

Short communication

The invasive round goby *Apollonia melanostoma* (Actinopterygii: Gobiidae) – a new intermediate host of the trematode *Neochasmus umbellus* (Trematoda: Cryptogonimidae) in Lake Erie, Ohio, USA

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Introduction

Trematodes belonging to the genus *Neochasmus* van Cleave and Müller, 1932 are common intestinal parasites of fishes and reptiles (Hoffman, 1999). Four species comprise this genus in North American waters: *Neochasmus ictaluri* Sogandares-Bernal, 1955; *N. olmecus* Lamothe-Argumedo et al., 1989; *N. sogandaresi* Overstreet, 1971; and *N. umbellus* van Cleave and Müller, 1932 (Hoffman, 1999). Of these, *N. umbellus* is the sole species that has been described to parasitize fishes in Lake Erie of the Great Lakes (Dechtiar and Nepszy, 1988). The metacercariae of *N. umbellus* are located in the muscles of relatively small-sized fishes [including the emerald shiner *Notropis atherinoides* (Rafinesque, 1818), johnny darter *Etheostoma nigrum* (Rafinesque, 1820), and blackside darter *Percina maculata* (Girard, 1859)]. Adult *N. umbellus* are commonly found in piscivorous fishes [e.g. the least darter *Etheostoma microperca* Jordan and Gilbert, 1888; tessellated darter *E. olmstedii* Storer, 1842; smallmouth bass *Micropterus dolomieu* Lacépède, 1802; white perch *Morone americana* (Gmelin, 1789); white bass *M. chrysops* (Rafinesque, 1820); and yellow bass *M. mississippiensis* Jordan and Eigenmann, 1887] (Muzzall and Peebles, 1987; Dechtiar and Christie, 1988; Dechtiar and Nepszy, 1988; McLaughlin et al., 2006). The first intermediate host of this parasite is unknown. A progenetic life cycle, in which the reproductive organs of the parasite develop during the metacercariae stage (Poulin and Cribb, 2002), is typical for *N. umbellus* (McLaughlin et al., 2006).

The round goby *Apollonia melanostoma* (Pallas, 1814), formerly known as *Neogobius melanostomus* (Stepien and Tumeo, 2006), is a Ponto-Caspian fish species that invaded the Great Lakes in the early 1990s via ballast water (Jude et al., 1992). Parasites of the round goby in the Great Lakes are

poorly studied to date. Investigations of round goby parasites by Muzzall et al. (1995), Pronin et al. (1997), and Camp et al. (1999) focused on specimens from Lake St Clair, the St Clair River (the original area of the round goby introduction), and southern Lake Michigan; and did not document *Neochasmus* trematodes.

Materials and methods

Fishes were sampled using seines in Maumee Bay of Lake Erie off the City of Oregon, Ohio, USA (41°41.423'N, 83°23.953'W), in October–November 2006. Specimens included 30 round goby *A. melanostoma*, 15 white perch *M. americana*, 17 white bass *M. chrysops*, and 10 emerald shiner *N. atherinoides*. Specimens were measured (standard length, SL), killed, and immediately examined.

The skin, fins, gills, muscles, brain, eyes, gut, liver, spleen, kidneys, body cavity, and mesentery were examined for metazoan parasites. The metacercariae were first isolated from cysts. Parasite larvae and adults were fixed in heated 70% ethyl alcohol, stained in acetic carmine, dehydrated in a series of increasing alcohol concentration and then mounted in Canada balsam for species identification. Parasitological indices were calculated according to Bush et al. (1997), including prevalence (P, %), intensity (as intensity range, IR), mean intensity (MI), and abundance (A). The standard deviation (SD) of the parameter mean values (M) was calculated.

Results and discussion

Metacercariae were identified in muscle, eye, and brain tissues of the round goby, as well as in muscles of the emerald shiner

Table 1

Neochasmus umbellus parasitism of Lake Erie fishes (October–November 2006), including number of each host species examined (n), mean standard length (SL, cm) of the host ± its standard deviation (SD) and range, tissue location of the parasite, number of fish of each species infected (N), along with the parasite's prevalence (P, %), intensity range (IR), mean intensity (MI ± SD), and abundance (A)

Host species	n	SL ± SD (range)	Location	N	P, %	IR	MI ± SD	A
<i>Apollonia melanostoma</i>	30	5.4 ± 1.4 (2.6–10.5)	Muscles	16	53.3	1–18	7.2 ± 5.4	3.8
			Eyes	3	10.0	1–2	1.7 ± 0.6	0.2
			Brain	1	3.3	1	1.0	0.03
<i>Morone americana</i>	15	16.3 ± 1.1 (14.3–18.2)	Intestine	2	13.3	1	1.0 ± 0.0	0.1
<i>M. chrysops</i>	17	22.9 ± 8.2 (5.5–29.0)	Intestine	14	82.4	19–218	97.6 ± 61.4	80.4
<i>Notropis atherinoides</i>	10	4.3 ± 1.2 (3.2–6.5)	Muscles	10	100.0	5–17	10.1 ± 4.2	10.1

(Table 1). The round goby was found to be a newly described host for *Neochasmus umbellus*. The muscles were the predominant location for metacercariae, that rarely appeared in the brain or eyes. The round goby appeared to be less infected than were shiners. According to published data, shiners *Notropis* spp. and darters *Etheostoma* spp. are the most common hosts of metacercariae (Muzzall and Peebles, 1987; McLaughlin et al., 2006). The metacercariae often are found in many other smaller-sized fishes, but rarely occur in predatory fishes, such as yellow perch *Perca flavescens* (Mitchill, 1814) and smallmouth bass *Micropterus dolomieu* (Carney and Dick, 2000; McLaughlin et al., 2006).

Adult *N. umbellus* were identified in the intestines of Moronidae (white bass and white perch; Table 1). Examination of white perch specimens yielded only two immature specimens of *N. umbellus* in the gut. However, white bass specimens were infected with greater numbers of *N. umbellus* (Table 1). According to several authors (Dechtiar and Christie, 1988; Dechtiar and Nepszy, 1988; also see van Cleave and Müller, 1934; Bangham and Venard, 1942; McReynolds and Webster, 1980; Anthony, 1985), the white bass is one of the most heavily parasitized fishes in the Great Lakes. In the Canadian waters of Lake Erie and Lake Ontario, the white bass has been noted as the sole host of *N. umbellus* (Dechtiar and Christie, 1988; Dechtiar and Nepszy, 1988). Thus, the white bass appears to be the primary definitive host of this parasite.

The metacercariae of two species belonging to the Cryptonimidae family are common parasites of the round goby in its native habitats in the Black Sea basin, including *Metadena pauli* (Vlasenko, 1931) and *Timoniella imbutiforme* (Molin, 1859) (Naidenova, 1974; Kvach and Korniyuchuk, 2002; Kvach, 2005). Those parasites appear ecologically similar to *N. umbellus* (i.e., are located mostly in muscles and rarely in the eyes or brain). Thus, in their new invasive habitat, the round goby is infected by a species of parasite that appears ecologically analogous to parasitic species in its native range. In both its native and exotic habitats (Black Sea and Lake Erie), the round goby is not the main host of the trematodes. In the Black Sea, the main definitive host of *T. imbutiforme* is the pipefish *Syngnathus typhle* L., 1758, and the main second intermediate hosts are small gobiids belonging to the genus *Pomatoschistus* that are consumed by the pipefish. Because large-sized gobies cannot be consumed by the pipefish for food, the round goby host thus prevents the metacercariae from completing their life cycle (i.e., the goby grows too large to be eaten by the pipefish). In Lake Erie, a similar situation may occur with *N. umbellus*. The main hosts of the *N. umbellus* metacercariae are shiners and darters, in whose muscles the larvae develop to maturity. In our study, round goby samples housed metacercariae without developed sexual organs. Further study from additional sampling sites is recommended to determine whether any of these parasites develop sex organs in the round goby, in Lake Erie or other areas of the Great Lakes. Shiners are common prey for white bass (the main definitive host of *N. umbellus*), which also consume a variety of other small fishes, including the round goby. However, since many round gobies are larger than shiners, it is possible that the round goby may circumvent more of the metacercariae from completing their life cycle.

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