Marine free-living nematodes of the subfamily Stilbonematinae (Nematoda, Desmodoridae): taxonomic review with descriptions of a few species from the Nha Trang Bay, Central Vietnam

Alexei V. Tchesunov*

Abstract

Five nematode species of the subfamily Stilbonematinae (Desmodorida, Desmodoridae) found in the Bay of Nha Trang (Central Vietnam) are described. Catanema dambayensis sp. n. differs from C. exile Cobb, 1920, the only other species of Catanema, by slightly shorter body (2368–2669 µm vs. 3400 µm in males) and absence of a midventral preanal supplementary organ. Eubostrichus africanus Muthumbi et al., 1995 has been found for the first time after its original description in Kenya mangroves. Stilbonema smurovi sp. n. differs from S. annulatum Gerlach, 1963 and S. majum (Cobb, 1920) by notably lesser body length and lesser index a, and from S. brevicolle Cobb, 1920 in character of body annulations, longer cephalic setae and two versus three circles of subcephalic setae on the cephalic capsule. Laxus sp. and Robbea sp. are briefly described but not identified because of absence of males. Emended diagnoses of all valid genera of Stilbonematinae together with annotated lists of all valid species are provided. Some questionable species identifications are discussed. Eubostrichus phalacrus Greeff, 1869, Laxus contortus Cobb, 1894 and Laxus septentrionalis Cobb, 1914 are qualified as species inquirendae because of incompleteness of their descriptions. Species composition of certain genera is changed and generic diagnoses emended in accordance with their type species. New combinations Laxus gerlachi (Hopper & Cefalu, 1973) comb. n. (= Catanema gerlachi Hopper & Cefalu, 1973), Laxus sigma (Gerlach, 1963) comb. n. (= Leptonemella sigma Gerlach, 1963), Robbea macintyrei (Platt & Zhang, 1982) comb. n. (= Catanema macintyrei Platt & Zhang, 1982), Robbea porosum (Hopper & Cefalu, 1973) comb. n. (= Catanema porosum Hopper & Cefalu, 1973), Robbea smo (Platt & Zhang, 1982) comb. n. (= Catanema smo Platt & Zhang, 1982) are suggested.

Key words: Catanema, Eubostrichus, Laxus, Robbea, Stilbonema

The Stilbonematinae are known primarily because of their remarkable association with ectosymbiotic bacteria. These sluggish nematodes are known to be especially numerous in carbonate sands of tropical shallow waters and can be quickly identified even at low magnification of a binocular microscope owing to very long and thread-like body with some swollen anterior end, and bright snow-white appearance in reflected light. An unusual feature of many Stilbonematinae is

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multicellular sensory-glandular organs arranged in longitudinal rows along the body. Obviously, these organs participate in maintaining association with bacteria (Nebelsick et al. 1992, Bauer-Nebelsick et al. 1995, Nussbaumer et al. 2004, Bulgheresi et al. 2006). The symbiotic prokaryotes are inserted in the slime film issued by these sensory-glandular organs. The symbionts look different in different genera; often the bacteria are large and cover densely the entire nematode body except mouth region and tail tip; they may make the nematode appearance very odd. These symbionts are proved to be chemolitoautotroph organisms which build up organic compounds using energy of chemical bonds which is releasing at oxidizing of sulphides (Ott & Novak 1989, Ott et al. 1991). Possibly, the Stilbonematinae mainly live at expense of primary production of bacterial chemosynthesis, like pogonophorans, vestimentiferans and vesicomyid bivalves. Usually, the Stilbonematinae inhabit sheltered intertidal and subtidal sediments where these nematodes are concentrated at the interface between the surface oxidized layer and the deeper anoxic sediment zone, since the stilbonematines need both oxygen for their respiration and reduced compounds for chemosynthesis of their symbionts.

Stilbonematinae nematodes are well studied in aspects of their ecology and symphysiology with bacterial ectosymbionts (Schiemer et al. 1990; Hentschel et al. 1999; Ott 1995; Ott et al. 2004a,b). However, the diversity of Stilbonematinae is now not well classified, diagnoses and boundaries of taxa are not clearly defined, species are often transferred from one to another genus, many species in experimental papers are indicated as undescribed species of a genus. History of some genera and species is tangled. Thus, the genus Robbea was erected by Gerlach (1956) and he considered the buccal muscular bulb as a peculiar structure distinguished the taxon from other related genera. Further, Gerlach (1963) synonymized Catanema Cobb, 1920 with Eubostrichus Greeff, 1869 and supposed that Laxus Cobb, 1894 also can prove to be identical to Eubostrichus. Hopper and Cefalu (1973) decided to maintain Catanema and pointed out the buccal muscular bulb as its main feature. Platt and Zhang (1982) synonymized Robbea and Catanema. According to Lorenzen (1994) there are six valid genera belonging to the subfamily Stilbonematinae Chitwood, 1936: Eubostrichus Greeff, 1869 (with Catanema

Table 1. Differential diagnostic characters of genera of Stilbonematinae.

<table>
<thead>
<tr>
<th>Genera</th>
<th>Somatic cuticle</th>
<th>Cephalic cuticle</th>
<th>Amphideal fovea</th>
<th>Anterior pharynx (procorpus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adelphos</td>
<td>fine annulated</td>
<td>thickened, annulated</td>
<td>lateral, large, rounded, coiled in 1.5 turns</td>
<td>slightly gradually widened</td>
</tr>
<tr>
<td>Catanema</td>
<td>very fine annulated</td>
<td>not thickened, annulated</td>
<td>apical, small, usually with protruding corpus gelatum</td>
<td>swollen and distinctly separated from the isthmus</td>
</tr>
<tr>
<td>Eubostrichus</td>
<td>very faint annulated</td>
<td>not thickened, annulated</td>
<td>lateral, large, rounded, coiled in 1.5 or more turns; often indistinct</td>
<td>slightly gradually widened</td>
</tr>
<tr>
<td>Laxus</td>
<td>fine annulated</td>
<td>thickened and modified</td>
<td>lateral but close to the apex small, coiled in about 1.5 turns</td>
<td>slightly gradually widened</td>
</tr>
<tr>
<td>Leptonemella</td>
<td>fine annulated</td>
<td>smooth, punctuated or reticulated, set off the body</td>
<td>apicolateral, small, may be with protruding corpus gelatum</td>
<td>slightly gradually widened</td>
</tr>
<tr>
<td>Parabostrichus</td>
<td>very faint annulated</td>
<td>not thickened, annulated</td>
<td>lateral, large, rounded, coiled in 1.5 or more turns; indistinct</td>
<td>slightly gradually widened</td>
</tr>
<tr>
<td>Robbea</td>
<td>fine annulated</td>
<td>annulated or smooth</td>
<td>lateral, large, rounded, coiled in 1.5–2.5 turns</td>
<td>swollen and distinctly separated from the isthmus</td>
</tr>
<tr>
<td>Squanema</td>
<td>fine annulated</td>
<td>thickened, consists of plates</td>
<td>lateral, large, rounded, coiled in 1.5 turns</td>
<td>slightly gradually widened</td>
</tr>
<tr>
<td>Stilbonema</td>
<td>thick, coarsely annulated</td>
<td>smooth or punctuated, set off the body</td>
<td>apical, small, usually with protruding corpus gelatum</td>
<td>slightly gradually widened</td>
</tr>
</tbody>
</table>

The main object of this paper is therefore a critical reappraisal of generic composition and unification of generic diagnoses. Composition of species diagnosis of every genus is based here on characters of the type species. An additional ground for the paper appeared from finding of a few Stilbonematinae species in Nha Trang area, where these nematodes were not known before.

Material and methods

Samples of sediments were collected by a cylinder of 3 cm² area during the low tide in mangroves or with a scoop by diving in upper sublittoral zone, and fixed in situ with 4 % formaldehyde solution on sea water. The meiofauna stained by Bengal rosa was isolated by decantation and filtration through a sieve of 70 µm mesh size. The nematodes were extracted and put into watch glasses with Seinhorst’s solution I (ethanol-glycerin-water mixture in proportion 29:1:70) and the ethanol and water were allowed to evaporate slowly. Specimens were mounted into permanent glycercin slides with a paraffin ring, glass bead separators and Glyceel seals. These slides were then studied with Leica DM5000 light microscope.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>body length divided by maximum body diameter;</td>
</tr>
<tr>
<td>am.w.</td>
<td>width of the amphideal fovea, in µm;</td>
</tr>
<tr>
<td>b</td>
<td>body length divided by pharyngeal length;</td>
</tr>
<tr>
<td>bulb l.</td>
<td>length of posterior pharyngeal bulb, in µm;</td>
</tr>
<tr>
<td>bulb w.</td>
<td>width of posterior pharyngeal bulb, in µm;</td>
</tr>
<tr>
<td>c</td>
<td>body length divided by tail length;</td>
</tr>
<tr>
<td>c'</td>
<td>tail length, expressed in anal diameters;</td>
</tr>
<tr>
<td>c.s.</td>
<td>length of cephalic setae, in µm;</td>
</tr>
<tr>
<td>diam.am.</td>
<td>body diameter at the level of amphideal fovea, in µm;</td>
</tr>
<tr>
<td>diam.ani</td>
<td>anal body diameter, in µm;</td>
</tr>
<tr>
<td>diam.ca.</td>
<td>body diameter at the level of cardia, in µm;</td>
</tr>
<tr>
<td>diam.midb.</td>
<td>midbody diameter, in µm;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male’s anterior structures</th>
<th>Male’s posterior structures</th>
<th>Dorso-caudal apophysis of the gubernaculum</th>
<th>Symbiotic cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>sound spike-like setae in ventral row posterior to the cardia</td>
<td>sound spike-like lateroventral setae on the tail</td>
<td>present</td>
<td>elongate crescent-like</td>
</tr>
<tr>
<td>enlarged midventral glands with tiny setae</td>
<td>thick spike-like setae on the tail</td>
<td>present</td>
<td>short bacilla</td>
</tr>
<tr>
<td>no</td>
<td>sound spike-like setae on the tail (porids)</td>
<td>absent</td>
<td>elongate crescent-like</td>
</tr>
<tr>
<td>no</td>
<td>no</td>
<td>absent</td>
<td>coccoid to short bacilla</td>
</tr>
<tr>
<td>may be series of stout setae</td>
<td>stout subventral setae</td>
<td>absent</td>
<td>coccoid to short bacilla</td>
</tr>
<tr>
<td>no</td>
<td>short subventral setae on papilloid projections</td>
<td>present</td>
<td>elongate crescent-like</td>
</tr>
<tr>
<td>cup-shaped supplementary organs may be present</td>
<td>not differentiated</td>
<td>present</td>
<td>various</td>
</tr>
<tr>
<td>no</td>
<td>no</td>
<td>absent</td>
<td>elongate crescent-like</td>
</tr>
<tr>
<td>cup-shaped supplementary organs may be present</td>
<td>not differentiated</td>
<td>absent</td>
<td>not observed</td>
</tr>
</tbody>
</table>
Fig. 1. Icons of the Stilbonematinae genera (*Adelphos* – adapted from Ott 1997; *Catanema* – adapted from Cobb 1920; *Eubostrichus* – adapted from Muthumbi et al. 1995; *Laxus* – adapted from Ott et al. 1995; *Leptonemella* – adapted from Riemann et al. 2003; *Parabostrichus* – adapted from Tchesunov et al. 2012; *Robbea* – adapted from Gerlach, 1956; *Squanema* – adapted from Gerlach 1963b; *Stilbonema* – adapted from Gerlach 1963b)

diam.n.r. – body diameter at the level of nerve ring, in µm;
diam.subc.s. – body diameter at the level of the anterior subcephalic setae, in µm;
gub.apo. – length of dorso-caudal apophysis of the gubernaculum, in µm;

isthmus w. – width of isthmus, median slender portion of the pharynx, in µm;
L – body length, in µm;
procorpus l. – length of procorpus, the anterior muscular portion of the pharynx, in µm;
procorpus w. – width of procorpus, the anterior muscular portion of the pharynx, in µm;
spic.ar. – spicule’s length along the arch, in µm;
spic.ch. – spicule’s length along the chord, in µm;
subc.s. – length of the subcephalic setae (if single circle), in µm;
subc.s. I – length of the anterior (preamphideal) subcephalic setae, in µm;
subc.s. II – length of the posterior (postamphideal) subcephalic setae, in µm;
V – distance of vulva from anterior end as percentage of body length, in %

**Taxonomic part**

**Order** Desmodorida de Coninck, 1965
**Family** Desmodoridae Filipjev, 1922

**Subfamily Stilbonematinae Chitwood, 1936**


Distinguishing features of genera of the Stilbonematinae are summarized in the table 1 and figure 1.

**Adelphos Ott, 1997**

**Diagnosis** (modified after Ott, 1997). Stilbonematinae. Cuticle finely annulated. Head cuticle thickened but annulated. Amphideal fovea large, coiled in 1.5 turns, lateral but close to the apex, and surrounded with annulation. Anterior part of the pharynx swollen but not sharply differentiated from the median narrow region; round terminal bulb present. Gubernaculum with weak curved dorsocaudal apophysis. Males with one row of midventral thorn-like setae posterior to the neck region and paired rows of thorn-like setae on the tail. Body covered with long crescent-like symbiotic bacteria arranged in spiral pattern.

**Type species:** *A. rolandi* Ott, 1997. No other species.

**Catanema Cobb, 1920**

**Diagnosis.** Stilbonematinae. Cuticle very fine annulated. Cephalic cuticle not thickened. Amphids apical, small, difficult to see. Minute onchia-like structures in the small stoma may be present. Anterior region of the pharynx swollen and distinctively separated from the narrow median region. Gubernaculum with dorso-caudal apophysis. In male, a series of enlarged midventral glands associated with tiny setae from the cardia to the anterior midgut; several pairs of subventral tubular setae on the tail.


**Other Catanema species:**

*Catanema dambayensis* Tchesunov sp. n. Present paper.

Gerlach (1963a: 96) transferred the species *Catanema exile* to the genus *Eubostrichus* Greeff 1869 and considered the generic name *Catanema* as a junior synonym of *Eubostrichus*. Specimens cited under the name *Eubostrichus exilis* (Cobb 1920) from the Maldive Islands and the Red Sea (Gerlach 1963a, 1964) definitely do not belong to the species described by Cobb. Ott et al. (1995: 517) have expressed the view that both *Eubostrichus exilis* sensu Gerlach, 1963a and 1964 belong to *Laxus cosmopolitus*.

**Catanema dambayensis sp. n.**

Table 2; Fig. 2, 3, 9A

**Material.** One holotype male, four paratype males and one paratype female. Type specimens are deposited in the Nematological collection of the Center of Parasitology of A. N. Severtsov Institute of Ecology and Evolution of the Russian
Fig. 2. *Catanema dambayensis* sp. n., paratype male. A. entire; B. anterior body; C. cephalic end; D. posterior body. Scale bars: A, 200 µm, B,D, 50 µm, C, 10 µm.
Fig. 3. *Catanema dambayensis* sp. n., paratype female. A. entire; B. neck region; C. tail. Scale bars: A, 100 µm; B, 10 µm; C, 20 µm.
Academy of Sciences, Moscow, Russia. Inventory number of the holotype 50/4, paratypes 50/2-50/3.

**Locality.** Central Vietnam, Nha Trang Bay, Tre Island, Dam Bay (a narrow armlet at the south side of the Island), plantation of young mangrove saplings *Rhizophora* sp. in the tidal zone, coarse sand. March 27, 2007.

**Etymology.** The species name is derived from Dam Bay, a site where the new species was found.

**Description.** Body cylindrical, thread-like, slightly widened anteriorly, yellowish. Cuticle very fine transversely striated, the striation hardly discernible, about or over 30 annules in 10 µm. The striation starting apically at the level of cephalic setae. Cephalic capsule not developed and cephalic cuticle unlikely differs from that of the neck region. Fine cuticular annulation spreads to the tail terminal pore, so a terminal cone not developed.

Mouth opening small and withdrawn inward a bit, i.e. situated on the bottom of shallow conical pit. Body cuticle not widened or modified in the head region.

There six minute acute outer labial papillae around the mouth apically. Four rather long cephalic setae situated also close to the mouth and directed straight forward. Amphideal apertures are formed as big pores situated apically close to the mouth opening. The apertures lead rearward into short cylindrical fovea with slightly sclerotised walls and upward give long (29–31 µm) vermiform corpus gelatum directed straight ahead. About six or eight cervical setae 3.5–5 µm long form an irregular circle posterior to the cephalic setae around the apex. There are shorter irregular somatic setae thinning out gradually to the posterior pharynx and midgut. The somatic setae 1.5–3 µm in median and lateral rows are associated with light globular glands.

Chelostoma small and unclear. Pharyngostoma small, 2.5–5 µm long and 3.5–6 µm wide, conoid, with slightly sclerotised walls, unarmed. Pharynx consists of elongate oval procorpus with distinct radial muscular striation, long slender isthmus devoid of the striation, and rounded apple-shaped glandular posterior bulb. Internal cuticular lining, distinct and rather thick in the procorpus, becomes thinner and less definite in the posterior isthmus and bulb. Nerve ring in the middle of the isthmus. Cardia indistinct, conical, internal. There is no content, particularly that resembling external bacterial cells.

Tail cylindroconical, with indistinctly separated narrowed terminal cone. Caudal glands entirely within the tail.

♀. Reproductive system didelphic, amphidelphic; ovaries antidromously reflected. Anterior ovary situated to the right and posterior gonad to the left of the intestine. Uteri empty, spermathecas are filled with minute lens-formed spermatozoa.

♂. There is a row of 24–30 large midventral glands situated tight close to one another from the level of the cardia to the anterior midgut. The glands are associated with tiny setae. The gland cells are filled with large dense inclusions or vacuoles. Spaces between these glands widen to the posterior end of the row. The row of the large dense glands is continued further posteriorly with smaller light globular glands.

Male gonad situated to the right of the intestine contains small light globular ?spermatids with excentric nuclei. Spicules short, strong, arcuate, proximally cephalated and distally pointed.

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**Table 2. Morphometry of Catanema dambayensis sp. n.**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Holotype</th>
<th>Four Paratypes</th>
<th>Paratype Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>2670</td>
<td>2370–2640</td>
<td>3170</td>
</tr>
<tr>
<td>a</td>
<td>124</td>
<td>91.1–103</td>
<td>95.9</td>
</tr>
<tr>
<td>b</td>
<td>30.3</td>
<td>27.9–29.2</td>
<td>34.4</td>
</tr>
<tr>
<td>c</td>
<td>30.3</td>
<td>25.9–33.8</td>
<td>40.1</td>
</tr>
<tr>
<td>c'</td>
<td>3.38</td>
<td>2.92–3.92</td>
<td>3.76</td>
</tr>
<tr>
<td>V</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>diam.subc.s.</td>
<td>16</td>
<td>14.5–18</td>
<td>16</td>
</tr>
<tr>
<td>diam.n.r.</td>
<td>25</td>
<td>23–26</td>
<td>25</td>
</tr>
<tr>
<td>diam.ca.</td>
<td>25</td>
<td>22–26</td>
<td>25</td>
</tr>
<tr>
<td>diam.midb.</td>
<td>21.5</td>
<td>25–28</td>
<td>33</td>
</tr>
<tr>
<td>diam.ani</td>
<td>26</td>
<td>23–26</td>
<td>21</td>
</tr>
<tr>
<td>c.s.</td>
<td>12</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>subc.s. I</td>
<td>3.5</td>
<td>4–5</td>
<td>4</td>
</tr>
<tr>
<td>procorpus l.</td>
<td>25</td>
<td>27–29</td>
<td>29</td>
</tr>
<tr>
<td>procorpus w.</td>
<td>9</td>
<td>10–11</td>
<td>11</td>
</tr>
<tr>
<td>isthmus w.</td>
<td>5</td>
<td>5–6</td>
<td>4</td>
</tr>
<tr>
<td>bulb l.</td>
<td>13</td>
<td>10–12</td>
<td>?</td>
</tr>
<tr>
<td>bulb w.</td>
<td>13</td>
<td>15–18</td>
<td>?</td>
</tr>
<tr>
<td>spic.cho.</td>
<td>31</td>
<td>25–30</td>
<td></td>
</tr>
<tr>
<td>spic.arc.</td>
<td>41</td>
<td>33–42</td>
<td></td>
</tr>
<tr>
<td>gub.apo.</td>
<td>13</td>
<td>9–12</td>
<td></td>
</tr>
</tbody>
</table>
Gubernaculum with paired broad dorso-caudal apophyses.

Tail bears thin subdorsal setae 2–3 µm long and five to seven subventral thick spike-like setae with truncated top (indicated as porids in Hopper & Cefalu, 1973) 1.5–2 µm long.

**Symbionts.** Bacteria look like short bacilla about 1.5–2.5 µm long and 0.5–1 µm wide. The bacteria form dense settlements here and there on the body where they are situated vertically on the cuticle. The bacteria can be detached easily; the nematodes in glycerin slides are often surrounded with suspension of crumbled bacteria. Cuticle is not modified beneath the bacterial colonies.

**Diagnosis.** In males, body length 2368–2669 µm, index a 91–124 and index c’ 2.92–3.38. In female, the same figures 3166 µm, 96 and 3.76, respectively. Cuticle very fine striated. Cephalic setae with suspension of crumbled bacteria. Cuticle is not modified beneath the bacterial colonies.

**Discussion.** The only hitherto known species of the Catanema, *C. exile* Cobb, 1920 is described on a single male from Florida, and the original diagnosis lacks some important morphological details and measurements. *C. dambayensis* sp. n. differs from *C. exile* by some shorter body (2368–2669 µm versus 3400 µm in males) and absence of a midventral preanal supplementary organ.

**Eubostrichus** Greeff, 1869

**Diagnosis.** Stilbonematinae. Cuticle with very faint or sometimes even indiscernible transverse striations. Head cuticle not thickened and not modified, striations of the cuticle starts from the apex. Amphideal fovea situated laterally, large, spirally coiled, but often obscure because its cuticular margin is not clear. Buccal cavity not developed as such. Anterior region of the pharynx slightly widened and not separated sharply from the narrow median region; small posterior bulb. Gubernaculum without a dorso-caudal apophysis. In males, strong and stout subventral setae (porids) occur on the tail. Body covered mostly with long crescent-like symbiotic bacteria often arranged in a spiral pattern (in *E. dianeae* the symbionts are straight non-septate filaments up to 100 µm long).

**Type species:** *Eubostrichus filiformis* Greeff, 1869. Greeff (1869): 117–118, pl. 7, fig. 1–4 (North Sea).

It is considered as species inquirenda by Gerlach (1963a): the original description is so poor that this species cannot be recognized if found again.

**Other species:**


Muthumbi et al., 1995: 190.


*E. parasitiferus* Chitwood, 1936. Chitwood, 1936: 7, fig. 1 DD-EE (North Carolina, beach below low-tide mark). Identity of specimens from Maldives and Red Sea designated by Gerlach (1963a, 1964) as *E. parasitiferus* remains questionable. Male specimen from Maldives (Gerlach, 1963) differs from those of North Carolina and Florida by distinct spiral amphideal fovea and another shape of modified subventral setae on the male tail, short setae on rounded sacle versus strong thorn-like setae. Description of a female specimen from the Red Sea (Gerlach, 1964) also having distinct amphideal fovea is not sufficient for *Eubostrichus* species identification because male’s structures as modified preanal and postanal setae are necessary as important characters.

*E. phalacrus* Greeff, 1869. Greeff, 1969: 118, pl. 7, fig. 5–6 (English Channel). Since the original description misses such important details as cuticular annulations, amphids, male structures as well as morphometric data, the species is designated here as species inquirenda.

Table 3. Morphometry of *Eubostrichus africanus* Muthumbi et al., 1995 from NhaTrang.

<table>
<thead>
<tr>
<th>Character</th>
<th>males</th>
<th>females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2 specimens)</td>
<td>(2 specimens)</td>
</tr>
<tr>
<td>L</td>
<td>2477-2906</td>
<td>3014-3500</td>
</tr>
<tr>
<td>a</td>
<td>171-183</td>
<td>159-167</td>
</tr>
<tr>
<td>b</td>
<td>30.2-33.5</td>
<td>31.3-37.2</td>
</tr>
<tr>
<td>c</td>
<td>46.7-52.8</td>
<td>43.3-44.8</td>
</tr>
<tr>
<td>c'</td>
<td>3.79-3.79</td>
<td>5.35-6.24</td>
</tr>
<tr>
<td>V–</td>
<td>39.5-43.5</td>
<td></td>
</tr>
<tr>
<td>diam.am.</td>
<td>13-15</td>
<td>11.5-13.5</td>
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<td>diam.n.r.</td>
<td>16.5-19</td>
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<td>diam.ca.</td>
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<td>diam.midb.</td>
<td>13.5-17</td>
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<td>c.s.</td>
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<td>subc.s. I</td>
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<td>am.w.</td>
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<td>bulb.l.</td>
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<td>bulb.w.</td>
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<td>spic.ch.</td>
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<td>spic.ar.</td>
<td>26-29</td>
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<tr>
<td>gub.apo.</td>
<td>12.5-14</td>
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Fig. 4. *Eubostrichus africanus* male. A. entire; B. neck region; C. tail. Scale bars: A, 100 µm; B, 10 µm; C, 20 µm.
**Laxus Cobb, 1894**

**Diagnosis.** Stilbonematinae. Cuticle with fine transverse striae. Cephalic cuticle thickened; its surface irregularly annulated, reticulated, or sculptured in a fingerprint pattern. Amphideal fovea small, coiled in about 1.5 turns, situated close to the apex. Anterior region of the pharynx fovea close to the apex, no indication of sharp separation of the narrow median region. Gubernaculum directed dorsally, no dorso-caudal apophysis. Tail short, conical, mostly 1.4–2 anal diameters long. Symbiotic bacteria coccoid.

**Type species:** *Laxus longus* Cobb, 1894. Cobb, 1894: 415–416, fig. 11 I–IV (Australia, New South Wales, marine sand).

**Other species:**


*Laxus contortus* Cobb, 1894. Cobb, 1894: 413–414 (Mediterranean, Bay of Naples, sand). Since the original description based on a single female without illustrations and some necessary dimensions the species is considered here as species inquirenda.

*Laxus cosmopolitus* Ott, Bauer-Nebelsick & Novotny, 1995. Ott et al., 1995: 509–517, Tables 1–3, figures 1–8 (Caribbean Sea, Belize, coarse, poorly sorted coralline sand, 0.2–0.5 m sand).

*Laxus oneistus* Ott, Bauer-Nebelsick & Novotny, 1995. Ott et al., 1995: 509–517, Tables 1–3, figures 1–8 (Caribbean Sea, Belize, coarse, poorly sorted coralline sand, 0.2–0.5 m sand).

*Laxus septentrionalis* Cobb, 1914. Cobb, 1914: 29–30, fig. 23 (Antarctica). The species has been found in cold Antarctic water that is unusual for *Laxus* species. Ott et al. (1995) argued that this species does not belong to the genus *Laxus*. However, it is unlikely possible to place the species in a certain genus. Since the original description is very poorly illustrated, and morphometric data are insufficient, the species is considered here as a species inquirenda.

*Laxus sigma* (Gerlach, 1963) comb. n. Gerlach, 1963a: 97, Taf. 11, Fig. g-k (as *Leptonemella sigma*, Maldives, 2 m deep). This species belongs to *Laxus*, because of shape of the head not set off the body and short conical tail.

**Laxus sp.**

Fig. 5D–E, 10A–B

**Material.** One female specimen.

**Locality.** Central Vietnam, Nha Trang Bay, Hon Mun Island, depth 3 m, small clearing between coral beds, with sparse lawn of sea grass *Halophila ovalis*, medium-grained coral sand. April 27, 2004.
Fig. 5. Females Laxus sp. and Robbea sp. A. Robbea sp., entire; B. Robbea sp., anterior body; C. Robbea sp., tail; D. Laxus sp., anterior body; E. Laxus sp., tail. Scale bars: A, 100 µm; B,C,E, 50 µm; D, 20 µm.
**Description.** Body cylindrical, long, filiform, yellow-brownish. L 5161 µm, a 96, b 44.9, c 55.5, V 44.5 %, c’ 1.98. Body diameter at the level of the amphideal fovea 83.5 µm, nerve ring 49 µm, cardia 46 µm, midbody 54 µm, anus 47. Cuticle very finely annulated, about 18–20 annules in 10 µm. The annulation commences at some distance posterior to the apex; the annulation is indiscernible here and there from the level of the anterior intestine caudad but again becomes distinct in the tail region. Cephalic capsule is made up by thickened cuticle with facile mosaic pattern. There is no sharp borderline between mosaic network and annulation at the hind rim of the cephalic capsule since the annulation overlays the mosaic network at some extent.

Small mouth opening is surrounded by six minute outer labial setae and then four cephalic setae about 28 µm long. The latter are rooted at the margin of the apical surface. About eight much shorter subcephalic setae (two sublateral and two submedian pairs, 7–8 µm long) are located at the level of the amphideal fovea. Amphideal fovea is 13 µm (39 % c.b.d.) wide, spirally coiled in two turns, slightly transversally oval in outline; situated at the margin of the apical surface. Numerous shorter somatic setae 3 µm long are arranged in about eight longitudinal rows extended throughout the entire body. All setae are inserted in small crater-shaped pores. All the somatic setae are associated with voluminous epidermal glands which occupy together a considerable part of the internal space of the body.

Buccal cavity very small, elongate conical, unarmed, with walls hardly differing from the posterior internal cuticular pharyngeal lumen. Pharynx clearly muscular throughout its length, consisted of anterior slightly fusiform portion constituting almost 50 % of its entire length, then slightly narrowed and curved isthmus with the nerve ring and distinct triangular terminal bulb 22 µm long and 28 µm wide. Cardia conical, enveloped with the intestinal tissue. Intestine slender, with distinct internal lumen.

Female ovaries paired, antidromously reflected, both anterior and posterior branches situated to the right of the intestine. There one egg 230 µm long and 41 µm wide in the uterus of the anterior branch and no eggs but a group of oval spermatozoa in the uterus of the posterior branch.

Tail very short, conical, with clear spinneret and incaudal glands.

**Symbionts.** Body is covered by a discontinuous layer of short-stick-shaped bacteria. The cells are shaped as cylinders with length twice or thrice greater than diameter (2–2.5 µm × 1 µm). The cells are arranged vertically to the cuticle surface and crowded tight to one another. The bacteria come off from the cuticle here and there, not individually but as entire layer. Evidently, the cells are stuck to the cuticle and to one another with a secret released by numerous big epidermal cells (see also Bulgheresi et al., 2006).

**Discussion.** This specimen fits morphometrically to both *Laxus* species with well described females, i.e. to *L. cosmopolitus* and *L. oneistus*. Evidently, species of *Laxus* unlikely can be identified on the base of only females.

**Leptonemella Cobb, 1920**

**Diagnosis.** Stilbonematinae. Cuticle with fine but distinct annulation. Cephalic capsule convex, smooth or punctuated, separated by a slight constriction from the annulated body cuticle. Amphideal fovea apicolateral, small, spirally coiled in 1.5 turns, loop-shaped or formed as a shepherd’s crook; sausage-like corpus gelatun may be protruded. Buccal cavity not developed. Pharynx very slightly swollen anteriorly. Gubernaculum without dorso-caudal apophysis. Males of some species equipped with stout postcervical, preanal and postanal subventral setae. Tail elongate-conical, c’ 3–5. Symbiotic bacteria coecoid to short-stick-shaped.


**Other species:**


Leptonemella parabullata Hoschitz, Buchholz & Ott, 1999. Hoschitz et al., 1999: 424-428, fig. 1-14 (northern Adriatic Sea, coarse sand at 3-4 m depth).

Leptonemella juliae Hoschitz, Buchholz & Ott, 1999. Hoschitz et al., 1999: 428-432, fig. 15-24 (northern Adriatic Sea, coarse sand at 3-4 m depth).

Leptonemella vestari Hoschitz, Buchholz & Ott, 1999. Hoschitz et al., 1999: 428-432, fig. 15-24 (northern Adriatic Sea, coarse sand at 3-4 m depth).


Leptonemella sigma Gerlach, 1963. The species is transferred to Laxus, see above.

Parabostrichus Tchesunov, Ingels & Popova, 2012

Diagnosis. Stilbonematinae. Cuticle with very faint or sometimes even indiscernible striations. Head cuticle not thickened and not modified, annulations of the cuticle starts from the apex. Amphideal fovea situated laterally, large, spirally coiled, but obscure because its cuticular margin smoothe. Buccal cavity not developed as such. Anterior region of the pharynx slightly widened and not separated sharply from the narrow median region; small posterior bulb. Gubernaculum with a dorso-caudal apophysis. In males, short subventral setae on papilloid projections on the tail. Body covered with long crescent-like symbiotic bacteria often arranged in a spiral pattern.

Type species: Parabostrichus bathyalis Tchesunov, Ingels & Popova, 2012. Tchesunov et al., 2012: (Slope canyons in the north-east Atlantic, depths 700-1000 m).

Robbea Gerlach, 1956

Diagnosis. Stilbonematinae. Cuticle fine striated. Cephalic capsule mostly not clearly separated, annulated or smooth. Four cephalic setae much longer than subcephalic ones and usually directed straight forward, Amphideal fovea large, spirally coiled in 1.5-2.5 turns, situated laterally posterior to the apex. Tiny unarmed cylindro-conical stoma with sclerotised walls. Pharynx tripartite, with anterior swollen muscular region clearly separated from the narrow median region, long slim isthmus, and small posterior swelling. Gubernaculum with dorso-caudal apophyses. Cervical prominent cup-shaped supplementary organs may be present (in R. tenax). Cuticle often covered by coccoid symbionts inserted in supracuticular slimy pellicle.

Type species: Robbea caelestis Gerlach, 1956. Gerlach, 1956: 213-214, Taf. 28, Fig. a-e (Brazil, Pernambuco, ground water, fine sand).

Other species:

Robbea gallica Vitiello, 1974. Vitiello, 1974: 142-144, fig. 4a-d (Mediterranean, Gulf of Marseilles, depth 82 m).


Robbea macintyreii (Platt & Zhang, 1982) comb. n. Platt & Zhang, 1982: 231-234, fig. 2-3 (as Catanema macintyreii, Scotland, sublittoral sand, 3 m depth). The species is here transferred to the genus Robbea because of its large spirally coiled amphideal fovea in lateral position.

Robbea porosum (Hopper & Cefalu, 1973) comb. n. Hopper & Cefalu, 1973: 586-588, fig. 12-15 (as Catanema porosum, Florida, sand bottom within bed of turtle grass, Thalassia testudinum). The species is here transferred to the genus Robbea because of its large spirally coiled amphideal fovea in lateral position.

Robbea smo (Platt & Zhang, 1982) comb. n. Platt & Zhang, 1982: 234-235, fig. 4 (as Catanema smo, Scotland, sublittoral sand, 3 m depth). The species is here transferred to the genus Robbea because of its large spirally coiled amphideal fovea in lateral position.

**Robbea sp.**  
Fig. 5A-C, 9F.

**Material.** Two females. Body length of one of them is not measurable because the body is coiled in a dense clew.


**Description.** Body cylindrical, long and very slender, filiform, yellowish. Body length 3987 µm, a 137, b 44.5, c 57, c' 3.81-3.88, V 54 %. Body diameter at the level of: amphideal fovea 19 µm, nerve ring 23.5-25 µm, cardia 25.5-29 µm, mid-body 25.5-29 µm, anus 18-22 µm. Cuticle thin, transversal striation hardly discernible. Cuticle of the cephalic end around the amphideal fovea looks granular or finely reticular.

Cephalic end rounded. There are minute outer labial setae with little drops squeezed out on their ends around the small mouth out. Four long (13-20 µm) and thin cephalic setae situated apically and directed forward. Two subventral and two subdorsal pairs of thin and shorter (6-7 µm) anterior subcephalic setae close to the apex, at the anterior edge of the amphideal fovea. There are two sublateral pairs of posterior subcephalic setae (6 µm) at the posterior edge of the amphideal fovea. Two successive lateral setae 3 µm long farther posterior at the level of the anterior pharynx. Amphideal fovea lateral but close to the apex, large (9.5-10 µm wide, 50-53 % c.b.d.), round, with fine but distinct contour, cryptospirally coiled in one+ turn, with a central spot.

Somatic cuticle a bit widened and slightly modified at the level of the amphideal fovea. A small conical unarmed buccal cavity with weakly sclerotised walls present (2.5-3 µm long and 2-5 µm wide). Pharynx distinctly consists of anterior oval muscular portion with clear radial striation (procorpus) 32-38 long and 11-14 µm wide, slightly twisted medium portion (isthmus) 4-7 µm wide and terminal small and wide bulb 12.5-13 µm long and 14-19 µm wide.

Tail conical, with a few lateral setae.

**Symbionts.** On one of the female little, as short sticks sized 3 × 0.5-1 µm and similar to those covering cuticle of *Eubostrichus africanus* found close by.

**Squanema Gerlach, 1963**


**Type species:** *Squanema articulatum* Gerlach, 1963. Gerlach, 1963a: 98, Taf. 12, fig. d-f (Maldive Islands, coarse sand).

No other species.

**Stilbonema Cobb, 1920**

(= *Laxonema* Cobb, 1920, opinion of Ott, 1997: 421)

**Diagnosis.** Stilbonematinae. Cuticle thick, distinctly annulated, annules broad. Cephalic capsule bulging, with smooth or punctated cuticle, separated by a constriction from the body cuticle. Amphideal fovea in apical position, as a short, weakly sclerotised cylinder often with long vermiform corpus gelatum protruding from the anterior outlet of the short cylinder. Buccal cavity not developed. Anterior muscular region of the pharynx not sharply separated from the median region. Gubernaculum without dorso-caudal apophysis. Cervical cup-shaped supplementary organs may be present. Symbiotic bacteria not mentioned.

**Type species:** *Stilbonema brevicolle* Cobb, 1920. Cobb, 1920: 242-243, 19a-b (shoal in Kingston Harbour, Jamaica in about one foot of water).

**Other species:**

*Stilbonema annulatum* Gerlach, 1963. Gerlach, 1963a: 97-98, Taf. 12, Fig. a-c (Maldive Islands, 2 m depth).

*Stilbonema majum* (Cobb, 1920) comb. n. Cobb, 1920: 243-244, fig. 20 (as *Laxonema majum*; shoal in Kingston Harbour, Jamaica in about one foot of water).

*Stilbonema smurovi* sp. n. Present paper.
Stilbonema is a poorly known genus yet. According to some physiological and molecular works Stilbonema majum and Stilbonema sp. are abundant in Belize (e.g. Schiemer et al., 1990; Bulgheresi et al., 2011). But all the taxonomic descriptions of Stilbonema species are presented now by only original diagnoses.

Stilbonema smurovi sp.n.

Fig. 6, 7A–B, 8A–B, 10D–F

Material. One male specimen (holotype) and one female specimen) (paratype).

Locality. Central Vietnam, Nha Trang Bay, Hon Mun Island, depth 3 m, small clearing with sparse...
Fig. 7. *Stilbonema smurovi* sp. n., holotype male, body parts. A. anterior body; B. tail. Scale bars 50 µm.

**Etymology.** The species is named in honour of Prof. Dr. A. V. Smurov who sampled the nematodes in coral and mangrove biotopes in the Nha Trang area.

**Measurements.** Male: L 2333 µm, a 64.9, b 17.7, c 24.7. Female: L 4372 µm, a 97.2, b 35.5, c 36.7, V 45.9 %. Male: diam.c.s. 22 µm, diam.n.r. 34 µm, diam.ca. 31 µm, diam,midb. 34 µm, diam.ani 37 µm. Female: diam.c.s. 23 µm, diam.nr. 33 µm, diam.ca. 34.5 µm, diam,midb. 45 µm, diam.ani 27 µm.

**Description.** Body long, cylindrical, thread-like, but not extremely filiform as that in other stilbonematines. Cuticle brownish, sharply annulated, the annules relatively wide, approximately of the same width throughout the body (5–6 annules in the stretch 10 µm). The cuticle rather thick, especially in the pharyngeal region; weak longitudinal striation on the annules of the anterior body.

Head distinctly separated, spherically inflated as a cephalic capsule, its cuticle non-annulated and thinner than the posterior annulated cuticle. Surface of the cephalic capsule smooth, without punctations and reticulation. There several smaller and bigger pores on the cephalic capsule; the bigger pores perhaps associated with sensilla.
Fig. 9. Three species of Nha Trang stilbonematines and their ectosymbionts. A. *Catanema dambayensis* sp. n. covered with symbiotic bacteria; B. *Eubostrichus africanus* in a suspension of crumbled symbiotic cells; C. *Eubostrichus africanus*, symbiotic cells loosely arranged on the cuticle along the hopst’s body; D. *Eubostrichus africanus*, female, entire; E. *Eubostrichus africanus*, pharyngeal body part; F. *Robbea* sp., symbiotic cells on the cuticle. Scale bars: A–C, E–F, 20 µm; D, 200 µm.
Fig. 10. Two species of Nha Trang Stilbonematinae and their ectosymbionts. A. Laxus sp., female, entire; B. Laxus sp., female, body part with ectosymbionts; C. Stilbonema smurovi sp. n., holotype male, body cuticle; D. Stilbonema smurovi sp. n., paratype female, tail tip; E. Stilbonema smurovi sp. n., paratype female, head, optical section; F. Stilbonema smurovi sp. n., paratype female, head, surface view. Scale bars: A, 200 µm; B,D-F, 20 µm; C, 10 µm.
There six short (3–4 \(\mu\)m in both specimens) outer labial setae visible apically. They are followed with four also apical rather long (22 \(\mu\)m in male, 25 \(\mu\)m in female) cephalic setae directed forward. There are also eight(?) a bit shorter anterior subcephalic setae (14 \(\mu\)m in male, 15–16 \(\mu\)m in female) and eight similar posterior subcephalic setae (14–15 \(\mu\)m in male, 15 \(\mu\)m in female) on the cephalic capsule. Very short cervical and then somatic setae (>10 \(\mu\)m) distributed farther along the body.

Amphids situated apically and consist of a short cylindrical pit (fovea) with slightly sclerotized walls and a vermiciform corpus gelatum (60 \(\mu\)m in male, 40 \(\mu\)m in female) emerging from the pit. In the male, there is a row of nine midventral supplementary organs from the level of the cardia to the anterior intestine. The organs are cup-shaped with a narrowed base; a short acute seta sticks up from the cup centre. The row of supplements is followed by numerous (>50) tiny midventral setae to nearly the cloacal opening.

Buccal cavity not developed. Pharynx short and slender, with fine radial muscular striation in its anterior region; the anteriormost part or procorpus of the pharynx slightly widened (in male, 63 \(\mu\)m long and 19 \(\mu\)m), posterior part of the pharynx widened as an oval bulb (in male, 26.5 \(\mu\)m long and bulb. Midgut slender, with distinct internal lumen.

Male reproductive system poorly discernible. Spicules short (chord 35 \(\mu\)m, arc 59 \(\mu\)m) arcuate, distally pointed, proximally with ventrally bent knobs. Gubernaculum as a nearly straight dorsally directed trough 22 \(\mu\)m long.

Tail conical, \(c'\) 3.2 in male and 4.41 in female, with terminal cone of smooth cuticle. In male, there are three successive short and thick setae preanally and three shorter thick setae postanally on the tail.

**Symbionts.** No evident bacterial cells on the cuticle are detected.

**Diagnosis.** *Stilbonema.* Male: L 2333 \(\mu\)m, a 65, b 18, c 25, \(c'\) 3.2. Female: L 4372 \(\mu\)m, a 97, b 36, c 37, \(c'\) 4.4. C.s. 22 \(\mu\)m. Two successive circles of eight shorter subcephalic setae on the cephalic capsule. In male, a midventral row of nine cup-shaped supplementary organs extended from the level of the pharynx posterior end to the anterior midgut. Neither any posterior preanal nor postanal modified setae or supplementary organs.

**Discussion.** Two type specimens, male and female differ strongly in body length from one another. However, the female is not distinguished significantly from the male in any other structural features and dimensions except the much greater body length. The new species differs from *S. annulatum* Gerlach 1963 and *S. majum* (Cobb 1920) by notably lesser body length and lesser index \(a\) (2333 \(\mu\)m and 65 versus 5977 \(\mu\)m and 124 in *S. annulatum*, 10000 \(\mu\)m and 143 in *S. majum*), and from *S. majum* also by presence of cervical supplementary organs (the latter are lacking or at least not noted in *S. annulatum*). On the contrary, *S. smurovi* sp. n. relates to *S. brevicolle* Cobb 1920 in body length and slenderness (\(L > 3000 \mu m, a > 67\)) but differs in character of body annulations (in *S. brevicolle*, the annules “retrorse in the posterior half of the body, the reverse in the anterior”), evidently longer cephalic setae (not measured by Cobb in *S. brevicolle*) and two versus three circles of subcephalic setae on the cephalic capsule.

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