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Three New Species of Free-living Marine Nematodes (Nematoda: Enoplida) from Northern Japan

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Three new species of free-living marine nematodes, belonging to three genera, *Epacanthion* Wieser, 1953, *Enoplolaimus* De Man, 1893 (both family Enoplidae Dujardin, 1845), and *Oncholaimus* Dujardin, 1845 (family Oncholaimidae Filipjev, 1916), are described from northern Japan. *Epacanthion quadridiscus* sp. nov. is most similar to *Epacanthion enoploidiforme* (Gerlach, 1953), *E. gorgonocephalum* Warwick, 1970, and *E. georgei* Inglis, 1971 in spicule length and the absence of a precloacal supplement, but differs from them in the shape of the gubernaculum and the arrangement of the subcephalic and cervical setae in the male. *Enoplolaimus longigubernaculum* sp. nov. differs from all of its congeners in having a long and straight gubernaculum. *Oncholaimus secundicollis* sp. nov. is distinguished from all of its congeners by the presence of a precloacal papilla, postcloacal papilla, and tail papilla in the male.

Key Words: Nematoda, Enoplida, *Epacanthion*, *Enoplolaimus*, *Oncholaimus*, new species, Japan.

Introduction

Since the first description of four species of free-living marine nematodes from Japanese waters by Steiner and Hoeppli (1926), 71 species have been described from this area (Allgén 1951; Wieser 1955; Kito 1976, 1977, 1978a, b, 1981; Allen and Noffsinger 1978; Yoshimura 1980a, b, 1982; Aryuthaka 1989a, b; Kito and Hope 1999). Of these, 19 are classified in the Enoplida, while the rest belong to either the Chromadorida or the Monhysterida.

During the course of a faunal survey of free-living marine nematodes in 2007, many specimens belonging to the Enoplida were obtained from intertidal sandy sediments around Hokkaido, northern Japan (Fig. 1A). As a result of our taxonomic study of the material, we here present the descriptions of three new species of the genera *Epacanthion* Wieser, 1953, *Enoplolaimus* De Man, 1893 (family Enoplidae Dujardin, 1845), and *Oncholaimus* Dujardin, 1845 (family Oncholaimidae Filipjev, 1916).

Fig. 1. Sampling points (triangles). A, Hokkaido; B, Rebun Island; C, Oshoro Bay; D, Akkeshi Bay.

Material and Methods

Sediment samples were taken from the surface layer (<5 cm in depth) of intertidal zones at three localities around Hokkaido, Japan, viz., Rebun Island, Oshoro Bay, and Akkeshi Bay (Fig. 1A–D). The sediment was washed first in fresh water, then in seawater at laboratories so that nematodes could be separated by using a sieve (63 μ m mesh). Nematode specimens were fixed with 10% formalin in seawater, transferred into 10% glycerin in 30% ethanol, then put in a desiccator for 2–3 weeks. After evaporation, nematodes were preserved in pure glycerin. Specimens were mounted on glass slides in pure glycerin supported by paraffin wax ring (Hooper 1986) and sealed with Canada balsam as permanent mount, observed with a differential interference contrast microscope, and drawn with the aid of a camera lucida. Additional specimens were dehydrated through a graded ethanol series, dried with a critical point dryer (Hitachi HCP-2), and Au-coated with a ion sputter (JEOL JFC-1100), then observed with a scanning electron microscope (SEM; Hitachi S-3000N). The specimens examined have been deposited in the Hokkaido University Museum, Sapporo, Japan, cataloged under the acronym “ZIHU”.

Taxonomy

Epacanthion quadridiscus sp. nov.

(Figs 2, 3, Table 1)

Material examined. Holotype: male, ZIHU 3360. Allotype: female, ZIHU 3365.

Paratypes: males, ZIHU 3361–3364, 3385, 3386 (3385 and 3386, Au-coated for SEM); females, ZIHU 3366–3369. All collected by D. Shimada on 17 October 2007 from intertidal coarse sand at Cape Karan-nai (45°16.3'N, 141°01.3'E), Rebun Island, Hokkaido, Japan (Fig. 1B).

Etymology. The specific name *quadridiscus* is a noun in apposition derived from the Latin *quattuor* (four) and *discus* (disk), referring to the four disk-like

Fig. 2. *Epacanthion quadridiscus* sp. nov, males (A, B, D–F, holotype, ZIHU 3360; C, paratype, ZIHU 3361) and female (G–J, allotype, ZIHU 3365) in lateral views. A, G, Head; B, mandible; C, H, cervical region; D, I, tail; E, J, tail end; F, left spicule and gubernaculum.

Fig. 3. *Epacanthion quadridiscus* sp. nov., SEM photographs of males (A, B, paratype, ZIHU 3385; C, D, paratype, ZIHU 3386). A, Head, frontal view; B, head, lateral view; C, spicules, frontal view; D, spicules, ventral view.

structures of the spicules.

Description. Body long, almost cylindrical, 4.4–5.9 mm in male and 5.0–5.6 mm in female. Maximum diameter 93–100 μm in male and 103–115 μm in female. Cuticle smooth. Head (Figs 2A, G, 3A, B) slightly tapered. Three lips high, six labial setae long. Six long and four short cephalic setae in single circle at middle of cephalic capsule. Buccal cavity small, conical in shape, with three mandibles and three onchia. Mandibles (Fig. 2B) well developed, each consisting of two hooked rods and one central thin sheet. Bases of mandibles situated at level of cephalic setae, tops situated at level of labial setae. Onchia solid, each length equal to that of mandible. Amphids and excretory pore not observed. Oesophagus cylindrical, 1/5 of body length, expanded at anterior end. Three large glands situated just posterior to buccal cavity, respectively opening at tip of each onchium. Nerve ring situated at 1/4 of oesophagus length. Tail long, sexually dimorphic.

Male. Twelve pairs of subcephalic setae arranged in single circle (Fig. 3B), situated just posterior to cephalic setae. Cervical setae densely arranged between posterior end of head and level of nerve ring, further posteriorly becoming suddenly sparser (Fig. 2C). Six bundles of cervical setae in single circle situated at level of nerve ring (Fig. 2C). Spicules (Fig. 2F) relatively short for this genus, 1.0–1.2 times as long as cloacal diameter on arc; proximal end expanded; distal portion with four disk-shaped structures, consisting of three transverse ridges sur-

Table 1. Measurements (in μm) of *Epacanthion quadridiscus* sp. nov.

	Males		Females	
	Holotype ZIHU 3360	Paratypes* ZIHU 3361–3364	Allotype ZIHU 3365	Paratypes* ZIHU 3366–3369
Body length	5619	5206 (4434–5947)	5580	5218 (5007–5596)
Maximum diameter	93	96 (93–100)	125	107 (103–115)
Distance from anterior end of body to				
nerve ring	258	250 (219–274)	280	266 (242–277)
posterior end of oesophagus	1063	1034 (934–1127)	1198	1078 (1066–1108)
vulva	–	–	3140	2892 (2740–3104)
cloaca (anus)	5281	4886 (4144–5603)	5239	4896 (4679–5274)
Body diameter at level of				
head (at cephalic setae)	52	54 (52–56)	79	63 (48–70)
posterior end of oesophagus	81	87 (84–93)	123	99 (93–109)
vulva	–	–	123	106 (103–113)
cloaca (anus)	61	62 (58–64)	83	72 (64–81)
Longest labial seta length	18	18 (16–21)	18	20 (18–23)
Longest cephalic seta length	41	48 (45–52)	57	52 (42–58)
Longest subcephalic seta length	42	41 (37–47)	–	–
Longest cervical seta length	24	25 (23–31)	23	21 (19–24)
Tail length	338	320 (290–348)	341	322 (209–328)
Tail length/cloacal diameter	5.5	5.2 (4.9–5.5)	4.1	4.5 (4.0–5.1)
Spicule length on arc	67	67 (65–69)	–	–
Spicule length on chord	53	55 (51–58)	–	–
Spicule length on arc/ cloacal diameter	1.09	1.09 (1.04–1.19)	–	–
Spicule length on arc/ tail length	0.20	0.21 (0.19–0.24)	–	–
Gubernaculum length	30	34 (31–36)	–	–
Gubernaculum length/ spicule length on arc	0.45	0.51 (0.47–0.52)	–	–
V (%)	–	–	56.3	55.4 (54.6–56.8)
a	60.2	54.4 (47.5–61.6)	44.7	49.0 (48.6–49.4)
b	5.3	5.0 (4.7–5.4)	4.7	4.8 (4.6–5.2)
c	16.6	16.3 (14.5–18.0)	16.3	16.2 (15.2–17.4)

* Mean (range).

Abbreviations: V, position of vulva from anterior end of body as percentage of body length; a, body length/maximum diameter; b, body length/distance from anterior end to posterior end of oesophagus; c, body length/tail length.

rounding spicule and a round expansion of its distal end (Fig. 3C, D). Gubernaculum (Fig. 2F) large, H-shaped, with knob-like projection at dorsal proximal end. Precloacal supplement absent. Testis single, situated left of intestine. Tail (Fig. 2D, E) conical, slightly bent ventrally, 4.9–5.5 times as long as cloacal diameter, with sparse single short setae; tail end blunt, without any seta.

Female. Subcephalic setae and bundles of cervical setae absent (Fig. 2H). Single cervical setae present, fewer than in male. Reproductive system didelphic. Ovaries equal in shape and length, opposed, and not reflexed. Vulva situated at 55% of body length from anterior end. Tail (Fig. 2I, J) conical, not bent ventrally, 4.0–5.1 times as long as cloacal diameter, with sparse single short setae; tail end

blunt, without any seta.

Diagnosis and Discussion. *Epacanthion quadridiscus* sp. nov. is characterized by a large body size (4.4–5.9 mm long), a long tail (4.0–5.5 times cloacal diameter), 2×12 subcephalic setae, a single circle of six bundles of cervical setae at the level of the nerve ring in males, short spicules (1.0–1.2 times cloacal diameter on arc) with disk-shaped structures, a large H-shaped gubernaculum, absence of a precloacal supplement, and unreflexed ovaries.

The genus *Epacanthion* currently consists of about 20 species, 11 of which possess short spicules as in *E. quadridiscus* sp. nov. Of these congeners, three species, *E. enoploidiforme* (Gerlach, 1953), *E. gorgonocephalum* Warwick, 1970, and *E. georgei* Inglis, 1971, are especially similar to *E. quadridiscus* in that they commonly possess a gubernaculum and lack a precloacal supplement (cf. Gerlach 1953; Warwick 1970; Inglis 1971). *Epacanthion enoploidiforme* and *E. georgei* differ from *E. quadridiscus* in their small gubernacula; *E. enoploidiforme* can also be distinguished from *E. quadridiscus* by the mandible shape, which is similar to that of species of the genus *Enoploides* Ssaweljev, 1912 (Gerlach 1953). *Epacanthion gorgonocephalum* differs from *E. quadridiscus* by the presence of 3×12 subcephalic setae and no bundles of cervical setae versus 2×12 subcephalic setae and bundles of cervical setae in the latter.

***Enoplolaimus longigubernaculum* sp. nov.**

(Figs 4, 5, Table 2)

Material examined. Holotype: male, ZIHU 3351. Allotype: female, ZIHU 3356. Paratypes: males, ZIHU 3349, 3350, 3352–3354, 3387, 3388 (3387 and 3388, Au-coated for SEM); females, ZIHU 3355, 3357–3359. All collected by D. Shimada on 14 April 2008 from intertidal fine sand at Oshoro Bay (43°12.3'N, 140°51.3'E), Hokkaido, Japan (Fig. 1C).

Etymology. The specific name *longigubernaculum* is a noun in apposition, referring to the fact that the gubernaculum of this species is the longest of any species in this genus.

Description. Body long, almost cylindrical, 4.4–4.9 mm in male and 5.2–5.9 mm in female. Maximum diameter 70–92 µm in male and 101–132 µm in female. Cuticle smooth. Head (Figs 4A, G, 5A, B) slightly tapered. Three lips high; six long labial setae situated at middle of cephalic capsule. Six long and four short cephalic setae in single circle at posterior end of cephalic capsule. Buccal cavity small, conical in shape, with three mandibles and three onchia. Mandibles (Fig. 4B) well developed, each consisting of two lateral rods and one curved bar. Bases of mandibles situated at level of cephalic setae and tips situated at level of labial setae. Onchia solid, shorter than mandibles. Amphids oval, just posterior to level of labial setae. Excretory pore not observed. Oesophagus cylindrical, 1/5 of body length, expanded at anterior end. Three glands situated just posterior to buccal cavity, respectively opening at tip of each onchium. Nerve ring situated at 20–25% of oesophagus length. Tail long, sexually dimorphic.

Male. Subcephalic setae arranged in eight bundles (each bundle with four setae) in single circle situated just posterior to cephalic setae. Single cervical setae

Fig. 4. *Enoplolaimus longigubernaculum* sp. nov., male (A–F, holotype, ZIHU 3351) and female (G–I, allotype, ZIHU 3356) in lateral views. A, G, Head; B, mandible; C, H, tail; D, I, tail end; E, precloacal supplement; F, spicules and gubernaculum.

densely arranged between posterior end of head and level of nerve ring, then becoming suddenly sparser. Spicules (Fig. 4F) of average length for this genus, 1.3–1.6 times cloacal diameter on arc, proximal end bent strongly like a handle, distal end slightly expanded. Gubernaculum (Fig. 4F) long, almost equal to spicules, straight, and without any accessory structure. Precloacal supplement (Fig. 4E) small, 11–13 μm long, situated at 2.0–2.6 times cloacal diameter anterior to cloaca. Testis single, situated left of intestine. Tail (Fig. 4C, D) conico-cylindrical, slightly bent ventrally, 3.1–4.0 times as long as cloacal diameter, with sparse single short setae;

Fig 5. *Enoplolaimus longigubernaculum* sp. nov., SEM photographs of males (A, paratype, ZIHU 3387; B, paratype, ZIHU 3388). A, Head, lateral view; B, head, frontal view.

tail end blunt and expanded, with two pairs of short setae situated dorsally.

Female. Subcephalic setae absent. Single cervical setae present, fewer than in male. Reproductive system didelphic. Ovaries equal in shape and length, opposed, and not reflexed. Vulva situated at 60% of body length from anterior end. Tail (Fig. 4H, I) conico-cylindrical, not bent ventrally, 2.8–3.4 times as long as cloacal diameter, with sparse single short setae; tail end blunt and expanded, without any seta.

Diagnosis and Discussion. *Enoplolaimus longigubernaculum* sp. nov. is characterized by a large body size (4.4–5.9 mm long), 32 subcephalic setae (in eight bundles, each comprising four setae), curved spicules with a bent proximal end, and a long, straight gubernaculum (almost equal in length to spicules).

The genus *Enoplolaimus* includes ten species with curved (not straight) spicules and a straight gubernaculum as in *E. longigubernaculum*. However, *E. longigubernaculum* differs from all of them in the extremely long gubernaculum (length almost equal to spicule length vs almost equal to or shorter than 0.5 times spicule length in the other species).

***Oncholaimus secundicollis* sp. nov.**

(Figs 6, 7, Table 3)

Material examined. Holotype: male, ZIHU 3370. Allotype: female, ZIHU 3378. Paratypes: males, ZIHU 3371–3377, 3389 (3389, Au-coated for SEM); females, ZIHU 3379–3384. All collected by D. Shimada on 3 July 2007 from intertidal fine sand containing hydrogen sulfide at Shinryu Beach (43°01.1'N, 144°50.4'E), Akkeshi Bay, Hokkaido, Japan (Fig. 1D).

Etymology. The specific name *secundicollis* is a noun in apposition derived from the Latin *secundus* (following) and *collis* (hill). It refers to the presence of a postcloacal papilla following behind the precloacal papilla.

Description. Body long, almost cylindrical, 3.0–3.5 mm in male and 3.4–4.0 mm in female. Maximum diameter 70–79 μm in male and 83–104 μm in female. Cuticle smooth. Head (Figs 6A, 7A, B) rounded with six lips, slightly constricted just posterior to cephalic setae. Labial sensory organs six, papilliform. Ten (6+4) short

Table 2. Measurements (in μm) of *Enoplolaimus longigubernaculum* sp. nov.

	Males		Females	
	Holotype ZIHU 3351	Paratypes* ZIHU 3349–3350, 3352–3354	Allotype ZIHU 3356	Paratypes* ZIHU 3355, 3357–3359
Body length	5150	4692 (4405–4910)	5449	5580 (5151–5890)
Maximum diameter	85	81 (70–92)	96	116 (101–132)
Distance from anterior end of body to				
posterior end of cephalic capsule	35	36 (32–39)	41	40 (38–44)
nerve ring	205	233 (194–283)	234	243 (218–275)
posterior end of oesophagus	968	934 (902–989)	1055	1046 (1012–1095)
vulva	–	–	3340	3383 (3158–3615)
cloaca (anus)	4925	4479 (4198–4698)	5266	5323 (4896–5612)
Body diameter at level of				
head (at cephalic setae)	46	44 (39–50)	57	55 (50–59)
posterior end of oesophagus	72	76 (66–85)	84	102 (92–114)
vulva	–	–	90	115 (99–132)
cloaca (anus)	65	61 (52–69)	67	81 (75–85)
Longest labial seta length	19	16 (13–18)	18	17 (15–18)
Longest cephalic seta length	52	53 (48–56)	54	53 (51–56)
Longest subcephalic seta length	26	24 (22–27)	–	–
Longest cervical seta length	17	16 (22–27)	16	15 (22–27)
Tail length	225	213 (207–224)	183	257 (234–278)
Tail length/cloacal diameter	3.5	3.5 (3.1–4.0)	2.7	3.2 (2.8–3.4)
Spicule length on arc	86	88 (80–94)	–	–
Spicule length on chord	69	68 (58–71)	–	–
Spicule length on arc/ cloacal diameter	1.32	1.45 (1.28–1.55)	–	–
Spicule length on arc/ tail length	0.38	0.41 (0.39–0.45)	–	–
Gubernaculum length	89	76 (71–89)	–	–
Gubernaculum length/ spicule length on arc	0.97	1.16 (0.99–1.25)	–	–
Precloacal supplement length	11	12 (11–13)	–	–
Distance between cloaca and supplement	130	137 (132–139)	–	–
V (%)	–	–	61.3	60.6 (59.7–61.4)
a	60.6	58.6 (47.9–65.5)	56.8	48.4 (43.8–51.0)
b	5.3	5.0 (4.5–5.4)	5.2	5.3 (5.1–5.7)
c	22.9	22.0 (21.3–23.2)	29.8	21.8 (20.2–24.7)

* Mean (range).

Abbreviations: V, position of vulva from anterior end of body as percentage of body length; a, body length/maximum diameter; b, body length/distance from anterior end to posterior end of oesophagus; c, body length/tail length.

cephalic setae in single circle. Buccal cavity large, cylindrical in shape, with thick cuticular wall and three teeth. Left subventral tooth 1.5 times as long as right subventral or dorsal teeth, tip situated at level of cephalic setae. Amphids pocket-like (Fig. 7B), situated just posterior to tips of right subventral and dorsal teeth. Oesophagus cylindrical, $1/7$ – $1/8$ of body length. Nerve ring situated at 45–50% of

Fig. 6. *Oncholaimus secundicollis* sp. nov., male (A–F, holotype, ZIHU 3370) and female (G–I, allotype, ZIHU 3378) in lateral views. A, Head; B, cervical region; C, G, tail; D, H, tail end; E, precloacal and postcloacal papillae with nine cloacal setae; F, right spicule; I, vulva and eggs in uterus.

oesophagus length. Excretory pore situated at 2.4–3.5 times buccal cavity length from anterior end of body. Tail long, sexually dimorphic (Fig. 6B, C).

Male. Spicules (Fig. 6D) of average length for this genus, 0.9–1.2 times cloacal diameter on arc. Gubernaculum absent. Conspicuous fleshy precloacal papilla present just anterior to cloaca, and smaller postcloacal papilla just posterior to

Fig. 7. *Oncholaimus secundicollis* sp. nov., SEM photographs of male (A–D, paratype, ZIHU 3389). A, Head, frontal view; B, head, lateral view; C, cloacal region, ventral view; D, cloacal region, lateral view.

cloaca (Fig. 7C, D). Nine pairs of long, stout cloacal setae situated from beside pre-cloacal papilla to behind level of postcloacal papilla (Fig. 7C, D). Cloaca transversely slit-shaped, with about ten setae on anterior edge (Fig. 7C, D). Testes two, anterior one situated left of intestine, posterior one right of intestine. Tail (Fig. 6B) conico-cylindrical, anterior 2/3 conical and posterior 1/3 cylindrical, gradually bent ventrally, 2.7–3.2 times as long as cloacal diameter; tail end blunt, with two pairs of short setae. One ventral papilla with two pairs of short setae situated at 60–70% of tail length.

Female. Reproductive system monodelphic. Only anterior ovary present, not reflexed. Two or more (2–20 in observed specimens) large eggs in uterus. Vulva situated at 70% of body length. Demanian system not clear but present, with terminal duct opening situated at 1.0–1.5 times tail length anterior to anus. No papilla or setae found in anal region. Tail (Fig. 6C) conico-cylindrical, longer than that of male, 3.6–4.5 times cloacal diameter; tail end blunt, with two pairs of short setae.

Diagnosis and Discussion. *Oncholaimus secundicollis* sp. nov. is characterized by the presence of both a precloacal and a postcloacal papilla, as well as a long conico-cylindrical tail, longer in the female than in the male, with a ventral papilla, nine pairs of long and stout cloacal setae in the male, and a Demanian system in the female.

Although the genus *Oncholaimus* is a large group, containing more than 80

Table 3. Measurements (in μm) of *Oncholaimus secundicollis* sp. nov.

	Males		Females	
	Holotype ZIHU 3370	Paratypes* ZIHU 3371–3377	Allotype ZIHU 3378	Paratypes* ZIHU 3379–3384
Body length	3274	3197 (2987–3470)	3713	3593 (3383–3998)
Maximum diameter	70	73 (70–79)	91	95 (83–104)
Distance from anterior end of body to				
amphid	15	13 (11–14)	14	12 (10–13)
base of buccal cavity	35	32 (31–35)	36	35 (33–36)
excretory pore	103	104 (87–110)	94	95 (85–111)
nerve ring	217	221 (211–238)	230	225 (211–245)
posterior end of oesophagus	470	460 (434–497)	489	483 (467–518)
vulva	–	–	2615	2534 (2310–2845)
cloaca (anus)	3166	3103 (2897–3379)	3577	3466 (3260–3852)
demanian system opening	–	–	3383	3308 (3110–3676)
Body diameter at level of				
head (at cephalic setae)	29	28 (26–32)	29	30 (28–31)
posterior end of oesophagus	63	68 (65–76)	78	76 (73–81)
vulva	–	–	83	83 (73–92)
cloaca (anus)	32	31 (28–34)	31	32 (29–34)
Longest cephalic seta length	7	6 (5–7)	7	6 (5–7)
Amphid width	7	8 (7–10)	7	8 (7–9)
Amphid width/head diameter	0.25	0.28 (0.22–0.36)	0.25	0.26 (0.23–0.31)
Buccal cavity width	14	16 (14–22)	17	17 (15–19)
Longest cloacal seta length	10	11 (9–13)	–	–
Tail length	109	94 (89–104)	136	127 (117–146)
Tail length/cloacal diameter	3.4	3.0 (2.7–3.2)	4.4	4.0 (3.6–4.5)
Spicule length on arc	29	32 (31–32)	–	–
Spicule length on chord	28	31 (30–31)	–	–
Spicule length on arc/ cloacal diameter	0.90	1.02 (0.91–1.16)	–	–
Spicule length on arc/tail length	0.27	0.34 (0.31–0.36)	–	–
V (%)	–	–	70.4	70.5 (68.3–71.3)
a	47.0	44.1 (40.7–49.8)	40.9	38.3 (33.5–41.7)
b	7.0	7.0 (6.7–7.2)	7.6	7.4 (7.2–7.7)
c	30.2	33.6 (30.2–38.3)	27.3	28.2 (26.8–30.3)

* Mean (range).

Abbreviations: V, position of vulva from anterior end of body as percentage of body length; a, body length/maximum diameter; b, body length/distance from anterior end to posterior end of oesophagus; c, body length/tail length.

species, only five species, that is, *O. appendiculatus* (Cobb, 1930), *O. campylocercoides* De Coninck and Stekhoven, 1933, *O. domesticus* (Chitwood and Chitwood, 1938), *O. qingdaoensis* Zhang and Platt, 1983, and *O. sinensis* Zhang and Platt, 1983, are reported to have a precloacal papilla and a tail papilla in the male. *Oncholaimus secundicollis* sp. nov. is clearly distinguished from all of them in having a postcloacal papilla in addition to a precloacal and a tail papilla in the male. However, we assume the postcloacal papilla might be overlooked in the five congeners owing to small size. Even so, *O. campylocercoides* and *O. domesticus* differ from *O. secundicollis* by the presence of two tail papillae (cf. Wieser and Hopper 1967;

Platt and Warwick 1983). *Oncholaimus appendiculatus* differs from this new species in the spicule length (about 2.5 times the cloacal diameter in *O. appendiculatus* vs 0.9–1.1 times in *O. secundicollis*) (cf. Wieser and Hopper 1967), and *O. qingdaoensis* differs in the conical tail shape (cf. Zhang and Platt 1983). *Oncholaimus sinensis* also differs from the new species by the presence of the 11 pairs of cloacal setae (nine pairs in *O. secundicollis*) (cf. Zhang and Platt 1983).

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