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New species of free-living marine Sabatieriinae (Nematoda: Monhysterida: Comesomatidae) from around South Korea*

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Abstract

Four new species from the subfamily Sabatieriinae Filipjev, 1934 are described from the south and west coast of South Korea: three new species of *Laimella* Cobb, 1920 and one new species of *Cervonema* Wieser, 1954. Two further species of *Cervonema* are informally described owing to the absence of male specimens. In addition, *Laimella filicaudata* Ward, 1974 is formally reinstated as an extant species. Sabatieriinae are relatively character poor, defined by a striate cuticle, closely spaced cephalic setae, small buccal cavity, simple arcuate spicules and precloacal supplements minute or absent. However, we have found that the de Man's ratios *a*, *b* and *c*, the comparable lengths of the anterior and posterior cephalic setae, the position of the amphid, shape and length of the oesophageal bulb, and the proportion of the cylindrical tail part are all species informative. *Laimella ferreroi* **sp. nov.** is most distinctive species described here, having the largest de Man's ratios *a* and *b*, the longest gubernaculum (as abd) and the longest, truly filiform, tail so far recorded in the genus. *Laimella socotris* **sp. nov.** has a distinct rounded posterior oesophageal bulb similar only to *L. longicauda* Cobb, 1920 and *L. filicaudata* Ward, 1974; in combination with the tail length and the relative length of the anterior and cephalic setae this defines the species. *Laimella tongyeongensis* **sp. nov.** is defined by a combination of characters, principally the de Man's ratios a, *b*, *c* and *c'*, the oesophageal bulb length and with regards to the length ratio between the anterior and posterior cephalic setae. *Cervonema pseudodeltensis* **sp. nov.** is the only species of the genus so far described which appears to have the anterior cephalic setae marginally longer than the posterior cephalic setae. It is also defined by the amphid position and the relative size of the oesophageal bulb. *Cervonema sp. A* , described only as females, is defined by the total body length and the relative length of the oesophagus and tail (de Man's *b* and *c*). *Cervonema sp. B*, on the other hand, is distinct with respect to the de Man's ratios *a* and *b*, the R2:R3 sensilla length ratio, and the amphid directly behind the cephalic setae. It also has not been fully described here owing to the lack of male specimens.

Key words: Benthic, *Cervonema*, *Laimella*, subtidal, West Sea, Yellow Sea

Introduction

The subtidal habitat along the coast of South Korea is diverse, ranging from shallow (< 100 m) muds and gravels in the West Sea, the Straits of Jeju and Korea Strait, to a narrow continental shelf and steep slope region in the East Sea (Sea of Japan). This is also reflected in the intertidal sediments, which tend to be fine sands and muds on the west coast and coarser sands on the east coast. The Yellow Sea, between the Korean Peninsula and eastern China, is a shallow semi-enclosed, western Pacific marginal sea, and at first sight it might be presumed that the fauna within this region would be homogenous. However, studies show that sedimentary sources to the eastern and western parts of this region are distinct (Lim et al. 2006) with Chinese riverine input being predominantly silt (on average 73 %), and Korean input more homogeneous (Sand, 23 %: Silt, 45 %: Clay, 32 %). We may therefore expect to encounter a relatively distinct meiofaunal assemblage in the Korean West Sea when compared to the Yellow Sea. Nematode assemblage structure and species composition are known to closely reflect sediment granulometry (Vanaverbeke et al. 2011).

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A significant amount of work has been undertaken on the marine free-living nematode fauna of the Bohai Sea (eg. Zhang 1990), and more recently the neighbouring Yellow Sea has been also relatively intensively studied (eg. Huang & Wu 2011). The marine free-living nematode fauna of the Korean Peninsula is relatively unknown, with the interesting but relatively low-abundance family Draconematidae receiving most attention (Rho & Min 2011). The species described here are from the common Family Comesomatidae Filipjev, 1918, but the relatively rare genera *Laimella* Cobb 1920 and *Cervonema* Wieser 1954 (subfamily Sabatieriinae Filipjev, 1934).

Material and methods

Specimens were collected during subtidal surveys along the South Korean coastline. Sampling was undertaken by the Biodiversity Laboratory, Hanyang University, from a number of local research vessels, managed by the Korean National Fisheries Research and Development Institute. Sediment samples were taken at water depths ranging from 0.5 – 80 m using a Van-Veen grab, with sub-samples taken for meiofauna using a hand-held corer. All samples were immediately preserved in 4% formalin.

In the Biodiversity Laboratory all meiofauna were extracted following the techniques of de Jonge & Bouwman (1977) and Platt & Warwick (1988). Sediment was washed over a 38 μm mesh sieve, and retained material centrifuged in Ludox-HS 40. Centrifuge supernatant was stored in 70 % alcohol until specimens were picked out. Specimens were then transferred to a 5 % glycerol dehydrating solution with phenol crystals (Seinhorst 1959) and evaporated to 100 % anhydrous glycerol for identification. Prepared specimens were mounted in pure anhydrous glycerol on clear glass slides using a standard wax-ring method (Hooper 1986a).

A 100x oil immersion objective with Nomarski Differential Interference Contrast (DIC) illumination was used to identify specimens, and a camera lucida was used for drawing. A digital map-measurer was used to make morphometric measurements of the figures. All characters measured are listed in the tables, but note that distance and lengths of reproductive characters are measured from the cloaca in males, and the vulva in females. Abbreviations used in the text and tables follow (Hooper 1986b), specifically: abd, anal body diameter; cbd, corresponding body diameter; hd, head diameter; mbd, maximum body diameter. Also the de Man's ratios are *a* (total body length / maximum body diameter); *b* (total body length / oesophageal length); *c* (total body length / tail length); *c'* (tail length / abd).

For each description the de Man's formula is provided for ease of reference, this represents:

Distance to:	Cephalic setae	Oesophagus base	Anterior ovary Vulva Posterior ovary (♀ only)	Anterior Gonad Anus Posterior Gonad (Gonads ♂ only)	Total length
cbd:	hd	cbd	mbd	abd	

All specimens are deposited at the National Institute for Biological Resources (NIBR), Korea, and registration numbers are given for each specimen in the descriptions.

Through-out, the classification employed is that proposed by Hodda (2007), who accounted for recent molecular advances whilst maintaining relationships based on morphological and behavioural data where other phylogenetic studies are currently lacking or insufficient.

Systematics

Family Comesomatidae Filipjev, 1918

Class Chromadorea Inglis, 1983

Subclass Plectia Hodda, 2007

Superorder Monhysterica Hodda, 2007

Order Monhysterida Filipjev, 1929

Suborder Araeolaimina De Coninck, 1965

Superfamily Axonolaimoidea Filipjev, 1918; sensu B. G. Chitwood & M. B. Chitwood, 1950

Family Comesomatidae Filipjev, 1918

Remarks. The monophyly of the Comesomatidae has been established only by the presence of a spiral amphid of at least 2.5 turns by Lorenzen (1994). However, the Comesomatidae are generally large species, > 1 mm long, with cylindrical body and conico-cylindrical tail. The cuticle usually has transverse rows of punctations of variable size, with or without lateral differentiation and an enlarged/elevated lateral field may be present. Somatic setae run along the length of the body in 4 longitudinal rows. The cephalic region has 6 lips and a 6+6+4 sensilla arrangement. The labial sensilla are papillate, the cephalic sensilla setose and in either one or two rings, the posterior cephalic setae usually longest. Amphids are usually multispiralled and located closely behind the cephalic setae, with the exception of *Cervonema* in which the cervical region is elongate. The buccal cavity is perhaps the most variable character across Comesomatidae, ranging from small and undifferentiated in *Cervonema* to having a sclerotized, dilated and conical posterior section with well developed teeth at its anterior margin in *Paramesonchium* Wieser 1954. The oesophageal lumen is tri-radiate with distinct marginal tubes. Ovaries and testes are paired, opposed and outstretched. The male copulatory apparatus typically comprises arcuate spicules, proximally cephalate and distally acute, and a gubernaculum with or without (usually paired) dorsocaudally directed apophyses.

Subfamily Sabatieriinae Filipjev, 1934

Remarks. The Sabatieriinae is comprised of 7 genera (*Actarjania* Hopper 1967, *Cervonema* Wieser 1954, *Laimella* Cobb 1920, *Pierrickia* Vitiello 1970, *Sabatieria* De Rouville 1903, *Scholpanialla* Sergeeva 1972, *Setosabatieria* Platt 1985), and although Platt (1985) concluded that they shared no unique characters (they are "described as lacking the derived features of the other two families"), in addition to the family characters, the Sabatieriinae generally have a weakly sclerotized buccal cavity, posterior section as a collapsed tube. Spicules enlarged proximally, gubernacular apophyses (is) paired or single. Also, *Laimella*, *Cervonema* and *Setosabatieria* exhibit a striate cuticle, rarely minutely punctations have been observed in *Laimella* (Ward 1974; Jensen 1979).

Genus *Laimella* Cobb, 1920

Emended diagnosis. Sabatieriinae with striate cuticle; fine punctations may be also observed. Anterior and posterior cephalic sensilla closely spaced, posterior setae usually longer than anterior. Buccal cavity small, three small teeth may appear as weak cuticularisation at base of anterior buccal cavity. Spicule simple arcuate, gubernaculum with posteriorly directed paired apophyses. Supplements minute or absent. Tail elongate, posterior section filiform.

Remarks. Presently, there are 7 species of *Laimella* recognised as valid species; *L. filipjevi* Jensen 1979, *L. minuta* Vitiello 1970, *L. longicauda* Cobb 1920 and *L. vera* Vitiello 1970 (following the revision by Jensen (1979)), and *L. annae* Chen & Vincx, 2000, *L. sandrae* Chen & Vincx, 2000 and *L. subterminata* Chen & Vincx, 2000, described by Chen & Vincx (2000). Two species formerly described as belonging to *Laimella* have been reclassified as *Paracomesoma* (*P. quadrisetosum* and *P. hexasetosum*, both B. Chitwood (1937)), and a third species reclassified as *Paramesonchium* (*P. serialis* Wieser 1954) all by Jensen (1979). However, Jensen (1979) also undertook a number of synonimisations, specifically:

1. *Laimella filipjevi* nom. nov., pro *Laimella longicaudata*, syn. *Sabatieria longicaudata* Filipjev 1922.
2. *L. longicauda* Cobb 1920, syn. *L. filicaudata* Ward 1974.

Laimella filipjevi has been recently re-examined by Tchesunov (2000) who additionally recorded the species in the White Sea. However, the current authors believe that the reasons given to refer *L. filicaudata* to the status of junior synonym of *L. longicauda* are not valid: The description of *L. filicaudata* and the differences listed therein between this species and *L. longicaudata* are well defined (Ward 1974). Namely, relative tail length (11.2 vs 17.7 abd, *L. filicauda* and *L. longicauda* respectively), proportion of tail cylindrical (81 % vs 66 %) and relative lengths of the cephalic setae (R2:R3 = 1:3 vs 1:4). *Laimella filicaudata* Ward, 1974 is therefore reinstated here.

TABLE 1. Comparative data table of morphometric measurements for published species of *Laimella*. All measurements in µm. Data presented is mean values, unless $n = 1$. Measurements are for males, except distance to vulva and corresponding body diameter at vulva, unless utherwise stated. Lengths of gonads are not given owing to the paucity of published data. Literature sources: [a]Chen and Vincx 2000; [b]Ward 1974; [c]Tchesunov 2000; [d]Jensen 1979; [e]Cobb 1920; [f]Hopper 1967; [g]Vitiello 1970; [h]Vitiello 1971; [i]Gourbault 1980. Other marks: * number of replicates unless otherwise stated (in brackets); † although 6 males were measured, only maximum and minimum values were provided; ‡ figures and corresponding text do not provide comparable measurements, only measurement quoted in the text presented here; × female measurement provided where missing for male.

	annae[a]	*filicaudata*[b]	*filipjevi*		*longicauda*			*minuta*[g]	*sandrae*[a]	*subterminata*[a]	*vera*	
Male	(n = 2*)	(n = 1)	(n = 2†)	(n = 10*)	/	(n = ?)[f‡]	(n = 1)	(n = 1)	(n = 1)	(n = 1)	(n = 3*)[h]	(n = 3)[i]
Female	(n = 2*)	(n = 1)	(n = 1)[c]	(n = 10*)[d]	(n = ?)[e]	/	(n = 1)[a]	/	(n = 2*)	(n = 3)	/	(n = 2*×)
Character (Abbreviation)												
Total body length (L)	1303 (1)	1780	1642	1273	1700	1400	1834	777	776	1162	1088	1075
Head diameter (hd)	9	18	13	12 (2)	16	15	18	7	9	11	10	9
Length of labial sensilla (R1)	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate
Length of anterior cephalic sensilla (R2)	5	7	4	4 (2)	6	6	6	papillate	5	7	4	4
Length of posterior cephalic sensilla (R3)	9	22	12	12 (?)	24	20	16	papillate	9	12	8	7
Distance from anterior edge to cephalic setae	4 (1)	5	n/f	3	6	n/f	n/f	3	2	n/f	4 (2)	3
Distance from anterior edge to base of buccal cavity	n/f	n/f	n/f	5	22	n/f	n/f	n/f	n/f	n/f	15 (1)	n/f
Length of teeth	n/a	5	n/a	2 (1)	n/f	n/f	n/f	3	n/a	n/a	n/f	n/a
Distance from anterior to anterior edge of amphid (AL)	5	8	4	5 (2)	7	7	7	5	3	6	6 (2)	6
Diameter of amphid (amp)	7	11	8	8 (2)	10	10	13	9	7	8	7	6
Number of turns in amphid	3	3.25	4	3	3.5	3.25	4	4.2	3	4	3	3.25
Amphid cbd	10	21	17 (1)	14 (2)	17	18	21	10	10	13	12	12
Distance from anterior edge to nerve ring	66	n/f	93	76 (1)	92	72	90	65	82	67	55	73 (×)
Corresponding body diameter at nerve ring	18 (1)	n/f	29	26 (1)	29	n/f	30	n/f	17	22	24 (1)	30 (×)
Distance from anterior edge to excretory pore	70	139	121	96	n/f	80	99	n/f	n/f	86	65	86 (×)
Distance from anterior edge to base of oesophagus (OL)	141	207	186 (1)	160 (1)	156	120	159	98	128	133	109	150 (171×)
Oesophageal bulb length (Ob)	30 (1)	51 (×)	36 (1)	n/a	n/f	27	35	17	29	24	24 (1)	86 (×)
cbd at base of oesophagus	21	n/f	31	28 (1)	34	n/f	34	16	18	25	26	23
Length of the cardia	9 (1)	n/f	9 (1)	n/f	n/f	n/f	16	n/f	5	6	4 (1)	n/f

……continue on next page

TABLE 1. (Continued)

	annae[a]	*filicaudata*[b]	*filipjevi*		*longicauda*		*minuta*[g]	*sandrae*[a]	*subterminata*[a]	*vera*	
Male	(n = 2*)	(n = 1)	(n = 2†)	(n = 10*)	/	(n = ?)[f,‡]	(n = 1)	(n = 1)	(n = 1)	(n = 3*)[h]	(n = 3)[i]
Female	(n = 2*)	(n = 1)	(n = 1)[c]	(n = 10*)[d]	(n = ?)[e]	/	(n = 1)[a]	/	(n = 2*)	(n = 3)	/	(n = 2**)
Character (Abbreviation)												
Maximum body diameter (mbd)	21	45	38	32 (1)	41	53	34	17	19	25	26	75
Distance from anterior edge to vulva (VL)	685	808	856	581	663	n/a	669	n/a	420	525	n/a	539
cbd at vulva	20 (1)	n/f	n/f	34 (1)	41	n/a	40	n/a	21 (1)	32 (1)	n/a	31
Distance from anterior to anus	1033 (1)	1375	1273 (1)	1001	1190	1030	1489	673	663	947	877	871
Anal body diameters (abd)	19	36	32	25	29	34	34	15	17	21	23	23
Length of spicules, as arc (spic)	30	49	51	44	n/a	56	41	15	24.8	36	43 (2)	38
Length of gubernacular apophysis, as arc	12	28	23	17	n/a	17	20	8	11	14	11	13
Number of supplements	5	5	4-7	7 - 8	n/a	9	11	n/a	0	6	2-3? (1)	0
Distance from anus to most posterior supplement	n/f	n/f	n/a	n/f	n/a	n/a	n/f	n/a	n/a	n/f	n/f	n/a
Distance from anus to most anterior supplement	n/f	n/f	n/a	n/f	n/a	n/a	n/f	n/a	n/a	n/f	n/f	n/a
Tail length (TL)	270 (1)	405	333 (1)	272	510	370	346	104	113	215	211	204
Number of terminal setae	0	0	0	3	0	0	0	n/v	2	0	0	0
Length of terminal setae	n/a	n/a	n/a	n/f	n/a	n/a	n/a	n/a	3	n/a	n/a	n/a

Published descriptions of these now eight known species of *Laimella* differ in the morphological characters considered of note, but reviewing these species the relative body proportions, including the de Man's ratios, are particularly important. Therefore Table 1 presents a comprehensive comparison of the morphometric measurements of these species and Table 2 provides the calculated body proportions, such as de Man's ratios. Where measurements were not presented in the original publications they are supplemented by measurements made by the authors from the original published figures where possible.

TABLE 2. Comparative data table of calculated body proportions for published species of *Laimella*. Data presented is mean values, unless otherwise stated (when n = 1). All measurement in µm. Literature sources: [a]Chen and Vincx 2000; [b]Ward 1974; [c]Tchesunov 2000; [d]Jensen 1979; [e]Cobb 1920; [f]Hopper 1967; [g]Vitiello 1970; [h]Vitiello 1971; [i]Gourbault 1980. Other marks: * number of replicates unless otherwise stated (in brackets); † although 6 males were measured, only maximum and minimum values are provided; ‡ figures and corresponding text do not provide comparable measurements, only measurement quoted in the text presented here; × female measurement provided where missing for male.

	annae[a]	*filicaudata*	*filipjevi*		*longicauda*			*minuta*	*sandrae*	*subterminata*	*vera*	
Male	(n = 2*)	(n = 1)	(n = 2†)	(n = 10*)	/	(n = ?)[f‡]	(n = 1)	(n = 1)	(n = 1)	(n = 1)	(n = 3*)[h]	(n = 3)[i]
Female	(n = 2*)	(n = 1)	(n = 1)[c]	(n = 10*)[d]	(n = ?)[e]	/	(n = 1)[a]	/	(n = 2*)	(n = 3)	/	(n = 2*×)
a = L / mbd	62.0 (1)	39.7	43.8	36.0	41.7	26.5	53.9	45.7	40.8	46.5	44.1	45.3
b= L / O	9.0 (1)	8.6	8.3	7.2	10.9	11.7	11.5	7.9	6.1	8.7	9.9	7.3
C = L / TL	4.8 (1)	4.4	4.7	4.7	3.3	3.8	5.3	7.5	6.9	5.4	5.1	5.5
c' = TL / abd	14.2 (1)	11.2	12.2	10.8	17.6	11.0	10.2	6.9	6.6	10.2	9.1	9.1
V= VL / L	0.4	0.43	0.5	0.5	0.4	n/a	0.44	n/a	49.3	0.44	n/a	49.0
R2/R3	0.56	0.32	0.3	0.33	0.25	0.3	0.38	~	0.56	0.58	0.5	0.51
amp / cbd	0.7	0.5	0.4	0.5	0.6	0.6	0.7	1.0	0.7	0.6	0.5	0.5
Ob / O	0.2 (1)	0.23 (×)	0.2 (1)	n/a	n/f	0.2	0.2	0.2	0.2	0.2	0.2 (1)	0.50 (×)
s' = spic / abd	1.6	1.2	1.4 (1)	1.4	n/a	1.7	1.2	1	1.5	1.7	2.0 (2)	1.7
Cylindrical tail section / TL	0.8 (1)	0.8	0.7	0.8	0.7	0.8	0.7	0.5	0.5	0.8	0.7 (1)	0.6

***Laimella ferreroi* sp. nov.**
(Fig. 1)

Type locality. Sub-tidally north-west of Socotra Rock (32.1523º N 125.1519 º E), at a depth of 51 m, in muddy sediment.

Type material. Holotype male NIBRIV0000245036, collected by Kwang-Soo Kim, in June 2011, from Research Vessel Tam-Gu 8.

Measurements. See Table 3 and 4 for detailed measurements and calculations.

male**1** $\frac{5 \quad 155 \quad - \quad {}^{992}1678^{906}}{11 \quad 31 \quad 33 \quad 25}$ 2283

Description. Male holotype (Fig. 1). Habitus elongate tubular, tapering to filiform tail posteriorly, anterior only slightly narrowed, blunt. Cuticle with faint but relatively coarse striation throughout body, tail appears smooth. Body diameter increases gradually from cephalic setae to mid-esophageal region, reduces slightly behind cardia, then approximately stable to cloaca. Tail conico-cylindrical, cylindrical section filiform, tail tip missing.

Labia as 6 small lips, labial papillae minute, 1 µm long. Six anterior cephalic setae (0.7 hd long) located about 0.2 hd from anterior extremity, 4 posterior cephalic setae (1 hd long) immediated behind. Amphid multi-spiralled with 3.5 turns (diameter 0.7 cbd), 0.5 hd from anterior. Cervical setae about 10 µm long, one setae 2.3 hd from anterior, then sub-lateral pair 3.5 hd from anterior. Somatic setae rare, 0.1–0.3 cbd. Row of latero-ventral post-cloacal setae, 6 µm long. Last setae observed 5 abd from the cloaca in cylindrical part of tail.

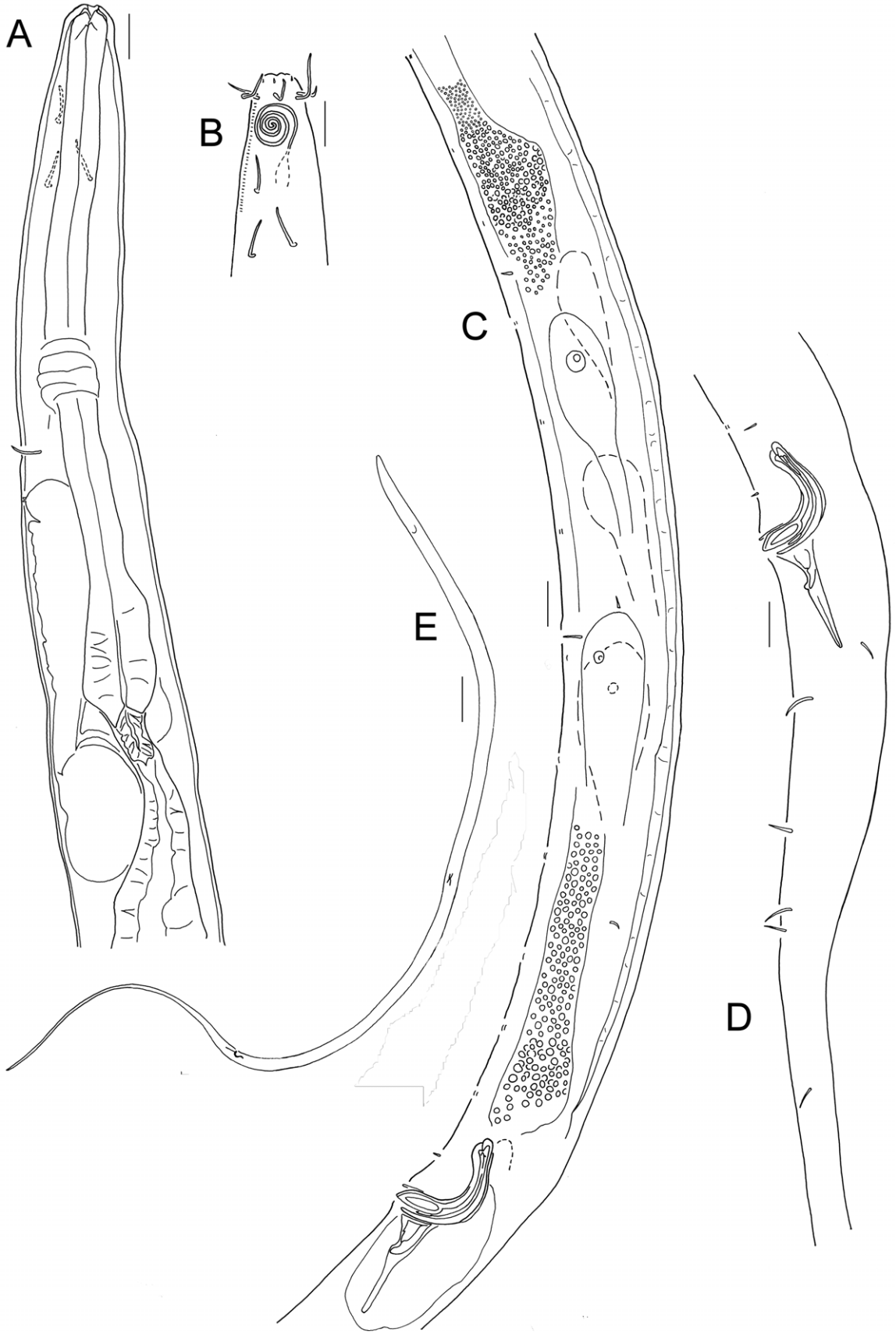

FIGURE 1. *Laimella ferreroi* **sp. nov.,** holotype male: A, oesophagus; B, head; C, pre-cloacal region; D, tail; E, habitus. Scale bars: 10 µm (A–D) and 100 µm (E).

Anterior section of buccal cavity shallow V-shape (2 μm deep) and posterior portion as undifferentiated collapsed tube, teeth not observed. Oesophageal musculature surrounds buccal cavity, sclerotization of oesophageal lumen not observed. Oesophagus narrow cylindrical tube until slender oesophageal bulb (20 % of oesophagus length), lining of bulb lumen not thickened. Cardia short (12 μm long). Nerve-ring at 48 % oesophageal length from anterior, ventral pore posterior to nerve ring (68 % of oesophageal length). Ventral gland large, round, distance from pore to base of gland 85 μm (55 % of oesophageal length).

Diorchic, outstretched testes, anterior testis 992 μm long, posterior testis 906 μm long. Spicules acutely arcuate (1.3 abd long, measured as curve), gubernaculum with posteriorly directed paired apophyses (0.9 abd long). One short mid-ventral papilla (1 μm long) located 0.4 abd anterior to cloaca. Twelve minute precloacal supplements observed, posterior supplement 1.1 abd from cloaca, anterior supplement 11.0 abd from cloaca. Cloaca as lateral slit. Caudal glands not observed. Five ejaculatory glands anterior to cloacal, 2 left lateral, 3 right lateral. Tail tip missing, but intact extent of tail 24.5 abd long, with filiform cylindrical portion 81 % of total. Terminal setae not observed.

Female. Unknown.

Etymology. The species is named in honour of Dr Tim Ferrero (Natural History Museum, London), as a recognition to his contribution to the field of marine nematodology.

Affinities. Although only one specimen of *Laimella ferreori* **sp. nov.** was found, it is the most distinctive of the new *Laimella* species described here. It differs from other known species by having the largest de Man's ratios *a* and *b* (even when accounting for the long tail [L'/mbd and L'/O]). It also has the longest relative gubernaculum so far recorded and the longest, truly filiform, tail. These differences are greater than that which might be found as intraspecific variability.

***Laimella socotris* sp. nov.**
(Fig. 2)

Type locality. Sub-tidally north-west of Socotra Rock (32.1523º N 125.1519º E), at a depth of 51 m, in muddy sediment.

Type material. Single specimen, holotype male NIBRIV0000245035. Collected by Kwang-Soo Kim, in June 2011 from Research Vessel Tam-Gu 8.

Measurements. See Tables 3 and 4 for detailed measurements and calculations.

male**1**	3	158	-	$^{708}1224^{647}$	1486
	13	26	41	32	

Description. Male holotype (Fig. 2). Habitus tubular, tapering to elongate tail posteriorly, slightly narrowed anteriorly. Cuticle with faint punctation mainly seen as sub-cuticular character, striation not observed. Body diameter increases gradually from cephalic setae to mid-oesophageal region, reduces slightly behind cardia, then approximately stable to cloaca. Tail conico-cylindrical.

Labia as 6 small lips, labial papillae minute. Six anterior cephalic setae (0.2 hd long) located about 0.2 hd from anterior extremity, 4 posterior cephalic setae (0.4hd long) directly behind. Amphid multi-spiralled with 3.25 turns (diameter 0.7 cbd), 0.4 hd from anterior. Cervical setae about 3 μm long, in 4 uneven longitudinal rows, possibly some breakage. Rows of latero-ventral somatic setae continue down body. Post-cloacal setae as latero-dorsal rows. Last setae observed as a pair at 56 % of the tail length from the cloaca on cylindrical portion of the tail.

Anterior section of buccal cavity shallow cup-shape (4 μm deep) and posterior portion as undifferentiated collapsed tube, with three teeth at anterior margin, 3 μm long. Oesophageal musculature surrounds buccal cavity, sclerotization not observed, cylindrical to nerve ring, then narrows until rounded oesophageal bulb (23 % of oesophagus length) with thickened lining of lumen. Cardia short (8 μm long). Nerve-ring at 50 % of oesophagus length from anterior, ventral pore posterior to nerve ring (61 % of oesophagus length). Ventral gland small, elongate, distance from pore to base of gland 90 μm (57 % of oesophagus length).

Diorchic, outstretched testes, anterior testis 708 μm long, posterior testis 647 μm long. Spicules arcuate (1.7 abd long, measured as curve), gubernaculum with posteriorly directed paired apophyses (0.7 abd long). Five ejaculatory glands anterior to cloacal, 3 left lateral, 2 right lateral. One short mid-ventral papilla (4 μm long)

located 0.3 abd anterior to cloaca. Eight minute precloacal supplements observed, posteriormost 1.0 abd from cloaca, anteriormost 6.2 abd from cloaca. Cloaca as lateral slit. Caudal glands not observed. Tail 8.1 abd long, with cylindrical portion 68 % of total tail length, terminal setae not observed.

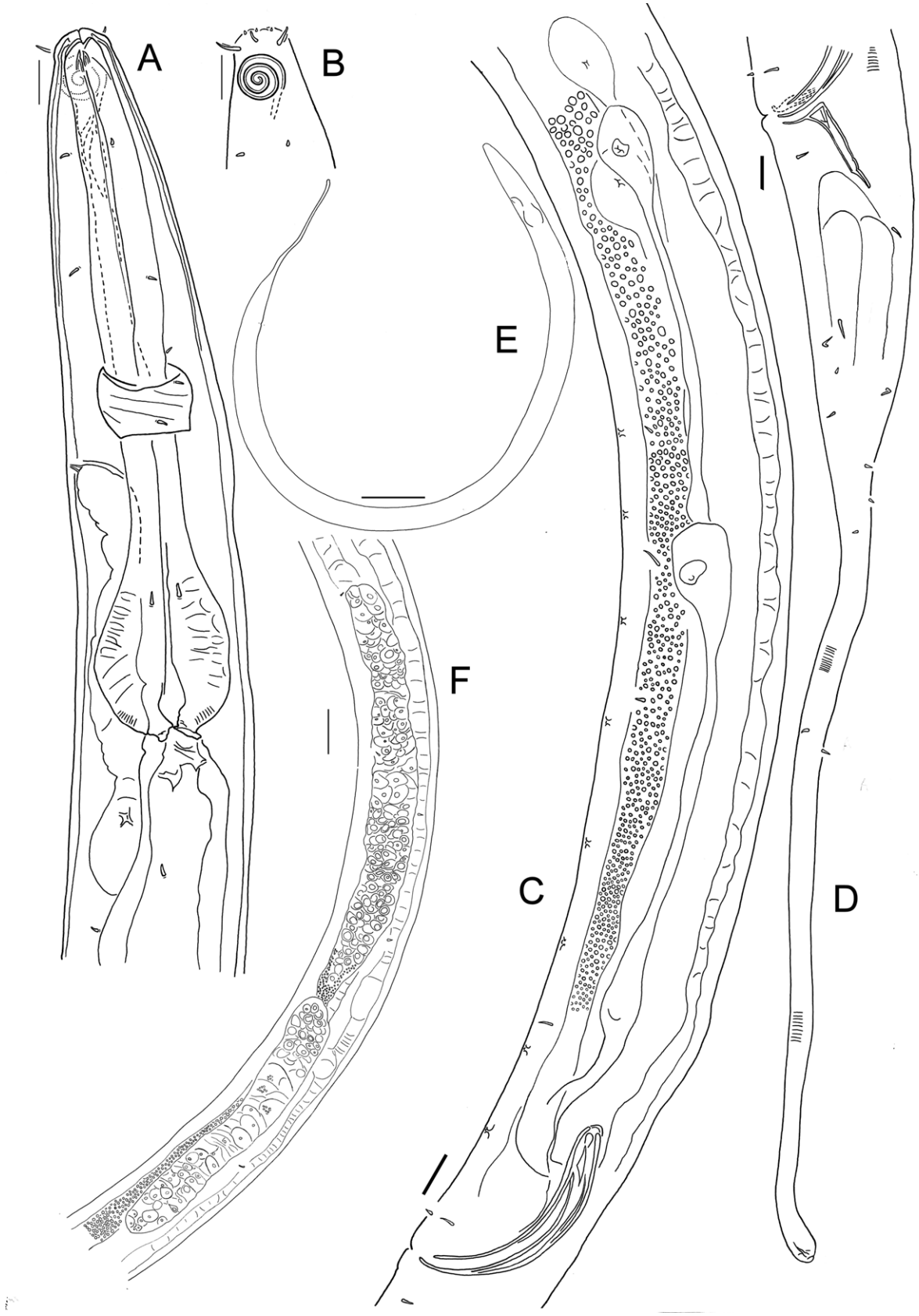

FIGURE 2. *Laimella socotris* **sp. nov.,** holotype male: , oesophagus; B, head; C, pre-cloacal region; D, tail; E, habitus; F, gonads. Scale bars: 10 µm (A–D), 100 µm (E), and 20 µm (F).

Female. Unknown.

Etymology. The species name refers to the sampling location, about 4.5 km north-west from Socotra Rock, discovered by the British merchant vessel Socotra in 1900.

Affinities. *Laimella socotrensis* **sp. nov.** is most similar to *L. longicauda* and *L. filicaudata* in having a distinct rounded posterior oesophageal bulb. It differs from *L. longicauda* however, with regard to the tail length (c' = 8.1 vs 17.7; Cobb 1920) and the relative length of the anterior and cephalic setae (0.2 + 0.4 hd vs 0.4 + 1.5 hd, respectively). It differs from *L. filicaudata* also with regard to the relative lengths of the anterior and posterior cephalic setae (vs 0.4 + 1.2 hd, respectively).

TABLE 3. Morphometric measurements for the newly described species of *Laimella*, *L. ferreroi* **sp. nov.**, *L. socotris* **sp. nov.** and *L.tongyeongensis* **sp. nov.**. All measurement in µm and data presented separately for each individual.

	ferreroi	*socotris*	*tongyeongensis*						
	Male	Male	Male			Female	Juveniles		
	holotype	holotype	holotype	paratypes		paratype	paratype		
	male1	male1	male1	male2	male3	female1	J1	J2	J3
Total body length (L)	2283	1486	1879	2188	1851	1505	1621	1646	-
Head diameter (hd)	11	13	17	16	15	11	14	14	12
Length of labial sensilla (R1)	Papillate	n/v	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate
Length of anterior cephalic sensilla (R2)	7	3	4	4	4	4	4	4	4
Length of posterior cephalic sensilla (R3)	12	6	13	13	12	7	9	11	15
Distance from anterior edge to cephalic setae	5	3	4	4	3	4	3	6	4
Distance from anterior edge to base of anterior buccal cavity	2	4	4	5	4	3	4	3	2
Length of teeth	n/a	3	6	5	5	4	3	4	n/a
Distance from anterior to anterior edge of amphid (AL)	6	5	7	8	6	6	8	8	6
Diameter of amphid (amp)	9	11	12	11	13	n/v	9	11	7
Number of turns in amphid	3.5	3.25	3.25	4.5	4.5	3.5	4	4	3.5
Amphid cbd (amp cbd)	13	15	20	19	18	14	20	18	15
Distance from anterior edge to nerve ring	75	80	104	103	91	79	88	88	79
Nerve ring cbd	22	34	37	35	35	28	27	32	23
Distance from anterior edge to excretory pore	105	96	114	123	108	97	102	104	106
Distance from anterior edge to base of oesophagus (OL)	155	158	205	222	189	172	189	194	157
Oesophageal bulb length (Ob)	30	36	50	54	52	37	51	49	33
cbd at base of oesophagus	31	39	42	42	39	33	32	38	26
Length of the cardia	12	8	12	6	11	12	15	13	n/v
Maximum body diameter (mbd)	33	41	43	49	42	42	34	41	31
Distance from anterior edge to vulva (VL)	n/a	n/a	n/a	n/a	n/a	629	n/a	n/a	n/a
cbd at vulva	n/a	n/a	n/a	n/a	n/a	35	n/a	n/a	n/a
Length of anterior ovary, measured from vulva	n/a	n/a	n/a	n/a	n/a	219	n/a	n/a	n/a
Length of posterior ovary, measured from vulva	n/a	n/a	n/a	n/a	n/a	205	n/a	n/a	n/a
Distance from anterior to anus	1679	1224	1494	1632	1398	1124	1164	1207	1353
Anal body diameters (abd)	25	32	36	38	36	27	26	30	21

.....continue on next page

TABLE 3. (Continued)

	ferreroi	*socotris*	*tongyeongensis*						
	Male	Male	Male			Female	Juveniles		
	holotype	holotype	holotype	paratypes		paratype	paratype		
	male1	male1	male1	male2	male3	female1	J1	J2	J3
Length of spicules, as arc (spic)	31	56	61	53	56	n/a	n/a	n/a	n/a
Length of gubernacular apophysis, as arc	23	22	23	23	22	n/a	n/a	n/a	n/a
Number of supplements	12	8	n/v	5	n/v	n/a	n/a	n/a	n/a
Distance from anus to most posterior supplement	29	32	n/a	20	n/a	n/a	n/a	n/a	n/a
Distance from anus to most anterior supplement	271	199	n/a	107	n/a	n/a	n/a	n/a	n/a
Length of anterior testis, measured from cloacal	992	708	977	979	799	n/a	n/a	n/a	n/a
Length of posterior testis, measured from cloacal	906	647	934	963	765	n/a	n/a	n/a	n/a
Tail length (TL)	+604	262	385	555	453	382	457	439	n/a
Number of terminal setae	n/v	0	0	0	0	0	0	0	n/v
Length of terminal setae	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

TABLE 4. Morphometric calculations for the newly described species of *Laimella*, *L. ferreroi* **sp. nov.**, *L. socotris* **sp. nov.** and *L. tongyeongensis* **sp. nov.** Data presented separately for each individual.

	ferreroi	*socotris*	*tongyeongensis*						
	Male	Male	Male			Female	Juveniles		
	holotype	holotype	holotype	paratypes		paratype	paratype		
	male1	male1	male1	male2	male3	female1	J1	J2	J3
a = L / mbd	69.03	35.99	43.58	44.26	44.50	36.19	48.38	40.27	n/a
b= L / O	14.73	9.39	9.25	9.86	9.81	8.73	8.57	8.49	n/a
c = L / TL	3.78	5.68	4.92	3.94	4.08	3.94	3.55	3.75	n/a
L'(L-TL)/O	10.83	7.74	7.30	7.36	7.41	6.52	6.15	6.23	8.61
c' = TL / abd	24.53	8.08	10.73	14.72	12.62	14.26	17.27	14.69	n/a
R2 / R3	0.57	0.50	0.33	0.32	0.35	fores.	0.38	0.38	0.27
amp / amp cbd	0.68	0.68	0.61	0.60	0.72	n/v	0.45	0.58	0.50
Ob / O	0.20	0.23	0.22	0.24	0.28	0.22	0.27	0.25	0.21
V= VL / L	n/a	n/a	n/a	n/a	n/a	0.42	n/a	n/a	n/a
s' = spic / abd	1.26	1.72	1.69	1.40	1.55	n/a	n/a	n/a	n/a
Cylindrical tail section / TL	0.81	0.68	0.83	0.80	0.79	0.77	0.79	0.77	n/a

Laimella tongyeongensis sp. nov.

(Figs. 3 & 4)

Type material. Three males, one female and three juveniles. Holotype male NIBRIV0000245028 and paratype males NIBRIV0000245030 and NIBRIV0000245032. Paratype female NIBRIV0000245031 and paratype juveniles NIBRIV0000245029, NIBRIV0000245033 and NIBRIV0000245034.

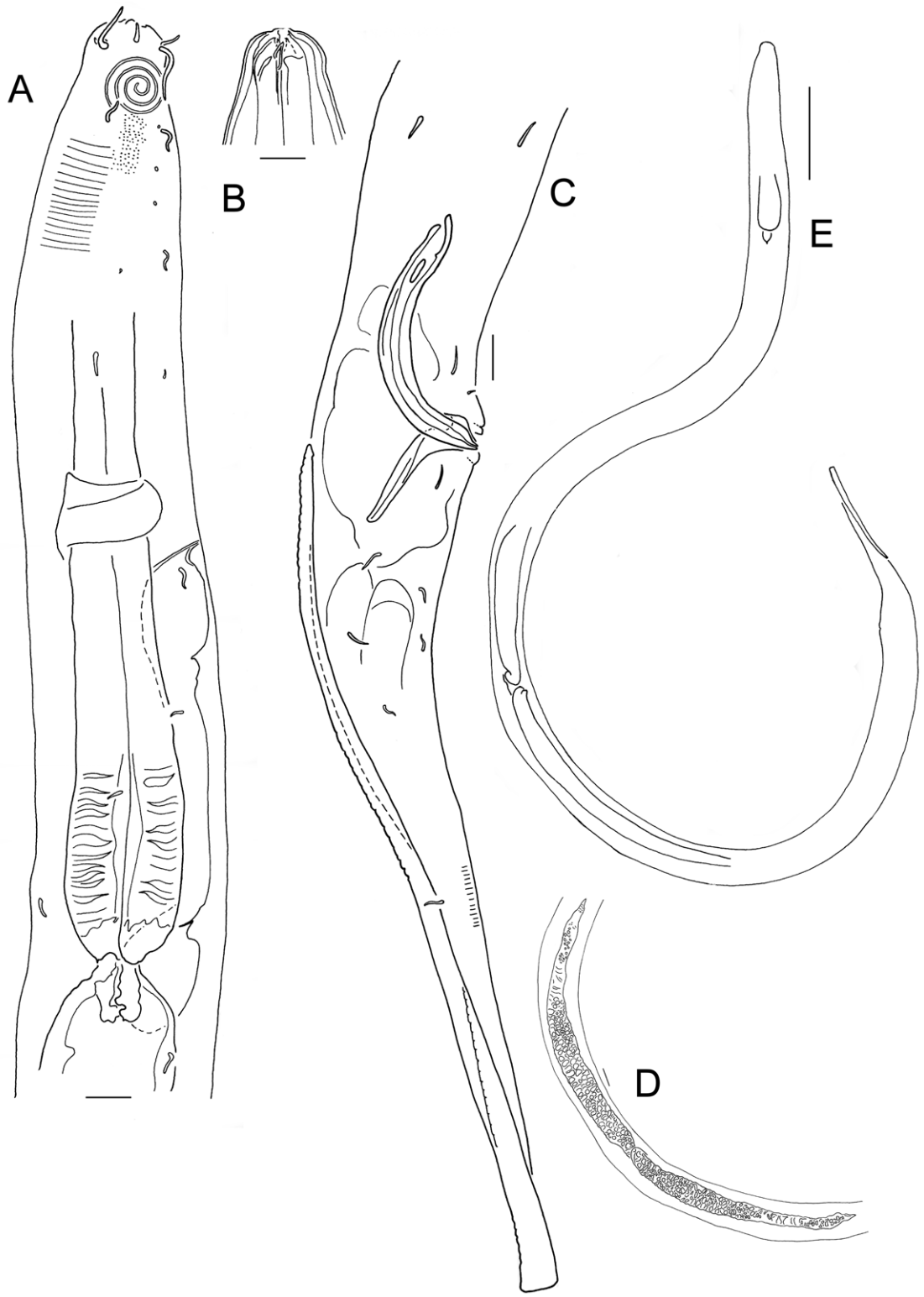

FIGURE 3. *Laimella tongyeongensis* **sp. nov.,** olotype male: A, oesophagus; B, head; C, tail; D, gonads; E, habitus. Scale bars: 10 µm (A–C), 20 µm (D), and 100 µm (E).

Type locality. All specimens were collected sub-tidally, near the islands of the southern extent of the Tongyeong sea, South Korea (34.5789º N 128.4169º E), at a depth of 49 m, in muddy sediment. Specimens were collected by Kwang-Soo Kim, Dong-Ju Lee, and Kichoon Kim in February, May and December 2010, respectively, from Research Vessel Tam-Gu 7.

Measurements. See Tables 3 and 4 for detailed measurements and calculations.

male**1**	4	205	-	$^{977}1494^{934}$	1897
	17	42	43	36	
female**1**	4	172	$^{219}629^{205}$	1124	1505
	11	33	35	27	

Description. Male holotype (Fig. 3). Habitus tubular, tapering to elongate tail posteriorly, blunt anteriorly. Cuticle with faint punctation in lateral field of cervical region, otherwise weakly striate, most visible as sub-cuticular character. Narrow region just behind cephalic setae, body diameter increasing to at most 2hd from anterior, then approximately stable to cloaca. Tail conico-cylindrical.

Labia as 6 small lips, labial papillae minute. Six anterior cephalic setae (0.3 hd long) located about 0.3 hd from anterior extremity, 4 posterior cephalic setae (0.8 hd long) immediate behind. Amphid multi-spiralled with 3.25 turns (diameter 0.6 cbd), close behind cephalic setae (0.4 hd from anterior). Cervical setae about 7 μm long, in 4 uneven longitudinal rows starting as a pair directly behind amphid, possibly some breakage. Somatic setae rare. Around the cloaca, setae as sub-dorsal and dorso-sublateral rows. Last observed setae at base of conical section of tail.

Buccal cavity with minute anterior section (4 μm deep) and posterior portion as weakly sclerotized collapsed tube, base not differentiated, with three teeth at anterior margin, 6 μm long. Slightly swollen oesophageal musculature surrounds buccal cavity, anteriorly faintly sclerotized, then cylindrical to elongate oesophageal bulb (22 % of oesophagus length) with thickened lining of lumen. Cardia short (12 μm long). Nerve-ring at 51 % of oesophageal length from anterior, ventral pore posterior to nerve ring (55 % of oesophagus length). Ventral gland small, rounded, distance from pore to base of gland 108 μm (53 % of oesophageal length).

Diorchic, outstretched testes, anterior testis 977 μm long, posterior testis 934 μm long. Spicules arcuate (length 1.7 abd, as curve), gubernaculum with posteriorly directed paired apophyses (0.6 abd long). Ejaculatory glands not observed. Cloaca as lateral slit. One short mid-ventral papilla (2 μm long) located 0.3 abd anterior to cloaca. Precloacal supplements not observed in holotype, 5 supplements noted in only one paratype male (male2); posterior supplement 0.5 abd from cloaca and anteriormost supplement 2.8 abd from cloacal. Three small caudal glands positioned posterior to gubernacular apophyses in conical region of tail. Tail 10.7 abd long, with elongate cylindrical portion 83 % of total tail length, terminal setae absent.

Female paratype (Fig. 4). Cephalic setae foreshortened in figure. Similar to male, except body shorter and de Man's *a* smaller, tail longer (14 abd, 77 % cylindrical). Vulva at 42 % of body length, as simple lateral slit without epiptygmata. Vagina short and straight, sclerotization appearing in lateral view as 2 closely spaced rods parallel to vaginal lumen. Didelphic, outstretched ovaries, anterior 218 μm, posterior 202 μm long. Supplements absent.

Etymology. The species name refers to the sampling location, specifically the Tongyeong Sea

Affinities. *Laimella tongyeongensis* **sp. nov.** is one of the longest *Laimella* species so far described. It differs from the previously described species of the genus with regards to combinations of features, rather than one specific difference. It is most similar to *L. annae* and *L. vera*: It is similar to *L. annae* with regards to de Man's ratios *b*, *c* and *c'*, but differs from it in terms of de Man's *a* (being much fatter), and the longer relative length of the R3 sensilla (R2/R3 = 0.3 vs 0.6). In addition, *L. annae* was described without teeth, whilst these were clearly visible in *L. tongyeongensis*. In contrast it is similar to *L. vera*, with regards de Man's ratios a and *c'*, but differs with regards to the ratio between the anterior and posterior cephalic setae (1:3 vs 1:2), the tail length (*c'*: 12.7 vs 9.1) and the spicule length (*s'*: 1.6 vs 2.0). In the male specimens studied here, the precloacal supplements were extremely difficult to observe, being visible only in those specimens with an ideal rotation. They should therefore not be used to differentiate the species.

Concluding remarks on Laimella. A search of the ecological literature finds the genus frequently recorded, though rarely in high numbers, in mainly muddy or fine sand sediments from the intertidal and estuarine habitats to the deep sea (Alongi, 1987; Dando et al., 1991; Moreno et al 2008; Miljutina et al 2010). However, it is unlikely that Laimella species are widely distributed. Eskin & Palmer (1985) found that in a turbulent creek, the two species of Laimella observed were never found in the water column (from a total of 71 species, these were two of only eight species that were never recorded in the water column); and indeed, long tails tend to be found in animals anchored to the substrate for long periods (Riemann 1974).

It is likely that the diversity of this genus is highly underestimated, partly owing to a paucity of specimens usually found, which does not aid formal description. Also, illustrated records of many species, including species

of *Laimella*, indicate that the accepted within-species range of morphological characters has resulting in the probable 'clumping' of species. The specimens recorded as *Laimella vera* by Gourbault (1980), for example, probably represents a 'new' species owing to the shape of the oesophageal bulb (approximately 50 % of oesophageal length, in comparison to the original description of 21 %); the caudal setation pattern; the length of the spicule (1.7 vs 1.4 abd); and the relative length of the oesophagus (*a*:14–15 vs 10). Whilst the latter two differences appear small, they are consistent across specimens within the genera and should be considered as species-informative characters, particularly in such a relatively character poor genus.

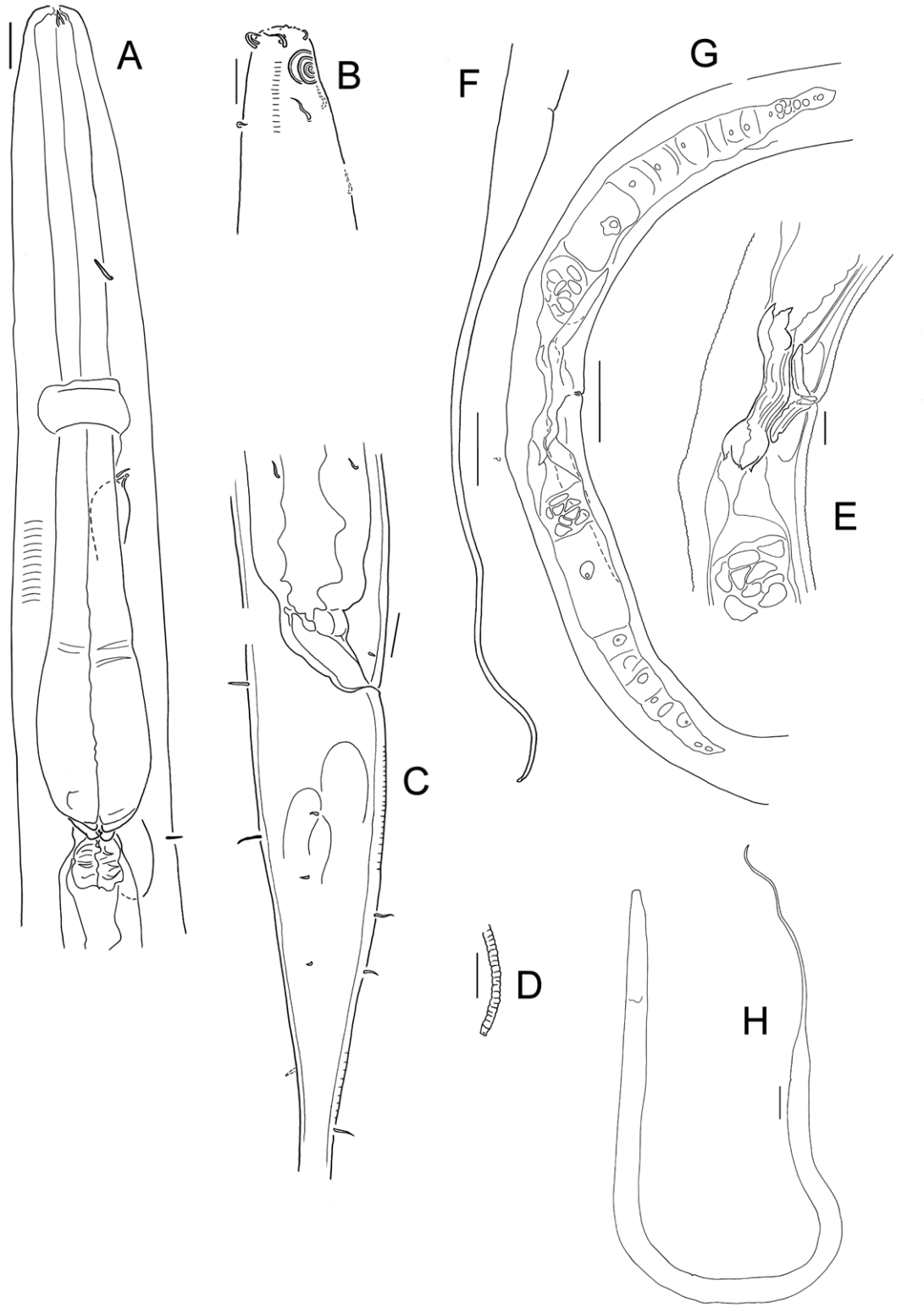

FIGURE 4. *Laimella tongyeongensis* **sp. nov.,** aratype female: A, oesophagus; B, head; C, anus; D, tail tip; E, vulva; F, tail; G, gonads; H, habitus. Scale bars: 10 µm (A–E), 40 µm (G), and 50 µm (H).

TABLE 5. Comparative data table of morphometric measurements for published species of *Cervonema*. All measurement in µm. Data presented is mean values, unless *n* = 1. Measurements are for males, except distance to vulva and corresponding body diameter at vulva, unless otherwise stated. Literature sources: [a]Gourbault 1980; [b]Chen and Vincx 2000; [c]Hope and Zhang 1995; [d]Muthumbi et al 1997; [e]Gourbault 1980; [f]Jensen 1979; [g]Jensen 1988; [h]Schuurmans Stekhoven, 1950. Other marks: * number of replicates unless otherwise stated (in brackets); † only maximum and minimum values provided; ‡ figures and corresponding text do not provide comparable measurements, only the measurement quoted in the text presented here; ϕ it was not possible to reconcile the measurements from the figures with those in the table, so additional measurements not provided; . measurement of the male spicules figured do not match the measurements provided in the text, but since Jensen describes them to have a 'weakly sclerotized proximal cap' it is presumed this is not clear in the figures and the values provided in the text used here; # holotype and paratype measurements quite different and provided separately.

	brevicauda[a]	*chilensis*[b]	*deltensis*[c]	*gourbaulti*[d]	*hermani*[b ϕ]	*jenseni*[e #]		*macramphis*[f]	*minutus*[d]	*papillatum*[g]	*shiae*[b]	*tenuicauda*[h]
Male	(n = 3*)	(n = 1)	(n = 4)	(n = 2*†)	(n=3*)	(n = 1, holotype)	(n = 3, paratype)	(n = 2*)	(n = 2*)	(n = 3*)	(n = 3)	/
Female	(n = 3)	/	(n = 1)	(n = 2*†)	(n=3*)	n/a	(n = 2)	(n = 1)	(n = 1)	(n = 2*)	(n = 1)	(n = 1)
Character (Abbreviation)												
Total body length (L)	953	1192	1217	1348	1608	3458	1740	1309 (1)	826	1173	668	820
Head diameter (hd)	9	9	8	10	12	23	12	8 (1)	5 (1)	101 (2)	6	8
Length of labial sensilla (R1)	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	papillate	n/f
Length of anterior cephalic sensilla (R2)	3	7	4	5	9	9	4	3	2	3	3	2
Length of posterior cephalic sensilla (R3)	3	7	4	5	9	9	4	3	2	3	4	4
Distance from anterior edge to cephalic setae	3 (1)	n/f	3	n/f	/	10	n/f	2 (1)	n/f	3 (1)	1	n/f
Distance from anterior edge to base of buccal cavity	n/f	n/f	3	n/f	n/f	n/f	n/f	5 (1)	n/f	10 (1)	n/f	n/f
Distance from anterior to anterior edge of amphid (AL)	18 (1)	7	15	21	9	41	n/f	15	17	21 (2)	15	n/f
Diameter of amphid (amp)	11	10	10	14	13	20	15	12	9	10 (1)	10	n/f
Number of turns in amphid	5.5	5.5	3 – 5	5.0	5.5	7.0	7.0	7.0	4.5	6 (1)	5.75	5.5
Amphid cbd (amp cbd)	14	11	15 (1)	17	16	31	21	13	10	14 (1)	11	n/f
Distance from anterior edge to nerve ring	n/f	80	86	97	94	230	n/f	104 (1)	79	116 (1)	79	n/f
Nerve ring cbd	n/f	25	30	30 (1)	/	75	n/f	27 (1)	18.6 (1)	25 (1)	17 (1)	n/f
Distance from anterior edge to excretory pore	n/f	92	112	115	/	250	n/f	142 (1)	96 (1)	140 (1)	86	n/f
Distance from anterior edge to base of oesophagus (OL)	173	140	185	214	163	465	272	177 (1)	136	203 (1)	143	180
Oesophageal bulb length (Ob)	67 (1)	25	44	70	/	94	n/f	54.1 (1)	22 (1)	39 (1)	42 (1)	n/f
cbd at base of oesophagus	27	25	35 (1)	35	28	86	33	31 (1)	22	29 (1)	21	28
Length of the cardia	n/f	7	7 (1)	10	/	n/f	n/f	6.7 (1)	6	7 (1)	7 (1)	n/f

……continue on next page

TABLE 5. (Continued)

Character (Abbreviation)	*brevicauda*[a]	*chilensis*[b]	*deltensis*[c]	*gourbaulti*[d]	*hermani*[b,ϕ]	*jenseni*[e#]	*macramphis*[f]	*minutus*[d]	*papillatum*[g]	*shiae*[b]	*tenuicauda*[h]	28
Male	(n = 3*)	(n = 1)	(n = 4)	(n = 2*†)	(n=3*)	(n = 1, holotype)	(n = 3, paratype)	(n = 2*)	(n = 2*)	(n = 3*)	(n = 3)	/
Female	(n = 3)	/	(n = 1)	(n = 2*†)	(n=3*)	n/a	(n = 2)	(n = 1)	(n = 1)	(n = 2*)	(n = 1)	(n = 1)
Anal body diameters (abd)	24	25	28	29	25	65	33	26 (1)	23	29 (1)	18	20
Length of spicules, as arc (spic)	14	23	23	30 (3)	24	53	30	43	18	37 (2)	16	n/a
Length of gubernacular apophysis, as arc	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Number of supplements	0	7	7	0	9	0	0	0	0	6 – 7	4 - 5	n/a
Distance from anus to most posterior supplement	n/a	n/f	22	n/a	/	n/a	n/a	n/a	n/a	56	20 (1)	n/a
Distance from anus to most anterior supplement	n/a	n/f	162	n/a	/	n/a	n/a	n/a	n/a	170 (1)	n/f	n/a
Tail length (TL)	82	120	147	272	187	400	202	102 (1)	113	107 (1)	88	112
Number of terminal setae	3	3	3	2	3	3	n/f	2	3	2? (2)	3.0	n/f
Length of terminal setae	4 (1)	n/v	3.4	4.3	6.0	n/f	n/f	n/f	n/f	3 (2)	2?	n/f

Genus *Cervonema* Wieser 1954

Emended diagnosis. Sabatieriinae with striate cuticle; fine punctations may be also observed. Anterior and posterior cephalic sensilla in distinctly separate crowns and usually equal in length. Buccal cavity short and undifferentiated. Posterior elongate oesophageal bulb. Cervical region elongate and narrowed, amphids usually set back from cephalic setae, about 2 hd from the anterior, and up to 7 turns. Spicules simple, poorly sclerotized and < 2 abd in length, usually ≤ 1 abd. Gubernaculum plate-like, or not observed, apophyses absent. Supplements minute tubular pores or absent. Tail conico-cylindrical.

Remarks. To date 13 species of *Cervonema* have been described: *C. allometricum* Wieser 1954, C. *tenuicauda* Schuurmans Stekhoven jr. 1950, *C. macramphis* Jensen 1979, *C. jenseni* Gourbault 1980, *C brevicauda,* Gourbault 1980, *C. papillatum* Jensen 1988, *C. deltensis* Hope & Zhang 1995, *C. minutus* (Muthumbi et al. 1997), *C. gourbaulti* Muthumbi et al. 1997, *C. chilensis* Chen & Vincx 2000, *C. hermani* Chen & Vincx 2000, *C. shia* Chen & Vincx 2000, *C. proximamphidu* Tchesunov 2000. Table 5 presents a comprehensive comparison of the morphometric characteristics of these species and Table 6 provides the calculated body proportions, such as de Man's ratios. Where measurements were not presented in the original descriptions they are supplemented by measurements made by the authors from the original published figures where possible.

Here one species, *Cervonema pseudodeltensis* is described based on male and female specimens, and a further two species are informally described owing to a lack of males. The intention of these informal descriptions is to indicate the presence of additional species and to describe them as best as possible, without males, to allow subsequent researches an ability to compare records. Although for some taxa it is common practise to describe species based on females, it is not so for nematodes. Whilst for the *Cervonema* the male characters are not very informative to species differentiation, there is a risk of introducing nomenclatural problems, as yet unforeseen, if these species are described based on females only.

TABLE 6. Comparative data table of calculated body proportions for published species of *Cervonema*. All measurement in µm. Data presented is mean values, unless *n* = 1. Measurements are for males, except distance to vulva and corresponding body diameter at vulva, unless otherwise stated. Literature sources: [a]Gourbault 1980; [b]Chen and Vincx 2000; [c]Hope and Zhang 1995; [d]Muthumbi et al 1997; [e]Gourbault 1980; [f]Jensen 1979; [g]Jensen 1988; [h]Schuurmans Stekhoven, 1950. Other marks: * number of replicates unless otherwise stated (in brackets); † only maximum and minimum values provided; ‡ figures and corresponding text do not provide comparable measurements, only the measurement quoted in the text presented here; ϕ it was not possible to reconcile the measurements from the figures with those in the table, so additional measurements not provided; ɵ the de Man's ratios values provided by Jensen do not correspond to our calculations, we therefore assume that he has used different formulae and present here the recalculated values; ˙measurement of the male spicules figured do not match the measurements provided in the text, but since Jensen describes them to have a 'weakly sclerotized proximal cap', it is presumed this is not clear in the figures and the values provided in the text used here; # holotype and paratype measurements quite different and provided separately.

	brevicauda	*chilensis*	*deltensis*	*gourbaulti*	*hermani*	*jenseni*		*macramphis*	*minutus*	*papillatum*	*shiae*	*Ctenuic auda*
Male	(n = 3*)	(n = 1)	(n = 4)	(n = 2*†)	(n=3*)	(n = 1, holotype)	(n = 3, paratype)	(n = 2*)	(n = 2*)	(n = 3*)	(n = 3)	/
Female	(n = 3)	/	(n = 1)	(n = 2*†)	(n=3*)	n/a	(n = 2)	(n = 1)	(n = 1)	(n = 2*)	(n = 1)	(n = 1)
a = L / mbd	33.65	35.10	32.00	38.5	60.00	36.00	39.84	40.91 (1)	27.52	32.00	31.13	29.30
b= L / O	5.50	8.50	6.60	6.31	9.90	7.40	6.40	7.40 (1)	6.09	5.77	4.67	4.55
c = L / TL	11.58	9.90	8.30	4.95	8.70	8.60	8.63	12.83 (1)	7.34	10.43	7.60	7.32
c' = TL / abd	3.43	5.00	5.30	9.35	7.53	6.15	6.11	3.92 (1)	6.5	3.86 (1)	4.80	5.60
V= VL / L	0.54	n/a	0.49	0.47	0.50	n/a	0.51	0.54	0.49	0.54	0.57	0.54
R2/R3	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.64
amp / amp cbd	0.75	0.89	0.64	0.81	0.81	0.65	0.74	0.94	0.9	0.70 (1)	0.91	0.77
Ob / O	0.35 (1)	0.18	0.24	0.33	0.20 (1)	0.20	n/f	0.31 (1)	0.15 (1)	0.19 (1)	0.29	n/f
s' = spic / abd	0.60	1.00	0.82	0.81 (1)	0.97	0.82	0.92	1.63 (1)	0.8	1.32•	0.83	n/a
Cylindrical tail section / TL	0.46 (1)	0.53	0.56	0.80	0.75	0.63	0.51	0.63 (1)	0.53	0.35 (2)	0.5	0.52

***Cervonema pseudodeltensis* sp. nov.**
(Figs. 5 & 6)

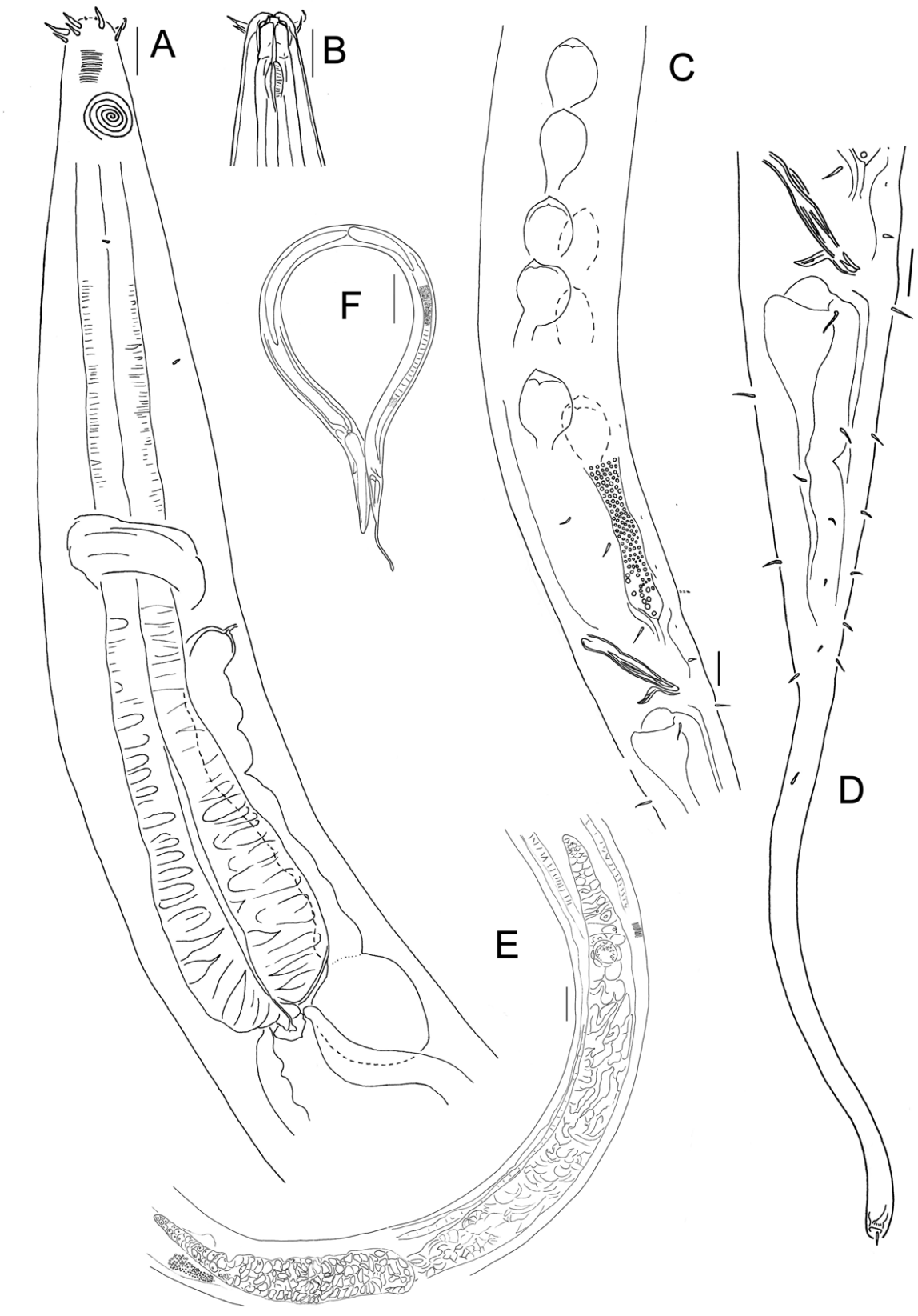

FIGURE 5. *Cervonema pseudodeltensis* **sp. nov.,** holotype male: A, oesophagus; B, head; C, pre-cloacal region; D, tail; E, gonads; F, habitus. Scale bars: 10 µm (A–D), 20 µm (E), and 100 µm (F).

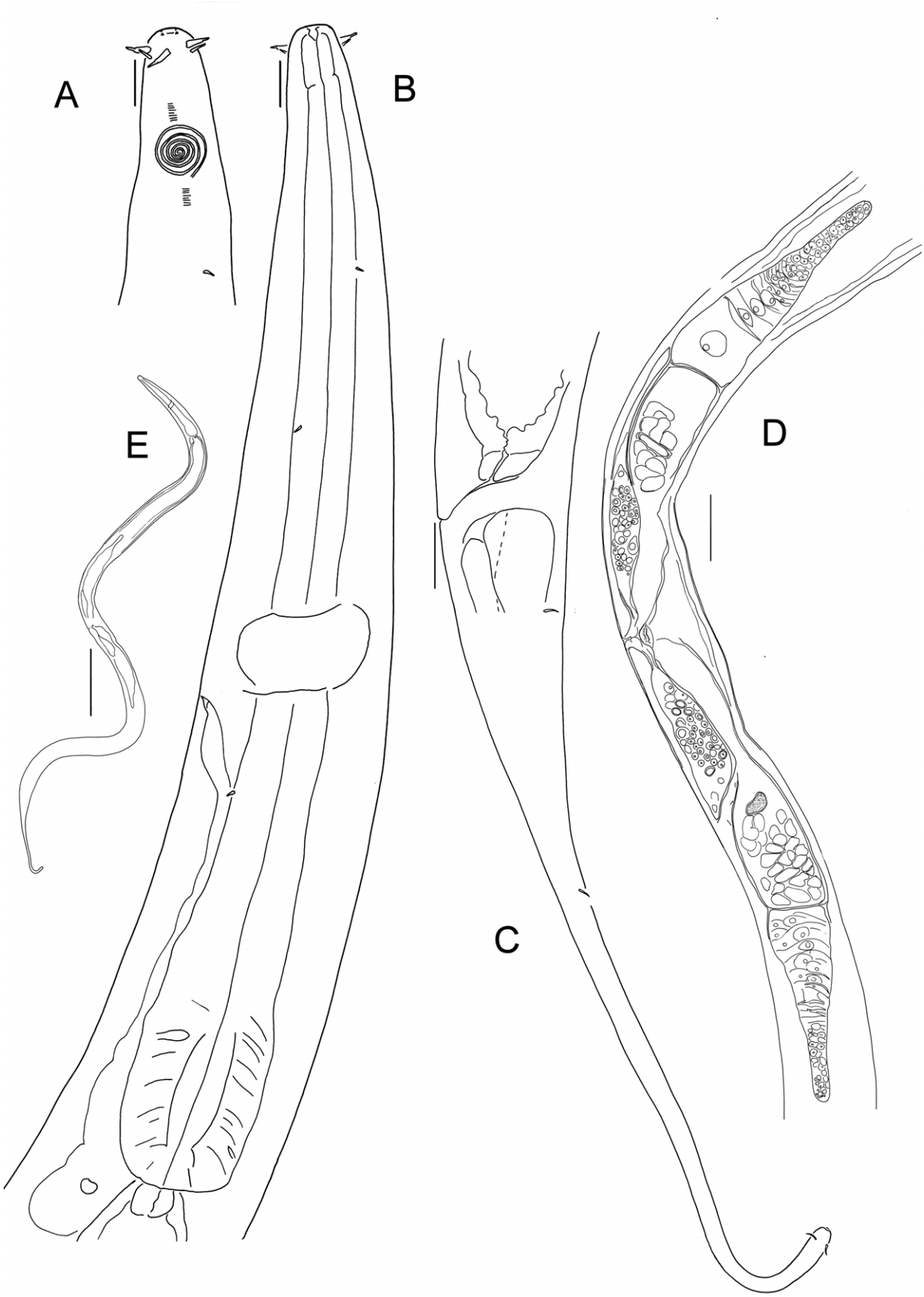

FIGURE 6. *Cervonema pseudodeltensis* **sp. nov.,** paratype female: A, head; B, oesophagus; C, tail; D, gonads; E, habitus. Scale bars: 10 µm (A, B), 20 µm (C), 40 µm (D), and 200 µm (E).

Type locality. Subtidally off the Korean west-south coast (34.410º N 127.577º E), south-east of Oeraro Island, from clayey silt and 19 m water depth.

Additional localities. Paratype males specimens from Korean west-south coast (34.436º N 126.955º E), east of Joyag Island, in a region of intense aquaculture activity, at a depth of 22 m in clayey silt. Juvenile collected subtidally, near the islands of the southern extent of the Tongyeong sea, South Korea (34.5738º N 128.4169º E) at a depth of 42 m in muddy sediment.

Type material. Four males, two females and 1 juvenile. Holotype male NIBRIV000024586. Paratype male NIBRIV000024586 and 2 paratype females NIBRIV000024586-4 on one slide. Two paratype males NIBRIV0000245865and one paratype juvenile NIBRIV000024586, on separate slides as listed. Holotype and all paratype adults collected by Jong-ho Hong from Research Vessel Tam-Gu 17. Juvenile collected by Dong-Ju Lee from Research Vessel Tam-Gu 7 in the Tongyeong sea in June 2010.

Measurements. See Tables 7 and 8 for detailed measurements and calculations.

male**1**	4	224	-	$^{960}1421^{803}$	1638
	11	51	53	34	
female**1**	3	265	$^{340}943^{289}$	1567	1755
	10	52	56	37	

Description. Male holotype (Fig. 5). Habitus tubular, tapering from cloaca to conico-cylindrical tail posteriorly, anterior narrowing more gently from cardia to lips. Cuticle with faint, relatively fine striation throughout body, cylindrical section of tail appears smooth. In the lateral field of the cervical region striations appear as punctations so closely spaces as to appear fused: In the sublateral field of the post-cloacal region, the irregular punctations are clear.

Six small lips indistinct, labial papillae minute. Six anterior cephalic setae (0.6 hd long) located about 0.4 hd from anterior extremity, 4 jointed posterior cephalic setae (0.4 hd long) in distinctly separate crown. Amphid multi-spiralled with 5.5 turns (diameter 0.6 cbd). Cervical setae scarce, 2 μm long. Somatic setae not observed. Row of 6 subventral post-cloacal setae, 9–3 μm long in conical region of tail, 2 subventral setae pre-cloacally. Row of 3 dorso-sublateral setae in also in conical tail region. Lateroventral setae scattered. Last somatic setae observed 3.1 abd from the cloaca in the cylindrical region of the tail.

Diorchic, outstretched testes, anterior testis 960 μm long, posterior testis 803 μm long. Spicules approximately straight (1 abd long), gubernaculum with indication of posteriorly directed paired apophyses (0.2 abd long), seen only owing to rotation of specimen. Eight ejaculatory glands anterior to cloacal, 3 left lateral, 5 right lateral. One short mid-ventral papilla (3 μm long) located 0.3 abd anterior to cloaca. Five minute precloacal supplements observed, posterior supplement 0.6 abd from cloaca, anterior supplement 2.4 abd [However, 6, 6, & 7 supplements were recorded in other specimens, anterior supplement up to 5.2 abd from cloaca]. Cloaca as lateral slit. Caudal glands start level with cloaca. Tail conico-cylindrical 6.4 abd long, with cylindrical portion 56 % of total, 3 terminal setae, 3 μm long.

Female paratype (Fig. 6). Similar to male, longer (2104 μm), anterior cephalic setae equal to or shorter than posterior cephalic. Vulva at 47 % of body length, as lateral slit. Vagina short and straight without sclerotizations or epiptygmata. Didelphic, outstretched ovaries, anterior 323 μm, posterior 307 μm long. Supplements absent. Cylindrical tail section slightly longer than in males (66 % of total tail length).

Affinities. *Cervonema pseudodeltensis* **sp. nov.** is unique within the genus, being the only species so far described which appears to have anterior cephalic setae marginally longer than the posterior cephalic setae. It is superficially similar to *C. deltensis* Hope and Zhang 1995, described from the Bohai Sea, and they share similar spicules lengths (as abd), amphid size, oesophageal bulb size and a similar proportional relationship between the conical and cylindrical sections of the tail. However, they differ with regard to body length of adults (male1559 – 1755 μm vs 1201 – 1237 μm; female 1828 – 2104 μm vs 1250 μm), the proportional lengths of the cephalic setae, the relative length of the oesophagus (*b* = 7.0 – 7.9 vs 6.3 – 6.7) and the number of ejaculatory glands (3 + 5 vs 6 + 6).

TABLE 7. Morphometric measurements for the three Korean species of *Cervonema*, *C. pseudodeltensis* **sp. nov.,** *Cervonema sp. A*, and *Cervonema sp. B*. All measurement in µm and data presented separately for each individual. * Sub-adult female, vulva visible, but not open and ovaries not developed.

	pseudodeltensis							*sp. A*		*sp. B*
	Male				Females					
	holotype	paratypes			paratypes			non-types		non-types
Character (Abbreviation)	male1	male2	male3	male4	female1	female2	*J1	female1	female2	female1
Total body length (L)	1638	1559	1655	1755	2104	1828	1247	1463	1445	1727
Head diameter (hd)	11	11	10	n/v	10	n/v	10	12	11	10
Length of labial sensilla (R1)	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate	Papillate
Length of anterior cephalic sensilla (R2)	7	6	5	n/v	5	n/v	4	6	5	7
Length of posterior cephalic sensilla (R3)	4	n/v	4	n/v	6	n/v	4	6	4	9
Distance from anterior edge to cephalic setae	4	4	3	n/v	3	n/v	3	3.87	3	3
Distance from anterior edge to base of anterior buccal cavity	1	1	2	n/v	4	n/v	n/v	3	4	2
Distance from anterior to anterior edge of amphid (AL)	16	15	17	n/v	21	n/v	18	19	19	5
Diameter of amphid (amp)	11	11	11	12	11	n/v	8	11	10	10
Number of turns in amphid	5.5	5.5	5.5	5.5	5.5	n/v	5.5	5	5	4
Amphid cbd (amp cbd)	17	16	17	17	17	n/v	15	20	16	13
Distance from anterior edge to nerve ring	113	110	112	115	128	121	89	108	117	75
Nerve ring cbd	42	37	39	40	41	39	32	37	35	30
Distance from anterior edge to excretory pore	136	145	136	138	159	139	120	134	132	90
Distance from anterior edge to base of oesophagus (OL)	224	222	230	222	265	249	201	259	248	138
Oesophageal bulb length (Ob)	51	53	56	56	67	72	54	80	65	28
cbd at base of oesophagus	51	51	51	51	52	56	37	46	42	33
Length of the cardia	5	n/v	5	6	8	5	6	7	8	4
Maximum body diameter (mbd)	53	51	51	54	62	58	37	53	49	42
Distance from anterior edge to vulva (VL)	n/a	n/a	n/a	n/a	989	943	631	693	640	792
cbd at vulva	n/a	n/a	n/a	n/a	56	56	34	52	44	40
Length of anterior ovary, measured from vulva	n/a	n/a	n/a	n/a	323	340	n/a	222	193	298
Length of posterior ovary, measured from vulva	n/a	n/a	n/a	n/a	307	289	n/a	236	211	295
Distance from anterior to anus	1421	1355	1444	1549	1820	1567	1068	1236	1211	1534
Anal body diameters (abd)	34	35	37	37	42	37	28	36	30	31
Length of spicules, as arc (spic)	34	30	30	30	n/a	n/a	n/a	n/a	n/a	n/a
Length of gubernacular apophysis, as arc	6	4	n/v	6	n/a	n/a	n/a	n/a	n/a	n/a
Number of supplements	5	7	7	6	n/a	n/a	n/a	n/a	n/a	n/a
Distance from anus to most posterior supplement	19	27	30	26	n/a	n/a	n/a	n/a	n/a	n/a
Distance from anus to most anterior supplement	83	183	125	177	n/a	n/a	n/a	n/a	n/a	n/a

.....continue on next page

TABLE 7. (Continued)

	pseudodeltensis							*sp. A*		*sp. B*
	Male				Females					
	holotype	paratypes				paratypes		non-types		non-types
Character (Abbreviation)	male1	male2	male3	male4	female1	female2	*J1	female1	female2	female1
Length of anterior testis, measured from cloacal	960	961	910	1027	n/a	n/a	n/a	n/a	n/a	n/a
Length of posterior testis, measured from cloacal	803	769	799	867	n/a	n/a	n/a	n/a	n/a	n/a
Tail length (TL)	217	204	211	206	284	261	179	227	234	193
Number of terminal setae	3	3	3	3	3	3	n/v	3	3	3
Length of terminal setae	3	4	5	5	4	4	n/a	4	4	4

TABLE 8. Morphometric calculations for the three Korean species of *Cervonema*, *C. pseudodeltensis* **sp. nov.,** *Cervonema sp. A*, and *Cervonema sp. B.* Data presented separately for each individual.

	pseudodeltensis							*sp. A*		*sp. B*
	Male				Females					
	holotype	paratypes				paratypes		non-types		non-types
Character (Abbreviation)	male1	male2	male3	male4	female1	female2	*J1	female1	female2	female1
a = L / mbd	31.04	30.74	32.64	32.37	33.76	31.58	34.05	27.71	29.32	40.87
b= L / O	7.30	7.03	7.19	7.90	7.93	7.35	6.21	5.65	5.83	12.53
(L-TL)/O	6.33	6.11	6.27	6.97	6.86	6.30	5.32	4.77	4.89	11.12
c = L / TL	7.56	7.66	7.86	8.51	7.41	7.00	6.98	6.45	6.18	8.93
c' = TL / abd	6.35	5.78	5.73	5.53	6.78	7.13	6.49	6.32	7.90	6.25
V= VL / L	n/a	n/a	n/a	n/a	0.47	0.52	0.51	0.47	0.44	0.46
R2/R3	1.64	n/a	1.27	n/a	0.72	n/a	1.00	1.00	1.08	0.77
amp / amp cbd	0.63	n/v	0.63	0.67	0.66	n/v	0.57	0.57	0.62	0.78
Ob / O	0.23	0.24	0.24	0.25	0.25	0.29	0.27	0.31	0.26	0.20
s' = spic / abd	0.99	0.86	0.83	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cylindrical tail section / TL	0.56	0.63	0.58	0.55	0.66	0.64	0.69	0.69	0.61	0.74

Cervonema indet. **A**

(Fig. 7)

Sampling Locality. About 6 km off-shore, north-east from Sehwa-ri, Jeju Island (33.5700º N, 126.8900º E), in sandy sediment and 55 m water depth.

Material. Two females, NIBRIV000024586-9 on separate slides, collected by Kwang-Soo Kim in May 2011 from Research Vessel Tam-Gu 8.

Measurements. See Tables 7 and 8 for detailed measurements and calculations.

female1	6	259	$^{222}693^{236}$	1236	1463
	12	46	52	36	
female2	3	248	$^{193}640^{211}$	1211	1445
	11	42	44	30	

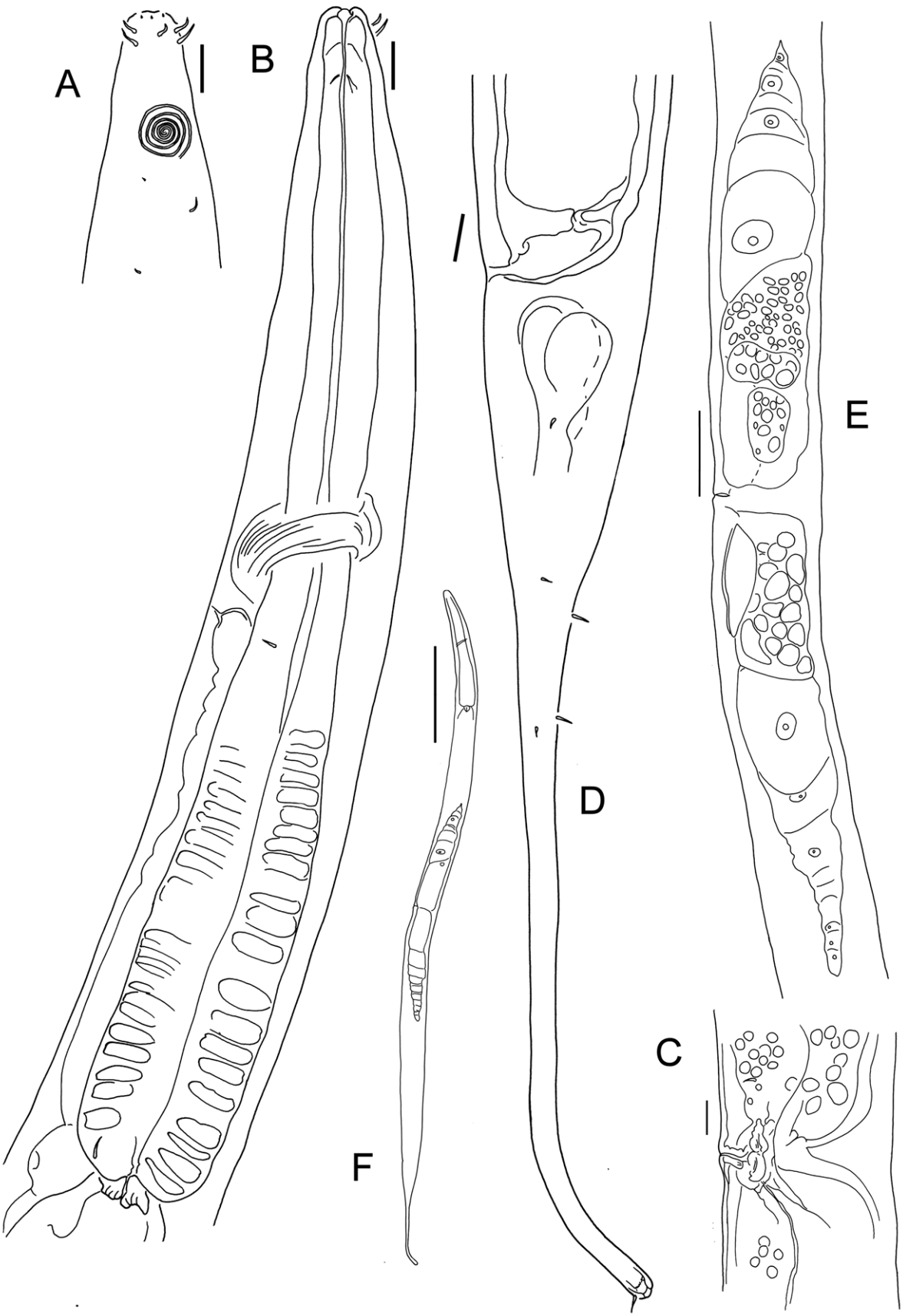

FIGURE 7. *Cervonema sp. A*., female: A, head; B, oesophagus; C, vulva; D, tail; E, gonads; F, habitus. Scale bars: 10 µm (A–C), 20 µm (D); 40 µm (E), and 200 µm (F).

Description. Female (Fig. 7). Habitus tubular, tapering from cloaca to conico-cylindrical tail posteriorly, anterior narrowing more gently from nerve ring to lips. Cuticle with faint, relatively fine striation throughout body, cylindrical section of tail appears smooth.

Six small lips indistinct, labial papillae minute. Six anterior cephalic setae (0.5 hd long) located about 0. 4 hd from anterior extremity, 4 posterior cephalic seta. (0.5 hd long) in distinctly separate crown. Amphid, 1.5 hd from anterior, multi-spiralled with 5 turns (diameter 0.6 cbd). Cervical setae scarce, 4 μm long. Somatic setae scarce, 5 μm long. Setae scattered around lateral field in cloacal region, last setae observed 2.7 abd (43 % of tail length) from the cloaca in cylindrical portion of tail.

Anterior section of buccal cavity minute (3 μm deep), posterior section not observed. Oesophageal musculature surrounds buccal cavity, sclerotization not observed. Posterior elongate oesophageal bulb (31 % of oesophagus length). Cardia short (7 μm long). Nerve-ring at 42 % of oesophageal length from anterior, ventral pore posterior to nerve ring (52 % of oesophageal length). Ventral gland small, round, behind cardia, distance from pore to base of gland 135 μm (52 % of oesophageal length).

Vulva at 47 % of body length, as lateral slit without epiptygmata. Vagina short and straight without sclerotizations. Didelphic, outstretched ovaries, anterior 222 μm, posterior 236 μm long. Supplements absent. Tail conico-cylindrical 6.3 abd long, with cylindrical portion 69 % of total, three terminal setae (4 μm long).

Affinities. Cervonema sp. A is superficially similar to C. deltensis Hope and Zhang 1995 described from the Bohai Sea and and C. pseudodeltensis sp. nov. However, comparing females, it differs from C. deltensis with regard to the relative length of the oesophagus (b = 5.7 – 5.8 vs 6.3 – 6.7) and tail length (c = 6.2 – 6.5 vs 7.3). It also differs from C. pseudodeltensis with regard to relative length of the oesophagus (b = 5.7 – 5.8 vs 7.0 – 7.9), and body length (1445 – 1463 μm vs 1828 – 2104 μm), and the simpler and short anterior cephalic setae (length of R2 and R3 equal in Cervonema sp. A).

***Cervonema indet.* B**
(Fig. 8)

Material. One female, NIBRIV0000245890. Collected by Jinwook Back in May 2007 from Research Vessel Tam Gu 18.

Sampling locality. Subtidal, 25 m, in silty sand off the Korean west coast (36.251º N 126.198º E), within the chain of islands from Sapsi-do to Eoncheong-do.

Measurements. See Tables 7 and 8 for detailed measurements and calculations.

female**1**	3	138	$^{298}792^{295}$	1534	1727
	10	33	40	31	

Description. Female (Fig. 8). Habitus tubular, tapering from cloaca to conico-cylindrical tail posteriorly, anterior narrowing more gently from nerve ring to lips. Cuticle with faint, relatively fine striation throughout body, cylindrical section of tail appears smooth.

Six small lips indistinct, labial papillae minute. Six anterior cephalic setae (0.7 hd long) located about 0.3 hd from anterior extremity, 4 posterior cephalic seta. (0.9 hd long) in distinctly separate crown. Amphid, 0.5 hd from anterior, multi-spiralled with 4 turns (diameter 0.8 cbd). Cervical setae in two sub-lateral rows, 7 μm long, somatic setae scarce, 9 μm long. Setae scattered around lateral field in cloacal region, last setae observed 3.7 abd (60 % of tail length) from the cloaca in cylindrical portion of tail.

Anterior section of buccal cavity minute (2 μm deep), posterior section not observed. Oesophageal musculature surrounds buccal cavity, sclerotization not observed. Posterior oesophageal bulb (20 % of oesophagus length), distinct rounded triangular shape; flattened posterior base. Cardia short (3 μm long). Nerve-ring at 54 % oesophageal length from anterior, ventral pore posterior to nerve ring (65 % of oesophageal length). Ventral gland small, round, behind cardia, distance from pore to base of gland 85 μm (62 % of oesophageal length).

Vulva at 46 % of body length, as lateral slit without epiptygmata. Vagina short and straight without sclerotizations. Didelphic, outstretched ovaries, anterior 298 μm, posterior 295 μm long. Supplements absent. Tail conico-cylindrical 6.3 abd long, with cylindrical portion 74 % of total, three terminal setae (obscured).

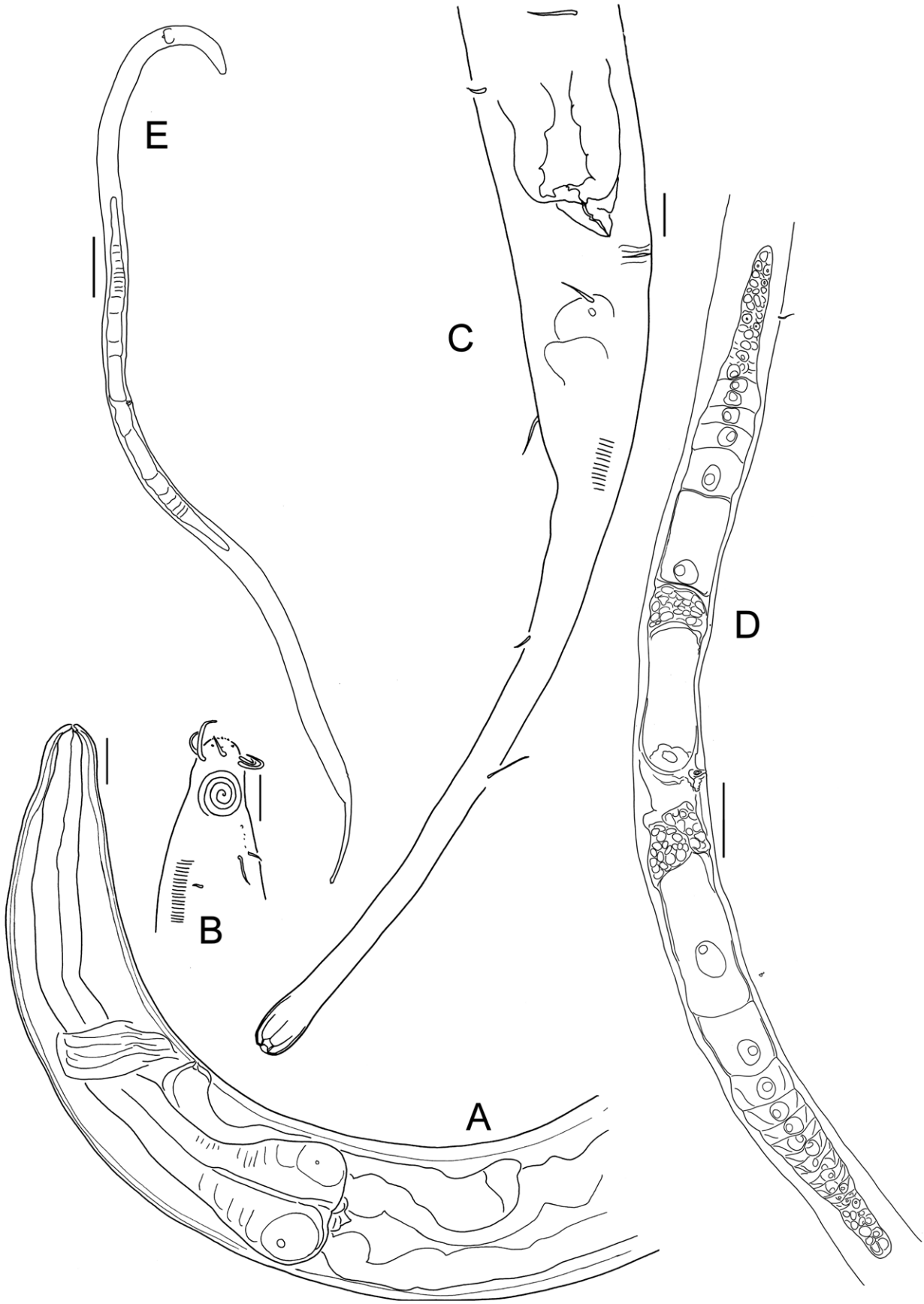

FIGURE 8. *Cervonema sp. B*., female: Scale bars: A, oesophagus; B, head; C, tail; D, gonads; E, habitus. Scale bars: 10 µm (A–C), 40 µm (D), 200 µm (E).

Affinities. *Cervonema sp. B* is similar to *C. chilensis* and *C. hermani* in having the amphids positioned almost directly behind the cephalic setae. It is additionally similar to *H. hermani* owing to the relative lengths of the cephalic setae (as hd) and the tail (as abd). It differs from *C. hermani* and *D. chilensis*, however, with regard to the de Man's ratio *a* (43 vs 60 and 35, respectively) and de Man's ratio *b (*12.5 vs 9.9 and 8.5, respectively). It is additionally different from *C. hermani* and *C. chilensis* with regard to the R2:R3 sensilla length ratio (0.8 vs 1 and 1, respectively), and in having fewer turns of the amphid (4 vs 5.5 and 5.5, respectively).

Concluding remarks on *Cervonema*. Like *Laimella*, species of *Cervonema* are recorded from the intertidal and estuarine habitats to the deep sea, and mostly recorded in fine sand and muddy sediments. It has also been noted that they tend to be restricted to marine or near-marine salinities (Soetaert et al. 1995). Forster (1998) noted that an upper-shore species of *Cervonema* was able to osmoregulate under osmotic stress conditions (immersion in hypo- or hyper-tonic solutions), though of course this will reflect habitat-specific adaptation across the Nematoda rather than a species or genus specific characteristic.

Cervonema have been described from Africa, America, Asia and Europe, and have been recorded in, but not described to, the Arctic and Southern Oceans (Vanreusel et al. 2000; Lee et al. 2001; respectively). They may be (co-)dominant in some habitats (eg. upper and mid-slope; see Muthumbi et al. 2004; Ingels et al. 2011) and deep-sea manganese nodule provinces (Miljutina et al. 2010; Vopel & Thiel 2001) and have been observed to increase in abundance in disturbed sediments (Lee et al. 2001).

Discussion

The species described here fit well with those already known from the *Laimella* and *Cervonema*. Rather than increasing known morphological ranges or providing additional information with regard to the differentiation of species, we show that inter-species variation is minimal, and extreme care should be taken to identify species of these genera. Our knowledge of intraspecific variation is also limited for the known species, including two of those described here, and it is likely that as more species are described there will be characters overlap between species. It is therefore essential that a maximal number of characters are utilised to identify and describe species.

Key characters used to differentiate species in both genera are the relative lengths of the cephalic setae; number of turns and relative diameter of the amphids; the shape and relative length of the posterior oesophageal bulb; the shape and relative size of the spicules; and the tail length and the relative length of the posterior conical section. Additional informative characters in the *Laimella* are the size and shape of the teeth, and the shape and relative size of the gubernaculum. It is also noted here that *Cervonema* species may or may not have jointed R2 anterior cephalic setae. They were recorded in *C. pseudodeltensis* **sp. nov.** and we also note that in the description of *C. deltensis* Figure 19, a photomicrograph of an allotype male, suggests jointed R2 setae.

Here we described species of both *Laimella* and *Cervonema* with pre-cloacal supplements and pre-cloacal ejaculatory glands. Ejaculatory glands have been previously recorded in *Cervonema* (*C. deltensis*) and in other Comesomatidae (eg. *Hopperia hexadentata* Hope and Zhang 1995), but this is the first time they are noted in a species of *Laimella* . It is possible therefore that they are a common character in the family, but tend to be overlooked. Equally, although differences in the number of supplements may distinguish these species, they tend to be minute and difficult to observe with light microscopy, and it is best not to use them as a character for differential diagnosis. Without SEM examination we believe it is not possible to confidently determine the number of supplements in every specimen or even species.

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