

Taxonomic review of microlaimids with description of five species from the White Sea (Nematoda: Chromadoria)

S.V. Kovalyev & A.V. Tchesunov

Kovalyev, S.V. & Tchesunov, A.V. 2005. Taxonomic review of microlaimids with description of five species from the White Sea (Nematoda: Chromadoria). *Zoosystematica Rossica*, **14**(1): 1-16.

Taxonomic problems in the family Microlaimidae are discussed, and a key to the genera of Microlaimidae is given. Five species of *Microlaimus* are recorded from the White Sea for the first time. *Microlaimus paraconothelis* sp. n. is described from the White Sea.

S.V. Kovalyev, A.V. Tchesunov, Department of Invertebrate Zoology, Faculty of Biology, Moscow State University, Moscow 119899, Russia. E-mail: Ishokoval@spacenet.ru

Introduction

Descriptions of several species of microlaimids have been known by the 1950th (De Man, 1880, 1922; Allg in, 1930; De Coninck & Schuurmans-Stekhoven, 1933; Schuurmans-Stekhoven, 1935, 1950; Gerlach, 1950; etc.). In the first taxonomic review of microlaimids (Gerlach, 1950), the genus *Microlaimus* was divided into six groups, and a key for their identification was given. Wieser (1954) described several *Microlaimus* species and erected the genus *Paramicrolaimus* (subsequently excluded from the family). Later, Wieser (1959) redescribed 16 known *Microlaimus* species and described 3 new species. Lorenzen (1971, 1976) described new genera *Ixonema* Lorenzen, 1971 and *Calomicrolaimus* Lorenzen, 1976. Sergeeva (1976) erected the genus *Pseudomicrolaimus*, distinguishing it from the genus *Microlaimus* by the presence of numerous subventral teeth, and described the new species *P. murinae*. Jensen (1978) revised the family Microlaimidae and transferred some species classified earlier as *Microlaimus* to *Bolbolaimus* Cobb, 1920, *Molgolaimus* Ditlevsen, 1921, and *Calomicrolaimus* Lorenzen, 1976. He divided the family Microlaimidae into subfamilies Microlaiminae Micoletzky, 1922 and Bolbolaiminae Jensen, 1978. The latter includes a single genus *Bolbolaimus* Cobb, 1920 and differs from Microlaiminae in the position of cephalic setae (far from the front end in Microlaiminae and in the vicinity of the front end in Bolbolaiminae), shape of the terminal oesophageal bulb (pyriform in Microlaiminae and oval in Bolbolaiminae), degree of the buccal cavity sclerotization, and structure of copulatory apparatus. The genus *Pseu-*

domicrolaimus Sergeeva, 1976 was regarded by Jensen as a junior synonym of *Bolbolaimus* Cobb, 1920.

The genera *Microlaimus*, *Ixonema*, and *Calomicrolaimus* were placed by Jensen in the subfamily Microlaiminae, which he characterized by the weak sclerotization of buccal cavity and copulatory apparatus, absence of gubernaculum apophysis, and pyriform shape of terminal oesophageal bulb. In *Ixonema*, each caudal cell has its own outlet; in *Microlaimus* and *Calomicrolaimus*, caudal glands have a common outlet. According to Jensen, *Calomicrolaimus* differs from *Microlaimus* in the position of amphids situated far from the anterior end, elongated cervical region, presence of long or stout somatic setae, and shape of the tail.

The genus *Aponema* Jensen, 1978 was described for the species *Microlaimus torosus* Lorenzen, 1973 possessing a single anterior testis and referred to a separate subfamily Aponematinae Jensen, 1978 (with outstretched ovaries) within the Molgolaimidae, while the genera *Molgolaimus* Ditlevsen, 1921 and *Prodesmodora* Micoletzky, 1923 were placed in the subfamily Molgolaiminae Jensen, 1978 (reflexed ovaries). According to Jensen, Molgolaimidae differ from Microlaimidae in the spherical oesophageal bulb, sclerotization of its lumen, and position of cervical pore in relation to the nerve ring. The genera *Cinctonema* Cobb, 1920, *Crassolaimus* Kreis, 1929, and *Ungulilaimella* Allg in, 1958 were mentioned by Jensen as dubious and were not included in any family.

Lorenzen (1994) disagreed with separation of the family Molgolaimidae. He included molgolaimids in Desmodoridae and assumed that the

presence of outstretched ovaries in *Aponema* is a good cause to include the genus in the Microlaimidae.

Discussion of taxonomic problems

As already stressed by Lorenzen, the characters used by Jensen for the Microlaimidae classification vary significantly within the family and even at the generic level (for example, *M. globiceps* has an oval bulb with thick strongly sclerotized walls). The position of excretory pore varies in different species. For example, the cervical pore is placed in *M. honestus* behind the nerve ring, while in *M. spirifer*, on the ventral side near the amphid level (Warwick, 1970; Platt & Warwick, 1988), i.e. in front of the nerve ring, as in molgolaimids. Hence, the position of cervical pore and the shape and sclerotization of the lumen of esophageal bulb cannot be used for distinguishing Microlaimidae and Molgolaimidae and for classification of microlaimids at the generic level. Jensen described the difference in the tail shape between Microlaimidae and Molgolaimidae and the reduction of cephalic setae of the two first circles in Molgolaimidae. Actually, all known *Molgolaimus* species possess almost spherical bulb with strongly sclerotized walls and elongated thin tail enlarged to the tip. However, species either with spherical bulb or with enlarged tip of the tail (but with outstretched ovaries) occur also within Microlaimidae. Hence, all features of Molgolaimidae indicated by Jensen have diagnostic value only if the ovaries are antedromously reflexed.

The following *Microlaimus* species were transferred to *Molgolaimus* by Jensen (1978): *M. allgeni* Gerlach, 1950, *M. citrus* Gerlach, 1959, *M. cuanensis* Platt, 1973, *M. labradorensis* Allgün, 1957, *M. lazonus* Vitiello, 1971, *M. tenuicaudatus* Allgün, 1959, *M. tenuilaimus* Allgün, 1932, *M. tenuispiculum* De Man, 1922, *M. parallgeni* Vitiello, 1973 and *M. turgofrons* Lorenzen, 1972.

We agree with Lorenzen and Jensen as to the taxonomic position of most *Microlaimus* species transferred to *Molgolaimus*, with the exception of *Microlaimus citrus* Gerlach, 1959. According to the original description and figure (Gerlach, 1959), *M. citrus* has papilliform cephalic sensillae of third circle and strongly sclerotized stoma with small teeth. Combination of these features (although it resembles *Molgolaimus* in the round oesophageal bulb with sclerotized walls and in subcylindrical distal part of the tail) is characteristic of *Crassolaimus conicaudatus* Kreis, 1929, and does not occur within other microlaimids or molgolaimids (Kreis, 1929). The absence of necessary details in Gerlach's description does not allow including *Microlaimus citrus* Gerlach,

1959 as well as the genus *Crassolaimus* Kreis, 1929 in any family, and we suggest placing it into "incertae sedis" group.

The outstretched ovaries in females are really one of the most important features of the family Microlaimidae. Therefore, we follow Lorenzen and place *Aponema* in Microlaimidae. In our opinion, the differences between the genera of Microlaimidae are not so significant to subdivide the family into subfamilies. The genus *Aponema* differs from other Microlaimidae (except for *Bathynox*) in the single anterior testis.

The genus *Bathynox* Bussau & Vopel, 1999, also with the single anterior testis, differs from *Aponema* in the protruding corpus gelatum and presence of somatic setae inserted on short processes. Corpus gelatum of similar type occurs also in Microlaimidae with two testes: *Ixonema sordidum* Lorenzen, 1971, *Microlaimus rugatus* (Lorenzen, 1976) (Lorenzen, 1971, 1976).

The tail is conical in most Microlaimidae species, and difference among them concerns mainly the relative length of tails (*c* and *cr* De Man indexes). In two *Aponema* species, the tip of the tail is almost cylindrical, with terminal bulbiform dilatation. Tail with subcylindrical distal part usually occurs in Molgolaimidae, but is not typical of the majority of Microlaimidae and occurs only in *Microlaimus pygmaeus* Meyl, 1954, *M. honestoides* Meyl, 1954, and *M. gerlachi* Wieser, 1954 (Meyl, 1954; Wieser, 1954; Jensen, 1978).

The degree of sclerotization of the stoma and copulatory apparatus differs within the family. In *Ixonema*, spicules and gubernaculum are weakly sclerotized; in several *Microlaimus* species (e.g. *M. acinaces* Warwick & Platt, 1973, *M. robustidens* De Coninck & Schuurmans-Stekhoven, 1933, *M. pinguis* Wieser, 1954, *M. conothelis* Lorenzen, 1973) spicules are almost so strongly sclerotized as in the genera *Bolbolaimus* Cobb, 1920 and *Pseudomicrolaimus* Sergeeva, 1976 (De Coninck & Schuurmans-Stekhoven, 1933; Wieser, 1954; Lorenzen, 1973; Warwick & Platt, 1973). Hence, it is advisable to regard this character in combination with other features.

We disagree with Jensen that the genus *Pseudomicrolaimus* Sergeeva, 1976 is a synonym of *Bolbolaimus* Cobb, 1920. According to Sergeeva (1976), this genus differs from *Microlaimus* in the presence of numerous denticles on the left subventral side of the stoma. In other characters, *Pseudomicrolaimus* is similar to *Bolbolaimus*. We suggest transfer of all *Bolbolaimus* species with numerous denticles to the genus *Pseudomicrolaimus*. Thereby, the following 3 species belong to the genus *Pseudomicrolaimus*:

P. dentatus (Allgün, 1935) Sergeeva, 1976 = *Microlaimus dentatus* Allgün, 1935;

P. denticulatus (Cobb, 1920), **comb. n.** = *Bolbolaimus denticulatus* Cobb, 1920;

P. murinae Sergeeva, 1976.

The similarity of different species of *Microloaimus* and *Calomicrolaimus* in most of the important features (head shape, length of cephalic setae, shape and position of amphids, structure of stoma) and the high rate of variability within these groups render distinguishing of these two genera impossible. We regard the genus *Calomicrolaimus* Lorenzen, 1976 as a junior synonym of *Microloaimus* De Man, 1880.

The diagnosis of the family Microloaimidae and descriptions of four known and one new species are given below.

Material and methods

The samples were taken from the sublittoral zone of the Velikaya Salma Strait (Kandalaksha Bay, White Sea, Biological Station of Moscow State University). *Microloaimus paraconothelis* sp. n. was also found in another locality of the White Sea (Nickodimsky lighthouse). Nematodes were fixed with 4% formalin, processed and mounted in glycerin on glass. Observations were made with light microscope "Jenamed" (Carl Zeiss).

The papers by Stewart & Nicholas (1987), Soetaert & Vincx (1988) and Bussau & Vopel (1999) were used to compile the key to the genera and those by Jaysree & Warwick (1977), Vincx (1981) and Blome (1982), to prepare the list of species.

The type material is deposited in the nematode collection at the Institute of Oceanology, Russian Academy of Sciences, Moscow.

Family MICROLAIMIDAE Micoletzky, 1922

Type genus: *Microloaimus* De Man, 1880.

Diagnosis. Cuticle annulated, without lateral differentiation, often smooth at the front end of the head, sometimes optically smooth. Cephalic sensillae in three distinct circles (6 + 6 + 4). Amphid turned ventrally in one-turn spiral, looks usually almost round or oval, rarely multispiral (*Microloaimus spirifer*, the genus *Spirobolbolaimus*). Cheilostoma twelve-folded; oesophastoma with larger dorsal and two smaller subventral teeth and sometimes denticles (*Pseudomicrolaimus*). Pharynx muscular, dilated in posterior bulb. Ovaries didelphic, amphidelphic, outstretched. Testes opposite; sometimes only the single anterior (*Aponema*, *Bathynox*) or posterior (*Microloaimus capillaris*) testis present.

Genera included: *Acanthomicrolaimus* Stewart & Nicholas, 1987; *Bathynox* Bussau & Vopel, 1999; *Bolbolaimus* Cobb, 1920; *Caligocanna* Bussau & Vopel, 1999; *Ixonema* Lorenzen, 1971;

Microloaimus De Man, 1880; *Pseudomicrolaimus* Sergeeva, 1976; *Spirobolbolaimus* Soetaert & Vincx, 1988.

Key to the genera of Microloaimidae

- 1(14) Cephalic sensillae of the third circle equal to or longer than sensillae of the second circle 2
- 2(11) Two testes present 3
- 3(4) Body cuticle covered with numerous thorns
 **Acanthomicrolaimus**
- 4(3) Body cuticle without thorns 5
- 5(6) Each caudal gland with its own outlet. Spicules and gubernaculum weakly sclerotized **Ixonema**
- 6(5) Caudal glands with common outlet. Spicules and gubernaculum more or less sclerotized 7
- 7(10) Cephalic sensillae of second and third circles closely spaced (distance between them less than 1/3 of the head diameter). Peribuccal tissue of esophagus enlarged in pharyngeal bulb 8
- 8(9) Left subventral side of stoma with numerous denticles **Pseudomicrolaimus**
- 9(8) No numerous subventral denticles **Bolbolaimus**
- 10(7) Cephalic sensillae of second and third circles widely spaced (by more than 1/3 of the head diameter). Peribuccal tissue not enlarged or weakly enlarged
 **Microloaimus**
- 11(2) Only anterior testis presents 12
- 12(13) Somatic setae on short processes **Bathynox**
- 13(12) Somatic setae never located on processes
 **Aponema**
- 14(1) Cephalic sensillae of third circle shorter than sensillae of second circle 15
- 15(16) Numerous postamphidial somatic setae present. Amphids multispiral **Spirobolbolaimus**
- 16(15) Postamphidial somatic setae absent. Amphids monospiral **Caligocanna**

Genus *Microloaimus* De Man, 1880

- = *Microloaimoides* Hoeppli, 1926 (syn. Andrössy, 1960).
- = *Paracothonolaimus* Schulz, 1932 (syn. Schuurmans-Stekhoven & De Coninck, 1933).
- = *Calomicrolaimus* Lorenzen, 1976, **syn. n.**

Type species: *M. globiceps* De Man, 1880.

Diagnosis. Stoma with one dorsal and two subventral teeth, without numerous subventral denticles. Cephalic sensillae of the third circle quite far from the sensillae of the second circle (more than 1/3 of head diameter). Cuticle annulated, sometimes optically smooth. Amphids usually monospiral, almost round or oval, placed at different distances from the front end, very rarely multispiral (*M. spirifer*). Caudal glands and terminal spinneret with common outlet.

List of valid *Microloaimus* species

- M. acanthus* Jaysree & Warwick, 1977 (*Calomicrolaimus acanthus*: Blome, 1982)
- M. acinaces* Warwick & Platt, 1973
- M. acicularis* Lorenzen, 1976
- M. acuticaudatus* Stekhoven & De Coninck, 1933
- M. aequisetosus* Blome, 1982
- M. affinis* Gerlach, 1958

M. africanensis Furstenberg & Vincx, 1992
M. annelisiae Jensen, 1976
M. arenarius (Blome, 1982), **comb. n.** = *Calomicrolaimus arenarius* Blome, 1982
M. arenicola Schulz, 1938
M. borealis Steiner, 1916
M. capillaris Gerlach, 1957
M. clancularius Bussau & Vopel, 1999
M. cochleatus Wieser, 1959
M. compridus Gerlach, 1956 (*Calomicrolaimus compridus*: Gourbault & Vincx, 1988)
M. conothelis (Lorenzen, 1973)
M. copulatus Jensen, 1988
M. crassiceps Gerlach, 1953
M. criminalis Rieger & Ott, 1971
M. cyatholaimoides De Man, 1922
M. decoratus Pastor de Ward, 1989
M. dimorphus Chitwood, 1937
M. discolensis Bussau & Vopel, 1999
M. dixiei Wieser, 1959
M. falklandiae Allgün, 1959
M. formosus Gerlach, 1957
M. gerlachi Wieser, 1954
M. globiceps De Man, 1880
M. honestoides Meyl, 1954
M. honestus De Man, 1922
M. inermis Ditlevsen, 1923
M. kaurii Wieser, 1954
M. latilaimus Allgün, 1959
M. lepturus De Cillis & Odorato, 1917
M. limnophilus Turpeenniemi, 1997
M. longispiculum Timm, 1961
M. luneatus (Wieser & Hopper, 1967)
M. macrocirculus Gerlach, 1950
M. macrolaimus Allgün, 1947
M. marinus (Schulz, 1932) Schuurmans-Stekhoven & De Coninck, 1933 = *Paracothonolaimus marinus* Schulz, 1932
M. microseta Gerlach, 1953
M. minutus Muthumbi & Vincx, 1999
M. monstrosus Gerlach, 1953 = *M. conspicuus* Lorenzen, 1973, syn. Vincx, 1981
M. naidinae Tshesunov, 1978
M. oblongilaimus Gerlach, 1955
M. ostracion Schuurmans-Stekhoven, 1935
M. papillatus Gerlach, 1956 (*Paramicrolaimus papillatus*: Wieser & Hopper, 1967)
M. papilliferus Allgün, 1959
M. paraconothelis **sp. n.**
M. parahonestus Gerlach, 1950
M. pecticaudata Murphy, 1966
M. pinguis Wieser, 1954
M. ponticus Sergeeva, 1976
M. porosus Bussau & Vopel, 1999
M. punctulatus Gerlach, 1950
M. pygmaeus Meyl, 1954
M. pwani Muthumbi & Vincx, 1999
M. robustidens Schuurmans-Stekhoven & De Coninck, 1933
M. rugatus (Lorenzen, 1976), **comb. n.** = *Calomicrolaimus rugatus* Lorenzen, 1976
M. sensus Wieser, 1954
M. setosus Hoeppli, 1926
M. sicarius Wieser, 1954
M. spinosus Gerlach, 1957
M. spirifer Warwick, 1970 (*Calomicrolaimus spirifer*: Jensen, 1978)
M. tenuicaudatus Allgün, 1959
M. tenuispiculum De Man, 1922
M. teuthonicus Riemann, 1966

M. texianus Chitwood, 1951
M. undulatus Gerlach, 1953
M. zosteriae Allgün, 1930

Microlaimus affinis Gerlach, 1958 (Figs 1-4)

Microlaimus affinis Gerlach, 1958: 245, fig. 3a-c.

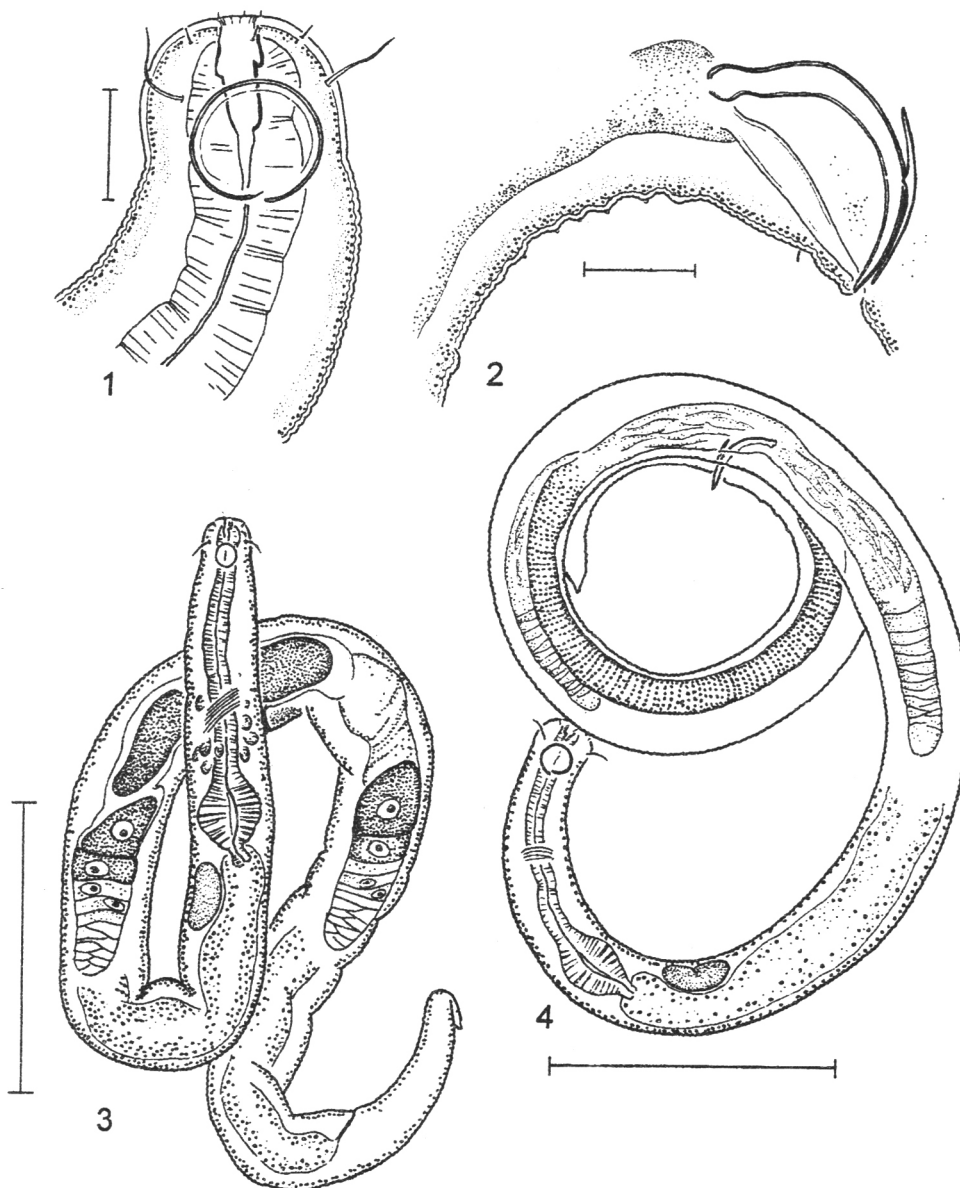
Material. **Russia:** 2 ♂, 2 ♀ in glycerin slides, White Sea, Kandalaksha Bay, Velikaya Salma strait, Biological Station of Moscow State University, accumulation of decaying algae, transect B, 20 m, depth 9 m, outwash from the red algae.

Description. ♂. L 710-892 µm. *a* 22.9-24.1; *b* 6.1-7.1; *c* 9.0-10.3; *cr* 3.1-3.3. Length of pharynx 116-125 µm, tail length 79-87 µm. Distance between the anterior end and cephalic sensillae of third circle 7.2-8.0 µm, dorsal tooth 4.3-4.6 µm, amphid 8.8-9.5 µm, nerve ring 55-65 µm. Body diameter at the level of cephalic sensillae of second circle 10.2-11.5 µm, third circle 15.6-17.1 µm, amphid 18.0-20.3 µm, nerve ring 28.0-29.4 µm, cardia 30-34 µm, mid-body 31-37 µm, anus 25.5-26.2 µm.

♀. L 735-784 µm. *a* 22.9-23.1; *b* 6.2-6.5; *c* 8.9-9.2; *cr* 3.4-3.5; *V* 55-63%. Length of pharynx 119-120 µm, tail length 83-85 µm. Distance between the anterior end and cephalic sensillae of third circle 7.0-7.5 µm, amphid 8.0-9.0 µm, nerve ring 58-63 µm, vulva 431-460 µm. The body diameter at the level of cephalic sensillae of second circle 10.8-11.0 µm, third circle 16.2-16.9 µm, amphid 15.1-17.6 µm, nerve ring 27.6-28.5 µm, cardia 28-30 µm, mid-body 32-34 µm, anus 23.7-24.6 µm.

Body (Figs 3, 4) short, rather stout, brownish. Cuticle thin, dense, weakly annulated. Cuticle annuli without dots. Hypoderm with brown granules. Head (Fig. 1) weakly separated by cervical constriction. Cephalic cuticle smooth, annulated from the mid-amphid level. Oral opening without lips. First circle formed by 6 small conical inner labial papillae. Second circle formed by 6 conical outer labial papillae. Four quite long cephalic setae situated at the level of mid-head (7.0-7.5 µm long). Amphid in the neck region, round, with apparent cuticular edge interrupted ventrally. Amphid diameter 9.8-11.4 µm (52-54% of corresponding body diameter) in males, 7.5-8.2 µm (47-50%) in females.

Cheilostoma with 12 longitudinal ribs. Oesophastoma sclerotized, cyathiform, with triangular dorsal tooth and two small subventral processes against it. Oesophageal tissue thickened (especially dorsally) around oesophastoma. Maximum width of oesophastoma 4.0-5.3 µm. Diameter of pharynx before the nerve ring 8.0-11.8 µm. Posterior part of pharynx dilated in bulb (25.7-27.8 µm long, 20.3-23.8 µm wide). Somat-



Figs 1-4. *Microloaimus affinis* Gerlach. **1**, male head; **2**, copulative apparatus and preloacal region of male; **3**, total view of female; **4**, total view of male. Scales: 10 µm (1, 2), 100 µm (3, 4).

ic setae not observed. Cardia not large, trapezoid. Cervical pore not observed. A large cell placed ventrally to the intestine behind cardia.

Anterior testis outstretched, situated to the right of the intestine. Spermatozoa elongated. Spicules (Fig. 2) not long, 24-25 µm (measured along the straight line), thin, curved, tapering distally, capitated proximally. Gubernaculum lamellar, 11-12 µm long. Supplements in form of 6-7 con-

cavities, situated preanally. Ovaries paired, outstretched. Anterior ovary placed to the right of the intestine; posterior ovary placed to the left. Tail conical, with terminal spinneret.

Discussion. Our description is mainly in agreement with the original description of Gerlach (1958), therefore we identify the species as *M. affinis*. The comparison of our description with Gerlach's one is given below (Gerlach's data

are in brackets): L 710-892 μm (vs. 732-767 μm); *a* 22.9-24.1 (vs. 25-26); *b* 6.1-7.1 (vs. 6.7-7.0); *c* 8.9-10.3 (vs. 9.5-10.0); *V* 55-63% (vs. 50%); length of spicules 24-25 μm (vs. 24 μm); length of gubernaculum 11-12 μm (vs. 11 μm); diameter of amphids 7.5-11.4 μm (vs. 5.5 μm); mid-body diameter 31-37 μm (vs. 28-31 μm). Cephalic sensillae of second circle are papilliform as in Gerlach's description.

M. affinis from the White Sea differs from Gerlach's description in the smaller diameter of amphids and presence of precloacal supplements not mentioned by Gerlach (supplements are not always observed because of the small size).

Distribution. Red Sea. The species is recorded from the White Sea for the first time.

Microloaimus honestus De Man, 1922 (Figs 5-10)

Microloaimus honestus De Man, 1922: 241, fig. 30a-c; Allgün, 1930: 61-62, fig. 4a-b; De Coninck & Schuurmans-Stekhoven, 1933: 88-90, fig. 73-76; De Coninck, 1944: 195-196, fig. 47-49; Gerlach, 1950: 200-201, fig. 7a-c; 1953: 10-12, fig. 5a-d; 1965: 130, fig. 11a-c
Calomicrolaimus honestus: Jensen, 1979: 155-157, fig. 17-24; Bowmann, 1981: 45-47, fig. 1a-h; Platt & Warwick, 1988: 390-391, fig. 181.

Material (in glycerin slides). **Russia:** 1 σ , 1 φ , White Sea, Kandalaksha Bay, Velikaya Salma Strait, Biological Station of Moscow State University, sand near the Cross; 3 φ , White Sea, Nickodimsky lighthouse, depth 15 m.

Description. σ . L 1230 μm . *a* 31.9; *b* 7.7; *c* 13.7; *cr* 3.1. Length of pharynx 160 μm , tail length 90 μm . Distance from the anterior end to dorsal tooth 6 μm , amphid 23 μm , nerve ring 96 μm . Body diameter at the level of cephalic sensillae of the second circle 10 μm , third circle 12.5 μm , amphid 23 μm , nerve ring 33 μm , cardia 37 μm , mid-body 38.5 μm , anus 29 μm .

φ . L 1073-1205 μm . *a* 28.7-31.7; *b* 7.2-7.9; *c* 13.1-13.5; *cr* 3.0-3.2; *V* 45-53%. Length of pharynx 142-159 μm , tail length 82-89 μm . Distance from the anterior end to dorsal tooth 5.5-6.0 μm , amphid 18.5-22.0 μm , nerve ring 85-92 μm , vulva 517-593 μm . Body diameter at the level of cephalic sensillae of the second circle 9.2-10.0 μm , third circle 11-13 μm , amphid 18.5-20 μm , nerve ring 30-32 μm , cardia 34-35 μm , mid-body 35-39 μm , anus 26-28 μm .

Body (Figs 8, 9) fusiform. Cuticle annulated, covered with dots, becoming smooth in front of the level of long cephalic setae. Small brownish granules situated under cuticle.

Head (Figs 5, 6) weakly separated from the remaining body; cephalic capsule not seen. Cephalic sensillae arranged in three circles: 6 inner labial papillae, 6 short cephalic setae (2.1-2.5 μm long) and 4 mediolateral (6.8-7.3 μm long) setae situated at 5.9-6.4 μm from the front end. Am-

phid almost round, curved ventrally in one-turn spiral, relatively large (especially in male): 14.9 μm in male (65% of corresponding body diameter), 9.2-10.6 μm in females (50-57%). Amphids placed quite far from the front end and behind the buccal cavity region.

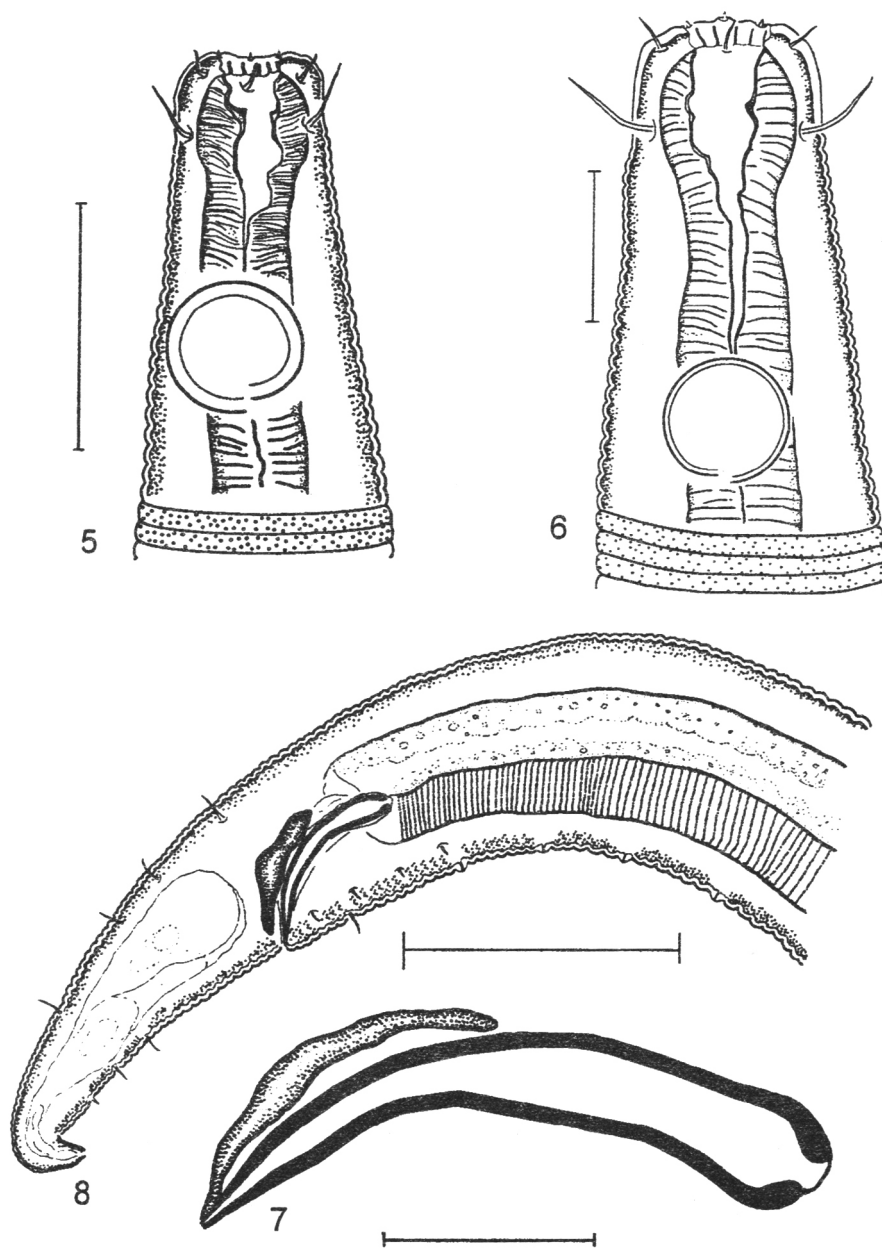
Stoma with folded cheilostoma, bearing longitudinal ribs, and oesophastoma surrounded by oesophageal tissue anteriorly weakly dilated in pharyngeal bulb. Total length of stoma 19.0-20.9 μm , length of oesophastoma 17.4-19.5 μm , its maximum width 4.5-5.3 μm . A large dorsal and two smaller subventral teeth and a small dorsal process at the distance of 5 μm behind the dorsal tooth. Dorsal tooth triangular, acute. Cuticle of oesophastoma slightly thickened, sclerotized distinctly behind the dorsal tooth.

Pharynx cylindrical from amphid to the nerve ring level, enlarged around oesophastoma anteriorly, forming cardiac bulb posteriorly. Bulb pyriform, 32-36 μm long, 24-30 μm wide. Cuticle of oesophageal lumen thickened. Cardia from roundish to trapezoid, 7.1 \times 12.0 μm . Renetta is found in one female only. Its body situated ventrally to the cardia and anterior part of the intestine; ampoule and cervical pore placed behind the nerve ring (pore 12 μm behind the nerve ring and 107 μm behind the front end). Testes (Fig. 9) paired, opposite. Spermatozoa large (about 20 μm long). Spicules (Fig. 7) proximally capitated, arcuated, distally acute. Spicules 30-32 μm long (measured along the arc); gubernaculum 18-20 μm long, without apophysis. Four preanal supplements (Fig. 10) in form of protuberances of medioventral cuticle. Tail covered with somatic setae (Fig. 10).

Reproductive system of female (Fig. 8) didelphic, amphidelphic, with spermathecae; ovaries outstretched. Tail conical, with tip curved laterally. Caudal gland cells incaudal, with terminal spinneret.

Discussion. According to our revised classification, *Calomicrolaimus* Lorenzen, 1976 is a junior synonym of *Microloaimus* De Man, 1880. Hence, we regard the species as *Microloaimus honestus* De Man, 1922.

Comparison. In most measurements, our specimens of *M. honestus* from the White Sea are very similar to *C. honestus* from the littoral zone of south-western shore of England (Platt & Warwick, 1988). The relative measurements are as follows (the data of Platt & Warwick are in brackets): L 1.07-1.23 mm (vs. 1.3-1.4 mm); maximum corresponding body diameter 35-39 μm (vs. 32-41 μm); *a* 29-32 (vs. 32-42); *V* 45-53% (44-49%); length of long cephalic setae 6.8-7.3 μm (vs. 6-7 μm), diameter of amphids 8.2-10.9 μm (vs. 7-8 μm), length of spicules 30-32 μm (vs. 30-34 μm), length of gubernaculum 18-20 μm (vs. 19-22 μm). The difference concerns only the

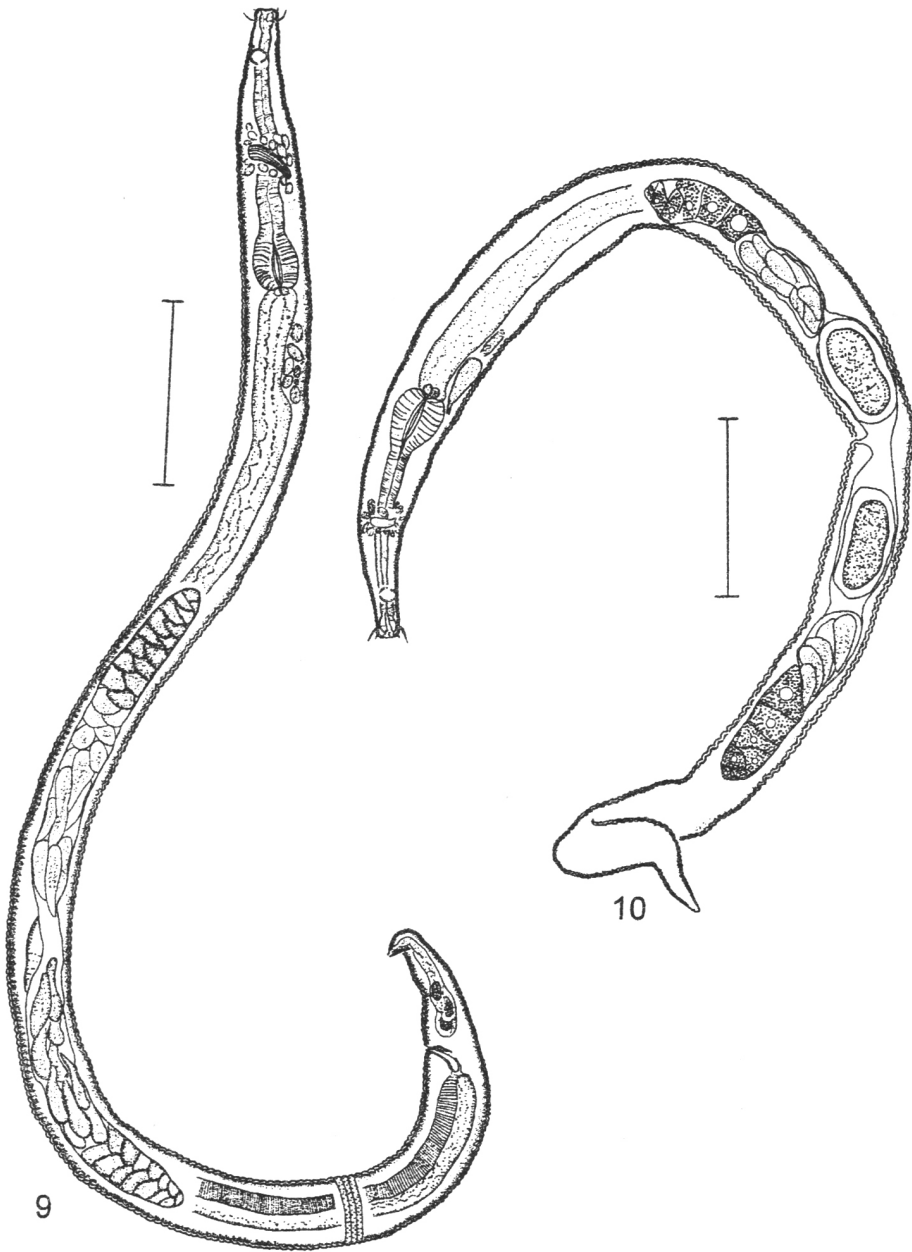


Figs 5-8. *Microloaimus honestus* De Man. 5, male head; 6, female head; 7, male tail; 8, male copulatory apparatus. Scales: 10 μm (5, 6, 8), 50 μm (7).

number of supplements: 5-6 precloacal supplements in the description of Platt & Warwick and 4 supplements of similar structure in our specimens.

At the same time, there is a difference in most measurements of *M. honestus* described by different authors. In the descriptions of De Man

(1922), Allgün (1930) and, especially, Gerlach (1965) the body is considerably shorter. For example, in Gerlach's description body length is just 578 μm (vs. 1073-1230 μm in our description), mid-body diameter is 21 μm (vs. 35-39 μm). However, 'a' and 'b' De Man indexes are similar: a 28 (vs. 29-32), b 6.2 (vs. 7.2-7.9).



Figs 9-10. *Microloaimus honestus* De Man. **9**, total view of male; **10**, total view of female. Scales: 100 μ m.

Jensen (1979) described *C. honestus* with body length 689-716 μ m (0.7 times as long as in our specimens), but with similar 'a' and 'b' indexes: a 31-33 (vs. 29-32), b 7.6-8.2 (vs. 7.2-7.9). In Gerlach's description (1950), the body length of *M. honestus* varies significantly (from 0.42 to

1.17 mm). The variability of De Man ratios is also evident: a 20-36; b 6-10; c 6-12. These differences are not a good cause to relate different forms of *M. honestus* to different species.

Bowmann (1981) described *M. honestus* from the Ems Estuary and supposed that *M. honestus*

is not a single species, but a group of related species. However, the shape of amphids (according to Bowmann's figures) does not correspond with those of majority of other descriptions of *M. honestus* and mostly resembles *M. parahonestus* Gerlach, 1950, which can be distinguished from *M. honestus* by spiralized amphids (in *M. parahonestus* amphids are 1.25-1.5 turned).

Our specimens of *M. honestus* from the White Sea resemble *M. punctulatus* from the Kiel Bay (Gerlach, 1950) and Oeresund (Jensen, 1978) in the structure of cuticle with dots, body length and proportions, and position of amphids. They differ from *M. punctulatus* in the structure of stoma (additional tooth, characteristic to *M. punctulatus*, absent in *M. honestus*), shape of spicules (with better developed capitulum in *M. honestus*) and gubernaculum (sickle-shaped in *M. honestus* and lamellar in *M. punctulatus*).

Distribution. North, Norway, Baltic, Red, Mediterranean Seas, Iceland, Falkland Islands, Chile coast, coast of California, English Channel. The species is recorded from the White Sea for the first time.

***Microilaimus limnophilus* Turpeenniemi, 1997** (Figs 11-15)

Microilaimus limnophilus Turpeenniemi, 1997: 40-44, fig. 3 a-e.

Material. Russia: 2 ♂, 3 ♀ in glycerin slides, White Sea, Kandalaksha Bay, Velikaya Salma Strait, Biological Station of Moscow State University, supralittoral zone, tussock of *Festuca rubra*.

Description. ♂. L 456-472 µm. *a* 17.5-20.5; *b* 6.4-6.5; *c* 7.1-7.5; *cr* 4.2-4.6. Length of pharynx 71-73 µm, tail length 63-64 µm. Distance from the anterior end to amphid 13-14 µm, nerve ring 46-48 µm. Body diameter at the level of cephalic setae 6.5-7.0 µm, amphid 10.5-11.0 µm, nerve ring 15-16 µm, cardia 18-19 µm, mid-body 23-26 µm, anus 14-15 µm.

♀. L 440-460 µm. *a* 17.0-18.9; *b* 6.2-6.7; *c* 7.2-7.5; *cr* 4.4-4.7; *V* 56-59%. Length of pharynx 68-72 µm, tail length 59-64 µm. Distance from the anterior end to amphid 12.5-14.0 µm, nerve ring 45-47 µm, vulva 245-270 µm. Body diameter at the level of cephalic setae 6.0-6.9 µm, amphid 10.0-10.7 µm, nerve ring 14-15 µm, cardia 17-19 µm, mid-body 23.5-27.0 µm, anus 13.0-14.5 µm.

Body (Figs 11, 12) brownish, tapering to both ends. Tail conical, with pointed tip (Fig. 13). Cuticle dense, annulated; annuli broad, 1.2-1.5 µm at the level of mid-body. Cuticle ornamented with longitudinal rows of dots.

Head (Fig. 15) separated from the remaining body by cervical constriction. Oral opening surrounded by 6 inner labial papillae. Second and

third crowns of cephalic sensillae formed by 6 outer labial papillae and 4 short mediolateral setae (1.0-1.2 µm in males, 0.7-0.9 µm in females), respectively. Amphids monospiral, almost round, 2.8-3.0 µm in diameter in males (26-30% of corresponding body diameter) and 2.4-2.7 µm wide in females (22-26% of corresponding body diameter). Anterior part of stoma cyathiform, posterior part V-shaped. Total length of stoma 4.1-4.5 µm. Oesophastoma weakly sclerotized, surrounded by oesophageal tissue, with small triangular dorsal tooth and barely distinguished subventral teeth. Maximum width of buccal cavity 0.8-0.9 µm.

Oesophagus cylindrical in the middle part, enlarged in almost spherical cardiac bulb posteriorly (14.5-16 µm long, 13-15 µm wide), weakly dilated around stoma anteriorly.

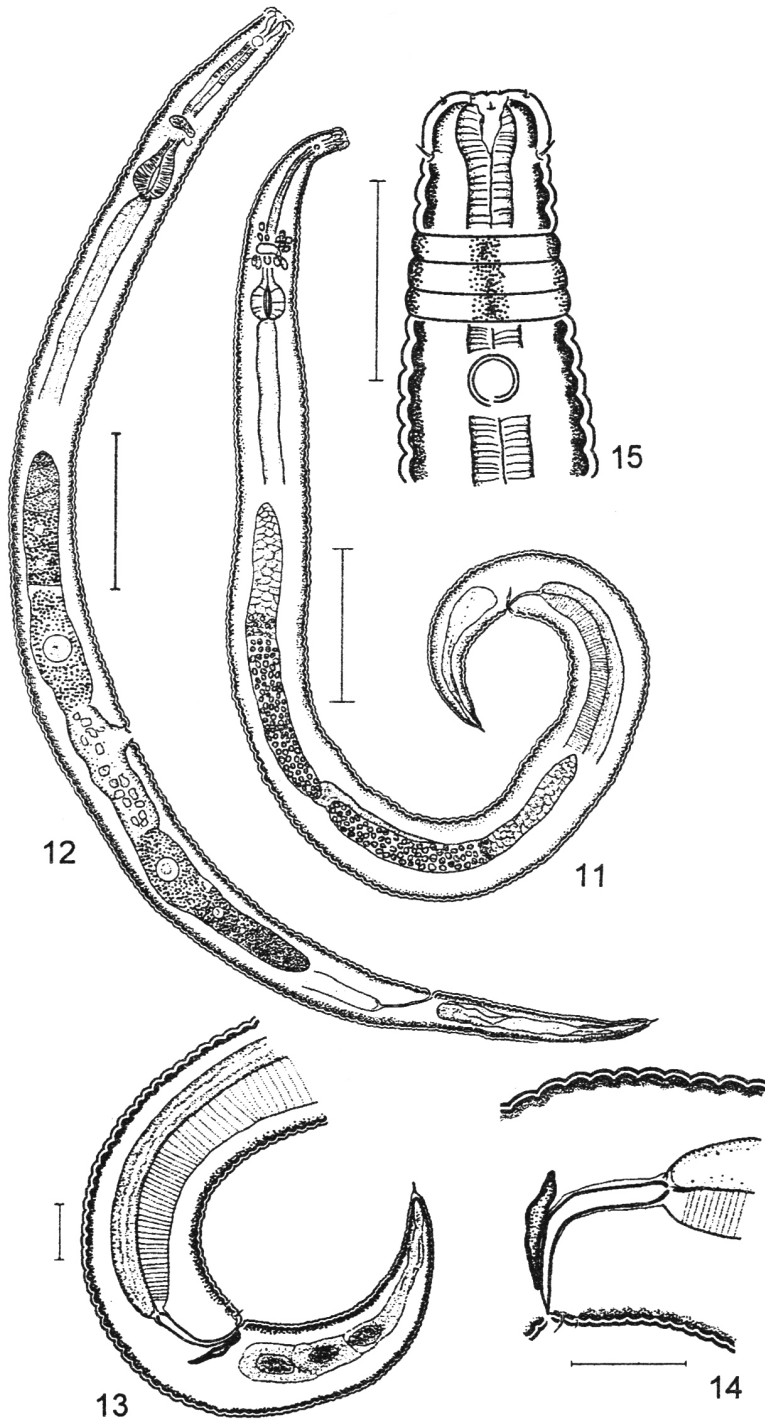
Nerve ring near the bulb, at 45-48 µm from the front end and at 20-24 µm in front of cardia. Diameter of pharynx before the nerve ring 3.7-4.2 µm. Lumen of terminal bulb dilated, its cuticle thickened and weakly sclerotized. Cardia not large, triangular, 2.3 Ч 5.5 µm. Ventral gland not seen.

Testes opposite, outstretched. Spermatozoa small, roundish. Spicules (Fig. 14) arcuated, proximally almost cylindrical, 18-20 µm long (measured along the arc). Gubernaculum rod-like, with a small dilatation in central part, 8-9 µm long. Two medioventral setae, 2.0 and 0.9 µm long, situated at 1.1 µm and 2.3 µm in front of anus.

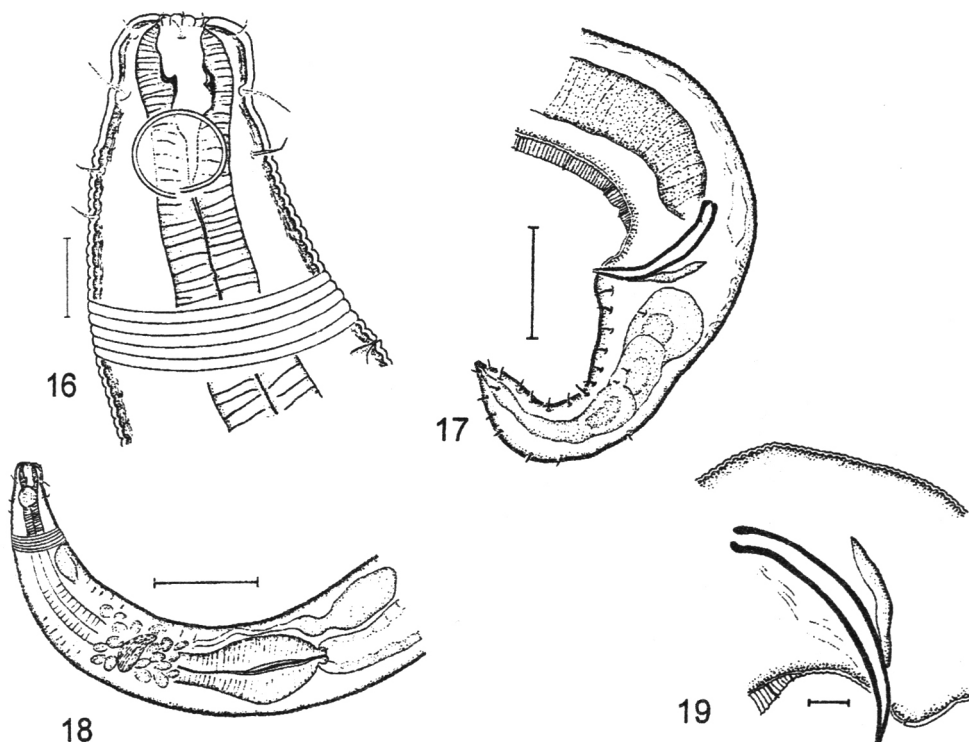
Females (Fig. 12) resemble males in most characters, differ in the shorter cephalic setae and smaller amphids placed at the level of 7-8 (6-7 in males) cuticle annuli. Ovaries didelphic, amphidelphic, outstretched. Spermathecae not seen. Caudal glands incaudal.

Comparison. Our specimens are very similar to those described by Turpeenniemi (1997) (Turpeenniemi's data are in brackets): L 440-472 µm (vs. 401-470 µm), length of pharynx 68-73 µm (68-75 µm), tail length 59-64 µm (vs. 55-73 µm), head diameter 6.5-7.0 µm (vs. 6-7 µm), body diameter at the level of cardia 17-19 µm (15-18 µm), mid-body 23-26 µm (vs. 16-21 µm), anal body diameter 13-15 µm (vs. 11-17 µm); length of spicules 18-20 µm (vs. 17.5-21.0 µm), gubernaculum 8-9 µm (vs. 8-10 µm); De Man indexes: *a* 17.1-20.5 (vs. 20.0-29.3), *b* 6.4-6.7 (vs. 5.4-6.6); *c* 6.9-7.4 (vs. 5.8-8.8). *cr* 4.0-4.5 (vs. 3.2-5.9). A larger dispersion in values of indexes in Turpeenniemi's description in comparison with our data is caused by larger sampling (5 specimens in our description vs. 26 specimens in the description of Turpeenniemi).

Two medioventral preanal setae and dots on cuticle observed in our specimens were not mentioned by Turpeenniemi, while the renetta and



Figs 11-15. *Microloaimus limnophilus* Turpeenniemi. **11**, total view of male; **12**, total view of female; **13**, male tail; **14**, male copulatory apparatus; **15**, anterior body region of female. Scales: 50 μm (11, 12), 10 μm (13-15).



Figs 16-19. *Microlaimus paraconothelis* sp. n. **16**, head of holotype male; **17**, tail of holotype; **18**, anterior body region of holotype; **19**, copulatory apparatus of holotype. Scales: 10 μm (16, 19), 50 μm (17, 18).

cervical pore noticed by Turpeenniemi are not observed in our material.

M. limnophilus resembles *M. globiceps*, which is a rather small species with annulated cuticle. According to Gerlach (1953), body length of *M. globiceps* from the Kiel Bay is 515 μm (vs. 440-472 μm in our description of *M. limnophilus*), mid-body diameter 22 μm (vs. 24-27 μm); *a* 23 (vs. 17.1-20.5); *b* 6.4 (vs. 6.4-6.7); *c* 6.5 (vs. 6.9-7.4). According to Turpeenniemi (1997), *M. globiceps* is characterized by the following measurements (our measurements of *M. limnophilus* are given in brackets): L 546-648 μm (vs. 440-472 μm), oesophageal length 94-103 μm (vs. 68-73 μm), tail length 47-88 μm (vs. 59-64 μm), mid-body diameter 16-23 μm (vs. 24-27 μm), length of spicules 19-23 μm (vs. 18-20 μm), length of gubernaculum 9-12 μm (vs. 8-9 μm); indexes *a* 27.1-37.9 (vs. 17.1-20.5); *b* 5.4-6.5 (vs. 6.4-6.7); *c* 6.8-11.8 (vs. 6.9-7.4); *cr* 2.9-7.6 (vs. 4.0-4.5). *M. limnophilus* and *M. globiceps* differ in the width of cuticle annuli, shape of terminal esophageal bulb, and size of testes (in *M. globiceps* anterior testis is almost twice as large as posterior one, while in *M. limnophilus* both testes are well-developed and equal in size).

Distribution. Baltic Sea, Gulf of Bothnia, depth 5-17 m. The species is recorded from the White Sea for the first time.

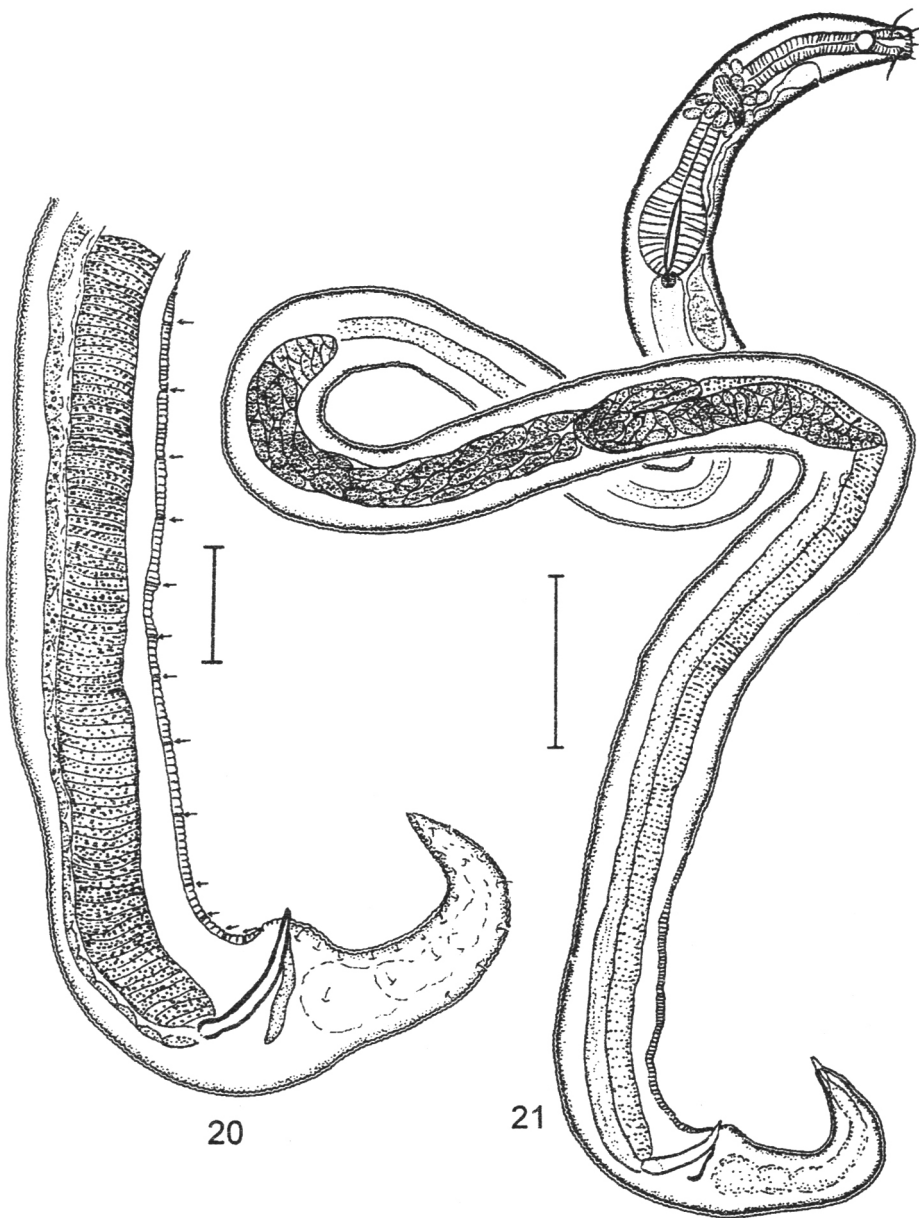
***Microlaimus paraconothelis* sp. n.**
(Figs 16-21)

Holotype. σ , **Russia**, White Sea, Nickodimsky lighthouse, depth 15 m, glycerin slide no. D-1/5.

Paratype. σ , **Russia**, White Sea, Kandalaksha Bay, Velikaya Salma Strait, Biological Station of Moscow State University, sand with spicules, depth 12 m, glycerin slide no. D-1/6.

Description. *Holotype.* L 1702 μm . *a* 31.1; *b* 8.3; *c* 11.7; *cr* 2.5. Length of pharynx 204 μm , tail length 145 μm . Distance from the anterior end to amphid 15.7 μm , cervical pore 49 μm , nerve ring 131 μm . Body diameter at the level of cephalic sensillae of the second circle 15.5 μm , third circle 18.0 μm , amphid 22.1 μm , nerve ring 45 μm , cardia 49 μm , mid-body 55 μm , anus 58 μm .

Paratype. L 1548 μm . *a* 27.6; *b* 7.9; *c* 12.4; *cr* 2.4. Length of pharynx 195 μm , tail length 125 μm . Distance from the anterior end to amphid 12.2 μm , cervical pore 46.5 μm , nerve ring 110 μm . Body diameter at the level of cephalic



Figs 20-21. *Microilaimus paraconothelis* sp. n. **20**, tail and prelocaal area of holotype (supplements are pointed by arrows); **21**, total view of male. Scales: 30 μm (20), 100 μm (21).

sensillae of the second circle 14.6 μm , third circle 17.4 μm , amphid 20.5 μm , nerve ring 39 μm , cardia 48 μm , mid-body 56 μm , anus 52 μm .

Body (Fig. 21) brownish, long, relatively thick, mostly cylindrical, tapering to both ends. Cuticle annulated, smooth in head region in front of amphids.

Head (Fig. 16) weakly separated from the rest of body by a slight cervical constriction. Buccal cavity cyathiform, 21-24 μm long. Cheilostoma with longitudinal ribs; oesophastoma surrounded by pharyngeal tissue. Stoma with three prominent teeth (dorsal and two subventral). Cuticle of stoma weakly sclerotized. Maximum width of

stoma 6.1-6.4 μm . Cephalic sensillae represented by 6 minute labial papillae (0.7-0.9 μm long), 6 cephalic setae of the second circle (3.0-3.5 μm long) and 4 mediolateral setae of the third circle (7.6-8.0 μm long). Amphid large, almost round, 12.7 μm (11.5-12.7 μm) in diameter (51-54% of corresponding body diameter), situated at the level of posterior part of stoma. Two equal setae situated at the level of amphid (4.7 μm long) in dorsal and ventral position, with short dorsal seta behind.

Pharynx (Fig. 18) muscular, cylindrical in the middle part, enlarged anteriorly in pharyngeal bulb around stoma, forming posteriorly pyriform cardiac bulb (53-56 μm \square 32-35 μm) with thickened lumen cuticle. Diameter of pharynx in the middle part 15 μm (13 μm in paratype). Cardia roundish, 7 μm \square 10 μm . Renetta placed ventrally to the posterior part of cardiac bulb, cardia and anterior part of the intestine. Cervical pore situated in front of the nerve ring.

Two testes present: outstretched anterior and posterior, bent near the outlet of vas deferens. Spermatozoa large (to 30 μm long), oblong. Vas deferens consisting of cylindrical cells with brownish granules. Spicules (Fig. 20) 77 μm long in holotype, 70 μm long in paratype, curved (measured along the arc). Gubernaculum 38 μm (30 μm in paratype) long, weakly dilated proximally. Cuticle (Fig. 19) weakly thickened in pre-anal area, with 12-13 medioventral supplements in the form of minute protuberances connected with intracuticular canals. Tail (Fig. 17) obtusely conical, short, covered with 13 lateroventral, 7 laterodorsal and 4 lateral somatic setae. Caudal glands incaudal; spinneret terminal.

Discussion. *M. paraconothelis* sp. n. is characterized by the relatively short tail thickened behind anus, with several rows of setae, sclerotized stoma, relatively long (1.54-1.73 μm) and thick (mid-body diameter is 56-60 μm) body.

The species has similar pattern of cephalic sensillae position with *Microloaimus* and cannot be related to *Bolbolaimus* Cobb, 1920, in spite of the presence of pharyngeal bulb around oesophastoma and sclerotization of its cuticle. *M. paraconothelis* mostly resembles *M. conothelis* in the subequal body length (1.4-1.8 mm in *M. conothelis* (Lorenzen, 1973) and 1548-1733 μm in *M. paraconothelis*), and short (according to Lorenzen's figure) and conical tail thickened behind cloaca (Lorenzen, 1973). Such combination of characters occurs only in *M. paraconothelis* and *M. conothelis*. These species are also similar in shape, position and relative diameter of amphids (51-54% in *M. paraconothelis* vs. 50% of corresponding body diameter in *M. conothelis*). Cephalic setae of *M. paraconothelis* are subequal in length to

those of *M. conothelis*: length of setae of the second circle is 3.4-3.6 μm (vs. 3.5 μm), third circle 9.5-11.8 μm (vs. 8.5-9.0 μm in *M. conothelis*). Both species are characterized by the presence of somatic setae on the tail.

M. paraconothelis differs from *M. conothelis* in the thicker body (*a* 27.0-30.6 vs. 42-69 in *M. conothelis*), considerably longer spicules (70-77 μm vs. 28-32 μm), shape of gubernaculum, structure and number of supplements. Thus, *M. paraconothelis* is characterized by 12 supplements in the form of canals in precloacal thickened medioventral cuticle, while *M. conothelis* has 3-4 conical preanal supplements situated on protuberances. These species also differ in the number of rows of somatic setae on the tail (in *M. conothelis*, somatic seta are arranged in two sublateral rows). Most of the somatic setae present in *M. conothelis* in the neck region are absent in *M. paraconothelis*.

***Microloaimus zosteræ* Allgün, 1930** (Figs 22-28)

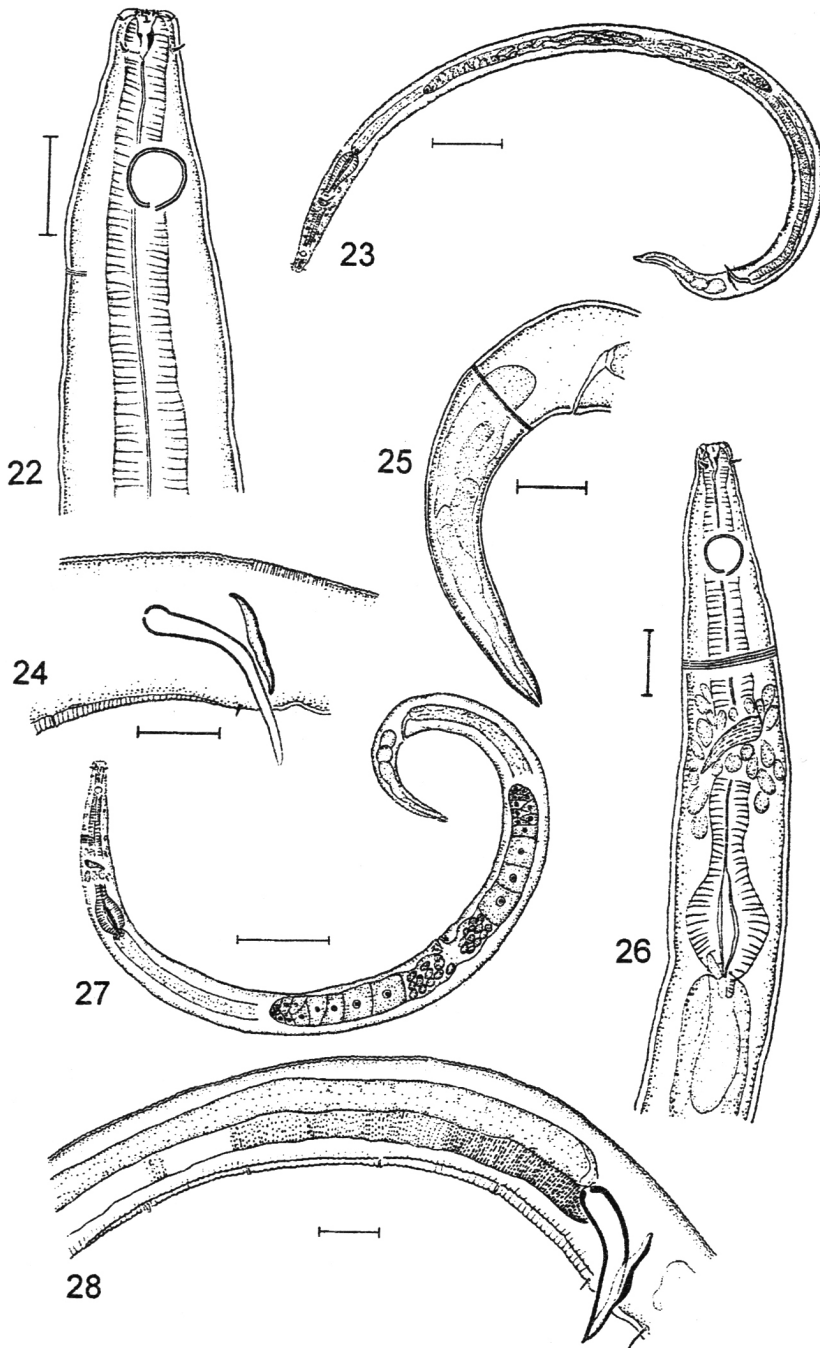
Microloaimus zosteræ Allgün, 1930: 62-63, fig. 5a-c; Platt & Warwick, 1988: 402-403, fig. 187.

Material. **Russia:** 3 σ , 3 φ in glycerin slides, White Sea, Kandalaksha Bay, Velikaya Salma Strait, Biological Station of Moscow State University, accumulation of decaying algae, transect B, 0 m, wash-out from laminaria.

Description. σ . L 618-691 μm . *a* 27.0-29.4; *b* 6.7-7.2; *c* 9.4-9.9; *cr* 3.6-3.8. Length of pharynx 92-96 μm , tail length 66-70 μm . Distance from the anterior end to amphid 14.5-16.0 μm , nerve ring 50-52 μm . Body diameter at the level of outer cephalic sensillae 10.5-11.6 μm , amphid 12.4-13.5 μm , nerve ring 15.7-19.2 μm , cardia 18.5-21.0 μm , mid-body 22.9-23.5 μm , anus 18.0-19.7 μm .

φ . L 584-635 μm . *a* 27.4-29.5; *b* 6.4-6.8; *c* 8.8-9.2; *cr* 3.9-4.0; *V* 48-52 %. Length of pharynx 89-94 μm , tail length 66-69 μm . Distance from the anterior end to amphid 13.5-15.0 μm , nerve ring 48-49 μm , vulva 286-320 μm . Body diameter at the level of cephalic sensillae of the third circle 11.4-12.5 μm , amphid 13.2-15.5 μm , nerve ring 16.5-18.0 μm , cardia 19-20 μm , mid-body 20.8-21.8 μm , anus 16.7-17.3 μm .

Body (Figs 23, 27) oblong, brownish, fusiform. Cuticle from almost smooth to weakly striated, without dots. Head (Fig. 22) not separated from the remaining body. Six inner labial papillae (first circle), 6 papillae of the second circle and 4 short papilliform setae of the third circle present. Stoma 5.9-6.5 μm long, with two small teeth (dorsal tooth and small denticles opposite to it). Amphid roundish, monospiral, distance from it to the front end about twice the stoma length. Diameter of amphid 5.8-6.1 μm in males (43-45% of corre-



Figs 22-28. *Microloaimus zosterae* Allgün. **22**, male head; **23**, total view of male; **24**, male copulatory apparatus; **25**, female tail; **26**, total view of female; **27**, anterior body region of male; **28**, male precloacal area. Scales: 10 μ m (24, 28), 50 μ m (23, 27), 12 μ m (22, 25, 26).

sponding body diameter), 4.5-5.9 μm in females (34-39% of corresponding body diameter).

Pharynx (Fig. 26) muscular, with posterior cardiac bulb (16.5-18.4 μm long, 12.8-14.6 μm wide), cylindrical anteriorly to the bulb, with very weak dilatation surrounding stoma. Diameter of pharynx at the level of the nerve ring 5.8-7.1 μm . Cardia not large, oval. Renetta not observed.

Two outstretched testes present (Fig. 23): longer anterior, with short germinative zone to the right of the intestine, and shorter posterior to the left of the intestine. Spicules (Fig. 24) measured along the arc 28-31 μm long, arcuate, capitated. Gubernaculum 14.5-16.2 μm long, without apophysis, curved, tapering to the ends, wider in the middle part. Medioventral cuticle weakly thickened along 87-100 μm area in front of cloaca. 4-5 supplements in the form of thin canals in cuticle, with outlets on minute protuberances.

Ovaries didelphic, amphidelphic, outstretched. Spermathecae absent. Tail short, conical, tapering to the tip, with terminal spinneret.

Discussion. *M. zosteræ* differs from other *Microloaimus* species in the short body (less than 0.9 mm), papilliform setae of the third circle, very weakly striated or optically smooth cuticle, conical tail, and distance between amphids and front end more than corresponding head diameter. Supplements noticed in our description were not mentioned in previous works. Jensen (1978) placed *Microloaimus zosteræ* Allg n, 1930 in the group of *species inquirenda*. Actually, the original description of Allg n (1930) is not detailed, though it contains a figure and some measurements. Platt & Warwick (1988), however, re-described this species and provided more details.

Distribution. North Sea; Baltic Sea, Oeresund; Strangeford (North Ireland). The species is recorded from the White Sea for the first time.

Acknowledgements

We thank Mr. D.G. Zhadan, Mr. D.M. Miljutin and all divers who collected the material.

References

- Allg n, C. 1930.  ber einige neue oder wenig bekannte Brakwasser-Nematoden von der Litoralzone des  resunds. *Zool. Anz.*, **88**: 58-72.
- Blome, D. 1982. Systematik der Nematoda eines Sandstrandes der Nordseeinsel Sylt. *Mikrofauna des Meeresbodens*, **86**: 271-457.
- Bowmann, L.A. 1981. A survey of nematodes from the Ems Estuary. Part I: Systematics. *Publication of the project "Biological Research in the Ems-Dollart estuary"*, no. 37: 15-66.
- Bussau, C. & Vopel, K. 1999. New nematode species and genera (Chromadorida, Microloaimidae) from the deep sea of the eastern tropical South Pacific (Peru Basin). *Ann. naturhist. Mus. Wien (B)*, **101**: 405-421.
- De Coninck, L.A. 1944. Scientific results of Prof. Dr. Van Oye's expedition in Iceland. XVI. Les n matodes libres des eaux et des terres saum tres. *Biol. Jaarb. Dodonaea*, **11**: 165-220.
- De Coninck, L.A. & Schuurmans-Stekhoven, J.H. 1933. The free-living marine nemas of the Belgian coast II. *M m. Mus. r. Hist. natur. Belg.*, **58**: 90-92.
- De Man, J.G. 1880. Die einheimischen, frei in der reinen Erde und im s ssen Wasser lebende Nematoden. *Tijdschr. Nederl. Dier. Ver.*, **5**: 1-104.
- De Man, J.G. 1922. Vrij levende nematoden. In: *Flora en fauna der Zuiderzee*: 214-261. Den Helder: De Boer.
- Gerlach, S.A. 1950. Die Nematoden-Gattung *Microloaimus*. *Zool. Jb. (Syst.)*, **79**: 188-208.
- Gerlach, S.A. 1953. Die Nematodenfauna der Uferzonen und des K stengrundwassers am finnischen meerbusen. *Acta zool. fenn.*, **73**: 1-32.
- Gerlach, S.A. 1958. Freilebende Nematoden von den Korallenriffen des Roten Meeres. *Kieler Meeresforsch.*, **14**: 241-246.
- Gerlach, S.A. 1959. Neue Meeres-nematoden aus dem Supralitoral der deutschen K sten. *Int. Rev. ges. Hydrobiol. Hydrogr.*, **44**: 463-467.
- Gerlach, S.A. 1965. Freilebende Meeres-nematoden aus der Gezeitenzone von Spitzbergen. *Veruff. Inst. Meeresforsch. Bremerh.* **9**: 109-172.
- Jaysree, K. & Warwick, R.M. 1977. Free-living marine nematodes of a polluted sandy beach in the Firth of Clyde, Scotland. Description of seven new species. *J. natur. Hist.*, **11**: 289-302.
- Jensen, P. 1978. Revision of Microloaimidae, erection of Molgolaaimidae fam. n., and remarks on the systematic position of *Paramicroloaimus* (Nematoda, Desmodorida). *Zool. Scripta*, **7**: 160-173.
- Jensen, P. 1979. Nematodes from the brackish waters of the southern archipelago of Finland. Benthic species. *Ann. zool. Fenn.* **16**: 151-158.
- Kreis, H. 1929. Freilebende marine Nematoden von der Nordwestk ste Frankreichs (Trebeurden Cotes du Nord). *Capita zool.*, **2**(7): 1-98.
- Lorenzen, S. 1971. *Ixonema sordidum* gen. n., sp. n. (Microloaimidae, Nematoda) aus sublitoralem Grobsand bei Helgoland. *Mar. Biol.*, **8**: 267-269.
- Lorenzen, S. 1973. Freilebende Meeres-nematoden aus dem Sublitoral der Nordsee und der Kieler Bucht. *Veruff. Inst. Meeresforsch. Bremerh.*, **14**: 103-130.
- Lorenzen, S. 1976. *Calomicroloaimus rugatus* n. gen., n. sp. (Desmodorida, Nematodes) from a sandy beach in Colombia. *Mitt. Inst. Colombo-Aleman Invest. cient.*, **8**: 79-82.
- Lorenzen, S. 1994. *The phylogenetic systematics of free-living nematodes*. 383 p. London: The Ray Society.
- Meyl, A.H. 1954. Beitr ge zur Kenntnis der Nematodenfauna vulkanisch erhitzter Biotope III. Mitteilung. Nematoden aus der Mischungszone strandn her, heisser Subwasserquellen mit dem Meerwasser auf der Insel Ischia. *Z. Morph.  kol. Tiere*, **42**: 421-448.
- Platt, H.M. & Warwick, R.M. 1988. Free-living marine nematodes. Part I: British Chromadorids. *Synopses of the British Fauna (N. S.)*, no. **38**. Leiden etc.: Linn. Soc. Lond. & Estuarine and Brackish-Water Sci. Assoc.
- Schuurmans-Stekhoven, J.H. 1935. Additional notes to my monographs of the free-living marine nemas of the Belgian coast I. and II. *M m. Mus. r. Hist. natur. Belg.*, **72**: 1-36.
- Schuurmans-Stekhoven, J.H. 1950. The free-living marine nemas of the Mediterranean. I. The Bay of Villefranche. *M m. Inst. r. Sci. natur. Belg.*, **37**(2): 1-220.

- Sergeeva, N.G.** 1976. New data on the taxonomy of the nematodes of subfamily Microloaiminae. *Zool. Zh.*, **55**: 1090-1094. (In Russian).
- Soetaert, K. & Vincx, M.** 1988. *Spirobololaimus bathyalis*, gen. nov., sp. nov. (Nematoda, Microloaimidae) from the Mediterranean (Calvi). *Hydrobiologia*, **164**: 33-38.
- Stewart, A.C. & Nicholas, W.L.** 1987. *Acanthomicroloaimus jenseni* n. g., n. sp. (Nematoda: Microloaimidae) from marine sand. *Cah. Biol. mar.*, **28**: 91-96.
- Turpeenniemi, T.A.** 1997. Four new nematode species from the Bothnian Bay, Northern Baltic Sea, with a redescription of *Microloaimus globiceps* de Man, 1880 (Nematoda). *Nematologica*, **43**: 31-58.
- Vincx, M.** 1981. New and little known nematodes from the North Sea. *Cah. Biol. mar.*, **22**: 431-451.
- Warwick, R.M.** 1970. Fourteen new species of free-living marine nematodes from the Exe estuary. *Bull. Br. Mus. natur. Hist. (Zool.)*, **19**(4): 137-177.
- Warwick, R.M. & Platt, H.M.** 1973. New and little known marine Nematodes from a Scottish sandy beach. *Cah. Biol. mar.*, **14**: 135-158.
- Wieser, W.** 1954. Free-living marine nematodes. II. Chromadoroidea. *Acta Univ. Lund (N. F. 2)*, **50**(16): 1-148.
- Wieser, W.** 1959. *Free-living nematodes and other small invertebrates of Puget Sound beaches*. 179 p. Seattle: Univ. Washington Press.

Received 12 May 2005