

Two new species and one new record of free-living marine nematodes from the Yellow Sea, China

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Abstract: Two new species and one new record of free-living marine nematodes: *Terschellingia major* sp. nov., *Halalaimus longamphidus* sp. nov. and *Paramicrolaimus mirus* Tchesunov, 1988 from the Yellow Sea, China are described. *Terschellingia major* sp. nov. is characterized by large body size, papilliform precloacal supplements and absence of posterior bulb; *Halalaimus longamphidus* sp. nov. is characterized by very long amphids (more than 70 μ m) and long bifid tip of tail. *Paramicrolaimus mirus* Tchesunov is redescribed and tabular key to the three known species in this genus is given. Types are deposited in the College of Marine Life Sciences, Ocean University of China.

Résumé : Deux espèces nouvelles et un nouveau signalement de nématodes libres marins de Mer Jaune, Chine. Deux espèces nouvelles et un nouveau signalement de nématodes libres marins : *Terschellingia major* sp. nov., *Halalaimus longamphidus* sp. nov. et *Paramicrolaimus mirus* Tchesunov, 1988 de la Mer jaune en Chine, sont décrites et illustrées. *Terschellingia major* sp. nov. est caractérisée par un corps de grande taille, des suppléments précloacaux papilliformes et l'absence de bulbe oesophagien ; *Halalaimus longamphidus* sp. nov. est caractérisée par des amphides très longues (plus de 70 μ m) et une queue à extrémité bifide allongée. *Paramicrolaimus mirus* Tshesunov est redécrite et une clé tabulaire des trois espèces du genre est donnée. Les types sont déposés au Collège des Sciences Marines du Vivant, Université de l'Océan de Chine.

Keywords: Free-living marine nematoda, New species, Yellow Sea, China.

Introduction

In January 2003, undisturbed sediments were taken from a grid of 23 sampling stations from 32.5°N to 37°N, 121.5°E to 125°E during an ecological survey of the over-winter ground for anchovy in the Yellow Sea, China (Fig. 1). Meiofauna abundance varied from 553 to 1400 individuals

per 10 cm² by a depth of 8 cm (929 ± 289 ind.10 cm⁻²), with 81% to 93% (809 ± 247 ind.10 cm⁻²) of the specimens being nematodes. Up to now, only forty species of marine nematodes have been recorded (or described) from the Yellow Sea (Zhang & Platt, 1983; Zhang, 1991, 1992; Zhang et al., 1994; Zhang & Ji, 1994; Hope & Zhang, 1995; Guo & Warwick, 2001; Huang & Zhang, 2004; Huang & Zhang, 2005; Zhang, 2005, Zhang & Huang, 2005). During this investigation, a number of previously undescribed species of nematode were found. These were studied in detail at the Ocean University of China.

The genus *Terschellingia* was set up by de Man (1888). So far, 30 species are reported in the world, of which, *Terschellingia austenae* Guo, 2000 was first recorded in the Bohai Sea, China. *Terschellingia longicaudata* de Man, 1907 was found in the Southern Yellow Sea, China. We found a new one, *Terschellingia major* sp. nov. in this genus in the Southern Yellow Sea again. The genus *Halalaimus* was set up by de Man (1888). Up to now, 72 species were reported in the world. We found fifteen species in present study in the Yellow Sea, China, and one of them (*Halalaimus longamphidus* sp. nov.) is a new to science.

Material and Methods

Undisturbed sediment samples were taken using a 0.1m² improved Gray-O'Hara box corer in January 2003 (Jonasson & Olausson, 1966), and meiofauna samples were taken using sawn-off syringe tube with a 2.6 cm inner diameter, pushed into the sediment down to 8 cm. Samples were fixed with 5% formalin in filtered seawater. In the laboratory, samples were stained with 0.1% rose Bengal for more than 24 hours (Higgins & Thiel, 1988). Then all the samples were washed to remove the formalin and sieved over two mesh sizes (500 µm and 50 µm) in order to separate the macrofauna (> 500 µm) from the meiofauna (> 50 µm). Heavier sediment particles were removed using centrifugation in Ludox-TM with a specific gravity adjusted to 1.15 (Jonge & Bouwman, 1977). Each sample was washed into a lined Petri dish and the meiofauna was sorted under a stereoscopic microscope up to higher taxono-

mic levels. Nematodes were transferred into a 9:1 (V:V) solution of 50% alcohol: glycerol in block cavity to slowly evaporate alcohol and then mounted in glycerol on permanent slides (McIntyre & Warwick, 1984). The descriptions were made from glycerin mounts using interference contrast microscopy. Drawing was done with a camera lucida. Types were deposited in the College of Marine Life Sciences, Ocean University of China.

Measurements are in µm. Abbreviations are as follows: a, body length/max. body diameter; a.b.d., anal body diameter; b, body length/oesophagus length; c, body length/tail length; c.d., corresponding body diameter; L, total body length; N%, nerve ring from anterior end of body/oesophagus length; Sc, spicule length as chord; V, distance of vulva from the anterior end of body; V%, V/L; Md_φ, media diameter of the particle size.

Species descriptions

Order Monhysterida

Family Linhomoeidae Filipjev, 1922

Genus *Terschellingia* De Man, 1888

Terschellingia major sp. nov.

(Figs. 2-3)

Type material

Three males and three females collected from stations 7674. Holotype: ♂ 1 (ZB030167) on the slide number ZB030101121; paratype: ♂ 2 (ZB030168) ZB030101321; paratype: ♂ 3 (ZB030169) ZB030101322; allotype: ♀ 1 (ZB030170) ZB030101321; paratype: ♀ 2 (ZB030171) ZB030101331; paratype: ♀ 3 (ZB030172) ZB030101312.

Type locality and habitat

Subtidal bottom muddy sediment in the Yellow Sea. Station 7674: 37°0.09'N, 123°5.04'E, water depth 72 m, bottom water temperature 7.85 °C, salt 32.34, silt+clay 38.09%, Md_φ 3.795, organic matter 2.01%.

Etymology

This species is named after the character of very large body size.

Measurements (Table 1)

Holotype ♂:

— 293	M	3493	3943 μm; a = 60.7, b = 13.5,	
29	65	65	52	c = 8.8, Sc = 49

Allotype ♀:

— 300 V 3500	4120 μm; a = 52.8, b = 13.7,
31 66 78 42	c = 6.6, V = 49.8%

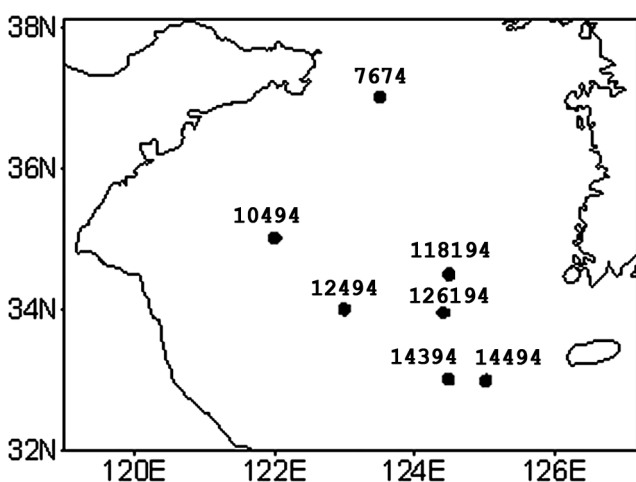


Figure 1. Map of distributed stations of new species in the Yellow Sea.

Figure 1. Carte des stations réparties des espèces nouvelles dans le Fleuve Jaune.

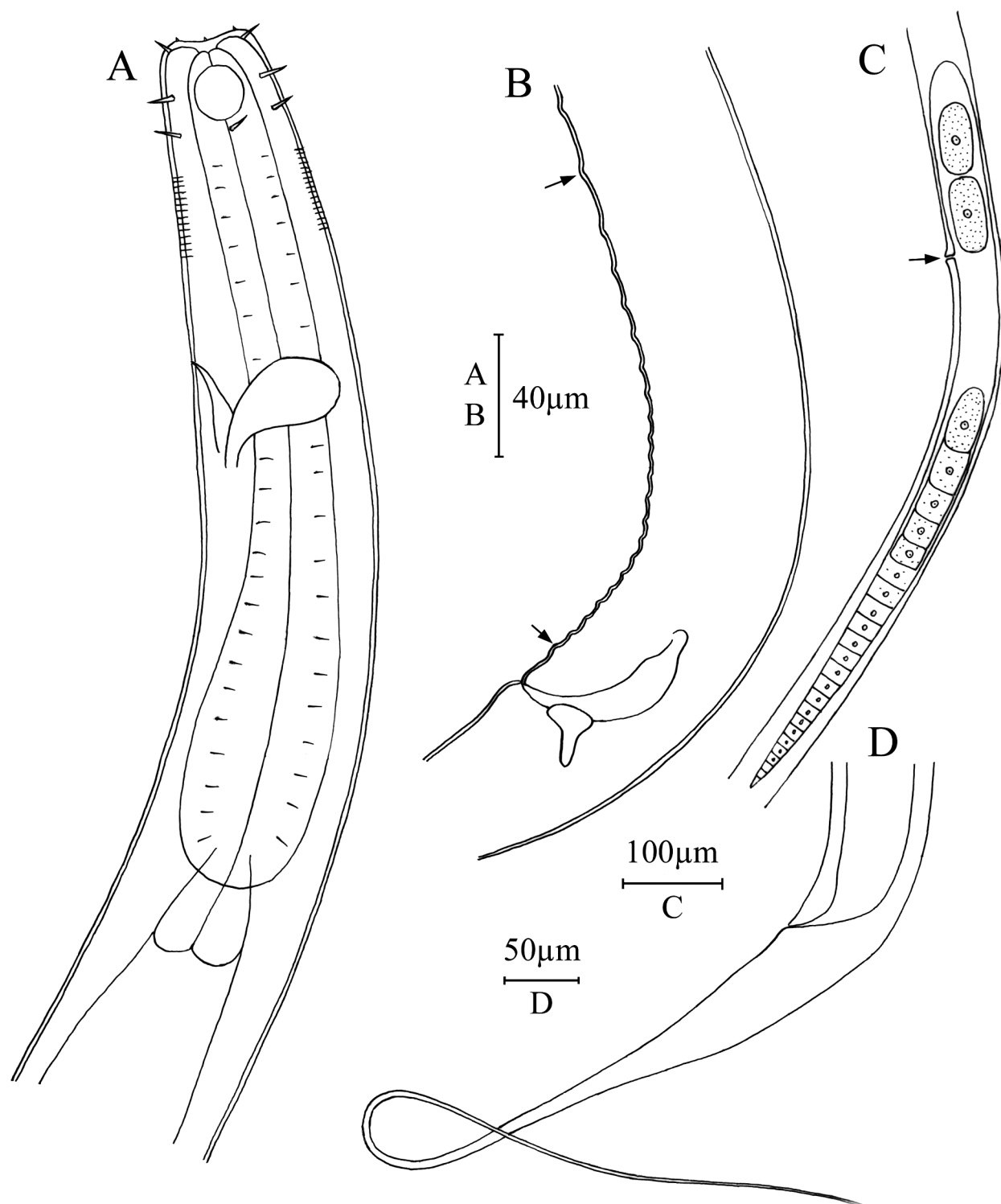


Figure 2. *Terschellingia major* sp. nov. **A.** Lateral view of male anterior end, showing amphids and oesophageal base. **B.** Lateral view of male posterior part, showing spicules and supplements. **C.** Lateral view of female middle part, showing vulva, eggs and ovary. **D.** Lateral view of female tail, showing long tail filiform.

Figure 2. *Terschellingia major* sp. nov. **A.** Vue latérale de l'extrémité antérieure du mâle, montrant les amphides et la base de l'œsophage. **B.** Vue latérale de l'extrémité postérieure du mâle montrant les spicules et les suppléments. **C.** Vue latérale de la partie médiane de la femelle montrant la vulve, les œufs et l'ovaire. **D.** Vue latérale de la queue de la femelle montrant la longue queue filiforme.

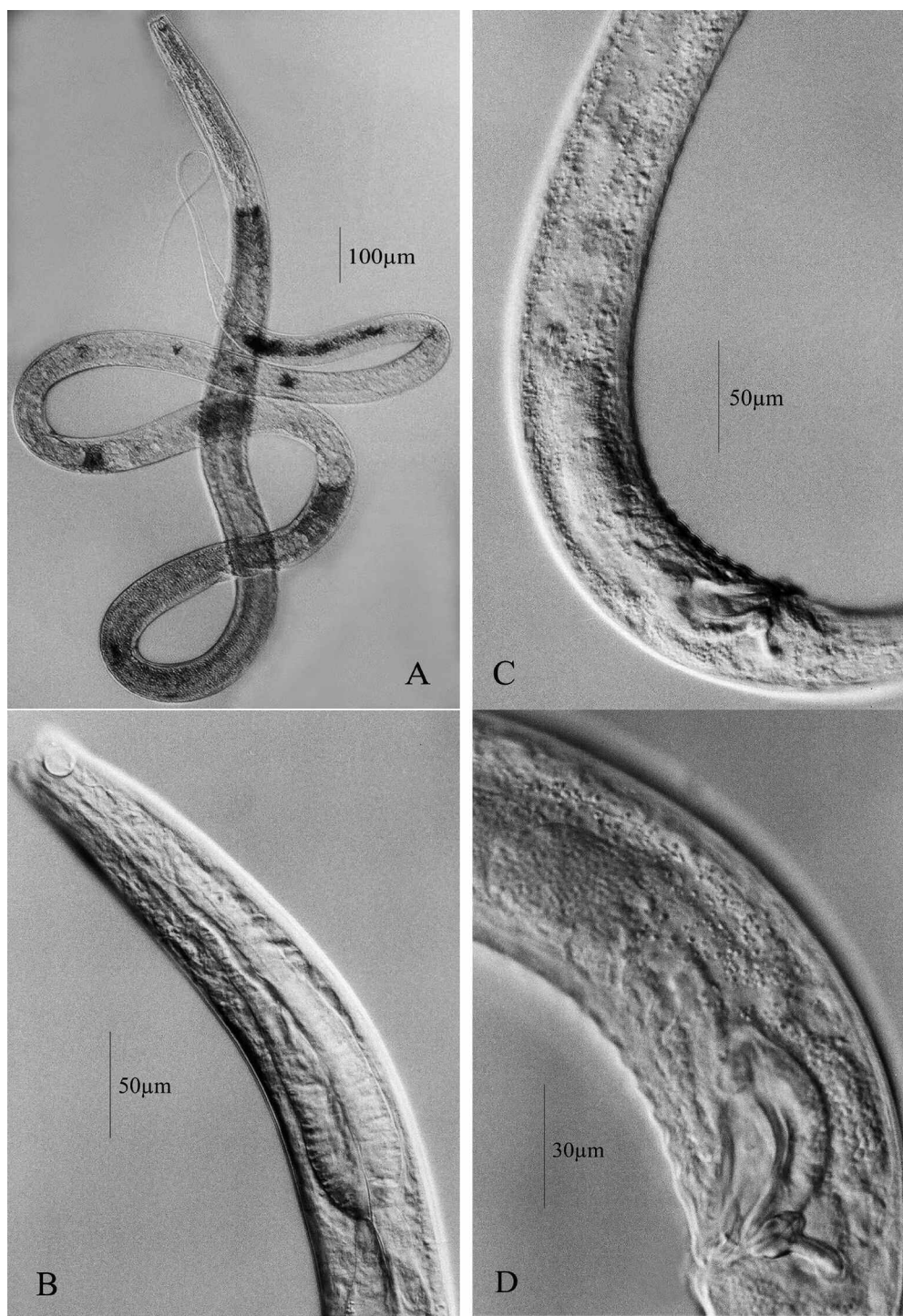


Figure 3. *Terschellingia major* sp. nov. **A.** Total view of female body. **B.** Lateral view of male anterior end, showing amphids and oesophageal base. **C.** Lateral view of male posterior part, showing spicules and supplements. **D.** Lateral view of male cloacal region, showing spicules and supplements.

Figure 3. *Terschellingia major* sp. nov. **A.** Vue d'ensemble de la femelle. **B.** Vue latérale de l'extrémité antérieure du mâle montrant les amphides et la base de l'œsophage. **C.** Vue latérale de l'extrémité postérieure du mâle montrant les spicules et les suppléments. **D.** Vue latérale de la région cloacale du mâle montrant les spicules et les suppléments.

Table 1. Measurements of *Terschellingia major* sp. nov. (μm). SD: standard deviation.**Tableau 1.** Mesures de *Terschellingia major* sp. nov. (μm). SD : écart-type.

Characters	♂ 1	♂ 2	♂ 3	♀ 1	♀ 2	♀ 3	Mean	SD
Total body length	3943	3700	3436	4120	4120	3530	3808	297
Maximum body diameter	65	62	62	78	70	60	66.2	6.8
Head diameter	29	32	31	31	28	29	30.0	1.5
Length of cephalic setae	7	7	6	6	7	5	6.3	0.8
Amphid diameter	13	15	16	15	16	14	14.8	1.2
Amphid diameter / c.d. (%)	39	43	48	43	50	44	44.5	3.9
Nerve ring from the anterior end	120	112	108	127	124	119	118.3	7.2
Nerve ring c.d.	52	50	52	58	55	51	53.0	3.0
Oesophagus length	293	290	270	300	296	283	288.7	10.8
Oesophagus c.d.	65	62	62	66	70	60	64.2	3.6
Excretory pore from the head end	130	106	103	-	-	92	107.8	16.0
Spicule length as chord	49	48	52	-	-	-	49.7	2.1
Spicule length as arc	61	59	62	-	-	-	60.7	1.5
Length of gubernaculum	15	13	13	-	-	-	13.7	1.2
Number of precloacal supplements	38	42	42	-	-	-	40.7	2.3
Tail length	450	530	380	620	560	450	498.3	87.5
Anal diameter	52	49	46	42	44	41	45.7	4.2
Tail length / a.b.d.	8.7	10.8	8.3	14.8	12.7	11	11.1	2.4
Vulva from anterior	-	-	-	2050	2090	1840	1993	134
Vulva c.d.	-	-	-	78	70	60	69.3	9.0
V%	-	-	-	49.8	50.7	52.1	50.9	1.2
a	60.7	59.7	55.4	52.8	58.9	58.8	57.7	3.0
b	13.5	12.8	12.7	13.7	13.9	12.5	13.2	0.6
c	8.8	7.0	9.0	6.6	7.4	7.8	7.8	1.0

Table 2. Main differentiating characters of *Terschellingia* species without a clearly offset oesophageal bulb (μm).**Tableau 2.** Caractères différentiels de diagnose dans le genre *Terschellingia* (μm).

Characters	L	a	Acid	T / a.b.d.	Sc	PS
Species						
<i>T. brevicauda</i> Ott, 1957	1400-1610	23-33	43-48	3.5-4.3	47-53	absence
<i>T. capitata</i> Vitiello, 1969	1509	52	60	9.6	23	absence
<i>T. claviger</i> Wieser, 1956	1620	33	40	10	73	absence
<i>T. goubaultae</i> Austen, 1989	1830-2390	24-38	22-38	5.5-8.0	80-88	absence
<i>T. maldivensis</i> Gerlach, 1963	2370	38	45	15	34	absence
<i>T. austenae</i> Guo, 2000	770-950	37-44	50-60	12-16	16-22	absence
<i>T. major</i> sp. nov.	3436-4120	52.8-60.7	39-50	8.3-14.8	48-52	presence

Note: L-body length; a-body length/max-body diameter; Acid-amphid width as % of corresponding diameter; T/a.b.d.-tail length/anal body diameter; Sc-Spicule length as chord, PS-precloacal supplement.

Description

Body length 3436-4120 (3808 ± 297) μm . Maximum diameter 60-78 (66 ± 6.8) μm . Cuticle fine striated. Head somewhat truncate at anterior end; six short labial setae; four cephalic setae at sublateral position, 5-6 μm long; four subcephalic setae at amphids level, 8-10 μm long; a circle of six 5-6 μm cervical setae behind the posterior edge of amphids. Without somatic setae. Amphids circular, 13-16

μm in diameter or 39-50% c.d., situated 5-6 μm from anterior end. Small buccal cavity shallow cup-shaped and unsclerotized. Oesophagus with an elongated expanded posterior part, not forming an offset rounded bulb. Nerve ring 108-127 μm behind anterior end or 39-42% of oesophageal length. Excretory pore at 92-130 μm from head end just located anterior to nerve ring. Tail conico-cylindrical, 380-620 μm long or 8.3-14.8 anal body diameter, with one fourth conical part and three fourths filiform.

Males. Spicules paired, equal and arcuate, 59-62 μm long as curve, or about 1.2-1.5 a.b.d., broad and with a small cephalate proximally. Gubernaculum with a pair of 13-15 μm dorsal apophyses. About 40-42 papilliform precloacal supplements, the 15-18 posteriormost placed close to each other, the more anterior, the more spaced and more shallow.

Females. Same characters as males, but with slightly longer tail. Single anterior ovary, outstretched, about 700 μm long. Vulva at 50-52% of body length from the anterior end.

Diagnosis and discussion

Terschellingia major sp. nov. is characterized by a large body size, numerous papilliform precloacal supplements and the absence of posterior bulb. The genus *Terschellingia* was established by de Man in 1888 based on the minute or absent buccal cavity; four setose cephalic sensilla; four subcephalic setae; amphid usually positioned relatively far forward on the head and conico-cylindrical tail. So far, 30 species are known in this genus (Warwick et al., 1998; Guo & Zhang, 2000). The genus was separated into two groups of species according to the shape of the oesophageal bulb by Austen (1989). The majority has a distinctly offset, well rounded oesophageal bulb. In the second small group of species, the posterior portion of oesophagus only slightly expanded and without true rounded bulb. *Terschellingia major* sp. nov. belongs to the second group. Up to now, there are seven species in this group including *Terschellingia major* sp. nov., i.e. *T. brevicauda* Ott, 1972, *T. capitata* Vitiello, 1969, *T. claviger* Wieser, 1956, *T. gourbaultae* Austen, 1989, *T. maldivensis* Gerlach, 1963 and *T. austenae* Guo, 2000. For convenience of identification of these species, we cited tabular key to this group made by Austen and Guo (Table 2).

Order Enoplida

Family Oxystominidae

Genus *Halalaimus* de Man, 1888

Halalaimus longamphidus sp. nov.

(Figs. 4-5)

Type material

Three males and two females collected from stations 10494, 12494 and 126194. Holotype: ♂ 1 (ZB030146) on the slide number ZB030109311, Station 10494; paratype: ♂ 2 (ZB030147) ZB030116112, Station 126194; paratype: ♂ 3 (ZB030148) ZB030115213; allotype: ♀ 1 (ZB030149) ZB030109112, Station 10494; paratype: ♀ 2 (ZB030150) ZB030109313, Station 10494.

Type locality and habitat

Subtidal bottom muddy sediment in the Yellow Sea. Station 10494: 35°00.46'N, 122°00.37'E, water depth 50 m, bot-

tom water temperature 9.85°C, Md_0 4.94, organic matter 2.44%; Station 12494: 33°59.76'N, 122°59.85'E, water depth 68 m, bottom water temperature 11.24°C, salt 32.62, silt+clay 93.29%, Md_0 7.54, organic matter 2.77%. Station 126194: 33°57.12'N, 122°24.57'E, water depth 85 m, bottom water temperature 12.16°C, Md_0 6.59, organic matter 2.12%.

Etymology

This species is named after the feature of very long amphids.

Measurements (Table 3)

Holotype ♂:

— 810	M	3040				3391 μm ; a = 94.2, b = 4.2,
6.5	32	42	25			c = 9.7, Sc = 36

Allotype ♀:

— 830	V	3030				3380 μm ; a = 73.5, b = 4.1,
6	38	46	21			c = 9.7, V = 54.1%

Description

Body length 2173-3391 μm , maximum diameter 26-46 μm . The anterior end strongly attenuated. Oesophageal region very long, about 24-32% of total body length. Six labial setae, about 3.5 μm long. Cephalic setae 5-11 μm long (1.3-1.8 h.d.), arranged in two circles (6 + 4) about 1.5 μm apart. six anterior cephalic situated about 4 μm from anterior end. Buccal cavity absent. Amphids very long and narrow, beginning about 20 μm from anterior end, 70-81 μm long, about 3.5 times distance from anterior end of body. Oesophagus length about 25% of body length with small posterior dilation. Tail long, 252-351 μm (13-17 a.b.c.), anterior half conical, and posterior half filiform, and end in a bifid tip, about 13-16 μm long.

Males: Spicules 29-46 μm long as curve (24-35 μm as chord), with faint ventral ala. Gubernaculum 14-15 μm long, surrounding tip of spicules; apophyses absent. Two opposed testes. Lateral striations present on anterior part of tail.

Females. Two opposed, outstretched ovaries. Vulva in the middle of body.

Diagnosis and discussion

Halalaimus longamphidus sp. nov. is characterized by distinct long thin neck, very long amphids and long bifid tip of tail. It seems much closer to *H. paralectcheri* Keppner, 1992 and *H. fletcheri* Mawson, 1958 in the presence of a bifurcate tail tip and body length, but differs from *H. para-*

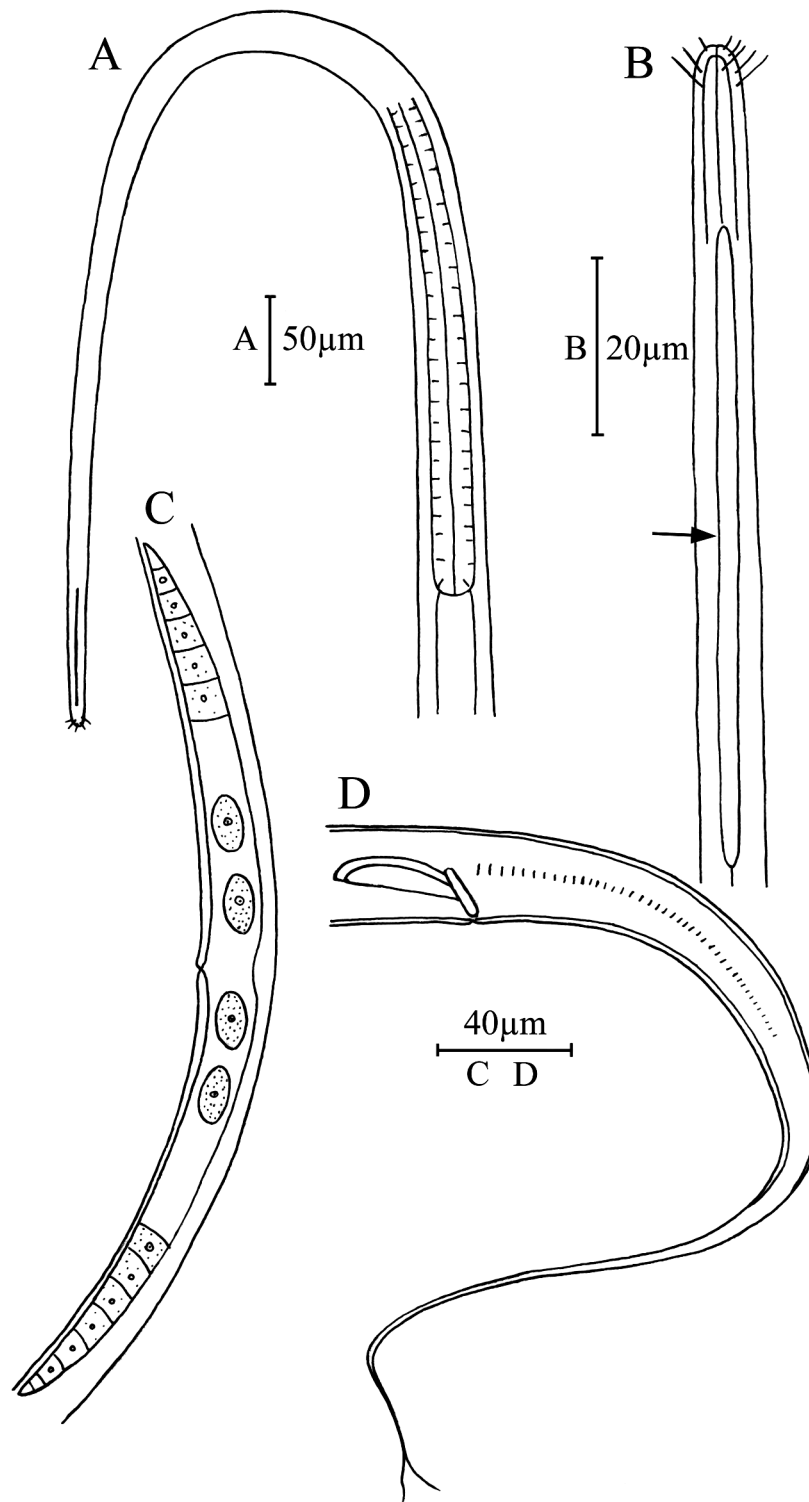


Figure 4. *Halalaimus longamphidus* sp. nov. **A.** Lateral view of male anterior end. **B.** Lateral view of female head end, showing amphids. **C.** Lateral view of female middle body part, showing ovaries, eggs. **D.** Lateral view of male tail, showing spicules, bifid tip of tail.

Figure 4. *Halalaimus longamphidus* sp. nov. **A.** Vue latérale de l'extrémité antérieure du mâle. **B.** Vue latérale de la tête de la femelle montrant les amphides. **C.** Vue latérale de la partie médiane du corps de la femelle montrant les ovaires et les œufs. **D.** Vue latérale de la queue du mâle montrant les spicules et l'extrémité bifide.

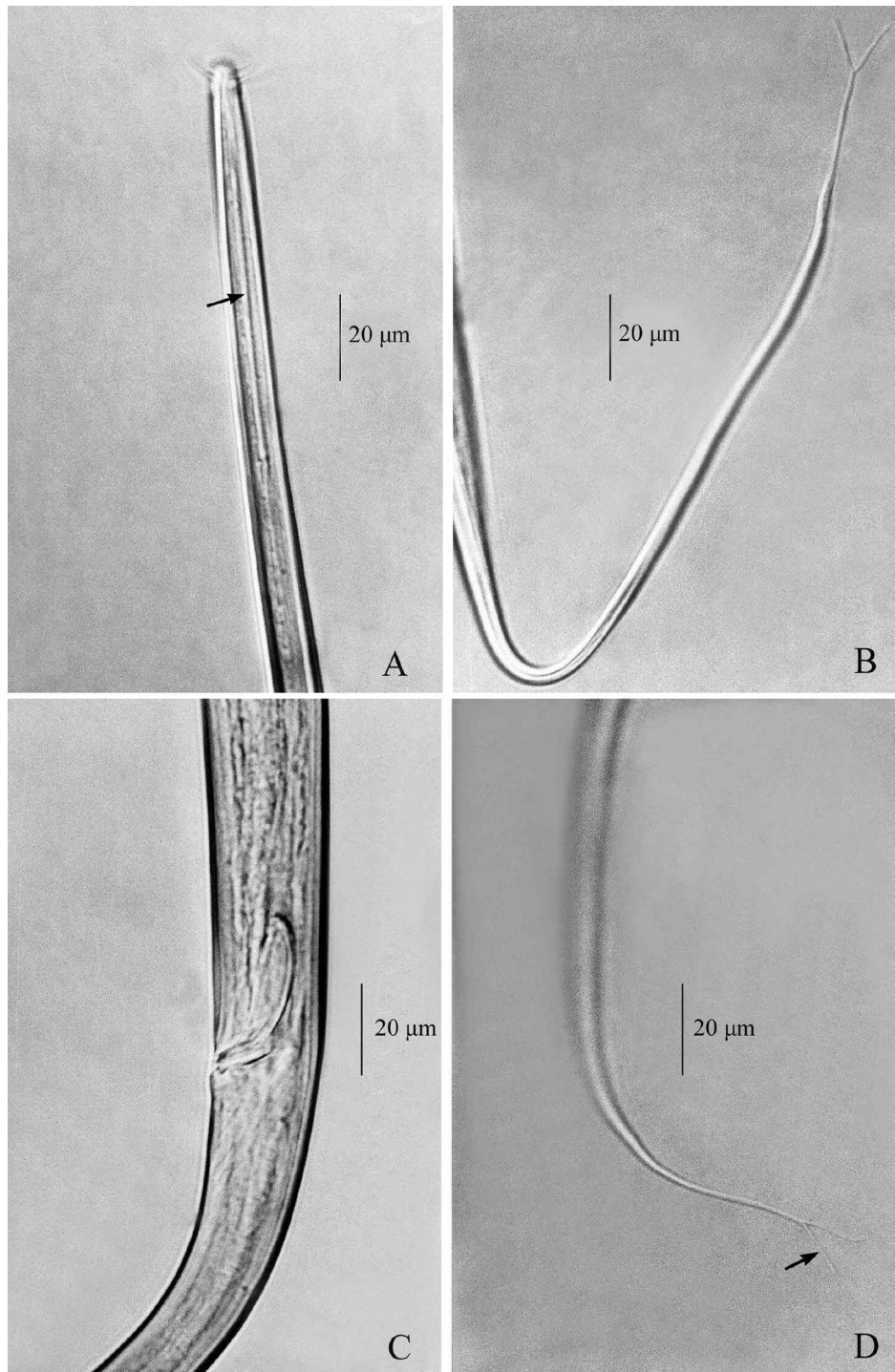


Figure 5. *Halalaimus longamphidus* sp. nov. **A.** Lateral view of female head end, showing slit-like amphids. **B.** Lateral view of female tail end. **C.** Lateral view of male posterior body part, showing spicules. **D.** Lateral view of male tail end, showing bifid tip of tail.

Figure 5. *Halalaimus longamphidus* sp. nov. **A.** Vue latérale de l'extrémité antérieure de la femelle montrant les amphides. **B.** Vue latérale de l'extrémité postérieure de la femelle. **C.** Vue latérale de la partie postérieure du mâle montrant les spicules. **D.** Vue latérale de la partie postérieure du mâle montrant l'extrémité bifide de la queue.

Table 3. Measurements of *Halalaimus longamphidus* sp. nov. (in μm). SD: standard deviation.**Tableau 3.** Mesures de *Halalaimus longamphidus* sp. nov. (en μm). SD : écart-type.

Characters	♂:1	♂:2	♂:3	♀:1	♀:2	Mean	SD
Total body length	3391	3120	2173	3380	2202	2853	617.4
Head diameter	6	4.5	4	6	5	5.1	0.9
Length of the longest cephalic setae	9	6	5	10	5	7.0	2.3
Length of amphids	74	79	81	70	77	76.2	4.3
Oesophagus length	810	910	573	830	700	764.6	130.7
Oesophagus c.d.	32	26	26	38	24	29.2	5.8
Maximum body diameter	42	31	26	46	28	34.6	8.9
Spicule length as chord	35	29	24	-	-	29.3	5.5
Spicule length as arc	46	34	29	-	-	36.3	8.7
Length of gubernaculum	14	15	14	-	-	14.3	0.6
Anal diameter	25	20	18	21	20	20.8	2.6
Tail length	351	310	280	350	252	308.6	43.4
Tail length / a.b.d.	14	15.5	15.6	16.7	12.6	14.9	1.6
Vulva from anterior	-	-	-	1830	1250	1540	410.1
Vulva c.d.	-	-	-	46	28	37.0	12.7
V%	-	-	-	54.1	56.7	55.4	1.8
a	94.2	100.6	83.6	73.5	78.6	86.1	11.1
b	4.2	3.4	3.8	4.1	3.1	3.7	0.5
c	9.7	10.1	7.8	9.7	8.7	9.2	0.9

Table 4. Main differentiating characters of *Halalaimus* species with a bifurcate tail tip.**Tableau 4.** Caractères différentiel de diagnose dans le genre *Halalaimus*.

Species and Characters	L (mm)	a	LA (μm)	CS	PS	LS : CS
<i>H. filicollis</i> Timm	1.3-1.6	56-67.5	36	present	absent	short
<i>H. fletcheri</i> Mawson	2.6-2.37	74.3-91.2	17	absent	absent	short
<i>H. diacros</i> Mawson	1.6-2.1	40-52	20-35	present	absent	longer
<i>H. brimis</i> Keppner	1.27-1.32	48.1-57.7	41	present	absent	longer
<i>H. paralectcheri</i>	2.17-2.78	52.8-70.9	32-45	absent	present	short
<i>H. longamphidus</i> sp. nov.	2.17-3.39	73.5-100.6	70-81	absent	absent	short

Note: L-body length; a-body length/max. body diameter; LA-length of amphid; CS-cuticular striations; PS-precloacal seta; LS:CS-length of out labial seta : length of cephalic seta

fletcheri Keppner in the absence of precloacal seta in males; differs from *H. fletcheri* Mawson in length of amphids (70 μm versus 17 μm) and the presence of ornamented caudal alae. *H. longamphidus* sp. nov. is similar to *H. brimi* Keppner, 1992, *H. diacros* Mawson, 1958 and *H. filicollis* Timm, 1961 in the tail shape, too, but differs from them in the larger body and much longer amphids. For convenience of identification of these species with a bifurcate tail tip, the tabular key is given as table 4.

Order Chromadorida

Family Paramicrolaimidae Lorenzen, 1981

Genus *Paramicrolaimus* Wieser, 1954

Paramicrolaimus mirus Tchesunov

(Figs. 6-7)

Type material

Five males and four females collected from stations 126194, 12494, 14494, 14394 and 11819 (Figure 1). Paratype: ♂1 (ZB030156) on the slide number ZB030116221; paratype: ♂2 (ZB030157) ZB030115222; paratype: ♂3 (ZB030158) ZB030121331; paratype: ♂4 (ZB030159) ZB030116121; paratype: ♂5 (ZB030160) ZB030120212; paratype: ♀1 (ZB030162) ZB030116121; paratype: ♀2 (ZB030163) ZB030116121; paratype: ♀3 (ZB030164) ZB030116121; paratype: ♀4 (ZB030165) ZB0301016121.

Type locality and habitat

Subtidal bottom muddy sediment in the Yellow Sea. Station 126194: 33°57.12'N, 122°24.57'E, water depth 85 m, bot-

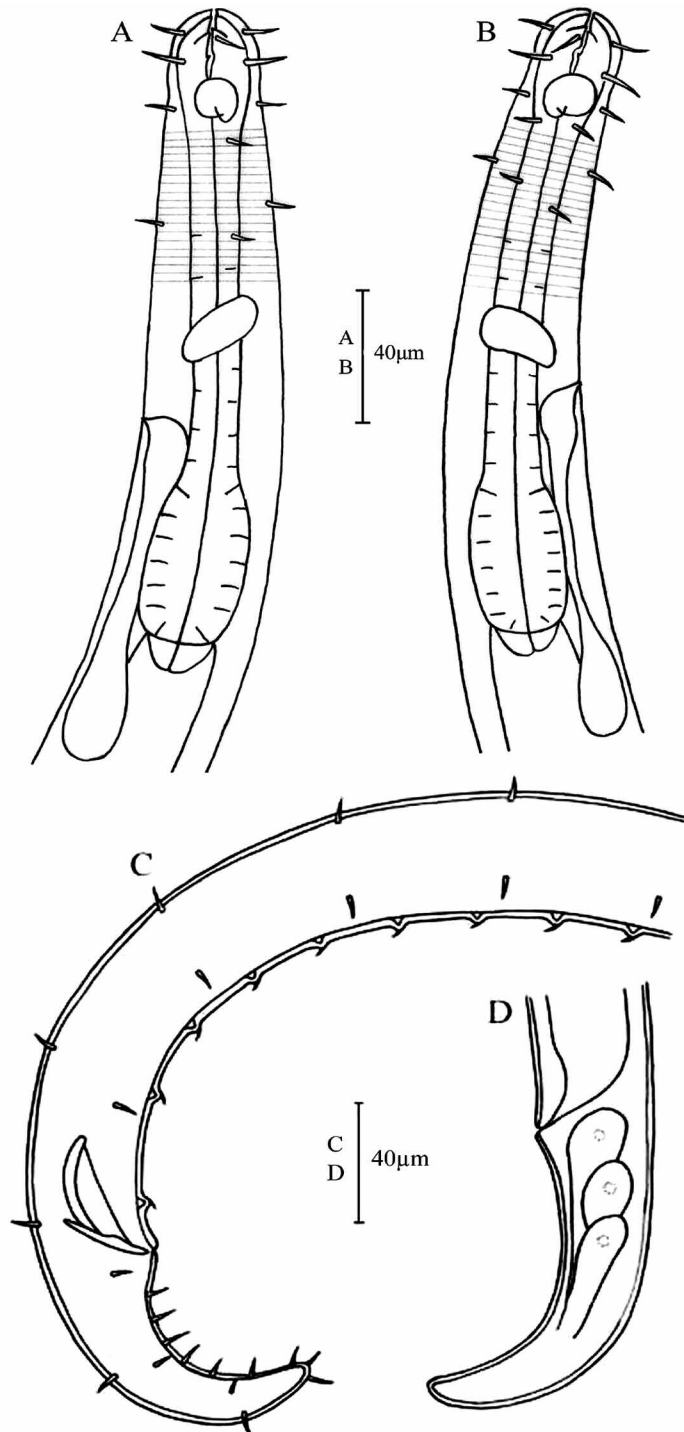


Figure 6. *Paramicrolaimus mirus* Tchesunov. **A.** Lateral view of female anterior end, showing buccal cavity and oesophageal bulb. **B.** Lateral view of male anterior end, showing amphid, ventral gland and excretory pore. **C.** Lateral view of male posterior end, showing spicules, supplements and caudal seta. **D.** Lateral view of female tail.

Figure 6. *Paramicrolaimus mirus* Tchesunov. **A.** Vue latérale de l'extrémité antérieure de la femelle montrant la cavité buccale et le bulbe oesophagien. **B.** Vue latérale de l'extrémité antérieure du mâle montrant l'amphide, la glande ventrale et le pore excréteur. **C.** Vue latérale de l'extrémité postérieure du mâle montrant les spicules, les suppléments et la soie caudale. **D.** Vue latérale de l'extrémité postérieure de la femelle.

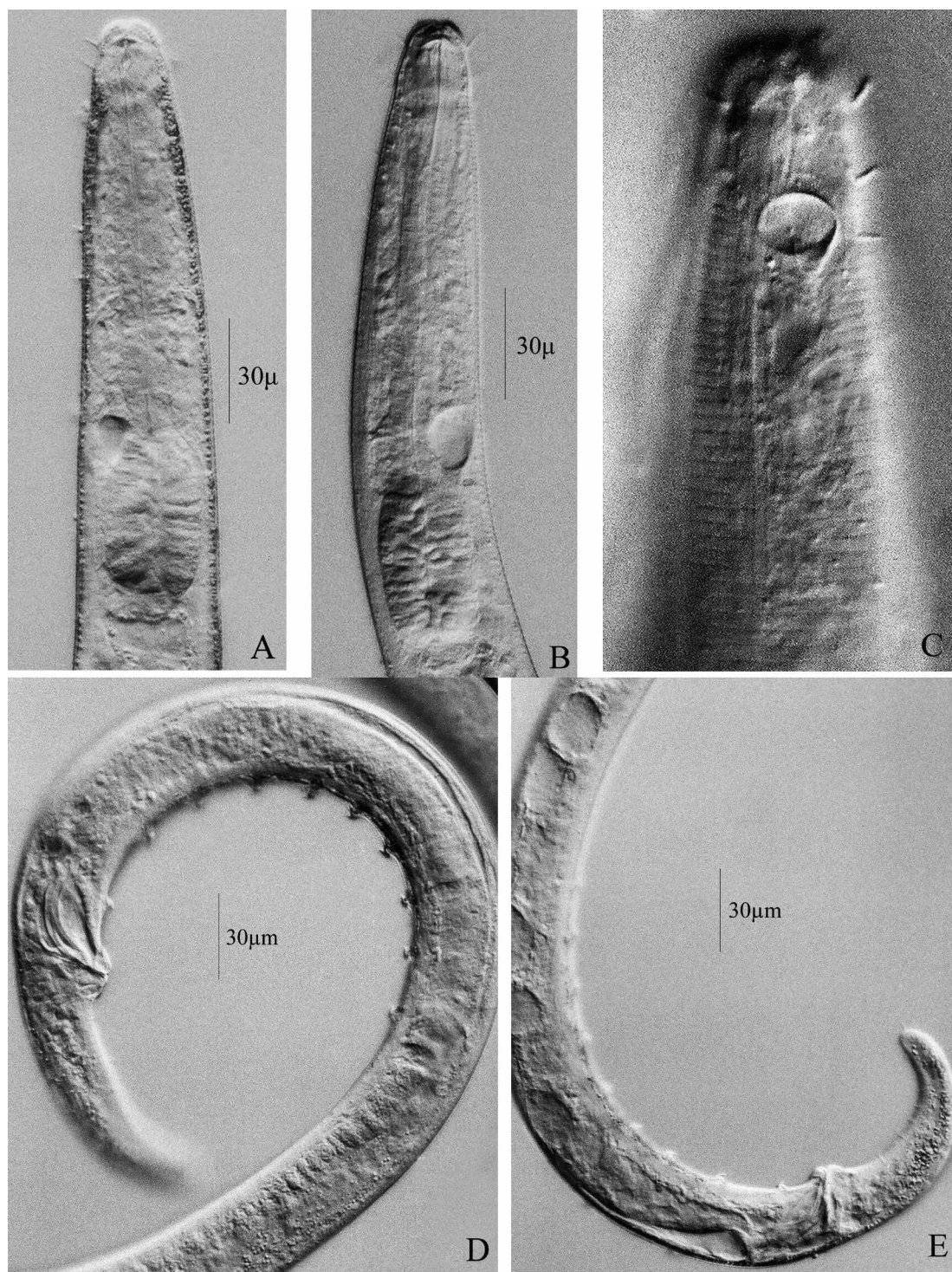


Figure 7. *Paramicrolaimus mirus* Tchesunov. **A.** Sublateral view of male anterior end, showing buccal cavity and oesophageal bulb. **B.** Lateral view of female anterior end, showing oesophageal bulb and excretory pore. **C.** Lateral view of female head end, showing amphid and cephalic setae. **D.** Lateral view of male posterior end, showing spicules and supplements. **E.** Lateral view of male tail, showing postcloacal ventral setae and terminal setae.

Figure 7. *Paramicrolaimus mirus* Tchesunov. **A.** Vue sous-latérale de l'extrémité antérieure du mâle montrant la cavité buccale et le bulbe oesophagien. **B.** Vue latérale de l'extrémité antérieure de la femelle montrant le bulbe oesophagien et le pore excréteur. **C.** Vue latérale de la tête de la femelle montrant l'amphide et les soies céphaliques. **D.** Vue latérale de l'extrémité postérieure du mâle montrant les spicules et les suppléments. **E.** Vue latérale de la queue du mâle montrant les soies ventrales postcloacales et les soies terminales.

Table 5. Measurements of *Paramicrolaimus mirus* Tchesunov (μm).**Tableau 5.** Mesures de *Paramicrolaimus mirus* Tchesunov (μm).

Characters	♂ 1	♂ 2	♂ 3	♂ 4	♂ 5	Mean	♀ 1	♀ 2	♀ 3	♀ 4	Mean
Total body length	3250	3052	3400	3600	3400	3340	3740	3680	4340	4080	3960
Max. body diameter	40	40	38	43	40	40.2	49	43	50	45	46.8
Head diameter	20	20	19	20	19	19.6	20	19	20	20	19.8
L of cephalic setae	8	8	8	7	7	7.6	8	8	9	9	8.5
L of subcephalic setae	10	10	9	10	9	9.6	10	10	11	10	10.3
Amphid diameter	12	11	13	12	12	12	13	12	13	11	12.3
Amphid diameter / c.d.	55	50	57	43	50	51	48	52	54	46	50.0
DN	87	88	87	85	86	86.6	82	89	88	85	86.0
Nerve ring c.d.	35	32	36	40	37	36	39	36	39	39	38.3
Oesophagus length	190	192	172	183	175	182.4	193	145	176	196	177.5
Oesophagus c.d.	40	40	38	43	39	40	47	43	45	45	45.0
DE	108	120	94	128	108	111.6	128	113	115	118	118.5
Spicule length as chord	41	42	37	39	41	40	-	-	-	-	0.0
Spicule length as arc	50	50	45	45	50	48	-	-	-	-	0.0
L of gubernaculum	28	26	22	30	22	25.6	-	-	-	-	0.0
NS	10	9	9	9	8	9	-	-	-	-	0.0
Tail length	102	100	105	98	102	101.4	130	130	142	148	137.5
Anal diameter	34	32	32	34	32	32.8	32	30	34	32	32.0
Tail length / a.b.d.	3.0	3.1	3.3	2.9	3.2	3.1	4.1	4.3	4.2	4.6	4.3
Vulva from anterior	-	-	-	-	-	-	1610	1430	1780	1700	1630
Vulva c.d.	-	-	-	-	-	-	49	40	50	44	45.8
V%	-	-	-	-	-	-	43	39	41	42	41.3
a	81.3	76.3	89.5	83.7	85	83.16	76.3	85.6	86.8	90.7	84.9
b	17.1	15.9	19.8	19.7	19.4	18.38	19.4	25.4	24.7	20.8	22.6
c	31.9	30.5	32.4	36.7	33.3	32.96	28.8	28.3	30.6	27.6	28.8

Note: L-length; DN-distance of nerve ring from the anterior end; DE-distance of excretory pore from the head end; NS- number of precloacal supplements

Table 6. Main differentiating features of three species in the genus *Paramicrolaimus* (μm).**Tableau 6.** Caractères différentiels de diagnose dans le genre *Paramicrolaimus* (μm).

Characters	Body length	a	c	Lscs	Pb	Os	Spicules ala
<i>P. primus</i>	2340	44.7	22.3	10	slight	longitudinal bars	-
<i>P. spirulifer</i>	4180-5170	130-150	52-55	16-18	absent	absent	absent
<i>P. minus</i>	3052-4340	76-91	28-37	9-11	prominent	absent	present

Note: Lscs-length of second circle of cephalic setae; Pb-posterior bulb; Os-ornamentation of striate.

tom water temperature 12.16 °C, Md_ϕ 6.59, organic matter 2.12 %; Station 12494: 33°59.76'N, 122°59.85'E, water depth 68 m, temperature 11.24°C, Md_ϕ 7.54, organic matter 2.77%; Station 14494: 32°59.34'N, 125°1.14'E, water depth 82m, bottom water temperature 14.79°C, Md_ϕ 5.9, organic matter 2.13%; Station 14394: 33°0.36'N, 124°29.22'E, water depth 64 m, bottom water temperature 12.98°C, Md_ϕ 3.64, organic matter 1.1%; Station 118194: 34°29.77'N, 124°29.89'E, water depth 77 m, bottom water temperature 10.37°C, Md_ϕ 3.85, organic matter 2.39%; Station 12494: 33°59.76'N, 122°59.85'E, water depth 68 m,

bottom water temperature 11.24°C, Md_ϕ 7.49, organic matter 2.77%.

Measurements (table 5)

Description

Cuticle with fine transverse striations. Hypodermal gland cells present. Short somatic setae only distributed in tail and precloacal supplements region. Head slightly constricted at the level of amphids, 19-20 μm in diameter. Amphids transversely oval, spiral, describing 1.25 turns, 11-13 μm width,

or 43-57% of corresponding body diameter. Ten cephalic setae in two circles; the anterior circle with six short (8-9 μm) setae and the posterior one with four slightly longer (10-11 μm) setae. Buccal cavity irregular, with deep and narrow anterior part and posterior part with sclerotized walls, teeth present as two projections (one dorsal and the other right subventral) at the border to the anterior portion. Oesophagus 172-192 μm long; anterior part swelling and surrounding buccal cavity; posterior fourth enlarged and forming an elongated weak "bulb", 50-60 μm long and 23-30 μm wide. Ventral gland 35-45 μm behind end of oesophagus; exit pore about 2/3 of oesophagus length from anterior end, nerve ring at about 0.5 times oesophagus length. Tail stout, conical, bent ventrally, about 3 a.b.d. long, with 6 postcloacal ventral setae and four terminal setae. Three caudal glands.

Males. Body length 3052-3600 (3340 ± 204) μm ; maximum diameter 38-43 (40 ± 1.8) μm . Spicules equal, curved, with ventral ala; 37-42 μm long as chord or about 1.2 a.b.d.. Gubernaculum plate-shaped, 22-30 μm long, with lateral wing in middle part. 8-10 (typically 9) precloacal supplements, papilliform and with caudally directed thornlike structures at their lateral top. The gap between the posterior two supplements being about 1.5 times of that between any other adjacent pair. Anteriormost supplement located about 230-260 μm in front of cloaca. Testes paired, both directed anteriorly.

Females. Body size slightly larger than males, 3680-4640 (3960 ± 309) μm long and maximum diameter 43-50 (46.8 ± 3.3) μm . No somatic setae and caudal setae. Two opposed and reflexed ovaries. Vulva at about 41% of body length.

Diagnosis and discussion

The genus *Paramicrolaimus* was established with type species *P. primus* by Wieser (1954). So far, three species in this genus are described, *P. primus* Wieser 1954, *P. spirulifer* Wieser 1959 and *P. mirus* Tchesunov, 1988. Our specimens are the same as the original description by Tchesunov in 1988, but differs from it in the value of de man ratio a (76-91 versus 105-106) and the structure of gubernaculum (Tchesunov's specimen has a thin bar gubernaculum parallel to spicules).

The main differentiations of the three known species in this genus refer to the tabular key (Table 6).

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References

- Austen M.C. 1989. New species of *Terschellingia* (Nematode: Linhomoeidae) from the Tamar estuary, England and the Maldive Islands. *Journal of the Marine Biological Association of the United Kingdom*, **69**: 93-99.
- De Man J.G. 1888. Sur quelques Nématodes libres de la mer du Nord nouveaux ou peu connus. *Mémoires de la Société Zoologique de France*, **1**: 1-51.
- Guo Y.Q. & Zhang Z.N. 2000. A new species of *Terschellingia* (Nematoda) from the Bohai Sea, China. *Journal of Ocean University of Qingdao*, **30**: 487-492.
- Guo Y.Q. & Warwick R.M. 2001. Three new species of free-living nematodes from the Bohai Sea, China. *Journal of Natural History*, **35**: 1575-1586.
- Higgins R.P. & Thiel H. 1988. Introduction to the study of meiofauna. *Smithsonian Institution Press, Washington D. C.*, 488 pp.
- Hope W.D. & Zhang Z.N. 1995. New nematodes from the Yellow Sea, *Hopperia hexadentata* sp. nov. and *Cervonema deltensis* sp. nov. (Chromadorida: Comesomatidae), with observations on morphology and systematic. *Invertebrate Biology*, **114**: 119-138.
- Huang Y. & Zhang Z.N. 2004. A new genus and three new species of free-living marine nematodes (Nematoda: Enoplida: Enchelidiidae) from the Yellow Sea, China. *Cahiers de Biologie Marine*, **45**: 343-354.
- Huang Y. & Zhang Z.N. 2005. Three new species of the genus *Belbolla* (Nematoda: Enoplida: Enchelidiidae) from the Yellow Sea, China. *Journal of Natural History*, **39**: 1689-1703.
- Jonasson A. & Olausson E. 1966. New devices for sediment sampling. *Marine Geology*, **4**: 365-372.
- Jonge, V.N. de & Bouwman L.A. 1977. A simple density separation technique for quantitative isolation of meiobenthos using the colloidal silica Ludox-TM. *Marine Biology*, **42**: 143-148.
- Keppner E.J. 1992. Eleven new species of free-living marine nematodes of the genus *Halalaimus* de Man, 1888 from Florida with keys to the species. *Gulf Research Reports*, **8**: 333-362.
- Mawson P.H. 1958. Free-living nematodes, section 3: Enoploidea from subantarctic stations. *Published by the B.A.N.Z.A.R. Expedition Committee*, **1**, part 3.
- McIntyre A.D. & Warwick R.M. 1984. Meiofauna techniques In: Holme, N. A. and McIntyre, A. D., *Methods for the study of marine benthos. Blackwell Scientific Publications, Oxford*, 217-244.
- Platt H.M. 1973. Free-living marine nematodes from Strangford Lough, Northern Ireland, *Cahiers de Biologie Marine*, **14**: 295-321.
- Tchesunov A. V. 1988. New species nematodes from the White

- Sea. *Proceedings of the Zoological Institute, Leningrad*, **180**: 68-76.
- Timm R.W. 1961.** The marine nematodes of the Bay of Bengal. *Proceedings of the Pakistan Academy of Sciences*, **1**: 25-88.
- Warwick R.M., Platt H.M & Somerfield P.J. 1998.** Free-living marine nematodes, Part III: British Monhysteridae, Field Studies Council, Shrewsbury, pp. 296.
- Wieser W. 1954.** Free-living marine nematodes. Chromadoroidea. *Acta Universita Lundensis*, (N. F.), **50**: 1-48.
- Wieser W. 1956.** Free-living marine nematodes. Axonolaimoidea and Monhysteroidea. Reports of the Lund University Chile Expedition 1948-49. *Acta Universita Lundensis*, (N. F.), **52**: 1-115.
- Wieser W. 1959.** Free-living marine nematodes and other small invertebrates of Puget Sound Beaches. University of Washington Press. 179 pp.
- Zhang Z.N. 1991.** Two new species of marine Nematodes from the Bohai sea, China. *Journal of Ocean University of Qingdao*, **21**: 49-60.
- Zhang Z.N. 1992.** Two new species of the genus *Dorylaimopsis* Ditlevsen from the Bohai Sea, China. *Chinese Journal of Oceanology and Limnology*, **10**: 31-39.
- Zhang Z. N. 2005.** Three new species of free-living marine nematodes from the Bohai Sea and Yellow Sea, China. *Journal of Natural History*, **39**: 2109-2123.
- Zhang Z. N. & Huang Y. 2005.** One new species and two new records of free-living marine nematodes from the Yellow Sea, China. *Acta Oceanologica Sinica*, **24**: 91-97.
- Zhang Z.N & Ji R.B. 1994.** The first record of *Terschellingia longicaudata*. *Journal of Ocean University of Qingdao*, **24**: 215-219.
- Zhang Z.N., Lin X. & Yu Z.S. 1994.** Preliminary study on the phytal meiofauna from the rocky beach at Shicao Dalian, China. *Journal of Ocean University of Qingdao*, **24**: 373-383.
- Zhang Z.N. & Platt H.M. 1983.** New species of marine nematodes from Qingdao, China. *Bulletin of the British Museum of Natural History*, **45**: 253-261.