DOI: 10.2478/s11686-013-0139-5

Acta Parasitologica, 2013, 58(3), 263–268; ISSN 1230-2821

VERSITA

Philometra johnii sp. nov. (Nematoda, Philometridae), a new gonad-infecting philometrid from the sin croaker *Johnius dussumieri* (Cuvier) (Perciformes, Sciaenidae) from marine waters of Iraq

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Abstract

A new nematode species, *Philometra johnii* sp. nov. (Philometridae), is described from male and female specimens found in the ovary of the sin croaker, *Johnius dussumieri* (Cuvier) (Perciformes, Sciaenidae), in the Arabian Gulf, off the southern coast of Iraq. Based on light and scanning electron microscopical examination, the new species differs from all other gonad-infecting *Philometra* spp. with dorsal lamella-like structures on the distal tip of the gubernaculum in having a dorsal bipartite protuberance formed by two subdorsal lamellated parts separated from each other by a smooth longitudinal field. This gubernaculum structure is unique among all philometrids. Other distinguishing features include the structure of the male tail, number (6 pairs) and arrangement of genital papillae and the length of spicules (102–153 µm). From eight congeneric, gonad-infecting species with unknown males, the new species can be distinguished by some morphological and biometrical features found in gravid females (absence of caudal projections, length of oesophagus, moderately developed anterior oesophageal inflation, length of first-stage larvae) by the host type (fish family) and geographical distribution. *Philometra johnii* sp. nov. is the fourth known philometrid species recorded from marine waters of Iraq.

Keywords

Parasitic nematode, *Philometra*, new species, marine fish, *Johnius*, Iraq, Arabian Gulf

Introduction

Gonad-infecting species of philometrid nematodes (Philometridae) may be severely pathogenic in fish ovaries and can affect reproduction (Moravec and de Buron 2013). They are widely distributed in marine fishes in tropical and subtropical regions of the Atlantic, Indian and Pacific Oceans, sometimes also occurring in brackish-water environments (Moravec and Manoharan 2013).

Within the Indian Ocean region, the fauna of philometrid nematodes parasitizing marine fishes in the Arabian (= Persian) Gulf remains little studied (El-Nafar *et al*. 1992; Kardousha 1992, 1999; Petter and Sey 1997; Moravec and Ali 2005; Mohamed *et al*. 2010; Moravec *et al*. 2012). To date, only four nominal species of *Philometra* Costa, 1845 (*P. globiceps* (Rudolphi, 1819), *P. lateolabracis* (Yamaguti, 1935), *P. strongylurae* Moravec et Ali, 2005 and *P. tylosuri* Moravec et Ali, 2005) and one of *Philometroides* Yamaguti, 1935 (*P. acanthopagri* Moravec, Jassim et Al-Salim, 2012) have been reported from there from hosts belonging to different fish families (Belonidae, Carangidae, Lutjanidae, Mugilidae, Psettotidae, Scombridae, Serranidae, Synodontidae and Trichiuridae). Moreover, two *Philometra* spp., *P. ivaschkini* Parukhin, 1976 and *P. lateolabracis*, were reported from off the nearby coast of Oman (Parukhin 1976). However, as indicated by Moravec *et al*. (2012), all the numerous records of gonad-infecting *P. lateolabracis* and *P. globiceps* from this region were based on misidentifications and, until new studies are carried out, these nematodes should be designated as *Philometra* sp.

During parasite studies of marine fishes of the Arabian Gulf, off the coast of southern Iraq, specimens of a previously undescribed species of *Philometra* were recovered from the ovaries of the sin croaker *Johnius dussumieri* (Cuvier) (Sciaenidae, Perciformes). This new nematode species is described

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herein. *Johnius dussumieri* (maximum body length 40 cm) is a tropical, marine commercial fish distributed in the Indian Ocean region from Pakistan to Andaman Islands. It is found in coastal waters and enters estuaries (Froese and Pauly 2013).

Materials and Methods

Fish were collected by fixed gill nets and a trawl net in the Arabian Gulf from off Khor Al-Ummia, Basrah (48°28′E, 28°55′N), southern Iraq during May and July 2012. The nematodes obtained from fish gonads were washed in physiological saline and were then fixed and preserved in 4% formaldehyde solution. Philometrid males were dissected out from formalin-fixed fish ovaries. For light microscopy (LM) examination, the nematodes were cleared with glycerine. Drawings were made with the aid of a Zeiss drawing attachment. Specimens used for 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 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 2012).

Results

***Philometra johnii* sp. nov.** (Figs 1 and 2)

Description: Male (4 specimens; measurements of holotype in parentheses). Body filiform, whitish, 2.19–2.34 (2.20) mm long, maximum width at middle 36–51 (36); anterior part of body narrower than middle and posterior parts. Maximum width/body length 1: 46–61 (1: 61); width of cephalic end 21–24 (24), that of posterior end 27–33 (33). Cuticle smooth. Cephalic end rounded. Oral aperture small, triangular, surrounded by 14 small cephalic papillae arranged in two circles: external circle formed by four submedian pairs of papillae (each pair consisting of one circular and one narrower, more elongate papilla); internal circle by four submedian and two lateral papillae. Small lateral amphids just posterior to lateral papillae of internal circle (Figs 1D; 2A, B). Oesophagus 315–417 (393) long, maximum width 21–24 (21), comprising 14–18 (18)% 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. 1H); anterior oesophageal inflation 12–18 (18) long and 12–15 (15) wide; oesophageal nucleus and nerve ring 237–279 (258) and 102–147 (120), respectively, from anterior extremity. Excretory pore not found. Testis reaching anteriorly nearly to level of nerve ring (Fig. 1H). Posterior end of body blunt, with broad, two-lobed, kidney-shaped, lateral mounds; dorsal ends of these mounds far from each other (Figs 1O; 2E, F). One pair of preanal, two pairs of adanal and one pair of postanal very flat, hardly visible caudal papillae close to each other near cloacal aperture on mounds (Figs 1O; 2E, F); additional pair of small subdorsal postanal papillae present near middle of mounds; pair of larger subdorsal papillae situated posterior to cloacal aperture, at level of middle part of lateral mounds (Figs 1O; 2C, E, F). Phasmids not observed. Spicules slender, needle-like, equal or slightly subequal, with somewhat expanded proximal and sharply pointed distal tips (Figs 1L, M; 2C, D); length of spicules 102–153 (132), comprising 6–7 (6)% of body length. Gubernaculum narrow, 60–72 (72) long, with anterior portion somewhat dorsally bent; length of anterior bent part 21–36 (33), representing 35–55 (46)% of entire gubernaculum length; posterior end of gubernaculum with dorsal protuberance and numerous transverse lamella-like structures, rounded (Figs 1J, L-N; 2C, D). Length ratio of gubernaculum and spicules 1 : 1.55–2.55 (1 : 1.83). Spicules and gubernaculum well sclerotized; yellowish, anterior part of gubernaculum colourless.

Gravid female (3 larvigerous specimens; measurements of allotype in parentheses). Body of fixed specimens whitish, with distinct dark-brown intestine visible through cuticle, with rounded ends. Posterior part of body narrower than anterior part; maximum width in region posterior to oesophagus. Cuticle smooth. Body length 96–170 (170) mm, maximum width 680–1,074 (1,074), maximum width/body length ratio 1 : 141–189 (1 : 158). Width of cephalic end 204 (204). Cephalic papillae small, indistinct when viewed laterally (Fig. 1A, B). Oral aperture oval to somewhat triangular, surrounded by four pairs of submedian cephalic papillae of external circle and six single papillae (two lateral and four submedian) of internal circle (Fig. 1C). Amphids indistinct. Oesophagus including slightly outlined anterior bulbous inflation 843–966 (966) long, comprising 0.6–0.9 (0.6)% of body length; anterior inflation 82–109 (109) long and 95–122 (122) wide; maximum width of oesophagus including gland 82–136 (109). 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 272 (272) and 571–612 (571), respectively, from anterior extremity. Small ventriculus 27–41 (27) long and 68–82 (82) wide. Oesophagus opening into intestine through distinct valve (Fig. 1A). Intestine narrow at anterior end; its posterior end narrow, attached by ligament ventrally to body wall near caudal end (Fig. 1I); ligament 462–639 (462) long. Vulva and anus absent. Ovaries long, reflected, situated near body ends (Fig. 1A, I). Uterus occupying most space of body, filled with numerous larvae with long, slender tail (Fig. 1G); larvae (n = 5) in one paratype 459–492 long and 18 wide; length of oesophagus 144–150, of tail 123–150, representing 30–32% and 27–31%, respectively, of entire body length of larva. Posterior end of female rounded, 109–272 (272) wide, without any caudal projections (Fig. 1I).

Subgravid female (5 ovigerous specimens). Body length 19.20–32.87 mm, maximum width 190–354; maximum

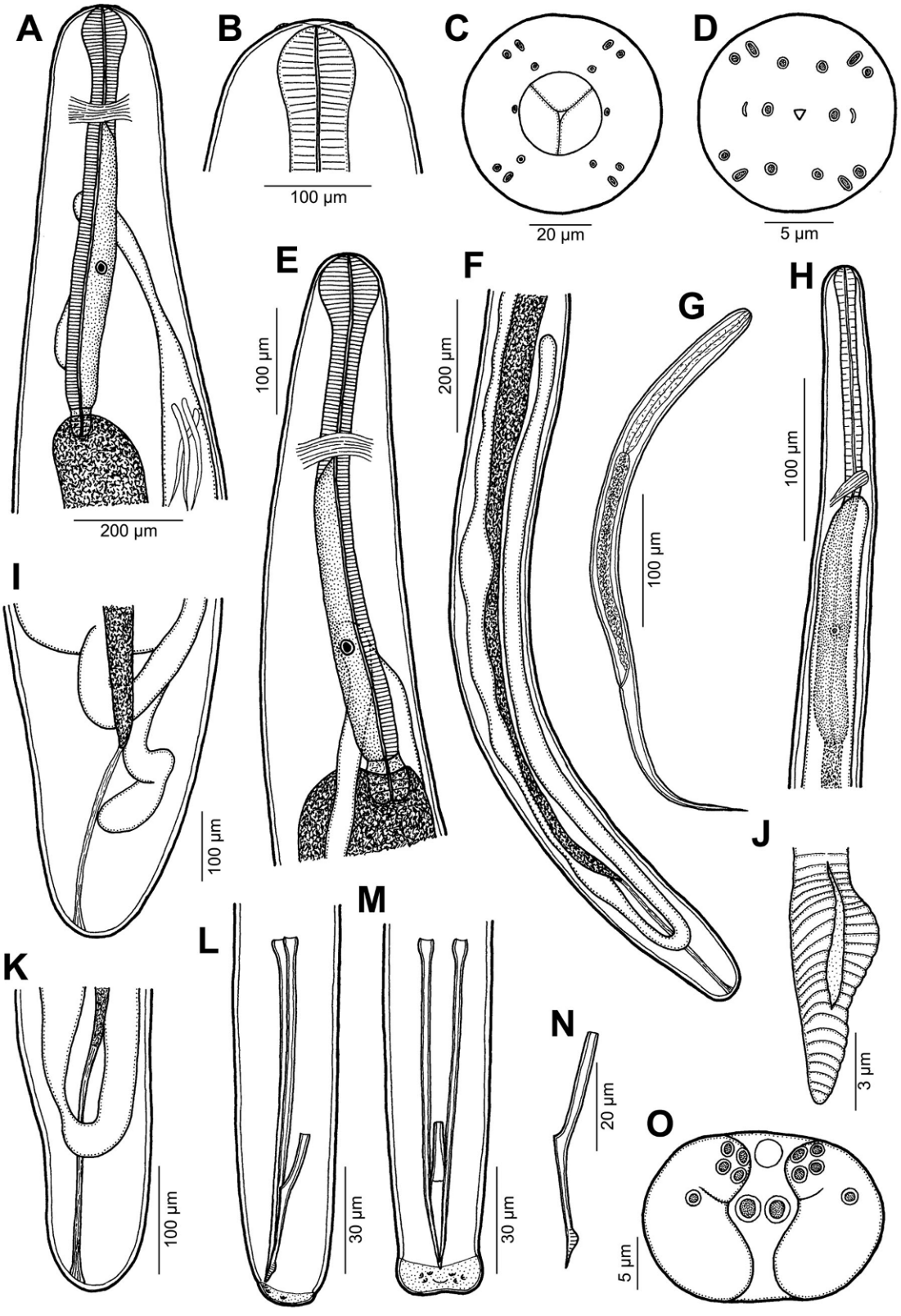

Fig. 1. *Philometra johnii* sp. nov.: **A** – anterior end of gravid female, lateral view. **B** and **C** – cephalic end of gravid female, lateral and apical views. **D** – cephalic end of male, apical view. **E** and **F** – anterior and posterior ends of subgravid female, lateral views. **G** – larva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

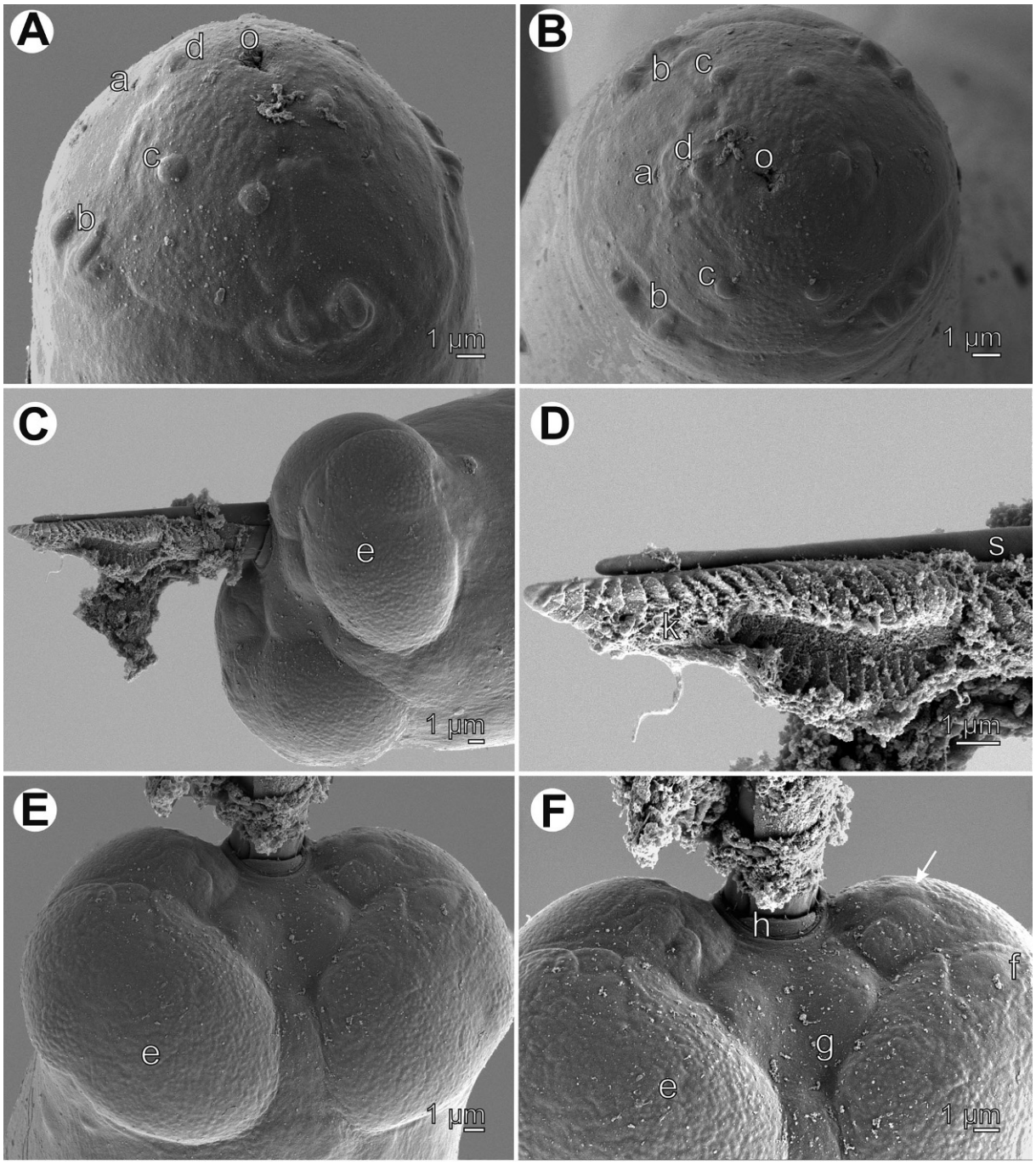

Fig. 2. *Philometra johnii* sp. nov., scanning electron micrographs of male: **A** and **B** – cephalic end, subapical and apical views. **C** – caudal end with protruded gubernaculum and spicules, subdorsal view. **D** – protruded gubernaculum and spicule (enlarged), subdorsal view. **E** – caudal end, apical view. **F** – region of cloacal aperture, apical view (arrow indicates a group of four genital papillae located near cloacal aperture). **Abbreviations: a** – amphid; **b** – pair of external submedian cephalic papillae; **c** – internal submedian cephalic papilla; **d** – internal lateral cephalic papilla; **e** – caudal mound; **f** – subdorsal genital papilla of last postanal pair situated on caudal mound; **g** – papilla of dorsal postanal pair; **h** – cloacal aperture; **k** – gubernaculum; **o** – oral aperture; **s** – spicule

width/length ratio 1 : 51–93. Width of anterior end 68–150, of posterior end 41–109. Entire oesophagus 517–707 long, representing 2.0–4.3% of body length, and 41–54 wide. Anterior oesophageal bulb 66–75 × 51–72, ventriculus 15–27 × 33–45. Nerve ring and oesophageal nucleus 190–218 and 367–435, respectively, from anterior extremity. Intestinal lig-

ament 272–1,700 long. Vulva and vagina absent. Uterus filled with many eggs.

Type host: Sin croaker, *Johnius dussumieri* (Cuvier) (Sciaenidae, Perciformes) (body length 15–19 cm).

Site of infection: Gonad (ovary).

Type locality: Arabian Gulf, off Khor Al-Ummia, Basrah (48°28´E, 28°55´N), southern Iraq (collected in May and July 2012).

Prevalence and intensity: Larger females only: 19% (6 fish infected/32 fish examined); 1–4 (mean 2) nematode specimens per fish. Of two fixed fish ovaries, one contained 1 male and a female body fragment, whereas the other one 3 males.

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-1005).

Etymology: The specific name of this nematode relates to the genitive form of the generic name of the host.

Discussion

At present, 36 gonad-infecting species of *Philometra* are known to infect marine and brackish-water fishes (Moravec and Manoharan 2013). Of them, only the following 13 species possess numerous dorsal or lateral lamella-like structures on the posterior end of the gubernaculum: *P. brevicollis* Moravec et Justine, 2011, *P. charlestonensis* Moravec, de Buron, Baker et González-Solís, 2008, *P. cyanopodi* Moravec et Justine, 2008, *P. genypteri* Moravec, Chávez et Oliva, 2011, *P. gerrei* Moravec et Manoharan, 2013, *P. lateolabracis* (Yamaguti, 1935), *P. madai* Quiazon, Yoshinaga et Ogawa, 2008, *P. nemipteri* Luo, 2001, *P. priacanthi* Moravec et Justine, 2009, *P. saltatrix* Ramachandran, 1973, *P. sciaenae* Yamaguti, 1941, *P. scomberomori* (Yamaguti, 1935) and *P. terapontis* Moravec, Gopalakrishnan, Rajkumar, Saravanakumar et Kaliyamoorthy, 2011 (see Quiazon *et al*. 2008a, b; Moravec and Justine 2009, 2011; Moravec *et al*. 2008, 2011a, b; Moravec and Manoharan 2013). Of these, a distinct dorsal protuberance near the distal extremity of the gubernaculum, which occurs in the new species, is also present only in *P. gerrei*, *P. lateolabracis*, *P. priacanthi* and *P. terapontis*.

However, the dorsal protuberance on the gubernaculum of the new species appears as single in lateral view, but, in fact, it consists of two dorsolateral parts separated from each other by a narrow, smooth longitudinal field when observed dorsally (Figs 1J, N; 2C, D). This is a unique feature among all philometrids. Quiazon *et al*. (2008b) illustrated a bipartite dorsal protuberance on the gubernaculum of *P. sciaenae*, but although the transverse lamella-like structures on the protuberance were dorsally interrupted by a median longitudinal line, there was no median smooth field between the two parts of the protuberance. To date, a dorsal smooth field separating lateral transverse lamella-like structures has been observed on the distal end of the gubernaculum only in *P. brevicollis*, but the gubernaculum of that species has no protuberance at its distal end (Moravec and Justine 2011).

Of the four species possessing a dorsal protuberance on the gubernaculum, *P. priacanthi* also differs from the new species in the male body length (3.01–3.60 vs 2.19–2.34 mm) and in that the male caudal mound is not separated dorsally; *P. terapontis* in a different number and arrangement of caudal papillae, the male caudal mound not separated dorsally and in the presence of small papilla-like caudal projections in female; *P. lateolabracis* in the shape and size of the oral aperture in large females (triangular and small vs almost circular and large); and *P. gerrei* in the number of genital papillae (6 vs 5 pairs) in the male.

Eight gonad-infecting species of *Philometra*, *P. inimici* Yamaguti, 1941, *P. managatuwo* Yamaguti, 1941, *P. neolateolabracis* Rajyalakshmi, Hanumantha Rao et Shyamasundari, 1985 [*species inquirenda*], *P. neptomeni* Mateo, 1972, *P. otolithi* Moravec et Manoharan, 2013, *P. rajani* Mukherjee, 1963 [*species inquirenda*], *P. sebastisci* Yamaguti, 1941 and *P. serranellicabrillae* Janiszewska, 1949 are known only from females with a rather uniform morphology. Conspecific males have not subsequently been discovered for these nominal species.

However, in contrast to the new species, gravid females of all these species are noted for the well-developed bulbous inflation of the anterior end of the oesophagus. Moreover, *P. otolithi* can be differentiated by the large buccal cavity provided with many conspicuous transverse lamellae; *P. rajani* allegedly by the presence of spines on the caudal end of the gravid female; the body length of gravid females of *P. serranellicabrillae* is distinctly smaller (40–60 vs 96–170 mm) and that of *P. managatuwo* (445–460 mm) distinctly greater; and the larvae of *P. sebastisci* are markedly shorter (264–350 vs 459–492). *Philometra inimici* differs in the order of its fish hosts (Scorpaeniformes vs Perciformes), whereas *P. neptomeni* in the host family (Centrolophidae vs Sciaenidae) and the geographical region (Pacific Ocean, off Peru vs Arabian Gulf, Indian Ocean, off Iraq) (Moravec 2006; Moravec and Manoharan 2013).

Of the above-mentioned gonad-infecting *Philometra* spp. described solely from females, *P. neolateolabracis* and *P. rajani* are the only two nominal species reported from the same fish family (Sciaenidae) as *P. johnii* sp. nov. However, the former species *P. neolateolabracis* was inadequately described based on a single subgravid female from *Pennahia argentata* (Houttuyn) (reported as *Johnius argentatus*) off India (Rajyalakshmi *et al*. 1985) and was designated a *species inquirenda* by Moravec *et al*. (2011b). The latter species *P. rajani* was inadequately described solely from females recovered from *Eleutheronema tetradactylum* (Shaw) (Polynemidae) and *P. argentata* from an unknown locality (probably off India) (Mukherjee 1963) and was designated a *species inquirenda* by Moravec and Manoharan (2013). It may well be that both *P. neolateolabracis* and the specimens from *P. argentata* identified as *P. rajani* were conspecific with *P. sci-*

aenae, a philometrid described from the gonads of the same host species off Japan (Yamaguti 1941; Moravec *et al*. 1998; Quiazon *et al*. 2008b).

In contrast, *P. rajani* is probably a different species, because its type host is *E. tetradactylum* (see Moravec and Manoharan 2013) belonging to a different family. Mohan (1971) reported *P. rajani* from sciaenids *Johnius dussumieri*, *J. belangerii* (Cuvier), *Nibea maculata* (Bloch et Schneider) and *Pennahia anea* (Bloch) off southern India, but this identification was most probably wrong. It may well be that at least Mohan's specimens from *J. dussumieri* were conspecific with *P. johnii* sp. nov. Gonad-infecting philometrids from off southern India have recently been reported from *J. belangerii* by Moravec and Manoharan (2013), but because only subgravid females were available, they have been identified as *Philometra* sp.; they also might belong to *P. johnii*. *Philometra johnii* is the fourth known philometrid species recorded from marine waters of Iraq.

Acknowledgements. We thank the Department of Fisheries and Marine Resources, College of Agriculture, University of Basrah, Basrah, Iraq for providing space and resources for this research. 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 by institutional support (RVO:60077344, Institute of Parasitology, BC, ASCR).

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(Accepted March 25, 2013)