

# ***Philometra dissimilis* n. sp. from the ovary of *Johnius belangerii* (Sciaenidae) and other new records of philometrids (Nematoda: Philometridae) from fishes of the Bay of Bengal, India**

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## **Article info**

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## **Summary**

Based on light and scanning electron microscopical studies, a new gonad-infecting species of *Philometra* Costa, 1845, *P. dissimilis* n. sp. (Nematoda: Philometridae), is described from the marine fish (Belanger's croaker) *Johnius belangerii* (Cuvier) (Sciaenidae, Perciformes) in the Bay of Bengal, off the eastern coast of India. The species is mainly characterized by the body length of male 2.73 – 3.37 mm and that of gravid female 145 – 171 mm, needle-like, equal spicules 96 – 120 µm long, length of the gubernaculum 75 – 90 µm, distal end of the gubernaculum with lamellar structures forming a simple dorsal protuberance and by the V-shaped male caudal mound. *Philometra dissimilis* is the seventh known gonad-infecting species of this genus parasitizing sciaenid fishes. Moreover, an additional two species of *Philometra* (only females) were recorded from fishes in the Bay of Bengal: *P. lobotidis* Moravec, Walter et Yuniar, 2012 from the abdominal cavity of *Lobotis surinamensis* (Bloch) (Lobotidae, Perciformes), which is a new geographical record, and *Philometra* sp. from the ovary of *Platycephalus indicus* (Linnaeus) (Platycephalidae, Scorpaeniformes), representing probably an undescribed species.

**Keywords:** parasitic nematode; Dracunculoidea; marine fish; Sciaenidae; Indian Ocean

## **Introduction**

During recent helminthological investigations of some marine fishes in the Bay of Bengal, India, nematode specimens of the genus *Philometra* Costa, 1845 (Philometridae) were found in the ovaries of the Belanger's croaker *Johnius belangerii* (Cuvier) (Sciaenidae, Perciformes) and the bartail flathead *Platycephalus indicus* (Linnaeus) (Platycephalidae, Scorpaeniformes), and in the abdominal cavity of the Atlantic tripletail *Lobotes surinamensis* (Bloch) (Lobotidae, Perciformes). Their closer examination revealed that they represent one new, one known and one specifically unidentifiable species. Results of the evaluation of this material is presented herein. All the aforementioned host species are tropical or subtropical marine fishes which are widespread in the Indo-West Pacific

(*J. belangerii* and *P. indicus*) or in all oceans (*L. surinamensis*) and are targeted by commercial and recreational fisheries (Froese & Pauly, 2015).

## **Material 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 Pazhayar (11°21'N, 79°50'E) on the eastern coast of India. The nematodes collected from fish were washed in physiological saline and were then fixed and preserved in 4 % formalin. Philometrid males were dissected out from formalin-fixed fish ovaries. For light microscopy 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 & Pauly, 2015).

## Results

Family Philometridae Baylis et Daubney, 1926

### *Philometra dissimilis* n. sp.

(Figs. 1 – 3)

Description: Male (10 specimens; measurements of holotype in parentheses): Body filiform, whitish, 2.73 – 3.37 (3.02) mm long, maximum width at middle of body 48 – 60 (51); anterior part of body somewhat narrowed just posterior to cephalic end (Figs. 1E, 3C); body width at this narrowed part 27 – 33 (27). Maximum width/body length ratio 1:51 – 62 (1:59). Cuticle smooth. Cephalic end rounded, 39 – 45 (42) wide. Oral aperture small, triangular, surrounded by small circular elevation. 14 minute cephalic papillae arranged in two circles present: external circle formed by four submedian pairs of papillae (each pair consisting of one larger and one smaller papilla); internal circle by four submedian and two lateral papillae. Small lateral amphids just posterior to lateral papillae of internal circle, followed by fairly large lateral crescent-shaped formations of slightly elevated cuticle; additional short lateral rod-like cuticular elevations present just posterior to inner lateral papillae (Figs. 1C,D, 2C,E). Oesophagus 396 – 516 (516) long, comprising 13 – 17 % (17 %) of body length, with inflation at anterior end measuring 39 – 48 × 24 – 30 (48 × 24); posterior part of muscular oesophagus overlapped by well-developed oesophageal gland with large cell nucleus; maximum width of gland 18 – 24 (24). Nerve ring and oesophageal nucleus 147 – 180 (180) and 315 – 409 (360) from anterior extremity, respectively. Excretory pore 195 – 228 (225) from anterior end. Testis extending anteriorly to short distance posterior to level of excretory pore, overlapping thus posterior portion of oesophagus (Fig. 1E). Posterior end of body blunt, 36 – 42 (39) wide, provided with broad V-shaped mound situated laterally and dorsally to cloacal opening; anterior part of each arm of mound separated from posterior part by transverse groove (Figs. 1G,L,M, 2D,F, 3A). Four adanal pairs of very flat, hardly visible caudal papillae present on anterior parts of caudal mound; additional pair of larger subdorsal papillae situated posterior to cloacal aperture. Phasmids small, located at approximately middle of each of posterior arm of caudal mound, followed by pair of small shallow cuticular depressions situated more dorsally (Figs. 1G, 2D,F, 3A,B). Spicules slender, needle-like, equally

long, with somewhat expanded proximal and sharply pointed distal tips (Figs. 1L,M, 2D,F, 3D,E); length of spicules 96 – 120 (111), representing 3 – 4 % (4 %) of body length. Gubernaculum 75 – 90 (87) long, with anterior portion somewhat dorsally bent; length of anterior bent part 42 – 51 (45), representing 50 – 61 % (52 %) of entire gubernaculum length (Fig. 1K – M); posterior portion of gubernaculum markedly broad at anterior end, forming ventral tooth in lateral view; distal end of gubernaculum narrow, with 12 – 14 dorsal, transverse lamella-like structures forming distinct dorsal protuberance in lateral view (Figs. 1I – M, 2D,F, 3D,E). Length ratio of gubernaculum and spicules 1:1.21 – 1.39 (1:1.29). Spicules and gubernaculum well sclerotized; spicules and gubernaculum yellowish, anterior part of gubernaculum colourless.

Gravid female (2 complete larvigerous specimens; measurements of allotype in parentheses): Body of fixed specimens grey-white, with distinct dark-brown intestine visible through cuticle; body ends rounded. Posterior part of body narrower than anterior part; maximum width in region posterior to oesophagus. Cuticle smooth. Body length 145 (171) mm, maximum width 1.06 mm (1.29 mm); maximum width/body length ratio 1:137 (1:161). Cephalic end rounded, with two small lateral elevations (Figs. 1A,B, ); width of cephalic end 299 (340). Cephalic papillae small, indistinct when viewed laterally. Oral aperture oval, surrounded by four pairs of submedian cephalic papillae of external circle (each pair formed by one circular and one more elongate papilla) and six single papillae (two lateral and four submedian) of internal circle (Figs. 1B, 2A,B). Amphids indistinct. Two small lateral triangular cuticular elevations present somewhat posterior to inner lateral papillae. Oesophagus including anterior bulbous inflation 1.25 mm (1.16) mm long, comprising 0.9 % (0.6 %) of body length; anterior inflation 136 (109) long and 136 (109) wide; maximum width of oesophagus including gland 136 (163). Oesophageal gland relatively narrow, opening into oesophagus just posterior to nerve ring, with large cell nucleus in middle (Fig. 1A). Nerve ring and oesophageal nucleus 381 (340) and 884 (843) from anterior extremity, respectively. Small ventriculus 41 (41) long and 109 (109) wide. Oesophagus opening into intestine through distinct valve. Intestine narrow at anterior end; its posterior end narrow, attached by ligament ventrally to body wall near caudal end (Fig. 1H); ligament 408 (1,238) long. Vulva and anus absent. Ovaries reflected, situated near body ends (Fig. 1A,H). Uterus occupying most space of body, filled with numerous larvae with long, slender tail (Fig. 1F); larvae (n=5) from paratype 480 – 528 long and 18 wide; length of oesophagus 147 – 180, of tail 114 – 150, representing 31 – 34 % and 22 – 31 %, respectively, of entire body length of larva. Posterior end of female rounded, 408 (272) wide, without any caudal projections (Fig. 1H).

Subgravid female (2 complete and 4 incomplete ovigerous specimens): Body length 30 – 72 mm, maximum width 598 – 911; maximum width/body length ratio 1:50 – 79. Width of cephalic end 199 – 299. Cephalic papillae small, indistinct when viewed laterally.

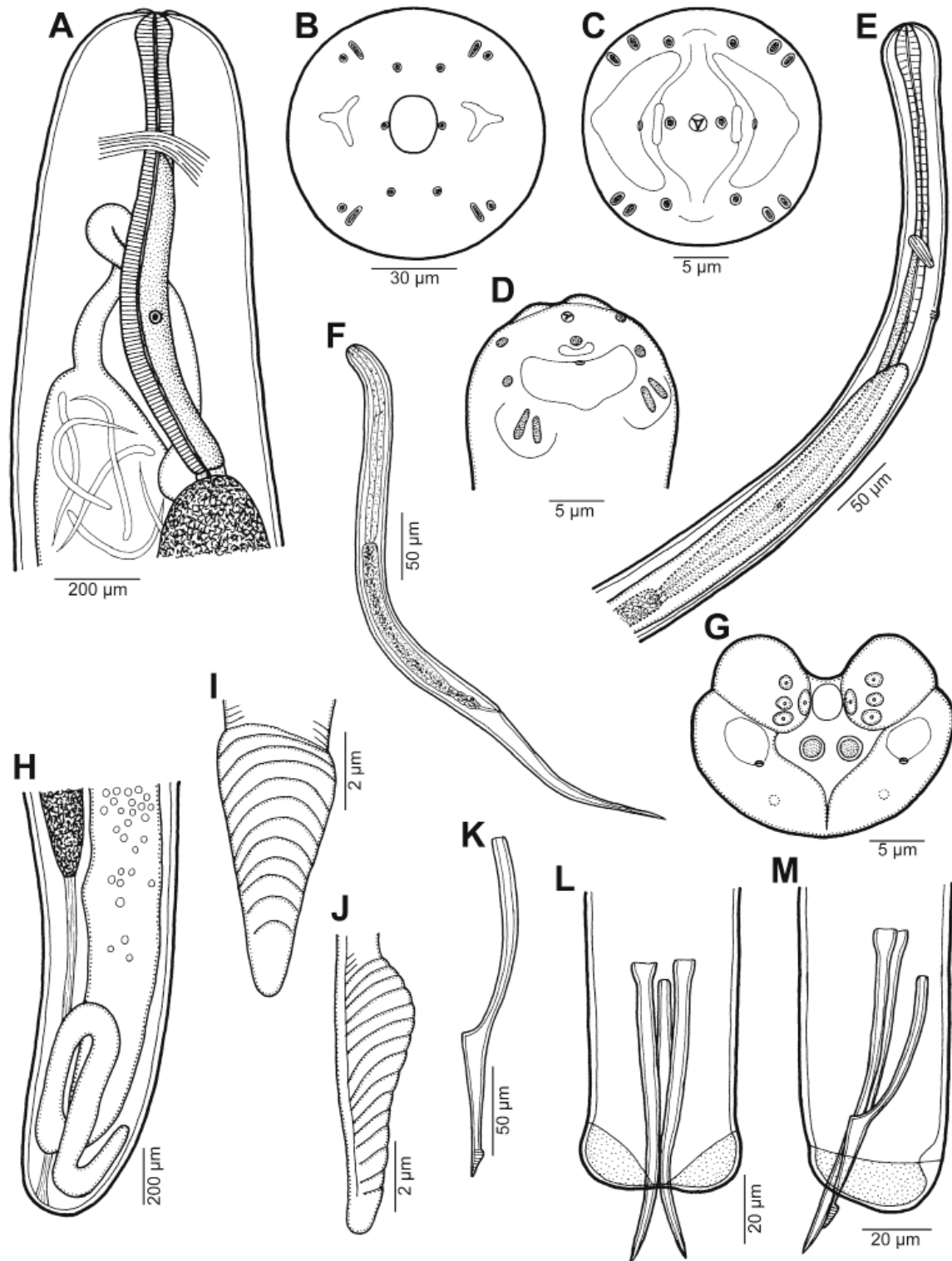


Fig. 1. *Philometra dissimilis* n. sp. A – anterior body end of gravid female, lateral view; B – cephalic end of subgravid female, apical view; C, D – cephalic end of male, apical and sublateral views, respectively; E – anterior body end of male, lateral view; F – larva from uterus, lateral view; G – caudal end of male, apical view; H – posterior end of gravid female, lateral view; I, J – distal end of gubernaculum, dorsal and lateral views, respectively; K – gubernaculum, lateral view; L, M – posterior end of male, ventral and lateral views, respectively

Oesophagus including anterior bulbous inflation 830 – 843 long, comprising 1.2 – 2.8 % of body length; anterior inflation 82 – 126 long and 82 – 122 wide; maximum width of oesophagus including gland 95 – 136. Nerve ring and oesophageal nucleus 218 – 299 and 571 – 666 from anterior extremity, respectively. Small ventriculus 27 long, 68 – 82 wide. Length of intestinal ligament 299 – 517. Uterus filled with spherical eggs. Posterior end of body rounded, 163 – 258 wide, without any caudal projections.

Nongravid female (1 mature specimen): Length of body 4.28 mm, maximum width 84; maximum width/body length ratio 1:51. Width of anterior end 57. Entire oesophagus 517 long and 36 wide. Anterior oesophageal bulb 48 long, 33 wide; ventriculus 27 long, 36 wide. Nerve ring and oesophageal nucleus 177 and 351 from anterior extremity, respectively. Vulva and incompletely developed vagina present; former situated 2.92 mm from anterior extremity (at 68 % of body length). Uterus empty. Posterior end rounded, without caudal projections.

#### Taxonomic summary

Type host: Belanger's croaker *Johnius belangerii* (Cuvier) (Sciaenidae, Perciformes), total body length (15 – 18 cm).

Site of infection: Ovary.

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

Prevalence and intensity: 20 % (4 fish infected/20 fish examined); mean intensity 24 nematode specimens per fish. A single fixed fish ovary contained 58 males and 2 gravid, 7 subgravid and 1 nongravid female nematodes.

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 – 1108).

Etymology: The specific name of this nematode *dissimilis* (= dissimilar, different, unlike) is a Latin adjective that relates to the fact that this species differs from the morphologically close *Philometra johnii*.

#### Remarks

At present, 67 gonad-infecting species of *Philometra* are known to parasitize marine fishes (Moravec & de Buron, 2013; Quiazon & Yoshinaga, 2013; Moravec & Diggles, 2014a, 2015; Moravec & Justine, 2014, 2015; Moravec & Manoharan, 2014a, b; Moravec et al., 2014a, 2016a, b; Moravec & Barton, 2015). However, as indicated by some recent studies of these nematodes from marine fishes, they exhibit a high degree of host specificity, when different morphologically well-distinguishable species of *Philometra* are recorded from different species of congeneric hosts in the same locality (Moravec & Manoharan, 2014a, b; Moravec et al., 2014a, 2016b). Therefore, it is possible to deal with these parasites according to the families of their fish hosts.

To date, the following six nominal gonad-infecting species of *Philometra* have been reported from fishes of the family Sciaenidae: *P. carolinensis* Moravec, de Buron et Roumillat, 2006 from *Cynoscion nebulosus* (Cuvier) and *Menticirrhus americanus* (Linnaeus), and *P. floridensis* Moravec, Fajer-Ávila et Bakenhaster, 2010 from *Sciaenops ocellatus* (Linnaeus), both off the Atlantic coast of the USA; *P. johnii* Moravec et Ali, 2013 from *Johnius dussumieri* (Cuvier) and *Johnius* sp. in the Persian Gulf and off northern Australia, respectively; *P. otolithi* Moravec et Manoharan, 2013 from *Otolithes ruber* (Bloch et Schneider) in the Bay of Bengal and the Persian Gulf; *P. protonibeeae* Moravec et Barton, 2015 from *Protonibea diacanthus* (Lacépède) off northern Australia; and *P. sciaenae* Yamaguti, 1941 from *Pennahia argentata* (Houttuyn) off Japan (Yamaguti, 1941; Moravec et al., 1998, 2006, 2010, 2013, 2014b; Quiazon et al., 2008a; Moravec & de Buron, 2009, 2013; Moravec & Ali, 2013, 2014; Moravec & Manoharan, 2013; Moravec & Diggles, 2014b; Moravec & Barton, 2015).

Moreover, *P. lateolabracis* (Yamaguti, 1935), a specific parasite of the Lateolabracidae, was reported from fishes belonging to six genera of the Sciaenidae (see Moravec, 2006; Quiazon et al., 2008b), but, in the view of the paper by Quiazon et al. (2008b), the nematodes from these hosts were evidently misidentified. An additional, poorly described species *P. rajani* Mukherjee, 1963, a parasite of *Eleutheronema tetradactylum* (Shaw), was reported from the ovary of some sciaenid fishes off India (Mohan, 1971; Mukherjee, 1963), but later it was designated as a *species inquirenda* (Moravec & Manoharan, 2013).

All of the above-mentioned valid species are easily distinguishable from *P. dissimilis* n. sp. by the morphology of the males and, in particular, by the structure of the distal end of the gubernaculum. In contrast to the new species, the gubernaculum of *P. carolinensis* and *P. floridensis* is smooth, not transversely lamellate, but possesses a distinct dorsal barb on its distal end. The gubernaculum of *P. johnii*, *P. otolithi*, *P. protonibeeae* and *P. sciaenae* is provided with many marked transverse lamella-like structures forming a distinct dorsal protuberance visible in lateral view, as in the new species. However, the dorsal protuberance on the gubernaculum of *P. johnii* and *P. otolithi* appears to be single in lateral view but in fact consists of two dorsolateral parts separated from each other by a smooth longitudinal field when observed dorsally; the dorsal protuberance on the gubernaculum of *P. sciaenae* is also bipartite, where no median smooth field between the two parts of the protuberance is present, but the lamella-like structures on the protuberance are interrupted dorsally by a median longitudinal line (Quiazon et al., 2008a). In contrast to *P. johnii*, *P. otolithi* and *P. sciaenae*, the protuberance on the gubernaculum of *P. dissimilis* n. sp. and *P. protonibeeae* is simple, without a division into two parts, and its lamella-like structures are not interrupted dorsally.

The new species differs from *P. protonibeeae* mainly in the absence of a small median triangular structure at the dorsal region anterior to the proximal end of the protuberance on gubernaculum, less numerous transverse lamella-like structures forming the protube-



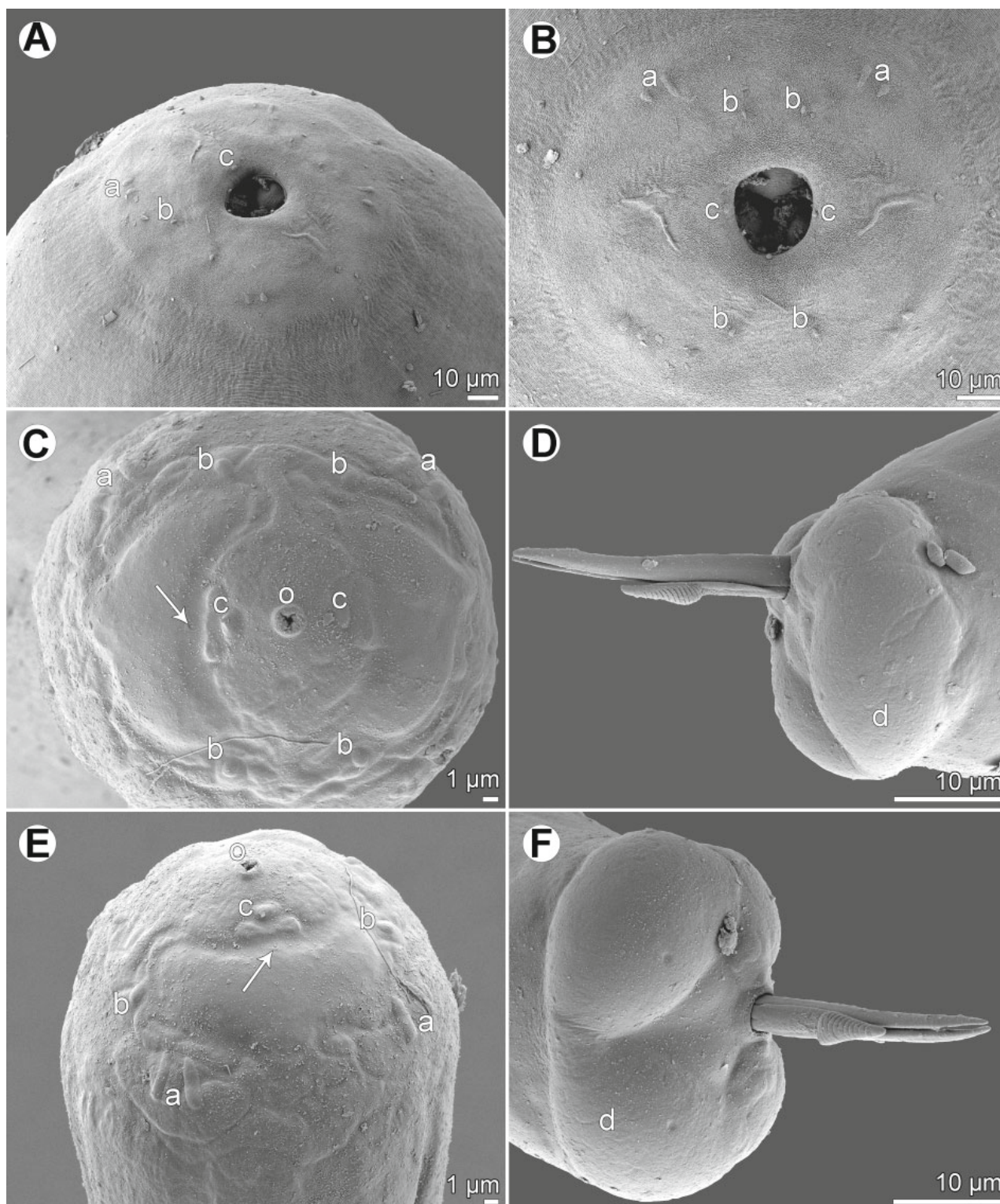


Fig. 2. *Philometra dissimilis* n. sp., scanning electron micrographs. A, B – cephalic end of gravid female, subapical and apical views, respectively; C – cephalic end of male, apical view (arrow indicates amphid); D – caudal end of male, lateral view; E – cephalic end of male, lateral view (arrow indicates amphid); F – caudal end of male, dorsal view. Abbreviations: a – submedian pair of papillae of external circle; b – submedian papilla of internal circle; c – lateral papilla of internal circle; d – caudal mound; o – oral aperture

rance (12 – 14 vs. 20) and the presence (vs. absence) of a pair of large caudal papillae located posterior to the cloacal opening; also in having shorter spicules (96 – 120  $\mu\text{m}$  vs. 126 – 141  $\mu\text{m}$ ), a somewhat different gubernaculum/spicules length ratio (1:1.21 – 1.39 vs. 1:1.40 – 1.62) and a shorter oesophagus in the gravid female (1.16 – 1.25 mm vs. 1.56 – 2.49 mm).

It has been mentioned above that *P. johnii* is the only other valid gonad-infecting species of *Philometra* parasitizing *Johnius* spp. In addition to the different structure of the gubernaculum (see above), *P. johnii* differs from *P. dissimilis* n. sp. in the shape of the caudal mound (mound consisting of two lateral, reniform parts distinctly separated from each other dorsally vs. mound V-shaped), the body length of males (2.19 – 2.34 mm vs. 2.73 – 3.37 mm), the length of gubernaculum (60 – 72  $\mu\text{m}$  vs. 75 – 90  $\mu\text{m}$ ) and the

gubernaculum/spicules length ratio (1:1.55–2.55 vs. 1:1.21–1.39). The fact that two morphologically different gonad-infecting species of *Philometra* occur in congeneric hosts (*J. dussumieri* and *J. belangerii*) in the same geographical region (region of the Indian Ocean) indicates a high degree of the host specificity of these parasites in sciaenids. Previously, such a high degree of host specificity was found in gonad-infecting *Philometra* spp. in fishes of the Serranidae (Moravec & Justine, 2014; Moravec & Manoharan, 2014a; Moravec et al., 2016b) and Lutjanidae (Moravec & Manoharan, 2014b; Moravec et al., 2014a).

Moravec & Diggles (2014b) reported *P. johnii* from the ovary of *Johnius* sp. off the coast of northern Australia. However, because no conspecific males were available and considering the above-mentioned high degree of host specificity of gonad-infecting

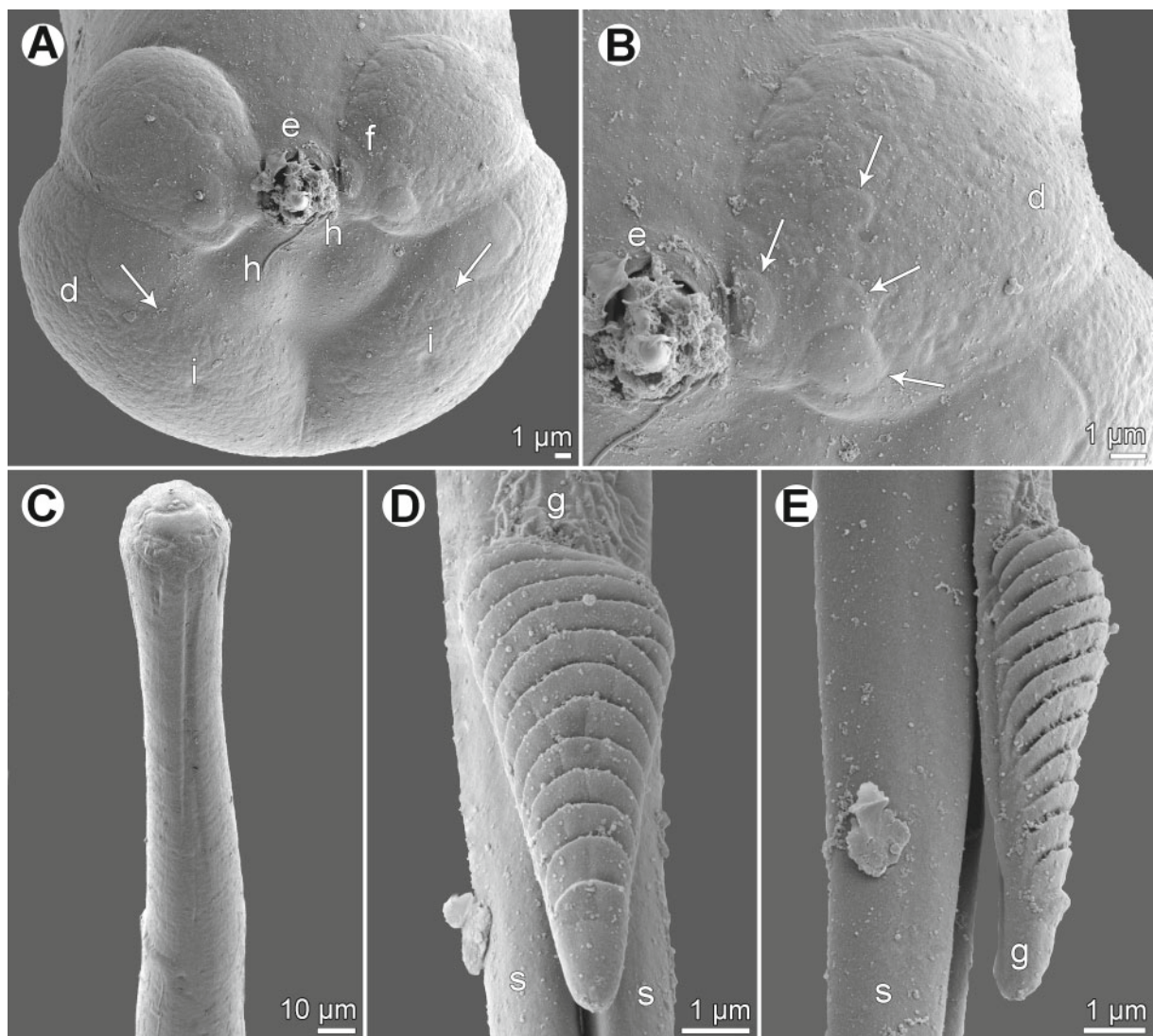


Fig. 3. *Philometra dissimilis* n. sp., scanning electron micrographs of male. A – caudal end, apical view (arrows indicate phasmids); B – region of cloacal aperture, apical view (arrows indicate adanal papillae); C – anterior end of body, lateral view; D, E – distal end of gubernaculum, dorsal and lateral views, respectively.

Abbreviations: d – caudal mound; e – cloacal aperture; f – group of four adanal papillae; g – gubernaculum; h – large submedian papilla situated posterior to cloaca; i – small caudal cuticular depression; s – spicule



*Philometra* spp. in sciaenids, this identification is not reliable and the respective nematode from *Johnius* sp. should be reported as *Philometra* sp.

Gonad-infecting philometrids (only females) from *J. belangerii* in India were already reported by Mohan (1971), who identified them as *P. rajani*. However, *P. rajani* [species inquirenda] is a parasite of *E. tetradactylum* (Polynemidae) (see above), so that this identification was most probably wrong (Moravec & Ali, 2013). Gonad-infecting philometrids designated as *Philometra* sp. were also reported by Moravec & Manoharan (2013) based on available female specimens collected from *J. belangerii* in the Bay of Bengal, off India. In our opinion, the philometrids from *J. belangerii* reported by Mohan (1971) and Moravec & Manoharan (2013) belonged to *P. dissimilis* n. sp.

#### ***Philometra lobotidis* Moravec, Walter et Yuniar, 2012**

Description: Gravid female (3 body fragments of 2 specimens): Body grey-white with brown-coloured intestine visible through cuticle. Available fragment of anterior portion of body 140 mm long, maximum width 2.41 mm. Width of cephalic end 680. Cephalic end rounded, cephalic papillae very small, indistinct when viewed laterally. Oesophagus 2.58 mm long, 326 wide including oesophageal gland; anterior bulbous inflation markedly broad, 163 long and 286 wide. Ventriculus small, 54 long, 122 wide. Nerve ring and oesophageal nucleus 286 and 1.306, respectively, from anterior extremity. Uterus filled with larvae 498 – 510 long, maximum width 18 – 21; length of their oesophagus 156 – 171, representing 31 – 34 % of body length; sharply pointed tail 144 – 150 long, representing 28 – 30 % of body length. Posterior end of female rounded, 680 – 748 wide, without any caudal projections.

##### **Taxonomic summary**

Host: Atlantic tripletail *Lobotes surinamensis* (Bloch) (Lobotidae, Perciformes), total body length 61 – 73 cm.

Site of infection: Abdominal cavity.

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

Prevalence and intensity: 10 % (10 fish infected/100 fish examined); mean intensity 2 nematode specimens per fish.

Voucher specimens: Helminthological Collection of the Institute of Parasitology, Biology Centre of the Czech Academy of Sciences, České Budějovice (Cat. No. N-984).

##### **Remarks**

Although only female body fragments were available, the species identification as *P. lobotidis* could be made on the basis of morphological features, in particular the structure of oesophagus and caudal end, the same host species, the same location in the host and the distribution in the Indian Ocean. The first-stage larvae of the Indian specimens were found to be somewhat longer than

those reported in the original species description, but this may be considered to be within the intraspecific variability of this species. On the other hand, the shape of the anterior bulbous oesophageal inflation (short and markedly wide) found in the specimens of the present material is typical of *P. lobotidis*.

*Philometra lobotidis* was originally described solely from gravid females found in the abdominal cavity of *L. surinamensis* off the southern coast of Java, Indonesia (Indian Ocean) (Moravec et al., 2012) and it has not been recorded since. This is the first finding of this parasite in Indian waters. It shows that *P. lobotidis* may be widespread within the Indo-West Pacific range of its fish host, *L. surinamensis*.

#### ***Philometra* sp. 2 of Moravec, Ali, Shaker et Abed, 2016**

Description: Gravid female (1 larvigerous specimen without body ends): Available body fragment 93 mm long, maximum width 1.29 mm. Body grey-brown, with dark brown intestine visible through cuticle. Uterus filled with numerous larvae with long, slender tail; larvae (n=5) from 420 – 441 long and 12 – 15 wide; length of oesophagus 123 – 135, of tail 126 – 141, representing 28 – 31 % and 30 – 32 %, respectively, of entire body length of larva.

##### **Taxonomic summary**

Host: Bartail flathead, *Platycephalus indicus* (Linnaeus) (Platycephalidae, Scorpaeniformes); total body length 54 – 67 cm.

Site of infection: Ovary.

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

Prevalence and intensity: 5 % (2 fish infected/10 fish examined); 1 nematode specimen.

Voucher specimen: Helminthological Collection, Institute of Parasitology, Biology Centre of the Czech Academy of Sciences, České Budějovice (Cat. No. N-1100).

##### **Remarks**

Moravec et al. (2016a) reported *Philometra* sp. 2 from the ovary of *P. indicus* in the Persian Gulf off Iraq, based on two nongravid nematode females and the caudal end of the gravid female at their disposal. Since the only available Indian specimen of the present material was found in the ovary of the same host species also from the region of the Indian Ocean, we consider it conspecific with the above-mentioned nematodes of Moravec et al. (2016a).

According to Moravec et al. (2016a), *Philometra* sp. 2 probably represents a new species. They mention that it may be identical with nematodes described by Moravec & Nagasawa (1989) from the gonads of *P. indicus* in Japan, which were assigned to an inadequately described *P. inimici* Yamaguti, 1941, a species originally described from the abdominal cavity of *Inimicus japonicus* (Cuvier) (Synanceiidae). However, a prerequisite for the future description of a new species of *Philometra* parasitizing the gonads

of *P. indicus* is to collect well-preserved specimens, preferably including the males.

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