Note

Occurrence of the Deepwater Sculpin (Myoxocephalus thompsoni) in Western Lake Erie

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Abstract. Reported here is the collection of two specimens of deepwater sculpin (Myoxocephalus thompsoni) from Ohio waters of western Lake Erie in 1995. Both specimens were collected while sampling for pelagic walleye (Stizostedion vitreum) larvae. A 15.0-mm TL deepwater sculpin larva was collected over Toussaint Reef on 29 April 1995 and a 17.0-mm TL juvenile was collected west of South Bass Island State Park on 12 May 1995. It appears that there are no references to collections of deepwater sculpins from western Lake Erie in the literature or from communications with local management agency personnel. While these young deepwater sculpin may have come from ballast water or from a reproducing population in Lake Erie, the collection of 21 deepwater sculpin (12 to 19 mm TL) in the St. Clair River in May 1990 provides evidence of downstream transport from Lake Huron where indigenous populations exist.

INDEX WORDS: Deepwater sculpin, Myoxocephalus thompsoni, western Lake Erie, larval fish, transport mechanisms.

Introduction

The deepwater sculpin (Myoxocephalus thompsoni) is distributed in all the Great Lakes, except Lake Erie (Hubbs and Lagler 1958, Emery 1976, Trautman 1981, Smith 1985). Greeley (1929) and Fish (1932) reported that deepwater sculpin were rare in the eastern basin of Lake Erie in the late 1920s; however, Auer (1982) suspects that identification of Fish's specimens may be inaccurate and that these fish were actually Cottus bairdi. Greeley's (1929) account of the species in Lake Erie is based on identifications by Fish. In this paper, the first known occurrence of age-0 deepwater sculpin in western Lake Erie is documented.

Little is known about deepwater sculpin biology or early life history in the Great Lakes, mainly because it occupies profundal habitats. Adult deepwater sculpins feed primarily on Diporeia and Mysis (Selgeby 1988, Wojcik et al. 1986) and zooplankton is probably the mainstay of the diet during the pelagic larval stage (8 to 22 mm) (Mansfield et al. 1983).

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The reproductive cycle of this species is not fully understood. Most sources suggest that spawning occurs primarily in late fall and winter (Brandt 1986, Selgeby 1988, Geffen and Nash 1992). Geffen and Nash (1992) observed that larval deepwater sculpins in Lake Michigan hatched in deep water in March, rose to the surface, and were transported inshore. These larvae moved offshore and deeper in the water column after metamorphosis and were demersal by late fall.

**Study Area**

The 1990 study area was located at the Belle River Power Plant on the St. Clair River, south of St. Clair, Michigan (Jude 1991). The historical mean discharge of the river is approximately 5,100 m$^3$/s with current velocities exceeding 5.0 km/h (Derecki 1984, Griffiths et al. 1991). The 1995 study area encompassed the Ohio waters of western Lake Erie located between latitudes N 41° 30' to N 41° 43' and longitudes W 82° 50' to W 83° 14' (Fig. 1). Water depths in the study area ranged from 1.5 to 11 m. Physical and chemical characteristics of western Lake Erie are well documented (Herdendorf and Braidech 1972, Boyce et al. 1987). Generally, the western basin is isothermal throughout the year due to mixing of its shallow waters and seldom becomes anoxic. Bottom substrates consist primarily of sand and clay, although dolomite limestone forms several major reef complexes (Herdendorf and Braidech 1972).

*Fig. 1. Larval fish collection sites in the St. Clair River and western Lake Erie. ★ indicates Belle River Power Plant sampling site; T = Toussaint Reef; B = South Bass Island; ---- indicates shipping lane.*
Walleyes, the dominant predator in the western basin, are supported by a prey base of gizzard shad (*Dorosoma cepedianum*), alewife (*Alosa pseudoharengus*), minnows (*Notropis atherinoides* and *N. husonius*), white perch (*Morone americana*), white bass (*Morone chrysops*), and yellow perch (*Perca flavescens*). Other common fish species include common carp (*Cyprinus carpio*), freshwater drum (*Aplodinotus grunniens*), rainbow smelt (*Osmerus mordax*), channel catfish (*Ictalurus punctatus*), and suckers (*Catostomidae*) (Knight and Vondracek 1993).

**Methods**

In 1990, entrainment samples (24) were collected hourly by filtering water from the plant's intake pump through 363-µm-mesh nets from one to three times per week from 7 March to 29 October at the Belle River Power Plant on the St. Clair River, south of St. Clair, Michigan (Jude 1991). Sampling for larval fish in the river in front of the power plant was conducted using a 0.5-m diameter net of the same mesh size once per week during May, June, and July. An oblique, stepped, 10-min tow was made in 6 m of water 10 times during the day and 10 times at night each week. Catch from both types of samples were quantified using flow meters.

In 1995, a 2.0-m$^2$, framed ichthyoplankton net fitted with 500-µm-mesh netting was used to sample pelagic larval fishes at 15 to 40 sites in western Lake Erie from early April through late June 1995 (Roseman et al. 1996). A flow meter was positioned in the center of the net opening to record the volume of water sampled. The net was towed in the upper 2 m of the water column at approximately 1 m/sec for 5 min and usually filtered 600 m$^3$ of water during each tow. Fish larvae were preserved in 95% ethanol and identified following Auer (1982). Total length (TL), standard length (SL), and preserved wet weight (WW) were recorded for each fish.

**Results**

Deepwater sculpin larvae (21) were collected in entrainment samples at the Belle River Power Plant on the St. Clair River from 11 April through 21 May 1990 and ranged in size from 11 to 19 mm TL (Jude 1991). Deepwater sculpin were collected in the river in front of the power plant over a narrow period of time, 1 to 16 May 1990, and they ranged from 12 to 19 mm TL (mean = 15.5).

In Lake Erie, a single deepwater sculpin larva (15.0 mm TL; 13.1 mm SL; 0.019 g WW) was collected at mid-day on 29 April 1995 in a sample taken between the 2-m and 4-m contours over Tous-saint reef where the water temperature was 8.3°C (Fig. 1). This sampling site is approximately 6 km NNE from Locust Point on the OH shoreline and 30 km south of the international shipping channel. A second deepwater sculpin larva (17.0 mm TL; 15.0 mm SL; 0.038 g WW) was collected at midday on 12 May 1995 from a site 0.2 km west of South Bass Island State Park where the water temperature was 10.1°C and depth ranged from 3 to 5 m (Fig. 1). This site is approximately 30 km south of the international shipping channel. Identification of both specimens was verified and the specimens archived at the University of Michigan Museum of Zoology in Ann Arbor, Michigan. They are catalogued UMMZ 231324 and 231323, respectively.

**Discussion**

This is the first report of deepwater sculpin in western Lake Erie. Emery (1976) stated that the deepwater sculpin (fourhorn sculpin) was present in all of the Great Lakes except Lake Erie. Cooper et al. (1981) reported the collection of larval *Cottus* species from western Lake Erie waters, but did not report *Myoxocephalus*. Neither adult nor juvenile deepwater sculpins have been observed in assessment surveys conducted by management agencies in western
Lake Erie in the past four decades (Personal communications: R. Haas, Michigan Department of Natural Resources, Mt. Clemens, Michigan; R. Knight, Ohio Division of Wildlife, Sandusky, Ohio; S. Nepszy, Ontario Ministry of Natural Resources, Wheatley, Ontario).

In Lake Michigan, deepwater sculpins hatched at 6 to 7 mm TL (Mansfield et al. 1983) and grew at a rate of about 6.3 mm/month during the pelagic stage (Nash and Geffen 1991, Geffen and Nash 1992). Using these size and growth data, both collected specimens were estimated to have hatched in mid to late March approximately 1.5 months prior to capture. Geffen and Nash (1992) reported that most deepwater sculpin from the 1983 age-group in Lake Michigan also hatched in March.

The deepwater sculpins from Lake Erie could have originated from three possible sources: in situ production by adults in Lake Erie, transport and discharge with ballast water of ships from the upper Great Lakes, or downstream drift from Lake Huron. Perhaps the least probable origin of the specimens is from reproduction of adult deepwater sculpins in the western basin of Lake Erie. This would require that a reproducing population of deepwater sculpins be extant in western Lake Erie or that adults migrated in from Lake Huron the previous year and spawned in Lake Erie producing these young. However, these fish would likely hatch sooner and grow faster than larvae from colder waters upstream. The existence of a reproducing population of deepwater sculpins in western Lake Erie would contradict much of the biological information that is available on this species. In the other Great Lakes, adults are found at depths greater than 50 m, and at water temperatures below 5°C (Becker 1983). In inland lakes of Canada, they are found only in deep lakes with hypolimnetic temperatures that do not exceed 8°C (Dadswell 1972). Although western Lake Erie has sufficient depth to support a population of deep-water sculpins, temperature is likely to exceed the 8°C limit in this region of the lake. Collection of adult deepwater sculpins from western Lake Erie is needed to confirm this possible explanation.

Alternatively, it is possible that these fish were transported from the upper Great Lakes via the ballast water of ships. Deepwater sculpin larvae are known to occupy the pelagic and littoral areas of Lake Michigan (Geffen and Nash 1992) and may have been taken into ship ballast and discharged into Lake Erie. This is the primary mechanism by which recently introduced species (i.e., Dreissenidae, round goby Neogobius melanostomus, tubenose goby Proterorhinus marmoratus) have spread in the Great Lakes (Jude et al. 1992, Mills et al. 1993). The primary international shipping lane is about 30 km north of the sites where the deepwater sculpin were collected and the shipping channel into the Maumee River at Toledo, Ohio, is about the same distance west. Prevailing wind and currents in western Lake Erie during April and May (Herdendorf and Braidech 1972) could transport fish from either of these locations to the sites where they were collected.

Deepwater sculpins are well established in Lake Huron (Scott and Crossman 1973, Emery 1976) and results from 1990 sampling indicate their presence in the St. Clair River. To drift from Lake Huron into western Lake Erie, fish would need to move down the St. Clair River, through Lake St. Clair, and down the Detroit River into western Lake Erie. The minimum distance for this trip is 250 km, the last 50 km of which is from the mouth of the Detroit River to Toussaint Reef. Current velocity in the St. Clair River is high (6.0 km/hr) and flow time from Port Huron to Lake St. Clair is about 21 h (Derecki 1984). Mean current velocity in western Lake Erie is 0.15 m/sec (Herdendorf and Braidech 1972) and is generally in an easterly direction. At a mean transport velocity of 0.1 m/sec, the fish would need approximately 6 days to travel the final 50 km. Given the estimated hatching date for these fish (mid-March), it is plausible that they could have originated in Lake Huron and drifted as embryos or larvae from Lake Huron into Lake Erie.

In support of this hypothesis, Hatcher and Nester (1983) reported the collection of several deepwater sculpin larvae from the St. Clair and Detroit rivers in 1977 and 1978. They identified deepwater sculpin larvae in samples collected from Port Huron, Michigan downstream as far as Grosse Isle in the Detroit River in both years. While most larvae were collected in April and May of both years, they did identify some deepwater sculpin larvae in
samples collected in late July 1977. Hatcher and Nester (1983) concluded that these deepwater sculpin larvae were derived from populations that spawned in Lake Huron. The deep central and eastern basins of Lake Erie offer colder refuge for deepwater sculpin than the western basin. Based on information about deepwater sculpins in other lakes, it is possible that fish transported from upstream sources could survive in the deeper basins of Lake Erie and eventually result in a viable population. To speculate even further, downstream transport of fish may explain the occasional occurrences of deepwater sculpin in Lake Ontario. The species was extirpated in the 1950s (Christie 1972) but has been collected intermittently in the lake since that time. The most recent collection occurred in 1996 when three adult deep-water sculpins were collected (J. Casselman, Ontario Ministry of Natural Resources, Picton, Ontario, personal communication).

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