

Larval Parasitic Nematodes Infecting Marine Crustaceans in Eastern Canada. 2. Passamaquoddy Bay, New Brunswick

DAVID J. MARCOGLIESE¹ AND M. D. B. BURT²

¹ Department of Fisheries & Oceans, Maurice Lamontagne Institute, P.O. Box 1000, Mont-Joli, Quebec, Canada G5H 3Z4 and

² Department of Biology, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 6E1

ABSTRACT: Four species of crustaceans were collected from Passamaquoddy Bay and vicinity and examined for parasitic nematodes using a pepsin digest in a modified Baermann apparatus. Sealworm (*Pseudoterranova decipiens*) and *Ascarophis* sp. were identified in a sample of 170 mysids (*Mysis stenolepis*) from Brandy Cove, New Brunswick. Eight *Paracuaria adunca* were found in 340 *M. stenolepis* from St. Croix Island, and 11 *P. adunca* also were found in 1,047 *Marinogammarus obtusatus* from Mohawk Island, new host records for this nematode. One specimen of *Tetrameres* sp. was also found in *M. obtusatus*.

KEY WORDS: sealworm, *Pseudoterranova decipiens*, *Paracuaria adunca*, *Ascarophis* sp., *Tetrameres* sp., mysid, *Mysis stenolepis*, amphipod, *Marinogammarus obtusatus*, Passamaquoddy Bay, Bay of Fundy.

Recent surveys show that infection levels of larval sealworm *Pseudoterranova decipiens* (Krabbe, 1878) (Nematoda: Ascaridoidea) are increasing in eastern Canada groundfish (McClelland et al., 1983a, b, 1987, 1990), and that infection levels in American plaice (*Hippoglossoides platessoides*) from the Bay of Fundy are among the highest in eastern Canada (McClelland et al., 1987). Passamaquoddy Bay, near the mouth of the Bay of Fundy, is home to large numbers of harbor seals (*Phoca vitulina*), definitive hosts of sealworm (Scott and Fisher, 1958).

As part of an ongoing study of the life cycle of *P. decipiens*, invertebrates from Passamaquoddy Bay, New Brunswick, were screened for nematode parasites, using a pepsin digest technique in a modified Baermann apparatus (Marcogliese, 1992). This bay was chosen as sampling site because of the high levels of sealworm in fish residing there, and because of the accessibility of seal haul-out areas, where heavily infected intermediate hosts might be found. The digestion technique permitted rapid screening of large numbers of invertebrates for parasitic nematodes, thus providing insight into the life cycles of various nematode species.

Materials and Methods

Invertebrates were collected with a 6-m beach seine with a 1-mm mesh or by hand near seal haul-out areas in Passamaquoddy Bay, New Brunswick, in May 1991. We seined 340 and 170 mysids (*Mysis stenolepis*) from St. Croix Island and Brandy Cove, respectively. Brandy Cove (45°05'N, 67°05'W) is situated near the mouth of the St. Croix River, which divides New Brunswick and Maine, and St. Croix Island (45°07.8'N, 67°08'W) is located 6.6 km upstream. At low tide, 1,047 am-

phipods (*Marinogammarus obtusatus*) were gathered from under rocks on Mohawk Island, a rocky outcropping frequented by harbor seals, and 300 amphipods (*Corophium volutator*) were picked by hand from an intertidal beach on Long Island. Mohawk Island (45°02.3'N, 66°54.3'W) is situated on the Fundy side of Letite Passage, one of the channels separating Passamaquoddy Bay from the Bay of Fundy. Long Island (45°08.8'N, 66°57.5'W) is located on the northeast side of the head of Passamaquoddy Bay in Digdequash Harbor. Sand shrimp (*Crangon septemspinus*) ($N = 353$) were collected by beach seine on St. Croix Island.

Crustaceans were sorted by species, counted, and placed in a modified Baermann apparatus containing 7 g pepsin, 4 ml concentrated HCl, and 6 g NaCl and 1,000 ml H₂O solution and fitted with a 1-mm sieve. The filtrate was examined periodically over a 24-hr period with a stereomicroscope, and all nematodes found were fixed in hot 5% glycerol in 70% ethanol. Nematodes were measured and identified using a Leitz Diaplan compound microscope equipped with a calibrated ocular micrometer.

Results

Digestion of 170 *Mysis stenolepis* collected from Brandy Cove yielded 1 third-stage sealworm larva and 1 larval *Ascarophis* sp. (Spirurida: Habronematoidea). Eight larval *Paracuaria adunca* (Nematoda: Acuarioidea) were found in the 340 *M. stenolepis* collected on St. Croix Island. Eleven larval *P. adunca* and 1 larval *Tetrameres* sp. (Spirurida: Habronematoidea) were found in the 1,047 *M. obtusatus* collected on Mohawk Island. No nematodes were found in 300 *Corophium volutator* from Long Island, nor in 353 *Crangon septemspinus* from St. Croix Island.

The sealworm from *M. stenolepis* possessed lip primordia, a boring tooth, an excretory pore

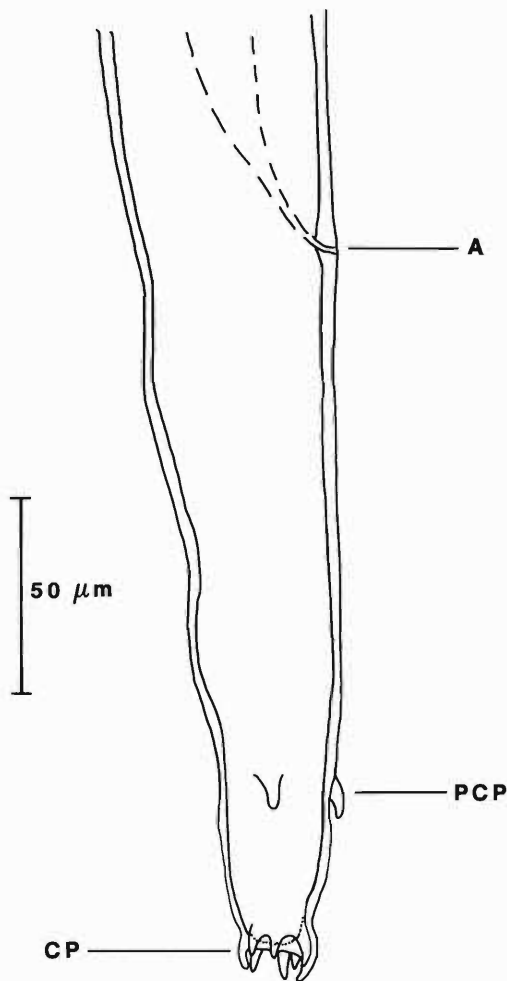


Figure 1. Diagram of posterior end of *Tetrameres* sp. found in *Marinogammarus obtusatus* collected from Mohawk Island, Bay of Fundy. A, anus; CP, caudal papillae; PCP, pre-caudal papillae.

at the anterior end, an intestinal cecum attached to the body wall at its distal end by a cecal ligament, and a tail mucron. The nematode was 2.784 mm in length, the preventriculus, ventriculus, and intestinal cecum, 0.406, 0.241, and 0.058 mm in length, respectively. The nerve ring was 0.132 mm from the anterior end, and the tail was 0.087 mm long. Measurements correspond to those of third-stage *P. decipiens* in McClelland (1990).

The single *Ascarophis* sp. from *M. stenolepis* was characterized by 2 lateral pseudolabia each bearing conical protuberances, 4 cephalic papillae, and 2 lateral amphids. This nematode measured 2.304 mm in length, the muscular esoph-

Table 1. Characteristic mean dimensions and standard error of 7 *Paracuaria adunca* from the mysid *Mysis stenolepis* and 11 *P. adunca* from the amphipod *Marinogammarus obtusatus* collected in Passamaquoddy Bay, New Brunswick in May 1991. Measurements of buccal cavity, nerve ring, and excretory pore reflect distance from anterior end. Ranges of measurements in millimeters are in parentheses.

Host	Length (position) of structure	
	<i>M. stenolepis</i>	<i>M. obtusatus</i>
Total length	2.642 ± 0.427 (1.984–3.040)	3.142 ± 0.302 (2.624–3.712)
Buccal cavity	0.097 ± 0.006 (0.087–0.106)	0.106 ± 0.008 (0.093–0.122)
Nerve ring	0.117 ± 0.005 (0.109–0.125)	0.127 ± 0.007 (0.116–0.138)
Excretory pore	0.159 ± 0.015 (0.141–0.177)	0.183 ± 0.011 (0.157–0.196)
Muscular esophagus	0.326 ± 0.024 (0.289–0.358)	0.368 ± 0.033 (0.302–0.425)
Glandular esophagus	0.886 ± 0.138 (0.691–1.067)	1.032 ± 0.065 (0.953–1.130)
Tail	0.082 ± 0.006 (0.071–0.092)	0.090 ± 0.006 (0.083–0.100)

agus, the glandular esophagus, and the tail, 0.151, 0.563, and 0.128 mm in length, respectively. The buccal cavity, nerve ring, and excretory pore were 0.067, 0.109, and 0.164 mm from the anterior end, respectively.

The specimen of *Tetrameres* sp. from *M. obtusatus* possessed 8 cuticular caudal papillae arranged in a circle and 2 papillae 0.039–0.045 mm from the posterior end (Fig. 1). The nematode was 1.760 mm in length, the muscular esophagus, the glandular esophagus, and the tail, 0.218, 0.466, and 0.141 mm in length, respectively. The buccal cavity, nerve ring, and excretory pore were 0.013, 0.138, and 0.176 mm from the anterior end, respectively.

All specimens of *P. adunca* possessed prominent triangular pseudolabia, interlabia, and 2 pairs of cephalic papillae. Measurements of *P. adunca* are presented in Table 1.

Representative specimens of *P. adunca* from *M. stenolepis* (#CMNP1992-0024) and *M. obtusatus* (#CMNP1992-0025) have been deposited in the Canadian Museum of Nature (P.O. Box 3443, Station D, Ottawa, Ontario, Canada K1P 6P4), as have the single specimens of *P. decipiens*, *Ascarophis* sp., and *Tetrameres* sp. (#CMNP1992-0023, -0026, and -0027, respectively).

Discussion

This is the first irrefutable record of a natural larval sealworm infection in the mysid, *Mysis stenolepis*. Sealworm was tentatively reported in other mysids previously, including *Mysis mixta*, *M. stenolepis*, and *Erythrope erythroptalma* (Scott and Black, 1960), and confirmed in *Neomysis americana* (Marcogliese, 1992) and *Mysis mixta* (Martell, 1992). *Mysis stenolepis* was shown to be susceptible to *Pseudoterranova decipiens* infection in the laboratory, but nematodes were subsequently destroyed by a hemolytic response (McClelland, 1990).

Larval *P. decipiens* also has been found in the gammaridean amphipod, *Marinogammarus obtusatus*, in the White Sea (Val'ter, 1987), but the parasite was not found in 1,047 *M. obtusatus* collected directly from a seal haul-out area in the Bay of Fundy. Possibly greater numbers of amphipods would have to be examined in order to detect the parasite. Larval sealworm has been found in a second amphipod species, the beach flea, *Americorchestia megalophtalma*, collected close to haul-out areas on Sable Island (Marcogliese, 1993), but strong tidal currents in the Bay of Fundy may carry eggs and free-living second-stage larvae away from seal haul-outs. The only infected crustacean, *M. stenolepis*, was collected in Brandy Cove, a populated area avoided by seals. Presence of infected mysids in this cove could be attributed to passive dispersal of eggs and infective stages by tidal currents.

Ascarophis is a cosmopolitan genus composed of 23 species, all of which infect a wide variety of marine and freshwater fish (Ko, 1986). Adults of a single ascarophid (Ko, 1986), *Ascarophis arctica* Poljansky, 1952, have been identified from 3 species of fish, the ocean pout (*Macrozoarces americanus*), the winter flounder (*Pleuronectes americanus*), and the rock gunnel (*Pholis gunnelus*) in Passamaquoddy Bay (Appy, 1981). Larval *Ascarophis* spp. are found primarily in decapods, including shrimp, lobsters, crabs, and hermit crabs (Uspenskaja, 1960; Uzman, 1967; Petter, 1970; Poinar and Kuris, 1975; Poinar and Thomas, 1976; Owens, 1987), but *A. pacificus* has been described from the amphipods *Anisogammarus kygi*, *A. tiuschovi*, and *A. ochotensis* and the isopod *Idothea ochotensis* (Tsimbalyuk et al., 1970). An unusual monoxenous form (*A. arctica*?) was found in *Gammarus oenicus* in the White Sea (Val'ter et al., 1987).

Paracuaria adunca and *Tetrameres* sp. parasitize birds as adults. Mature *P. adunca* are cosmopolitan in piscivorous birds (Wong and Anderson, 1982), and infective stages can be found in crustaceans inhabiting both freshwater (Anderson and Wong, 1982) and marine (Marcogliese, 1992) environments. The mysid (*Mysis stenolepis*) and amphipod (*Marinogammarus obtusatus*) are new intermediate host records for this acuarioid nematode. In general, measurements of *P. adunca* correspond to third-stage larvae except that total lengths of 3 of those from *M. stenolepis* and 10 from *M. obtusatus* were longer than those measured by Anderson and Wong (1982). However, all larvae were smaller than the fourth-stage larvae as indicated by Anderson and Wong (1982). The genus *Tetrameres* contains many species, 2 of which, *T. crami* Swales, 1933, and *T. fissispina* (Diesing, 1861), are widespread in North America (Wong et al., 1990). *Tetrameres crami* is known only from freshwater amphipods (*G. fasciatus*, *Hyaella azteca*) (Swales, 1936), but marine and freshwater invertebrates, including amphipods, isopods, cladocerans, ostracods, insects, flatworms, and oligochaetes are reported as intermediate hosts for *T. fissispina* (McDonald, 1969). Third-stage larvae of *T. crami*, with 9 papillae surrounding a central papilla on the posterior end (Swales, 1936), and *T. fissispina*, having a ring of 10 papillae (Garkavi, 1949), differ from our specimen of *Tetrameres*, which has a circle of 8 caudal papillae. However, the number of caudal papillae may not be a reliable taxonomic character, as third-stage larvae of *T. cardinalis* Quentin and Barre, 1976, possess 5–8 papillae (Quentin and Barre, 1976).

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