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THE TAXOCENE OF FREE-LIVING NEMATODES UNDER TECHNOGENIC POLLUTION (SEVASTOPOL, NORTHWESTERN BLACK SEA)

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INTRODUCTION

Sevastopol Bay has long been receiving an influx of pollutants from two main sources - municipal sewage discharge and the navy. Sea bottom sediment accumulates most of the pollutants and at the same time harbours the taxocene of free-living nematodes. The sediments are polluted with oil hydrocarbons (chloroform extracted bitumenoids, B_{chl}) and heavy metals – Cu, Mn and Zn (0.34-19.20, 1.96-21.94 and 0.12-7.99 mg·kg^{-1}, respectively) (*Osadchaya et al.*, 2003; Ovsyaniy *et al.*, 2003).

METHODOLOGY

Material for the investigation was collected in June 2001 from 32 stations located across Sevastopol Bay, in the depth range of 4 – 17 (Figure 1). At each station duplicate samples of meiobenthos were taken with a 20-cm^2 meiobenthos tube and core samples of the uppermost bottom substrate with a 0.08 m^2 Petersen grab. The sediments were washed and fractionated using a set of sieves with the smallest pore size of 64 µm, and stained with Rose Bengal for further counts of living organisms under a light microscope.

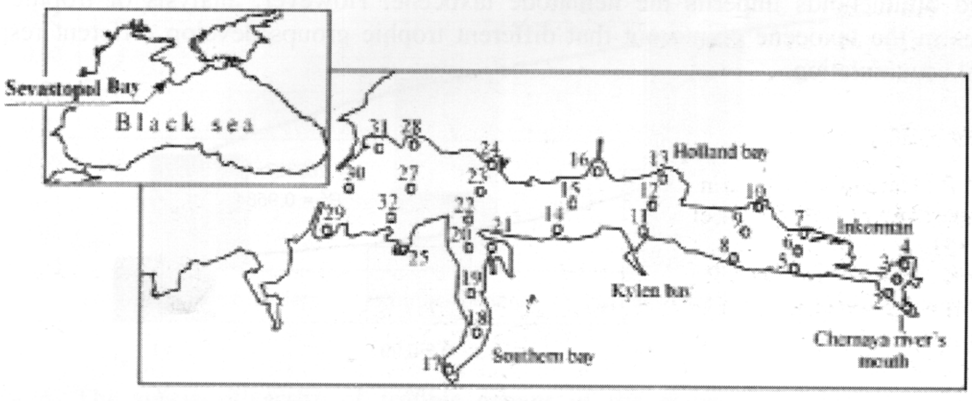

Figure 1. The study area and location of the sampling stations (Sevastopol Bay, June 2001).

RESULTS

Nematoda, the main component of the meiobenthic assemblage in the bay, determine the distribution of meiobenthos abundance; estimates were highest in the inner part and in the mouth of the bay (Figure 2). The taxocene of Nematoda is represented by 6 orders and includes 115 species of 57 genera.

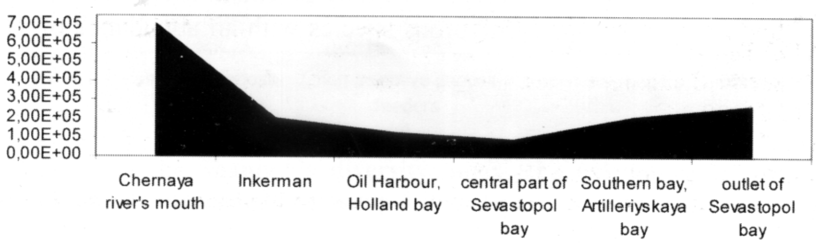

Fig. 2. The average abundance of nematodes (ind*m^{-2}) in Sevastopol Bay.

In an earlier paper (Mazlumyan, Sergeeva, 1988) we described the gradient of sediment change determined from the content of organic carbon and chloroform extracted bitumenoids. In the smaller bays and inlets of Sevastopol Bay we registered two levels of organic carbon accumulation in sea bottom sediment – one from 0.1 to 0.99 g/per 100g and the other >1 g/per 100g. The former is characteristic of taxocenes at three stations only (sts. 24, 30, 32); at the other 29 stations the taxocenes are situated in accordance with the increasing Corg gradient estimates (Corg. >1 g/per 100g). It is noteworthy that the average computed for nematode groups at these stations is considerably less (Figure 3).

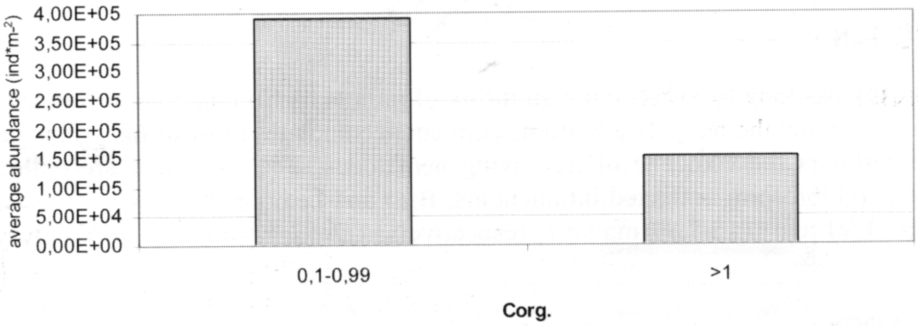

Figure 3. The average abundance of nematode groups as related to organic carbon content (C_{org}) in the upper layer of bottom sediment.

Figure 4 shows three levels of chloroform extracted bitumenoids accumulation in the sea floor. At 9 stations nematodes of the III group have average numbers of 297957.4 ± 204581 and the IV group – 99048.63 ± 64710.58; the average abundance of the V group was 125049.2 ± 84983.91 at 13 stations. This tendency indicates that accumulation of organic substances and chloroform extracted bitumenoids imperils the nematode taxocene. However, analysis of trophic diversity estimates in the taxocene points out that different trophic groups develop different responses to pollutant accumulation.

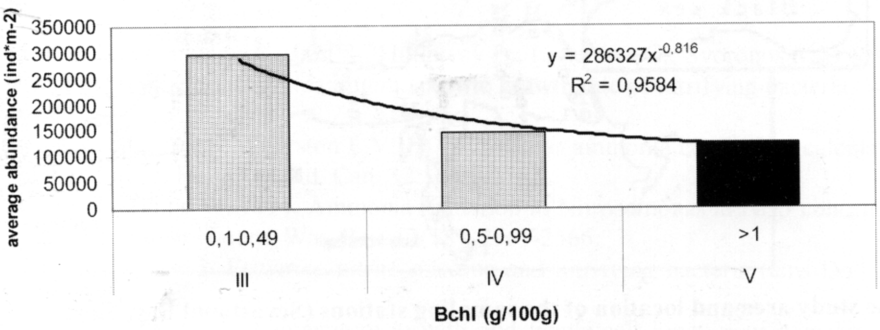

Figure 4 The average abundance of nematode groups as related to bitumenoid concentration in the upper layer of bottom sediment.

In Sevastopol Bay which is subject to strong technogenic load, the detritus chain of organic matter utilization prevails; 40 species of non-selective deposit-feeders with an abundance of 1432.4×10^3 ind.·m^{-2} and 27 species of selective deposit-feeders with an abundance of 2838×10^3 ind.·m^{-2} are involved in the chain.The grazing chain is represented by 26 epistrate species with an abundance of 932×10^3 ind.·m^{-2} and 24 omnivorous-carnivorous species with an abundance of 419×10^3 ind.·m^{-2} (Figure 5).

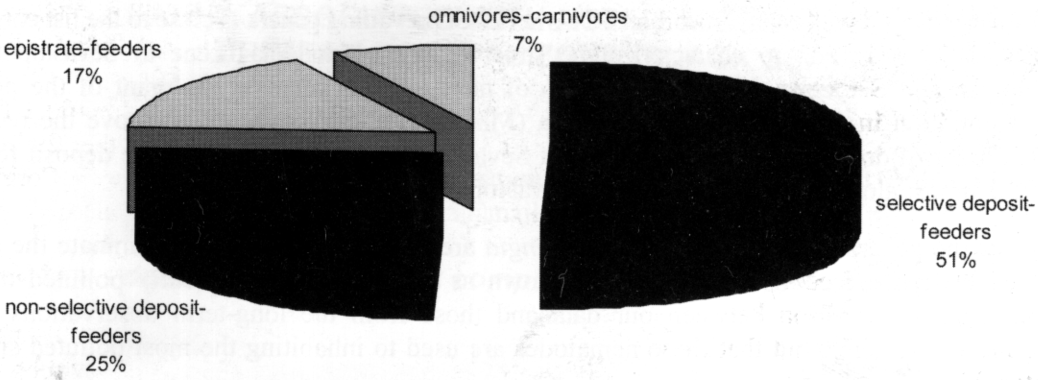

Figure 5 The trophic structure of nematode taxocene in Sevastopol Bay.

Non-selective deposit-feeders and omnivorous-carnivorous species are tolerant of severe pollution. They can rapidly increase in number and change the trophic structure of nematode taxocen. It was reported (Kiyashko *et al.*, 2001; Fadeeva, 2005) that some marine nematodes absorb carbon from oil hydrocarbons and use it as an additional source of organic matter. Evidently, the ability of nematodes to utilize such food item and detoxicate heavy metals in the organism (Howell, 1982, 1983) predetermines their adaptation to polluted habitats.

Epistrate feeders prevail only where detritus in sea bottom substrate is available and therefore are not abundant. According to the evaluated species richness index (Figure 6), predatory species demonstrate the greatest diversity. Very close to these estimates are those obtained using Shannon`s diversity index (H′) (Figure 7).

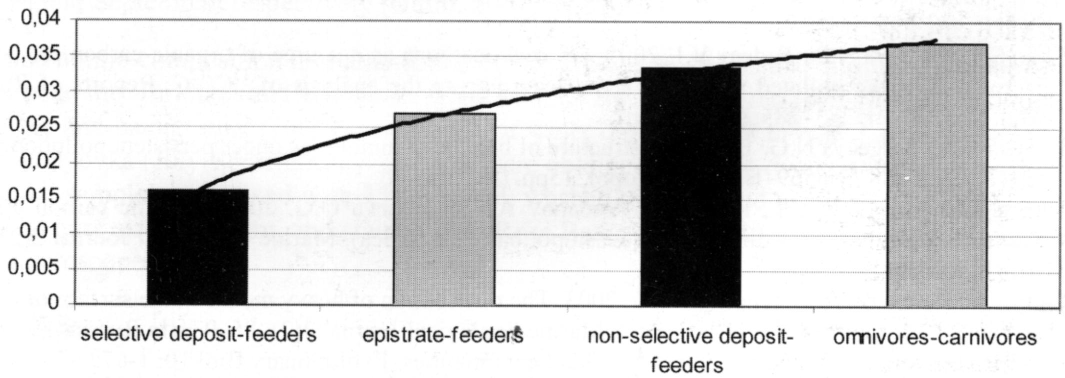

Figure 6. The species diversity of trophic groups of the nematode taxocene in Sevastopol Bay (Whittaker, 1977). Dmn=S/N-2

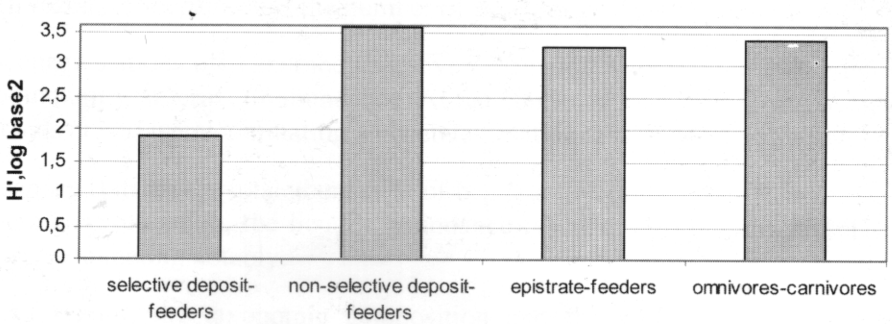

Figure 7. Changes in the Shannon's diversity index (H′) calculated for the abundance of trophic groups of the nematode taxocene in Sevastopol Bay.

With regard to population density, 5 genera were identified as dominant: *Sabatieria*, *Terschellingia*, *Theristus*, *Spirinia* and *Viscosia*. *Sabatieria* and *Terschellingia* are highly tolerant of substrates polluted with oil hydrocarbons. This series of prevailing genera is close to the list compiled earlier in 1973 and 1982 to characterize the structure of nematode taxocene in Sevastopol Bay (Mazlumyan and Sergeeva, 1988). This group of nematodes is relatively tolerant of the present level of pollution in the sea floor. Earlier data (Mazlumyan, Sergeeva, 1988) prove the recently revealed order of dominance in the taxocene of Sevastopol Bay. The non-selective deposit feeders are found almost along all of the sea floor of Sevastopol Bay.

Species of the genera *Sabatieria* and *Terschellingia* are so abundant that they dominate the group of selective deposit-feeders. They are also known as indicators of persistently polluted marine environments. Comparison between our data and those from the long-term observations made during the 1980s points out that these nematodes are used to inhabiting the most polluted sites of Sevastopol Bay.

CONCLUSIONS

In Sevastopol Bay the detritus chain of organic matter utilization prevails in the taxocene of nematodes. The ongoing accumulation of organic pollutants and chloroform extracted bitumenoids endangers the nematode taxocene. Though the species richness and diversity are high as yet, the fauna in the bay transforms into that typical of heavily polluted sediment.

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