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A New Free-Living Marine Nematode, *Chaetonema longicorpus* sp. nov. (Enoplida: Anoplostomatidae) from a Subtidal Zone of the East Sea, Korea

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ABSTRACT

A new free-living marine nematode, *Chaetonema longicorpus* sp. nov., was discovered in a subtidal benthic habitat around the Uljin nuclear power plant in the East Sea. *Chaetonema longicorpus* sp. nov. differs from other *Chaetonema* species in its very long body length, relatively long cephalic setae, long and narrow buccal cavity, bottle-shaped amphideal fovea, short spicules, only one pre-cloacal seta instead of a pre-cloacal supplement, and conspicuous ventral swelling at the middle of the tail. Herein, we provide a taxonomic description and illustrations of this new species using differential interference contrast microscopy. Furthermore, an illustrated pictorial key to all valid species, including the new species and comparative tables on the biogeographical and morphological characteristics of the genus *Chaetonema*, are provided.

Keywords: taxonomy, diversity, marine nematode, new species, Uljin

INTRODUCTION

The family Anoplostomatidae Gerlach and Riemann, 1974 consists of two genera, *Anoplostoma* Butschli, 1874 and *Chaetonema* Filipjev, 1927, each of which belongs to two subfamilies (Anoplostomatinae Gerlach and Riemann, 1974 and Chaetonematonae Gerlach and Riemann, 1974) (Gerlach and Riemann, 1974; Smol et al., 2014). Most species in this family are reported to live in an apparent cosmopolitan distribution of marine environments, but some taxa have been discovered in freshwater habitats (Smol et al., 2014). The genus *Chaetonema* was firstly erected by Filipjev (1927), and most species in this genus have been discovered in various marine habitats. The genus *Chaetonema* can be distinguished from other genera of the family Anoplostomatidae in having diagnostic features such as a large flask-shaped unarmed buccal cavity posteriorly surrounded by pharyngeal tissue and sexual dimorphism in amphideal fovea.

Platt (1973) developed the identification key for species of the genus *Chaetonema*. Later, Lo Russo et al. (2016) provided a revised identification key for all valid *Chaetonema* species, describing a new species of *C. patagonica* from the Patagonian coast of Argentina, South Atlantic; currently, five valid species are recorded in this genus. Other three species (*C. longisetum* Steiner, 1916, *C. steineri* Filipjev, 1927 and *C. vicinum* Gerlach, 1954) are recognized as *species inquirendae* because they are described based only on specimens of females or juveniles (Platt, 1973; Lo Russo et al., 2016).

During surveys on the species diversity of the free-living marine nematodes around the Uljin nuclear power plant in the East Sea of Korea, a new species of *Chaetonema* was identified from washing coarse sediments from a shallow subtidal benthic interstitial environment. To date, 32 species of free-living marine nematodes representing 16 genera have been described from the East Sea of Korea; however, taxonomic reports on the genus *Chaetonema* are entirely unknown (Rho and Kim, 2004, 2005; Lim and Chang, 2006; Rho et al., 2006a, 2006b, 2007, 2010; Rho and Min, 2011; Lee et al., 2015a, 2015b, 2016, 2021a, 2021b; Hong et al., 2016; Jeong et al., 2019; Lee and Rho, 2019; Rho et al., 2020). The present report provides a taxonomic description of. *C. longicorpus* sp. nov. with illustrations and photomicrographs taken using differential interference contrast (DIC) microscopy. We also provide an illustrated pictorial key to all valid species and

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Table 1. Morphometrics of *Chaetonema longicorpus* sp. nov.

Characters	*Chaetonema longicorpus* sp. nov.					
	Holotype	Paratypes				
	♂1	♂2	♂3	♀1	♀2	♀3
Total body length	2,372	2,426	2,330	2,463	2,554	2,424
a	79	77	78	67	72	64
b	6	7	7	7	7	7
c	16	17	18	15	15	15
Head diameter at cephalic setae level	12	12	13	14	14	13
Body diameter at pharynx level	29	28	27	32	31	33
Maximum body diameter	30	32	30	37	36	38
Length of short cephalic setae	25	24	24	22	25	25
Length of long cephalic setae	73	70	68	69	76	68
Cephalic setae length as proportion of head diameter	6	6	5	5	5	5
Amphideal fovea diameter	4	4	5	4	4	3
Amphideal fovea length	14	13	14	8	7	6
Buccal cavity diameter	6	6	5	6	6	5
Buccal cavity length	15	15	14	15	16	15
Distance from anterior end to amphids	85	88	88	70	72	77
Distance from anterior end to nerve ring	166	153	163	168	165	173
Body diameter at amphids level	22	22	22	20	19	20
Body diameter at nerve ring level	27	27	27	30	29	29
Pharynx length	365	336	342	369	360	368
Spicules length along the arc	21	22	21	–	–	–
Gubernaculum length	11	13	13	–	–	–
Distance from anal body diameter to pre-cloacal setae	24	23	24	–	–	–
Pre-cloacal setae length	2	2	2	–	–	–
Distance from anterior end to vulva	–	–	–	1,167	1,187	1,109
Body diameter at vulva level	–	–	–	39	37	37
V (%)	–	–	–	47	46	46
Anal body diameter	22	22	22	21	23	21
Tail length	145	141	126	169	171	167

All measurements are in μm.

comparison tables of the biogeographical and morphological characteristics of the species within the genus *Chaetonema*.

MATERIALS AND METHODS

Sediment samples were collected from subtidal zone around the Uljin nuclear power plant at a depth of 25 m using the Smith McIntyre grab. Meiofauna were separated from the sediments by decantation methods using 67 μm mesh sieve in the field after freshwater rinsing for less than a minute for osmotic shock, and then fixed in 5% formalin (Kristensen and Higgins, 1989). In the laboratory, fixed samples were sorted under high magnification dissecting microscope (LEICA 205C, Germany). The marine nematodes were picked out and transferred to 5% glycerin solution and mounted between two cover slips on the slide (Shirayama et al., 1993). The mounted nematodes were identified, measured, photographed, and drawn using Olympus BX 53 microscope (Japan) equipped with Olympus DP 26 digital camera and Olympus CellSens corresponding imaging software. All the measured sized are given in μm. Abbreviations used in the text are as follows: a, body length divided by maximum body diameter; b, body length divided by pharynx length; c, body length divided by tail length; V (%), vulva distance from anterior end as percentage of total body length.

SYSTEMATIC ACCOUNTS

Phylum Nematoda Potts, 1932
Class Enoplea Inglis, 1983

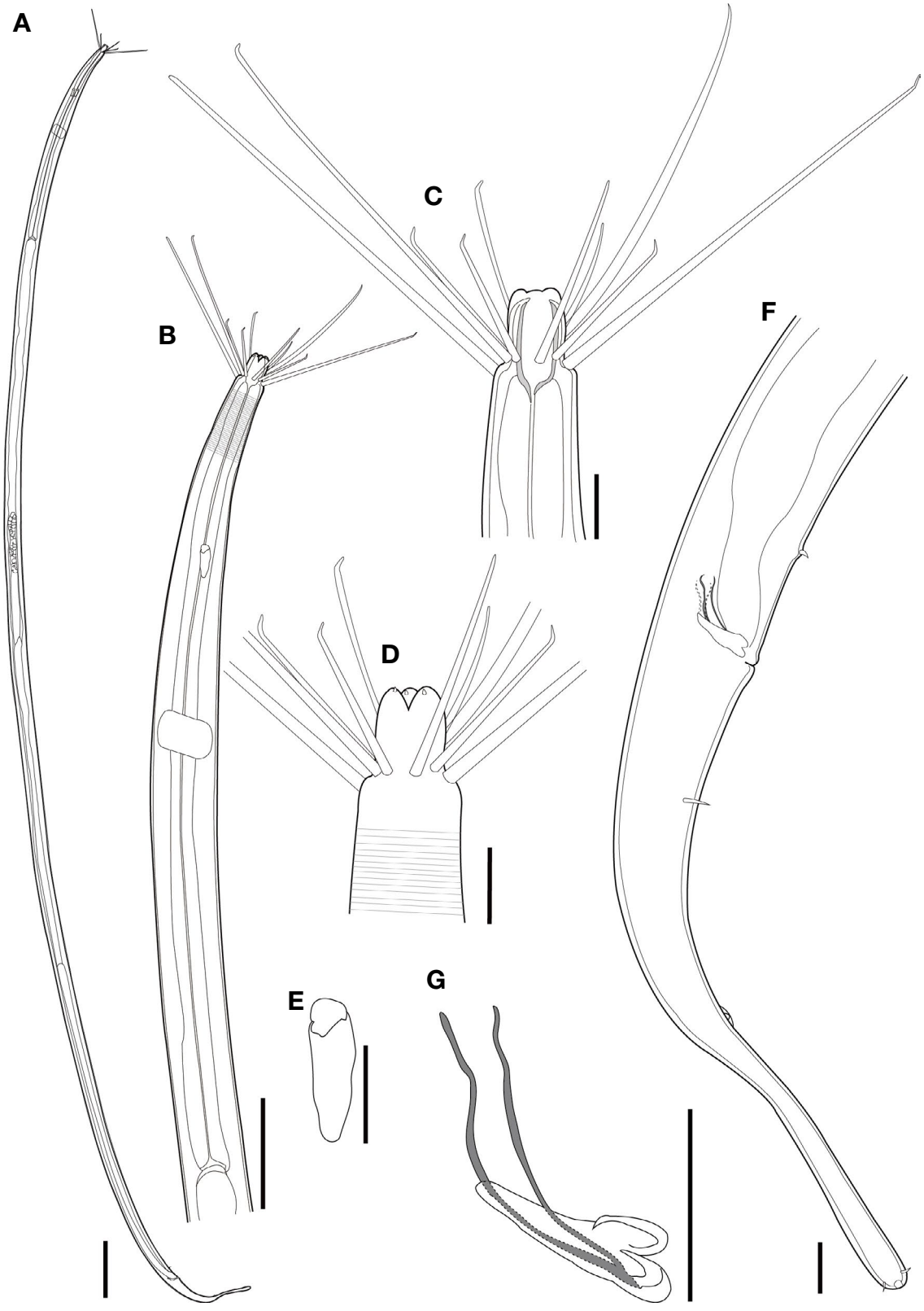

Fig. 1. *Chaetonema longicorpus* sp. nov., holotype male in lateral view: A, Habitus; B, Anterior region; C, Head region; D, Head region (external); E, Amphideal fovea; F, Spicule and tail region; G, Spicules and gubernaculum. Scale bars: A, B = 100 μm, C–G = 10 μm.

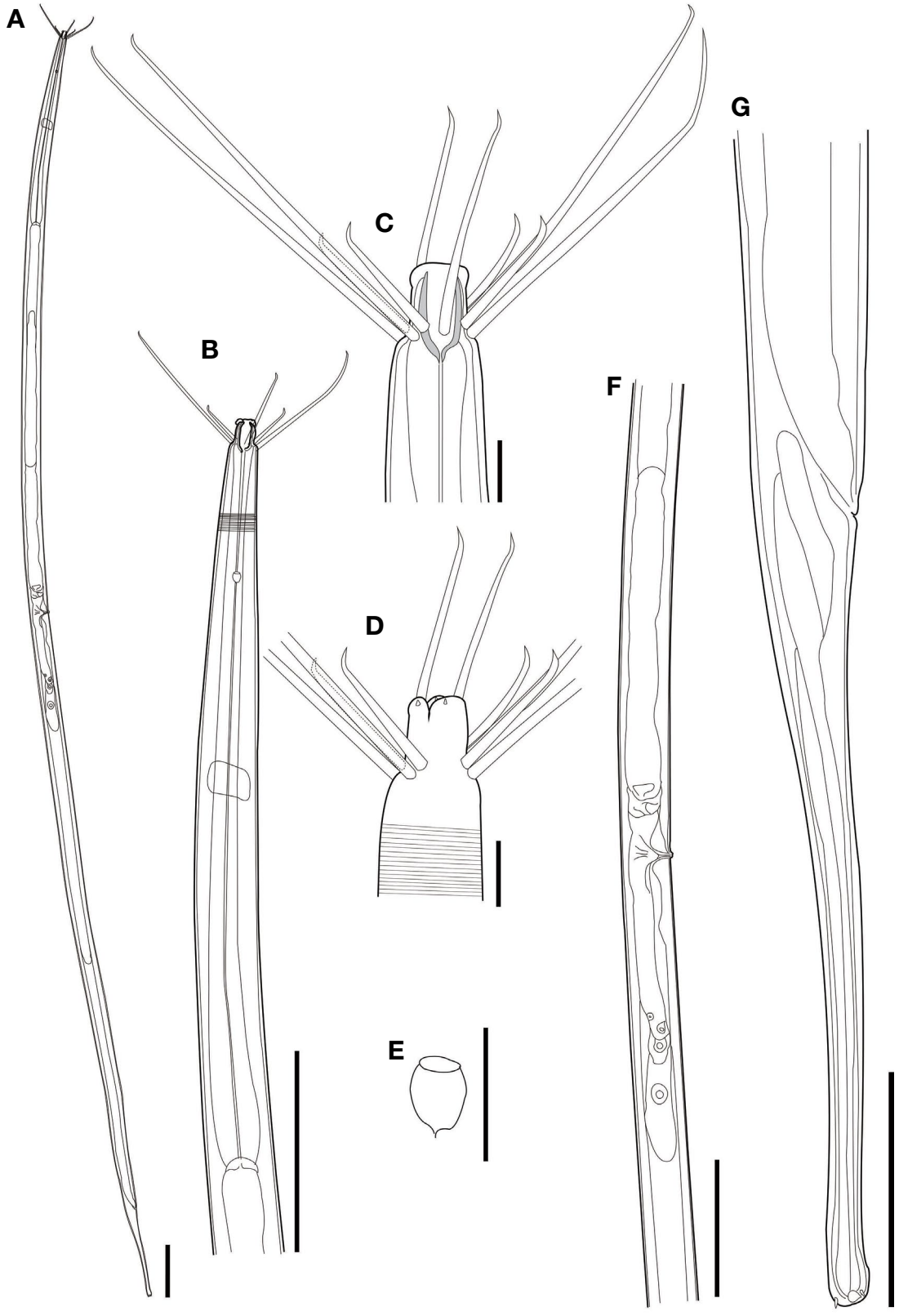

Fig. 2. *Chaetonema longicorpus* sp. nov., paratype females in lateral view: A, Habitus; B, Anterior region; C, Head region; D, Head region (external); E, Amphideal fovea; F, Vulva region; G, Tail region. Scale bars: A, B, F = 100 μm, C–E = 10 μm, G = 50 μm.

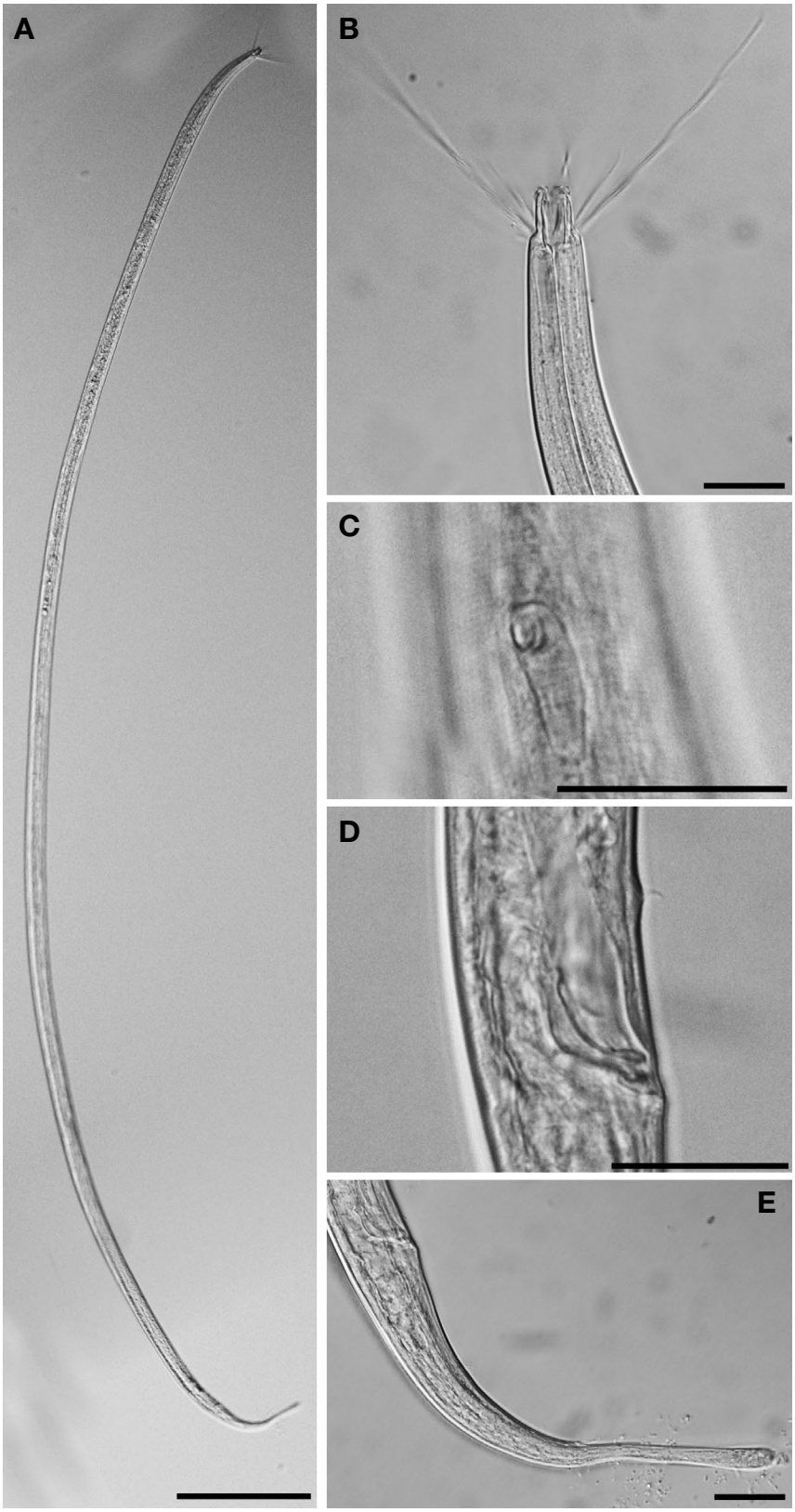

Fig. 3. *Chaetonema longicorpus* sp. nov., differential interference contrast photomicrographs, holotype male in lateral view: A, Habitus; B, Head region; C, Amphideal fovea; D, Spicules and gubernaculum; E, Tail region. Scale bars: A = 200 μm, B–E = 20 μm.

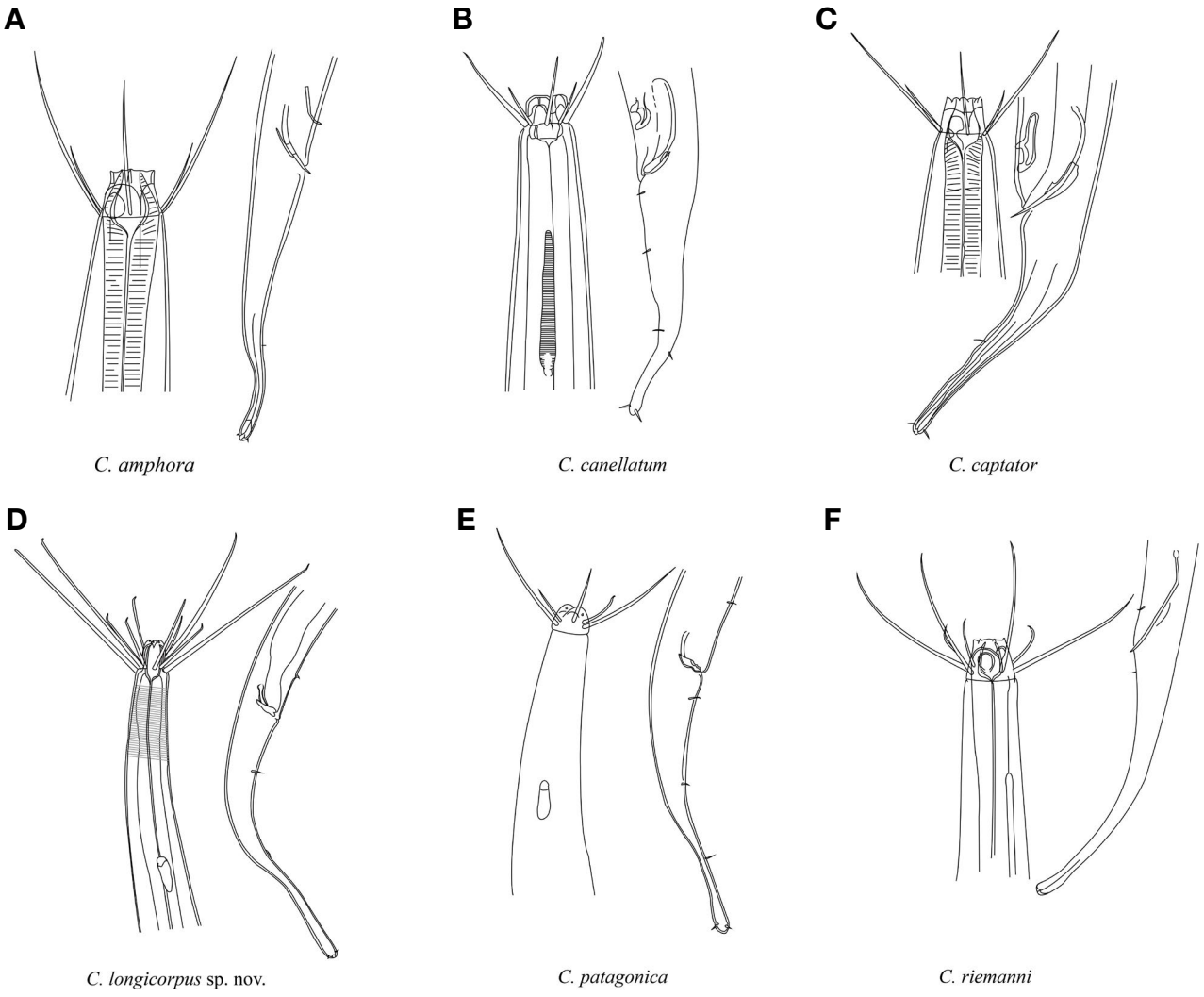

Fig. 4. Illustrated pictorial key for the valid species of the genus *Chaetonema*. Source of figures: A, Wieser (1953); B, Gerlach (1956); C, Wieser (1953); D, *C. longicorpus* sp. nov.; E, Lo Russo et al. (2016); F, Platt (1973).

Order Enoplida Filipjev, 1929
Family Anoplostomatidae Gerlach and Riemann, 1974
Subfamily Chaetosomatinae Gerlach and Riemann, 1974
Genus *Chaetonema* Filipjev, 1927

***Chaetonema longicorpus* sp. nov. (Table 1, Figs. 1–3)**
urn:lsid:zoobank.org:act:A13615D1-3DCC-4110-8627-D51E9244360A

Material examined. Holotype male (MABIK NA00157 736), in glycerin on HS slide, was deposited in the nematode collection at the specimen conservation room of the Marine Biodiversity Institute of Korea (MABIK), Seochun, Korea. Two paratype males (KIOST NEM-1-2645, KIOST NEM-1-2646) and three females (KIOST NEM-1-2647, KIOST NEM-1-2648, KIOST NEM-1-2649), mounted on HS slides, were deposited in the nematode collection at the specimen conservation room of the Bio-Resources Bank of Marine Nematodes (BRBMN), East Sea Research Institute, Korea Institute of Ocean Science and Technology (KIOST), Korea. All the specimens collected on 9 Jun 2020 from the type locality by Rho HS and Lee H.

Measurements. See Table 1 for detailed measurements and morphometric ratios.

Diagnosis. Body very long (2,330–2,426 μm in males and 2,424–2,554 μm in females) and slender; cuticles finely striated; head slightly constricted; relatively 4 long cephalic setae (68–76 μm); buccal cavity cylindrical without teeth; sexual dimorphism in amphideal fovea: long bottle-shaped in males and oval pocket-shaped in females; relatively short spicules (21–22 μm) and tubular gubernaculum; one pre-cloacal seta in males; conico-cylindrical tail with a pair of relatively long subventral setae behind the cloacal opening, and

Table 2. Character comparisons of *Chaetonema longicorpus* sp. nov. with its congeners

Taxa	Characters				
	Body length	Head diameter	Longest cephalic setae length	Spicule length	Pre-cloacal supplement
C. amphora Wieser, 1953	1,500–1,850	13	38	30	Tubular
C. canellatum Gerlach, 1956	1,168	12	25	35	Tubular
C. captator Wieser, 1953	1,670–2,220	14–16	45	59	Tubular
C. longicorpus sp. nov.	2,372–2,538	12–13	70–73	21–22	Setae
C. patagonica Lo Russo, Villares and Pastor de Ward, 2016	1,495–1,751	8–9	31–35	21–22	Setae
C. riemanni Platt, 1973	1,229–1,237	10	30–33	38–40	Setae

All measurements are in μm. Males only, morphometric values rounded.

Table 3. Biogeographical and ecological characteristics of the genus *Chaetonoma* including *C. longicorpus* sp. nov.

Taxa	Geographic distribution	Ocean	Ecological habitat
C. amphora Wieser, 1953	Seno Reloacavi, Chile	Pacific Ocean	Marine; littoral zone; algae on sand (11 m depth)
C. canellatum Gerlach, 1956	Tenglo Island, Chile	Pacific Ocean	Marine; sublittoral zone; coarse sand (35 m depth)
C. captator Wieser, 1953	Pernambuco, Brazil	Atlantic Ocean	Marine; fine sand with ripple marks (30 m depth)
C. longicorpus sp. nov.	East Sea, Korea	Pacific Ocean	Marine; subtidal zone; sediment (25 m depth)
C. patagonica Lo Russo, Villares and Pastor de Ward, 2016	San Julian Bay, Argentina	Atlantic Ocean	Marine; littoral coast
C. riemanni Platt, 1973	Strangford Lough, Northern Ireland	Atlantic Ocean	Marine; intertidal sand flat

conspicuous ventral swelling situated in the middle of the tail.

Description. Males: Body very long and slender (2,330–2,426 μm long), extremely tapering towards both extremities (Figs. 1A, 3A). Cuticle finely striated, which begins in cervical region and extends to base of tail, each striation about 0.7 μm wide (Fig. 1D). Maximum body diameter at mid body level, 30–32 μm wide. Head diameter 12–13 μm wide, with three lips, each with a pair of inner labial papillae. Anterior parts of head around cephalic setae separated with slight constriction. Six relatively short outer labial setae (24–25 μm long) arranged in one circle and four cephalic setae (68–73 μm long) in one circle. Two circles arranged very closely. Four cephalic setae relatively long, about 5–6 times of corresponding head diameter (Figs. 1C, 3B). Buccal cavity cylindrical (14–15 μm long and 5–6 μm wide) without teeth, and surrounded by pharyngeal tissue only in posterior section. Amphideal fovea long bottle-shaped, 13–14 μm long, and situated at 85–88 μm from anterior end (Figs. 1E, 3C). The Steiner's organ not visible. Pharynx cylindrical, 336–365 μm long, about 6–7% length of total body length, and 27–29 μm corresponding body diameter. Nerve ring situated at 153–166 μm from anterior end, approximately 45–46% of pharynx length, and 27 μm corresponding body diameter (Fig. 1B). Reproductive system diorchic, testis opposed and outstretched. Spicules short and equal, slightly arcuated with pointed distal end and cephalated proximal end. Spicules 21–22 μm long, about 1.0 times of cloacal body diameter. Gubernaculum 11–13 μm long, small and tubular-shaped, without apophysis (Figs. 1G, 3D). A pre-cloacal setae thick and small, 2 μm long, situated at 23–24 μm in front of cloacal opening. Tail consists of conical proximal part and cylindrical distal one-third part, and swollen tip with two-minute terminal setae. Tail 126–145 μm long, about 5.7–6.6 times of anal body diameter. Tail with a pair of relatively long subventral setae (5–6 μm) situated at 27–32 μm behind cloacal opening. Conspicuous ventral swelling situated at middle of tail, about 68–74 μm behind cloacal opening (Figs. 1F, 3E).

Females: Similar to males in general appearance, but differ in several dimensions, amphideal fovea, and sexual characteristics (Fig. 2A–D). Body length 2,424–2,554 μm; cylindrical body distinctly tapered toward both extremities. Maximum body diameter 36–38 μm wide (Fig. 2A). Amphideal

fovea smaller than males: oval pocket-shaped, 3–4 μm wide, 7–8 μm long, and situated at 71–77 μm from anterior end (Fig. 2E). Reproductive system didelphic. Anterior ovary situated on right side of intestine, posterior on right side of intestine. Vulva 1,109–1,187 μm from anterior end, situated at 46–47% of total body length (Fig. 2F). Tail 167–171 μm long, about 2.6–2.7 times of anal body diameter. Conoid tail with two pairs of setae (Fig. 2G).

Remarks. The genus *Chaetonema* was established by Filipjev (1927) and classified within the subfamily Chaetonematinae Gerlach and Riemann, 1974 of the family Anoplosomatidae Gerlach and Rimann, 1974 belonging to the order Enoplida Filipjev, 1929 based on having a large flask-shaped unarmed buccal cavity posteriorly surrounded by pharyngeal tissue, and sexual dimorphism in amphideal fovea (previously, the amphideal fovea in the male was mistaken for the Steiner's organ) (Gerlach and Riemann, 1974; Lorenzen, 1994; Smol et al., 2014). The genus *Chaetonema* has been revised, and currently, five valid species have been recorded: *C. amphora* Wieser, 1953, *C. canellatum* Gerlach, 1956, *C. captator* Wieser, 1953, *C. patagonica* Lo Russo, Villares and Pastor de Ward, 2016, *C. riemanni* Platt, 1973 (Wieser, 1953; Platt, 1973; Lo Russo et al., 2016). For comprehensive species identification, we provide a pictorial identification key, including illustrations of the head and posterior body regions of the species (Fig. 4). Additionally, comparative tables on the biogeographical and morphological characteristics of the genus *Chaetonema* are also provided (Tables 2, 3).

Chaetonema longicorpus sp. nov. is characterized by a combination of the following morphological diagnostic features: (1) long (2,330–2,426 μm in males, 2,424–2,554 μm in females) and slender body; (2) the constricted head at the cephalic setae region; (3) very long cephalic setae (68–76 μm); (4) a long and narrow buccal cavity without teeth; (5) sexual dimorphism in amphideal fovea: long bottle-shaped in males and oval pocket-shaped in females; (6) the presence of relatively short spicules (21–22 μm) and tubular gubernaculum; (7) the presence of one pre-cloacal seta; and (8) the conico-cylindrical tail with a pair of relatively long subventral setae behind the cloacal opening, and conspicuous ventral swelling situated in the middle of the tail. Among the species of the genus *Chaetonema*, two species, *C. riemanni* and *C. patagonica*, have pre-cloacal setae instead of pre-cloacal supplement, with the new species. *Chaetonema longicorpus* sp. nov. differs from *C. riemanni* by its longer body length in males (2,330–2,426 μm vs. 1,229–1,237 μm), longer cephalic setae length as a proportion of head diameter (5–6 vs. 3–3.3), shorter spicule length (21–22 μm vs. 38-40 μm), and the presence of ventral swelling situated in the middle of the tail. *Chaetonema longicorpus* sp. nov. closely resembles *C. patagonica* based on the presence of bottle-shaped amphideal fovea, relatively short spicules, and tubular gubernaculum. However, *C. longicorpus* sp. nov. is distinguished from *C. patagonica* by its longer body length in males (2,330–2,426 μm vs. 1,495–1,751 μm) and longer buccal cavity (14–16 μm vs. 7 μm). Moreover, an additional morphological difference is that *C. longicorpus* sp. nov. has a pair of relatively long subventral setae and conspicuous ventral swelling situated in the middle of the tail, whereas *C. patagonica* has only three post-cloacal subventral setae without any ventral swelling on the tail.

Etymology. This species name, *longicorpus*, is derived from Latin *longus* (long) and *corpus* (body), in referring to the very long body length, one of the taxonomic key characters of the new species.

Type locality and habitat. Subtidal zone around the Uljin nuclear power plant (37°08′36.72″N, 129°22′09.45″E), Buk-myeon, Uljin-gun, Gyeongsangbuk-do, Korea. The nematodes were extracted from subtidal sediments with tiny shell gravels and detritus collected at a depth of 25 m.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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