of voucher specimens, and the inability to locate living specimens. *Esox masquinongy x lucius*, *Cyprinus carpio*, *Phoxinus eos*, *Catostomus catostomus*, *Fundulus diaphanus* ssp. *menona*, *Gasterosteus aculeatus*, and *Cottus bairdi* are new records for the island. Unidentified members of the genera *Notropis* and *Moxostoma* were also recorded.

The Cyprinidae, Centrarchidae, and Percidae had the largest representation (6 species each; Table 1). The most frequently encountered and widely distributed species were *Esox lucius* (northern pike), *Culaea inconstans* (brook stickleback), *Lepomis macrochirus* (bluegill sunfish), and *Perca flavescens* (yellow perch). Ten species were reported from only a single site. Several of these have likely been extirpated due to unfavorable habitat.

Barney's Lake. Eleven species, including three new records, were reported for Barney's Lake. The presence of *Fundulus d. diaphanus* (banded killifish) in this lake as well as in another land-locked lake (Font Lake) is curious, as waters associated with Lake Michigan (Big Sandy Bay and Sucker Point) harbor *Fun-*

dulus d. menona. This dichotomous distribution may be an artifact of the island's previous attachment to the mainland.

The 1960 report of *Micropterus dolomieu* (smallmouth black bass) by the Michigan Department of Natural Resources probably represents stocked fish. The current habitat at Barney's Lake (mud-bottom) and the lack of recent reports suggest that this species no longer occurs there. Recent reports of this species, with the exception of those from coastal ponds, are lacking from the island's inland waters. Reports of black bass from the island have been almost entirely restricted to *Micropterus salmoides* (largemouth black bass) in recent years. This species is most common in warm, eutrophic, muddy waters, such as those provided by most of Beaver Island's lakes.

Egg Lake. A single species, *Culaea inconstans*, was noted in this shallow bog lake. While the interstitial waters of the bog mat have pH values of 3.5, the open water of the lake has values as high as 9.0. The apparent lack of a rich assemblage of fish may be a function of water depth, because a "false bottom" of flocculent organic sediments is no more than one meter from the surface in most places. The entire water column is trophogenic, and during peak summer months, low dissolved oxygen concentrations are probably limiting.

Font Lake. Eleven species were reported for this lake. The report of *Esox masquinongy* x *lucius* (tiger muskellunge) was from a local fisherman, who caught an individual during the summer of 1994. The specimen was the tiger variety, a stocked hybrid.

The reports of *Ammocrypta pellucida* (eastern sand darter) and *Etheostoma caeruleum* (rainbow darter) by F. Menapace (unpubl. student rep., 1966) are probably incorrect. Beaver Island is north of the natural range of both species (Page and Burr, 1991). The reported specimens were probably *Etheostoma nigrum* (johnny darter) and *Etheostoma exile* (Iowa darter). These species are somewhat similar to *A. pellucida* and *E. caeruleum*, respectively, and the presence of the latter two has been verified by voucher specimens.

Fox Lake. Since 1960, twelve species have been reported from Fox Lake. The Michigan Department of Natural Resources poisoned Fox Lake during the summer of 1961, presumably killing most or all of the fish. In the fall of 1961 and in 1962, the Michigan Department of Natural Resources stocked *Salvelinus fontinalis* measuring nine inches in length. *Oncorhynchus mykiss* (rainbow trout; stocked by the Michigan Department of Natural Resources in 1964) and *Salvelinus fontinalis* are certainly extirpated at present, as the habitat is not conducive to their reproduction, and stocking has not occurred for several decades. No reports of these species are known after 1964.

Micropterus dolomieu was reported by the Michigan Department of Natural Resources in 1960; however, no reports are known since then. Most current records are of *M. salmoides*. Reports of *M. dolomieu* in the inland lakes may have resulted from stocked fish which no longer exist.

Green's Lake. Whether Green's Lake, a dystrophic bog lake, ever supported naturally occurring fish populations is not known. The Michigan Department of

Table 2. The fishes reported from the inland waters of Beaver Island, Michigan (Michigan Department of Natural Resources, 1942; Michigan Department of Natural Resources, 1960; Michigan Department of Natural Resources, 1964; Menapace, 1966; Simpson, 1967; Mellon, 1968; anonymous, 1969; anonymous, 1972; anonymous, 1994). These sources have not been published and are available from J.C. Gillingham of Central Michigan University. The species in bold-face print represent new records.

	Site ^a									
	1	2	3	4	5	6	7	8	9	10
SALMONIDAE										
<i>Oncorhynchus mykiss</i>				1964 ^b						
<i>Salvelinus fontinalis</i>					1960			X ^c		
UMBRIDAE										
<i>Umbra limi</i>			1960	X				X	X	
ESOCIDAE										
<i>Esox lucius</i>	X			X	1972	1960		X		
<i>Esox masquinongy</i> x <i>lucius</i>			1994							
CYPRINIDAE										
<i>Cyprinus carpio</i>									X	X
<i>Notemigonus chrysoleucus</i>				1960					X	X
<i>Notropis heterolepis</i>		1960		1966, 1967 ^b						
<i>Notropis</i> sp. 1										X
<i>Notropis</i> sp. 2										X
<i>Phoxinus eos</i>									X	X
<i>Pimephales notatus</i>						1960				
CATOSTOMIDAE										
<i>Catostomus catostomus</i>								X		
<i>Catostomus commersoni</i>			1960, 1966, X			1960, 1968 ^b		X	X	
<i>Moxostoma</i> sp.								X		
ICTALURIDAE										
<i>Ictalurus melas</i>					1942, 1969					
<i>Ictalurus nebulosus</i>	1960				X	1960				

	Sites ^a									
	1	2	3	4	5	6	7	8	9	10
CYPRINODONTIDAE										
<i>Fundulus diaphanus</i>		1960,		1960,						
<i>diaphanus</i>		X		1966						
<i>Fundulus diaphanus</i>									X	X
<i>menona</i>										
GASTEROSTEIDAE										
<i>Culaea inconstans</i>		X	1960					X	X	X
<i>Gasterosteus aculeatus</i>									X	X
COTTIDAE										
<i>Cottus bairdi</i>							X			
CENTRARCHIDAE										
<i>Ambloplites rupestris</i>		X			X		1969 ^b , X			X
<i>Lepomis gibbosus</i>				1960		X				
<i>Lepomis macrochirus</i>	X		1968	1960	1942	X				
<i>Micropterus dolomieu</i>	1960			1960						X
<i>Micropterus salmoides</i>	1960			X		X				
<i>Pomoxis nigromaculatus</i>				1960						
PERCIDAE										
<i>Ammocrypta pellucida</i>			1966							
<i>Etheostoma caeruleum</i>			1966							
<i>Etheostoma exile</i>	1960					1960				
<i>Etheostoma nigrum</i>	1960		1960,			1960				
			1966							
<i>Percina caprodes</i>						1960				
<i>Perca flavescens</i>	1960		1960,	1960,	X	X				
			1967 ^b	X						

^a Sites: 1 = Barney's Lake; 2 = Egg Lake; 3 = Font Lake; 4 = Fox Lake; 5 = Green's Lake; 6 = Lake Geneserath; 7 = Iron Ore Creek; 8 = Jordan River; 9 = Sandy Bay Ponds and Pools; 10 = Sucker Point Ponds and Pools.

^b Specimen in the Central Michigan University Biological Station collection.

^c An X identifies a species collected in 1994; a voucher specimen was placed in the Central Michigan University Biological Station collection.

Natural Resources (unpubl. rep., 1942) reports stocking fish into the lake as early as 1942. During that year, both *Ameiurus melas* (black bullhead) and *Lepomis macrochirus* were introduced. No other fishes were noted by the Michigan Department of Natural Resources. Later, in 1972, several *Esox lucius* were netted from Barney's Lake and introduced into Green's Lake (anonymous source). The number of introductions and the success of the endeavor are unknown.

Residents of the island reported that at one time, presumably in the early seventies, a population of *Perca flavescens* existed in the lake. Some individuals were reported as being more than 40 cm in length. The residents believed that a winter freeze in the late seventies or early eighties killed all of the fish in the lake. However, collections during the summer of 1994 confirmed the continued existence of *P. flavescens* in the lake. The mean length of captured specimens was 13.8 cm with a range of 13.6 to 15.3 cm. Analysis of growth patterns on the scales taken from the fish showed that they ranged in age from 5 to 7 years (mean = 5.75 yrs). Whether the original population and/or the existing population represent naturally occurring fish or fish that were introduced by island residents is not known.

The only species, other than *P. flavescens*, that was collected in 1994 was *Ameiurus melas*. These fish are apparently descendants of the 1942 stocking. *Lepomis macrochirus* introductions into Green's Lake were apparently unsuccessful, as no specimens were found to exist there.

Lake Geneserath. Thirteen species were reported from this lake, the most for any of the sites studied. The lake is the only site on the island where *Percina caprodes* (logperch) has been reported. Sport fishing pressure on this lake is probably greater than anywhere else on the island. Recently, residents have discussed the merits of stocking *Stizostedion vitreum* (walleye) into the lake. This lake is the only lake on the island considered to be deep enough to provide sufficient habitat for this species.

Iron Ore Creek. This lotic system is rather ephemeral, depending on the amount of rainfall in a given year. The two species noted, *Oncorhynchus mykiss* and *Cottus bairdi* (mottled sculpin), are migrants from Lake Michigan.

Jordan River. Like Iron Ore Creek, the fishes in Jordan River, for the most part, are transient species from Lake Michigan. Suckers, *Catostomus catostomus* (longnose sucker) and *C. commersoni* (white sucker), are found only in the spring during their spawning run. *Moxostoma* sp. (redhorse sucker) has been reported (J.C. Gillingham, pers. comm.), but no voucher specimens have been located. Only *Umbra limi* (central mudminnow) and *Culaea inconstans* appear to be permanent residents of the river. A single juvenile of *Esox lucius* was also noted.

Sandy Bay Ponds and Pools. Several discrete ponds were surveyed on Big Sandy Bay. A total of eight species was noted. Many appeared to be transients from coastal waters. *Umbra limi* and *Culaea inconstans* are permanent residents and breed in the algal mats and submergent macrophytes. The presence of *Gasterosteus aculeatus* (three-spined stickleback) at both the Sandy Bay and the

Sucker Point stations suggests that this species is expanding its western range within the Great Lakes drainage, as Page and Burr (1991) report the species' westernmost occurrence in the Great Lakes drainage as Lake Ontario.

Sucker Point Ponds and Pools. Like Big Sandy Bay, most of the ten species found here are washed-in on an annual basis from Lake Michigan and become stranded in the pools. Although the ponds are comparatively large and deep (1 m), it is unlikely that they are deep enough to support large fish such as *Cyprinus carpio* (carp) throughout the winter.

CONCLUSION

The fish fauna of Beaver Island's inland waters is somewhat similar in overall species composition and abundance to corresponding habitats in other parts of northern Michigan. However, non-game predators such as gar and bowfin are curiously absent. In addition, the Cyprinidae are relatively poorly represented. More intensive sampling and taxonomic research is needed to ascertain their actual richness and abundance. Small, non-game forage species such as cyprinids are often better indicators of environmental quality.

Although the results of the present study probably represent the majority of Beaver Island's fishes, additional sites and collecting techniques should be explored. Several beaver ponds remain unsampled, and identifications of specimens known only by genus are needed.

As sport fishing pressure increases with tourism, quantification and age analysis of gamefish populations may be needed for management purposes.

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LITERATURE CITED

- Fitzgerald, S. and R.E. Bailey. 1975. Vegetational characteristics of a circumneutral bog, Barney's Lake, Beaver Island, Michigan. *Proc. Michigan Acad. Sci.* 57: 477-489.
- Page, L.M. and B.M. Burr. 1991. A field guide to freshwater fishes of North America, north of Mexico. Houghton Mifflin Co., Boston, 432 pp.

