Acta Zoologica Lituanica, 2002, Volumen 12, Numerus 1
ISSN 1392-1657

BIOINDICATION OF THE NERIS RIVER BASED ON THE STRUCTURE OF HYDROBIOCENOSES

Algis BUBINAS, Irena JAGMINIENĖ

Institute of Ecology, Akademijos 2, 2600 Vilnius, Lithuania

Abstract. Productivity, species composition and distribution of macrozoobenthic organisms in all the investigated parts of the Neris River indicate low pollution with organic materials. Biogenic pollution was of different intensity in the investigated stretches of the river. However, the highest pollution with biogenic materials was registered in the stretch of the river near Gariūnai. The structure of the communities of macrozoobenthic organisms ensures intensive biological self-cleaning processes. Changes occurring in the groups and species of macrozoobenthic organisms reveal the future dynamics of the ecological state in the Neris River. Due to the analysis of these changes, it will be possible to normalise the anthropogenic press, to disperse pollution from agricultural territories and to manage better purification of country sewage.
Key words: benthos, biomass, species composition

Introduction

Pollution and eutrophication in the Neris River is of uneven intensity due to different amounts of organic and biogenic substances getting into different stretches of the river. There is a great variety of biotic and abiotic environmental factors forming conditions for the existence and biological variety of different groups of organisms and for the formation of different structures of zoocenoses and populations. On the basis of data acquired on these factors, we may evaluate the ecological state of a water body, to establish the stability level of an ecosystem and to forecast possible results of ecological risk. In our research, we concentrated our attention on the indicators of the biomass (productivity) and abundance of different groups and species and on the distribution of the so-called 'indicative' species.
The aim of this study was to investigate the structure of the populations of macrozoobenthic organisms and zoocenoses, to evaluate the current ecological situation and to establish parameters of the ecological risk under the ecotoxic influence.

Material and methods

During a complex expedition, samples were collected in the Neris River upstream of Vilnius (near Nemenčinė), downstream of Vilnius (near Gariūnai) and downstream and upstream of Jonava. In the riparian zone of the river, samples were taken applying a drag (covering the area of 225 cm²) and a dredger (covering the area of 0.5 cm²). Applying classical hydrological methods in laboratory, we established the diversity of species and the quantitative and qualitative composition of separate species and communities. In addition, indicative species were revealed (Makrushin 1974; MBAFB 1976; UMWQI 1966; Zenkevich 1979).

Results

Due to variable environmental conditions and biotopes, the species composition of macrozoobenthic organisms, the structure, biomass and abundance of their communities in the stretches of the Neris River near Nemenčinė, Gariūnai and downstream and upstream of Jonava were different (Table 1).
The most numerous organisms in our samples were mayflies (Ephemeridae). Upstream of Jonava, 13 Ephemeridae species were found. They made about 60.5% of the species composition of communities (biocenoses). Near Nemenčinė, we found 17 Ephemeridae species (60%); near Jonava, we found ten species (45.8%) and near the Gariūnai Bridge, nine Ephemeridae species (29.4%) were found (Fig. 1).
According to the saprobity, the species composition in separate biocenoses was different. In the Neris River near Nemenčinė, the following Ephemeridae species prevailed: *Ecdyonurus fluminum* Pict., *Ecdyonurus venosus* Fab., *Oligoneuriella rhenana* and *Heptagenia coerulans* Rost. Representatives of the family Caenis were also abundant.

Table 1. The structure of biocenoses of macrozoobenthic organisms based on the abundance of individuals in benthose groups in 1998 (%).

Sampling site in the Neris River	The structure of biocenoses (%)									
	Ephemeroptera	Plecoptera	Trichoptera	Hirudinea	Odonata	Molluscs	Crustacea	Coleoptera	Chironomidae	Oligochaeta
Near Nemenčinė	60.0	2.3	5.1	1.1	-	1.1	-	11.0	10.3	3.1
Near Gariūnai	29.4	-	-	10.2	3.2	4.3	22.5	-	23.5	7.0
Upstream of Jonava	60.5	0.5	0.2	4.2	0.7	17.4	1.3	4.4	4.4	6.4
Downstream of Jonava	45.8	-	-	7.7	0.5	8.6	3.0	-	25.0	9.6

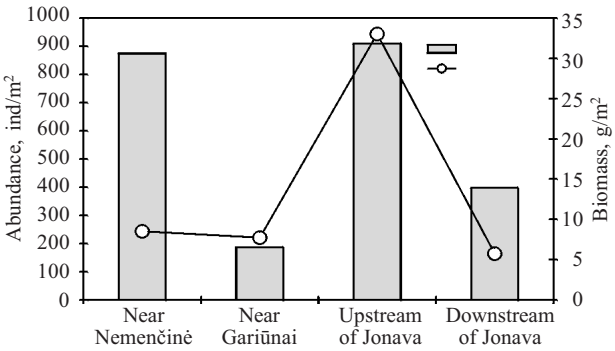

Figure 1. The abundance (ind/m²) and biomass (g/m²) of macrozoobenthic organisms.

Plecoptera larvae (*Taeniopteryx nubeculosa*, *Isoperla* sp.) and Trichoptera larvae (*Polycentropus*, *Rhyacophyla*) were found there as well (Table 2). They are macrozoobenthic organisms dwelling in relatively clean α- and β-saprobial waters. In this stretch of the river, the following chironomids were prevalent: *Cryptochironomus rolli* Kirpitsch., *Polypedilum* sp., and *Tendipedinae genuinae № 3*; among grasses, *Cricotopus gr. silvestris* F., *Cricotopus biformis* Edw., and *Cricotopus latidentatus* Tschern were most abundant. The above-mentioned chironomid species feed not only on the tissues of macrophytes, but on planktonic algae getting into the holes burrowed by chironomids in the tissues of macrophytes. In comparison to other stretches of the Neris River, here we found less leeches and Oligochaeta. In addition, mussels (*Anodonta*, *Unio*, *Sphaerium* and *Pisidium*) are found there.

All the above-mentioned organisms are good filtrates and they actively participate in the processes of biological self-cleaning. Thus, we may maintain that the stretch of the Neris River near Nemenčinė is not heavily polluted; degradation of the biocenoses in this stretch has not been established yet.

In the stretch of the Neris River upstream of Jonava, bottom-dwelling representatives of oligo- and β-saprobial zones were prevalent, too. In addition, there were mayflies of the family Caenis and quite a large number of different leech species belonging to α- and β- saprobial zone. Molluscs were the most abundant organisms (17.4%), among which *Bithynia tentaculata* populations were prevalent. In the Neris River upstream of Jonava, the number of Plecoptera larvae and Trichoptera larvae was rather small (they made 0.5% and 0.2% respectively). According to the species composition of organisms and the indicative values for the category of water cleanliness, this part of the Neris River belongs to the oligo- and β-saprobial zone.

In the Neris River downstream of Jonava, the quantitative and qualitative composition of Oligochaeta, chironomids and leeches has improved. Among the aquatic plants of the Neris River, larvae of the following chironomids are frequently found: *Glyptotendipes*, *Endochironomus* and *Cricotopus*. In this stretch of the Neris River, we have not found any Plecoptera larvae and Trichoptera larvae representatives of the bottom fauna sensitive to pollution. This is a β-saprobial stretch of the Neris River containing quite a large amount of biogenic substances.

In the biocenoses of the bottom fauna of the Neris River at the Gariūnai Bridge, we registered an increase of the larvae of oligochaetes, chironomids and crustaceans (*Asellus aquaticus*), which are resistant to pollution. Chironomidae larvae feeding on detritus are predominant here. This stretch of the river is also attributed to the β-saprobial category of pollution with abundant biogenic material.

Generalisation

The productivity of macrozoobenthic organisms, their species composition and distribution along all the investigated stretches of the Neris River indicate a low degree of pollution with organic materials.

The level of biogenic pollution in the investigated stretches of the river was uneven. The highest concen-

Table 2. Species composition of the benthic fauna in the Neris River (1998).

Species of benthic organisms	Sampling sites			
	Near Nemenčinė	Near Gariūnai	Upstream of Jonava	Downstream of Jonava
Ephemeroptera				
Heptagenia sulphurea (Müller)			+	
Heptagenia flava (Rostok)			+	+
Heptagenia coerulans (Rostok)	+		+	+
Heptagenia fuscogrisea (Rostok)				+
Potamanthus luteus (Linné)		+	+	+
Centroptilum luteolum (Müller)	+	+	+	
Oligoneuriella rhenana (Imhot)	+		+	+
Ecdyonurus fluminum (Pictet)	+			
Ecdyonurus venosus Fabricius	+		+	
Ephemerella ignita (Poda)		+	+	+
Eurycaenis harrisella Curtis	+	+	+	+
Caenis horaria (Linné)	+		+	+
Caenis moesta (Bengston)	+			+
Caenis macrura (Stephens)	+			+
Paraleptophlebia submarginata (Steph.)	+		+	
Baetis bioculatus (Pictet)			+	
Baetis atrebatinus Eaton	+			
Baetis venustulus Eaton	+			
Siphlurella linnean Eaton	+			
Procloeon ornatum Tshern.		+	+	
Procloeon bifidum Bengts.		+	+	
Isonychra ignota (Walker)	+	+		
Pseudocloeon inexpectatum Tshern.	+			
Ephemera vulgata Linné	+			
Ephemera lineata Eaton	+			
Leptophlebia vespertina (Linné)		+		
Habrophlebia lauta McLachlan		+		
Hirudinea				
Glossiphonia complanata (Linné)		+	+	+
Glossiphonia heteroclita (Br.)				+
Helobdella stagnalis (Bl.)	+	+	+	+
Herpobdella octoculata (Linné)	+	+	+	+
Pisciola geometra (Linné)			+	+
Mollusca				
Physa fontinalis	+	+		
Anodonta	+		+	
Unio	+			
Limnea stagnalis		+		+
Viviparus viviparus		+	+	
Theodoxus fluviatilis	+		+	
Radix auricularia			+	
Pisidium	+		+	
Valvata cristata			+	+
Bithynia tentaculata			+	+
Galba palustris				+
Radix ovata				+
Sphaerium	+			

Table 2 continued

Species of benthic organisms	Sampling sites			
	Near Nemenčinė	Near Gariūnai	Upstream of Jonava	Downstream of Jonava
Crustacea				
Asellus aquaticus Linné		+	+	+
Coleoptera				
Notonecta	+			
Hydrophilus			+	
Aphelocheirus narwae			+	
Aphelocheirus aestivalis	+		+	
Trichoptera				
Hydropsyche ornatula McLach.	+		+	
Polycentropus flavomaculatus (Pictet)	+			
Rhyacophila	+			
Plecoptera				
Taeniopteryx nubeculosa L.	+			
Isoperla sp.	+		+	
Odonata				
Aeschna grandis L.			+	
Gomphus vulgatissimus L.		+	+	
Agrion splendens Harris			+	
Chironomidae				
Tanytarsus gr. gregarius Kieff.		+		
Cryptochironomus rolli Kirpitsch	+			
Cryptochironomus gr. camtolabis Kieff.		+		
Cryptochironomus fridmanae Tschern.			+	+
Cryptochironomus fuscimanus Kieff.		+		
Cryptochironomus defectus Kieff.		+	+	+
Cryptochironomus conjugens Kieff.		+	+	+
Cryptochironomus deneijers	+			
Endochironomus signaticornis Kieff.		+		
Limnochironomus nervosus Staeg.		+		+
Limnochironomus gr. tritomus Kieff.		+		
Polypedilum breviantennatum Tschern.	+			+
Polypedilum gr. convictum Walk.		+		
Polypedilum gr. scalaenum Schr.	+			
Polypedilum sp. *Tendipedinae genuinae №. 3*	+	+		+
Allochironomus Kieff.		+		
Endochironomus gr. tendens F.		+		+
Cricotopus gr. silvestris F.	+	+	+	+
Cricotopus biformis Edw.	+	+	+	+
Cricotopus latidentatus Tshern.	+	+	+	+
Cricotopus algarum Kieff.	+	+	+	+
Glyptotendipes gripekoveni Kieff.				+
Pentapedilum exectum Kieff.	+			
Lauterborniella gr. agroloides Kieff.	+			
Paratendipes intermedius Tschern.			+	
Paratendipes gr. albimanus Mg			+	
Eukiefferiella		+		
Orthocladius sp.		+		
Oligochaeta				
Oligochaeta sp.	+	+	+	+

tration of biogenic materials was registered in the stretch of the Neris River near Gariūnai.
The composition of the communities of macrozoobenthic organisms in the Neris River ensures intensive processes of biological self-cleaning.
Due to the analysis of the changes in the groups and species of macrozoobenthic organisms, it will be possible to normalise the anthropogenic press, to disperse pollution from agricultural territories and to manage better purification of country sewage in future.

Conclusions

1. In the investigated stretches of the Neris River we found: 27 species of mayflies, 28 species of Chironomidae, 13 species of molluscs, three species of Plecoptera larvae, three species of Trichoptera larvae, four species of beetles, three species of Odonata larvae, three species of leeches and higher crustaceans and oligochaetes the species composition of which we have not determined yet. In total, 85 species of macrozoobenthic organisms have been found.
2. Due to the miscellaneous food-chains of zoobenthic organisms, the processes of self-cleaning are intensive. They (food-chains) also ensure decomposition of organic materials present in the bottom and water of the river and accumulation of pollutants.
3. On the basis of the sensitivity of zoobenthic (bottom-dwelling) organisms to the pollution of environment, they can be divided into the following groups:
Group 1, comprising benthic organisms which are most sensitive to pollutants: Plecoptera larvae, Trichoptera larvae and mayflies (*Ecdyonurus fluminum*, *Ecdyonurus venosus*).
Group 2, comprising benthic organisms sensitive to pollutants: the remaining species of mayflies, Odonata larvae, mussels.
Group 3, comprising benthic organisms which are less sensitive to pollutants: crustaceans (*Asellus aquaticus*), Chironomidae, oligochaetes.
4. On the basis of the distribution of the above-presented indicative organisms in different stretches of the Neris River, we may conclude as follows: the stretch of the Neris River near Nemenčinė is relatively clean; the stretch of the Neris River upstream of Jonava is slightly polluted (pollution index is equal to 1); the stretch of the Neris River downstream of Jonava is polluted (pollution index is equal to 3); the stretch of the Neris River near Gariūnai is polluted (pollution index 3).
The structure of the population of benthic organisms and their species composition indicate an ecological state of water bodies and can be applied in the evaluation of pollution and other damage done to water ecosystems.

References

Makrushin, A.V. 1974. *Biological analysis of water quality*. Leningrad: the Academy of Sciences of the USSR. [Макрушин, А.В. 1974. *Биологический анализ качества вод*. Ленинград: АН СССР.]

Methods of biological analysis of freshwater bodies [MBAFB] 1976. *Collection of scientific articles*. Leningrad: the Academy of Sciences of the USSR. [Методы биологического анализа пресных вод. 1976. *Сборник научных работ*. Ленинград: АН СССР.]

Unified methods of water quality investigations [UMWQI] 1966. Part IV. Methods of biological and microbiological analysis of water bodies. Chapter 2. *Conference of the heads of the hydroeconomic bodies of the member countries of economic mutual assistance*. Moscow, 1–95. [Унифицированные методы исследовании качества вод. 1966. Часть IV. Методы биологического и микробиологического анализа вод – расдел 2. *Совещание руководителей водохозяйственных органов стран членов СЭВ*, Москва, 1–95.]

Zenkevich, L. 1979. The programme and methods of the investigation of water bodies. *Collection of articles*, pp. 213–227. Moscow. [Зенкевич, Л.А. 1979. Программа и методы изучения биогеоценозов водной среды. *Сб. статьей*, 213– 227. Москва.]

Neries upės bioindikacija pagal hidrobiocenozių struktūrą

A. Bubinas, I. Jagminienė

Santrauka

Makrozoobentosinių organizmų produktyvumas, rūšinė sudėtis ir jų pasiskirstymas visose Neries upės tirtose atkarpose rodo mažą užterštumą organinėmis medžiagomis. Biogeninis užterštumas tirtose atkarpose yra skirtingo intensyvumo. Labiausiai užteršta biogeninėmis medžiagomis buvo Neris prie Gariūnų. Makrozoobentosinių organizmų bendrijų sudėtis užtikrina intensyvius biologinės savivalos procesus. Šių organizmų grupių ir rūšių kaita leis ateityje analizuoti ekologinės būklės dinamiką, normuojant antropogeninę apkrovą, nuo dirbamų žemės ūkio teritorijų išskaidytą taršą, sprendžiant kaimo nuotekų valymo klausimus.

Received: 15 October, 2001
Accepted: 01 March, 2002