

Research Article

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Five species of *Philometra* Costa, 1845 (Nematoda: Philometridae) newly recorded from marine fishes in Iraq, including the description of *P. arabiensis* sp. n. from the ovary of the shrimp scad *Alepes djedaba* (Carangidae)

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Abstract: Recent examinations of some marine fishes from off the southern coast of Iraq revealed the presence of five species of *Philometra* Costa, 1845 (Nematoda: Philometridae): *Philometra arabiensis* sp. n. (males and females) from the ovary of the shrimp scad *Alepes djedaba* (Forsskal) (Carangidae, Carangiformes), *Philometra psettoditis* Moravec, Walter et Yuniar, 2012 (females) from the body cavity of the Indian halibut *Psettodes erumei* (Bloch et Schneider) (Psettodidae, Pleuronectiformes), *Philometra terapontis* Moravec, Gopalakrishnan, Rajkumar, Saravanakumar et Kaliyamoorthy, 2011 (female) from the ovary of the jarbua terapon *Terapon jarbua* (Forsskal) (Terapontidae, Centrarchiformes), *Philometra* sp. (females) from the ovary of the Arabian blackspot threadfin *Polydactylus mullani* (Hora) (Polynemidae, Carangiformes) and *Philometra* sp. 2 of Moravec et al. (2016a) (females) from the ovary and body cavity of the bartail flathead *Platycephalus indicus* (Linnaeus) (Platycephalidae, Perciformes). *Philometra arabiensis* sp. n. is mainly characterised by the length of spicules (198–243 µm) and gubernaculum (75–99 µm), the gubernaculum/spicule length ratio (1 : 2.33–2.79), the structure of the gubernaculum distal portion and the male caudal end, and the body length of males (1.86–2.73 mm). The present findings of *P. psettoditis* and *P. terapontis* in fishes of the Arabian Gulf represent new geographical records for these parasites.

Keywords: Parasitic nematodes, Dracunculoidea, taxonomy, hosts, Arabian Gulf.

Philometrid nematodes (Philometridae) are common tissue-dwelling parasites of freshwater, brackish-water and marine fishes throughout the world (Moravec 2023). The present knowledge of these important parasites occurring in fishes of the Arabian (= Persian) Gulf was reviewed by Moravec et al. (2021a).

During recent helminthological investigations of some marine fishes in the Arabian Gulf, off the coast near Basrah, southern Iraq, specimens of *Philometra* Costa, 1845 were found in the shrimp scad *Alepes djedaba* (Forsskal) (Carangidae, Carangiformes), the Indian halibut *Psettodes erumei* (Bloch et Schneider) (Psettodidae, Pleuronectiformes), the jarbua terapon *Terapon jarbua* (Forsskal) (Terapontidae, Centrarchiformes), the Arabian blackspot threadfin *Polydactylus mullani* (Hora) (Polynemidae, Carangiformes) and the bartail flathead *Platycephalus indicus* (Linnaeus) (Platycephalidae, Perciformes). Results of their closer examination are described below.

Alepes djedaba often forms large schools, feeds mostly on small planktonic crustaceans and occasionally on small

fishes (Carpenter et al. 1997). *Psettodes erumei* feeds on substratum-living animals, mainly fishes (Carpenter et al. 1997). *Terapon jarbua* is omnivorous, feeds on fishes, algae, insects and sand-dwelling invertebrates. *Polydactylus mullani*, recently reported from Iraqi marine waters (Ali et al. 2021), feeds on shrimps and small fishes (Froese and Pauly 2022). *Platycephalus indicus* is mainly piscivorous, sometimes feeding on shrimps, crabs and cuttlefish (Hashemi et al. 2013). All these fish species are utilised as food fishes in Iraq and other countries in the Gulf.

MATERIALS AND METHODS

The fishes examined were caught by trawl net during December 2021 till May 2022. The nematodes recovered were washed in physiological saline and then fixed in hot 5% formalin. For light microscopical examination (LM), they were cleared with glycerine. Drawings were made with the aid of a Zeiss microscope drawing attachment. Specimens used for scanning electron microscopical examination (SEM) were postfixed in 1% osmium tetroxide (in phosphate buffer), dehydrated through a graded acetone series,

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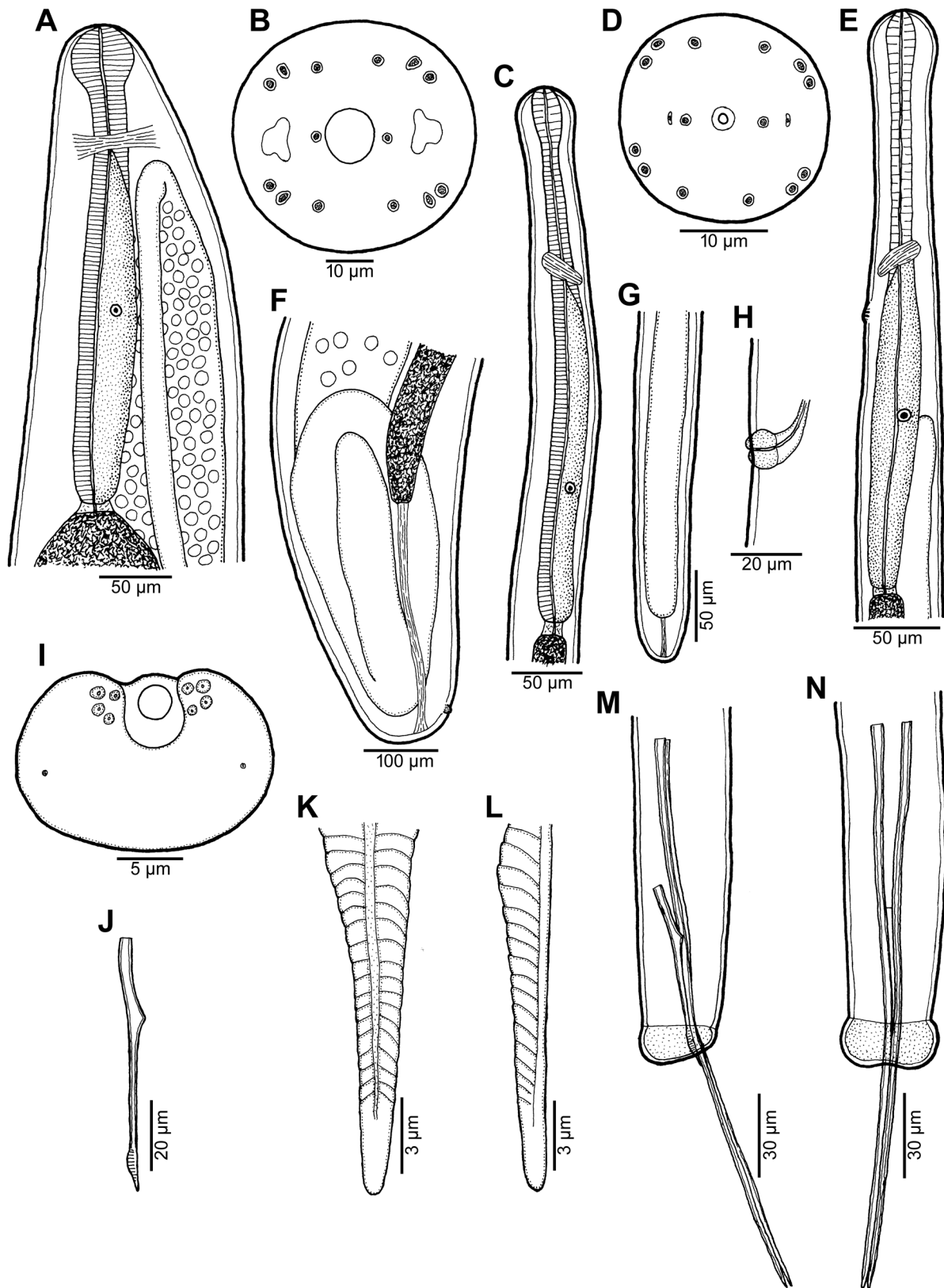


Fig. 1. *Philometra arabiensis* sp. n. **A** – anterior end of largest ovigerous female, lateral view; **B** – cephalic end of ovigerous female, apical view; **C** – anterior end of non gravid female, lateral view; **D** – cephalic end of male, apical view; **E** – anterior end of male, lateral view; **F** – posterior end of largest ovigerous female, lateral view; **G** – posterior end of non gravid female, lateral view; **H** – vulva of non-gravid female, lateral view; **I** – caudal end of male, apical view; **J** – gubernaculum, lateral view; **K, L** – distal portion of gubernaculum, dorsal and lateral views, respectively; **M, N** – posterior end of male, lateral and ventral views, respectively.

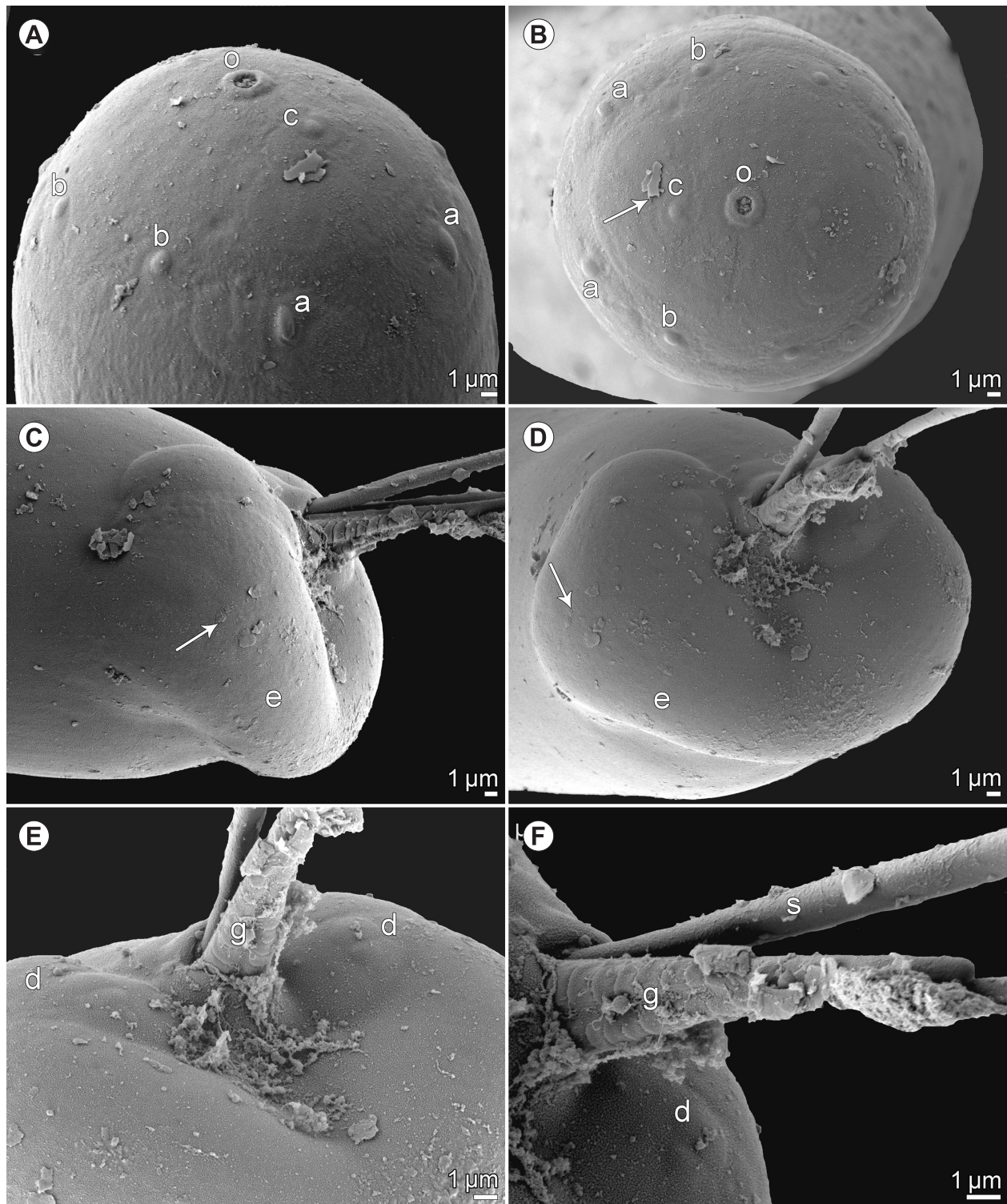


Fig. 2. *Philometra arabiensis* sp. n., scanning electron micrographs of male. **A, B** – cephalic end, sublateral and apical views, respectively (arrow indicates amphid); **C, D** – caudal end, lateral and apical views, respectively (arrow indicates phasmid); **E, F** – region of cloaca, subdorsal and dorsal views, respectively. **Abbreviations:** a – submedian pair of cephalic papillae of external circle; b – submedian cephalic papilla of internal circle; c – lateral cephalic papilla of internal circle; d – group of four caudal papillae near cloacal aperture; e – caudal mound; g – gubernaculum; o – oral aperture; s – spicule.

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 in species descriptions are in micrometres unless otherwise indicated. The type and voucher specimens were deposited in the Helmintho-

logical Collection of the Institute of Parasitology, Biology Centre of the Czech Academy of Sciences, České Budějovice, Czech Republic (IPCAS). The fish nomenclature follows FishBase (Froese and Pauly 2022), while the names of higher taxa (fish orders and families) are according to Fricke et al. (2022).

RESULTS

Family Philometridae Baylis et Daubney, 1926

Philometra arabiensis sp. n.

Figs. 1–3

ZooBank number for species:

[urn:lsid:zoobank.org:act:52A7407F-763E-41A8-AE07-19DC48E59C1C](https://zoobank.org/act:52A7407F-763E-41A8-AE07-19DC48E59C1C)

Male (10 specimens; measurements of holotype in parentheses): Body filiform, whitish, 1.86–2.73 (2.73) mm long, maximum width 51–60 (60); anterior end of body rounded, 36–42 (39) wide, with distinct constriction at short distance posterior to cephalic extremity (Figs. 1E, 3A); width of body at this constriction 30–36 (33). Maximum width/body length ratio 1 : 33–46 (1 : 46). Cuticle smooth. Oral aperture small, circular, surrounded by slightly elevated narrow ring. Cephalic papillae 14 in number, arranged in 2 circles; outer circle formed by 4 submedian pairs, inner circle consists of 4 submedian and 2 lateral papillae (Figs. 1D, 2A,B). Pair of small, slit-like amphids somewhat posterior to lateral cephalic papillae (Figs. 1D, 2B). Oesophagus 315–390 (351) long, comprising 13–19% (13%) of body with slight inflation at anterior end measuring 33–39 × 21–27 (33 × 24); posterior part of muscular oesophagus overlapped by well-developed oesophageal gland with large cell nucleus; maximum width of gland 18–27 (18). Small ventriculus 6 (–) long, 9 (–) wide. Nerve ring and oesophageal nucleus 135–171 (156) and 210–285 (210), respectively, from anterior extremity. Testis extending anteriorly approximately to level of oesophageal cell nucleus (Fig. 1E).

Posterior end of body blunt, 24–33 (30) wide in lateral view, provided with markedly broad U-shaped mound situated lateral and dorsal to cloacal opening; in lateral view, dorsal part of body end posteriorly exceeding cloacal aperture to form rounded tail 3–6 (6) long (Figs. 1I,M,N, 2C,D, 3B). Four pairs of small, very flat, hardly visible adanal papillae present on caudal mound; pair of small sublateral phasmids present on caudal mound (Fig. 2C–F). Spicules needle-like, approximately equally long, with somewhat expanded proximal and sharply pointed distal tips; length of spicules 198–243 (198), representing 7–12% (7%) of body length (Figs. 1M,N, 3B). Gubernaculum narrow, 75–99 (75) long, with anterior portion somewhat dorsally bent; length of anterior bent part 24–33 (33), comprising 27–44% (44%) of entire gubernaculum length; distal portion of gubernaculum tongue-shaped in dorsal view, rounded at tip, forming distinct dorsal protuberance in lateral view, composed of 2 longitudinal parts bearing numerous transverse lamella-like structures and demarcating depressed narrow smooth field between them (Figs. 1J–M, 2C–F, 3C). Length ratio of gubernaculum and spicules 1 : 2.33–2.79 (1 : 2.64). Spicules and gubernaculum well sclerotised.

Subgravid female (15 ovigerous specimens; measurements of allotype in parentheses): Body of fixed specimens whitish to brownish, filiform, 1.00–3.20 (3.20) mm long, maximum width 299–476 (476). Maximum width/body length 1 : 3–7 (1 : 7). Cephalic end rounded, 69–177 (177)

wide. Cephalic papillae small, indistinct in lateral view. Oral aperture oval, surrounded by 14 small papillae arranged in 2 circles: 4 submedian pairs of papillae of outer circle and 6 single papillae (4 submedian and 2 lateral) of inner circle; amphids indistinct (Figs. 1B, 3D,E). Oesophagus 625–979 (979) long including its anterior bulbous inflation, representing 30–31% (31%) of body length; anterior inflation 66–114 (114) long and 69–129 (129) wide; maximum width of posterior part of oesophagus including well-developed dorsal gland 66–109 (109) (Fig. 1A). Ventriculus 24–33 (33) long, 66–75 (75) wide. Nerve ring and oesophageal nucleus 150–231 (231) and 408–625 (625), respectively, from anterior extremity. Intestine brown-coloured, straight, ending blindly; posterior end of intestine atrophied, forming ligament 258–340 (340) long attached ventrally to body wall close to posterior extremity (Fig. 1F). Vulva and anus absent. Ovaries long, narrow, reflexed near body ends (Fig. 1A,F). Uterus filled with little-developed eggs. Posterior end rounded, 68–136 (136) wide, with pair of minute papilla-like caudal projections (Fig. 1F).

Nongravid female (2 specimens): Body whitish, 2.60–2.70 mm long, maximum width 36–60; maximum width/body length ratio 1 : 45–72. Cephalic end rounded, 36–45 wide, with distinct constriction at short distance posterior to cephalic extremity; width of body at this constriction 33–39 (Fig. 1C). Cephalic papillae small, indistinct in lateral view. Oesophagus including anterior bulbous inflation 408–429 long, comprising 16% of body length; its anterior inflation 33–39 long and 21–24 wide (Fig. 1C). Posterior portion of oesophagus including oesophageal gland 24–33 wide. Nerve ring and oesophageal nucleus 87–126 and 165–270, respectively, from anterior extremity. Ventriculus 24 long, 66 wide. Rudimentary vulva at 1.73–1.93 mm from anterior extremity (at 66–71% of entire body length) (Fig. 1H). Uterus empty. Posterior end rounded, 21–27 wide, without caudal projections (Fig. 1G).

Type host: *Alepes djedaba* (Forsskal) (Carangidae, Carangiformes), shrimp scad.

Site of infection: Ovary.

Type locality: Near Basrah, northwestern Arabian Gulf, Iraq (collected during February to May 2022).

Prevalence and intensity: 17% (4 fish infected/24 fish examined); 1–50 (mean 16) nematodes per fish.

Deposition of type specimens: Holotype (male), allotype (female) and 160 paratypes (males and females) in the Helminthological Collection of the Institute of Parasitology, Biology Centre of the Czech Academy of Sciences, České Budějovice, Czech Republic (IPCAS N-1273).

Etymology: The species name *arabiensis* relates to the region (Arabian Gulf) from where this parasite is recorded.

Remarks. Since gonad-infecting species of *Philometra* are known to exhibit a high degree of host specificity (Moravec et al. 2016b), the new species is compared only with its congeners recorded from fishes of the family Carangidae. To date, eight nominal species of this genus have been reported from carangid hosts: *Philometra austropacifica* Moravec et Justine, 2014, *P. carangis* Moravec et Diggles, 2014, *P.*

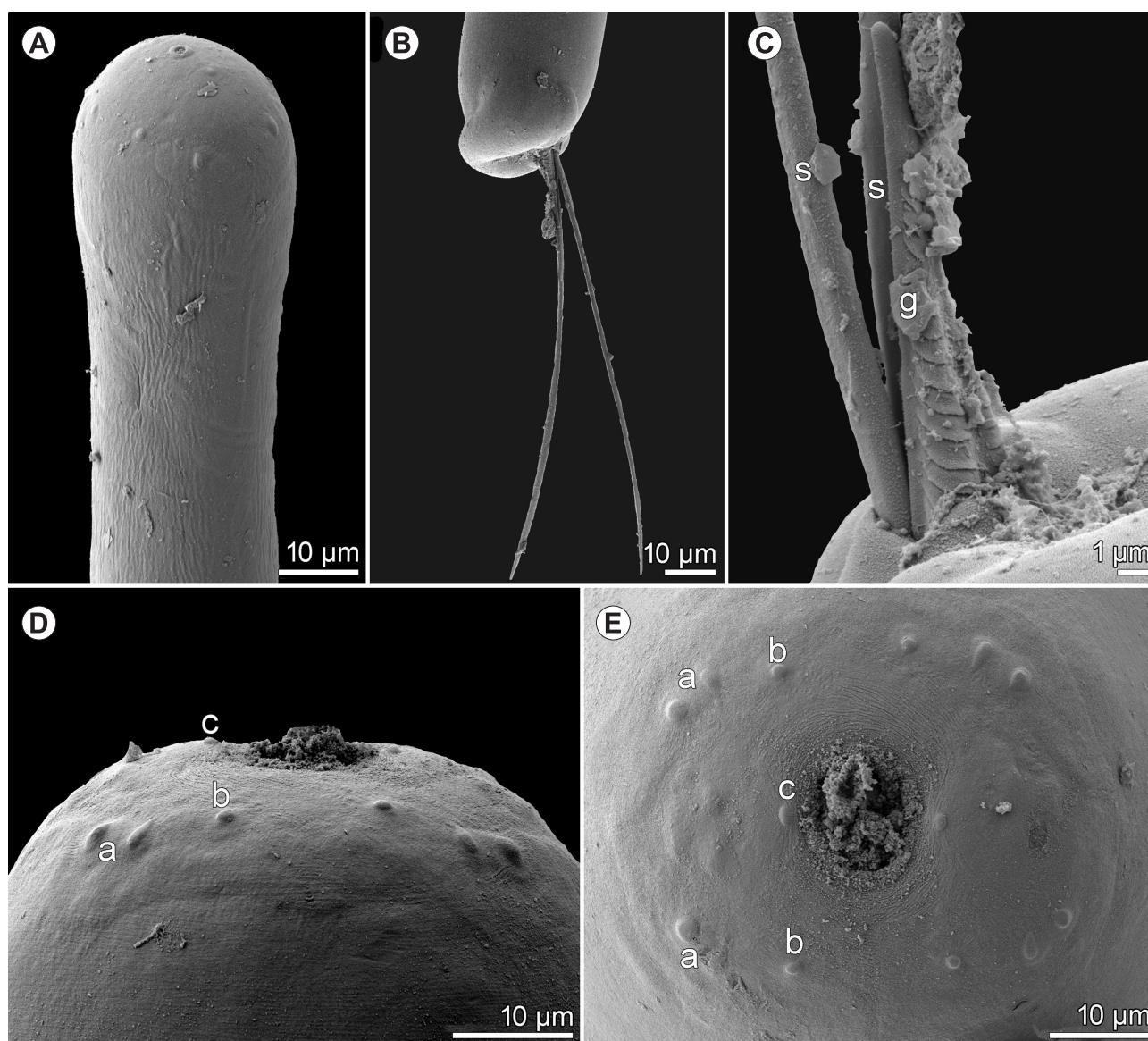


Fig. 3. *Philometra arabiensis* sp. n., scanning electron micrographs. **A** – anterior end of male, sublateral view; **B** – caudal end of male, lateral view; **C** – gubernaculum and spicules protruding out of body, lateral view; **D, E** – anterior end of subgravid female, dorsoventral and apical views, respectively. *Abbreviations:* a – submedian pair of cephalic papillae of external circle; b – submedian cephalic papilla of internal circle; c – lateral cephalic papilla of internal circle; g – gubernaculum; s – spicule.

dispar Moravec, Gey et Justine, 2016, *P. globiceps* (Rudolphi, 1819), *P. lateolabracis* (Yamaguti, 1935), *P. megalaspidis* Moravec, Ali, Abed et Shaker, 2016, *P. selaris* Moravec et Justine, 2014 and *P. tauridica* Ivashkin, Kovaleva et Khromova in Ivashkin, Sobolev et Khromova, 1971.

Of these, however, *P. globiceps* and *P. lateolabracis* in *Alepes djedaba* (as *Caranx kalla*) in the Arabian Gulf off Kuwait (Petter and Sey 1997) and *Seriola dumerili* (Risso) in the Mediterranean Sea (Moravec et al. 2003, Moravec and Genc 2004), respectively, were evidently misidentified (see Quiazon et al. 2008, Moravec and Diggles 2014a, Moravec and Tedesco 2015, Moravec et al. 2016b), because these species are specific parasites of the hosts belonging to other families, *Uranoscopus scaber* Linnaeus (Uranoscopiidae) or *Lateolabrax japonicus* (Cuvier) (Lateolabracidae).

Of the remaining six species parasitising carangids, *P. dispar* and *P. selaris*, parasites of *Carangoides dinema*

Bleeker and *Selar crumenophthalmus* (Bloch), respectively, from New Caledonia (Moravec and Justine 2014, Moravec et al. 2016b), can be easily distinguished from the new species by the considerably longer body of the males (5.14 and 5.26–5.49 mm vs 1.86–2.73 mm), shorter and unequally long spicules (123/96 and 96/87 µm vs 198–243 µm) representing 2.3% and 1.7–1.8%, respectively, (vs 6–11%) of the entire body length, the gubernaculum lacking transverse lamellar structures at its distal portion (vs lamellae present) and by a different number and arrangement of male genital papillae. Moreover, *P. dispar* and *P. selaris* may also differ in the site of infection, because their males (conspecific females are not known) were found in washes of the hosts' bodies, so that their presumed location was reported as abdominal cavity (vs ovary).

In having transverse lamellar structures on the distal portion of the gubernaculum, *P. arabiensis* sp. n. resembles

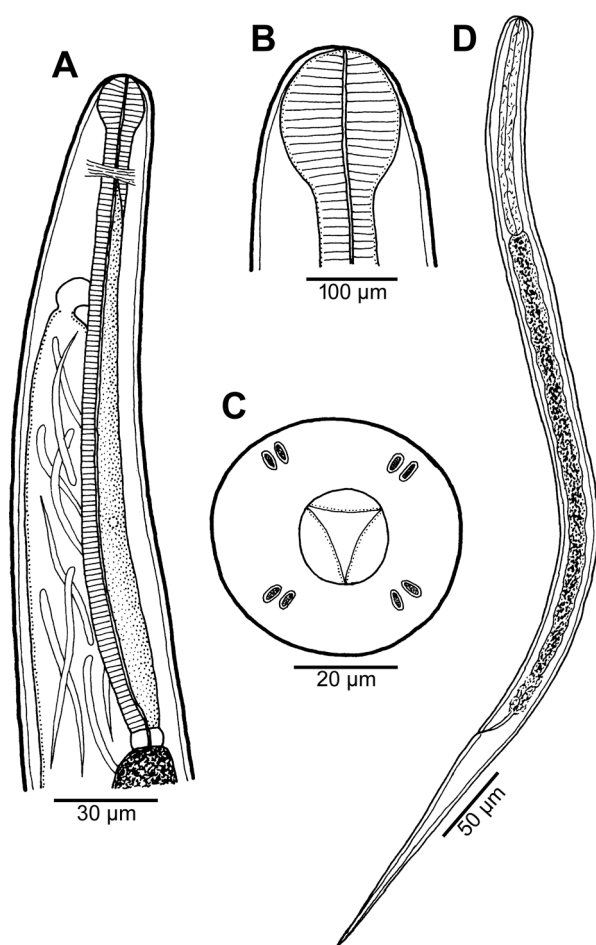


Fig. 4. *Philometra psettoditis* Moravec, Walter et Yuniar, 2012. **A** – anterior end of gravid female, lateral view; **B**, **C** – cephalic end of gravid female, lateral and apical views, respectively; **D** – larva from uterus, lateral view.

only *P. austropacifica* from the ovary of *Alepes vari* (Cuvier) in New Caledonia (Moravec and Justine 2014) and *P. carangis* from the ovary of *Caranx bucculentus* Alleyne et MacLeay from off the northern Australian coast (Moravec and Diggles 2014a). However, in contrast to the new species, the males of both of them possess a pair of distinct papillae situated dorsally to the cloacal aperture (vs such papillae are absent). In addition, the males of *P. carangis* are longer (3.22–4.15 mm vs 1.86–2.73 mm) and their spicules are shorter and unequally long (159–189/153–183 µm vs 198–243 µm), representing 4–5% (vs 6–11%) of the body length. *Philometra austropacifica* is biometrically more similar to *P. arabiensis* sp. n., but its spicules are shorter (150–174 µm vs 198–243 µm) and the gubernaculum/spicule length ratio is somewhat smaller (1 : 2.04–2.32 vs 1 : 2.33–2.79); moreover, the hosts of both these species belong to different congeneric species in distant regions (*A. vari* in the South Pacific Ocean near New Caledonia and *A. djedaba* in the Arabian Gulf).

Nevertheless, since both *A. vari* and *A. djedaba* have the same Indo-West Pacific distribution (Froese and Pauly

2022), the presence of two different gonad-infecting species of *Philometra* in these two congeneric hosts is apparently another example of a high degree of host specificity of gonad-infecting philometrids, previously observed in serranid, lutjanid and hemiramphid fishes (Moravec et al. 2016c, 2021a,b).

Philometra tauridica was inadequately described from specimens collected from the abdominal cavity of *Atherina boyeri* Risso (Atherinidae) and *Trachurus mediterraneus* (Steindachner) (Carangidae) of the Black Sea (Ivashkin et al. 1971). Later the same species was reported by Petter and Radujković (1986, 1989) from *A. boyeri* in the Adriatic Sea. This species can be easily distinguished from *P. arabiensis* sp. n., e.g., by very short spicules (70–90 µm vs 198–243 µm long) (Moravec 2006). Nevertheless, *P. tauridica* seems to be a parasite of atherinids, whereas the specimens from *T. mediterraneus*, assigned to this species by Ivashkin et al. (1971), might belong to a different species (Moravec 2006). *Philometra megalaspidis*, a gonad-infecting parasite of *Megalaspis cordyla* (Linnaeus) in the Arabian Gulf off Iraq (Moravec et al. 2016c), is only known by females, so that its morphological comparison with *P. arabiensis* sp. n. is impossible. However, taking into account a high degree of host specificity of gonad-infecting species of *Philometra* (see above), both these nematode species can be differentiated based on different genera (*Megalaspis* Bleeker and *Alepes* Swainson) of their fish hosts.

As mentioned above, Petter and Sey (1997) reported four philometrid males collected in *Caranx kalla* Cuvier (= syn. of *Alepes djedaba*) from the fish market in Kuwait City (apparently caught in the Arabian Gulf off Kuwait), which they had evidently misidentified as *P. globiceps*. They provided the body length of their specimens (2.40–2.95 mm), while the lengths of spicules (approximately 233 µm) and the gubernaculum (approximately 78 µm) can be derived from the line drawing of the male posterior end (based on LM) and the accompanying scale bar (fig. 10F). These measurements, as well as the same host species and the same locality clearly show that their nematodes belonged, in fact, to *P. arabiensis* sp. n. In contrast to the latter species, the males of *P. globiceps* from its type host *U. scaber* are much longer (5.81–7.40 mm), the spicules are shorter (168–186 µm), the gubernaculum is longer (117–126 µm) and substantial interspecific differences visible only with the use of SEM are in the structure of the male caudal end (Moravec and Tedesco 2015).

In addition to the above-mentioned nominal species, unidentified species of *Philometra* in carangids were reported as *Philometra* sp. 1 by Parukhin (1976) from the abdominal cavity of *Caranx sexfasciatus* Quoy et Gaimard in the Monar Bay of the Arabian Sea near India and from the abdominal cavity and ovaries of *Caranx malabaricus* (Bloch et Schneider), *Caranx* sp., *M. cordyla* and *Decapterus* sp. in the South China Sea. Some of these probably represent hitherto undescribed species, whereas those from *M. cordyla* were probably identical with *P. megalaspidis* (see Moravec et al. 2016a).

***Philometra psettoditis* Moravec, Walter et Yuniar, 2012**

Figs. 4, 5

Gravid female (2 anterior body fragments of 2 larvigerous specimens): Body of fixed specimens brownish in colour. Two body fragments examined 80 mm and 130 mm long, maximum width 435–544. Anterior (oesophageal portion) of body slender (Fig. 4A). Cephalic end rounded, 136 wide; cephalic papillae indistinct in lateral view (Fig. 4A,B). Oral aperture almost circular. Bottom of mouth formed by 3 flat oesophageal lobes. Cephalic papillae small, arranged in 2 circles: external circle formed by 4 pairs of submedian papillae, internal circle consisting of 6 papillae (4 submedian and 2 lateral) (internal papillae indistinct on SEM micrographs) (Figs. 4C, 5B). Oesophagus muscular, inflated at anterior end to form distinct bulb, 2.15–2.19 mm long; bulb spherical, 136–163 long and 136–163 wide, not separated from more posterior part of oesophagus (Fig. 4A). Dorsal oesophageal gland large, its cell nucleus indistinct. Small ventriculus 41 long and 82 wide present. Nerve ring encircles oesophagus 245–313 from anterior extremity. Intestine brown-coloured, its an-

terior end relatively narrow. Posterior end of body missing. Uterus filled with numerous larvae. Larvae ($n = 5$) 483–570 long, maximum width 15–18; oesophagus 106–165 long (22–29% of body length), length of tail 120–126 (21–25% of body length) (Figs. 4D, 5C,D).

Host: *Psettodes erumei* (Bloch et Schneider) (Psettodidae, Pleuronectiformes), Indian halibut.

Site of infection: Body cavity.

Locality: Near Basrah, northwestern Arabian Gulf, Iraq (collected in December 2021 and January–May 2022).

Prevalence and intensity: 44% (17 fish infected/39 fish examined); 1–4 (mean 2) nematodes per fish.

Deposition of voucher specimens: IPCAS N-986.

Remarks. The available material of this species consisted of many body fragments of larger (gravid and probably also subgravid) females with only very few anterior body ends and no posterior ends. However, the morphometrical features of the female anterior body ends, the comparatively large larvae from uterus, as well as the host species (*P. erumei*) and the site of infection (body cavity)

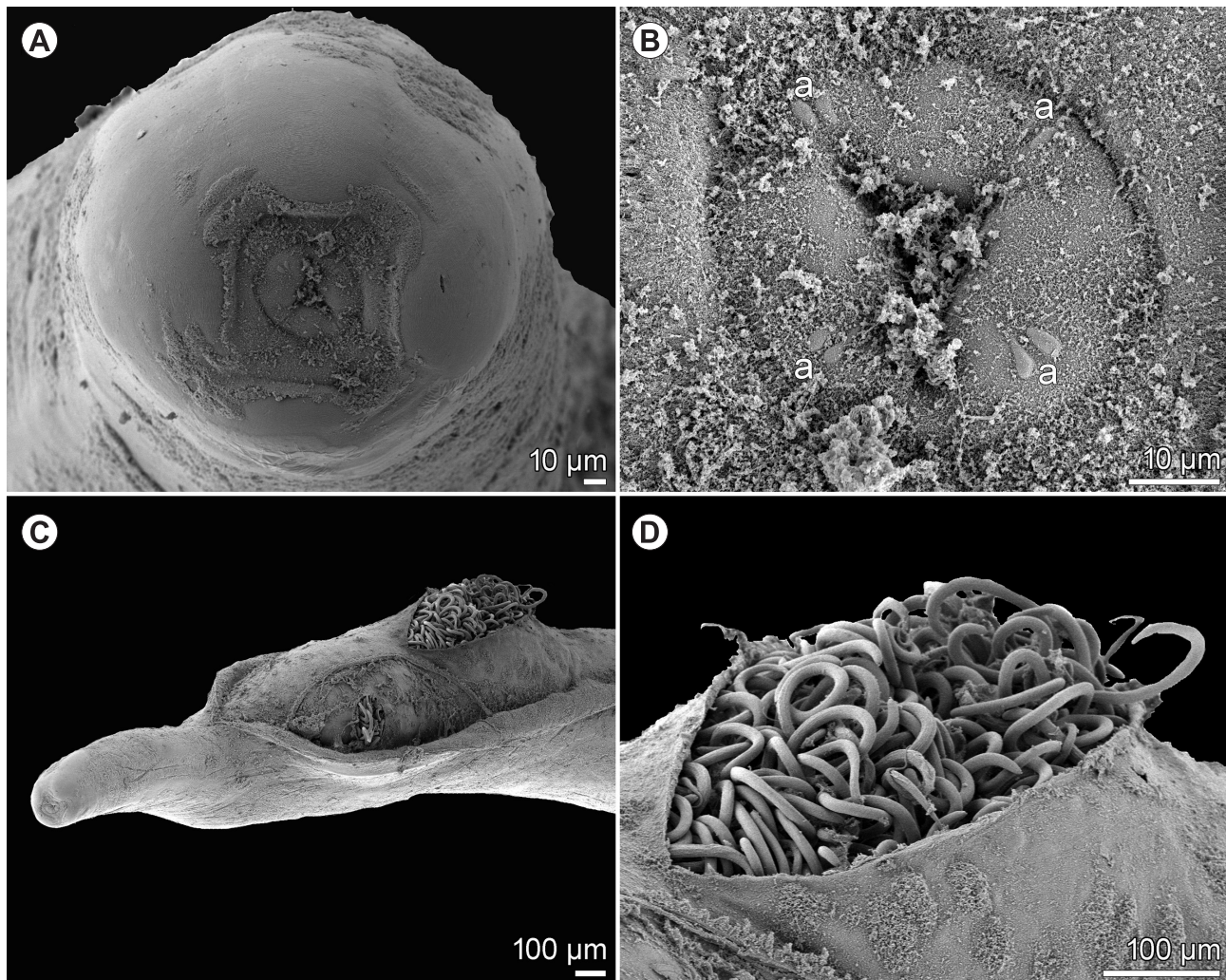


Fig. 5. *Philometra psettoditis* Moravec, Walter et Yuniar, 2012, scanning electron micrographs of gravid female. **A** – anterior end of body, apical view; **B** – region of oral aperture, apical view; **C** – ventral rupture of body wall in post-oesophageal region, subventral view; **D** – mass of larvae in ruptured body wall. **Abbreviations:** a – submedian pair of cephalic papillae of external circle.

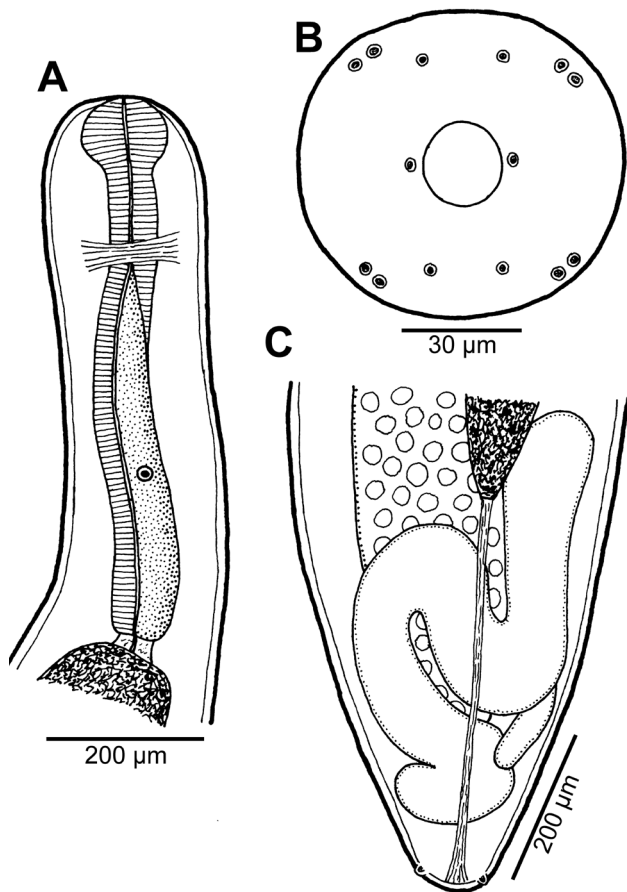


Fig. 6. *Philometra terapontis* Moravec, Gopalakrishnan, Rajkumar, Saravanakumar et Kaliyamoorthy, 2011, ovigerous female. **A** – anterior end, lateral view; **B** – cephalic end, apical view; **C** – posterior end, dorsoventral view.

of these nematodes show that they belong to *Philometra psettoditis*. A characteristic feature of large females of this species is, for example, the long oesophagus inside the relatively narrow anterior body end as compared with most other philometrids.

Philometra psettoditis is known only by its gravid females (body length 28–90 mm) found in the body cavity (allegedly also in the musculature) of *P. erumei* in the Indian Ocean off western Java, Indonesia (Moravec et al. 2012, 2022); the males remain unknown. The present finding of this species in the Arabian Gulf off Iraq considerably extends the distribution area of *P. psettoditis*. It is highly probable that also the philometrid females recorded by Kardousha (1999) from the ovaries of *P. erumei* in the Arabian Gulf off the United Arab Emirates and misidentified as *P. lateolabracis*, as well as those reported as *Philometra* sp. by Hosseini et al. (2013) from the same host species (*P. erumei*) in the Persian (= Arabian) Gulf off Iran and by Truong et al. (2022) off Vietnam, belonged, if fact, to *P. psettoditis*. All these findings suggest that *P. psettoditis* has the same Indo-West Pacific distribution as its fish host *P. erumei* (see Froese and Pauly 2022).

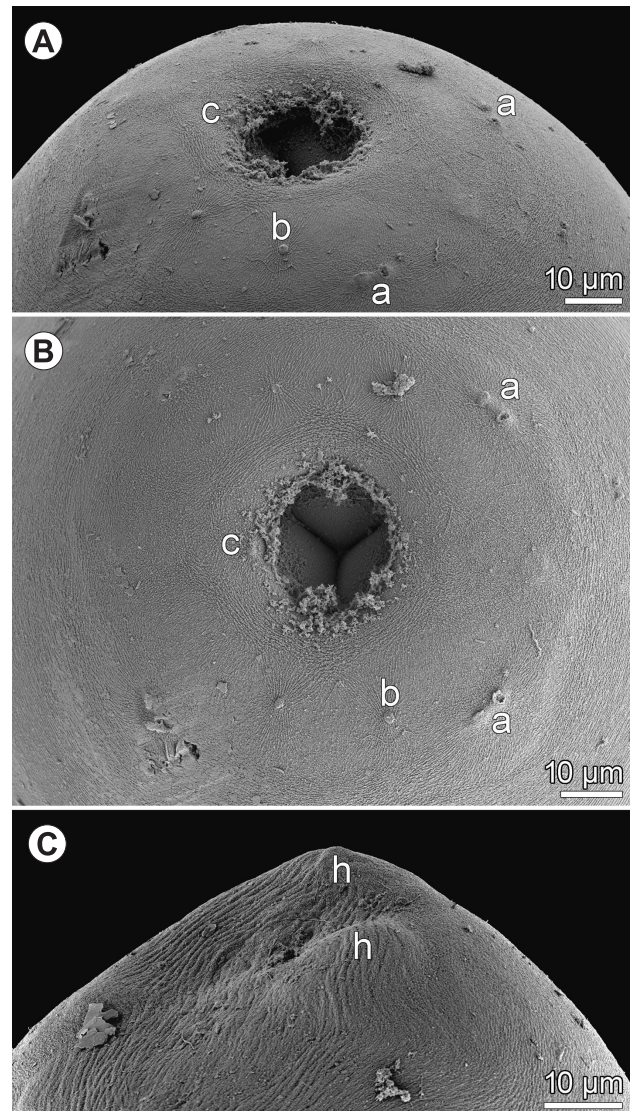


Fig. 7. *Philometra terapontis* Moravec, Gopalakrishnan, Rajkumar, Saravanakumar et Kaliyamoorthy, 2011, scanning electron micrographs of subgravid female. **A**, **B** – anterior end of body, subapical and apical views; **C** – caudal end, lateral view. *Abbreviations*: a – submedian pair of cephalic papillae of external circle; b – submedian cephalic papilla of internal circle; c – lateral cephalic papilla of internal circle; h – caudal projection.

***Philometra terapontis* Moravec, Gopalakrishnan, Rajkumar, Saravanakumar et Kaliyamoorthy, 2011**

Figs. 6, 7

Subgravid female (1 ovigerous specimen): Body of fixed specimen brownish, 65 mm long; maximum width 476; maximum width/body length ratio 1: 137. Cephalic end rounded, 177 wide (Fig. 6A). Cephalic papillae very small, indistinct when viewed laterally. Oral aperture oval, surrounded by 4 pairs of submedian cephalic papillae of external circle and 6 single papillae (2 lateral and 4 submedian) of internal circle (Figs. 6B, 7A,B). Oesophagus including anterior bulbous inflation 843 long; bulb 109 long, 122 wide; maximum width of posterior part of oesophagus including well-developed gland 109 (Fig. 6A). Nerve ring 231 from anterior extremity. Small ventriculus present. Intestine narrow at anterior end; its posterior end narrow,

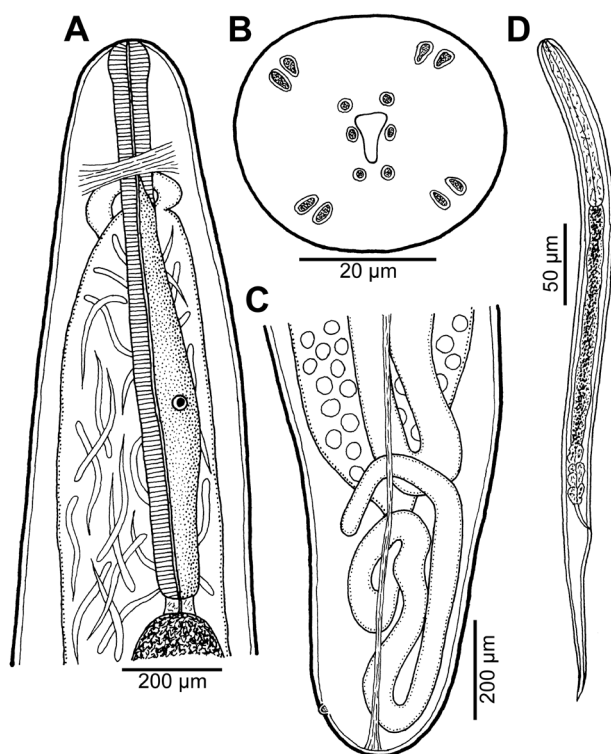


Fig. 8. *Philometra* sp. ex *Polydactylus mullani* (Hora). **A** – anterior end of gravid female, lateral view; **B** – cephalic end of gravid female, apical view; **C** – posterior end of gravid female, lateral view; **D** – larva from uterus, lateral view.

attached by short ligament ventrally to body wall near caudal end; ligament 544 long. Ovaries relatively short, thick, reflexed (Fig. 6C). Uterus filled with numerous eggs. Posterior end of body rounded, 122 wide, with 2 minute subterminal papilla-like caudal projections (Figs. 6C, 7C).

Host: *Terapon jarbua* (Forsskal) (Terapontidae, Centrarchiformes), jarbua terapon.

Site of infection: Ovary.

Locality: Near Basrah, northwestern Arabian Gulf, Iraq (collected in January 2022).

Prevalence and intensity: 33% (1 fish infected/3 fish examined); 1 nematode specimen.

Deposition of voucher specimen: IPCAS N-965.

Remarks. Considering the general morphology of the only available female specimen, the host species (*T. jarbua*) and the site of infection in the host (ovary), this nematode evidently belongs to *Philometra terapontis*, a species described by Moravec et al. (2011) from specimens (males and gravid females) found in the ovary of *T. jarbua* in the Indian Ocean (Bay of Bengal) off the eastern coast of India. The present finding of *P. terapontis* in Iraqi waters represents only the second record of this parasite since its original description and a new geographical record extending considerably the known distribution area of this nematode species.

Philometra sp.

Figs. 8, 9

Gravid female (2 complete and 1 incomplete larvigerous specimens): Body of fixed specimens brown, with

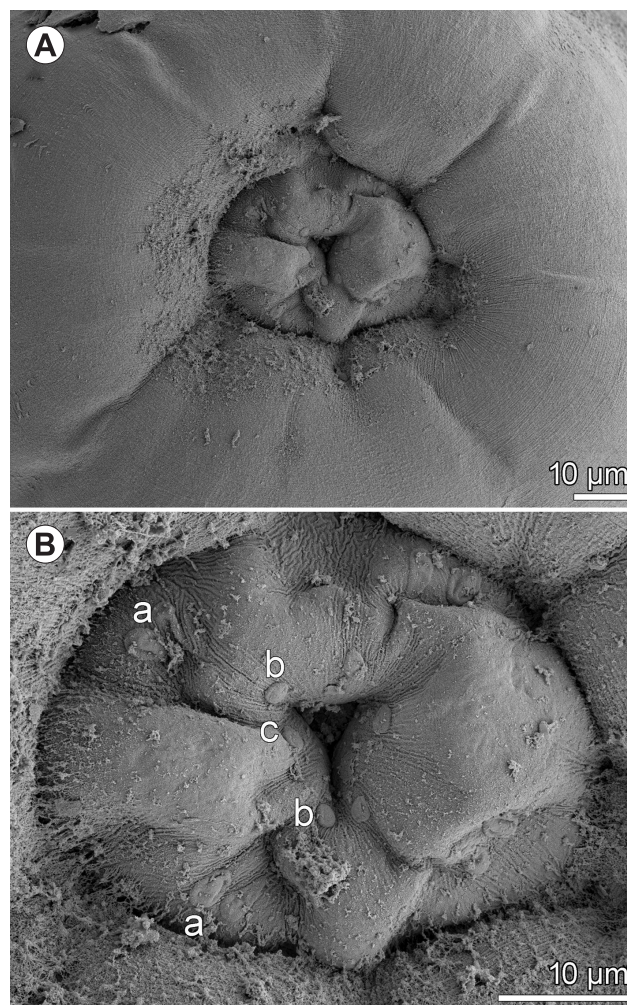


Fig. 9. *Philometra* sp. ex *Polydactylus mullani* (Hora), scanning electron micrographs of gravid female. **A** – Anterior end of body, apical view; **B** – region of oral aperture, apical view. **Abbreviations:** a – submedian pair of cephalic papillae of external circle; b – submedian cephalic papilla of internal circle; c – lateral cephalic papilla of internal circle.

distinct dark-brown intestine visible through cuticle, ends rounded. Posterior part of body somewhat narrower than anterior part; maximum width in region just posterior to oesophagus. Cuticle smooth. Body length 177–180 mm, maximum width 680–966; maximum width/body length ratio 1: 186–260. Width of cephalic end 150–326. Cephalic papillae small, indistinct when viewed laterally (Fig. 8A). Oral aperture small, roughly triangular, surrounded by small cephalic papillae arranged in 2 circles: inner circle consisting of 4 submedian and 2 lateral single papillae, outer circle formed by 4 submedian pairs of papillae; region of oral aperture and cephalic papillae demarcated by deep circular groove (Figs. 8B, 9A,B). Length of entire oesophagus 1.21–1.31 mm, 0.7% of body length; maximum width of posterior part of oesophagus including gland 109–136; anterior oesophagus inflation poorly developed, 82–95 long, 82–109 wide. Oesophageal gland well-developed, opening into oesophagus just posterior to nerve ring, with large cell nucleus in middle (Fig. 8A). Nerve ring and oesophageal nucleus 245–258 and 762–884, respec-

tively, from anterior extremity. Ventriculus small, 41–54 long, 82–95 wide. Posterior end of intestine attached by ligament to body wall near caudal end (Fig. 8C); length of ligament 966–1,995. Vulva and anus absent. Ovaries reflexed near body extremities. Uterus occupies most space of body, filled with numerous eggs and larvae (Fig. 8A). Larvae ($n = 5$) 285–393 long and 15–18 wide; oesophagus 108–153 long, comprising 27–40% of body length; length of sharply pointed tail 78–90, comprising 20–28% of body length (Fig. 8D). Posterior end of female rounded, 136–272 wide, with 2 very small sublateral papilla-like caudal projections (Fig. 8C).

Subgravid female (6 complete and 5 incomplete ovigerous specimens): Length of body 50–180 mm, maximum width 340–748; maximum width/body length ratio 1: 65–264. Width of cephalic end 109–163. Number and arrangement of cephalic papillae as in gravid specimens. Oesophagus including anterior, poorly developed inflation 1.07–1.21 mm long; maximum width of posterior part of oesophagus including gland 82–122; anterior oesophagus inflation 82–136 long and 68–136 wide. Nerve ring and oesophageal nucleus 231–258 and 707–789, respectively, from anterior extremity. Ventriculus 27–84 long, 66–99 wide. Length of intestinal ligament 109–1,995. Vulva and anus absent. Uterus filled with numerous eggs. Posterior end of body rounded, 109–272 wide, with 2 minute caudal projections.

Host: *Polydactylus mullani* (Hora) (Polynemidae, Carangiformes), Arabian blackspot threadfin.

Site of infection: Ovary.

Locality: Near Basrah, northwestern Arabian Gulf, Iraq (collected in December 2021 and January–February 2022).

Prevalence and intensity: 33% (12 fish infected/36 fish examined); 1–2 nematodes per fish.

Deposition of voucher specimen: IPCAS N-1272.

Remarks. The available material consisted of many, mostly fragmented nematode females of *Philometra*, including subgravid and gravid specimens. However, since no conspecific males were at disposal, the species identification of these nematodes was not possible.

Considering a high degree of host specificity of gonad-infecting species of *Philometra* (see above), the present nematodes from *P. mullani* were compared only with philometrid species parasitising fishes of the family Polynemidae. These include the following four valid species of *Philometra* (see Moravec 2022): *P. australiensis* Moravec et Diggles, 2014 from the swimbladder of *Polydactylus macrochir* (Günther) in Australia; *Philometra beninensis* Obiekezie, 1986 from the fins and gill covers of *Po. quadrifilis* (Cuvier) in Nigeria; *P. macrochiri* Moravec et Diggles, 2014 from the fins of *Po. macrochir* in Australia; and *P. polynemii* Rasheed, 1963 from the body cavity of *Eleutheronema tetradactylum* (Shaw) (type host) and *Po. sextarius* (Bloch et Schneider) from the Indian Ocean near Pakistan and India (Rasheed 1963, Parukhin 1971, Obiekezie 1986, Obiekezie and Anders 1991, Moravec and Diggles 2014b). In addition, a poorly described species *Philometra rajani* Mukherjee, 1963 [*species inquirenda*]

and *Philometroides eleutheronemae* Moravec et Manoharan, 2013 are reported from the gonads of *E. tetradactylum* from off India, and India, Iraq and Australia, respectively (Mukherjee 1963, Moravec and Manoharan 2013, Moravec and Diggles 2014b, Moravec et al. 2016a).

However, the gravid females of all the above-mentioned species of *Philometra*, i.e., *P. australiensis*, *P. beninensis*, *P. macrochiri*, *P. polynemii* and *P. rajani* [*species inquirendae*], possess a large bulbous inflation at the anterior end of oesophagus, by which they distinctly differ from the present gravid females collected from *Po. mullani*. Moreover, except for *P. rajani* [*species inquirendae*], the body length of gravid females of these species is much shorter than that of the latter nematodes (>70 mm vs 163 mm).

In having a poorly developed, only slightly outlined anterior oesophagus inflation, the present nematodes are similar to *P. eleutheronemae*, characterised by the presence of few minute cuticular bosses irregularly scattered on the body surface. Since the minute cuticular bosses were rarely observed on the body of gravid and subgravid females of *P. eleutheronemae*, Moravec et al. (2016a) write that subsequent studies may show that this species belongs in fact to *Philometra* rather than to *Philometroides*, where it is now placed.

Philometroides eleutheronemae is the only known species of this genus parasitising the fish gonads. Recent molecular studies do not support *Philometroides* as a valid genus (e.g., Černotíková et al. 2011, Barton et al. 2022). The present nematodes from *Po. mullani* also resemble *P. eleutheronemae* in the structure of the female cephalic end, as visible from SEM micrographs (fig. 12A,B) in the paper by Moravec and Manoharan (2013).

The present nematodes from *Po. mullani* probably belong to an undescribed species, but because no conspecific males are available, for the time being we refrain from its erection.

***Philometra* sp. 2 of Moravec et al. 2016a** Figs. 10, 11

Gravid female (1 larvigerous specimen): Body of fixed specimens brown, with distinct dark-brown intestine visible through cuticle, ends rounded. Posterior part of body somewhat narrower than anterior part; maximum width in region just posterior to oesophagus. Cuticle smooth. Body length 160 mm, maximum width 1.31 mm; maximum width/body length ratio 1 : 123. Width of cephalic end 380. Cephalic papillae small, indistinct when viewed laterally (Fig. 10A). Oral aperture surrounded by small cephalic papillae arranged in 2 circles: inner circle consisting of 4 submedian and 2 lateral single papillae, outer circle formed by 4 submedian pairs of papillae (Fig. 11A). Length of entire oesophagus including anterior bulbous inflation 1.44 mm, 0.9% of body length; maximum width of posterior part of oesophagus including gland 218; anterior oesophagus inflation 163 long, 204 wide. Oesophageal gland well-developed, opening into oesophagus just posterior to nerve ring, with large cell nucleus in middle (Fig. 10A). Nerve ring and oesophageal nucleus 340 and 952, respectively, from anterior extremity. Ventriculus small, 41 long, 109 wide. Posterior end of intestine attached by ligament

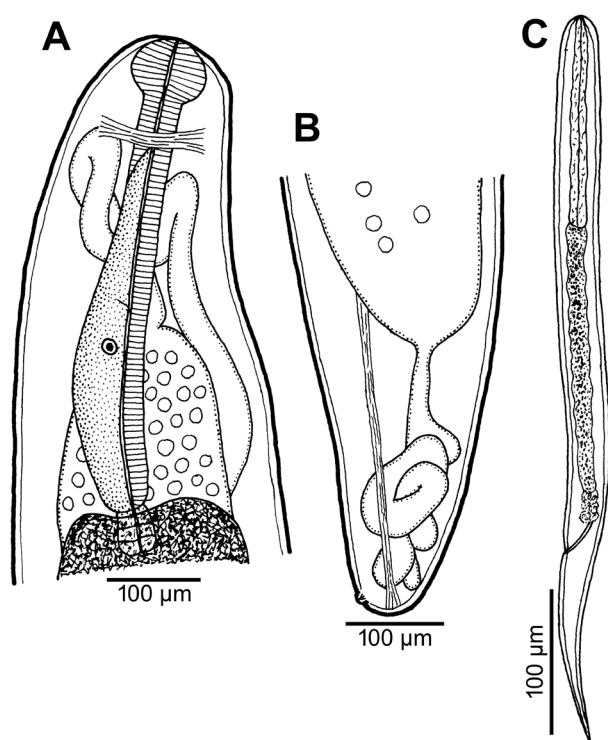


Fig. 10. *Philometra* sp. 2 of Moravec et al. (2016a) ex *Platycephalus indicus* (Linnaeus). **A, B** – anterior and posterior ends of gravid female, respectively, lateral views; **C** – larva from uterus, lateral view.

to body wall near caudal end (Fig. 10B); length of ligament 4.35 mm. Vulva and anus absent. Ovaries reflexed near body extremities (Fig. 10A,B). Uterus occupies most space of body, filled with numerous eggs and larvae (Fig. 10A). Larvae ($n = 5$) 426–549 long and 21–24 wide; oesophagus 141–150 long, comprising 26–33% of body length; length of sharply pointed tail 90–135, comprising 21–25% of body length (Fig. 10C). Posterior end of female rounded, 204 wide, with 2 very small subterminal papilla-like caudal projections (Figs. 10B, 11B).

Subgravid female (2 incomplete ovigerous specimens, anterior and posterior parts of body): Fragment of anterior part of body 60 mm long, that of posterior part 125 mm long; maximum width 1.31 mm and 1.17 mm, respectively. Width of cephalic end 218. Number and arrangement of cephalic papillae as in gravid specimens. Oesophagus including well-developed anterior inflation 1.40 mm long; maximum width of posterior part of oesophagus including gland 122; anterior bulbous inflation 109 long and 150 wide. Nerve ring and oesophageal nucleus 245 and 802, respectively, from anterior extremity. Ventriculus 27 long, 95 wide. Uterus filled with numerous eggs. Posterior end of body rounded.

Host: *Platycephalus indicus* (Linnaeus) (Platycephalidae, Perciformes), bartail flathead.

Sites of infection: Ovary and body cavity.

Locality: Near Basrah, northwestern Arabian Gulf, Iraq (collected during January–April 2022).

Prevalence and intensity: 10% (3 fish infected/29 fish examined); 1 nematode specimen.

Deposition of voucher specimen: IPCAS N-1100.

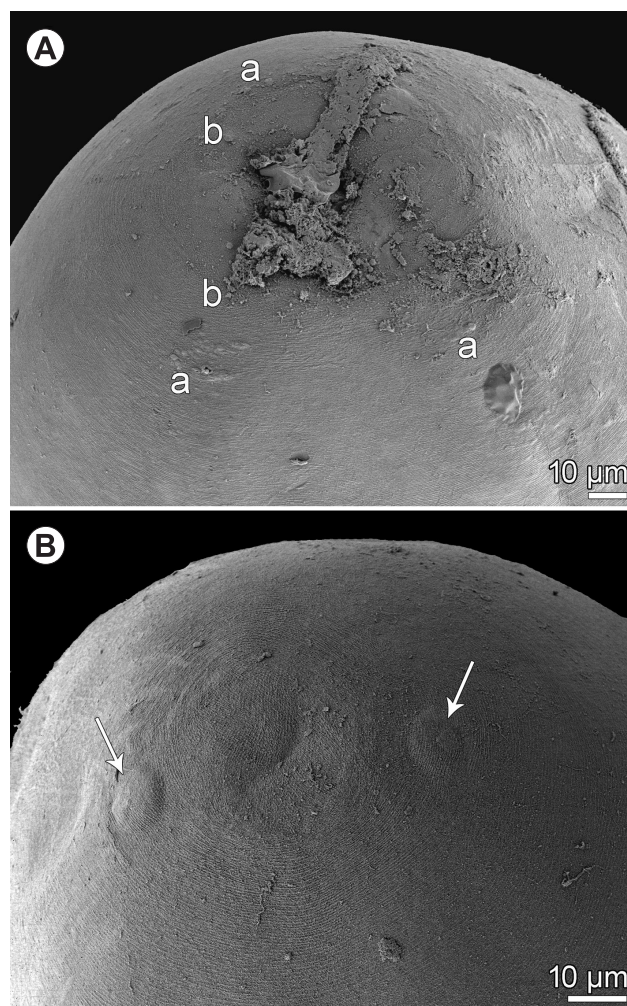


Fig. 11. *Philometra* sp. 2 of Moravec et al. (2016a) ex *Platycephalus indicus* (Linnaeus), scanning electron micrographs of gravid female. **A** – anterior end of body, subapical view. **B** – caudal end, apical view (arrows indicate weakly developed caudal projections). **Abbreviations:** a – submedian pair of cephalic papillae of external circle; b – submedian cephalic papilla of internal circle.

Remarks. This unidentified species of *Philometra* parasitising the ovary of *P. indicus* in Iraqi waters has already been reported by Moravec et al. (2016a, 2021a). To date, only the morphology of nongravid and subgravid (ovigerous) females of these nematodes is known, whereas that of the gravid (larvigerous) female remains almost unknown, because only the available body fragment of the posterior end of gravid female was described by Moravec et al. (2016a). Therefore, the full description of the gravid female of this species is provided in this paper for the first time.

While Moravec et al. (2016a) reported the presence of a pair of minute caudal projections in the gravid female and in small nongravid specimens, subsequently these were not observed in subgravid females by Moravec et al. (2021a). However, it is necessary to note that these minute caudal projections in females of some philometrids are hardly visible. Nevertheless, the presence of caudal projections in females of this species is confirmed by SEM in this paper (Fig. 11B). In addition to other characters, this species is

noted for the relatively long larvae from the female uterus and their rather thick cuticle.

As mentioned by Moravec et al. (2021a), it is highly probable that these nematodes from the gonads of *P. indicus* collected in Iraq, as well as the gonad-infecting philometrids from the same host species in India and Japan (see Moravec et al. 2016a, 2021a), belong to the same, hitherto undescribed species of *Philometra*. However, since the female morphology of these nematodes is similar to that of most other gonad-infecting congeners, the new species cannot be erected until conspecific males are collected and described (Moravec et al. 2021a).

DISCUSSION

Marine fishes are frequently parasitised by philometrids worldwide, particularly in the tropical and subtropical regions (Moravec 2023). Some species of these nematodes are pathogenic parasites of fish with economic importance, in stocks of both free-living and cultured fish. Nevertheless, to date a great many of species of philometrids are known solely by their large-sized and often red-coloured females, whereas conspecific males are very small and escape attention during routine fish dissections (Moravec et al. 2019). However, particularly the male morphology studied by SEM, especially the ultrastructure of the gubernaculum, is very important for the taxonomy of these parasites, enabling distinction between species, whose females are morphologically very similar. This is also the case of the new species of *Philometra* (*P. arabiensis* sp. n.) described in this paper.

As mentioned above, Moravec et al. (2021a) reviewed the records of philometrids in fishes of the Arabian (= Per-

sian) Gulf and described an additional new gonad-infecting species of *Philometra*, *P. parabrevicollis* Moravec, Mizher et al., 2021, in *Lutjanus lutjanus* Bloch (Lutjanidae) from off Iraq. Thus, they reported a total of 14 nominal philometrid species of the genera *Clavinemoides* Moravec, Khosheghbal et Pazooki, 2013 (one species), *Philometra* (11 species) and *Philometroides* (two species) in marine fishes of the Arabian Gulf. The present paper reports three more species of *Philometra* in this region, one of them being new to science. However, judging from numerous records of hitherto unidentified philometrids in various fish species of this region, many additional philometrid species, including those new to science, can be expected to occur there.

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Author contribution. Hassan A. Fazaa, Atheer H. Ali and Hussein A. Saud obtained the samples and undertook the processing for morphological identification of the nematodes. František Moravec carried out the identification and morphological analysis, and drafted the manuscript. All authors read and approved the final manuscript.

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