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Ecology and systematics of free-living nematodes from the Bothnian Bay, northern Baltic Sea

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Free-living nematodes were collected from a wide depth range (0.8-82m) and different substrate types in the northernmost part of the Bothnian Bay (Hailuoto, Krunnit area; salinity 2-3.5 %). The collection comprises 32 species and contains limnic and brackish-water elements. Most of the species showed a wide range of occurrence with regard to both depth and substrate type (especially the three most common species *Axonolaimus spinosus*, *Chromadorita fennica* and *Paracanthonchus bothnicus* n.sp.). The paper gives a detailed systematic account of several species, in particular *Hofmaenneria brachystoma*, *Chromadorita tentabunda*, *Neochromadora izhorica*, *Paracanthonchus bothnicus* n.sp. and *Tripyla filipjevi*.

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1. Introduction

The Bothnian Bay, the northernmost part of the Baltic Sea, is characterized by low and stable salinities (Hailuoto area, S = 2-3.5 ‰; see, e.g., E. Alasaarela 1979). A unique feature of the benthic fauna of this area is the predominance of meiobenthos, both in population numbers and in biomass (see Elmgren 1978). The Zoological Department of the University of Oulu therefore decided to start a project on the ecology and production biology of the meiobenthos in this area. To initiate this work a course on meiobenthos was organized at the field station in Hailuoto in June 1976. During this course a small series of nematode samples was collected. Although a large number of faunistical papers on the nematodes of the Baltic Sea have been published (for a review see Jensen 1983), the northern part of the Baltic has never been the object of a nematological study. The present paper provides some information on the faunal assemblages of nematodes under oligohaline, oligotrophic and subpolar conditions. The systematical analysis of the material required a critical description of some of the "well known" brackish-water species.

2. Material and methods

The main series of nematode samples was taken during the period 10-17.6.1977, from different types of sediment in water depths ranging from 5 to 82 metres (samples referred to as BB77/ stations 2, 3, 4, 5, 7, 8; see Table 1 and Fig. 1). Hakala and Kajak corers with a sampling area of 20 cm^2 were used. These core-samplers failed to function on hard, sandy substrates and a Van Ween crap was used. The samples were fixed in 5 % formalin and stained with Rose Bengal.

In addition to this material, nematodes collected in 1976 in the same area were made available to us (BB76/ stations 1, 5, 6). This collection contained mainly larger worms, since a 200 µm sieve was used for sorting.

For comparative purposes, nematode material from other parts of the Baltic (e.g. the Tvärminne area, Finland; Denmark), from the North Sea and from the Weser Estuary was anaysed. One of us (PJ) had the opportunity to check the collection of I. Filipjev at the Zoological Institute, Leningrad.

The Bothnian Bay material is in the collection of F. Schiemer, except the following slides, which are deposited in the "Nematodensammlung des Institutes für Meeresforschung in Bremerhaven": NSIMB 544 a-f (coll. Schiemer; *Chromadorita tentabunda, Neochromadora izhorica, Paracanthonchus bothnicus);* NSIMB 545 (leg. Turpeeniemi; *Chromadorita tentabunda).*

3. Composition and ecological characteristic of the nematode fauna

Our material of 877 specimens comprises 32 species (Table 2), and contains both limnic and brackish-water elements (see Gerlach, 1954).

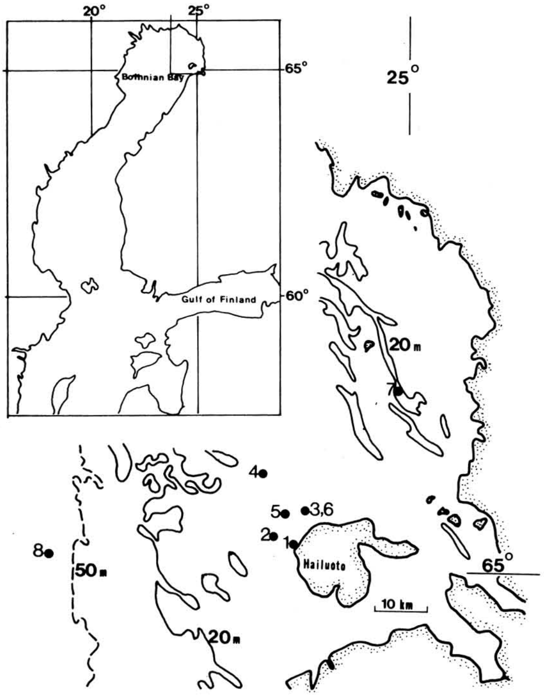


Fig. 1. Sampling stations. The 20 m and 50 m isopleths are indicated.

Most of the species encountered are already known from the Baltic; the exceptions are *Sphaerolaimus gracilis, Hofmaenneria brachystoma* and *Paracanthonchus bothnicus* n.sp. The composition of the fauna, as well as the ratio between the limnic, oligohaline and euryhaline elements, resembles the situation described by Gerlach (1953) from the German coast. Figure 2 compares the salinity range of some of the species, mainly on the basis of data from Gerlach (1953), Riemann (1966) and Jensen (1983). According to the salinity range we can distinguish several groups of species:

a) *Tobrilus gracilis, Tripyla setifera, Ironus tenuicaudatus, Chromadorita leuckarti* and, possibly, *Ethmolaimus pratensis* are freshwater species which are known from brackish-water habitats.

b) Most of the species encountered are typical brackish-water forms with a distribution centre in the oligohaline-β mesohaline zone: *Sphaerolaimus gracilis, Neochromadora izhorica, Dichromadora geophila, D. setosa, Microlaimus globiceps, Adoncholaimus thallassophygas, Oncholaimus conicauda, Chromadorita fennica. Tripyla setifera* may also belong to this category (see Gerlach 1953).

C) Some are euryhaline brackish-water species known from a very wide salinity range. The range of some of the species extends from freshwater into the polyhaline zone, e.g. *Daptonema setosum, Axonolaimus spinosus* and *Tripyloides marinus (Theristus flevensis* even into hypersaline conditions). Several of the "euryhaline species" may constitute a species complex (see, e.g. comments on *Leptolaimus elegans).*

The faunal diversity (expressed as diversity and evenness indices, see Table 2) at the various sampling stations is generally higher than in freshwater (e.g. Schiemer 1978) or marine habitats (e.g. Ott 1972).

Most of the species showed a very wide range of occurrence, with regard to both depth and substrate type. This holds particularly true of *Axonolaimus spinosus, Chromadorita fennica* and *Paracanthonchus bothnicus,* which were found at all six localities sampled in 1977. *Daptonema setosum, Enoplolaimus balgensis* and *Adoncholaimus thalassophygas* were additionally present in both shallow, sandy bottoms (BB2, 5 m) and in deep, soft mud sediments (BB8, 82m). As a result of this wide distribution of most of the species, faunal similarity between sampling stations (examined using Czekanowsky's similarity coefficient, see Wolda 1981) is generally high (<50 %). Slightly lower values are mainly characteristic of the deep, offshore sampling station (see Fig. 3).

The following species were found to be dominant at particular stations:

Table 1. Location and characteristics of sampling stations.

Sampling stations	Location	Water depth	Sediments
1. Marjaniemi, north shore	65° 03′N,24°34′E	0.9 m	sand-silt
2. Marjaniemi, north shore	65° 04′N,24°30′E	5 m	sand
3. Karvo	65° 06′N,24°36′E	16.5 m	sand
4. Karvo	65° 10′N, 24°25′E	17 m	hard sand bottom
5. Karvo	65° 06′N,24°32′E	22 m	soft mud
6. Karvo (near 3.)	65° 06′N,24°36′E	14 m	sand
7. Ulkokrunni	65° 19′N, 24°58′E	40 m	soft mud
8.	65° 02′N,23°30′E	81 m	soft mud

Table 2. List of species and number of individuals collected at different sampling stations, diversity and evenness indices.

	1976			1977					
	BB1	BB3	BB5	BB2	BB3	BB4	BB5	BB7	BB8
Ascolaimus elongatus (Bütschli, 1874)				23		14	1		
Axonolaimus spinosus (Bütschli, 1874)	11	8	14	46	13	2	43	5	1
Leptolaimus elegans (Sch.-Stekhoven and De Coninck, 1933)					4	25	5	2	
Leptolaimus papilliger De Man, 1876						1			
Tripyloides marinus (Bütschli, 1874)			1						
Hofmaenneria brachystoma (Hofmaenner, 1914)					1				1
Sphaerolaimus gracilis De Man 1876			1						
Monhystera sp. (aff. *parasimplex)*			1						
Theristus (Penzancia) scanicus Wieser, 1956				2		1	2		
Theristus (Penzancia) flevensis Sch.-Stekhoven, 1935			1	9			1		
Daptonema setosum (Bütschli, 1874)				4					1
Daptonema cf *biggi*									1
Daptonema leptogastrelloides Riemann, 1979				1					
Eleutherolaimus sp. (aff. *stenosoma)*				1	1	6	1		
Microlaimus globiceps De Man, 1880				2		9	18		
Chromadorina aff. *viridis*				1					
Chromadorita leuckarti (De Man, 1876)				1					
Chromadorita fennica Jensen, 1979		2	18	7	2	6	155	10	1
Chromadorita tentabunda (De Man, 1890)				2	2				
Neochromadora izhorica (Filipjev, 1929)		1		2			6	2	
Dichromadora setosa (Bütschli, 1874)				9		2			5
Dichromadora geophila (De Man, 1876)									1
Paracantonchus bothnicus n.sp.				54	2	6	8	2	25
Ethmolaimus pratensis De Man, 1880						2			3
Enoplolaimus balgensis Skwarra, 1921	1		1	6					3
Adoncholaimus thalassophygas (De Man, 1876)	56	70	3	2			1		1
Oncholaimus conicauda Filipjev, 1929				12	1		1		
Tripyla filipjevi Altherr, 1972			1			15	1	2	2
Tripyla setifera Bütschli, 1873						19		1	
Tobrilus gracilis (Bastian, 1865)	1		1		1		6		
Ironus tenuicaudatus De Man, 1876	12	21	3			11			
Dorylaimus sl.sp.									1
Number of individuals	81	102	45	184	27	119	249	24	46
Number of species *(S)*	5	5	11	18	9	14	14	7	13
Diversity index H (Shannon-Weaver)				3.1	2.5	3.3	1.9	2.4	2.5
Evenness index $(H/\log_2 S)$				0.74	0.79	0.89	0.50	0.85	0.67

Paracanthonchus bothnicus	BB77/2 (5m, sand) BB77/8 (82m, soft mud)
Axonolaimus spinosus	BB77/2 (5m, sand; subdominant) BB77/3 (16.5m, sand)
Chromadorita fennica	BB77/5 (22m, soft mud) BB77/7 (40m, soft mud)
Leptolaimus elegans	BB77/4 (17m, sand)

An additional analysis of the nematode fauna on the submerged macrophytes of the Bothnian Bay (Hailuoto area) showed high densities of *Punctodora ratzeburgensis* (v. Linstow 1976 and *Adoncholaimus thalassophygas,* and lower numbers of *Koerneria fictor* (Bastian 1865). *P. ratzeburgensis* and *K. fictor* which were not recorded in the sediments probably occur there during the winter (Jensen 1983).

4. Descriptions and comments

Leptolaimus elegans (Schuurmans Stekhoven & De Coninck, 1933)

Our material from the Bothnian Bay includes 5 ♂which are characterized by having 5 pre-anal tubuli. Lorenzen (1972) found 5 tubuli in ♂of *L. elegans* from the Tvärminne are, while specimens from polyhaline and euhaline habitats had 7 or 8 tubuli.

Hofmaenneria brachystoma (Hofmänner, 1914)

Material

1 ♂ (BB77/3/1), 1 ♂ (BB77/8/3); reference material from Attersee, Austria: 6♂,6♀ (leg. S. Dudzinski).

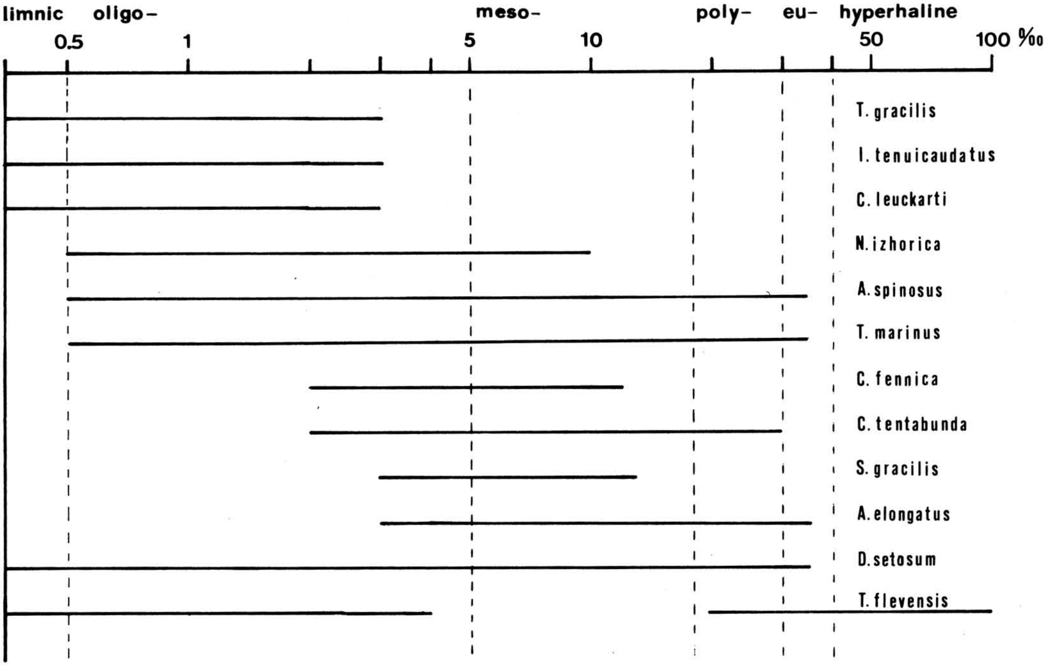
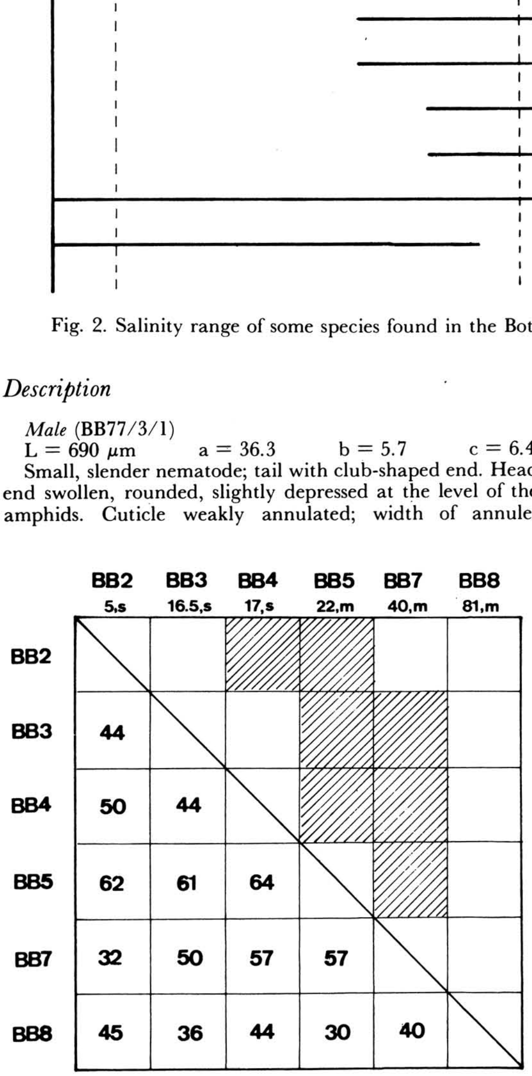


Fig. 2. Salinity range of some species found in the Bothnian Bay.

Description

Male (BB77/3/1)
$L = 690\ \mu m$ $a = 36.3$ $b = 5.7$ $c = 6.4$

Small, slender nematode; tail with club-shaped end. Head end swollen, rounded, slightly depressed at the level of the amphids. Cuticle weakly annulated; width of annules approximately 1 µm. Annulation starts between head end and amphids. Weak setation, mainly in the area of the oesophagus and on the tail. 10 (14?) fine cephalic setae, 4.5 µm long (60 % of head width). Lips with small papillae. Amphids circular, situated 22 µm from head end, 8.5 µm wide (70 % of corresponding body width). The stoma forms a simple cylindrical tube, 6 µm long, 4 µm wide with well sclerotised walls without interruptions. Oesophagus cylindrical, without terminal swelling; cardia spherical. Spicules slender, slightly curved proximally knobbed. Length of spicules 34.4 µm in the chord (2.5 times the anal body width). Gubernaculum short, without apophysis. Approximately 20 supplements in form of flat humps, starting 100 µm (i.e. three times the spicule length) anterior of the anus.



	BB2 5,s	BB3 16.5,s	BB4 17,s	BB5 22,m	BB7 40,m	BB8 81,m
BB2			▨	▨		
BB3	44			▨	▨	
BB4	50	44		▨	▨	
BB5	62	61	64		▨	
BB7	32	50	57	57		
BB8	45	36	44	30	40	

Fig. 3. Trellis diagram of faunal similarity (Czekanowski index in %) between different sampling stations. Shaded ≥50 %; white <50 %, Numbers below station symbols refer to depth (in metres) and sediment type (s = sand; m = soft mud).

Discussion

The indentification of the two males in the Bothnian Bay material was made possible by a comparison with male and female specimens, from the profundal zone of lake Attersee (Austria). This material shows full agreement with the two males from the Bothnian Bay. The specimens from the Bothnian Bay and from Attersee agree well with the few descriptions of *H. brachystoma* in the literature (see Table 3). Only few discrepancies have been noticed which may be due to observational errors: the cephalic setae in our specimen are clearly longer than depicted by Micoletzky (1922). However, they are rather fine and their termination is not easily visible except in phase- or interference contrast microscopy. The opaque bodies (glands) in the area of the supplements, which have been figured

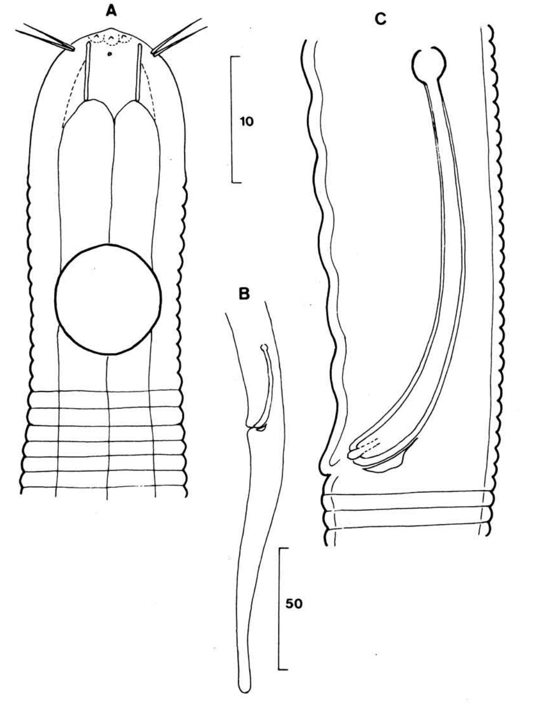


Fig. 4. *Hofmaenneria brachystoma.* — A: head end of ♂. — B: tail end. — C: spicular apparatus. Scale in μm.

so prominently by Micoletzky (1922) and Allgén (1927) are not always as clearly visible: we could not observe such structures in the Bothnian Bay material and only in one (out of six) male from Attersee.

While the original description of *H. brachystoma* by Hofmänner & Menzel (1915) is relatively clear, the description of *H. niddensis* by Skwarra (1921) is incomplete. Characteristic differences in the spicules, as described by Skwarra (1921) could not be substantiated by later authors. Thus, the main difference from *H. brachystoma* which remains from the original description is the larger body size of *H. niddensis*. Gerlach & Meyl (1957) and Gerlach & Riemann (1971) gave detailed descriptions of the location, size and sexual dimophism of the amphids, the form and the absolute size of the spicules, the pre-anal cuticle humps in the male and the form of the tail are all similar in both species. From the figures of Gerlach & Riemann (1971) it appears that in *H. niddensis* the buccal cavity is less distinct and relatively shorter than in *H. brachystoma.* A further differential characteristic may be the elongated, oval cardia in *H. niddensis* compared to a spherical cardia in *H. brachystoma.* A comparison of morphometric data in the literature for both species is given in Table 3.

H. brachystoma is a freshwater nematode which is known mainly from the profundal zone of lakes.

Table 3. Compilation of data (measurements in μm) of *Hofmaenneria brachystoma* and *niddensis.*

Source		*n*	L	a	b	c	V (%)	Amphid diam. μm	Amphid diam. % corr. body-width	Buccal cavity	Spicule length	Egg size	Location
Hofmaenneria brachystoma													
Hofmänner 1915	♀		450-600	30-40	4.3-5.3	5.8-6.4						40 x 13	Genfersee, Vierwaldstättersee, Langensee. Littoral - profundal.
	♂		530-690										
Micoletzky 1922	♀		620-750	30-38	4.6-5.0	5.4-6.1	61-63		20			25 x 16	Madü See, Plöner See.
	♂		660-690	34-42	4.8-5.0	5.8-6.7			50		38[1]		Profundal zone.
Micoletzky 1925	♂	2	640-710	38-41	5.0-5.3	5.6-5.7		6.3, 7.2			34,40		Furesee. Profundal.
Allgen 1927	♀		860	34	5.2	5.7	63		20				
	♂		900	30	4.5	9.0			33		45		Lake Vättern
Gerlach & Meyl 1957	♀		935	30	7.8	7.5	67	4	20				Lake Ohrid. Littoral
Dudzinski (unpubl.)	♀	6	467-622	32-47	4.0-5.1	5.2-6.3	61-65	2.4-2.9	22-30	7.3-7.8			Attersee.
	♂	6	610-643	31-38	5.0-5.2	5.7-6.2		7.3-7.8	56-64	6.3-7.3	30.7-37.6		Profundal.
This paper	♂	1	690	36	5.7	6.4		8.5			34.5		Bothnian Bay.
Hofmaenneria niddensis													
Skwarra 1921	♂	1	1200	50	5.2	5.8							Kurisches Haff.
Gerlach & Meyl 1957	♀		1018	35	5.5	4.8	61	5					Elbe
	♂		1128	44	5.4	6.1		10			36		
Gerlach & Riemann 1971	♀		1210	42	5.3	6.1	65					75	Elbe
	♂		1210	52	5.5	6.3					35		

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[1] In the original paper the spicule length was given as 98 μm; in Micoletzky 1925 the author gave the corrected value.

Sphaerolaimus gracilis De Man, 1876

Sphaerolaimus balticus G. Schneider, has so far been the only representative of the genus known from the Baltic. *S. gracilis* can be readily distinquished from *S. balticus* by the posterior location of the amphids and the form of the copulatory apparatus. Detailed descriptions of the two species have been given by Lorenzen (1969) and Jensen (1979a).

Eleutherolaimus sp. aff. **stenosoma**

Our material includes one species which resembles *E. stenosoma* De Man in some morphololological features. However, as discussed by Gerlach (1953), it may be, that the brackish-water representative is a distinct species different from the original description of *E. stenosoma* by De Man. Furthermore, the material collected by Keynäs & Keynäs (1978) in the Tvärminne area includes at least two *Eleutherolaimus* species closely related to *E. stenosoma* (P. J. unpubl.). With our limited material, we cannot draw any definite conclusions about the identity of the Bothnian Bay species before the Tvärminne material is finally analysed.

Chromadorita leuckarti (De Man, 1876)

Our material contains only one female (slide BB77/2/9), which has the vaginal muscle budles characteristic of *C. leuckarti.*

Chromadorita fennica Jensen, 1979

The diagnostic features and the differentiation from the related *C. leuckarti, C. tenuis* and *Neochromadora izhorica* have been discussed in detail by Jensen (1979a). *C. fennica* appears to be a common benthic species in the Baltic Sea (e.g. it was found to be a common inhabitant of the oxygenated sediment layers of Ringkøbing Bay, Denmark — Jensen 1983).

Chromadorita tentabunda (De Man, 1890)

Syn. *Chromadora pachydema* G. Schneider, 1926 nov. syn.

Material

1. Bothnian Bay: BB77/2, BB77/3 (3 ♀, 1 iuv.). Additional material from Bothnian Bay, leg. Turpeenniemi 1977, 65° 23.9′ N, 25° 09.5′ E, sand, 7m depth (1♂).

Reference material from:

2. Svanviken (Esknäs-Balget), Tvärminne, Finland, leg. P. Jensen 1980 (1♂, 2 ♀).

3. Weser Estuary, sand flat in Bremerhaven (see Riemann 1979), 1973-1976 (26 ♂, 48 ♀).

4. North Sea, Wadden area north of Bremerhaven, S = 27‰, leg. Farke 1979 (3 ♂, 1♀).

5. Lynher Estuary, England, collection R. M. Warwick (2 ♂, 5 ♀).

Reference material from the Bothnian Bay and the Weser Estuary is deposited in the "Nematodensammlung des Institutes für Meeresforschung in Bremerhaven" (NSIMB 536, 544-545).

Description

Female from the Bothnian Bay (BB77/2/1 = NSIMB 544a; Fig. 5 A-C).

L = 630 μm; a = 21; b = 6,3; c = 6.9; V = 50 %.

Small nematode with very strong, backward curved body setae, which are up to 12 μm long in the neck region and 10 μm in the posterior region; they are mostly situated in submedian rows. Widely separated, punctated cuticular rings, the punctation being more coarse in the neck region than behind. No lateral differentiation of the punctation and no lateral elevation of the cuticle present. A single row of 8 conspicuous ring pores is situated on either side in the dorsosublateral position-three in front of the vulva and five behind. These ring pores are the outlets of large hypodermal glands (see Fig. 5 D_1, F, G). In addition, few very minute pores could be detected in the ventrosublateral position (in most other specimens they are invisible). Lips with distinct incisions and minute, pointed papillae. Head papillae 1 μm long; six head setae 12 μm long (= 73 % of corresponding head diameter). Cervical gland pore clearly seen in lip region, the ampulla displacing the pharyngeal musculature to the dorsal side. Tail turned to the left side, with a dorsally directed spinneret.

Male from Weser Estuary (NSIMB 436 h; Fig. 5 D_1 and D_2): L = 530 μm; a = 22; b = 5.9; Spiculum 25 μm in the chord.

General body shape as in the female. Head setae 12 μm long (= 86 % of corresponding head diameter), cervical setae reaching 12 μm long. No pre-anal supplements (in one specimen, folds in the cuticle of the strongly curved pre-anal region give the impression of minute supplements). 7 ring pores between cardia and anus (in another male one additional ring pore was seen on the left side of the tail).

Additional observations

The one male from the Bothnian Bay (NSIMB 545) (L = 482 μm; a = 21; head setae 9 μm = 72 % of corr. diam.) shows similarities with the Weser specimens. The body seta pattern could not be clearly assessed because of the setiform microorganisms that are often attached to individuals of this species. The specimens from Svanviken are interesting because this site is the type locality of *"Chromadora pachydema"*. Data from the male (deposited in the Zoological Museum of Helsinki; Fig. 5 G-I): L = 580 μm; a = 20.5; Spiculum 33 μm in the chord; head setae 8 μm long (= 53 % corr. diam.), longest cervical setae 8 μm. 7 ring pores between the cardia and anus on the left side; the tail apparently bears only one pore on the right side. Data from a female (Fig. 5 F): L = 650 μm; a = 19; V = 49 %; head setae 7 μm long (= 44 % corr. diam.); cervical setae up to 11 μm long; 8 dorsosublateral ring pores distributed as in the female from the Bothnian Bay. We found the same pattern in the female from the North Sea; in this material the head setae are not more than 9 μm long (= 60 % of corr. diam.). The Lynher individuals also have short head setae (about 50 % corr. diam.); the spicular apparatus of one male (L = 46 = μm; a = 16) is shown in Fig. 5 K.

Only one caudal gland with one nucleus was observed in the well preserved material from the Weser Estuary (Fig. 5 E, NSIMB 536 i, further examples on slides 536 e,f). The ampulla of the gland duct is very large, occupying the posterior half of the tail. This situation could be demonstrated by fixation with formalin and propionic acid, sometimes with addition of ethanol.

Discussion

The bibliography of *Chromadorita tentabunda* and related species is treated by Gerlach & Riemann (1973 p. 349), who used the generic name proposed by Inglis 1969: *Innocuonema.* However, the diagnostic character of *Innocuonema,* namely the heterogeneous cuticular ornamentation, does not warrant a clear differentiation from the genus *Chromadorita* Filipjev 1922, because there is also a slight change in the cuticular ornamentation in this genus (e.g. *Chromadorita leuckarti).* this probably occurs in all Chromadoridae, which have been classifield as having a so called homogeneous cuticle. Thus, for the time being we prefer to use the older and widely accepted generic name *Chromadorita* for the species in question.

Our material shows a variation in the length of the head setae and body setae, in the curvature of the spicules, and in the body dimensions. Two variable characters are related to the salinity of the habitats. The individuals with the most conspicuous setosity and more strongly bent spicules come from the less haline sites and those with shorter setae and with more slightly curved spicules come from sites with a higher salinity. The latter specimens correspond more closely to the original description of *Chromadorita tentabunda* (De Man 1890) than the former. In spite of these difference it does not seem justified to distinguish two species in the material at hand. A comparable situation was found by Riemann (1966:98–99) in euryhaline *Daptonema setosum* (Bütschli 1874) populations, whichs showed considerable variation in setal lengths.

The new observation on the ring pore distribution pattern is important. We found the described pattern of 8 dorsosublateral ring pores, with the first one situated at the end of the cervical gland in populations with short head setae and in those with long setae as well. Sharma, Hopper & Webster (1979) suggest great taxonomic significance of the pore patterns in Cyatholaimidae and accordingly the same may hold true in Chromadoridae. Thus we think that the particular pattern in our material indicates a specific character. In the females of *Chromadorita nana* Lorenzen 1973 (type material, NSIMB 313 b, 331 c), which otherwise closely resemble *C. tentabunda,* there are about 15 ring pores on either side in an irregularly spaced arrangement which is different from that in our *C. tentabunda* material. They are in the lateral and dorsolateral positions.

Chromadorita tentabunda has never before been reported from Finland; instead, *C. pachydema* (G. Schneider 1926) is mentioned. The original description of *"Chromadora pachydema"* is based on a single female. Now that we have a male and additional females from the type locality we propose to synonymise this species with *C. tentabunda.* The description of Schneider deviates from our material by the greater relative body width (a = 12.5). However, Gerlach (1951) gave a description of a female of *C. tentabunda* from the North Sea with the Demanian quotient a = 10. Filipjev (1930) gave a redescription of *C. pachydema* from the Gulf of Finland (low salinity conditions); his material seems to correspond closely to our material from the Bothnian Bay and the Weser Estuary.

An interesting peculiarity of *Chromadorita tentabunda* is its possession of only one caudal gland. This character had not been noted by De Man (1890, 1922), but his figures demonstrate the single large terminal ampulla of the gland. The figure by Wieser (1954) of *"Graphonema amokuroides"* likewise indicates the presence of only one gland. Hopper (1968) reported one gland for *Chromadorita tenuis* (G. Schneider 1926). In contrast, the majority of Chromadoridae descriptions demonstrate three glands. *Dichromadora geophila* (De Man 1876), however, has only two caudal glands (from own observations of Weser material). We think, therefore, that in future more attention should be paid by taxonomists to the number of caudal glands in Chromadoridae; they could yield additional diagnostic characters in this taxonomically difficult group.

Bionomics

De Man (1890) stated that *Chromadorita tentabunda* is permanently attached to the substrate by its tail, and is thus always moving its head; Our observations with North Sea and Weser material support this statement. The species has a very limited capacity for locomotion and restricts itself almost entirely to intensive search movements with the head, in the course of which the substrate is often touched. The method of locomotion is a peculiar jumping movement, similar to that described by Gerlach (1954) and Lorenzen (1973 a). This is a mode of locomotion used by many small nematodes living in a habitat with relatively coarse interstices.

Such a habitat does not permit normal nematode movement by undulatory propulsion, which requires finer interstices with many alternating edges to permit propulsion. The adhasive capacity of *Chromadorita* is enormous; it is rarely possible to remove an attached specimen from the substrate by the suction of a pipette.

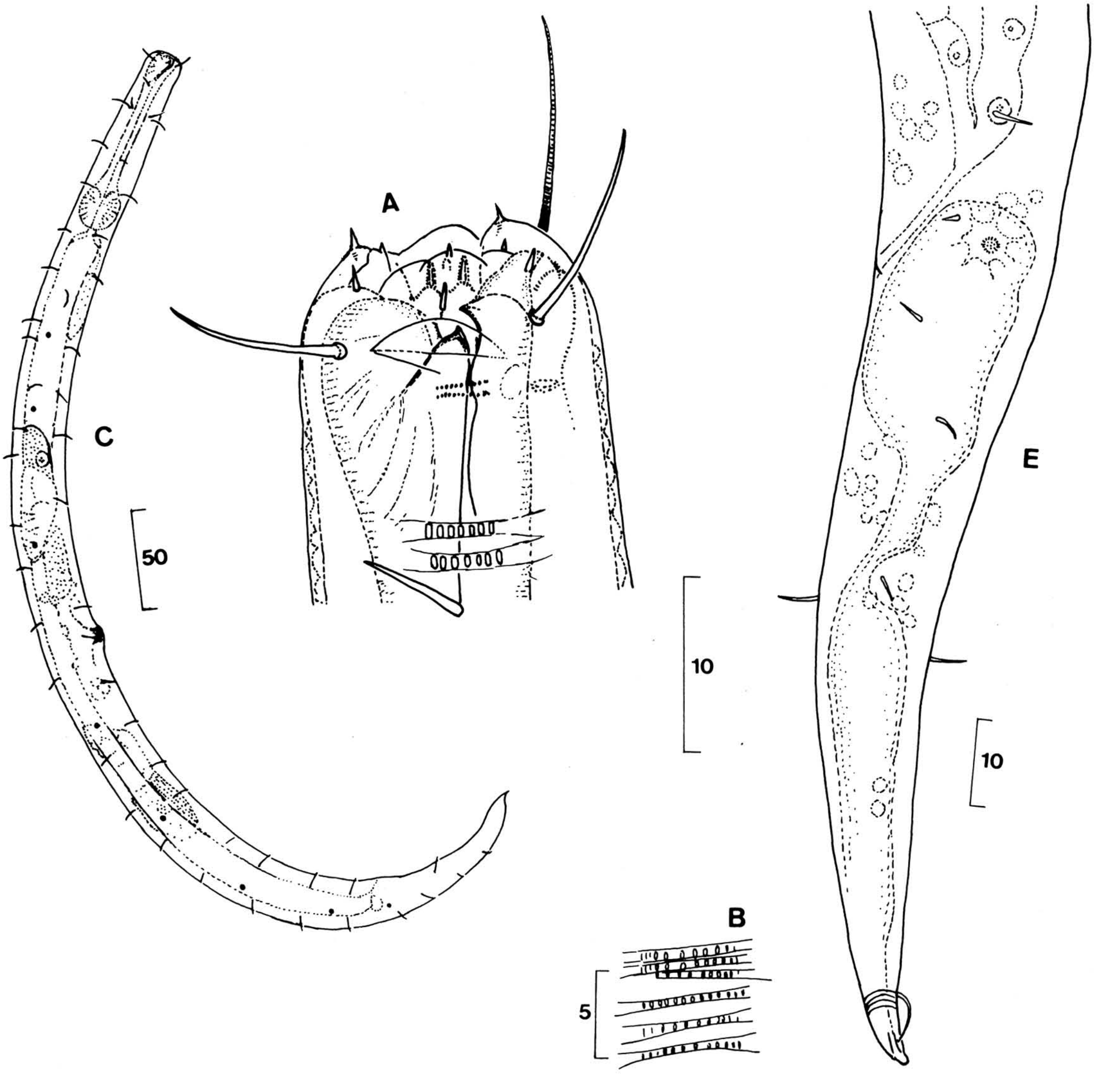
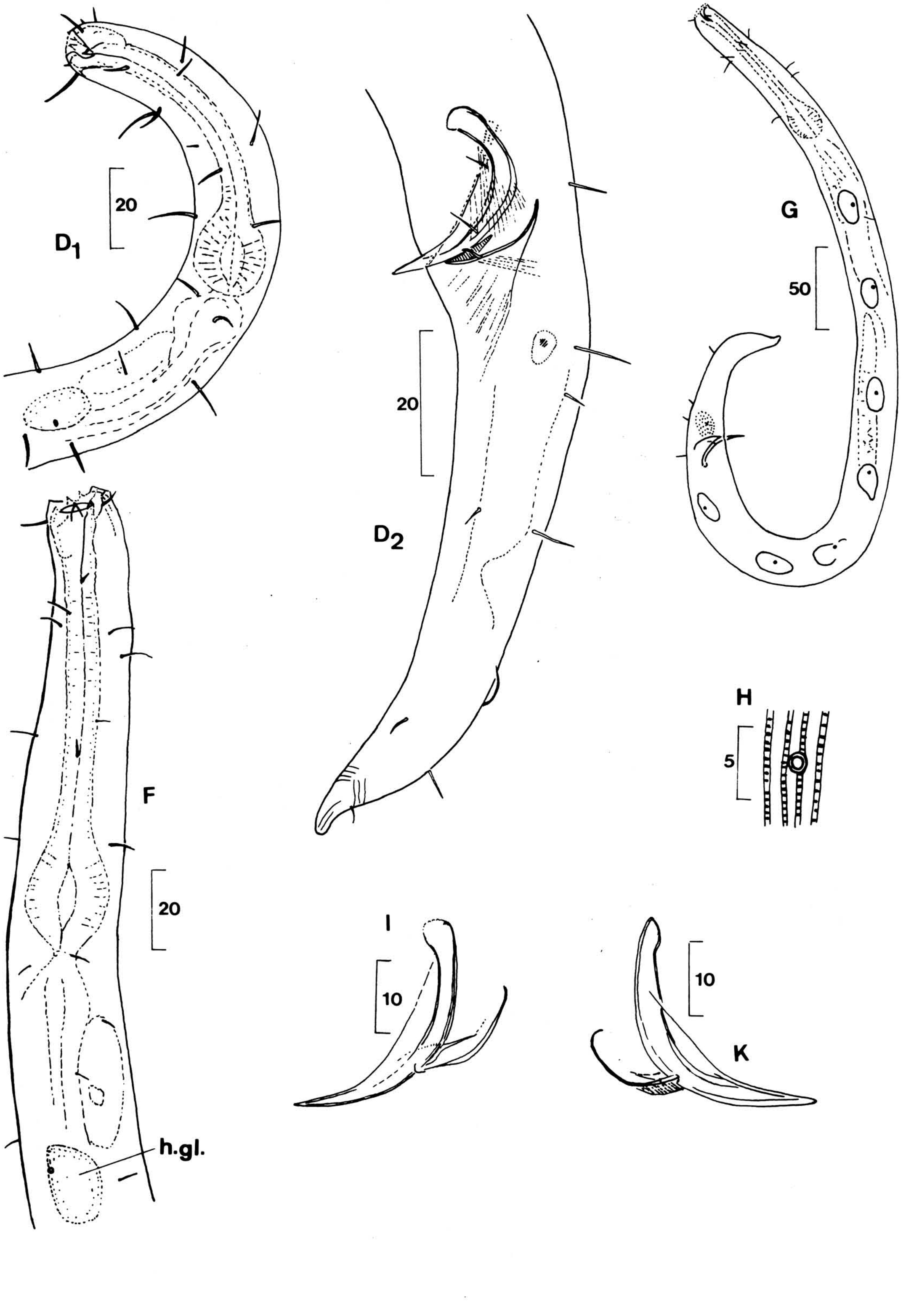


Fig. 5. *Chromadorita tentabunda.* — A: head of a female from the Bothnian Bay. — B: Lateral cuticular ornamentation of the same individual in the middle of the body. — C: Total view of the same female. — D_1: Anterior end of a male from the Weser Estuary. — D_2: Tail of the same male. — E: Tail of a female from the Weser Estuary. — F: Anterior end of a female from Svanviken, h.gl. = hypodermal gland. — G: Male from the same locality, showing hypodermal glands. Only the largest setae are drawn. — H: 4th hypodermal gland pore and surrounding cuticular ornamentation of the same male. — I: Spicular apparatus of the same male. — K: Spicular apparatus of a male from the Lynher Estuary. Scale in μm.

However, the worm easily detaches its tail tip when jumping. This rises the question of how the detachment is accomplished. After investigating a hopping *Theristus* species, Adams & Tyler (1980) assumed that the release from a substrate is brought about by chemical means, and related the detachment to the action of two small glands (releasing glands) that occur in addition to the usual three caudal glands (viscid glands). Other releasing mechanisms are possible in Chromadoridae. Considering the observation of Meschkat (1934), who described that certain Chromadoridae are always connected to the substrate by means of a continuously secreted mucus thread when creeping, we think that this also applies to *Chromadorita tentabunda.* It is probably due to the function of a caudal spinneret valve which controls the mucus flow so that the worm can


D1
20
D2
20
G
50
F
20
h.gl.
H
5
I
10
K
10

either stick firmly to the substrate or jump apparently unimpeded through the water. Lippens (1974) described the function and anatomy of the spinneret valve apparatus in Chromadoridae. It seems to us that the considerable size of the caudal gland ampulla in *C. tentabunda* is related to the necessity for rapidly releasing a great amount of mucus during locomotion.

Neochromadora izhorica (Filipjev, 1929)

Syn. *Chromadorella izhorica* Filipjev, 1929 op. Stekhoven (1935)

Material

1. Bothnian Bay: BB76/3, BB77/2, BB77/5, BB77/7; reference is made to ♂$_1$ on slide NSIMB 544b and ♀$_1$ on slide NSIMB 544a.

Reference material from:

2. Gulf of Finland (Tvärminne area), leg. P.J.: a) Henriksberg, 22m depth, fine sand, 7.6.1978, (6 ♂ and 4 ♀), b) Storfjärden, 5m depth, mud, 3.12.1977, (2 ♂ and 2 ♀), c) Östra Kvarnskärsgrundet, 0.2m depth, on submerged macrophytes (*Pilayella littoralis*), 4.5.1979, (1♂=♂$_2$, slide Tv 451 SF; 1♀=♀$_2$, slide Tv 451 SF), d) Kvarnskärsgrunden, 2.5 and 5m depth on submerged macrophytes (*Furcellaria lumbricalis*), 4.5.1979, (12 ♂ and 16 ♀) e) several specimens in laboratory culture during 1980 originating from other submerged macrophytes at Östra Kvarnskärsgrundet.

3. Gulf of Finland (Izhorica): type material from the collection of I. Filipjev at the Zoological Institute, Leningrad, USSR; several specimen of which 1♂ (slide N:F-136) and 1♀ (slide N:F-132) were examined.

Description

♂$_1$
L = 1.04 mm
a = 21
b = 7.2
c = 8.6

$$\frac{-\quad 145\quad M\quad 918}{15\quad 31\quad 50\quad 35}\ 1040\ \mu m$$

♂$_2$
L = 0.99 mm
a = 26
b = 7.9
c = 7.0

$$\frac{-\quad 125\quad M\quad 842}{15\quad 29\quad 38\quad 30}\ 985\ \mu m$$

♀$_1$
L = 1.19 mm
a = 31
b = 7.7
c = 7.7

$$\frac{-\quad 155\quad 635\quad 1038}{16\quad 29\quad 39\quad 24}\ 1190\ \mu m$$

♀$_2$
L = 0.95 mm
a = 21
b = 7.8
c = 6.7

$$\frac{-\quad 120\quad 450\quad 805}{16\quad 33\quad 44\quad 25}\ 945\ \mu m$$

Males: Body slender with cylindrical head and tail whereas remainder of body is flattened dorso-ventrally with lateral alae (about 4 μm wide) from the region of the renette cells to the tail (full line in Fig. 6 G, D, I); in the cervical region and in the anteriormost portion of the tail the lateral fields are only slightly enlarged (coarse punctations in Fig. 6 A, B, D).

Cuticle annulated, each annule bearing dots; first three annules with small, equally distributed dots; in the other annules the dots form a heterogenous pattern in the lateral fields: the cervical region has a characteristic open space between the two most laterally situated dots. Somatic setae in four sublateral rows, the most anterior ones in submedian position; the setae vary considerably in length, the longest ones (up to 22 μm) in the oesophageal region and in front of the cloaca, the smaller ones might be broken; two anteriormost dorso-submedian setae closely spaced separated by one or two annules. Cuticular pores present in four sublateral rows, the anteriormost one in dorsosublateral position. Amphids slit-like, situated between the cephalic setae; in a single male (♂$_2$) the corpus gelatum is partly expelled. Cephalic sense organs in three circles as six small pointed internal labial setae, six pointed external labial papillae and four cephalic setae, 13—18 μm long.

Buccal cavity with distinct sclerotized walls, but weakly sclerotized armature; one dorsal tooth and subventral teeth present together with minute denticles. Oesophageal musculature enlarged around the buccal cavity, elsewhere slender with a weakly developed posterior bulb. Renette cell large and slender, accompanied by smaller cells; excretory pore not observed, but most likely at the head just in front of a large excretory ampulla.

Gonad monorchic with outstretched and anteriorly directed testis. Copulatory apparatus with equally paired spicules, slightly bent, 31-33 μm long from tip to tip; gubernaculum in two or three parts with distal portion distinctly sclerotized and slightly bent. Seven preanal supplements present, cup-shaped and nearly equally spaced; a single ventral seta present just in front of the cloaca. Three caudal gland cells present within the tail. Spinneret asymmetrical with dorsal sector oblique.

Females: The lateral alae are narrower (2-3 μm wide), but the cuticular patterns are similar. Reproductive system didelphic-amphidelphic with opposite and reflexed ovaries.

Discussion

The specimens from the Bothnian Bay and the Tvärminne area were compared with the type specimens from the innermost part of the Gulf of Finland; no disagreements were found. A re-examination of the type material revealed that the buccal cavity has denticles.

Neochromadora izhorica is the only representative of the genus in the Baltic. At low magnification it might be confused with *Chromadorita fennica, C. tenuis* and *C. leuckarti*. *N. izhorica* has been found together with the two former *Chromadorita* species in the same samples from the Tvärminne area. *N. izhorica* can be distinguished at high magnification from all three species by the presence of an open space between the lateral dots in the oesophageal region, by the weakly sclerotised armature in the buccal cavity and by the seven equally spaced Pre-anal supplements in the males. Distinct lateral alae, as in *N. izhorica,* have also been found in some specimens of *C. tenuis* (Jensen 1979b: Fig. 17 c). *C. guidoschneideri,* another related species in the Tvärminne area, also possesses an open spacing between the lateral dots in the oesophageal region, which is, however, restricted to the posterior part (P.J., unpubl.).

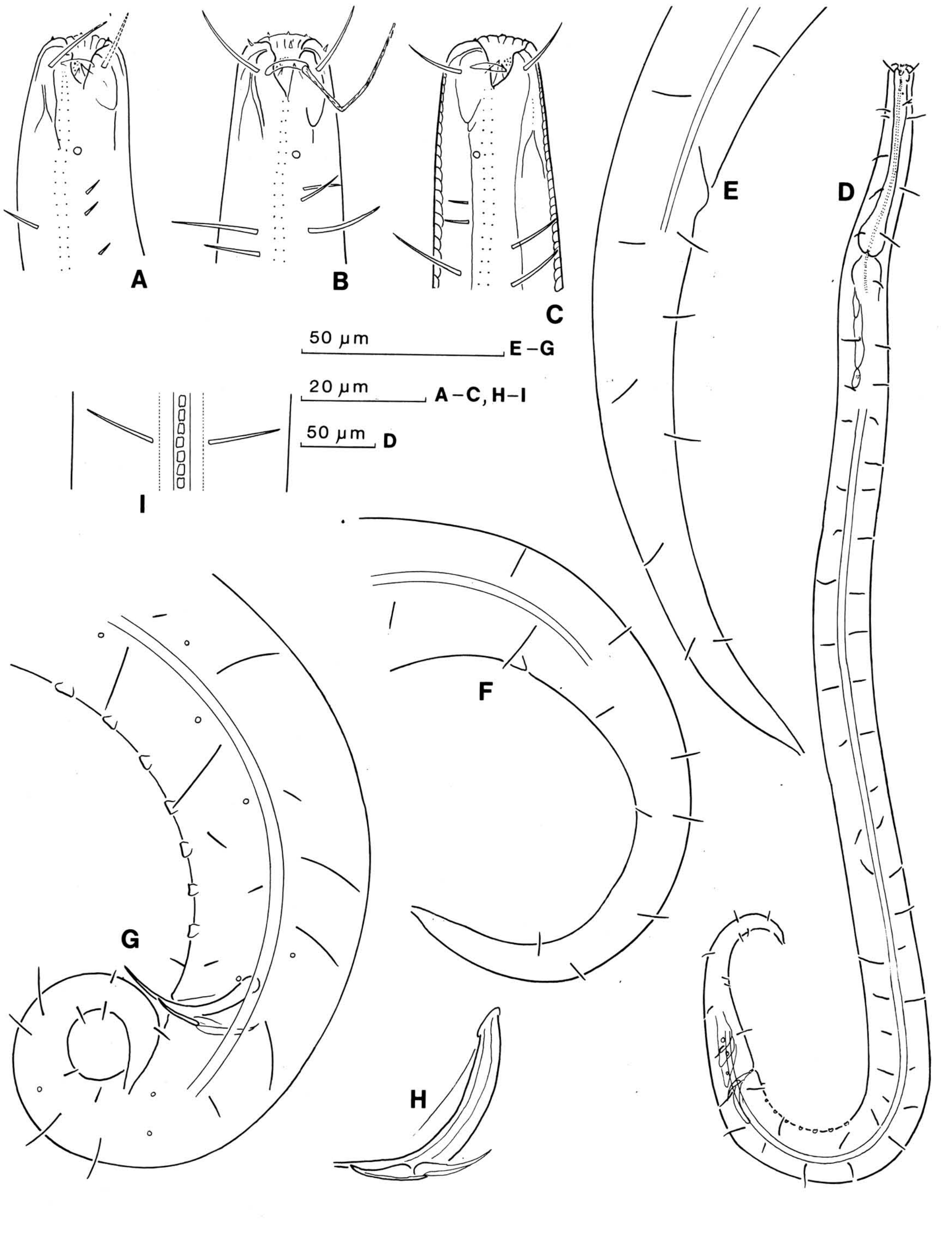


Fig. 6. *Neochromadora izhorica* (Filipjev, 1929). Lateral views (right: E, I; left: B, D, F–H); sublateral views (right: C, left: A). — A: head of ♂$_1$. — B: head of ♂$_2$. — C: head of ♀$_1$. — D: total view of ♀$_2$). — E: posterior region of ♀$_1$. — F: posterior region of ♀$_2$. — G: posterior region of ♂$_1$. — H: copulatory apparatus of ♂$_2$. — I: lateral ornamentation at the middle of the body of ♀$_1$.

Paracanthonchus bothnicus sp. n.

Material

Bothnian Bay: BB77/2 (54 ind.), BB77/3 (2 ind.), BB77/4 (6 ind.), BB77/5 (8 ind.), BB77/7 (2 ind.), BB77/8 (25 ind.)
Holotype: ♂₁, NSIMB 544c; Type locality:
Paratypes: ♂₂, NSIMB 544d; ♀₁, NSIMB 544e, ♀₂, NSIMB 544f; further paratypes in the collection F. Schiemer.

Description

♂₁ L = 1.80 mm
a = 36
b = 7.3
c = 10.4

$$\frac{-\quad 247\quad M\quad 1626}{21\quad 44\quad 50\quad 46}\ 1800\ \mu m$$

♂₂ L = 1.56 mm
a = 37
b = 7.1
c = 9.6

$$\frac{-\quad 221\quad M\quad 1405}{20\quad 37\quad 42\quad 33}\ 1568\ \mu m$$

♀₁ L = 1.78 mm
a = 32
b = 6.8
c = 10.6

$$\frac{-\quad 263\quad 947\quad 1615}{20\quad 42\quad 55\quad 34}\ 1784\ \mu m$$

♀₂ L = 1.72 mm
a = 36
b = 6.9
c = 10.2

$$\frac{-\quad 247\quad 927\quad 1547}{22\quad 39\quad 48\quad 35}\ 1715$$

Males: Body slender without lateral expansions. Cuticle ornamented with closely spaced dots; laterally only half the number of rows than elsewhere. Cuticular pores present in 14 longitudinal rows: 2 lateral rows consisting of two types of pores; i.e. at the head end and on the tail end they appear as distinct oval pores wheareas elsewhere they are circular in shape and nearly indistinct; the remaining 12 rows occur as distinct circular pores on the sublateral (4), submedian (4, restricted to the pre-anal region), subdorsal (2) and subventral (2) axes. Somatic setae in 4 submedian rows, 4–7 µm long. Amphids spiral with about 6 turns, 10 µm wide (i.e. 45 % of the corresponding body diameter). Cephalic sense organs arranged in two circles, one circle with six pointed internal labial papillae and a second circle of six external labial setae 10 µm long and four cephalic setae, 6–7 µm long.

Buccal cavity distinctly sclerotized, consisting of two compartments, i.e. a vestibulum with 12 ribs and a conical postorior portion with a dorsal tooth and two subventral ridges, each with two sclerotized tips at the end; the dorsal tooth points forward (i.e. in longitudinal direction, 25 specimens) or may be knocked down into a transversal position (7 specimens). The dorsal walls of the vestibulum are more strongly sclerotized than the other sections. Oesophageal musculature expanded around the buccal cavity, elsewhere cylindrical. Cardia small. Nerve ring and excretory pore not observed.

Gonad monorchic with outstretched and anteriorly directed testis. Copulatory apparatus with equally paired spicules, 50 µm long, with a slender distal part; gubernaculum paired with distinctly sclerotized shafts, distally expanded with two wings and provided with four small teeth. Five tubular pre-anal supplements: two very closely spaced, 6–10 µm from the cloaca, followed by one at 32 µm, one at 55 µm and one at 92 µm from the cloaca. Three caudal glands. Spinneret symmetrical and protruding.

Females: no differences observed apart from the sex characters.

Discussion

Paracanthonchus bothnicus sp. n. mainly differs from the other brackish-water species *P. caecus*, by the slender body form and the distinctly longer tail. It further differs in the cuticular ornamentation and the lack of sexual dimorphism in the amphids. A comparison with specimens from the newly described *P. sabulicolus* Bouwman, 1981, showed differences in the configuration of the pre-anal tubuli (2+1+1+1 in *P. bothnicus* vs. 1+1+1+1 in *P. sabulicolus;* terminology sensu Jensen 1979a). Moreover, the spicules and gubernaculum in *P. bothnicus* are more slender and less differentiated than in *P. sabulicolus.*

In the Tvärminne area, *P. caecus* occurs together with another *Paracanthonchus* species, which is habitually reminiscent of *P. bothnicus* and *P. sabulicolus* (slender tail), but differs in its smaller size, cuticular ornamentation and the configuration of the body pores. This species may turn out to be identical with *P. caecus* subsp. *balgensis,* Schneider, 1927. A detailed analysis of this problem is in preparation (PJ). Specimens of all three species may sometimes appear to have their dorsal tooth in a transversal position. This feature is thus not a specific character as proposed by Allgén (1929) in the description of *P. abnormis* (however, whether or not *P. abnormis* is synonymous with *P. caecus* as proposed by Stekhoven in 1935 remains questionable). The presence of the dorsal tooth in a transversal position as a nonspecific character among cyatholaimids was discussed by Riemann (1970) when redescribing *Paracyatholaimus ternus;* the same phenomenon was observed in *Pomponema multipapillatum* from Øresund and in *Cyatholaimus intermedius* from the Tvärminne area (PJ, unpubl.).

Tripyla filipjevi Altherr, 1972

(Tripyla cornuta apud Filipjev 1930, Brzeski 1964 and Andrássy 1967; nec *Tripyla cornuta* Skwarra 1921)

Material

BB76/5 (1 ind.), BB77/4 (15 ind.), BB77/5 (1 ind.) BB77/7 (2 ind.), BB77/8 (2 ind.)

Description

Male (slide BB77/4/8).

L = 1580 µm a = 29.1 b = 5.9 c = 6.4

Cephalic setae arranged in two circles, first circle with six stout papillae, second circle with 4 thinner setae situated approximately 10 µm behind the head end. Dorsal tooth 22 µm (= 0.8 × head width) posterior from the head end. Spicules stout, 41 µm long without lateral ridges; gubernaculum 16 µm

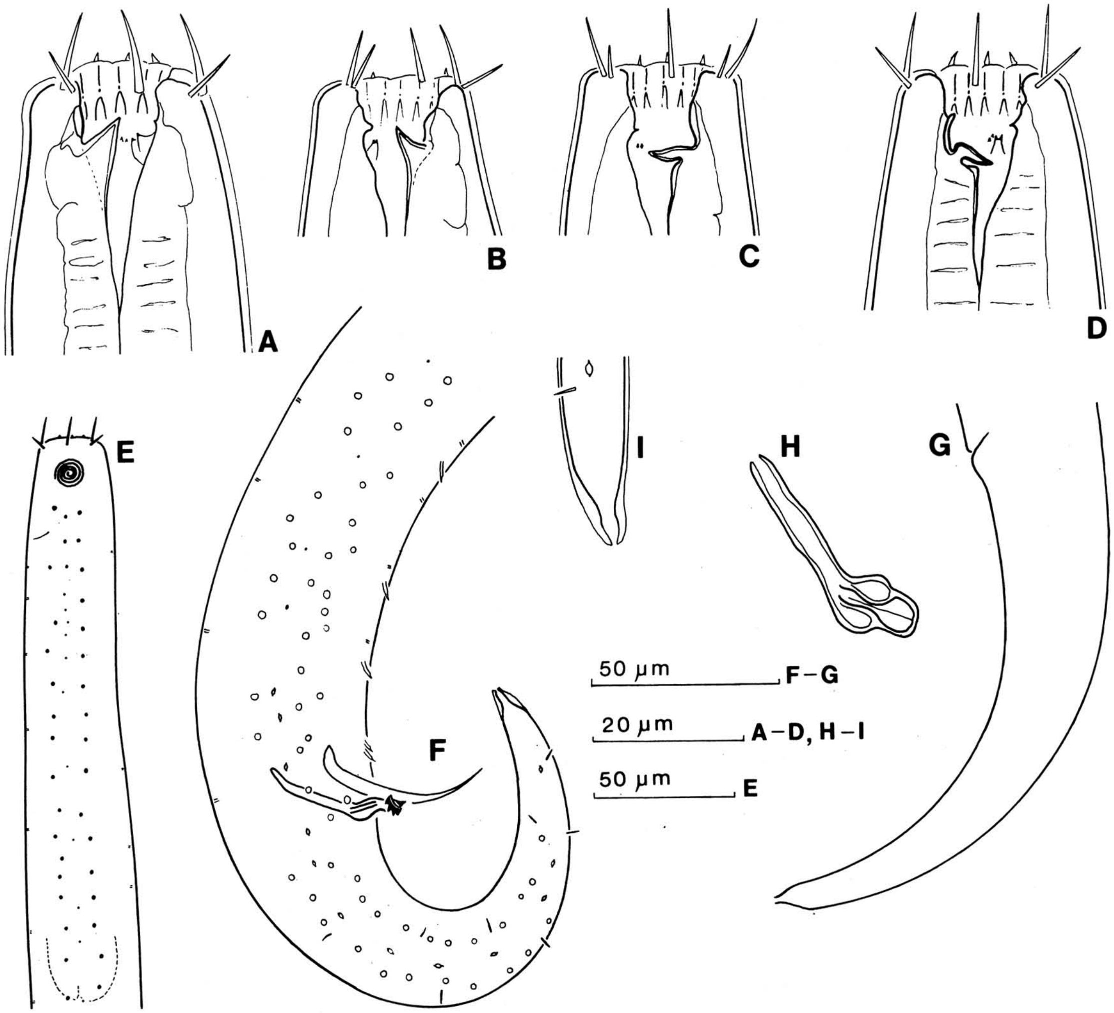


Fig. 7. *Paracanthonchus bothnicus* sp. n. Lateral views (right: F, I; left: C, G); sublateral views (right-dorso: A, right-ventro: D–E) left-ventro: B–C); ventral view: H. — A: Head of ♂$_1$. — B: head of ♀$_1$. — C: head of ♂$_2$. — D: head of another male. — E: configuration of cuticular pores in oesophageal region of another male. — F: posterior region of ♂$_1$. — G: posterior region of ♀$_2$. — H: gubernaculum of another male. — I: tail end of ♂$_1$.

long. Our material also agrees well in further details with the description given by Andrássy (1967) for *"T. cornuta"* from Swedish lakes.

Discussion

Altherr (1972) recognised the invalidity of Skwarra's (1921) original description of *Tripyla cornuta* (based on one ♀, most likely of *T. glomerans*, Bastian 1865). The name should consequently be considered as sp. inqu. as was already proposed by Micoletzky in 1925. Altherr (1972) considered *T. cornuta* apud Filipjev (1930) a valid species and proposed a new name, *Tripyla filipjevi*, Altherr 1972. The species was found by Brzeski (1964), Andrássy (1967) (in both cases quoted as *T. cornuta)* and by Altherr (1972). We have no doubt that these three findings refer to the same species, although the descriptions show some differences and some of the diagnostic features have not been clearly outlined.

Filipjev (1930) gave the following characteristics for his animals from the Gulf of Finland: ♀: L = 1280–1460 µm, a = 25–28, b = 4.7–6.6, c = 5.8–8.0, V = 48 %. ♂: L = 1120–1540 µm, a = 5.2–6.4, c = 5.2–6.6.
Spicules 47–52 µm; amphids 7 µm, 1/4 of the corresponding body width; 20–22 papillae; egg size 105 × 40 µm.

The most precise descriptions and figures of the species have been given by Andrássy (1967), who found the species together with the similar *T. glomerans* in the psammon of Swedish lakes. Andrássy mentioned as major differences the smaller body size (1.9 versus 3.1-3.4 mm), the slightly larges cephalic setae; the position of the second cephalic setae within small pouches; a stronger dorsal tooth; elongated eggs (105 × 30 µm versus 117 × 56 µm); shorter and broader spicules without lateral ridges.

The position of the posterior cephalic setae within small pouches was also found by Schiemer (1978) in populations of *T. glomerans* and therefore cannot be used for distinguishing the two species.

Brzeski (1964) named the size of the amphid aperture (1/9-1/8 of the corresponding body width, in contrast to 1/3 in *T. glomerans)* as being characteristic of "*T. cornuta*". This statement, however, is in contrast with his figures, in which the amphids are shown to be larger, and is also in contrast with Filipjevs description (7 µm, 1/4 of corresponding body width). Furthermore, in both species, this structure is usually too inconspicuous, even when using interference microscopy, to be a usable taxonomic characteristic. The number of pre-anal supplements, originally considered of differential value, is likely to overlap (Andrássy 1967; Brzeski 1964).

Although we feel that *T. filipjevi* and *T. glomerans* are still not clearly characterised, our specimen from the Bothnian Bay can be defined as *T. filipjevi* by the small size and the form and size of the spicules, which resemble the description and figures given by Andrássy (1967).

Tripyla setifera Bütschli, 1873

Material

BB77/4 (5 ♀, 2 iuv.), BB77/7 (1 iuv.)

Description

Female (slide BB77/4/9).

L = 1770 µm a = 33.5 b = 5.5 c = 6.5 V = 53.1 %

Cephalic setae 1/4-1/3 of head width, 7-9 µm long. Strong dorsal tooth situated 20 µm (= 2/3 of head width) behind the head end of the body. Egg size 127 × 43 µm. Numerous cristalloids.

Discussion

T. setifera is a well defined species. A detailed description has been given by Andrássy (1967) on the basis of specimens collected from Swedish lakes. The Bothnian Bay material is typical in the body size, form of the cephalic setae and the possession of numerous cristalloids. A small difference exists in the position of the dorsal, oesophageal tooth. In the Bothnian Bay specimen this tooth points laterally and not in a distal direction as described by Andrássy (1967) for the Swedish freshwater material.

Tobrilus gracilis (Bastian, 1865)

The characteristics of the Bothnian Bay material are as discussed by Schiemer (1978).

Ironus tenuicaudatus De Man, 1876

Description

Male (BB76/1/6) and *female* (BB76/1/3).

♂: L = 3129 µm a = 45.3 b = 5.72 c = 19.1 V = 52.2 %
♀: L = 2720 µm a = 42.8 b = 5.08 c = 15.5

The further morphometrical data refer to one : Tail length 4.7 times the anal body width. Cephalic setae stout, 5.4 µm long (30.5 % of head width). Amphids 11.2 µm wide (65 % of corresponding body width). Cuticle in the middle region of the body 2 µm thick. Spicules 60 µm long (1.6 times the anal body width). Buccal cavity 106 µm long (~20 % of oesophagus length), buccal teeth 5-6 µm long.

Ironus tenuicaudatus De Man, 1876 is a well defined and readily recognicable species. Our specimens show the characteristic features of the species as discussed by Andrássy 1968.

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References

Adams, P. J. M. & Tyler, S. 1980: Hopping locomotion in a nematode: Functional anatomy of the caudal gland apparatus of Theristus caudasaliens sp.n. — J. Morphol. 164: 265-285.

Alasaarela, E. 1979: Phytoplankton and environmetal conditions in central and coastal areas of the Bothnian Bay. — Ann. Bot. Fennici 16: 241-274.

Allgén, C. 1927: Über einige freilebende Nematoden aus dem Wettersee. — Arch. Hydrobiol. 17: 714-729.

—"— 1929: Südschwedische marine Nematoden. — Göteborgs Kungl. Vetenskaps—Vitterh. Samh. Handl. (B) 1: 1-40.

Altherr, E. 1972: Nématodes interstitiels des eaux douces des états-unis d'Amérique (états de Washington, du Colorado et du Massachusetts) récoltés par Cl. Delamare Deboutteville. — Ann. Spéléol. 27: 683-760.

Andrássy, I. 1967: Nematoden aus interstitiellen Biotopen Skandinaviens gesammelt von P.H. Enckell (Lund). 1. Nematoden aus der Uferregion des Vättern- und Torneträsk-Sees (Schweden). — Opusc. Zool. Budapest 7: 3-36.

—"— 1968: Fauna Paraguayensis. 2. Nematoden aus den Galeriewäldern des Acaray-Flusses. — Opusc Zool. Budapest 8: 167-315.

Bouwmann, L. A. 1981: Nematodes from Ems Estuary. Part 1: Systematics. — Zool. Jahrb. Syst. 108: 335-385.

Brzeski, M. 1964: Revision der Gattungen Tripyla Bastian und Paratripyla gen.n. (Nematoda, Tripylidae). — Ann. Zool., Warszawa 22: 157-178.

De Man, J. G. 1890: Quatrieme note sur les Nématodes libres de la mer du Nord et de la Manche. — Mem. Soc. Zool. France 3: 169-194.

—"— 1922: Vrijlevende Nematoden. — In: H. C. Redeke (ed.), Flora en Fauna der Zuidersee, 1922: 214-261. Te Helder (C. de Boer).

Elmgren, R. 1978: Structure and dynamics of Baltic benthos communities, with particular reference to the relationship between macro- and meiofauna. — Kieler Meeresforsch., Sonderh. 4: 1-22.

Filipjev, I. 1930: Les Nématodes libres de la baie de la Néva et de l'extrémité orientale du Golfe de Finlande. Deuxieme partie. — Arch. Hydrobiol. 21: 1-64.

Gerlach, S. A. 1951: Nematoden aus der Familie der Chromadoridae von den deutschen Küsten. — Kieler Meeresforsch. 8: 106-132.

—"— 1953a: Die Nematodenfauna der Uferzone und des Küstengrundwassers am finnischen Meerbusen. — Acta Zool. Fennica 73: 1-32.

—"— 1953b: Die biozönotische Gliederung der Nematodenfauna an den deutschen Küsten. — Zeitschr. Morphol. Ökol. Tiere 41: 411-512.

—"— 1954: Das Supralitoral der sandigen Meeresküsten als Lebensraum einer Mikrofauna. — Kieler Meeresforsch. 10: 121-129.

Gerlach, S. A. & Meyl, A. H. 1957: Freilebende Nematoden aus dem Ohrid-See. — Beaufortia 5: 157-170.

Gerlach, S. A. & Riemann, F. 1971: Über Zahnbildungen in der Mundhöhle von Nematoda Monhysteridae: Monhystrella und Hofmaenneria. — Nematologica 17: 285-294.

—"— 1973: The Bremerhaven Checklist of aquatic nematodes. — Veröff. Inst. Meeresforsch. Bremerhaven, Suppl. 4: 1-736.

Hofmänner, B. & Menzel, R. 1915: Die Freilebenden Nematoden der Schweiz. — Rev. Suisse Zool. 23: 109-243.

Hopper, B. E. 1968: Marine nematodes of Canada. I. Prince Edward Island. — Can. J. Zool. 46: 1103-1111.

Inglis, W. G. 1969: Convergence in the structure of the head and cuticle of Euchromadora species and apparently similar nematodes. — Bull. Brit. Mus. Nat. Hist. (Zool.) 17: 149-204.

Jensen, P. 1979a: Nematodes from the brackish waters of the southern archipelago of Finland. Benthic species. — Ann. Zool. Fennici 16: 151-168.

—"— 1979b: Nematodes from the brackish waters of the southern archipelago of Finland. Phytal species. — Ann. Zool. Fennici 16: 281—285.

—"— 1983: Ecology of benthic and epiphytic nematodes in brackish water. — Hydrobiologia (in press).

Keynäs, K. & Keynäs, L. 1978: Meiofauna in soft bottom sediments at Tvärminne, northern Baltic. Methods and preliminary results. — Memoranda Soc. Fauna Flora Fennica 54: 65-68.

Lippens, P. L. 1974: Ultrastructure of a marine nematode, Chromadorina germanica (Buetschli, 1874). I. Anatomy and cytology of the caudal gland apparatus. — Zeitschr. Morphol. Tiere 78: 181-192.

Lorenzen, S. 1969: Freilebende Meeresnematoden aus dem Schlickwatt und den Salzwiesen der Nordseeküste. — Veröff. Inst. Meeresforsch. Bremerhaven 12: 231-265.

—"— 1972: Leptolaimus-Arten (freilebende Nematoden) aus der Nord- und Ostsee. — Kieler Meeresforsch. 28: 92-97.

—"— 1973a: Theristus-Arten (freilebende Nematoden) mit unsymmetrischen Spicularapparat als Charakterarten mariner Sandbiotope in Nordsee und Kieler Bucht. — Veröff. Inst. Meeresforsch. Bremerhaven 14: 87-101.

—"— 1973b: Freilebende Meeresnematoden aus dem Sublitoral der Nordsee und der Kieler Bucht. — Veröff. Inst. Meeresforsch. Bremerhaven 14: 103-130.

Meschkat, A. 1934: Der Bewuchs in den Röhrichten des Plattensees. — Arch. Hydrobiol. 27: 436-517.

Micoletzky, H. 1922: Freilebende Nematoden aus dem Grundschlamm norddeutscher Seen (Madü- und Plönersee). — Arch. Hydrobiol. 13: 532-560.

Micoletzky, H. 1925: Die freilebenden Süßwasser- und Moornematoden Dänemarks. — Kongl. Danske Vidensk. Selsk. Skr., Math.-Naturv. 10: 55-310.

Ott, J. 1972: Studies on the diversity of the nematode fauna in intertidal sediments. — In: B. Battaglia (ed), Marine Biology: 275-286 Piccin, Padova.

Riemann, F. 1966: Die interstitielle Fauna im Elbe-Aestuar. Verbreitung und Systematik. — Arch. Hydrobiol. (Suppl.) 31: 1-279.

—"— 1970: Freilebende Nematoden aus dem Grenzbereich Meer-Süßwasser in Kolumbien, Südamerika. — Veröff. Inst. Meeresforsch. Bremerhaven 12: 365-412.

—"— 1979: Nematoden aus dem Brackwasser des Weser-Aestuars und Beschreibung von drei Monhysteroidea. — Veröff. Inst. Meeresforsch. Bremerhaven 17: 213-223.

Schiemer, F. 1978: Verteilung und Systematik der freilebenden Nematoden des Neusiedlersees. — Hydrobiologia 58: 167-194.

Sharma, J. Hopper, B. E. & Webster, J. M. 1979: Benthic nematodes from the Pacific Coast with special reference to the cyatholaimids. — Ann. Soc. R. Zool. Belg. 108: 47-56.

Skwarra, E. 1921: Diagnosen neuer freilebender Nematoden Ostpreußens. — Zool. Anz. 53: 66-74.

Stekhoven, J. H. & Schuurmans, 1935: Nematoda: Systematischer Teil, Nematoda errantia. — In: Grimpe, G. & E. Wagler (ed.), Die Tierwelt der Nord- und Ostsee (Leipzig) 5b: 1-173.

Wieser, W. 1954:. Free-living marine nematodes. II. Chromadoroidea. — Acta Univ. Lund (N.F.2) 50 (16): 1-148.

Wolda, H. 1981: Similarity indices, sample size and diversity. — Oecologia (Berl.) 50: 296-302.

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