Note

First Occurrence of a Juvenile Chain Pickerel (*Esox niger*) in Ontario Waters of Lake Ontario

Brian P. Morrison[1, 2, 4] and Daniel J. Moore[3]

[1]Ganaraska Region Conservation Authority, 2216 County Road 28, Port Hope, Ontario L1A 3V8 Canada
[2]Current address: 2620 Farmcrest Avenue, Peterborough, Ontario K9L 1H7 Canada
[3]Central Lake Ontario Conservation Authority, 100 Whiting Avenue, Oshawa, Ontario L1H 3T3 Canada
[4]Corresponding author: brianmorrison@trentu.ca

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This paper documents the first juvenile Chain Pickerel (*Esox niger*) captured in Ontario waters of Lake Ontario. It was found during August 2016 monitoring activities at Port of Newcastle. Its occurrence represents a significant westward range expansion from recently documented adults in the eastern basin of Lake Ontario/Bay of Quinte/St. Lawrence River, likely colonizing from United States waters of Lake Ontario.

Key Words: *Esox niger*; Chain Pickerel; range expansion; Ontario; Lake Ontario

Introduction

Chain Pickerel (*Esox niger*) is a small- to medium-sized (adult total length 381–762 mm), largely piscivorous member of the pike family (Esocidae), which usually inhabits lakes and large rivers with associated submerged aquatic vegetation and water depths of less than 3 m (Scott and Crossman 1998). Its native range is principally the Atlantic coastal plains, including parts of the St. Lawrence River, the New York (south) shore of Lake Ontario, and portions of Quebec. It is considered naturalized in New Brunswick, Nova Scotia, and other parts of Quebec (Greeley 1939; Coffie 1998; Page and Burr 2011; Carlson *et al.* 2016), with introductions expanding its range west of this (Coffie 1998).

Chain Pickerel has been widely introduced as a sport fish and has subsequently expanded its range in many parts of the United States and eastern Canada (Coffie 1998). Adult Chain Pickerel, native to the United States waters of Lake Ontario (Holm *et al.* 2009), were first confirmed in the eastern basin of Lake Ontario between 2008 and 2010 (Hoyle and Lake 2011). Adult Chain Pickerel have continued to be present in the upper St. Lawrence/eastern Lake Ontario basin (J. Hoyle, personal communication), with evidence of natural reproduction on the New York side of the eastern basin of Lake Ontario (Carlson *et al.* 2016). Hoyle and Lake (2011) speculated that range expansion west of the Bay of Quinte may be more difficult because the shoreline is largely devoid of warm, vegetated waters.

This paper documents the first occurrence of a juvenile Chain Pickerel in Canadian waters of Lake Ontario and a significant range expansion to the north shore of Lake Ontario.

Methods

Annual monitoring occurs across a series of Lake Ontario coastal wetland habitats as part of the Durham Region Coastal Wetland Monitoring Program (DRCWMP) and Bay of Quinte Remedial Action Plan. Sixteen wetlands are sampled annually in the Durham region and 15 wetlands are sampled on a 3-year rotation in the Bay of Quinte (Figure 1). The DRCWMP protocol is used at both locations; it notes fisheries, vegetation, and chemical characteristics of each wetland at the time of sampling (Environment Canada and Central Lake Ontario Conservation Authority 2007; Moore 2016).

Fishes are sampled via boat electrofishing along a linear transect, with six sampling points located 8 m apart, resulting in approximately 4-m-diameter sampling points along the 44-m transect. Each point along the transect is sampled for 20 electrofishing seconds, with one crew member netting all fishes for later processing. Genetic species identification was conducted by barcoding at the CO1 mitochondrial gene and cross-referencing sequences with the GENBANK database.

Results

On 22 August 2016, a 153-mm total length, 19-g juvenile Chain Pickerel (Figure 2) was captured by boat electrofishing at Port of Newcastle wetland (43°53'50.0172"N, 78°34'37.7322"W) during annual monitoring activities. The fish was considered a juvenile based on its size. It was preserved in 95% ethanol and sent to the Royal Ontario Museum for verification (ROM 101354).

The specimen had 15 branchiostegal rays, fully scaled gill covers, a prominent suborbital bar that does not slope backward, four pores on the ventral side of each mandible, and snout length greater than the distance from back of eye to top of gill slit (Table 1). In addition, DNA was extracted from the Chain Pickerel and it was positively identified using the GENBANK database, i.e., the CO1 mitochondrial gene (barcode) matched other Chain Pickerel sequences (799 base pairs

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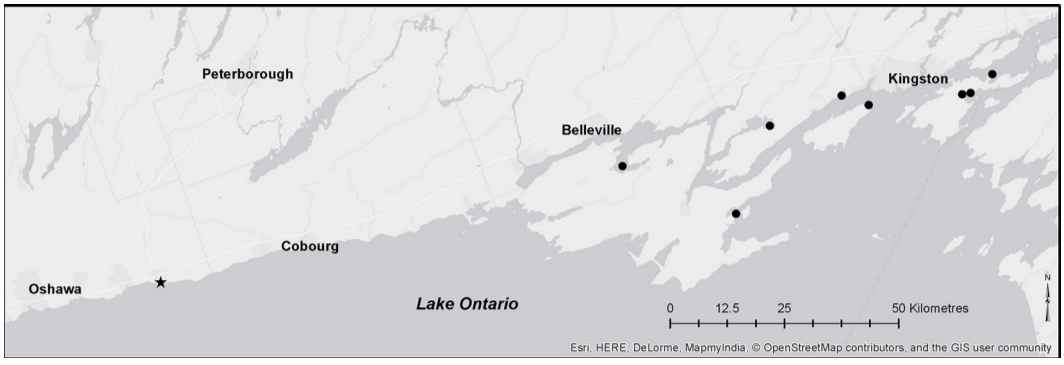

FIGURE 1. Location of juvenile Chain Pickerel (*Esox niger*) captured at Port of Newcastle (star) and recent adult Chain Pickerel captures in the Bay of Quinte and eastern basin of Lake Ontario (black dots).

FIGURE 2. First juvenile Chain Pickerel (*Esox niger*) caught in Ontario (total length 153 mm). Photo: B. Morrison.

of 802 matched; E. Holm and H. Haddrath, personal communications). Subsequent supplemental monitoring on 1 September 2016, using both boat electrofishing and seining, failed to detect any additional specimens.

Other fish species captured on 22 August 2016 in the Port of Newcastle wetland included Common Carp (*Cyprinus carpio*), Johnny Darter (*Etheostoma nigrum*), Largemouth Bass (*Micropterus salmoides*), Pumpkinseed (*Lepomis gibbosus*), Rock Bass (*Ambloplites rupestris*), and Round Goby (*Neogobius melanostomus*). Turbidity and conductivity in this coastal wetland were 5–15 nephelometric turbidity units (NTU) and 300–500 µS/cm, respectively, based on sampling in 2016 and earlier. Total aquatic plant cover at this location was around 60% and included Curly-leaved Pondweed (*Potamogeton crispus* L.), Eurasian Water-milfoil (*Myriophyllum spicatum* L.), Small Pondweed (*Potamogeton pusillus* L.), and Leafy Pondweed (*Potamogeton foliosus* Rafinesque). The substrate was quite coarse, consisting of a mix of contents from old gabion baskets and silt/sand. Aquatic vegetation throughout the marsh was inter-

TABLE 1. Identification features of Ontario esocids.

Species	No. branchiostegal rays	Gill cover	Suborbital bar	No. lower jaw pores
Chain Pickerel (*Esox niger*)	14–17	Fully scaled		8 (4 on each side)
Grass Pickerel (*Esox americanus vermiculatus*)	11–13	Fully scaled	Prominent	8 (4 on each side)
Northern Pike (*Esox lucius*)	14–15	Partly scaled		10 (5 on each side)
Muskellunge (*Esox masquinongy*)	16–19	Partly scaled		12–18 (6–9 on each side)

spersed with pockets of well-vegetated areas, but most of the area had little cover. Port of Newcastle is considered a drowned river mouth; a portion has been dredged for a marina.

Discussion

Chain Pickerel is believed to be native in New York waters of Lake Ontario (Carlson *et al*. 2016, and references within), but it has recently colonized Ontario waters in the eastern basin and upper St. Lawrence River, with increasing abundance in the former (Hoyle and Lake 2011). The capture of this Chain Pickerel is significant, as it is both the first juvenile captured, and its location was more than 100 km west of the closest record in Ontario waters.

Chain Pickerel have remained elusive in the Lake Ontario basin despite significant sampling in warm, highly vegetated habitats. Since 2002, 185 wetland sampling events have been completed in the Durham region and 50 in the Bay of Quinte under the DRCWMP. In addition, other agencies, largely the Ontario Ministry of Natural Resources and Forestry, carry out sampling in the Bay of Quinte using numerous gear types, and commercial fisheries expend a large amount of effort in the bay (Ontario Ministry of Natural Resources and Forestry 2016). Although significant wetland sampling occurs in the Durham region, limited sampling is done in adjacent Lake Ontario nearshore waters. The absence of adult records in the Durham region could be attributed to low abundance, a low sampling effort in areas with water depth greater than 2 m, and the timing of DRCWMP sampling, i.e., after adult fish have spawned and left wetland habitats (Environmental Canada and Central Lake Ontario Conservation Authority 2007; Sauvanet *et al*. 2013). Samarasin *et al.* (2017) have noted that sampling effort should be greater (either single or replicate sampling) in areas with more species and in larger wetlands to improve chances of detection. In addition to varying effort, challenges differentiating juvenile Chain Pickerel from other Esocidae could be complicating the recognition of range expansion.

Range expansion is difficult to monitor because of the rarity of a species at its leading edge and the potential for misidentification and hybridization with similar species. Although, not certain, it is unlikely that this specimen was introduced (e.g., via bait bucket or aquarium release); thus, this capture is likely evidence that the range of the Chain Pickerel is expanding westward in Ontario and that natural reproduction may have occurred in the Port of Newcastle wetland. It is unclear what role a significant drought in 2016 may have played in forcing fishes out of small coastal wetlands and concentrating them in larger wetland complexes with easy access from Lake Ontario, such as Port of Newcastle. Continued monitoring, with increased emphasis on areas that have been poorly sampled, should help determine abundance and confirm natural reproduction of Chain Pickerel in the Ontario waters of Lake Ontario.

Although the captured specimen appears to be a pure Chain Pickerel, it is possible that hybrids between Chain Pickerel and Northern Pike (*Esox lucius*) maybe present. Such a hybrid would be difficult to identify, and we recommend that any *Esox* that is not clearly a Northern Pike or Grass Pickerel be preserved and a tissue sample saved for genetic analysis. Specimens and tissues can be submitted for identification to the Royal Ontario Museum.

Limitations on the Chain Pickerel's range expansion are thought to be related to water temperatures and the amount of suitable habitat. Mandrak (1989) predicted that climate warming might lead to further expansion and establishment of Chain Pickerel in Ontario waters of Lake Ontario or connected waterbodies. Hoyle and Lake (2011) indicated that the lack of warm, heavily vegetated habitats in portions of Lake Ontario could create physical barriers to Chain Pickerel dispersal. Although the north shore of Lake Ontario has limited habitat for Chain Pickerel, the fish appears to have bridged this barrier. It is unknown how such habitat features affect dispersal of Chain Pickerel at various life stages or what mechanisms prompt movement or colonization. It is also not known what impact this species might have on existing fish communities, its potential for hybridization with other Esocidae (e.g., *E. lucius*), or its effect on recreational and commercial fisheries. Chain Pickerel have been implicated in simplifying fish communities, reducing overall fish abundance, and truncating the size spectrum of fishes in waterbodies where it has been introduced (Mitchell *et al.* 2010), but these effects may be muted because piscivorous species are already present in the existing fish community. Continued monitoring is encouraged to track the continued presence and establishment of Chain Pickerel in Ontario waters.

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