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VERSITA

New philometrids (Nematoda, Philometridae) from head tissues of two serranid fishes (*Epinephelus morio* and *Mycteroperca microlepis*) off Florida, northern Gulf of Mexico

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Abstract

A new species of nematode, *Philometra morii* sp. nov. (Philometridae), is described from males and gravid females collected from the mouth cavity of the red grouper, *Epinephelus morio* (Valenciennes) (Serranidae, Perciformes), from the northen Gulf of Mexico, off Florida, USA. The new species is characterized mainly by the length of spicules (84–90 and 72–87 µm) and the length (54 µm) and structure of the gubernaculum in the male, and by the presence of three large oesophageal teeth protruding from the mouth, the number and arrangement of small cephalic papillae (8 papillae in 4 pairs of external circle and 6 single papillae of internal circle), the length (1.09–1.50 mm) and structure of the oesophagus and two large papilla-like caudal projections, and by the length of their bodies (19.34–30.07 mm). *Philometra morii* is the third species of this genus reported from *E. morio* in the Gulf of Mexico, differing from the two previously described species, in addition to morphological features, by the site of infection in this host (mouth cavity and sinuses *vs* oculo-orbits or gonads). From the same region (northern Gulf of Mexico, off Florida), gravid females of *Philometra* Costa, 1845, morphologically and biometrically similar to those of *P. morii*, were found in the subcutaneous tissues and sinuses of the head of another serranid fish (gag), *Mycteroperca microlepis* (Good et Bean). Although their conspecificity with *P. morii* cannot be excluded, they have been designated as *Philometra* sp. until conspecific males are discovered and described. Based on light and scanning electron microscopy examination (latter used only for females), both these forms are described.

Keywords

Parasitic nematode, *Philometra*, marine fish, *Epinephelus*, *Mycteroperca*, Gulf of Mexico, Florida

Introduction

The nematode genus *Philometra* Costa, 1845 contains a large number of species parasitizing different freshwater, brackish-water and marine fishes. Despite that these parasites are usually pathogenic and occur frequently in commercially important wild and cultured fish hosts (Moravec 2006), the fauna of these nematodes parasitizing marine and brackish-water fishes in the western North Atlantic, including the Gulf of Mexico, is little known. In total, 16 species of *Philometra* have so far been reported from this region (Moravec 2006; Moravec and Salgado-Maldonado 2007; Moravec *et al*. 2008a, b, 2009a, b; Moravec and de Buron 2009a; Moravec and Bakenhaster 2010a, b), but records of some of them are probably based on misidentifications (see Petter and Radujković 1989, Moravec 2006).

During recent investigations into the status of Gulf of Mexico populations of the red grouper *Epinephelus morio* (Valenciennes), fish were found to commonly harbor two morphologically different nematode species of *Philometra*; whereas those found in the fish ovaries were males and females of *P. margolisi* Moravec, Vidal-Martínez et Aguirre-Macedo, 1995, a specific gonad-infecting parasite of *E. morio* (see Moravec *et al*. 1995, 1997), the nematodes located in the mouth cavity and sinuses proved to be representatives of a new species. Morphologically similar females of *Philometra* were also

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found in the subcutaneous tissues and sinuses of the head of the gag *Mycteroperca microlepis* (Goode et Bean) in the same region of the Gulf of Mexico (off Florida). Based on light and scanning electron microscopy examination (latter used only for females), both these forms are described herein.

Both *Epinephelus morio* (maximum body length 125 cm, weight up to 23 kg) and *Mycteroperca microlepis* (maximum body length 145 cm, weight 36.5 kg) are subtropical marine fishes distributed in the western Atlantic from North Carolina, USA to eastern Brazil, including the Gulf of Mexico, Caribbean, and Bermuda (Froese and Pauly 2010). The former species occurs from shallow waters (juveniles) to depths of 70–330 m (adults), and is especially abundant in the Gulf of Mexico on the Florida and Yucatan shelves (Bullock and Smith 1991). In the US, Mexico, and Cuba, this species is commercially very important, and in Florida where it is also important as a sport fish (434,226 kg recreational harvest in 2008 – National Marine Fisheries Service 2010), it is commercially the most valuable reef fish occurring in that state's waters (Heemstra *et al*. 2002). *Mycteroperca microlepis* is also the target of important sport and commercial fisheries in waters of the US coast and in the Gulf of Mexico, where it occurs in estuaries and seagrass beds (juveniles) to depths of 40–80 m (adults) (Heemstra *et al*. 2002).

Materials and methods

Parasites were opportunely removed from specimens of *E. morio* that were collected primarily from May and October of 2009, with a few supplemental specimens collected from July. Specimens of *M. microlepis* were collected from May through December of 2009. All hosts were collected as part of fisheries monitoring and research activities conducted by the Fisheries Independent Monitoring program (FIM) of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWC-FWRI). Sampling sites were in or near Tampa Bay or on the West Florida Shelf of the Gulf of Mexico, primarily from the Florida Middle Grounds (Fig. 1). Samplers used baited traps, seines, or hook and line to capture fish. Water quality measurements were taken with multiparameter water quality meters (Sea-Bird Electronics, Inc., YSI Incorporated, or Hach Company/Hydrolab) calibrated to the manufacturers' specifications and deployed to bottom depth. Immediately after capture fish were iced, until they could be measured and evaluated for parasites in laboratories either at FWC-FWRI in Saint Petersburg or aboard the University of South Florida's research vessle Weatherbird II.

All specimens were measured (standard length; SL) and evaluated for the presence of nematodes, which were macro-

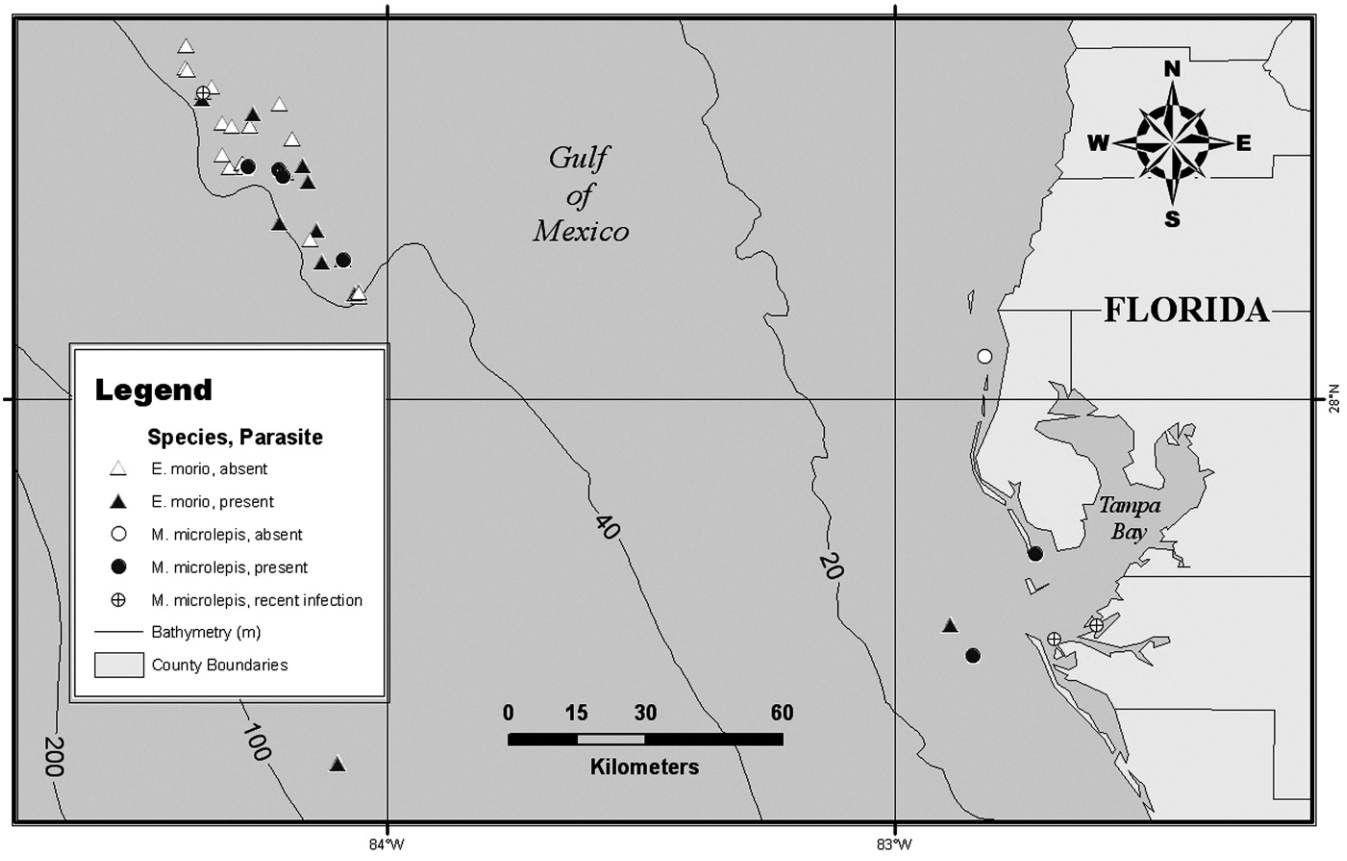

Fig. 1. Map of northeastern Gulf of Mexico showing sampling sites where specimens of the red grouper *Epinephelus morio*, and gag *Mycteroperca microlepis* were collected for evaluation of infection by *Philometra morii* sp. nov. and *Philometra* sp., respectively. Nematode presence, absence, or probable recent infections are indicated for each site

scopically visible either in subcutaneous tissue of the mouth or after dissection of anterior sinuses. Only female worms were considered in determining presence and intensity of infection because the males were very small and easily could have been missed. Prevalence was only determined for fish collected on sampling trips where more than one specimen of a host species was collected and all specimens examined for parasites were selected without preference for externally apparent infection. The Mann-Whitney Rank-Sum U test was used to check for differences in median SL of infected and uninfected specimens of *E. morio*.

Scalpels and forceps were used to cut and then tear host tissue away from subcutaneously encapsulated nematodes. Bone shears were used to dissect upper jaws and other bones and cartilage of the anterior skull to expose the sinus cavities. Fine forceps were used to excapsulate and transfer worms to dishes for rinsing. After rinsing, worms were placed in 70% ethanol or 5% phosphate buffered formalin. Tissues of the head and anterior trunk were masticated with heavy forceps in saline and evaluated under an Olympus SZ40 dissecting scope to check for the presence of males. For light microscopy (LM), nematodes were cleared with glycerine. Drawings were made with the aid of a Zeiss drawing attachment. After examination, the males of the new species were mounted in glycerine-jelly as slides, whereas all other type and voucher specimens were stored in vials with 70% ethanol. Specimens examined via scanning electron microscopy (SEM) were postfixed in 1% osmium tetroxide (in phosphate buffer), dehydrated through a graded acetone series, critical-point-dried and sputter-coated with platinum; they were examined using a JEOL JSM-7401F scanning electron microscope at an accelerating voltage of 4 kV GB low. All measurements are in micrometers unless otherwise indicated.

Results

In total, 52 specimens of *E. morio* were examined for infection by *P. morii*. These were collected at depths from 12 to 76 metres, salinities from 36.1 to 36.6, and temperatures from 21.1 to 29.4°C. Overall prevalence (considering only the 48 specimens that met our prevalence criteria, which were collected in May and October from the Florida Middle Grounds) was 35% and did not vary between spring and autumn samples. (May: n = 11 of 31; October: n = 6 of 17). Although uninfected hosts tended to be somewhat larger (median SL = 348.5 mm) than infected hosts (median SL = 325 mm) this difference was not significant (P = 0.270).

We evaluated 14 specimens of *M. microlepis*. These were collected at depths from 1.3 to 37 metres, salinities from 31.4 to 36.7, and temperatures from 18.7 to 30.4°C. Overall prevalence (considering only the 8 specimens that met our prevalence criteria, which were collected in May from the Florida Middle Grounds and in August from inside Tampa Bay) was 50%, but differed between the two sampling locations. Prevalence was 80% (n = 4 of 5) in May samples but live nematodes were not found infecting specimens collected from August (n = 3). However, all specimens collected from August showed encapsulations of size, shape, and location consistent with recent infection by *Philometra* sp. A specimen of *M. microlepis* collected about 10 kilometres off the mouth of Tampa Bay in late June was infected as were two specimens collected from the mouth of Tampa Bay in December.

***Philometra morii* sp. nov.** (Figs 2–4)

Description: Male (2 specimens; holotype; measurements of paratype in parentheses). Body filiform, whitish, 2.12 (1.81) mm long, maximum width 33 (33); width of cephalic end 24 (21), of caudal end 21 (24). Cuticle smooth. Cephalic end rounded, cephalic papillae indistinct. Oesophagus narrow, 390 (372) long, representing 18 (21)% of body length, with inflation at anterior end; posterior portion of oesophagus with well-developed, long oesophageal gland with large cell nucleus at middle. Oesophageal nucleus and nerve ring 291 (285) and 141 (117), respectively, from anterior extremity. Excretory pore (154) from anterior end of body. Testis reaching anteriorly to 396 (135) from anterior extremity. Posterior end of body blunt, with broad, U-shaped, lobular mound and with one pair of preanal and two pairs of postanal very flat and hardly visible caudal papillae. Spicules brownish, slender, needle-like, almost equally long (right spicule slightly longer), with somewhat expanded proximal and sharply pointed distal tips; length of spicules 84 (90) and 72 (87), representing 3–4 (5%) of body length. Gubernaculum narrow, 54 long, with approximately its proximal half somewhat dorsally bent; length of anterior bent part 33 (33), representing 61 (61)% of entire gubernaculum length; distal tip of gubernaculum pointed, with distinct reflected dorsal barb. Length ratio of gubernaculum and larger spicule 1:1.56 (1:1.67). Spicule and gubernaculum well sclerotized.

Gravid female (10 specimens; measurements of allotype in parentheses): Body of fixed specimens yellowish to brownish (live specimens red-coloured), somewhat tapering at both ends. Body 19.34–30.07 (23.71) mm long, its maximum width at middle 544–911 (544); maximum width/body length ratio 1:33–44 (1:44). Cuticle finely transversely striated. Cephalic end rounded, 109–122 (109) wide, with three distinctly protruding oesophageal teeth 6–15 (9–12) long; each tooth with small papilla-like tip and with inner surface bearing thin longitudinal keel; cephalic papillae very small, indistinct when viewed laterally. Oral aperture large, oval, surrounded by 14 small cephalic papillae arranged in two circles and slightly outlined lateral amphids; internal circle of papillae consisting of four submedian and two lateral single papillae, whereas external circle formed by four submedian pairs of papillae. Oesophagus including anterior bulbous inflation 1.09–1.50 (1.09) mm long, representing 4–6% (5%) of body length; bulb 87–105 (87) long and 90–102 (90) wide; muscular oesophagus posterior to bulb and not cov-

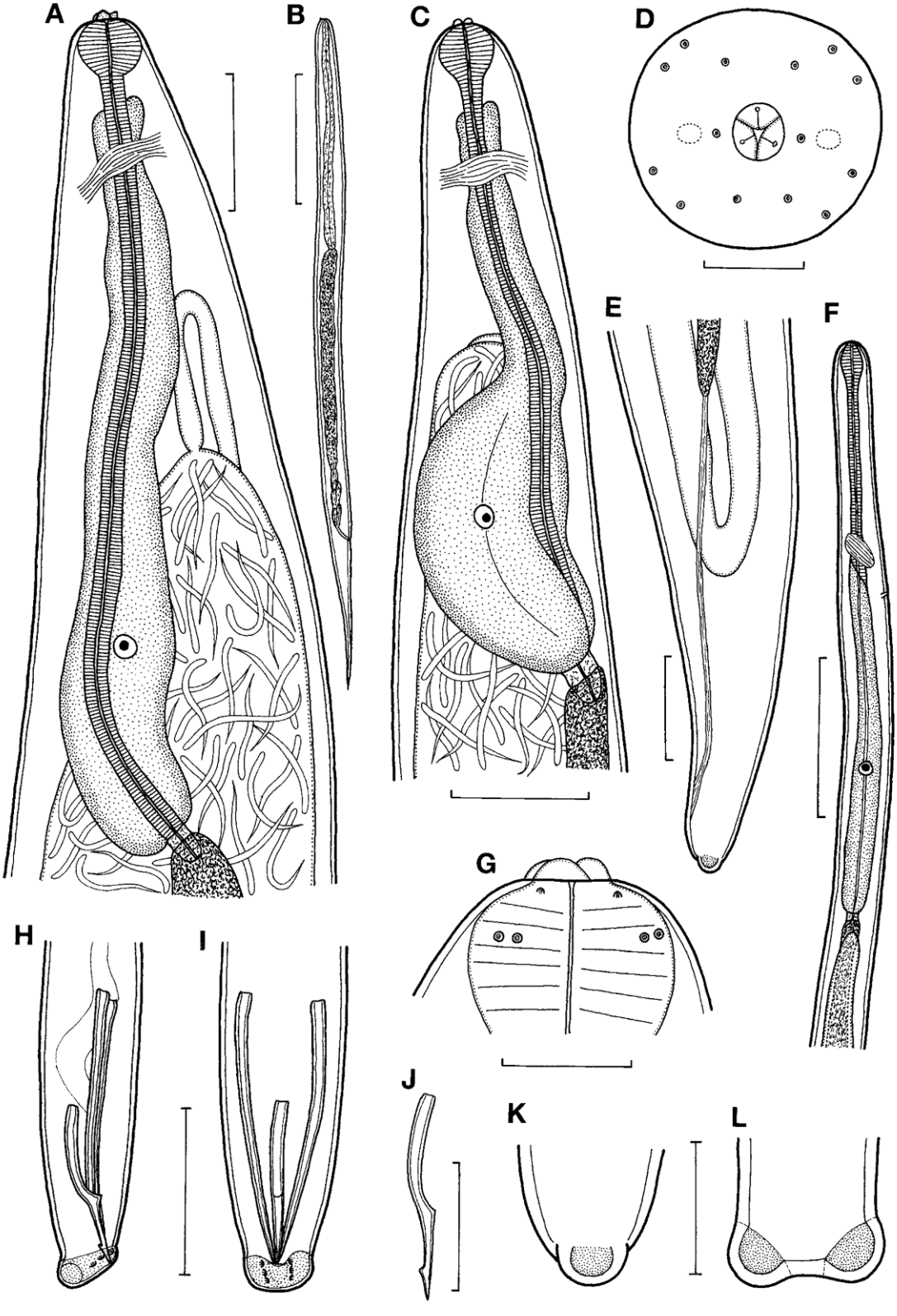

Fig. 2. *Philometra morii* sp. nov.: **A** – anterior end of largest gravid female, lateral view. **B** – first-stage larva from uterus. **C** – anterior end of smaller gravid female, lateral view. **D** – cephalic end of gravid female, apical view. **E** – posterior end of gravid female, lateral view. **F** – anterior end of male, lateral view. **G** – cephalic end of gravid female, lateral view. **H** and **I** – posterior end of male, lateral and ventral views. **J** – gubernaculum, lateral view. **K** and **L** – caudal end of gravid female, lateral and dorsoventral views. Scale bars = 200 μm (A, C), 100 μm (B, E-F), 30 μm (D, J) and 50 μm (G-I, K-L)

Fig. 3. *Philometra morii* sp. nov., posterior end of male, lateral view

ered by oesophageal gland 45–75 (45) long and 42–57 (57) wide. Oesophageal gland marked, extending anteriorly from posterior end of oesophagus to short distance posterior to bulb, thus exceeding considerably nerve ring anteriorly; large oesophageal gland nucleus 830–1,088 (830) from anterior extremity. Posterior half of oesophageal gland conspicuously expanded in most specimens. Maximum width of oesophagus at level of posterior half of oesophageal gland 204–272 (272), width at middle part of oesophagus 95–122 (95), at level of anterior end of oesophageal gland 82–95 (82). Nerve ring 216–279 (222) from anterior end of body. Small ventriculus 12–45 (18) long and 42–75 (42) wide present. Oesophagus opening into intestine through distinct valve. Intestine brown, narrow, ending blindly; its posterior end attached to body wall near caudal end by narrow ligament. Vulva and anus absent. Ovaries long, narrow, reflected, situated near body ends. Uterus occupying most space of body, filled with numerous larvae and eggs; anteriorly uterus not reaching level of nerve ring. Larvae (n = 5) from uterus 513–522 (–) long, maximum width 18–19 (–), length of oesophagus 189–195 (36–38% of body length), of sharply pointed tail 93–105 (18–20%). Posterior end of body with two large, lateral, rounded caudal projections 12–21 (12) long.

Type host: Red grouper, *Epinephelus morio* (Valenciennes) (Serranidae, Perciformes) (SL 187–650 mm).

Site of infection: Subcutaneous tissue of the buccal cavity and sinuses (just below buccal epithelium, sinus epithelium, internal cheek galleries, nasal cavity).

Type locality: West Florida Shelf of the northeastern Gulf of Mexico including the Florida Middle Grounds and shelf waters off Tampa Bay, Florida, USA (N 28.205633°, W 84.06273°; N 28.53608°, W 84.27053°; N 28.45420°, W 84.28097°; N 28.45845°, W 84.16432°; N 28.34583°, W 84.21132°; N 28.26860°, W 84.12718°; N 28.27257°, W 84.08603°; N 27.28152°, W 84.09575°; N 27.27993°, W 84.09582°; N 27.55267°, W 82.88778°; N 27.55293°, W 82.88657°; N 28.33245°, W 84.13885°; N 28.42883°, W 84.15410°; N 28.56178°, W 84.26385°; N 28.59000°, W 84.36422°; N 28.21068°, W 84.05413°).

Prevalence and intensity: 35%; 1–11 specimens per fish (female nematodes).

Deposition of specimens: Holotype, allotype and 10 female paratypes (N-934) in the Helminthological Collection of the Institute of Parasitology, Biology Centre of the ASCR, České Budějovice, Czech Republic; 14 paratypes (USNPC 102971 – male and USNPC 102970 – females) in the U.S. National Parasite Collection, Beltsville, Maryland, USA.

Etymology: The specific name *morii* relates to the scientific name of the host fish.

Comments: At present, *Philometra* comprises 94 valid species in total (Moravec 2006; Moravec and Salgado-Maldonado 2007; Moravec *et al*. 2007, 2008a, b, c, 2009a, b, c; Moravec and Justine 2008, 2009; Quiazon *et al*. 2008a, b; Caspeta-Mandujano *et al*. 2009; Moravec and de Buron 2009b; Moravec and Bakenhaster 2010a, b). These parasites exhibit a relatively high degree of host specificity, and individual species are characterized, in addition to morphological features and molecular sequence data, by the location of gravid females in the host (Moravec and Rohde 1992, Moravec 1994). According to Moravec (2006), Moravec *et al*. (2009c) and Moravec and Bakenhaster (2010a, b), of the 13 species with gravid females parasitic in the subcutaneous tissues, fins or the tissues of the buccal cavity, gill covers and gill arches of brackish-water and marine fishes, only four are located in the host's mouth.

Two of them are parasites of estuarine perciform fishes in South Carolina, USA: *P. cynoscionis* Moravec, de Buron et Roumillat, 2006 from the membranous area of mouth and "nose" of *Cynoscion nebulosus* (Cuvier) (Sciaenidae) and *P. overstreeti* Moravec et de Buron, 2006 from the capsules among teeth of *Paralichthys lethostigma* Jordan et Gilbert (Paralichthyidae). Gravid females of both these species (males are unknown) differ distinctly from those of *P. morii* sp. nov. in having conspicuously large cephalic papillae of the external circle and in the absence of oesophageal teeth and caudal projections. The other two species have recently been described from marine perciform fishes from the Gulf of Mexico: *P. brevispicula* Moravec et Bakenhaster, 2010 from the mouth

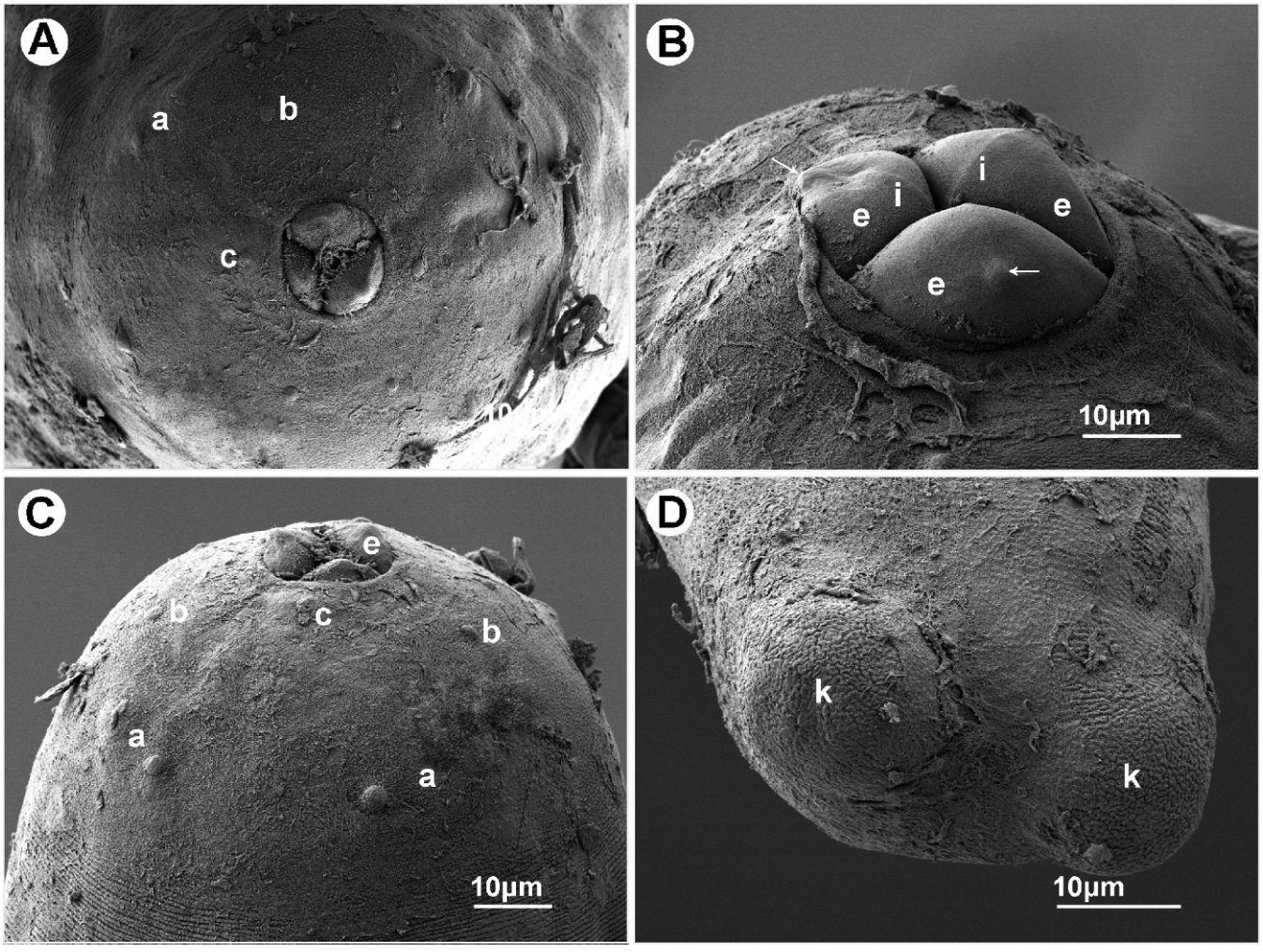

Fig. 4. *Philometra morii* sp. nov., scanning electron micrographs of gravid female: **A** – cephalic end, apical view. **B** – oral opening with oesophageal teeth (arrowheads indicate papilla-like tops of teeth). **C** – cephalic end, lateral view. **D** – caudal end, dorsoventral view. **Abbreviations:** a – pair of external cephalic papillae, b – submedian papilla of internal circle, c – lateral papilla of internal circle, e – oesophageal tooth, i – superficial keel on oesophageal tooth, k – papilla-like caudal projection

of *Lutjanus griseus* (Linnaeus) (Lutjanidae) and *P. diplectri* Moravec et Bakenhaster, 2010 mainly from the mouth, head tissues and the operculum of *Diplectrum formosum* (Linnaeus) (Serranidae). The former species differs from *P. morii* maily in having equal, markedly shorter spicules (45 *vs* 84–90 and 72–87) in male and in the absence of oesophageal teeth in gravid female, whereas the latter species in possessing conspicuously large external cephalic papillae and the absence of caudal projections in female.

A characteristic feature of gravid females of *P. morii*, found in all specimens, is the presence of three conspicuous oesophageal lobes (usually designated as teeth in philometrids) protruding from the mouth, by which it differs from almost all congeners. The only other species with large oesophageal teeth from a marine fish is *Philometra sydneyi* Rasheed, 1963 from the subcutaneous tissue of an unidentified "large white fish" from Australia (Rasheed 1963), but it differs from *P. morii* in having no caudal projections. Similar oesophageal teeth were recently described in *Philometra lati* Moravec, Charo-Karisa et Jirků, 2009 from the abdominal cavity of the Nile perch, *Lates niloticus* (Linnaeus) (Latidae, Perciformes), from Kenya (Moravec *et al*. 2009c); however, gravid females of *P. lati* are much longer (71–201 mm) and mostly without any caudal projections.

Males of most species of *Philometra* remain unknown mainly because of their small sizes and, therefore, their interspecific comparison may be problematic.

***Philometra* sp.** (Fig. 5)

Description: Gravid female (10 specimens; measurements of 7 subgravid specimens in parentheses). Body of fixed specimens yellowish to brownish (live specimens red-coloured), somewhat tapering at both ends. Body 26.00–52.00 (6.56–26.00) mm long, its maximum width at middle 612–843 (136–394); maximum width/body length ratio 1:35–76 (1:48–66).

Cuticle finely transversely striated. Cephalic end rounded, 105–117 (75–114) wide, with three distinctly protruding oesophageal lobes (teeth) 12–21 (6) long in four specimens; in all remaining specimens protruding oesophageal lobes indistinct. Cephalic papillae very small, indistinct when viewed laterally. Oral aperture large, oval, surrounded by 14 small cephalic papillae arranged in two circles and slightly outlined lateral amphids; internal circle of papillae consisting of four submedian and two lateral single papillae, whereas external circle formed by four submedian pairs of papillae. Oesophagus including anterior bulbous inflation 1.01–1.41 (0.56–0.91) mm long, representing 2–4% (4–9%) of body length; bulb 75–108 (54–84) long and 99–120 (60–83) wide. Oesophageal gland marked, extending anteriorly from posterior end of oesophagus to short distance posterior to bulb, thus exceeding considerably nerve ring anteriorly; large oesophageal gland nucleus 830–1,102 (476–721) from anterior extremity. Posterior half of oesophageal gland conspicuously expanded. Max-

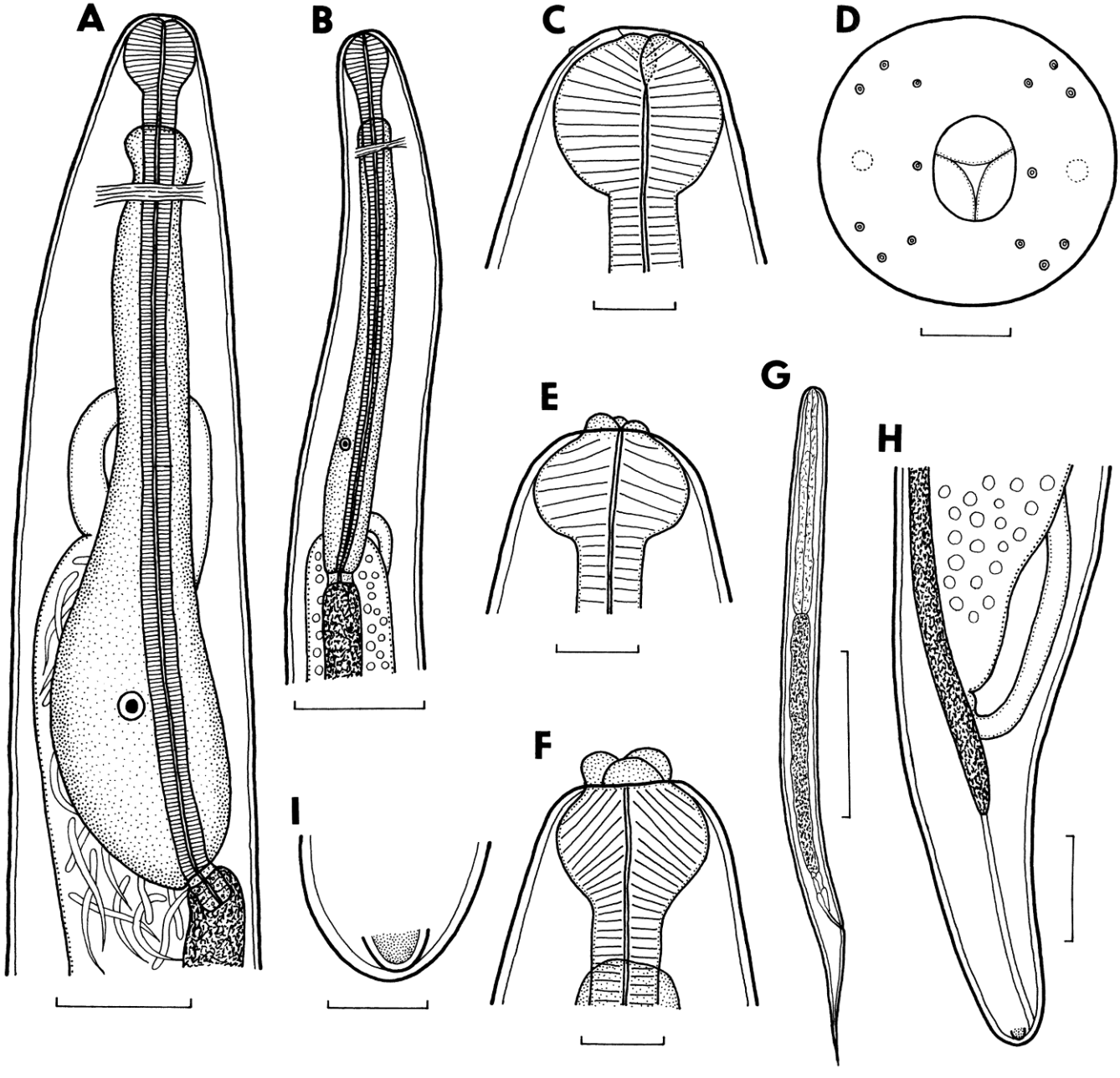

Fig. 5. *Philometra* sp., gravid female from subcutaneous tissues and sinuses of the head of *Mycteroperca microlepis*: **A** – anterior end of gravid specimen, lateral view. **B** – anterior end of smallest subgravid specimen, lateral view. **C** – cephalic end of specimen without protruding oesophageal teeth, lateral view. **D** – cephalic end, apical view. **E** and **F** – cephalic end of specimens with protruding oesophageal teeth, lateral views. **G** – larva from uterus. **H** – posterior end of body, lateral view. **I** – caudal end, lateral view. Scale bars = 200 μm (A, B, H), 100 μm (G), 50 μm (C, E, F), 30 μm (D, I)

imum width of oesophagus at level of posterior half of oesophageal gland 150–261 (54–95), width at middle part of oesophagus 78–117 (45–54), at level of anterior end of oesophageal gland 60–111 (45–68). Nerve ring 190–299 (129–219) from anterior end of body. Small ventriculus 27–41 (9–27) long and 66–82 (36–54) wide. Oesophagus opening into intestine through distinct valve. Intestine brown, narrow, ending blindly; its posterior end attached to body wall near caudal end by narrow ligament 300–490 (144–300) long. Vulva and anus absent. Ovaries long, narrow, reflected, situated near body ends. Uterus occupying most space of body, filled with numerous larvae and eggs; anteriorly uterus not reaching level of nerve ring. Larvae (n = 5) from uterus 375–426 (–) long, maximum width 18–21 (–), length of oesophagus 114–141 (27–34% of body length), of sharply pointed tail 51–81 (14–19%). Posterior end of body with two large, lateral, rounded caudal projections 9–15 (6–9) long.

Nongravid female (4 specimens): Body whitish, 2.12–3.31 mm long, maximum width 36–99; width of cephalic end 27–51, of caudal end 21–39. Small oesophageal teeth (3 high) present only in largest specimen. Entire oesophagus 348–456 long (14–17% of body length); anterior bulb 30–48 long, 18–42 wide. Length of ventriculus 9–15, width 15–33. Nerve ring and oesophageal nucleus 117–126 and 276–357, respectively, from anterior extremity. Vulva somewhat elevated, present only in smallest specimen, situated 1.41 mm from anterior end (at 67% of body length); vulva absent (atrophied) in other specimens. Uterus empty. Caudal projections indistinct.

Male: Unknown.

Host: Gag, *Mycteroperca microlepis* (Goode et Bean) (Serranidae, Perciformes) (SL 229–486 mm).

Site of infection: Subcutaneous tissue of the buccal cavity and sinuses (just below buccal epithelium, sinus epithelium, internal cheek galleries, nasal cavity).

Locality: Tampa Bay Florida, USA, and West Florida Shelf of the northeastern Gulf of Mexico including the Florida Middle Grounds (N 28.45685°, W 84.27410°; N 28.45193°, W 84.21285°; N 28.43860°, W 84.20505°; N 28.27395°, W 84.08612°; N 27.49283°, W 82.88410°; N 27.69372°, W 82.72023°).

Prevalence and intensity: 50%; 1–17 (female nematodes).

Deposition of specimens: 6 voucher specimens (N-934) in the Helminthological Collection of the Institute of Parasitology, Biology Centre of the ASCR, České Budějovice, Czech Republic; 7 voucher specimens (USNPC 102972) in the U.S. National Parasite Collection, Beltsville, Maryland, USA.

Comments: The general morphology of *Philometra* gravid females found in *M. microlepis* is very similar to that of *P. morii*, especially as to the structure of the oesophagus. Moreover, the localization of both these forms in the host is also similar (tissues of the head) and their host species are related, both belonging to Serranidae. *Philometra* sp. specimens from *M. microlepis* are mostly somewhat longer (26–52 *vs* 19–30 mm) than those of *P. morii*, their oesophagus represents 2–4 (*vs* 4–6)% of the entire body length, but their larvae from uterus are somewhat shorter (375–426 *vs* 513–522). Whereas all *P. morii* gravid specimens possess well developed oesophageal teeth, these were distinctly protruding only in two smaller gravid (29 and 31 mm long) and two subgravid specimens from *M. microlepis*. It seems that the three lobe-like anterior ends of oesophagus are eversible in younger specimens of the latter species.

It cannot be excluded that the above-mentioned differences are within the variability of a single species and that the specimens from *M. microlepis* belong to *P. morii*. However, some *Philometra* spp. can be distinguished only by their males, whereas their conspecific females are morphologically indistinguishable, as found, for example, in some gonad-infecting species from serranid fishes (*Epinephelus* and *Mycteroperca* spp.) (e.g., Moravec *et al*. 2008b, Quiazon *et al*. 2008a, Moravec and Justine 2009) or in some *Philometra* spp. parasitizing the abdominal cavity of European freshwater cyprinids (Moravec 2006). Therefore, until conspecific males are described, the female specimens from *M. microlepis* are designated as *Philometra* sp.

Discussion

Groupers of the genus *Epinephelus* Bloch are frequently hosts of *Philometra* spp. in different geographical regions. According to Moravec (2006), Moravec and Salgado-Maldonado (2007) and Moravec and Justine (2008, 2009), to date at least 18 species of *Epinephelus* were recorded as hosts of nine nominal and several unidentified species of *Philometra*. In the Gulf of Mexico, three species of *Philometra* have previously been recorded from *Epinephelus* spp. in Mexico: *P. margolisi* from the gonads of *E. morio* (see Moravec *et al*. 1995, 1997), *P. salgadoi* from oculo-orbits of *E. morio* (see Vidal-Martínez *et al*. 1995; Moravec *et al*. 1997, 2001), and *P. mexicana* Moravec et Salgado-Maldonado, 2007 from the gonads of *E. adscensionis* (Osbeck) (see Moravec and Salgado-Maldonado 2007). The new species *P. morii* differs distinctly from all these three species in having large oesophageal teeth and large caudal projections and in a considerably shorter body of gravid females (19–30 *vs* 65–230 mm); *P. salgadoi* also differs in possessing conspicuously large cephalic papillae of the external circle. Consequently, *P. morii* is the third known philometrid species parasitizing *E. morio* and the fourth species of *Philometra* recorded in *Epinephelus* spp. in the Gulf of Mexico.

To date, only two gonad-infecting species of *Philometra* have been reported from fishes belonging to *Mycteroperca* Gill: *P. lateolabracis* (Yamaguti, 1935) (probably misidentified) from *M. bonaci* (Poey) and *M. rubra* (Bloch) from the Gulf of Mexico and the Mediterranean Sea, respectively (Moravec 2006), and *P. charlestonensis* Moravec, de Buron, Baker et González-Solís, 2008 recently described from *M. phenax* (Jordan et Swain) from off the Atlantic coast of South Carolina, USA (Moravec *et al*. 2008b). Consequently, *Philometra* sp. of the present material is the third philometrid species in

Mycteroperca spp., and the first one with the location other than in the gonads of these fishes.

A situation when two species of *Philometra* parasitize the same fish species is not exceptional and has been observed in some freshwater, brackish-water, and marine fishes: *Philometra cyprinirutili* (Creplin, 1825) and *P. rischta* Skryabin, 1923 in *Abramis* spp. and *Rutilus rutilus* (Linnaeus) in Europe; *Philometra lati* and *P. spiriformis* Moravec, Charo-Karisa et Jirků, 2009 in *Lates niloticus* (Linnaeus) in Africa; *Philometra managatuwo* Yamaguti, 1941 and *P. ocularis* Moravec, Ogawa, Suzuki, Miyazaki et Donai, 2002 in *Epinephelus septemfasciatus* (Thunberg) in Japan; *Philometra cyanopodi* Moravec et Justine, 2008 and *P. ocularis* in *Epinephelus cyanopodus* (Richardson), and *P. lagocephali* Moravec et Justine, 2008 and *P. tenuicauda* Moravec et Justine, 2009 in *Lagocephalus sceleratus* (Gmelin) in New Caledonia; and *Philometra carolinensis* Moravec, de Buron et Roumillat, 2006 and *P. cynoscionis* Moravec, de Buron et Roumillat, 2006 in *Cynoscion nebulosus* (Cuvier) in North America (Moravec 2006; Moravec and Justine 2008, 2009; Moravec *et al*. 2009b). However, *Epinephelus morio* is the first species of fish in which three different species of *Philometra* have been recorded. In all these cases, the congeneric philometrids have different sites of infection in the shared fish host.

Philometra margolisi, *P. morii* and *P. salgadoi* are probably common and widespread parasites of *E. morio* in the Gulf of Mexico and it may well be that their distributions follow that of their fish hosts. Philometrid nematodes are known to cause serious damage to infected fishes (e.g., Vasilkov 1967, Vismanis and Nikulina 1968, Sakaguchi *et al*. 1987, Moravec 2006), especially under the conditions of aquaculture. In addition to gonad-infecting species of *Philometra*, which may even affect fish reproduction, other tissue-dwelling philometrids may also be important fish pathogens. Santos and Moravec (2009) have recently reported heavy infections with the philometrid *Rumai rumai* Travassos, 1960 associated with high mortality in farmed young arapaimas, *Arapaima gigas* (Schinz), in Brazil; the location of this parasite in the fish host (mainly tissues of the mouth cavity) is similar to that of *Philometra morii*.

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