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Community Structure of Free-living Marine Nematodes in the Area of Agar-Producing Alga *Ahnfeltia Tobuchiensis* Field (Starka Strait, Peter the Great Bay, East Sea)

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Abstract – The structure of the nematodes communities has been studied in the sediments on two sites located outside and under the layer of *Ahnfeltia tobuchiensis* (Kanno and Matsubara 1932; Makijenko 1970). Bottom sediments at the stations were represented by sands with a different degree of silting. Specific structure of nematodes at the stations was significantly different under the similar environmental conditions (water depth, dissolved oxygen saturation, salinity, temperature of the bottom layer and organic carbon content inside of the sediment). Nematodes dominated (75.7 %) in meiobenthos community under the layer of *A. tobuchiensis* where concentration of silt particles was 12 %. Representatives of the family Comesomatidae were dominant. Low index of species diversity and high Simpson domination index were detected in this community. Under a layer of *A. tobuchiensis* with the thickness of 30 cm concentration of the silt particles was 5.39 %; nematodes density was low and made 32.1 % of the general density of meiobenthos. Species of the families Xyalidae and Monoposthiidae were dominant. Outside of *A. tobuchiensis,* field percentage of silt particles was minimal (3.1 %) and representatives of families Cyatholaimidae and Axonolaimidae dominated. The specific structure of nematodes in this type of the ground is characterized by high index of species diversity and low level of domination.

Key words – density, nematodes, sediment type, agar-producing red alga *Ahnfeltia tobuchiensis*

1. Introduction

An agar-producing red alga, *Ahnfeltia tobuchiensis,* forms a friable layer on the bottom of the Starka Strait. During stormy weather this layer rises above the bottom, overturns and mixes up (Titlyanov *et al.* 1993). Numerous studies have been done on communities living on *A. tobuchiensis* with an attention on structure and distribution of bottom macrophytes and macrofauna in the layer of *A. tobuchiensis* (Titlyanova 1980; Titlyanov *et al.* 1993; Ivanova *et al.* 1994; Zhiltsova *et al.* 2002). There are almost no studies done on meiobenthos, both in the layer of *A. tobuchiensis* and in the ground deposits under the layer.

The purpose of the present work is the comparative study on meiobenthic community structure and free-living marine nematodes: in particular, under the layer of *A. tobuchiensis* and in the bottom sediments on a site located outside of the layer using the main characteristics of the communities – species composition, abundance and ecological indices.

2. Material and Methods

Meiobenthos samples collected in August 2006 in the Starka Strait (Peter the Great Bay) under the layer of *A. tobuchiensis* (stations 1 and 2) and on a site located outside of the field (station 3) were used for this research (Fig. 1). Water depth at the stations was 10 m. The samples were collected by scuba divers using a tubular bottom sampler with a mouth diameter of 5 cm with the height of the ground sample columns measuring 5 cm. Four replicate sediment samples at each station were taken. The samples were washed through 1mm and 42 μm nylon sieves, fixed

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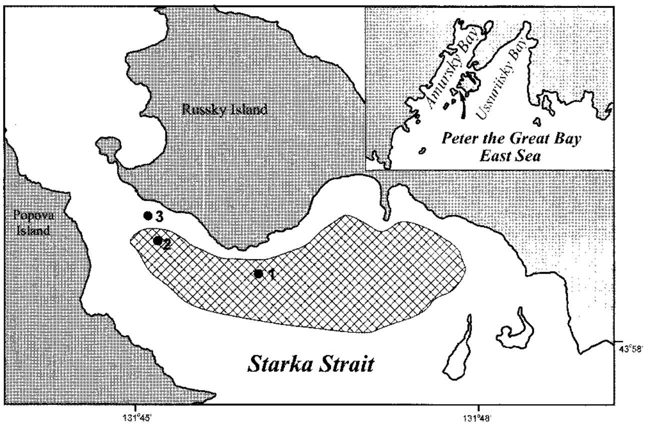

Fig. 1. A schematic map of sampling stations in Starka Strait.

by 4 % formaldehyde solution and then stained with "Rose Bengal".

Samples for granulometric analysis were also taken at each station; sediments were classified depending on the domination of particles of different size classes (Parsons *et al.* 1982). Three types of sediments were detected (Table 1). Samples for the analysis of organic content were immediately frozen. Chemical properties of the bottom layer were determined with a CTD "Valeport 660+" elemental analyzer (Table 2).

The Wieser classification (Wieser 1953), based on the structure of the mouth cavity of animals, was used for the estimation of the trophic structure of the nematode community. According to this classification, four groups of feeders were defined: selective deposit feeders (1A), non-selective deposit-feeders (1B), epistratum feeders (2A) and omnivores (2B).

The similarities in the species composition of nematodes in different types of substrates were estimated using the Chekanovsky-Sorensen index of similarity (*Ics*) (Pesenko 1982).

$$Ics = 2a/(a + b) + (a + c),$$

where a - is the number of common species on two lists, b and c - is the number of species in both lists under comparison.

Table 2. Environmental data of sampling stations in Starka Strait

Station	Tempera-ture, °C	Salinity, PSU	O_2 mg/l	O_2 %	C_{org} %
1	12.5	33	4.9	78.1	2.4
2	15	33	5.7	96.2	2.22
3	15	33	5.7	96.2	2.7

The Shannon-Wiener diversity index (*H*), the Simpson domination index (*C*) and Pielou evenness index (*e*) were used in the characterization of the nematodes community structure:

$$H = -\Sigma n_i / N \cdot \log n_i/N,$$
$$C = \Sigma (n_i / N)^2,$$
$$e = H / \log S,$$

where n_i - is community density of each species, N - total density of communities, H - index of Shannon-Wiener, S - number of species

Statistica 6.0 software was used for statistical analysis of material.

3. Results

The thickness of *A. tobuchiensis* layer reached up to 50 cm at station 1. Bottom sediments were represented by silted heterogeneous sand. Nematodes were the dominant group and an average density was determined to be at 208.9±72.3 thous. ind/m^2 (Fig. 2A). Thirteen species of nematodes were found in this biotope, dominated by the species of the Comesomatidae family. *Sabatieria pulchra* dominated (88.2±37.1 thous. ind/m^2, 42.7%), *S. palmaris* (45.2±25.7 thous. ind/m^2, 21.7 %) and *S. finitima* (40.5±27.1 thous. ind/m^2, 19.6%) subdominated (Table 3). Non-selective deposit-feeders (1B) dominated among nematodes with different feeding types - 88.5 % (Fig. 3). The Shannon-Wiener diversity index (2.32), and Pielou evenness index (1.19)

Table 1. Granulometric composition of bottom sediments (%) in Starka Strait

Stations	Sediment particle size, mm										Type of bottom sediments
	>10	7-10	5-7	3-5	2-3	1-2	0.5-1	0.25-0.5	0.15-0.25	<0.15	
1	0.84	0.09	0.24	0.59	6.36	25.44	19.97	23.99	9.64	12.84	I
2	-	-	0.08	0.30	0.30	2.84	26.57	59.58	4.94	5.39	II
3	-	-	-	-	0.07	0.84	18.35	68.91	8.74	3.09	III

Note: I - silted heterogeneous sand; II - silted medium and fine sand; III – silted fine sand

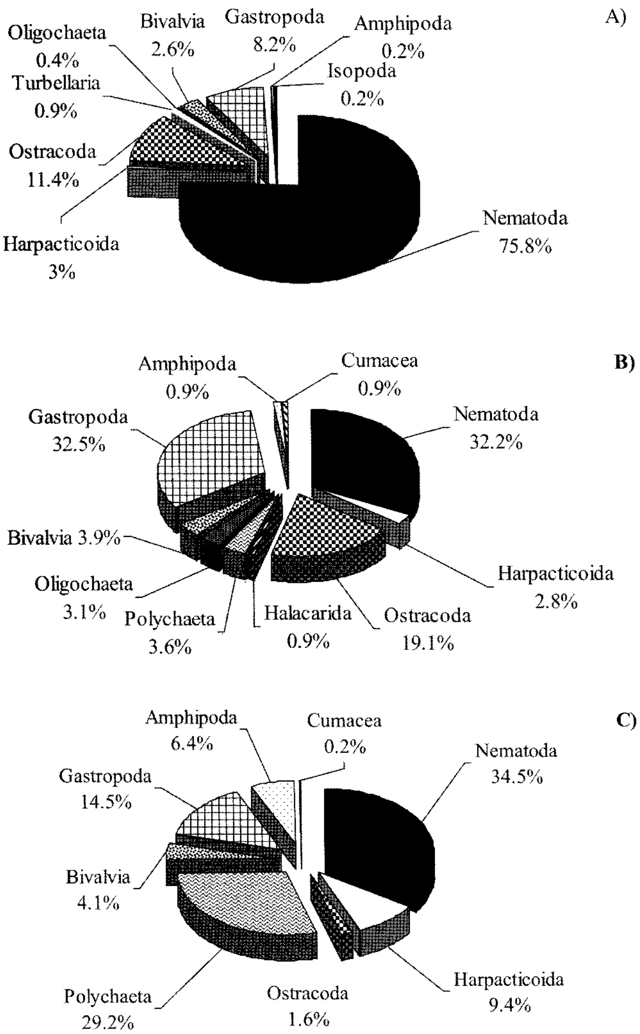

Fig. 2. The percentage of major meiobenthic groups at stations in. Starka Strait: A – station 1, B – station 2, C – station 3.

were lowest for this station, while the Simpson domination index (0.27) was the highest.

The thickness of *A. tobuchiensis* layer at the station 2 reached up to 30 cm. Bottom sediments were represented by silted medium and fine sand (sediment type II) (Table 1). The density of nematodes was lowest (21.1±12.2 thous. ind/m^2) and comprised 32 % of the total meiobenthos density (Fig. 2B). Fourteen species were found. *Daptonema variasetosum* (4.6±2.2 thous. ind/m^2, 22 %) and *Monoposthia latiannulata* (4.3±2.7 thous. ind/m^2, 20.5 %) dominated (Table 3). Non-selective deposit-feeders (1B, 40.3 %) and epistratum feeders (2A, 38.9 %) dominated among nematodes with different feeding types (Fig. 3). Meaning of the index of species diversity was 3.09, Simpson domination –0.21 and Pielou –1.58, respectively.

Station 3 is situated at some distance away from *A. tobuchiensis* layer. Bottom sediments were presented by silted fine sand [sediment type III (Table 1)]. The average density of nematodes was determined to be at 216.5±52.9 thous. ind/m^2, and comprised 34.5 % of the total meiobenthos density (Fig. 2C). 28 nematode species were found; *Paracanthonchus macrodon* (43.2±22.9 thous. ind/m^2, 20.2 %), *Axonolaimus seticaudatus* (33.8±17.1 thous. ind/m^2, 16.2 %) and *M. latiannulata* (33.5±15.2 thous. ind/m^2, 15.6%) dominated (Table 3). Epistratum feeders (2A, 64.3 %) formed the most important trophic group (Fig. 3). The highest indices of species diversity (3.7) and Pielou evenness (1.69) were recorded in this biotope, while the Simpson domination index (0.14) was the lowest.

Overall thirty nine species of nematodes were found in the research area. The highest index of similarity between the stations 1 and 2 – amounts to 34.15 %, and the lowest index between stations 1 and 3 to 19.6 %.

4. Discussion

Water exchange between Amursky Bay and the south part of Ussuryisky Bay is carried out through the Starka Strait. In the summer, the basic features of a field of currents in a passage are anticyclonic circulations in the pass of the strait, with the cyclonic turbulences adjoining from southeast. Movement of water defines a configuration, integrity and thickness of the *A. tobuchiensis* layer (Novojilov 1980, Ivanova *et al.* 1994). Under the influence of waves, the layer of *A. tobuchiensis* is capable of accumulating ground deposits. At the depth of 10 m, the wide areas of the bottom ground are covered by the silted fine sands which can move under influence of weak wave and currents movement colliding with *A. tobuchiensis* layer and filling it in. Vertical pulsations of a layer serve as the mechanism for removal of fine silt sediment fractions from *A. tobuchiensis* itself and underlying areas of the ground. Silted fine sands prevail in the zones of the maximal congestion of seaweed (thickness of a layer of 30-50 cm); however, on depth of 8-10 m, sand is the prevailing sediment; by the coast line, gravel prevails (Titlyanov *et al.* 1993). The sediment particle size is one of the most important factors for meiobenthic animals and, in particular, nematodes. Increase in concentration of the silt sediment fractions over 2 % significantly influences conditions of life in a deposit, changing specific structure

Table 3. Species composition, portion (%) of each species, and trophic groups in Starka Strait

Species	TG	1 station	2 station	3 station
Family Enoplidae Dujardin, 1845				
Enoplus anisospiculus Nelson, Hopper et Webster, 1972	2B	-	-	0.3
Enoplus michaelseni (Linstow, 1896)	2B	-	-	0.7
Family Thoracostomatidae Filipjev, 1927				
Enoploides rimiformis Pavlyuk, 1984	2B	-	-	1.6
Enoplolaimus medius Pavlyuk, 1984	2B	0.3	9.9	4.5
Family Phanodermatidae Filipjev, 1927				
Phanoderma (Phanoderma) *platonovae* Belogurov, 1980	2B	-	-	3.6
Family Anticomidae Filipjev, 1918				
Anticoma possjetica Platonova, Belogurov et Sheyenko, 1979	1A	-	-	4.2
Family Oncholaimidae Filipjev, 1916				
Pseudoncholaimus furugelmus Belogurov, 1977	2B	1.9	5.4	-
Viscosia stenostoma Platonova, 1971	2B	4.3	5.4	-
Family Enchelidiidae Filipjev, 1918				
Calyptronema stomodentata Belogurov, 1980	2B	-	-	0.7
Family Oxystominidae Chitwood, 1935				
Halalaimus leptoderma Platonova, 1971	1A	-	-	0.7
Oxystomina elegans Platonova, 1971	1A	0.6	-	1
Family Rhabdodemaniidae Filipjev, 1934				
Rhabdodemania orientalis Platonova, 1974	2A	-	-	1
Family Chromadoridae Filipjev, 1917				
Chromadora heterostomata Kito, 1978	2A	0.6	15.2	-
Panduripharynx unidentatum Dashchenko, Belogurov et Fadeeva, 1985	2A	-	0.8	-
Rhips sp.	2A	-	-	0.3
Family Cyatholaimidae Filipjev, 1918				
Paracanthonchus macrodon (Ditlevsen, 1919)	2A	-	0.8	20.5
Pomponema sp.	2B	-	-	0.3
Family Selachinematidae Cobb, 1915				
Cheironchus sp.	2B	0.3	-	-
Halichoanolaimus possjetiensis Belogurov et Fadeeva, 1980	2B	-	-	8.2
H. sonorous Belogurov et Fadeeva, 1980	2B	-	-	0.3
Richtersia sp.	2B	-	-	1.9
Synonchium sp.	2B	-	-	0.3
Family Desmodoridae Filipjev, 1922				
Chromaspirina sp.	2A	-	-	2.3
Metachromadora itoi Kito, 1978	2A	-	-	9.1
Spirinia sp.	2A	-	0.8	0.3
Family Monoposthiidae de Man, 1889				
Monoposthia latiannulata Platonova, 1971	2A	0.3	20.5	15.6
Family Xyalidae Chitwood, 1951				
Daptonema variasetosus (Pavlyuk, 1984)	1B	0.6	22	0.7
Pseudosteineria inaequispiculata (Platonova, 1971)	1B	-	5.4	-
Theristus(Penzancia) longispiculata (Platonova, 1971)	1B	-	9.8	-
Family Linhomoeidae Filipjev, 1922				
Metalinhomoeus sp.	1B	-	-	2.2
Megadesmolaimus rhodinus Chesunov et Yushin, 1991	1B	2.5	2.3	1.3
Terschellingia sp.	1B	-	0.8	-

Table 3. Species composition, portion (%) of each species, and trophic groups in Starka Strait

Species	TG	1 station	2 station	3 station
Family Axonolaimidae Filipjev, 1918				
Axonolaimus seticaudatus Platonova, 1971	2A	-	0.8	16.2
Family Comesomatidae Filipjev, 1918				
Comesomoides sp.	1B	-	-	1.6
Dorylaimopsis peculiaris Platonova, 1971	2A	-	-	0.3
Sabatieria intacta Fadeeva et Belogurov, 1984	1B	4.7	-	-
S. finitima Fadeeva et Belogurov, 1984	1B	21.7	-	-
S. palmaris Fadeeva et Belogurov, 1984	1B	19.6	-	-
S. pulchra (Schneider, 1906)	1B	42.5	-	-

Note: " – " species not found at this station; TG – trophic groups.

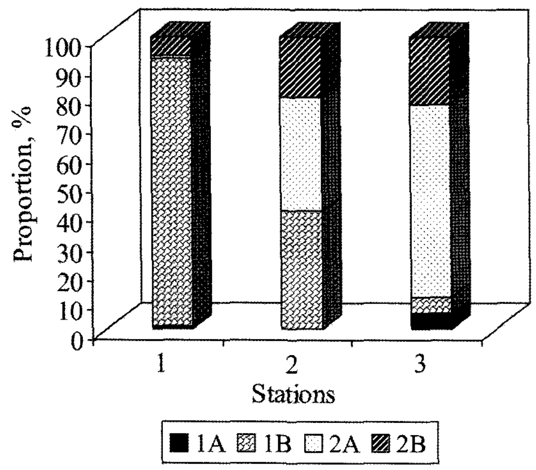

Fig. 3. Percentage of nematodes belonging to different trophic groups at stations. Trophic groups: (1A) selective deposit-feeders; (1B) non-selective deposit-feeders; (2A) epistrate feeders; (2B) omnivores.

in the layer of sediment (Gerlach 1958). Specific structure significantly varied from station to station with similar environmental conditions (water depth, dissolved oxygen saturation in the bottom layer, organic carbon content, salinity, temperature) in Starka strait (Table 2). Under the layer of *A. tobuchiensis* (the layer of alga 50 cm thick) where the percentage of silt particles was over 12 % (Table 1), members of Comesomatidae family were dominant in the nematodes community --which is usual for the silted sediments (Tietjen 1980). In sediment under the layer of *A. tobuchiensis* (the layer of alga 30 cm thick), the concentration of the silt particles was 5.39 % (Table 1), community density of nematodes was low, and species from families Xyalidae and Monoposthiidae dominated. Out of the *A. tobuchiensis* field, the concentration of silt particles from the bottom sediments was minimal (3.1 %), and species of Cyatholaimidae and Axonolaimidae families were dominant.

Thus, nematodes communities under the layer of *A. tobuchiensis* with higher concentration of silt are characterized by low level of species diversity but high degree of dominance, while the species composition of the sands with the low concentration of silt particles is characterized by high index of species diversity and low Simpson domination index.

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