SPECIES DIVERSITY OF FRESHWATER AND SOIL NEMATODES OF SOME LOCALITIES ALONG THE DNIESTER RIVER

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Abstract. *Species and trophic diversity of freshwater and soil nematodes of some localities along the Dniester River have been studied during the last few years. At present, 63 species of nematodes from 43 genera, 27 families and 9 orders were revealed in the sediment and river bank of the Dniester River. The largest number of nematode species belongs to the orders Dorylaimida-14 species (22.22% from total number of species), Rhabditida-12 (19%), Tylenchida-11 (17.46%) followed by Triplonchida-9 species (14.28%), Plectida-9 (14.28%), Monhysterida-5 (7.93%), Mononchida-2 (3.17%), Aphelenchida-1 (1.58%) and Chromadorida-1 (1.58%). Most of the nematode species are bacterial feeders-28 species (44.44%), followed by plant feeders-11 (17.46%), omnivores-11 (17.46%), predators-6 (9.52%), microalgae feeders-4 (6.35%) and hyphal feeders-3 (4.76%). In the littoral zone of the Dniester River the microalgae feeders (Tobrilidae), bacterial feeders (Monhysteridae, Plectidae, Cephalobidae, Panagrolaimidae and Rhabditidae) dominated both on the species diversity and their abundance. In the river bank the nematode plant parasites are mainly composed of ectoparasites, some populations of endoparasites were revealed.*

Keywords: *freshwater and soil nematodes, species and trophic diversity, the Dniester River.*

Rezumat. Diversitatea speciilor de nematode acvatice şi edafice în câteva localităţi de-a lungul fluviului Nistru. *A fost studiată diversitatea specifică şi structura trofică a comunităţilor (cenozelor) de nematode acvatice şi edafice colectate din diverse zone ale fluviului Nistru. Pînă în prezent (2009) au fost identificate 63 specii de nematode aparţinînd la 43 genuri, 27 familii şi 9 ordine. Cel mai mare număr de specii s-a găsit pentru ordinul Dorylaimida-14 specii (22.22% from total number of species), Rhabditida-12 (19%), Tylenchida-11 (17.46%) followed by Triplonchida-9 species (14.28%), Plectida-9 (14.28%), Monhysterida-5 (7.93%), Mononchida-2 (3.17%), Aphelenchida-1 (1.58%) şi Chromadorida-1 (1.58%). Cela mai multe specii de nematode aparţin grupei trofice bacteriofage-28 specii (44.44%), urmate de fitoparazite-11 specii (17.46%), omnivore-11 (17.46%), prădătoare-6 (9.52%), consumatoare de microalge-4 (6.35%) şi micofage-3(4.76%). În zona litorală a fluviului Nistru, nematodele consumatoare de microalge (Tobrilidae), bacteriofagele (Monhysteridae, Plectidae, Cephalobidae, Panagrolaimidae şi Rhabditidae) domină comunităţile atât prin abundenţă cât şi prin diversitatea specifică. Dintre nematodele edafice fitofage predomină ectoparazitele, dar uneori sunt întâlnite, de asemenea, specii de nematode endoparazite.*

Cuvinte cheie: *nematode acvatice şi edafice, specii şi diversitatea trofică, fluviul Nistru.*

INTRODUCTION

Nematodes are the most diverse, abundant and widely distributed group of invertebrate animals. Nematodes often occur in environmental conditions on water, sediment and soil; they occupy positions at the base of the food chains that ultimately sustain other animals. They are the main catalyst of some water, sediment and soil processes, especially mineralization and humification of dead organic matter, responsible for cycling of sediment and soil nutrients and self-purification of water due to their interaction with bacteria, algae and fungi (WASILEWSKA, 1997; BONGER, FERRIS, 1999 etc.).

In the last few years we have been studying the biodiversity of freshwater and soil nematodes from different localities and habitats along the Dniester River.

MATERIAL AND METHODS

Site description

The Dniester drains a long, narrow basin that is about 72,000 square km but nowhere is more than 100–110 km wide. The Dniester River flows through the territories of densely populated counties of Ukraine and Moldova. The river's basin is bounded on the north by the Volyn-Podilsk Upland and on the south of the river's upper course by the Carpathian Mountains. Farther to the south there are hilly plains and the Bassarabia Upland, and at the south eastern most end of the basin is the Black Sea Lowland. The climate of the river basin is humid, with warm summers. A large proportion of the land of the basin is under cultivation. The Dniester frequently floods, causing extensive damage to settled areas ("Ecosystems of Dniester River", 1990). Towards the Dniester's mouth, the composition of the bottom gradually alters from calcareous, shingly sand to sand, silt sand and silt with different textures. The river-bed is curved and stream velocity is slow especially in the lower stretch forming a large spectrum of habitats. According to the hydrological and physical characters, the Dniester River is divided in three stretches: the upper one – Carpathian (from source to the village of Cosauti, Soroca district), the middle one – Podolian (down to the town Dubasari) and the lower one (down to the mouth). The long-term research of the chemical composition of water and sediment of the Dniester River in the Laboratory of Hidrobiology and Ecotoxicology, Institute of Zoology ASM has shown that the levels of ammonium nitrogen, nitrite nitrogen, and phosphor mineral were comparable nowadays with those from the 1980s. However, the levels of organic nitrogen and organic matter were twice greater (ZUBCOV, 1988, ZUBCOV & SCHLENK, 2004). The water of the Dniester River was characterized as moderately polluted. The twice-increase of the ammonium

nitrogen and nitrite nitrogen is often observed in the water below the city Soroca. The channel of the river and water area of the Dubasari Reservoir intensively grows now with the higher water plants. Reception of cold water in the reservoir in summer time strengthens the processes of half-decay macrophytes that finally conduct to secondary pollution of water by organic substances and reduction of the dissolved oxygen (ZUBCOV, 1998; ZUBCOV & SCHLENK, 2004).

Sampling localities

The samples of sediment and soil of the river bank were collected in the localities along the Dniester River for different habitats and periods of time (2004-2008). In the upper stretch of the Dniester River the sampling localities were below the city Soroca (sediment samples); in the middle one - Dubasari Reservoir, near the towns of Rezina, Saharna and Malovata (soil samples of the river bank) and in the lower one - near villages Sucleia (sediment samples of littoral zone), Rascaeti (grassland) and town Olanesti (floodplain grassland, willow plantation) (Fig. 1).

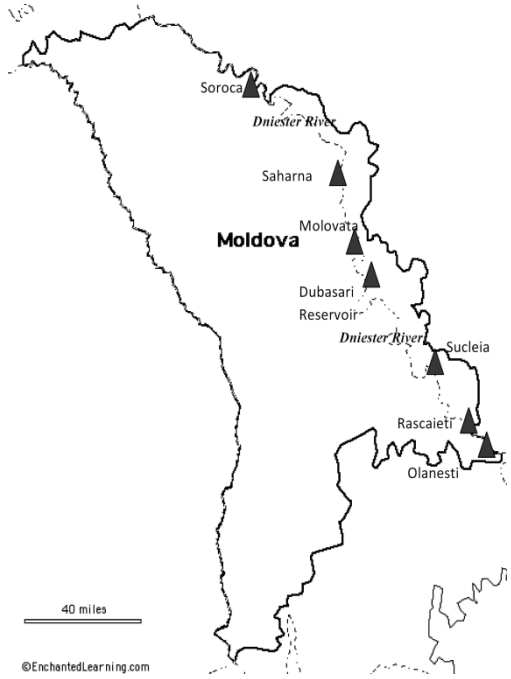

Figure 1. Sampling localities along the Dniester River (The Republic of Moldavia).
Figura 1. Localitățile de unde s-au prelevat probe de-a lungul Fluviului Nistru (Republica Moldova).

Sampling and extraction

Samples were collected for the last five years from different habitats. Soil samples were taken from a 25 square cm surface area and 10 cm depth. The aquatic nematodes were collected with a hand-held Perspex core tube in the littoral zone. Nematodes were extracted alive by sieving and decanting using standard methods of brass screens (40, 60, 100, 325 and 500 mesh) and Baermann funnels and fixed in hot 4% formaldehyde. Then the specimens of nematodes were accounted and some of them were picked out, and processed to glycerine, mounted on permanent slides, labelled with sampling data and reference numbers, identified and deposited in a managed collection ("Methods for the examination of organism diversity in soils and sediments", 1996). The nematode specimens were identified on mass-slides to species using the keys and species description by NESTEROV (1979), NICKLE (1991), JAIRAJPURI (1992), GAGARIN (1993, 2001), LOOF (1999), SIDDIQI (2000), ZULLINI (2005), ANDRASSY (2005), EYUALEM-ABEBE et al. (2006). Classification of Phylum Nematoda accepted in the "Fauna Europaea" database (www.faunaeur.org) is used in this paper. The nematode trophic groups were given according to YEATS et al. (1993).

RESULTS AND DISCUSSIONS

At present (2009), 63 species of freshwater and terrestrial nematodes from 43 genera, 27 families and 9 orders were revealed in the sediment and river bank of some localities along the Dniester River. The identified species of nematodes belong to the following orders and families, such as order **Chromadorida:** Chromadoridae - *Punctodora* sp.; **Dorylaimida:** Aporcelaimidae - *Aporcelaimellus amplexor* (NESTEROV & LISETSKAJA, 1965), *A. krygeri* (DITLEVSEN, 1928)**,** Dorylaimidae - *Dorylaimus montanus* STEFANSKI, 1923**,** *D. stagnalis* DUJARDIN, 1845**,** *Mesodorylaimus bastiani* (BÜTSCHLI, 1873), *M. mesonyctius* (KREIS , 1930), *M. potus* HEYNS, 1963, *M. pseudobastiani* LOOF, 1969**,** *Mesodorylaimus* sp., Leptonchidae - *Tylencholaimellus coronatus* THORNE, 1939, Qudsinematidae - *Eudorylaimus acuticauda* (DE MAN, 1880), *Thonus ettersbergensis* (DE MAN, 1885), Xiphinematidae - *Xiphinema pachtaicum* (TULAGANOV, 1938), Tylencholaimidae - *Tylencholaimus stecki* STEINER, 1914; **Mononchida:** Mononchidae - *Mononchus aquaticus* COETZEE, 1968, Mylonchulidae - *Mylonchulus sigmaturus* (COBB, 1917); **Monhysterida**: Monhysteridae - *Eumonhystera dispar* (BASTIAN, 1865), *E. filiformis* (BASTIAN, 1865), *Monhystera paludicola* DE MAN, 1881, *M. stagnalis* BASTIAN, 1865, Xyalidae - *Daptonema dubium* (BÜTSCHLI, 1873); **Plectida:** Rhabdolaimidae - *Udonchus tenuicaudatus* COBB, 1913, *Udonchus* sp., Chronogastridae - *Chronogaster typica* (DE MAN, 1921), Plectidae - *Anaplectus granulosus* (BASTIAN, 1865), *Plectus acuminatus* BASTIAN,1865**,** *P. aquatilis* ANDRÁSSY, 1985, *P. parietinus* BASTIAN, 1865**,** *P. parvus* BASTIAN, 1865**,** *P. rhizophilus* DE MAN, 1880; **Triplonchida:** Prismatolaimidae - *Prismatolaimus dolichurus* DE MAN, 1880, *P. intermedius* (BÜTSCHLI, 1873), Tobrilidae - *Brevitobrilus stefanskii* (MICOLETZKY, 1925), *Neotobrilus diversipapillatus orientalis* (DADAY, 1905), *N. longus* (LEIDY, 1852), *Tobrilus gracilis* (BASTIAN,1865), Tripylidae - *Tripyla affinis* DE MAN, 1880, *T. filicaudata* DE MAN, 1880, *Trischistoma monohystera* (DE MAN, 1880); **Aphelenchida:** Aphelenchidae - *Aphelenchus* sp.; **Rhabditida:** Cephalobidae - *Acrobeles complexus* THORNE, 1925, *Cephalobus parvus* THORN, 1937, *C. persegnis* BASTIAN, 1865, *Eucephalobus paracornutus* DE CONINCK, 1943, *Heterocephalobus elongatus* (DE MAN, 1880),

Diplogastridae - *Diplogaster rivalis* (LEYDIG, 1854), Panagrolaimidae - *Panagrolaimus hygrophilus* BASSEN, 1940, *P. rigidus* (A. SCHNEIDER, 1866), *Panagrolaimus* sp., Rhabditidae - *Poikilolaimus oxycerca* (DE MAN, 1895), *Caenorhabditis* sp., *Mesorhabditis* sp.; **Tylenchida:** Tylenchidae - *Aglenchus agricola* (DE MAN, 1884), *Filenchus filiformis* (BÜTSCHLI, 1873), *Tylenchus davainei* BASTIAN, 1865, Ecphyadophoridae - *Lelenchus leptosoma* (DE MAN, 1880), Hoplolaimidae - *Helicotylenchus erythrinae* (ZIMMERMANN, 1904), *Rotylenchus robustus* (DE MAN, 1876), Pratylenchidae - *Hirschmanniella* sp., *Pratylenchus pratensis* (DE MAN, 1880), Tylotylenchidae - *Merlinius brevidens* (ALLEN, 1955), *Merlinius* sp. and *Bitylenchus dubius* (BÜTSCHLII, 1873).

The largest number of species were noted from the orders Dorylaimida (14 species), Rhabditida (12), Tylenchida (11) followed (in descending order) by Triplonchida (9 species), Plectida (9), Monhysterida (5), Mononchida (2), Aphelenchida (1) and Chromadorida (1). According to the feeding types (trophic groups by Yeats et al., 1993) among the revealed nematode species prevailed the bacterial feeders (28 species), followed by the plant feeders (11, mainly ectoparasites and epidermal cell feeders), omnivores (11), predators (6), microalgae feeders (4) and hyphal feeders (3).

In the sampling locality situated below the wastewater treatment station of the city Soroca (sediment samples) the following species were revealed: *Tobrilus gracilis, Neotobrilus diversipappilatus orientalis, Neotobrilus longus, Brevitobrilus stefanskii, Monhystera paludicola, Plectus cf. rhizophilus, Chronogaster typica, Panagrolaimus* sp., *Panagrolaimus hygrophilus, Heterocephalobus elongatus, Ceanorhabditis* sp., *Aphelenchus* sp., *Poikilolaimus oxycerca, Dorylaimus stagnalis* and *Mesodorylaimus* sp.. The species belonging to the family *Tobrilidae* were diverse and numerous, their populations consisting in mature females, males and juveniles (sampled in June 2007). Between tobrilids the species of the genus *Neotobrilus* were dominant. Among the trophic groups the microalgae feeders (Tobrilidae) and bacterial feeders (Monhysteridae, Plectidae, Cephalobidae, Panagrolaimidae and Rhabditidae) were dominant. The common species *Dorylaimus stagnalis* prefers the standing polluted water.

In the sampling locality along the Dubasari Reservoir where the river bank was covered with herbaceous plants the species of plant feeders were numerous and diverse, such as *Filenchus filiformis, Lelenchus leptosoma, Helicotylenchus erythrinae, Rotylenchus robustus, Pratylenchus pratensis, Merlinius brevidens, Xiphinema pachtaicum* and between the bacterial feeders, the following species *Poikilolaimus oxycerca, Acrobeles complexus, Cephalobus parvus, Trischistoma arenicola, Aporcelaimellus amplexor, Tylencholaimus stecki* and *Tylencholaimellus coronatus* were predominant. In the littoral zone of the Dubasari Reservoir, with sandy bottom, the species *Tobrilus gracilis, Diplogaster rivalis, Tripyla affinis, Dorylaimus stagnalis, D. montanus* and *Mesodorylaimus potus* were found. The first four species were numerous.

In the flooded tree plantations along the lower stretches of the Dniester River (near the village Olanesti), which include willow, mixed forests and floodplain grassland, the following species have been noted, such as: *Aglenchus agricola, Tylenchus davainei, Filenchus filiformis, Bitylenchus dubius, Merlinius* sp., *Rotylenchus robustus, Mesorhabditis* sp., *Eucephalobus paracornutus, Cephalobus persegnis, Monhystera dispar, Anaplectus granulosus, Plectus aquatilis, P. parietinus, Prismatolaimus intermedius, Mylonchulus sigmaturus, Eudorylaimus acuticauda, Mesodorylaimus bastiani, M. mesonyctius, Aporcelaimellus krygeri* and *Thonus ettersbergensis*.

In the littoral zone with silt sand (the Dniester River near the village Olanesti) two species *Dorylaimus stagnalis* and *Tobrilus gracilis* were predominant among other species, such as: *Mesodorylaimus mesonyctius, M. potus, Plectus aquatilis, Trischistoma monohystera, Tripyla filicaudata, Diplogaster rivalis* and *Panagrolaimus* sp.

In the littoral zone of the lower stretches of the Dniester River (near the village Sucleia) the species *Punctodora* sp., *Chronogaster* sp., *Tobrilus gracilis, Brevitobrilus stefanskii, Neotobrilus diversipappilatus orientalis, Hirshmaniella* sp., *Mononchus aquaticus, Dorylaimus stagnalis, Monhystera stagnalis, Eumonhystera filiformis, Daptonema dubium, Prismatolaimus dolichurus, Ironus tenuicaudatus, Eumonhystera dispar, Plectus acuminatus, Ironus cf gagarini, Panagrolaimus hygrophilus, Udonchus* sp. were found.

The analysis of the nematode species from the littoral zone of some sampling localities along the Dniester River has been carried out using the ecological groups suggested by GAGARIN (2001). The first ecological group includes the hydrobionts formed by three subgroups, such as the true hydrobionts (oxygen consumers) are the species from the family Tobrilidae and the genera *Tripyla, Ironus, Mononchus* (*M. aquaticus*), some *Monhystera, Eumonhystera (E. dispar* and *E. filiformis), Daptonema, Chronogaster etc.*; the freshwater saprobionts (adapted for the deficiency of oxygen) are the species *Panagrolaimus hygrophilus* and *Diplogaster rivalis* and the phytoparasitic nematodes of freshwater macrophytes are the species of the genus *Hirschmanniella*. The second ecological group - amphibionts include the majority of species from the genera *Eumonhystera, Plectus, Anaplectus, Mylonchulus, Mesodorylaimus, Eudorylaimus,* species *Panagrolaimus rigidus, Poikilolaimus oxycerca* and few species of the genus *Aphelenchoides* living in the freshwater, moss and humidified soil. The third ecological group - edaphobionts adapted to the terrestrial conditions appearing in the freshwater casually. These species are not adapted for the dwelling in the aquatic environment for a long time though they suffer easily from the deficiency of oxygen. This group includes practically the majority of terrestrial species from the orders *Rhabditida, Tylenchida, Aphelenchida* and *Dorylaimida*.

CONCLUSIONS

A large spectrum of aquatic and terrestrial habitats along the Dniester River formed the favourable living conditions for the different species of Phylum *Nematoda*. At present (2009), 63 species of freshwater and terrestrial nematodes from 43 genera, 27 families and 9 orders were revealed in the sediment and river bank of some localities along the Dniester River. In the littoral zone of the studied localities, the microalgae feeders (Tobrilidae), bacterial feeders (Monhysteridae, Plectidae, Cephalobidae, Panagrolaimidae and Rhabditidae) are dominant concerning the species diversity and their abundances. The species *Dorylaimus stagnalis* was common in all freshwater samples. In the river bank the plant feeders are mainly composed of the non-obligatory plant parasites as ectoparasites and root hair feeders especially the genera *Filenchus, Lelenchus, Malenchus* and *Tylenchus*. Only the numerous populations of endoparasitic species *Pratylenchus pratensis* and ectoparasitic species *Helicotylenchus erythrinae*, *Rotylenchus robustus, Merlinius brevidens* and *Xiphinema* spp. could cause some depressions or diseases of herbaceous or tree plants.

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