



A new species of the rare nematode genus *Paramicrolaimus* Wieser, 1954 (Chromadorida: Paramicrolaimidae) from the south eastern Arabian Sea

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Abstract

A new paramicrolaimid nematode, *Paramicrolaimus damodarani* sp. nov., is described based on specimens from the continental shelf (95 m) of the south eastern Arabian Sea. *Paramicrolaimus damodarani* sp. nov. differs from other known species of the genus in having a smaller body size, form of the spicular apparatus, presence of 7 cuticularised protruding precloacal supplements and a strongly cuticularised terminal spinneret. This is the first record of the genus *Paramicrolaimus* from the northern Indian Ocean. A pictorial key to the four species of *Paramicrolaimus* is also provided, supplemented with comparative characters, based on published information.

Key words: Nematode, Arabian Sea, Indian Ocean, *Paramicrolaimus*, morphology, taxonomy, Identification key

Introduction

The genus *Paramicrolaimus* Wieser, 1954 is the type and sole genus in Paramicrolaimidae, a rare family of free living nematodes whose species are known from a few individual specimens (Holovachov 2014). There are few reports on the species of *Paramicrolaimus*, despite the volume of work carried out on diversity and systematics of marine free living nematodes across the world's oceans. Given its general body shape, circular amphid, rounded blunt head with crowns of cephalic setae, the typical shape and teeth of the sclerotised buccal cavity and the preanal papillae, the genus was originally placed under family Microlaimidae by Wieser, 1954. However, it differed from the other genera of Microlaimidae in having the two circles (6+4) of cephalic setae of more or less equal size, transversely oval shaped amphids with a small dorsal limb, oesophageal bulb almost absent or weakly developed and females with two antidromously reflexed ovaries.

While revising the Microlaimidae, Jensen (1978) discussed the obscurity of the systematic position of *Paramicrolaimus*. The slender and similar setae of the second and third crowns of cephalic sense organs, reduced buccal cavity and male gonads with one anteriorly directed outstretched testis suggest affinity of this genus with the Stilbonematinae (Spiriniidae); prompting Jensen (1978) to assign the genus to this family. Jensen (1978) also mentioned that *Paramicrolaimus* resembles the genus *Coninckia* in the arrangement of the cephalic sense organs, the shape of the male amphids, the structure of the oesophagus and the shape of the tail, but regarded these features as additional characters for distinguishing species. Lorenzen (1981) in classifying free living nematode species, contributed significant new interpretations and clarified the ambiguities in the systematics of *Paramicrolaimus* by erecting a new family Paramicrolaimidae. Since this revision, only one species, *Paramicrolaimus mirus* Tchesunov, 1988 has been described. In all, only 3 species of *Paramicrolaimus* are currently known.

A new species of *Paramicrolaimus* is described here, based on specimens collected off the southwest coast of India, in the south eastern Arabian Sea. This is the first record of *Paramicrolaimus* in the northern Indian Ocean.

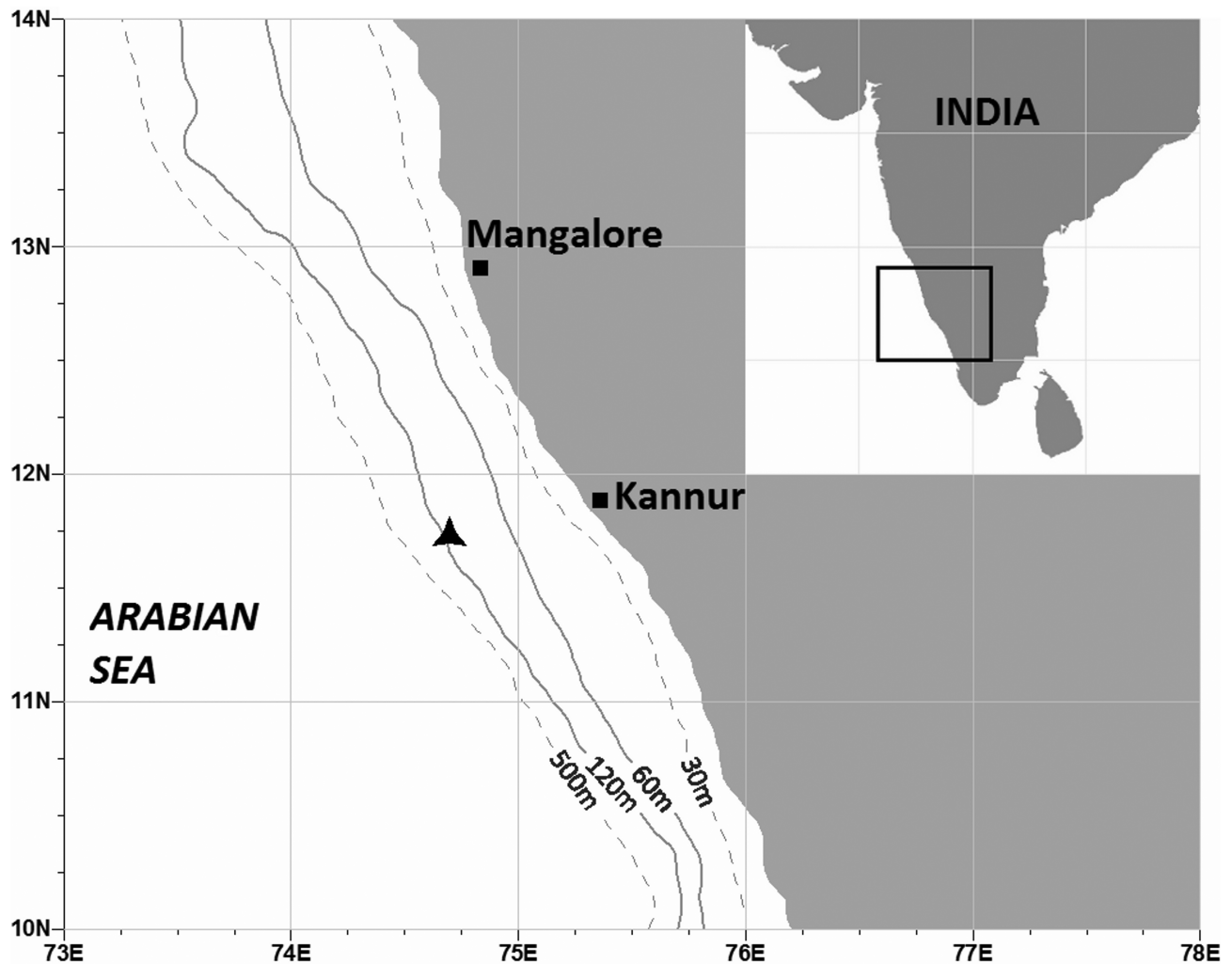


FIGURE 1. Map of south eastern Arabian Sea showing area of collection of *Paramicolaimus*.

Material and methods

Adult males of *Paramicolaimus* Wieser, 1954 were recovered among meiofaunal samples collected using a Smith McIntyre grab from the continental shelf of south eastern Arabian Sea, during a benthic survey on-board Fishery Oceanographic Research Vessel *Sagar Sampada* (FORVSS 295). The collection site was located off Kannur in the southwest coast of India, at a depth of 95 m. Juvenile specimens of the same species had been collected during previous surveys in the continental slope off Cape Comorin at a depth of 207 m (FORVSS 233). The meiofauna were sub-sampled from the grab using a glass corer of diameter 2.5 cm, and fixed and preserved in 7% formalin, stained with Rose Bengal. Salinity, temperature and dissolved oxygen of the water column just above the sediment were measured using the on-board Sea Bird CTD (SBE 911). Sediment texture was analysed using a Particle Size Analyser (Sympatec). Onshore, meiofauna were separated using a set of sieves (63 μm & 500 μm), and sorted manually using a stereo microscope (Leica EZ4). Nematodes were then processed to pure glycerine by the slow evaporation technique (Seinhorst 1959) and mounted on glass slides for detailed examination and taxonomic identification. Descriptions and drawings were made based on the glycerine mounts, using a Leica DM 1000 microscope with an attached drawing tube. The specimens were identified to genus level following Platt & Warwick (1988) and NeMys (Vanaverbeke *et al.* 2014).

Adult males of *Paramicolaimus* were only collected at one location off Kannur (at 95 m depth). Type specimens are deposited in the FORV Referral Centre, Centre for Marine Living Resources and Ecology, Kochi, Kerala, India. All measurements are in micrometers and all curved structures are measured along the arc.

Abbreviations in the text are as follows: *a*, body length/maximum body diameter; *abd*, anal body diameter; *b*, body length/pharynx length; *c*, body length/tail length; *L*, total body length; *mbd*, maximum body diameter; *hd*, head diameter; *cs*, length of cephalic setae; *ss*, length of somatic setae; *aw*, amphid width; *S*, spicule length; *t*, tail length.

Systematics

Order Chromadorida Filipjev, 1929

Family Paramicrolaimidae Lorenzen, 1981

Genus *Paramicrolaimus* Wieser, 1954

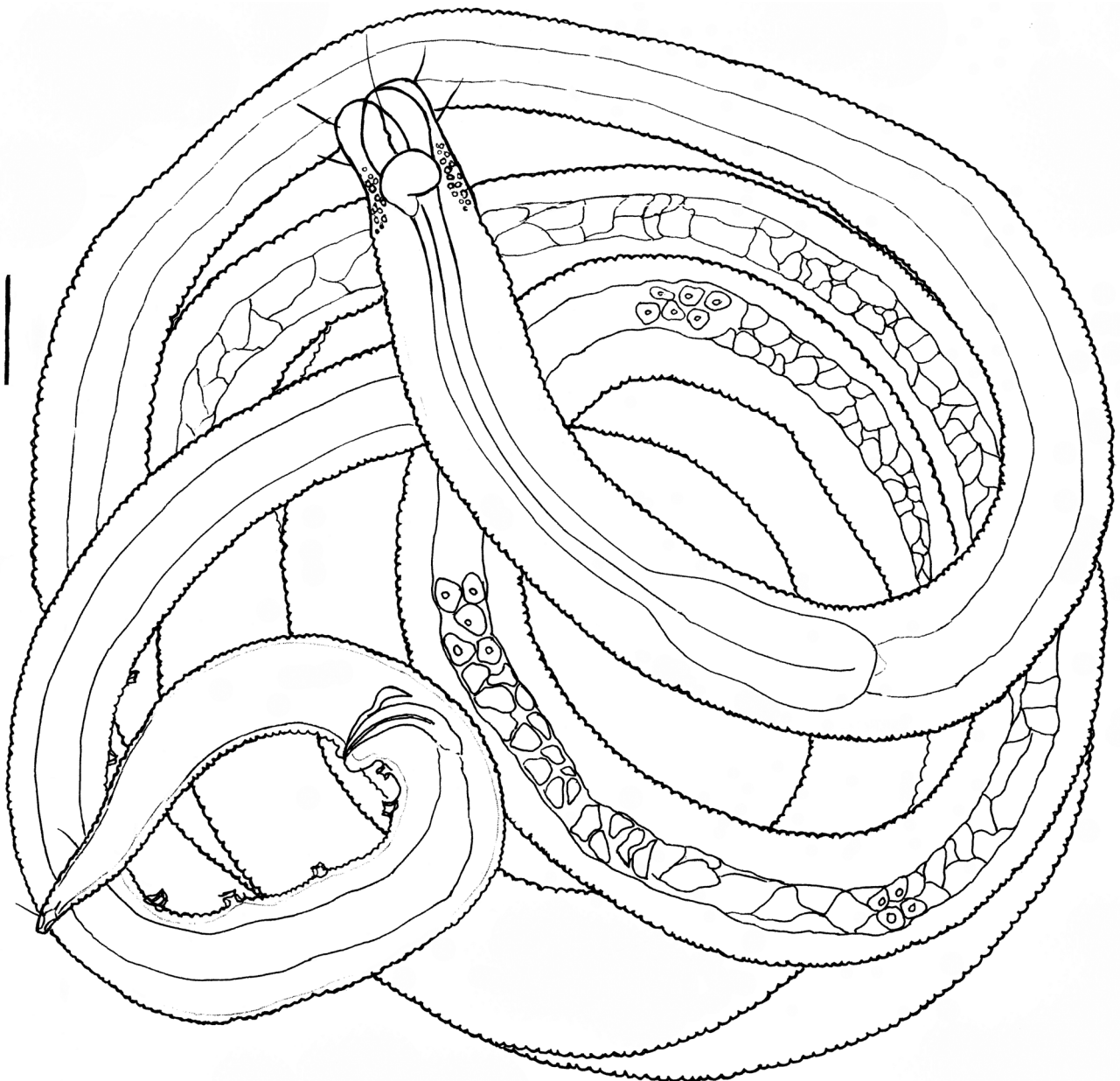


FIGURE 2. *Paramicrolaimus damodarani* sp. nov. entire organism. Scale bar 20 μ m.

Diagnosis. Finely striated cylindrical body. Labial sensilla papilliform, barely visible. Cephalic setae in two separate circles (6+4), almost equal in size. Amphids ventrally coiled, spiral, with a loop. Buccal cavity narrow,

tubular, with two denticle-like projections. Males with two opposed testes. Females with two antidromously reflexed ovaries. Ventrally placed pre-anal papillae present in males. Tail conoid.

List of valid species

Paramicrolaimus primus Wieser, 1954

Paramicrolaimus spirulifer Wieser, 1959

Paramicrolaimus mirus Tchesunov, 1988

Type species: *Paramicrolaimus primus* Wieser, 1954

Description of *Paramicrolaimus damodarani* sp. nov.

(Figs 2–4)

Material examined. Holotype, two paratype males and two juveniles [Slide No.IO/SS/NEM/00021; Deposited at FORV Referral Centre, Centre for Marine Living Resources and Ecology, Kochi, Kerala, India.] collected from continental margin of south eastern Arabian Sea.

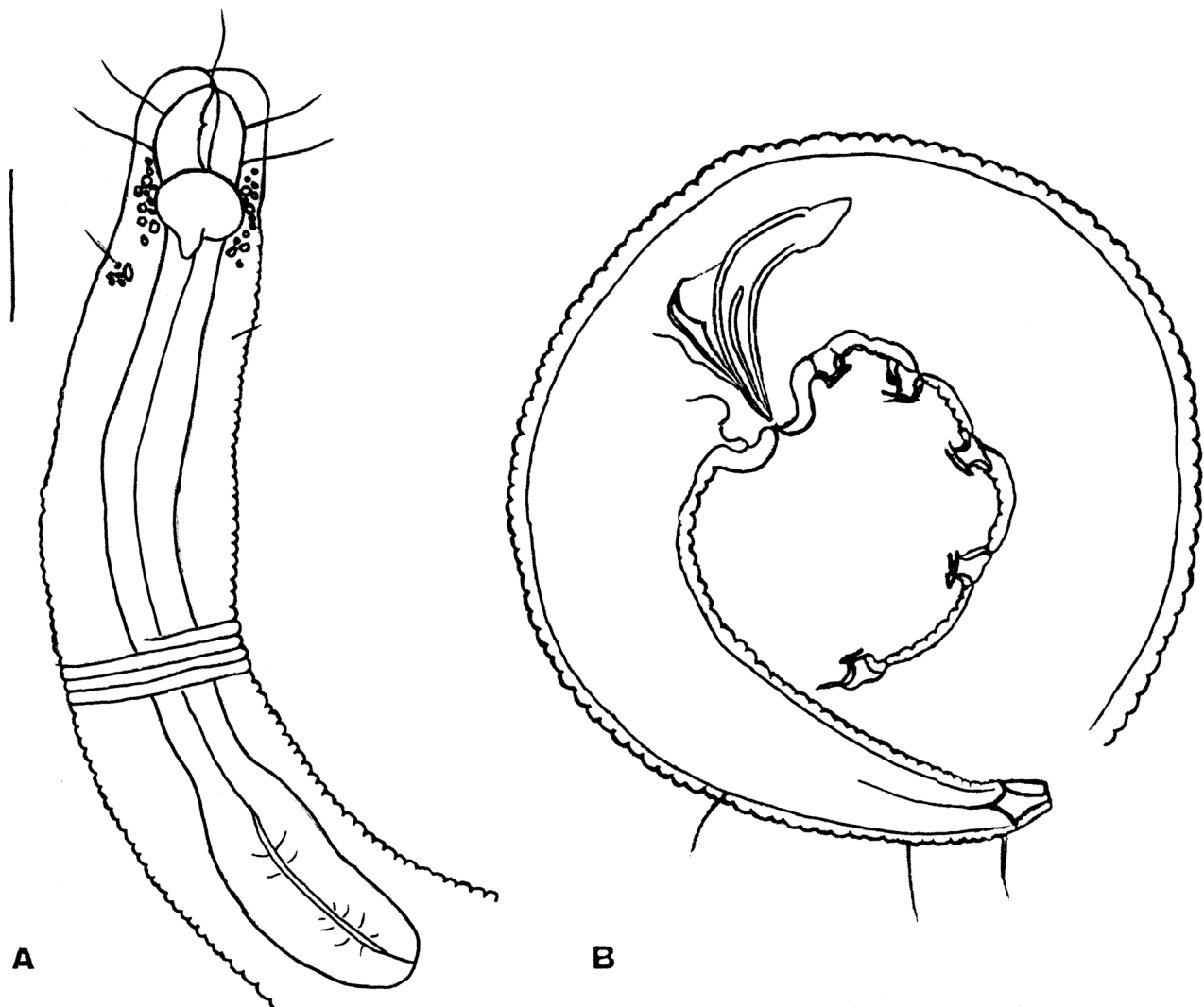


FIGURE 3. *Paramicrolaimus damodarani* sp. nov. Holotype (A) Cephalic region, (B) Caudal region showing spicule and precloacal supplements. Scale bar 20 μ m.

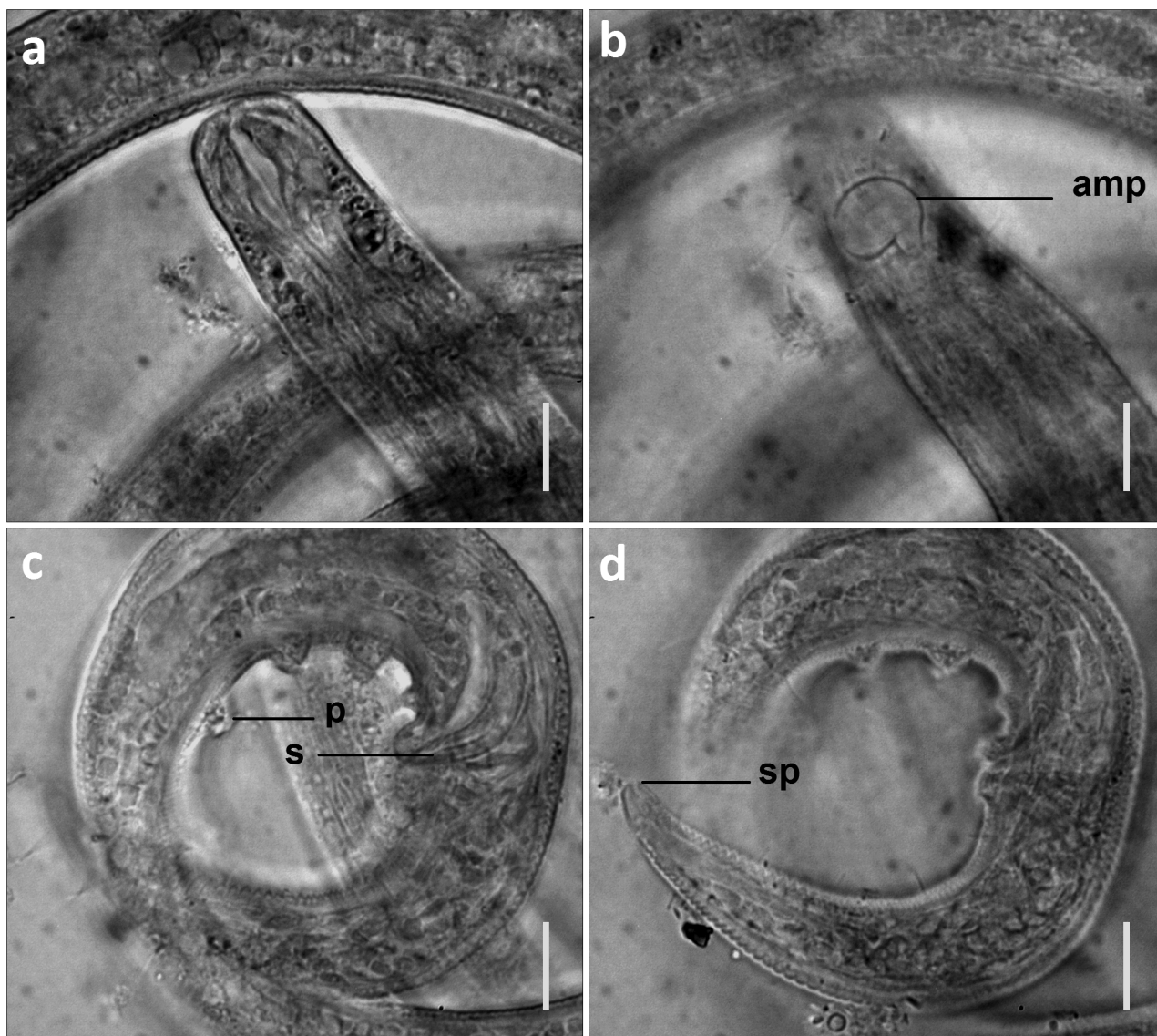


FIGURE 4. *Paramicrolaimus damodarani* sp. nov. (A) Cephalic region, (B) Amphid, (C) Spicule and precloacal suppliments, (D) Caudal region (amp, amphid; p, precloacal suppliments; s, spicule; sp, spinneret) Scale bars 10 µm.

Type locality. Holotype and paratype males: Continental margin of south eastern Arabian Sea—off Kannur, 11° 45' 02" N, 74° 41' 47" E, 95 m, 11.02.2012 (FORVSS 295). Two juveniles: South eastern Arabian Sea—off Cape Comorin, 7° 09' 12" N, 77° 19' 14" E, 207 m, 21.04.2005 (FORVSS 233). Sediment texture was silt with low percentages of clay, bottom temperature 26.6°C, bottom salinity 35.65 psu, bottom dissolved oxygen concentration 2.98 ml/l.

Description. Holotype (male): Body cylindrical, long and thread like. Total body length 1280 µm, $a=51.2$, $b=9.14$, $c=20.32$. Body diameter 20 µm at the level of posterior cephalic setae, with maximum 25 µm at mid body and 25 µm at anus. Cuticle thick, striated; striation in the cephalic region weak, distinct at mid body and caudal region. Hypodermal gland cells present. Head without striation, slightly constricted at the level of amphids. Labial sensillae barely visible. Cephalic setae in two separate circles (6+4), with similar lengths (13–14 µm). Somatic setae present in cephalic (5 µm) and caudal (7 µm) regions. Buccal cavity irregular, with deep and narrow anterior part and posterior part with sclerotized walls, two teeth present as dorsal and right subventral projections. Amphids wide (11 µm), thick walled, transversely oval-shaped with a small dorsal limb, located 19 µm away from the anterior end. Oesophagus 140 µm long with swollen anterior end, middle part thin and cylindrical; posterior end swollen resembling a slightly elongated or weak oesophageal bulb (35 µm long and 10 µm wide). Males diorchic. Spicules paired, equal in size, 28 µm long, strongly arcuate, proximally cephalate with a distinct ventral, raised

keel-like structure at mid-length. Gubernaculum parallel to spicule, simple in shape with lateral wing in the middle part. Seven distally expanded, cuticularised, protruding, precloacal supplements, each with distal thorn-like structures at their tips. First anterior and last posterior precloacal supplements slightly smaller than those between. Tail conoid, attenuated, ventrally coiled; 63 μm in length. Short, broad terminal spinneret present, strongly cuticularised, with long terminal setae arising from it dorsally.

Females and Juveniles. Females not found; juveniles resemble males in general morphology (Table 1).

TABLE 1. Morphometry of *Paramicrolaimus damodarani* sp. nov.

Material examined	Holotype ♂	Paratype ♂1	Paratype ♂2	Juvenile 1	Juvenile 2
L (μm)	1280	1310	1225	1230	1285
mbd (μm)	25	25	24	23	25
a	51.2	52.4	51.0	53.5	51.4
b	9.1	9.0	8.8	8.7	9.0
c	20.3	20.2	18.8	18.9	19.8
hd (μm)	20	20	20	20	20
cs (μm)	13+14	13+15	13+14	13+14	13+14
ss (μm)	5–7	5–7	5–7	5–7	5–7
aw (μm)	11	12	11	11	11
Distance from anterior end (μm)	19	20	19	19	19
Oesophagus length (μm)	140	145	140	142	142
Spicule length as arc (S) (μm)	28	29	28	–	–
L. of gubernaculum (μm)	19	19	19	–	–
No. of supplements	7	7	7	–	–
t (μm)	63	65	65	65	65

Diagnosis. Cuticle finely striated. Conspicuous amphids with thick wall, transversely oval-shaped with a small dorsal limb. Spicules paired, strongly arcuate, proximally cephalate with a distinct central keel. Gubernaculum simple, plate-like, with a lateral wing in the middle part. Seven cuticularised, protruding, ventrally placed precloacal supplements. Tail conoid with a cuticularised terminal spinneret.

Relationships. The general shape of the body and the spicular apparatus, position and number of cephalic setae, and position and shape of the amphid place the present specimens in *Paramicrolaimus* Wieser, 1954 (Figs 2–4; Tables 1 & 2). They are most similar to *Paramicrolaimus mirus* Tchesunov, 1988 in the general shape of the body, buccal cavity, oesophagus, size and shape of amphid and shape of gubernaculum. *Paramicrolaimus damodarani* sp. nov. strongly differs from *P. mirus* in body length (1.28 mm vs 4.06 mm), length of cephalic setae (6+8 μm vs 13+14–15 μm), *a*-value (105–106 vs 51–52.4), *b* - value (21.7–21.8 vs 8.8–9.1), *c*-value (28–40.5 vs 18.8–20.3), number of precloacal supplements (7 vs 9), shape and size of spicular apparatus (28 μm vs 23 μm), and in having a terminal spinneret which is absent in *P. mirus* (Figs 2–4, Tables 1 & 2). Specimens of *P. mirus* from the Yellow Sea (Huang & Zhang, 2005) showed larger measurements in all morphological characters compared with *P. damodarani* sp. nov. (Table 2). Also, the spicule of *P. mirus* has a velum (Huang & Zhang 2005) whereas *P. damodarani* sp. nov. has a central keel at mid-length. The gubernaculum in both the species were plate-shaped with a lateral wing in middle part but is of different size (19 μm vs 18 μm). The spinneret of *P. damodarani* sp. nov. has strongly cuticularised walls and the setae in the caudal region are longer (Figs 2, 3) than in *P. mirus*.

Paramicrolaimus damodarani sp. nov. can be differentiated from *P. spirulifer* in being smaller (1.28 mm vs 4.43 mm) in all morphological measurements in addition to the number of precloacal supplements (7 vs 6) and the shape of the gubernaculum (Figure 2–4; Table 2). While Wieser, 1959 reported 6 precloacal supplements in *P. spirulifer*, Jensen (1978) counted 10 in the redescription of the species. The gubernaculum in *P. spirulifer* is weakly sclerotized and apparently surrounds the distal parts of the spicules but in *P. damodarani* sp. nov. it is plate-shaped with a lateral wing in the middle part.

Etymology. The species is named in honour of Prof. R. Damodaran, with deep gratitude and in appreciation of his invaluable contributions to benthic studies in India.

Pictorial key to species of the genus *Paramicrolaimus* Wieser, 1954

Since morphometric characters or some details of nematodes are difficult to describe in a conventional dichotomous key, an identification guide with a pictorial key, coupled with descriptions of most important diagnostic characters has proved useful for generic identification of marine nematodes (Platt & Warwick 1988). Here, a similar pictorial key to the four known species of *Paramicrolaimus* is provided (Figure 5), and supplemented with morphometrics of these species, summarized from available descriptions (Table 2).

1. Cuticular ornamentation absent. 3
2. Cuticular ornamentation present in the form of longitudinal bars (Figure 5A) *Paramicrolaimus primus*
- 3(a). Spicular alae present 4
- 3(b). Spicular alae absent (Figure 5B) *Paramicrolaimus spirulifer*
- 4(a). Alae in the form of velum (Figure 5C) *Paramicrolaimus mirus*
- 4(b). Alae in the form of central keel (Figure 5D) *Paramicrolaimus damodarani* **sp. nov.**

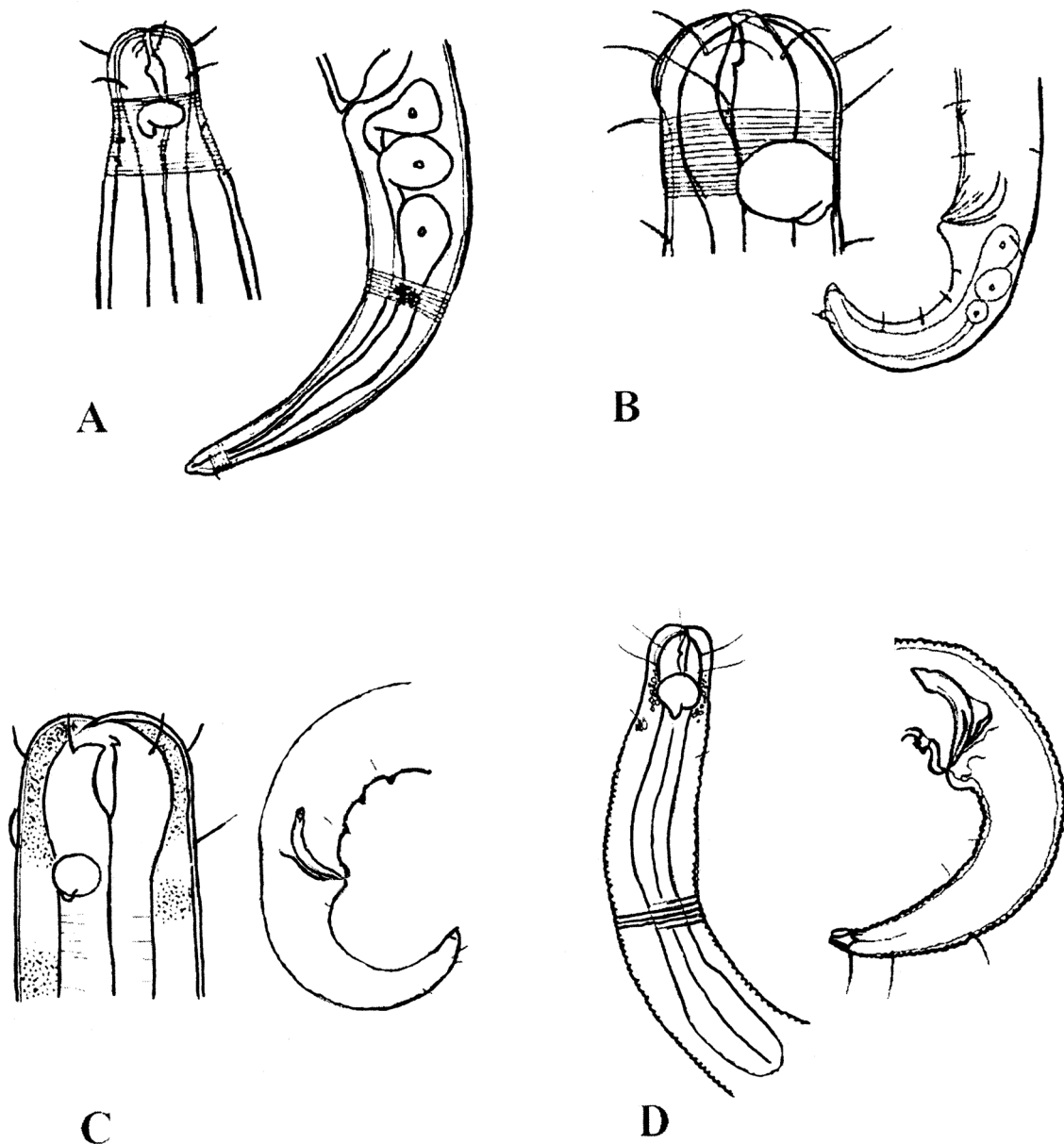


FIGURE 5. Pictorial key to *Paramicrolaimus* species: Anterior and posterior body region of holotypes of (A) *P. primus*, (B) *P. spirulifer*, (C) *P. mirus*, (D) *P. damodarani* **sp. nov.**

TABLE 2. Morphometry of valid *Paramicrolaimus* species.

Species	<i>P. primus</i> Wieser, 1954*	<i>P. spirulifer</i> Weiser, 1959	<i>P. spirulifer</i> Weiser, 1959	<i>P. mirus</i> Tchesunov, 1988	<i>P. mirus</i> Tchesunov, 1988	<i>P. damodarani</i> sp. nov.
Source	Original description	Original description	Redescription Jensen, 1978	Original description	Redescription Huang and Zhang, 2005	
L (µm)	2340	4180–4430	5170	3500–4060	3052–3600	1225–1310
mbd (µm)	52.3	30	38	33.3–38.3	38–40.2	24–25
a	44.7	139.3–147.7	136	105–106	76.3–89.5	51–52.4
b	16.8	22.1–29.3	23.5	21.7–21.8	15.9–19.8	8.8–9.14
c	22.3	52.2–55.4	30.6	28–40.5	30.5–36.7	18.8–20.32
Anterior cs (µm)	9	9–12	16	6	7–8	13
Posterior cs (µm)	10	10–16	18	8	9–10	14–15
aw (µm)	12	13–14	16	12	11–13	11–12
Oesophagus length (µm)	139.3	142.7–200.5	220	160.6–187.1	172–192	140–145
S (µm)	–	25	39	23	45–50	28–29
No. of supplements	–	6	10	9	10	7
t (µm)	104.9	80	169	100.2–125	98–105	63–65

* measurements of female.

Acknowledgement

This work was carried out under the Marine Living Resources Programme of the Ministry of Earth Sciences, Govt. of India. The support and encouragement of Dr. V. N. Sanjeevan (Former Director, CMLRE), Dr. R. Damodaran, Dr. Rosamma Philip (CUSAT), Dr. A. Shivaji, Dr. G. V. M. Gupta (CMLRE) are gratefully acknowledged. The authors wish to thank Ms. Usha V. Parameswaran, Ms. Aiswarya Gopal and Mr. Kevin P. V. for constant support and motivation in the laboratory. The authors acknowledge the efforts of Ms. Shruthi Venugopal and support staff on FORV *Sagar Sampada* (FORVSS 295) during sampling. The authors also wish to thank Dr. Alexei V. Tchesunov (Lomonosov Moscow State University, Russia) and Dr. Oleksandr Holovachov (Swedish Museum of Natural History, Sweden) for the references they have sent.

References

- Filipjev, I. (1929) Les Nematodes libres de la baie de la Neva et de l'extrémité orientale du Golfe de Finlande. Première partie. *Archiv für Hydrobiologie*, 20, 637–699.
- Holovachov, O. (2014) 7.16 Order Plectida Gadea, 1973. In: Schmidt-Rhaesa, A. (Ed.), *Handbook of Zoology. Gastrotricha, Cycloneuralia, Gnathifera. Vol. 2. Nematoda*. de Gruyter, Berlin, pp. 487–535.
- Huang, Y. & Zhang, Z. (2005) Two new species and one new record of free-living marine nematodes from the Yellow Sea, China. *Cahiers de Biologie Marine*, 46, 365–378.
- Jensen, P. (1978) Revision of Microlaimidae, erection of Molgolaimidae fam. n. and remarks on the systematic position of *Paramicrolaimus* (Nematoda, Desmodorida). *Zoologica Scripta*, 7, 159–173.
<http://dx.doi.org/10.1111/j.1463-6409.1978.tb00599.x>
- Lorenzen, S. (1981) *Entwurf eines phylogenetischen Systems der freilebenden Nematoden*. Veröffentlich. Institut für Meeresforschung Bremerhaven, 7 (Supplement), 1–449.
- Platt, H.M. & Warwick, R.M. (1988) *Free-living Marine Nematodes. Part II. British Chromadorids*. In: Kermack, D.M. & Barnes, R.S.K. (Eds.), *Synopses of the British Fauna, New Series*, No. 38, pp. 1–502. [Brill, Leiden]
- Seinhorst, J.W. (1959) A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. *Nematologica*, 4, 67–69.
<http://dx.doi.org/10.1163/187529259x00381>

- Tchesunov, A.V. (1988) New species nematodes from the White Sea. *Proceedings of the Zoological Institute*, 180, 68–76. [Leningrad]
- Vanaverbeke, J., Bezerra, T.N., Braeckman, U., De Groote, A., De Meester, N., Deprez, T., Derycke, S., Guilini, K., Hauquier, F., Lins, L., Maria, T., Moens, T., Pape, E., Smol, N., Taheri, M., Van Campenhout, J., Vanreusel, A., Wu, X. & Vincx, M. (2014) NeMys: World Database of Free-Living Marine Nematodes. Available from: <http://nemys.ugent.be> (accessed 11 November 2014)
- Wieser, W. (1954) Free-living marine nematodes. Chromadoroidea. *Acta Universita Lundensis*, 50, 1–48.
- Wieser, W. (1959) *Free-living marine nematodes and other small invertebrates of Puget Sound Beaches*. University of Washington Press, Seattle, 179 pp.