

# Gonad-infecting species of *Philometra* (Nematoda: Philometridae) from groupers *Epinephelus* spp. (Osteichthyes: Serranidae) in the Bay of Bengal, India

František Moravec<sup>1\*</sup> and Jayaraman Manoharan<sup>2</sup>

<sup>1</sup>Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic; <sup>2</sup>Faculty of Marine Sciences, Annamalai University, Parangipettai 806 550, Tamil Nadu, India

## Abstract

Based on light and scanning electron microscopical studies, two new and one specifically not identified gonad-infecting species of *Philometra* Costa, 1845 (Nematoda: Philometridae) are described from the ovary of marine fishes of the genus *Epinephelus* Bloch (Serranidae, Perciformes) in the Bay of Bengal, off the eastern coast of India: *P. indica* sp. nov. (male and females) from the honeycomb grouper *E. merra* Bloch, *P. tropica* sp. nov. (males and females) from the duskytail grouper *E. bleekeri* (Vaillant) and *Philometra* sp. (only females) from the cloudy grouper *E. erythrurus* (Valenciennes). *Philometra indica* is mainly characterized by the length of spicules 192–195 µm and the gubernaculum 84 µm, the distal tip of the gubernaculum without a dorsal protuberance, and by the presence of five pairs of caudal papillae. *Philometra tropica* is mainly characterized by the spicules conspicuously ventrally distended at their posterior halves, the distal tip of the gubernaculum with a dorsal protuberance, and the presence of three pairs of caudal papillae.

## Keywords

Parasitic nematode, new species, Dracunculoidea, marine fish, Indian Ocean

## Introduction

Gonad-infecting species of *Philometra* Costa, 1845 (Philometridae, Dracunculoidea) are common parasites of a variety of marine fishes belonging to different families (Moravec 2006; Moravec and de Buron 2013). Although twelve nominal species of these nematodes have been reported from the region of the Indian Ocean, only seven of them can be considered to be correctly identified and valid (Moravec and Manoharan 2013; Moravec and Ali 2014). Of them, only one, *P. piscaria* Moravec et Justine, 2014, is a parasite of the serranid fish. This species has recently been recorded from *E. coioides* (Hamilton) in the Persian Gulf (Moravec and Ali 2014). In addition, Kardousha (1999) reported *P. lateolabracis* (Yamaguti, 1935) from the ovary of *E. areolatus* (Forsskal) and *E. tauvina* (Forsskal) in the Arabian (= Persian) Gulf and Parukhin (1976) reported the same species from the ovary of *Epinephelus* “*ascolatus*” (?) in the Sea of Oman; both findings were based on evident misidentifications and these nematodes should be designated as *Philometra* sp. (Moravec 2008; Quiazon *et al.* 2008). Accordingly, gonad-infecting species of *Phi-*

*lometra* parasitizing fishes of the family Serranidae in the region of the Indian Ocean are so far little known.

During recent helminthological investigations of some marine fishes in the Bay of Bengal, off the eastern coast of India, nematode specimens of the genus *Philometra* were found in the ovaries of three species of *Epinephelus* Bloch: duskytail grouper *E. bleekeri* (Vaillant), cloudy grouper *E. erythrurus* (Valenciennes) and honeycomb grouper *E. merra* Bloch. Based on light and scanning electron microscopical examination, they proved to be representatives of two new and one specifically unidentifiable species, which are described herein. All the aforementioned host species are tropical marine fishes with the Indo-Pacific distribution and are targeted by commercial and recreational fisheries (Froese and Pauly 2014).

## Materials and Methods

Fish were caught by trawl nets by local fishermen in the Bay of Bengal and were obtained in the landing centres Cuddalore (11°42'N, 74°46'E), Parangipettai (11°29'N, 79°46'E) and

\*Corresponding author: moravec@paru.cas.cz

Pazhayar (11°21'N, 79°50'E) on the eastern coast of India. The nematodes collected from fish gonads were washed in physiological saline and then fixed and preserved in 4% formalin. Philometrid males were dissected out from formalin-fixed fish ovaries. For light microscopical examination, the nematodes were cleared with glycerine. Drawings were made with the aid of a Zeiss drawing attachment. Specimens used for scanning electron microscopy were postfixed in 1% osmium tetroxide (in phosphate buffer), dehydrated through a graded acetone series, critical-point-dried and sputter-coated with gold; they were examined using a JEOL JSM-7401F scanning electron microscope at an accelerating voltage of 4 kV (GB low mode). All measurements are in micrometres unless otherwise indicated. The fish nomenclature adopted follows FishBase (Froese and Pauly 2014).

## Results

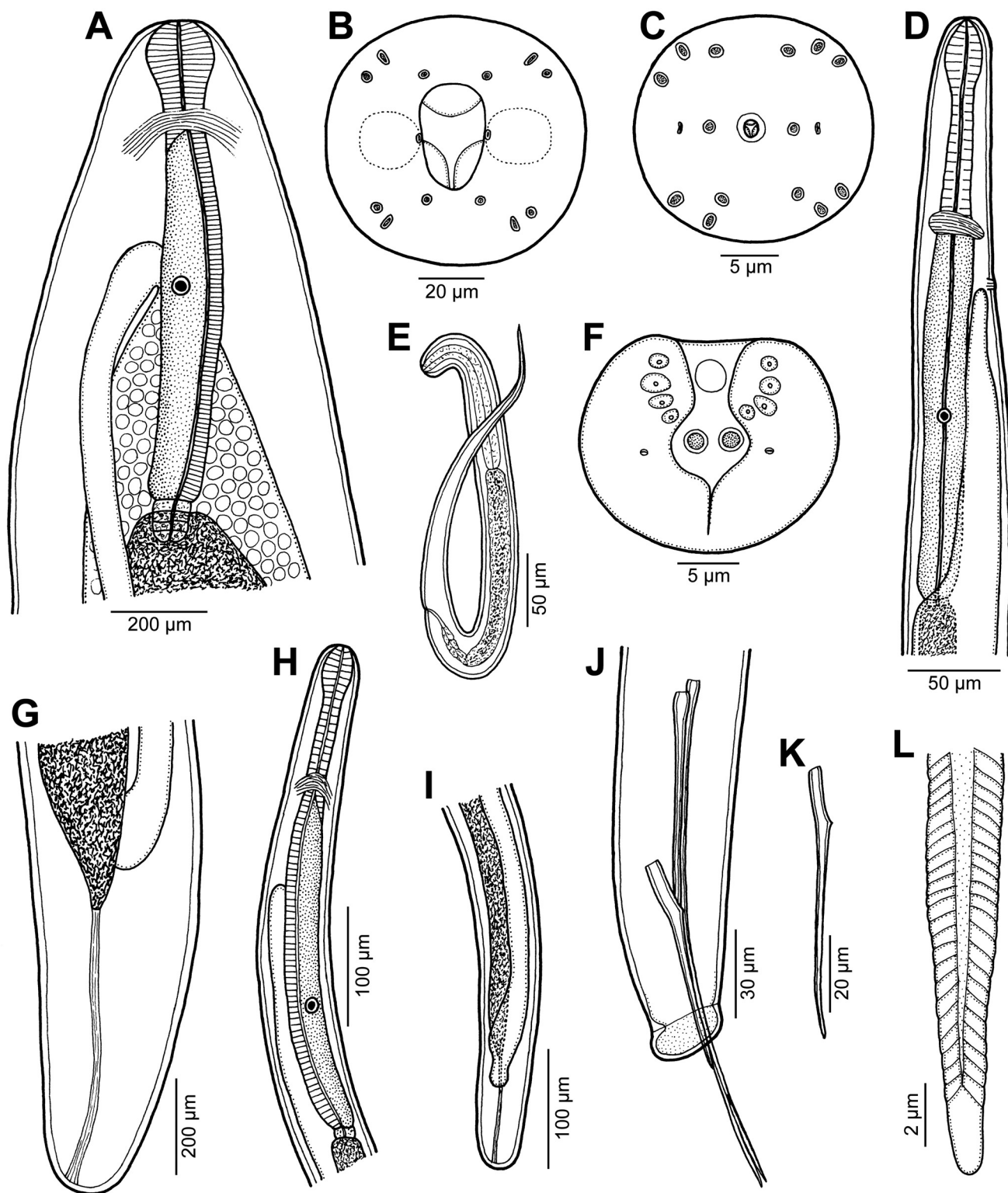
### Family Philometridae Baylis et Daubney, 1926

#### *Philometra indica* sp. nov. ( Figs. 1, 2)

Description: Male (1 specimen, holotype). Body whitish, filiform, tapering to both ends, 2.94 mm long, maximum width at middle 72; anterior part of body not narrower posterior to cephalic end (Fig. 1D). Maximum width/body length 1:41; width of cephalic end 27, that of posterior end 27. Cuticle smooth. Cephalic end rounded. Oral aperture small, oval, surrounded by 14 cephalic papillae arranged in two circles: external circle formed by four submedian pairs of papillae; internal circle formed by four submedian and two lateral papillae (Figs 1C; 2A). Small lateral amphids just posterior to lateral papillae of internal circle (Figs 1C; 2A). Oesophagus 357 long, maximum width 27, comprising 12% of body length, slightly inflated at anterior end; posterior part of muscular oesophagus overlapped by well-developed oesophageal gland with large cell nucleus in middle (Fig. 1D); anterior oesophageal inflation 24 long and 18 wide. Nerve ring, excretory pore and oesophageal nucleus 120, 156 and 228, respectively, from anterior extremity. Testis reaching anteriorly to level of excretory pore (Fig. 1D). Posterior end of body blunt, with broad, V-shaped mound extending dorsally and laterally (Figs 1F, J; 2C, D), forming short tail 6 long (Fig. 1F). Four pairs of very flat, hardly visible caudal papillae close to each other situated on either side of cloacal aperture on mound (Figs 1F; 2C, D); additional pair of papillae situated posterior to cloaca in space between both arms of caudal mound. Pair of small phasmids present at about middle of each mound arm (Figs 1F; 2C–E). Spicules slender, needle-like, slightly subequal, with somewhat expanded proximal and sharply pointed distal tips (Figs 1J; 2C–F); length of spicules 195 and 192, larger spicule comprising 7% of body length. Length ratio of spicules 1:1.02. Gubernaculum narrow, 84 long, with anterior portion somewhat dorsally bent; length of anterior bent part 18, representing 21% of entire gubernaculum length; posterior end of gubernaculum without dorsal protuberance, composed of two longitudinal parts bearing numerous transverse lamella-like structures and demarcating somewhat depressed, smooth narrow field between them (Figs 1J–L; 2D–F). Length ratio of gubernaculum and larger spicule 1:2.32. Spicules and gubernaculum yellowish, anterior part of gubernaculum colourless.

Gravid female (a single fragment of anterior part of 1 specimen). Body of fragment light-coloured, with distinct dark-brown intestine visible through cuticle, 166 mm long, maximum width 1.12 mm; cephalic end 218 wide. Cuticle smooth. Cephalic papillae small, indistinct when viewed laterally (Fig. 1A). Oral aperture dorsoventrally oval with broader dorsal part, surrounded by outer circle of 4 pairs of submedian cephalic papillae and inner circle of 6 single papillae (2 lateral and 4 submedian); each outer submedian pair formed by distinctly larger circular papilla and smaller elongate papilla (Fig. 1B). Amphids indistinct. Bottom of mouth formed by lobes of three oesophageal sectors (Fig. 1B). Oesophagus including anterior bulbous inflation 1.16 mm long; anterior inflation 135 long and 156 wide; maximum width of posterior part of oesophagus including gland 150. Oesophageal gland well developed, opening into oesophagus just posterior to nerve ring, with large cell nucleus (Fig. 1A). Nerve ring and oesophageal nucleus 272 and 762, respectively, from anterior extremity. Small ventriculus 54 long and 95 wide. Uterus filled with many eggs and several larvae. Larva 600 long, maximum width 18; length of oesophagus 129 (22% of body length), of tail 225 (30%) (Fig. 1E).

Subgravid female (2 ovigerous specimens; allotype; measurements of paratype in parentheses). Body of fixed specimens whitish with dark-coloured intestine, filiform, with rounded ends. Body length 43 (55) mm, maximum width 775 (625). Cuticle smooth. Maximum width/body length 1:55 (1:88). Width of cephalic end 163 (177). Cephalic papillae small, indistinct when viewed laterally. Oral aperture dorsoventrally oval with broader dorsal part, surrounded by outer circle of 4 pairs of submedian cephalic papillae and inner circle of 6 single papillae (2 lateral and 4 submedian); each outer submedian pair formed by distinctly larger circular papilla and smaller elongate papilla. Amphids indistinct. Bottom of mouth formed by lobes of three oesophageal sectors (Fig. 2B). Oesophagus including well-developed anterior bulbous inflation 1.16 (1.01) mm long, comprising 2.7% (1.8%) of body length; anterior inflation 120 (96) long and 126 (120) wide; maximum width of posterior part of oesophagus including gland 122 (109). Oesophageal gland well developed, opening into oesophagus just posterior to nerve ring, with large cell nucleus. Nerve ring and oesophageal nucleus 258 (218) and 694 (625), respectively, from anterior extremity. Small ventriculus 33 (39) long and 90 (96) wide. Posterior end of intestine attached by ligament ventrally to body wall near caudal end (Fig. 1G); ligament 666 (884) long. Vulva and anus absent. Ovaries reflexed, situated near body ends (Fig. 1G). Uterus filled with small numbers of not fully developed eggs.



**Fig. 1.** *Philometra indica* sp. nov.: **A** – anterior end of gravid female, lateral view. **B** – cephalic end of gravid female, apical view. **C** – cephalic end of male, apical view. **D** – anterior end of male, lateral view. **E** – larva from uterus, lateral view. **F** – caudal end of male, apical view. **G** – posterior end of subgravid female, lateral view. **H** and **I** – anterior and posterior ends of nongravid female, lateral views. **J** – posterior end of male, lateral view. **K** – gubernaculum, lateral view. **L** – posterior end of gubernaculum, dorsal view



Posterior end of body rounded, 163 (136) wide, without any caudal projections (Fig. 1G).

Nongravid female (1 mature specimen). Body length 4.66 mm, maximum width 75; maximum width/length ratio 1:62. Width of anterior end 36, of posterior end 36. Anterior part of body not narrower posterior to cephalic end (Fig. 1H). Entire oesophagus 459 long and 33 wide. Anterior oesophageal inflation 48 long, 27 wide. Nerve ring and oesophageal nucleus 126 and 345, respectively, from anterior extremity (Fig. 1H). Intestinal ligament short, 51 long. Vulva indistinct. Uterus empty. Caudal end rounded (Fig. 1I).

Type host: Honeycomb grouper, *Epinephelus merra* Bloch (Serranidae, Perciformes) (body length 24–29 cm).

Site of infection: Ovary.

Type locality: Bay of Bengal, off eastern coast of India (collected January–December 2013).

Prevalence and intensity: Larger females only: 20% (4 fish infected/20 fish examined); mean intensity 7 nematodes per fish. A single fixed fish ovary contained 2 males and 1 gravid, 2 subgravid and 1 nongravid female nematodes.

Deposition of type specimens: Holotype, allotype and paratypes in the Helminthological Collection of the Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, České Budějovice (Cat. No. N-1050).

Etymology: The specific name of this nematode relates to the country where the specimens were collected.

Comments: To date, ten nominal gonad-infecting species of *Philometra* are known to parasitize fishes of the perciform family Serranidae: *P. charlestonensis* Moravec, de Buron, Baker et González-Solís, 2008, *P. cyanopodi* Moravec et Justine, 2008, *P. fasciati* Moravec et Justine, 2008, *P. hyporthodi* Moravec et Bakenhaster, 2013, *P. jordanoi* (López-Neyra, 1951), *P. managatuwo* Yamaguti, 1941, *P. margolisi* Moravec, Vidal-Martínez et Aguirre-Macedo, 1995, *P. mexicana* Moravec et Salgado-Maldonado, 2007, *P. piscaria* Moravec et Justine, 2014 and *P. serranellibrillae* Janiszewska, 1949 (see Moravec and Justine 2014).

The new species can be easily distinguished by the length of spicules from *P. charlestonensis* (spicules 132–141 vs 192–195 µm), *P. hyporthodi* (135–138 µm), *P. jordanoi* (about 260 µm), *P. margolisi* (432–468 µm), *P. mexicana* (90–120 µm) and *P. fasciati* (147–156 µm). The spicules of *P. piscaria* are only slightly shorter (171–180 vs 192–195 µm), but the males are distinctly longer (3.67–4.19 vs 2.94 mm), the length ratio of the gubernaculum and the larger spicule is different (1:1.26–1.45 vs 1:2.32), the proximal, dorsally bent part of the gubernaculum is markedly longer, representing 43–57% (vs 21%) of the entire gubernaculum length, and the distal end of the gubernaculum bears a dorsal protuberance (vs dorsal protuberance absent).

The spicules of *P. cyanopodi* are of approximately the same length (186–228 µm) as those of *P. indica*, but the gubernaculum is distinctly longer (129–162 vs 84 µm) and the length ratio of the gubernaculum and spicules is different (1:1.22–1.54 vs 1:2.32); the anterior bent part of the gubernaculum

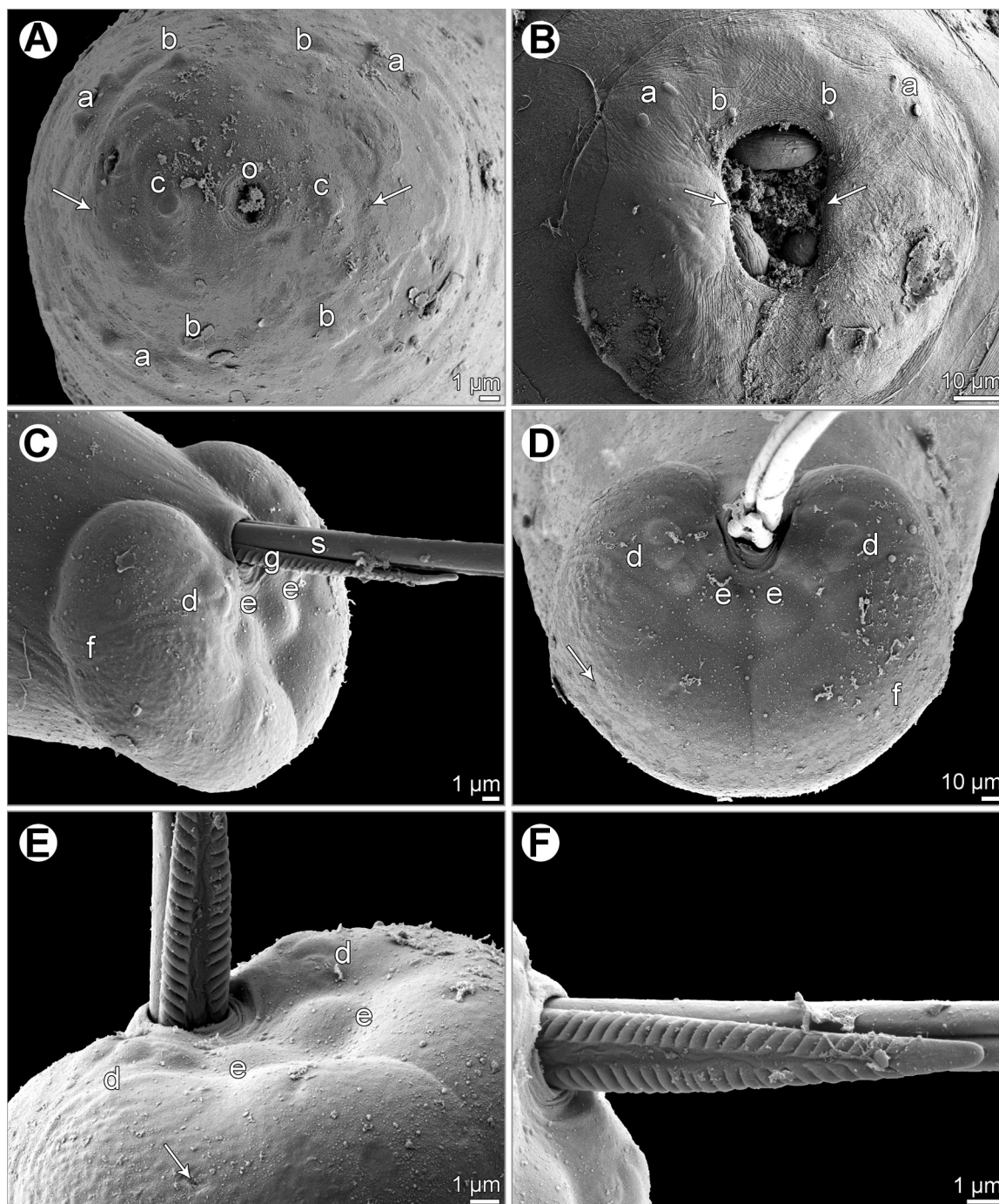
is relatively longer, representing 30–39% (vs 21%) of the entire gubernaculum length. The males of *P. managatuwo* and *P. serranellibrillae* are unknown, so at present these species can be distinguished from *P. indica* sp. nov. only by the geographical distribution (Mediterranean Sea and Japan and New Caledonia vs India).

#### *Philometra tropica* sp. nov. Figs 3, 4

Description: Male (10 specimens; measurements of holotype in parentheses). Body filiform, whitish, 2.86–3.99 (3.94) mm long, maximum width at middle 66–78 (78); anterior part of body with constriction just posterior to cephalic end (Fig. 3A); body width at this constriction 36–39 (39). Maximum width/body length 1:43–53 (1:51); width of cephalic end 36–45 (45), that of posterior end 36–51 (51). Cuticle distinctly transversely striated (Fig. 4H). Cephalic end rounded. Oral aperture circular, surrounded by 14 cephalic papillae arranged in two circles: outer circle formed by four submedian pairs of papillae; inner circle by four submedian and two lateral papillae. Small lateral amphids just posterior to lateral papillae of inner circle. Oesophagus 393–489 (393) long, forming 9–17 (10)% of body length, somewhat inflated at anterior end; posterior part of muscular oesophagus overlapped by well developed oesophageal gland 24–39 (39) wide with large cell nucleus in middle. Nerve ring and oesophageal nucleus 171–198 (198) and 318–390 (330) from anterior extremity, respectively. Excretory pore 231–264 (255) from anterior end. Testis overlaps oesophageal gland, reaching anteriorly up to level of nerve ring (Fig. 3A). Posterior end of body blunt, provided with broad V-shaped caudal mound, this mound nearly surrounding cloacal aperture except ventrally; three adanal pairs of very flat, hardly visible caudal papillae present on sides of cloacal aperture; phasmids not observed (Figs 3D, E, K; 4A, B, E, F). Spicules slightly subequal in length, slender, needle-like, with ventral margin conspicuously flared between second and fourth quarter of its length; proximal ends somewhat expanded, distal tips sharply pointed (Figs 3D, E, I; 4A–G); length of spicules 171–186 and 168–183 (180/177), representing 3.2–6.5 (5.6)% of body length; length ratio of spicules 1:1.02 (1:1.02); width of anterior portion of spicules 6 (6), of distended part 9–12 (9–12). Gubernaculum narrow, 120–138 (123) long, with anterior portion somewhat dorsally bent; length of bent part 63–75 (66), representing 47–57 (54)% of entire gubernaculum length; posterior end of gubernaculum with dorsal protuberance and numerous transverse lamella-like structures; dorsal protuberance on gubernaculum appears as single in lateral view but, in fact, it consists of two dorsolateral parts separated from each other by narrow, smooth longitudinal field when observed dorsally (Figs 3C–E, G, H; 4A–G); in lateral view, distal tip of gubernaculum slender, ventrally curved (Figs 3E, G, H; 4A–C, E–G). Length ratio of gubernaculum and larger spicule 1:1.31–1.51 (1:1.46). Spicules and gubernaculum well sclerotized, yellowish, except anterior part of gubernaculum colourless.

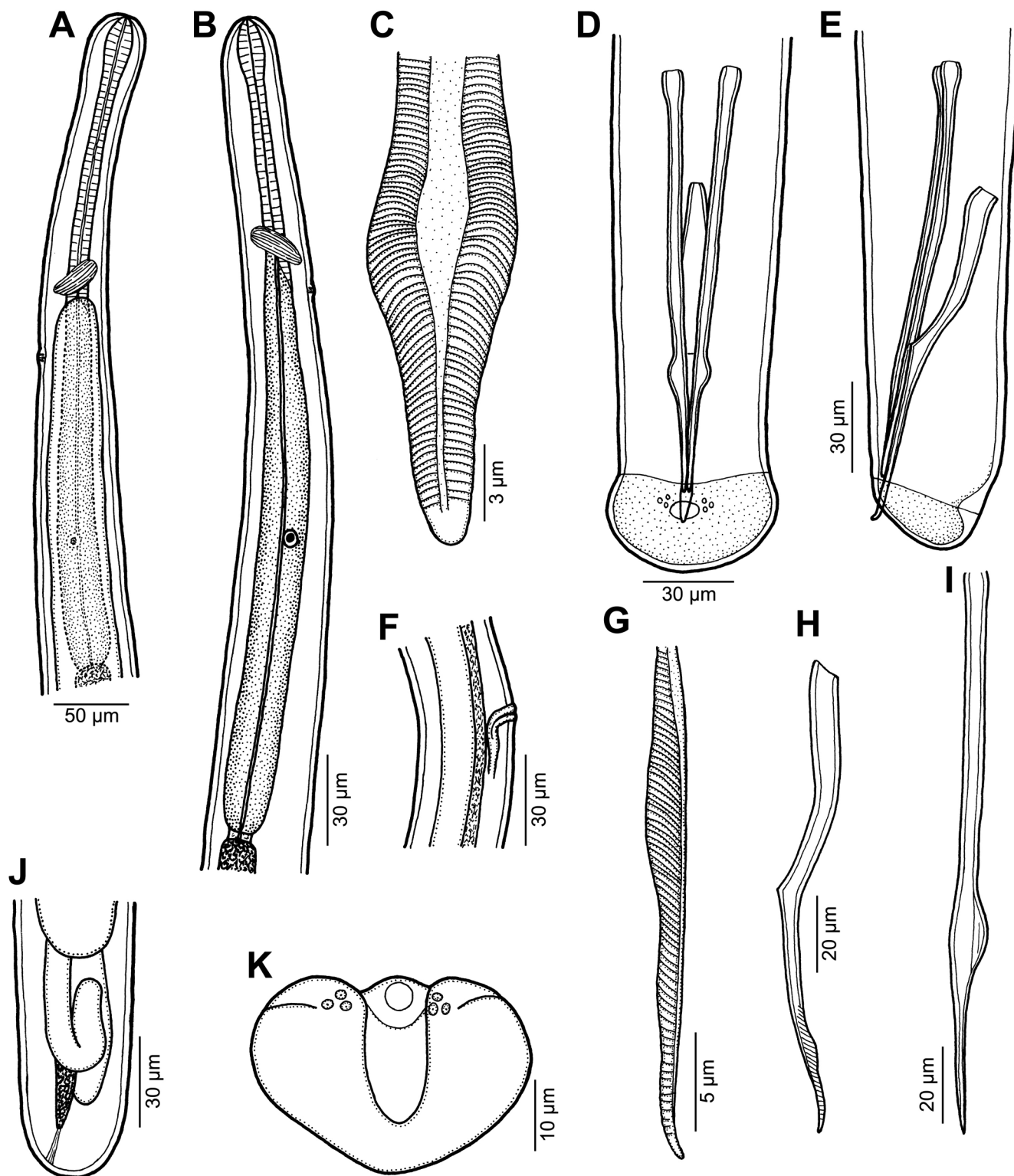
Nongravid female (2 mature specimens; allotype; measurements of paratype in parentheses). Body filiform, not narrowed posterior to cephalic extremity, length 4.65 (5.51) mm, maximum width 78 (78); maximum width/length ratio 1:60 (1:71). Width of anterior end 39 (39), of posterior end 39 (39).

Entire oesophagus 651 (675) long and 33 (36) wide. Anterior oesophageal bulbous inflation 45 (45) long, 21 (24) wide. Nerve ring, excretory pore and oesophageal nucleus 177 (186), 216 (231) and 393 (420) from anterior extremity, respectively (Fig. 3B). Small ventriculus 15 (15) long and 18 (15)

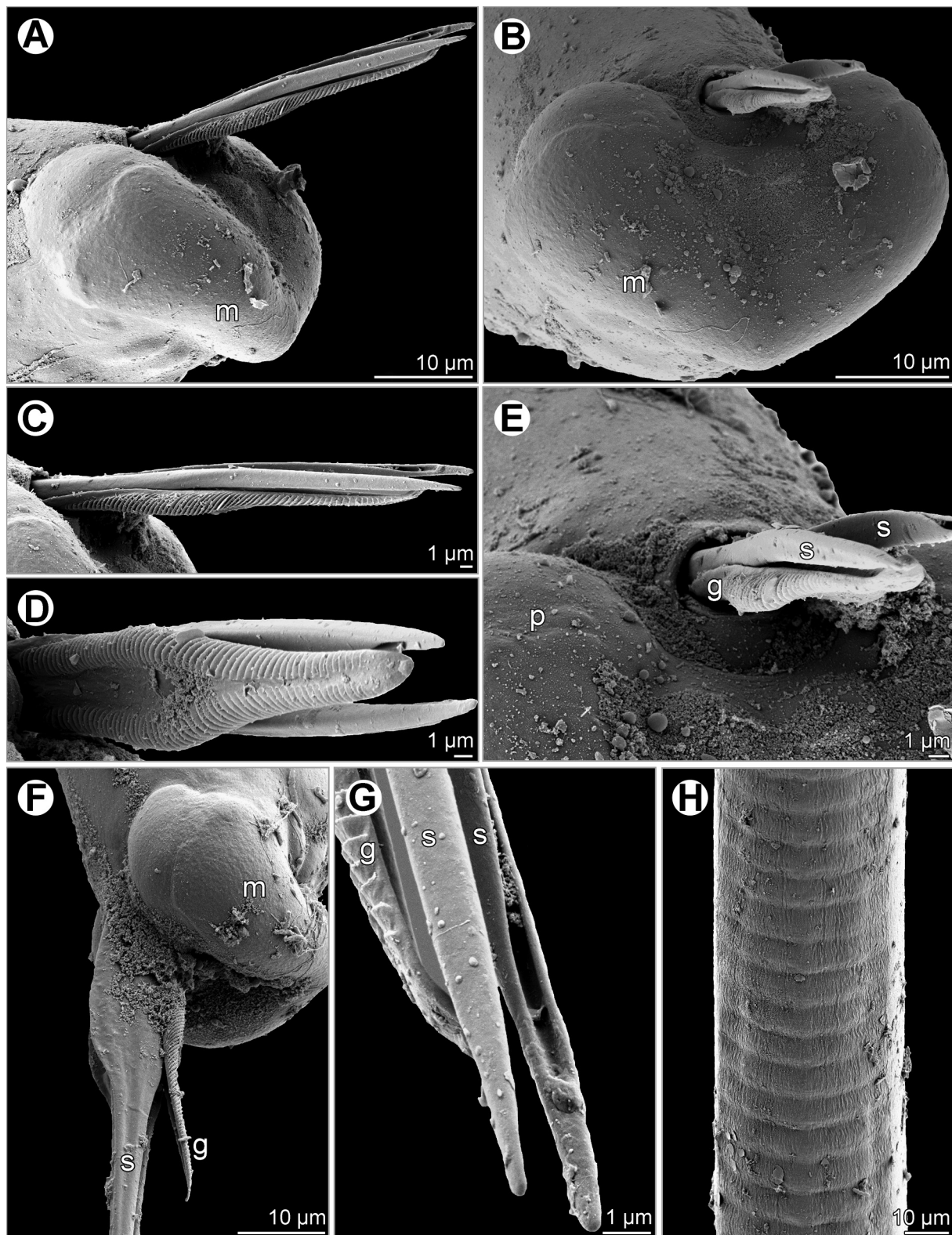


**Fig. 2.** *Philometra indica* sp. nov., scanning electron micrographs: **A** – cephalic end of male, apical view (arrows indicate amphids). **B** – cephalic end of subgravid female, apical view (arrows indicate amphids). **C** and **D** – caudal end of male, sublateral and apical views (arrow indicates phasmid). **E** – region of cloacal aperture, subdorsal view (arrow indicates phasmid). **F** – distal end of gubernaculum, dorsal view. **Abbreviations:** **a** – pair of cephalic papillae of external circle; **b** – submedian cephalic papilla of internal circle; **c** – lateral cephalic papilla of internal circle; **o** – oral aperture; **d** – group of four adcloacal papillae; **e** – postcloacal caudal papilla; **f** – caudal mound; **g** – gubernaculum; **s** – spicule





**Fig. 3.** *Philometra tropica* sp. nov.: **A** – anterior end of male, lateral view. **B** – anterior end of mature female, lateral view. **C** – distal end of gubernaculum, dorsal view. **D** and **E** – posterior end of male, ventral and lateral views. **F** – region of vulva of mature female, lateral view. **G** – distal end of gubernaculum, lateral view. **H** – gubernaculum, lateral view. **I** – spicule, lateral view. **J** – posterior end of mature female, lateral view. **K** – caudal end of male, apical view



**Fig. 4.** *Philometra tropica* sp. nov., scanning electron micrographs of male: **A** and **B** – caudal end, lateral and subapical views. **C** – extruded distal ends of spicules and gubernaculum, lateral view. **D** – distal end of gubernaculum, dorsal view. **E** – region of cloacal aperture. **F** – caudal end with extruded spicules and gubernaculum, lateral view (note conspicuously ventrally distended parts of spicules). **G** – tips of gubernaculum and spicules (note longitudinal canal inside spicule); **H** – transversely striated body. **Abbreviations:** g – gubernaculum; m – caudal mound; p – group of three caudal papillae; s – spicule



wide. Intestine narrow, ending blindly, attached by short ligament to body wall near caudal extremity. Vulva and incompletely developed vagina present, former situated 3.12 (3.71) mm from anterior extremity, at 67 (67)% of body length (Fig. 3F). Uterus empty. Caudal end rounded (Fig. 3J).

Type host: Duskytail grouper, *Epinephelus bleekeri* (Vailant) (Serranidae, Perciformes) (body length 54–60 cm).

Site of infection: Ovary.

Type locality: Bay of Bengal, off eastern coast of India (collected January–December 2013).

Prevalence and intensity: Larger females only: 6% (3 fish infected/50 fish examined); mean intensity 11 nematodes per fish. A single fixed fish ovary contained 10 males and 2 non-gravid female nematodes.

Deposition of type specimens: Holotype, allotype and paratypes in the Helminthological Collection of the Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, České Budějovice (Cat. No. N-1051).

Etymology: The specific name *tropica* (= tropical) of this nematode relates to the temperature zone where the specimens were collected.

Comments: *Philometra tropica* sp. nov. differs from almost all nominal gonad-infecting species of *Philometra* with described males in possessing spicules that are conspicuously ventrally distended at their posterior halves. The only other species with markedly ventrally distended spicules is *P. latispicula* Moravec, Bakehaster et Ávila, 2014, a parasite of *Lutjanus griseus* (Linnaeus) (Lutjanidae) in the Gulf of Mexico (Moravec *et al.* 2014). Although measurements of both these species are similar, they distinctly differ from each other in the structure of the gubernaculum. In contrast to the new species, the gubernaculum of *P. latispicula* is without a dorsal protuberance on its distal tip and the dorsal lamellar structures are not divided into two longitudinal parts by a median smooth field as in *P. tropica*. In addition, the distended parts of spicules are more elongate in *P. latispicula* as compared with those in *P. tropica* and the former species possesses a pair of large papillae posterior to the cloacal aperture (absent in the latter). Both species also differ in the host family (Serranidae vs Lutjanidae) and geographical distribution (Gulf of Mexico, region of the Atlantic Ocean vs Gulf of Bengal, region of the Indian Ocean).

Two gonad-infecting species parasitizing serranid fishes, *P. managatuwo* and *P. serranellibrillae*, were described solely from females, whereas conspecific males remain unknown (see above). Since the female morphology of most gonad-infecting species of *Philometra* is rather uniform, *P. managatuwo* and *P. serranellibrillae* can be distinguished from *P. tropica* sp. nov. mainly by the geographical distribution (Mediterranean Sea, Japan and New Caledonia vs Bay of Bengal).

#### *Philometra* sp. Fig. 5

Description: Subgravid female (2 complete and 2 incomplete specimens). Body of fixed specimens whitish with dark-co-

loured intestine, filiform, with rounded ends. Body length 158–262 mm, maximum width 612–1,224. Cuticle smooth. Maximum width/body length 1:142–214. Width of cephalic end 136–272. Cephalic papillae small, indistinct when viewed laterally. Oral aperture dorsoventrally oval, surrounded by outer circle of 4 pairs of submedian cephalic papillae and inner circle of 6 single papillae (2 lateral and 4 submedian); each outer submedian pair formed by circular papilla and elongate papilla. Amphids indistinct. Bottom of mouth formed by lobes of three oesophageal sectors (Fig. 5B). Oesophagus including well-developed anterior bulbous inflation 1.03–1.88 mm long, comprising 0.5–0.7% of body length; anterior inflation 109–163 long and 109–150 wide; maximum width of posterior part of oesophagus including gland 122–163. Oesophageal gland well developed, opening into oesophagus just posterior to nerve ring, with large cell nucleus. Nerve ring and oesophageal nucleus 299–408 and 625–1,234, respectively, from anterior extremity. Small ventriculus 39–41 long and 82–95 wide (Fig. 5A). Posterior end of intestine attached by ligament ventrally to body wall near caudal end (Fig. 5C); ligament 680–4,488 long. Vulva and anus absent. Ovaries reflexed, situated near body ends (Fig. 5A, C). Uterus filled with many eggs. Posterior end of body rounded, 136–258 wide, with 2 very small, hardly visible subterminal, lateral papilla-like caudal projections (Fig. 5C).

Nongravid female (1 anterior body fragment). Length of body fragment 33 mm, maximum width 585; width of cephalic end 109. Entire oesophagus 870 long and 109 wide. Anterior oesophageal inflation 95 long, 109 wide. Nerve ring and oesophageal nucleus 163 and 530 from anterior extremity, respectively. Uterus empty.

Host: Cloudy grouper, *Epinephelus erythrurus* (Serranidae, Perciformes) (body length 35–42 cm).

Site of infection: Ovary.

Locality: Bay of Bengal, off eastern coast of India (collected January–December 2013).

Prevalence and intensity: Larger females only: 5% (1 fish infected/20 fish examined); 5 nematode specimens. A single fixed fish ovary contained 4 subgravid and 1 nongravid female nematodes.

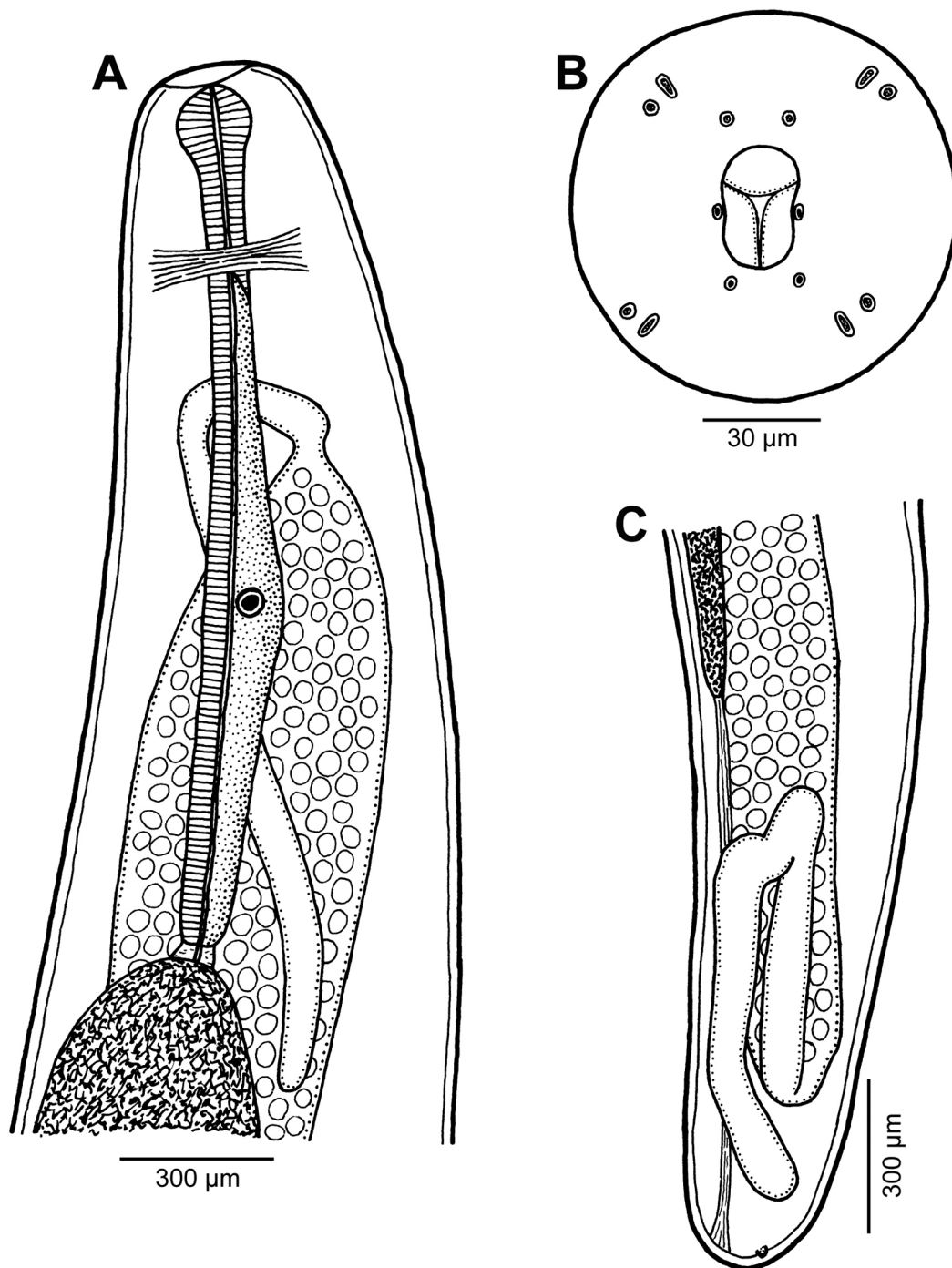
Deposition of voucher specimens: Voucher specimens in the Helminthological Collection of the Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, České Budějovice (Cat. No. N-1052).

Comments: Since only subgravid and one nongravid females are available, they cannot be identified to species. It may well be that they belong to an undescribed species, but having no conspecific males or gravid females, we refrain from the erection of a new species based on this material.

## Discussion

Groupers (*Epinephelus* spp.) are frequently recorded as hosts of philometrid nematodes (Moravec 2006). To date, ten nominal





**Fig. 5.** *Philometra* sp. from *E. erythrurus*, subgravid female: **A** – anterior end of largest specimen, lateral view. **B** – cephalic end, apical view. **C** – posterior end, lateral view

gonad-infecting species of *Philometra* are known from these hosts, of which two (*P. jordanoi* and *P. serranellibrillae*) occur in the Mediterranean region (Janiszewska 1949; López-Neyra 1951; Merella *et al.* 2005; Moravec *et al.* 2006); two (*P. margolisi* and *P. mexicana*) in the Gulf of Mexico (Moravec *et al.* 1995, 1997, 2007); one (*P. managatuwo*) in Japan (Moravec *et al.* 2002); three (*P. cyanopodi*, *P. fasciati* and *P. piscaria*) in

New Caledonian waters (Moravec and Justine 2008, 2014); and three (*P. indica* sp. nov., *P. piscaria* and *P. tropica* sp. nov.) in the Indian Ocean region (Moravec and Ali 2014; present data).

The occurrence of different species of these parasites in different species of congeneric hosts in the same region indicates a high degree of host specificity of gonad-infecting philometrids. Therefore, it is necessary to emphasize the ne-

cessity of studying the conspecific males for the correct species identification of these parasites. Identifications based solely on females may mask the presence of two or more morphologically similar species and may then lead to wrong conclusions. Apparently, many new philometrid species, including those from groupers, can be expected to be discovered and described during subsequent investigations. This is indicated by numerous published records of specifically undetermined philometrids (reported as *Philometra* sp.) parasitizing marine fishes.

**Acknowledgements.** We would like to express our gratitude to Prof. T. Balasubramanian, Dean, Faculty of Marine Sciences for his constant encouragement and the Annamalai University the facilities provided during the study period. Authors' thanks are also due to the staff of the Laboratory of Electron Microscopy, Institute of Parasitology, Biology Centre of the AS CR, České Budějovice for their technical assistance, and to Blanka Škoríková of the same Institute for help with illustrations. This study was partly supported by the Czech Science Foundation (grant No. P505/12/G112) and the Institute of Parasitology, BC AS CR (institutional support RVO:60077344).

## References

- Froese R., Pauly D. (Eds.). 2014. FishBase. World Wide Web electronic publication. <http://www.fishbase.org>, version March/2014.
- Janiszewska J. 1949. Some fish nematodes from the Adriatic Sea. *Zoologica Poloniae*, 5, 7–30.
- Kardousha M.M. 1999. The first record of *Philometra lateolabracis* Yamaguti, 1935 [sic] (Nematoda: Spirurida; Philometridae) from teleost fishes of the Arabian Gulf. *Qatar University Science Journal*, 18, 131–136.
- López-Neyra C.R. 1951. *Sanguinifilaria jordanoi* n. sp. (Nematoda; Filarioidea). *Boletín de la Universidad de Granada, Farmacia*, 291–293.
- Merella P., Reñones O., Garippa G. 2005. Reinstatement of *Philometra jordanoi* (López-Neyra, 1951) (Nematoda, Philometridae): a parasite of the Mediterranean dusky grouper *Epinephelus marginatus* (Lowe) (Osteichthyes, Serranidae). *Systematic Parasitology*, 61, 203–206.
- Moravec F. 2006. Dracunculoid and Anguillicoloid Nematodes Parasitic in Vertebrates. Academia, Prague, 634 pp.
- Moravec F. 2008. Systematic status of *Philometra jordanoi* (López-Neyra, 1951) and some other congeneric species previously identified as *Philometra lateolabracis* (Yamaguti, 1935) (Nematoda: Philometridae). *Folia Parasitologica*, 55, 159–160.
- Moravec F., Ali A.H. 2014. Additional observations on *Philometra* spp. (Nematoda: Philometridae) in marine fishes off Iraq, with the description of two new species. *Acta Parasitologica*, 87, 259–271. DOI: 10.2478/s11686-013-0139-5.
- Moravec F., Bakenhaster M., Fajer-Ávila E.J. 2014. Three new gonad-infecting species of *Philometra* (Nematoda: Philometridae) parasitic in *Lutjanus* spp. (Lutjanidae) in the northern Gulf of Mexico off Florida, USA. *Folia Parasitologica*, 61, 355–369.
- Moravec F., de Buron I. 2013. A synthesis of our current understanding of philometrids (Philometridae), a group of growingly important fish parasites. *Folia Parasitologica*, 60, 81–101.
- Moravec F., Justine J.-L. 2008. Some philometrid nematodes (Philometridae), including four new species of *Philometra*, from marine fishes off New Caledonia. *Acta Parasitologica*, 53, 369–381. DOI: 10.2478/s11686-008-0050-7.
- Moravec F., Justine J.-L. 2014. Philometrids (Nematoda: Philometridae) in carangid and serranid fishes off New Caledonia, including three new species. *Parasite*, 21, 21 (online). DOI: 10.1051/parasite/2014022.
- Moravec F., Manoharan J. 2013. Gonad-infecting philometrids (Nematoda: Philometridae) including four new species from marine fishes off the eastern coast of India. *Folia Parasitologica*, 60, 105–122.
- Moravec F., Ogawa K., Suzuki M., Miyazaki K., Donai H. 2002. On two species of *Philometra* (Nematoda, Philometridae) from the serranid fish *Epinephelus septemfasciatus* in Japan. *Acta Parasitologica*, 47, 34–40.
- Moravec F., Salgado-Maldonado G. 2007. A new species of *Philometra* (Nematoda, Philometridae) from the gonads of the rock hind *Epinephelus adscensionis* (Osteichthyes) from the southern Gulf of Mexico. *Acta Parasitologica*, 52, 376–381. DOI: 10.2478/s11686-007-0044-x.
- Moravec F., Ternengo S., Levron C. 2006. Three species of *Philometra* (Nematoda: Philometridae) from marine fishes off Corsica, France. *Acta Parasitologica*, 51, 111–118. DOI: 10.2478/s11686-006-0017-5.
- Moravec F., Vidal-Martínez V.M., Aguirre-Macedo M.L. 1995. *Philometra margolisi* n. sp. (Nematoda: Philometridae) from the gonads of the red grouper, *Epinephelus morio* (Pisces: Serranidae), in Mexico. *Canadian Journal of Fisheries and Aquatic Sciences (Suppl. 1)* 52, 161–165.
- Moravec F., Vidal-Martínez V.M., Vargas-Vázquez J., Vivas-Rodríguez C., González-Solís D., Mendoza-Franco E., Simá-Alvarez R., Güemez-Ricalde J. 1997. Helminth parasites of *Epinephelus morio* (Pisces: Serranidae) of the Yucatan Peninsula, southeastern Mexico. *Folia Parasitologica*, 44, 255–266.
- Parukhin A.M. 1976. Parasitic worms of commercial fishes of the southern seas. Naukova Dumka, Kiev, 183 pp. (In Russian.)
- Quiazon K.M.A., Yoshinaga T., Ogawa K. 2008. Taxonomical study into two new species of *Philometra* (Nematoda: Philometridae) previously identified as *Philometra lateolabracis* (Yamaguti, 1935). *Folia Parasitologica*, 55, 29–41.

**Received:** March 13, 2014

**Revised:** April 3, 2014

**Accepted for publication:** June 27, 2014