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Research article

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**Two new rapacious nematodes from intertidal sediments,
Gammanema magnum sp. nov. and *Synonchium caudatubatum* sp. nov.
(Nematoda, Selachinematidae)**

Benze SHI¹ & Kuidong XU^{2,*}

^{1,2}Department of Marine Organism Taxonomy and Phylogeny, Institute of Oceanology,
Chinese Academy of Sciences, Qingdao 266071, China.

²Laboratory for Marine Biology and Biotechnology, Qingdao National Laboratory
for Marine Science and Technology, Qingdao 266071, China.

²University of Chinese Academy of Sciences, Beijing 100049, China.

*Corresponding author: kxu@qdio.ac.cn

¹Email: shibenze@foxmail.com

¹[urn:lsid:zoobank.org:author:96263530-6EA2-4237-9029-A65835B9AF36](https://zoobank.org/author:96263530-6EA2-4237-9029-A65835B9AF36)

²[urn:lsid:zoobank.org:author:7338893E-D622-4301-8E76-3A412AFFC15E](https://zoobank.org/author:7338893E-D622-4301-8E76-3A412AFFC15E)

Abstract. Two new species of the family Selachinematidae Cobb, 1915 from an intertidal sandy flat in the East China Sea are described. Both species are distinct rapacious nematodes, preying on other nematodes. *Gammanema magnum* sp. nov. is characterized by its leaf-like labial setae, large loop-shaped amphideal fovea in the male and small spiral ones in the female, an anterior buccal cavity reinforced by 12 rhabdia, each rhabdion with about six denticles, and two unequally long spicules. *Gammanema magnum* sp. nov. is a striking species, exhibiting extreme sexual dimorphism in the amphideal fovea, but lacking a gubernaculum or precloacal supplements, all features by which it can be differentiated from congeneric species. *Synonchium caudatubatum* sp. nov. is characterized by a posterior buccal cavity, with three mandibles each with a large tooth flanked by three smaller teeth on both sides, a transverse oval-shaped multispiral amphideal fovea, and a bluntly rounded tail with a protuberant caudal duct. *Synonchium caudatubatum* sp. nov. is unique in the genus in having a protuberant caudal duct in the tail end. Furthermore, it differs from its congeners by its mandibles, which have seven teeth each. *Synonchium caudatubatum* sp. nov. lacks a gubernaculum and a precloacal supplement, both features present in congeners except *S. depressum* Gerlach, 1954.

Keywords. East China Sea, marine nematode, morphology, new species, sandy sediment.

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Introduction

Within the order Chromadorida Chitwood, 1933, the family Selachinematidae Cobb, 1915 is distinctly characterized by a large buccal cavity divided into two compartments. Nematodes of Selachinematidae

are mostly reported from relatively coarse sediments in shallow marine environments worldwide and may also occur in deep-sea habitats (Leduc 2013; Miljutin *et al.* 2010; Okhlopkov 2002; Tchesunov & Okhlopkov 2006). Many of them are repeatedly reported as predators of other nematodes, and may play a key role in the ecosystems of coarse sandy sediments given their high diversity and high numbers (Okhlopkov 2003; Tchesunov & Okhlopkov 2006).

The taxonomy of Selachinematidae was revised by Gerlach (1964) based on the classification of the buccal cavity structure. Later, Gerlach & Riemann (1973) differentiated two subfamilies within the Selachinematidae based on buccal cavity and cuticular structures. The subfamily Choniolaiminae Schuurmans-Stekhoven & Adam, 1931 is characterized by a buccal cavity reinforced by cuticularized rhabdia in both compartments: six well-developed rhabdia in the broad cup-shaped anterior chamber and three weaker rhabdia in the cylindrical posterior chamber (Tchesunov & Okhlopkov 2006). Members of the subfamily Selachinematinae Cobb, 1915 have a buccal cavity with a reduced anterior chamber and a posterior chamber with mandibles. At present, 15 genera are included in the family Selachinematidae (Vanaverbeke 2015).

So far, only five selachinematid species belonging to three genera, *Halichoanolaimus* de Man, 1886; *Richtersia* Steiner, 1916 and *Synonchiella* Cobb, 1933, have ever been reported from the sea areas of China (Liu 2008; Fu *et al.* 2013). In this paper we describe two new species of Selachinematidae from a sand beach in the East China Sea: *Gammanema magnum* sp. nov. (Choniolaiminae) and *Synonchium caudatubatum* sp. nov. (Selachinematinae). Both species are rapacious and prey on other nematodes. This is also the first record of both genera in the sea areas of China.

Material and methods

Sediment samples were collected from the Dasha'ao Sand Beach in the Nanji Islands National Marine Natural Reserve in the East China Sea (27°27.76' N, 121°3.48' E) in May 2014. Samples were fixed with formalin (5% final concentration) in filtered sea water. The fixed samples were stained with 0.1% Rose Bengal for 12 hours (Higgins & Thiel 1988) and subsequently rinsed on a 500 µm sieve to remove large particles and on a 31 µm sieve to retain meiofauna. Meiofauna was extracted from the remaining sediments using Ludox HS 40 by centrifugation (Platt & Warwick 1983) and sorted to higher taxa under a dissecting microscope. Nematodes were transferred into 9:1 (v/v) solution of 50% alcohol-glycerol in a cavity block to slowly evaporate to pure glycerol, and then mounted into permanent slides (Platt & Warwick 1983).

Species descriptions were made from glycerol mounts (Platt & Warwick 1983) using a differential interference contrast microscope (Nikon E80i). Line drawings were made with the aid of a drawing device. Type specimens have been deposited in the Marine Biological Museum of Chinese Academy of Sciences, Qingdao, China (MBMCAS). All measurements are in µm, and all curved structures are measured along the arc. The terminology used for describing the arrangement of morphological features follows Coomans (1979).

Abbreviations:

- a* = L/mbd
- abd = anal body diameter
- b* = L/pharynx length
- c* = L/tail length
- c'* = tail length/abd
- cbd = corresponding body diameter
- L = body length
- mbd = maximum body diameter

V = distance from anterior end to vulva

V% = $V \times 100/L$

Results

Order Chromadorida Chitwood, 1933

Family Selachinematidae Cobb, 1915

Subfamily Choniolaiminae Schuurmans-Stekhoven & Adam, 1931

Genus *Gammanema* Cobb, 1920

Gammanema magnum sp. nov.

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Figs 1–4; Table 1

Diagnosis

Body cylindrical, length 2540–4085 μm . Six short leaf-like inner labial setae with broad base, six long leaf-shaped outer labial setae with broad base and four slender cephalic setae arranged in three circlets. Anterior buccal cavity broad and cup-shaped, reinforced by 12 sclerotized rhabdia, each rhabdion with about six denticles at posterior end; posterior buccal cavity narrow and cylindrical with six broad rhabdia, surrounded by pharyngeal tissue. Amphideal fovea exhibiting extreme sexual dimorphism: large loop in about 1.3 turns occupying 79–82% of corresponding body diameter in males and very small spiral in about two turns occupying 12–14% of corresponding body diameter in females. Pharynx with anterior end slightly swelling, but not bulb-like enlarged. Two opposed testes. Sperm globular to oval. Two spicules unequally long and slightly curved, with left spicule (51–56 μm long) slightly shorter than right one (62–69 μm long). Two reflexed ovaries. Spermatheca large, filled up with sperm. Three caudal glands with spinneret. Tail short and conical.

Etymology

The specific epithet is from the Latin adjective ‘*magnus*’ (large) and refers to two distinct features of the species, i.e., the large body size and the large amphideal fovea in male.

Material examined

Holotype

EAST CHINA SEA: ♂, Nanji Islands, Dasha’ao Beach, 27°27.76’ N, 121°3.48’ E, May 2014, intertidal sandy sediment, temperature 22°C, salinity 28 psu during sampling, median particle diameter of sediment about 612 μm (coarse sand), sediment organic matter content about 2.5%, Benze Shi and Kuidong Xu leg. (MBMCAS NJ-20140513-73).

Paratypes

EAST CHINA SEA: 2 ♂♂, 7 ♀♀, same collecting data as for holotype (MBMCAS NJ-20140513-22, MBMCAS NJ-20140513-71, MBMCAS NJ-20140513-73, MBMCAS NJ-20140513-83, MBMCAS NJ-20140513-84).

Description

MEASUREMENTS. See Table 1.

BODY. Cylindrical. Cuticle thick and distinct annulated, rows of punctuations on the annules, without lateral differentiation (Figs 1A, 2D, 3A). Head blunt with six pairs of thin, membrane-like cuticle extensions. Anterior sensilla in three circles: six inner labial setae leaf-shaped with a broad base, six outer

Table 1. Morphometrics (measurements in μm) of *Gammanema magnum* sp. nov. Mean values for female paratypes are shown in brackets.

Characters	Holotype	Paratypes	
		Males (n = 2)	Females (n = 7)
Body length	4085	2900–3500	2540–3145 (2890)
Maximum body diameter	78	60–67	85–103 (92)
<i>a</i>	52.4	48.3–52.2	28.2–33.1 (31.3)
<i>b</i>	12.7	9.6–12.8	7.9–9.3 (8.7)
<i>c</i>	33.2	31–35.8	24.8–29.9 (29.8)
<i>c'</i>	2.1	1.4–2	1.1–1.8 (1.6)
Head diameter	51	50–51	72–85 (77.6)
Inner labial setae length	16	15–16	10–14 (11)
Outer labial setae length	25	22–25	20–21 (20)
Cephalic setae length	35	31–35	40–45 (43)
Amphideal fovea from anterior end	25	18–23	39–46 (41)
Amphideal fovea length	43	38–39	9–10 (10)
Amphideal fovea width	45	42–45	9–10 (10)
cbd at the amphideal fovea	55	52–57	72–85 (76)
Amphideal fovea width/cbd	82%	79–81%	12–14% (13)
Nerve ring from anterior end	140	122	130–165 (146)
cbd at nerve ring	60	52–56	77–78 (77)
Pharynx length	321	273–301	311–348 (335)
cbd at the cardia	60	50–55	65–75 (73)
Vulva from anterior end	–	–	1575–2125 (1915)
V%	–	–	62–67 (66%)
cbd at vulva	–	–	80–103 (90)
Left spicule length	56	51–53	–
Right spicule length	64	62–69	–
Anal body diameter	58	55–56	59–70 (62)
Tail length	123	81–113	80–110 (97)

labial setae leaf-shaped with a broad base and four slender cephalic setae (Figs 1A–B, 2B–C, 3A–B). Buccal cavity spacious, divided into two portions. Anterior buccal cavity broad, cup-shaped, with 12 cuticularized rhabdia, each rhabdion with about six pointed denticles at its posterior end. Posterior buccal cavity narrow and cylindrical, surrounded by six broad rhabdia (Figs 1B, 2C, 3B, 4A). Pharynx cylindrical, with slight anterior end swelling, not bubiform, surrounding the posterior buccal cavity, without posterior bulb. Numerous cells surrounding the pharynx. Intestine cells large, filled of orange-brown inclusions. Intestine lumen with irregular and variable appearance. Prey nematode species often observed in the intestine are probably members of *Epacanthion* Wieser, 1953, as observed in the intestine

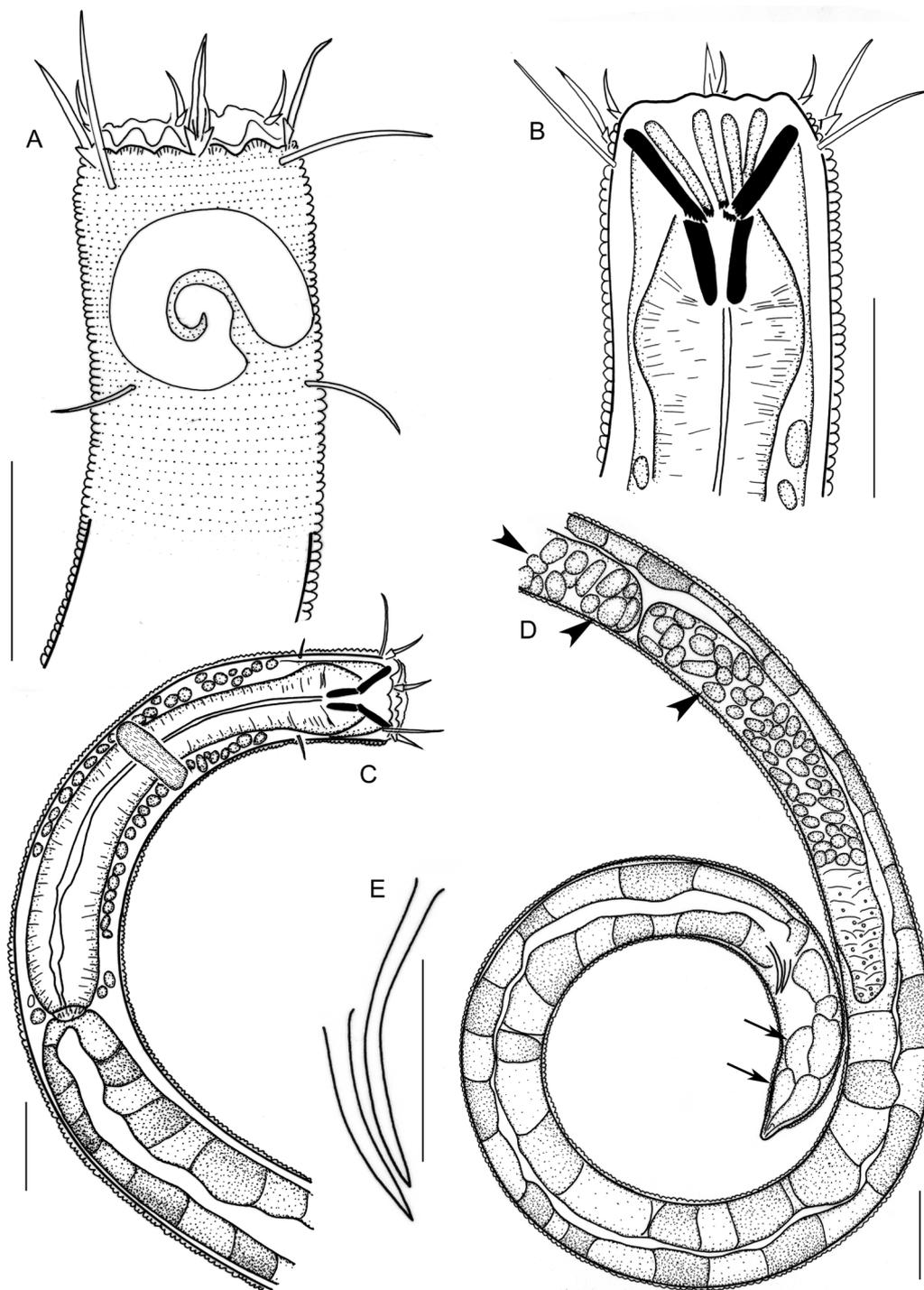


Fig. 1. *Gammanema magnum* sp. nov., holotype, ♂. **A.** Surface view of head, showing the very large amphideal fovea, six leaf-like outer labial setae, four slender cephalic and four slender cervical setae, and the transverse rows of punctuations. **B.** Inside view of head, showing the broad anterior buccal cavity reinforced by cuticularized rhabdia each with about six pointed denticles at the posterior end, the narrow and cylindrical posterior buccal cavity surrounded by six broad rhabdia, and the anterior pharynx swelling but not forming a bulb. **C.** Neck region, showing the pharynx surrounded by numerous cells, nerve ring, the large intestine cells filled of inclusions, and the irregular intestine lumen. **D.** Posterior region, showing the opposed testes with globular to oval sperm cells (arrowheads), the unequally long spicules, the caudal glands (arrows), and the short and conical tail. **E.** Two spicules. Scale bars: 50 μ m.

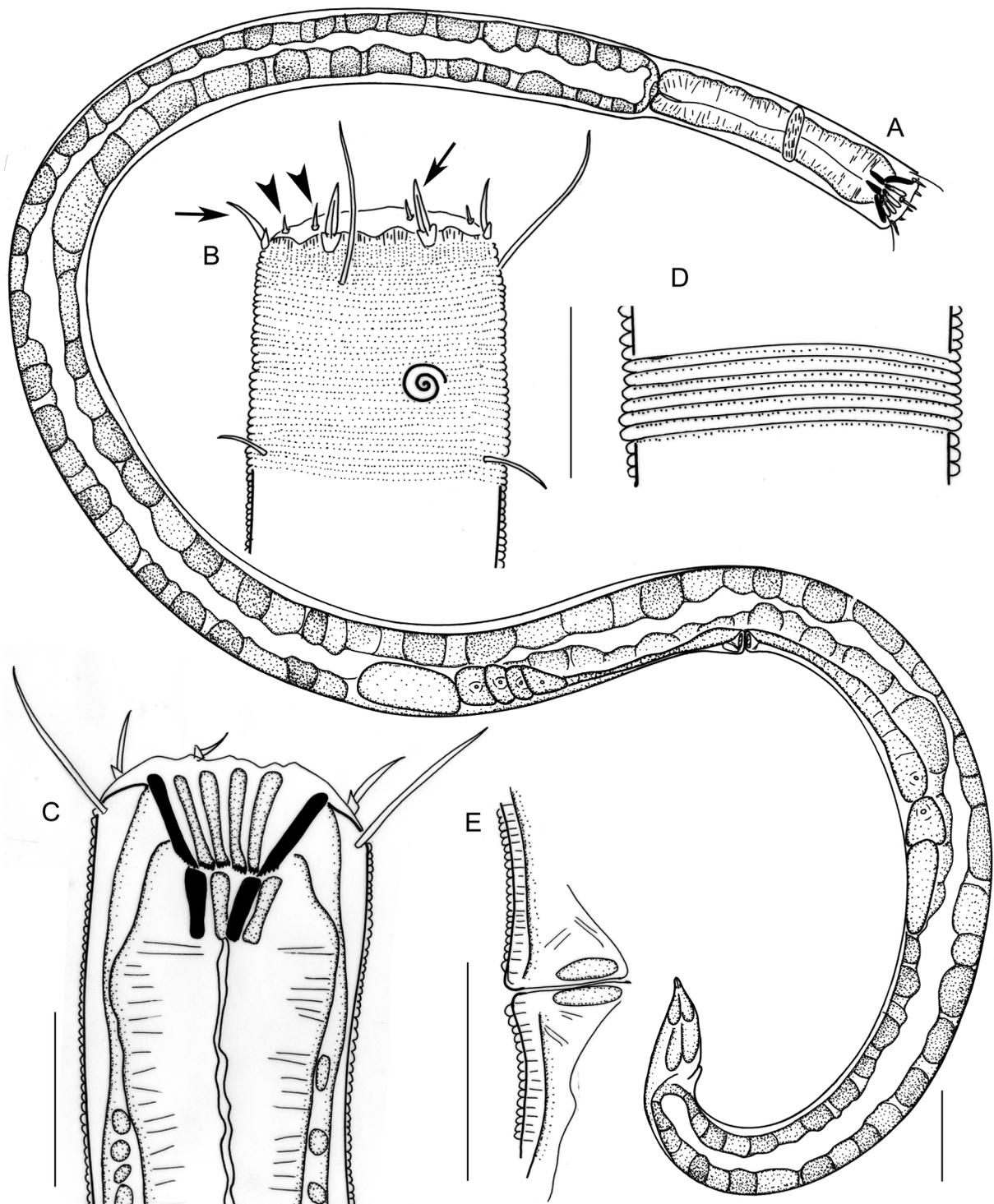


Fig. 2. *Gammanema magnum* sp. nov., paratype, ♀. **A.** Overview, showing the slender body shape, the cylindrical pharynx with anterior swollen portion, the two reflexed ovaries, the caudal glands with spinneret, and the conical tail. **B.** Surface view of head, showing the very small multispiral amphideal fovea, leaf-like inner (arrowheads) and outer (arrows) labial setae, four slender cephalic and four slender cervical setae, and the transverse rows of punctuations. **C.** Inside view of head, showing similar features as the male holotype. **D.** Cuticle with transverse rows of punctuations. **E.** Vulva. Scale bars: A = 100 µm, B–E = 50 µm.



Fig. 3. *Gammanema magnum* sp. nov., holotype, ♂. **A.** Surface view of head, showing the large amphideal fovea, outer labial setae (arrowheads), the slender cephalic setae (white arrows), and the transverse rows of punctuations. **B.** Neck region, showing the leaf-like inner labial setae (black arrows), the broad anterior buccal cavity reinforced by cuticularized rhabdia, each with about six pointed denticles at each posterior end, the narrow and cylindrical posterior buccal cavity surrounded by six broad rhabdia. **C.** Overview, showing the slender body and conical tail. **D.** Globular to oval sperm cells. **E.** Two unequally long spicules. **F.** Posterior region, showing the opposed testes with globular to oval sperm, the caudal glands with spinneret, and the conical tail. Scale bars: A–B = 50 μ m, C–F = 100 μ m.



Fig. 4. *Gammanema magnum* sp. nov., paratype, ♀. **A–B.** Head, showing the small multispiral amphideal fovea, the leaf-like inner (arrowhead) and outer (black arrow) labial setae, the transverse rows of punctuations, and the buccal cavity as drawn in Fig. 2. **C.** Anterior region, showing the cylindrical pharynx surrounded by numerous cells, with anterior end swelling but not forming a bulb. **D.** Large spermatheca with globular to oval sperm cells. **E.** Overview, showing the slender body and conical tail. **F.** The intestine contains a prey nematode, likely a member of *Epacanthion* Wieser, 1953 (white arrow). Scale bars: 50 μ m.

of a paratype specimen (Fig. 4F). Three caudal glands with spinneret. Tail short and conical (Figs 1D, 2A, 3E).

Male

Amphideal fovea large loop-shaped, in about 1.3 turns, covering 79–82% of corresponding body diameter (Figs 1A, 3A). Two opposed testes, situated ventrally left to the intestine. Sperm cells globular to oval (Figs 1D, 3D, F). Two spicules unequally long and slightly curved, with left spicule slightly shorter than right one (Fig. 1E). Gubernaculum absent. Precloacal supplement absent.

Female

Similar to male in body shape. Outer labial setae slightly shorter than in male but cephalic setae slightly longer than in male. Amphideal fovea small spiral, in about two turns, covering 12–14% of corresponding body diameter (Figs 2B, 4B). Two reflexed ovaries. Vulva a transverse slit, located at 62–67% of body. Vagina surrounded by well-developed constrictor muscles. Uterus broad. Spermatheca large, filled up with sperm (Fig. 4D).

Remarks

The new species is assigned to the genus *Gammanema* Cobb, 1920 based on its broad and cup-shaped anterior buccal cavity reinforced by 12 cuticularized rhabdia each with about six pointed denticles at posterior end and a narrow and cylindrical posterior buccal cavity surrounded by six broad rhabdia. The genus *Gammanema* now contains 13 valid species (Leduc 2013). Among these, sexual dimorphism in the amphideal fovea occurs in species where both males and females are known. However, the males of two species, *G. mediterraneum* Vitiello, 1970 and *G. cancellatum* Gerlach, 1955, remain hitherto unknown. Compared to the females, *Gammanema magnum* sp. nov. differs from *G. mediterraneum* in the greater body size, which is four times larger, the leaf-like labial setae (vs papillate) and the absence (vs presence) of long somatic setae. It differs from *G. cancellatum* in the leaf-like outer labial setae distinctly shorter than the cephalic setae (vs slender outer labial setae longer than the cephalic setae).

Gammanema magnum sp. nov. is a striking species exhibiting extreme sexual dimorphism in the amphideal fovea: large loop-shaped in males and small spiral in females. Only *G. fennicum* Gerlach, 1953, *G. conicauda* Gerlach, 1953 and *G. agglutinans* Leduc, 2013 show such dimorphism. However, *Gammanema magnum* sp. nov. differs distinctly from the three aforementioned species by the two unequally long spicules without gubernaculum (vs equal sized spicules with gubernaculum) and the lack of precloacal supplement (vs with supplements). The new species differs also distinctly from *G. conicauda* and *G. agglutinans* by its larger amphideal fovea in males (in 1.75 turns covering 79–82% of cbd vs a single loop covering 34–41% of cbd and a small open loop covering 28–29% of cbd, respectively) and the leaf-like labial setae (vs slender and conical setae, respectively).

Subfamily Selachinematinae Cobb, 1915

Genus *Synonchium* Cobb, 1920

Synonchium caudatubatum sp. nov.

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Figs 5–7; Tables 2–3

Diagnosis

Body cylindrical, length 2270–2760 μm . Labial and cephalic sensilla papillate. Anterior buccal cavity reduced, surrounded by 12 rhabdia, posterior buccal cavity with three mandibles each composed of one large tooth flanked by three smaller teeth on both sides. Amphideal fovea flattened multispiral, in about

three turns. Pharynx largely cylindrical with slight anterior swelling but not forming a bulb. Two opposed testes, sperm globular to oval. Two spicules sclerotized and almost straight, 55–60 µm long. Two reflexed ovaries. Three caudal glands with spinneret. Tail bluntly rounded, with a protuberant caudal duct.

Etymology

The specific epithet is a composite of the Latin noun ‘*cauda*’ (tail) and the Latin adjective ‘*tubatus*’ (with tube), referring to the presence of a protuberant caudal duct, a main feature of the species.

Material examined

Holotype

EAST CHINA SEA: ♂, Nanji Islands, Dasha’ao Beach, 27°27.76’ N, 121°3.48’ E, May 2014, intertidal sandy sediment, temperature 22°C, salinity at 28 psu during sampling, median particle diameter of sediment about 612 µm (coarse sand), sediment organic matter content about 2.5%, Benze Shi and Kuidong Xu leg. (MBMCAS NJ-20140513-105).

Paratypes

EAST CHINA SEA: 4 ♂♂, 5 ♀♀, same collecting data as for holotype (MBMCAS NJ-20140513-9, MBMCAS NJ-20140513-30, MBMCAS NJ-20140513-73, MBMCAS NJ-20140513-83, MBMCAS NJ-20140513-84, MBMCAS NJ-20140513-105).

Description

MEASUREMENTS. See Table 2.

BODY. Cylindrical. Anterior end of head almost truncate. Labial region with 12 lobes and six pairs of thin, membrane-like cuticle extensions (Figs 5D–E, 6A). Six inner labial papillae minute and conical situated on the lips, six outer labial papillae and four cephalic papillae large and conical. Cuticle thick and distinctly annulated, with lateral pores; each annule with a transverse row of punctations, without lateral differentiation. Amphideal fovea multispiral in about three turns, transverse oval-shaped (Figs 5D, 6B). Buccal cavity in two compartments: anterior one with 12 cuticularized rhabdia; posterior one surrounded by pharyngeal tissue, with three mandibles each bearing a large tooth flanked by three smaller teeth to each side (Fig. 5E). Pharynx cylindrical, with anterior end swollen. Nerve ring surrounding pharynx near its middle portion. Cardia flattened. Intestine cells large, filled with numerous small granules. Intestine lumen of irregular and variable appearance, containing remnants such as spicules and mandibles of prey nematodes (Fig. 7C). Three caudal glands with spinneret. Tail bluntly rounded, with a protuberant caudal duct (Fig. 7C).

Male

Two opposed testes short and broad, with anterior one slightly larger than posterior one, situated ventrally left to the intestine. Sperm cells globular to oval. Spicules sclerotized, almost straight, with proximal end weakly cephalated, distal end pointed and slightly bent ventrally. Gubernaculum and precloacal supplement absent.

Female

Similar to male except for reproductive system and sexual features. Two reflexed ovaries. Vulva a transverse slit in ventral view, located at posterior half of body (about 60%). Vagina short. Uterus broad.

Remarks

Synonchium Cobb, 1920 is characterized by the posterior buccal cavity equipped with three mandibles each composed of a large tooth flanked by several teeth and transverse oval-shaped multispiral amphideal fovea. The genus now contains nine valid species (Heyns & Swart 1995; Vinciguerra & Orsellini 1997;

Table 2. Morphometrics (measurements in μm) of *Synonchium caudatubatum* sp. nov. Figures between brackets represent mean values.

Characters	Holotype	Paratypes	
		Males (n = 4)	Females (n = 5)
Body length	2270	2460–2600 (2530)	2195–2760 (2557)
<i>a</i>	31.5	33.3–36.1 (34.3)	26.8–28.5 (27.3)
<i>b</i>	7.6	8.1–8.7 (8.4)	7.1–9.2 (8)
<i>c</i>	41.3	43.9–47.3 (45.8)	33.8–37.8 (36)
<i>c'</i>	1	1 (1)	1–1.1 (1)
Head diameter	63	58–62 (61)	70–75 (73.3)
Mandible length	28	25–29 (27)	28–30 (29.3)
Amphideal fovea from anterior end	20	20–21 (21)	20–27 (24.3)
Amphideal fovea length	9	10–12 (11)	9–10 (10)
Amphideal fovea width	19	20–21 (21)	16–18 (18)
cbd at amphideal fovea	69	63–66 (65)	76–85 (77)
Amphideal fovea width/cbd	28%	31%–32% (32%)	19%–26% (23%)
Nerve ring from anterior end	125	120–130 (125.8)	122–145 (135)
cbd at nerve ring	70	64–69 (67)	78–83 (80)
Pharynx length	300	300–308 (304)	300–327 (318)
cbd at cardia	72	65–70 (68)	75–90 (83)
Maximum body diameter	72	71–77 (74)	82–103 (94)
Vulva from anterior end	–	–	1271–1653 (1508)
V%	–	–	58–60 (59)
cbd at vulva	–	–	78–93 (84)
Spicule length	57	55–62 (57.3)	–
Anal body diameter	53	55–57 (55.5)	65–70 (68)
Tail length	55	55–56 (55.3)	65–75 (71)

Kamran *et al.* 2009). *Synonchium caudatubatum* sp. nov. is unique in the genus by having a protuberant caudal duct in the tail end. The new species also differs from congeners by its mandibles, each with seven teeth, while all other known members have either three or five teeth (Table 3). *Synonchium caudatubatum* sp. nov. lacks a gubernaculum and a precloacal supplement; both features occur in congeners except *S. depressum* Gerlach, 1954, a species with a conical tail.

Discussion

The two new species discovered in beach sand from the East China Sea represent the two subfamilies of Selachinematidae. Both species have a robust body, a broad truncated cephalic end and a spacious buccal cavity with well-developed cuticularized rhabdia and denticles or mandibles. Warwick (1971) indicates there is an increase in the dominance of predatory or omnivorous nematode species in sandy sediments. This is clearly shown by the nematode community in the Dasha'ao sand beach, where predatory nematodes dominated the meiofaunal assemblages contributing to about 62% of the total meiofaunal abundance. Among these nematodes, Thoracostomopsidae Filipjev, 1927 are the most predominant

Table 3. Tabular key to species of *Synonchium* Cobb, 1920.

Species	<i>Synonchium caudatubatum</i> sp. nov.	<i>Synonchium obtusum</i>	<i>Synonchium pakistanense</i>	<i>Synonchium oblongum</i>	<i>Synonchium pacificum</i>	<i>Synonchium. mediterraneum</i>	<i>Synonchium siculum</i>	<i>Synonchium capense</i>	<i>Synonchium depressum</i>	<i>Synonchium marinum</i>
Body length	2.3–2.6	1.8–2.4	1.1–1.2	1	1–2.9	2–2.1	2.5–3.5	1.13–1.61	1.1	2.2
<i>a</i>	31.5–36.1	19–23	24.3–24.5	25.7	15.9–32.1	21–25	27–38	21–30.7	20.3	28
<i>b</i>	7.6–8.7	6.5–9.9	8.2–10.2	7.2	5.6–9.5	8.6–10	7.3–8.3	7.4–10.1	7.2	11.8
<i>c</i>	41.3–47.3	39–47	36.1–39.8	23.1	26.3–51.4	42–51	41.6–56.4	48.5–63.6	18.8	51.6
<i>c'</i>	1	0.61–0.73	0.8	1.6	0.6–1.2	0.6–0.7	0.7–0.8	0.55–0.81	1.3	1.2
Amphideal fovea, shape	Slightly oval	Slightly oval	Slightly oval	Slightly oval	Circular	Slightly oval	Slightly oval	Circular	Oval	Oval
Mandibles, length	25–29	–	13.6–14.4	17.6	–	22.5	35–42.5	16–19	22	17.6
Teeth, number	7	5	5	5	5	3	3	3	3	3
Spicules, length	55–62	75–90	57.6–59.2	52	31–95	51–77 unequal	82.5–107.5	41–64 unequal	78	69.6
Gubernaculum	Absent	Absent	Absent	Present	Present	Present	Present	Absent	Absent	Absent
Supplements	Absence	2	4	1	7–9	1	Absent	1–2	Absent	4
Protuberant caudal duct	Present	Present or absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Tail shape	Bluntly rounded	Bluntly rounded	Bluntly rounded	Conical	Bluntly rounded	Bluntly rounded	Bluntly rounded	Bluntly rounded	Conical	Conical

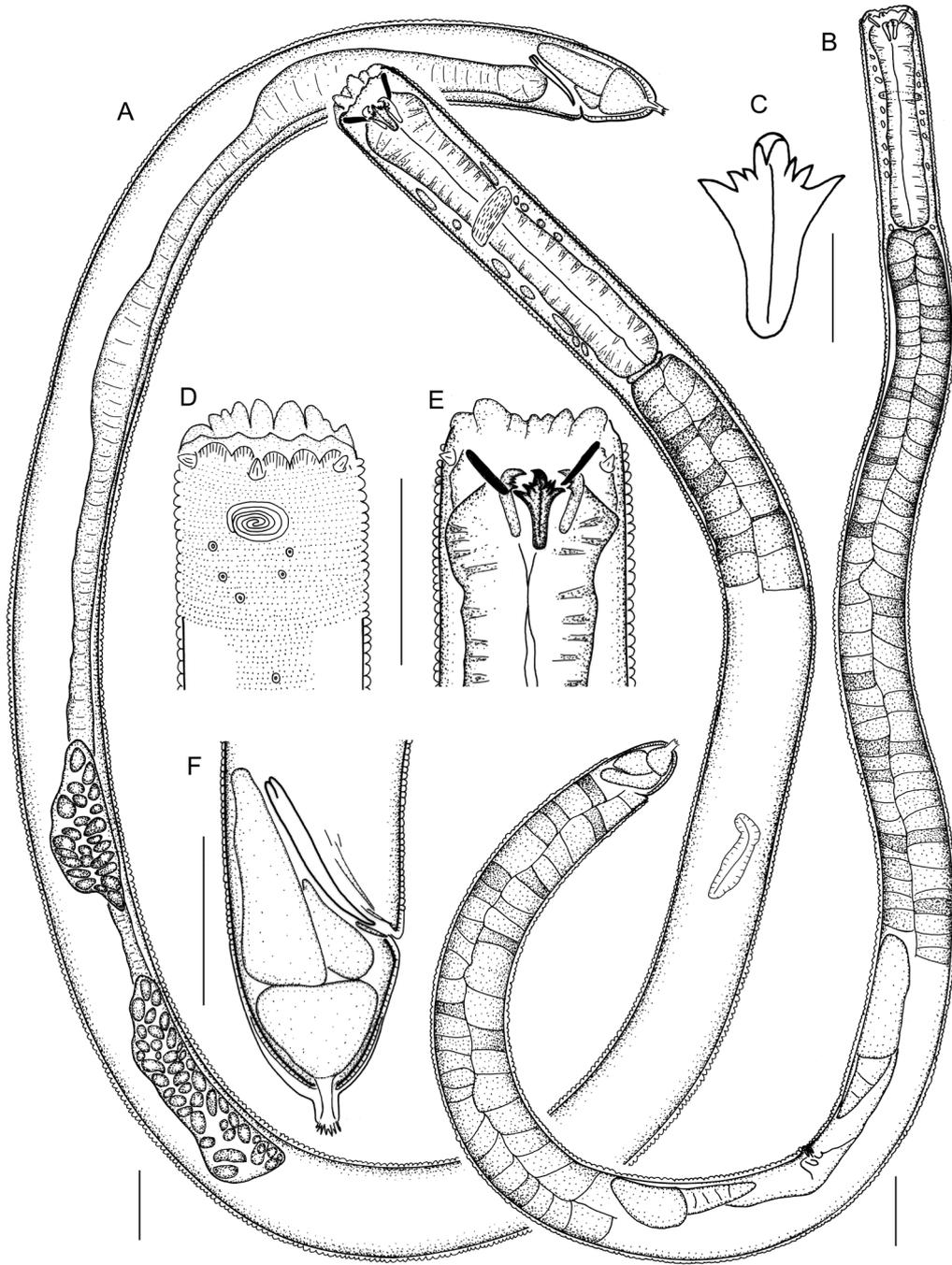


Fig. 5. *Synonchium caudatubatum* sp. nov., holotype, ♂ (A, C–F) and a paratype, ♀ (B). **A.** Overview, showing the slightly slender body shape, the broad anterior buccal cavity and the narrow posterior buccal cavity with three mandibles, the cylindrical pharynx with anterior end swelling, the two opposed testes with oval sperm cells, the almost straight spicules without gubernaculum, the caudal glands with spinneret, and the bluntly rounded tail with a protuberant caudal duct. **B.** Overview, showing same structures as male holotype except the two reflexed ovaries. **C.** Each mandible has a large tooth flanked by three small teeth to each side. **D–E.** Head, showing the papillate sensilla, transverse oval amphideal fovea, transverse rows of punctuations, lateral cuticle pores, the broad anterior buccal cavity and the narrow posterior buccal cavity with three mandibles. **F.** Tail, showing the almost straight spicules without gubernaculum, the three caudal glands with spinneret, and the bluntly rounded tail with protuberant caudal duct. Scale bars: A–B, D–F = 50 µm, C = 50 µm.

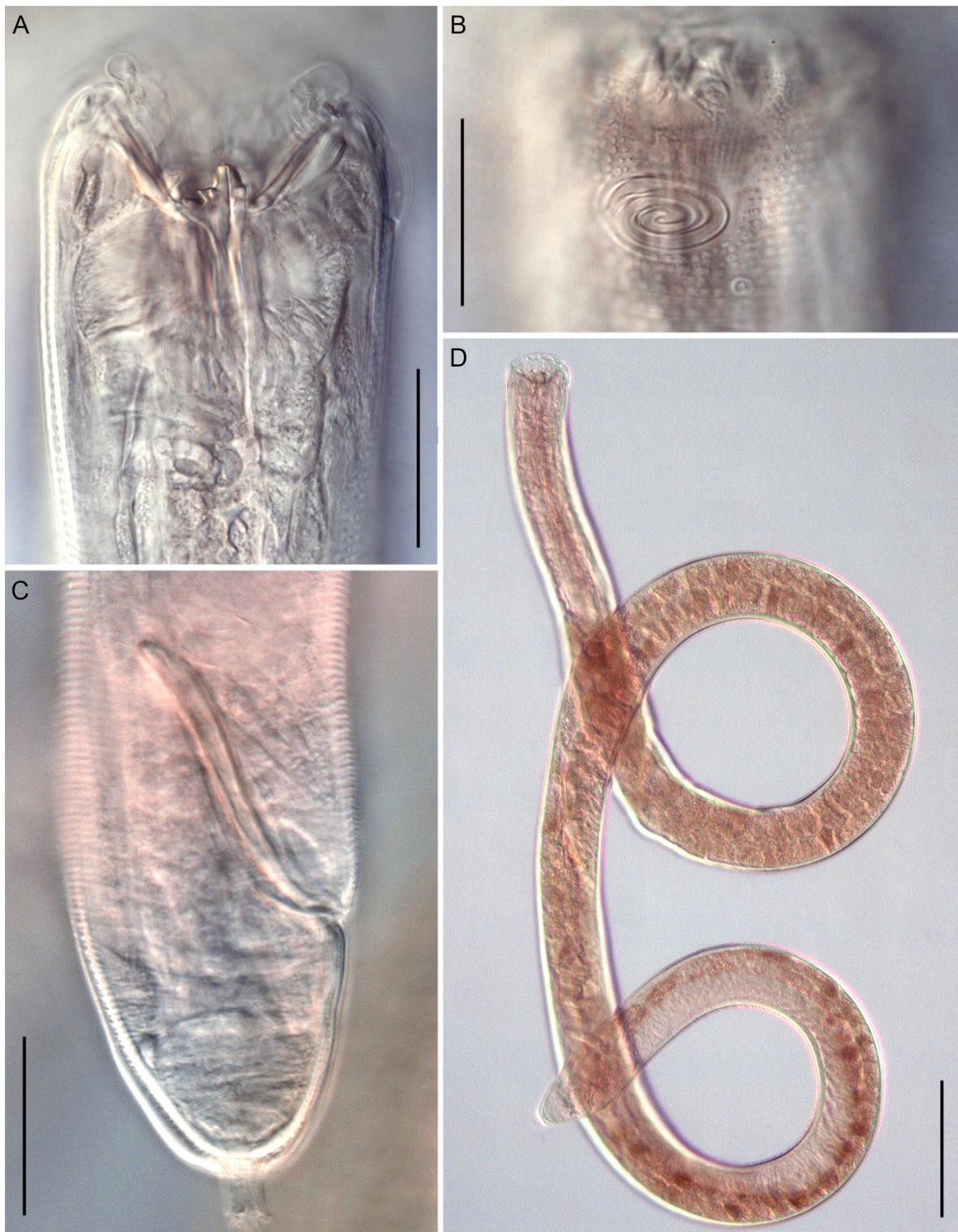


Fig. 6. *Synonchium caudatubatum* sp. nov. holotype, ♂ (A–C) and a paratype, ♂ (D). **A–B.** Head, showing the papillate sensilla, transverse oval amphideal fovea, transverse rows of punctuations, lateral cuticle pores, the broad anterior buccal cavity and narrow posterior buccal cavity with three mandibles each with seven teeth, and the swelling anterior end of pharynx. **C.** Tail, showing the almost straight spicules without gubernaculum, and the bluntly rounded tail with a protuberant caudal duct. **D.** Overview, showing the slightly slender body. Scale bars: A–C = 30 µm, D = 100 µm.

group occupying more than 60% of the nematode abundance. Members of Thoracostomopsidae are mostly large and predatory and thus may be significant in the sand beach due to their high dominance (Shi & Xu 2016). Selachinematidae contributed to only about 4.6% of the total nematode abundance. However, the two selachinematid species described here are more rapacious nematodes feeding on other nematodes, including members of Thoracostomopsidae Filipjev, 1927. Thus, it can be assumed that *Gammanema magnum* sp. nov. and *Synonchium caudatubatum* sp. nov. play a key role in regulating the micro- and meiobenthic communities of this sand beach environment.



Fig. 7. *Synonchium caudatubatum* sp. nov., paratypes, ♀♀. **A–B.** Head, showing the same structures as male holotype. **C.** Spicules (arrow) of prey nematodes left in the intestine. **D.** Tail, showing the caudal glands with spinneret and the bluntly rounded tail with a protuberant caudal duct. **E.** Overview, showing the slightly slender body shape and two opposed testes. Scale bars: A–D = 50 μ m, E = 100 μ m.

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References

- Coomans A. 1979. Addendum I. A proposal for a more precise terminology of the body regions in the nematode. *Annales de la Société royale zoologique de Belgique* 108: 155–117.
- Fu S., Cai L., Boucher G., Cao J. & Wu C. 2013. Two new *Richtersia* species from the northern Beibu Gulf, China. *Journal of Natural History* 47 (29–30): 1921–1931.
<https://doi.org/10.1080/00222933.2013.769640>
- Gerlach S.A. 1964. Revision der Choniolaiminae und Selachinematinae (freilebende Meeres-Nematoden). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut (Kosswig-Festschrift)* 61: 23–49.
- Gerlach S.A. & Riemann F. 1973. The Bremerhaven checklist of aquatic nematodes. A catalogue of Nematoda Adenophorea excluding the Dorylaimida. *Veröffentlichungen des Instituts für Meeresforschung in Bremerhaven*, Supplement 4 (1): 404.
- Heyns J. & Swart A. 1995. *Synonchium capense* n. sp. from South Africa (Nematoda: Cyatholaimidae). *Fundamental & Applied Nematology* 18 (6): 523–529.
- Higgins R.P. & Thiel H. 1988. *Introduction to the Study of Meiofauna*. Smithsonian Institution Press, Washington DC.
- Kamran M., Nasira K. & Shahina F. 2009. Three new species of the genus *Synonchium* Cobb, 1920 (Chromadorida: Selachinematidae) from mangrove areas of Pakistan. *Pakistan Journal of Nematology* 27 (2): 129–144.
- Leduc D. 2013. Two new genera and five new species of Selachinematidae (Nematoda, Chromadorida) from the continental slope of New Zealand. *European Journal of Taxonomy* 63: 1–32.
<https://doi.org/10.5852/ejt.2013.63>
- Liu R.Y. 2008. *Checklist of Marine Biota of China Seas*. Science Press, Beijing.
- Miljutin D.M., Gad G., Miljutina M.M., Mokievsky V.O., Fonseca-Genevois V. & Esteves A.M. 2010. The state of knowledge on deep-sea nematode taxonomy: how many valid species are known down there? *Marine Biodiversity* 40: 143–159. <https://doi.org/10.1007/s12526-010-0041-4>
- Okhlopkov J.R. 2002. Free-living nematodes of the families Selachinematidae and Richtersiidae in the White Sea (Nematoda, Chromadorida). *Zoosystematica Rossica* 11: 41–55.
- Okhlopkov J.R. 2003. Feeding of free-living nematodes of the families Selachinematidae and Richtersiidae in the White Sea. *Proceedings of the Pertsov White Sea Biological Station* 9: 127–139.
- Platt H.M. & Warwick R.M. 1983. Free-living Marine Nematodes. Part I: British Enoplids. Pictorial key to world genera and notes for the identification of British species. In: Kermack D.M. & Barnes R.S.K. (eds) *Synopses of the British Fauna (New Series)* 28: 169–171. Cambridge University Press, Cambridge.
- Shi B. & Xu K. 2016. Four new species of *Epacanthion* Wieser, 1953 (Nematoda: Thoracostomopsidae) in intertidal sediments of the Nanji Islands from the East China Sea. *Zootaxa* 4085 (4): 557–574.
<https://doi.org/10.11646/zootaxa.4085.4.6>

Tchesunov A.V. & Okhlopkov J.R. 2006. On some selachinematid nematodes (Chromadorida: Selachinematidae) deposited in the collection of the Smithsonian National Museum of Natural History. *Nematology* 8: 21–44. <https://doi.org/10.1163/156854106776179890>

Vanaverbeke J. 2015. Selachinematidae Cobb, 1915. In: Guilini K., Bezerra T.N., Eisendle-Flöckner U., Deprez T., Fonseca G., Holovachov O., Leduc D., Miljutin D., Moens T., Sharma J., Smol N., Tchesunov A., Mokievsky V., Vanaverbeke J., Vanreusel A., Venekey V. & Vincx M. 2017. NeMys: World Database of Free-Living Marine Nematodes. Available from <http://nemys.ugent.be/aphia.php?p=taxdetails&id=2166> [accessed 2 Jun. 2017].

Vinciguerra M.T. & Orselli L. 1997. Nematodes from Italian sand dunes. 2. Four new and a rare species of Chromadoria. *Nematologia Mediterranea* 25: 261–270. Available from <http://www.inaav.ba.cnr.it/vol25-2,%201997/vol25-2r.pdf> [accessed 16 Jan. 2018].

Warwick R.M. 1971. Nematode associations in the Exe estuary. *Journal of the Marine Biological Association of the United Kingdom* 51: 439–454. <https://doi.org/10.1017/S0025315400031908>

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