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*Research Note*

# Helminths of the Round Goby, *Neogobius melanostomus* (Perciformes: Gobiidae), from Southern Lake Michigan, Indiana

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ABSTRACT: Round gobies (*Neogobius melanostomus*) were collected from Hammond Marina and Calumet Harbor, southern Lake Michigan, Indiana, and examined for helminths. Sixty-four gobies were collected at Hammond Marina and 245 gobies and 4 sculpins were collected from Calumet Harbor. Larval helminths recovered from gobies included *Diplostomum* sp. and *Eustrongylides* sp. *Acanthocephalus dirus* (Van Cleave, 1931) was the only other parasite found. *Diplostomum* sp. was only found in gobies from Calumet Harbor, but *A. dirus* and *Eustrongylides* sp. were found in gobies from both collection sites. Parasite species richness, prevalence, mean intensity, and mean abundance were low in gobies. Parasite species found in gobies have been found previously in native fish species in the Great Lakes.

KEY WORDS: round goby, *Neogobius melanostomus,* introduced species, helminths, southwest Lake Michigan, Indiana, *Acanthocephalus dirus, Diplostomum* sp., *Eustrongylides* sp.

The round goby, *Neogobius melanostomus,* was introduced into the Great Lakes between 1986 and 1988 (Jude et al., 1992) probably from the Black Sea to the St. Clair River or Lake St. Clair in the ballast water of transoceanic freighters. The round goby is merely one of numerous animal species that have been introduced into the Laurentian Great Lakes (Mills et al., 1993). Jude et al. (1992) discussed the impact of round gobies on native fish species and suspected that native sculpins may be significantly impacted because they share similar resource requirements with the more aggressive gobies. The round goby appears to have established dense populations (Jude et al., 1992), leading to a decline in local native species (Crossman et al., 1992).

Muzzall et al. (1995) reported that all species of parasites of the round goby and tubenose goby, *Proterorhinus marmoratus,* from the St. Clair River and Lake St. Clair, Michigan, had been previously reported from other fish species in the Great Lakes and suggested that no parasites from the Black Sea had become established when the gobies were introduced to the Great Lakes. However, the following fish pathogens and parasites have been introduced into the Great Lakes: the myxosporean *Myxosoma cerebralis,* which causes whirling disease in salmonids, the microsporidian *Glugea hertwigi,* which infects rainbow smelt, and the bacterium *Aeromonas salmonicida,* which causes furunculosis (Mills et al., 1993).

The purpose of this study was to determine which parasite species were being recruited as the round gobies spread into southern Lake Michigan. We wanted to determine if the gobies were recruiting parasites found in native fish species, as found by Muzzall et al. (1995), and if parasites from Eurasia had become established in the gobies.

Divers utilizing SCUBA netted gobies in southern Lake Michigan from 2 sites. From June through October 1995, gobies were collected from Hammond Marina (41°69′N, 87°51′W). From May through October 1996 and June through October 1997, they were collected from Calumet Harbor (41°72′N, 87°52′W). The Hammond Marina site was used only during 1995 because the site was destroyed by human development in 1996. The 2 sites were approximately 4 km apart along the southwestern shore of Lake Michigan. Fish were collected near shore in water depths ranging from 2 to 8 m. Gobies were transported alive to the laboratory, where they were euthanized with MS-222. At necropsy, they were weighed and measured (total length), and sex was determined. The location of collection, number of fish examined, and weight and

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**Table 1. Prevalence (PR), mean (±SD) intensity (I) and (A), and number of helminths found in *Neogobius melanostomus* from southern Lake Michigan, 1995, 1996, and 1997.**

| Parasite | Calumet Harbor ($n$ = 245) PR | I | A | No. worms recovered (range) | Hammond Marina ($n$ = 64) PR | I | A | No. worms recovered (range) | Site |
|---|---|---|---|---|---|---|---|---|---|
| Digenea | | | | | | | | | |
| *Diplostomum* sp. | 6.1 | 4.5 ± 5.3 | 0.3 ± 0.5 | 67 (1–21) | | | | | lens |
| Acanthocephala | | | | | | | | | |
| *Acanthocephalus dirus* | 2.4 | 1.0 | 0.2 ± 0.5 | 6 | 4.7 | 1.3 ± 0.6 | 0.06 ± 0.01 | 4 (1–2) | intestine |
| Nematoda | | | | | | | | | |
| *Eustrongylides* sp. | 0.5 | 1.0 | 0.004 ± 0.06 | 1 | 1.6 | 1.0 | 0.02 ± 0.1 | 1 | encysted in mesenteries |

total length ranges (followed by mean ± SD) are as follows: round gobies: Hammond Marina (Hammond, Indiana), $n$ = 64, 0.7–78.0 (10.7 ± 14.4) g, 2.0–19.5 (8.1 ± 3.0) cm; Calumet Harbor (Illinois–Indiana state line), $n$ = 245, 0.3–33.1 (5.3 ± 5.2) g, 3.3–13.3 (7.1 +1.8) cm; sculpins: Calumet Harbor (Illinois–Indiana state line), $n$ = 4, 4.1–14.2 (7.8 ± 4.6) g, 7.2–9.8 (8.3 ± 1.1) cm.

The skin, gills, eyes, orbits, peritoneal cavity, mesenteries, and peritoneal viscera were examined for parasites. Fish were examined within 24 hr of capture. Routine procedures were used to collect and process parasites. Terminology follows the definitions given by Bush et al. (1997). Voucher specimens of *Acanthocephalus dirus* and *Diplostomum* sp. were deposited in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland (USNPC 87778 and 87779, respectively).

The current study is the first to report parasites from naturalized gobies in southern Lake Michigan. *Acanthocephalus dirus, Diplostomum* sp., and *Eustrongylides* sp. were found in gobies from 1 or both sites (Table 1). *Diplostomum* sp. was found only in gobies from Calumet Harbor. All 4 sculpins were infected with *A. dirus* at the same mean intensity and mean abundance, 4.0 ± 2.4. The mean intensity, mean abundance, and prevalence of helminth species were too low to make any meaningful comparisons for sampling site, sex, or length of the gobies.

We found only 3 species of helminths compared with the 7 species found in round gobies by Muzzall et al. (1995). Additionally, we observed very low intensities of infection (Table 1). Muzzall et al. (1995) suggested that low intensities for most helminth species may result from the limited time the gobies have been present in the system. This explanation also applies to our results. Gobies were first reported from Hammond Marina and Calumet Harbor in 1994 (Charlebois et al., 1997). Our collections of gobies in Hammond Marina began 1 yr after they were first reported.

A second factor is the presence or absence of intermediate hosts that can serve to complete a parasite life cycle. Intermediate hosts may serve as food items for the gobies or may merely release larval stages that can infect the gobies. For example, snails of the genus *Lymnaea* serve as the first intermediate host for *Diplostomum* sp., and these snails may have been less common in Hammond Marina than in Calumet Harbor. *Acanthocephalus dirus* utilizes aquatic isopods (*Caecidotea* spp.) as intermediate hosts, and these isopods were not well represented in the gut contents of the gobies we examined. However, zebra mussels were a common food item in the gut of round gobies, as was found by Muzzall et al. (1995) and Pronin et al. (1997). Toews et al. (1993) reported very low prevalence and intensity of infection of zebra mussels with parasites from Lake St. Clair. We also examined 500 zebra mussels from southern Lake Michigan and found no parasites in them. Zebra mussels do not appear to be a significant source of infective stages of parasites.

In a similar study, Radomski et al. (1991) suggested that armadillos, *Dasypus novemcinctus,*

near the periphery of their geographic range have fewer species and lower numbers of helminths, whereas more established populations tend to have greater numbers and species richness. The round gobies in southern Lake Michigan are near the periphery of their distribution and exhibit lower mean intensities and species richness when compared with the gobies from the St. Clair River and Lake St. Clair.

The founding population in southern Lake Michigan was most likely small and would have carried few if any parasites (Marcogliese, 1992; Pronin et al., 1997). This latter phenomenon has been termed the geographic barrier hypothesis (Radomski et al., 1991).

Muzzall et al. (1995, p. 228) suggested that native species such as sculpins might also "have low intensities in similar niches and should be examined for comparative purposes." We collected 4 sculpins that were all infected with *A. dirus,* but the sample size was too small to make any meaningful comparisons with the present goby infection data. Although the sample size of sculpins was small, 1 female *A. dirus* found in a sculpin was gravid, suggesting that native sculpins can serve as a suitable host for *A. dirus.* However, the female *A. dirus* found in gobies were not gravid, so it is not known if gobies can serve as a suitable host.

Parasite species in the round gobies apparently did not arrive with the original goby colonizers of Lake Michigan but were acquired after their introduction to the lake. *Diplostomum* sp., *Eustrongylides* sp., and *A. dirus* have been previously reported from native fishes in the Great Lakes (Amin, 1977, 1985; Dechtiar et al., 1988). The larval *Diplostomum* sp. and *Eustrongylides* sp. infecting the gobies can mature in vertebrates found in the Great Lakes region (Muzzall et al., 1995). Although *Diplostomum* sp. has a widespread distribution (including the Black Sea watershed), it was most likely recruited locally as opposed to being introduced from the Black Sea.

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