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DIFFERENCES IN SUBMERGED AND EMERGENT EULITTORAL SEDIMENT BIOTA OF LAKE SAKADAŠ (KOPAČKI RIT NATURE PARK, CROATIA)

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Bogut, I. & Vidaković, J.: Differences in submerged and emergent eulittoral sediment biota of Lake Sakadaš (Kopački Rit Nature Park, Croatia). Nat. Croat., Vol. 11, No. 2., 157–170, 2002, Zagreb.

Sediment granulometry, organic matter and moisture content in sediment were measured in an attempt to assess their importance for the structure of sediment biota (bacteria, protozoa, and especially, meiofauna) in the period between February and December 1998 at three eulittoral sites (submerged, at the land-water interface and emergent) of Lake Sakadaš in the Kopački rit Nature Park, Croatia.

Ten groups of meiofauna were recorded in total: Nematoda, Copepoda (incl. nauplii), Rotatoria, Oligochaeta, Gastrotricha, Cladocera, Tardigrada, Turbellaria, Acari and Insecta larvae. The relatively high number of meiofauna groups with a low abundance was the consequence of the physical and chemical characteristics of the study area, primarily of the sandy structure of sediment. Nematodes were the dominant group of meiofauna at all study sites.

At the submerged site a significant correlation existed between the organic matter in the sediment and the water level of Lake Sakadaš, between the organic matter and the moisture content in the sediment, and between the number of total bacteria and protozoa. At the land-water interface a significant correlation existed between the sediment moisture content and the total meiofauna and nematode abundance. At the same site, as well as at the emergent site, a correlation existed between the protozoa and meiofauna and between the protozoa and nematode abundances.

Key words: bacteria, protozoa, meiofauna, eulittoral, lake

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Granulometrijska svojstva sedimenta, količina organske tvari i sadržaj vlage u sedimentu mjereni su radi utvrđivanja njihove važnosti u određivanju biotičke strukture sedimenta (bakterija, praživotinja, i posebno, meiofaune) u razdoblju od veljače do prosinca 1998. godine na tri postaje (submerznoj, na kontaktu vode i kopna te emerznoj) u eulitoralu Sakadaškog jezera u Parku prirode Kopački rit u Hrvatskoj.

Ukupno je zabilježeno 10 skupina meiofaune: oblići, veslonošci (uključujući nauplije), kolnjaci, maločetinaši, trbodlaci, rašljoticalci, dugoživci, virnjaci, grinje i ličinke kukaca. Utvrđen relativno velik broj skupina meiofaune, ali s malom gustoćom, posljedica je fizičkih i kemijskih čimbenika istraživanog područja, prvenstveno pjeskovite strukture sedimenta. Oblići su bili dominantna skupina meiofaune na svim istraživanim postajama.

Na submerznoj postaji statistički značajna korelacija utvrđena je između količine organske tvari u sedimentu i vodostaja Sakadaškog jezera, između količine organske tvari i sadržaja vlage u sedimentu te između broja ukupnih bakterija i praživotinja. Na kontaktu vode i kopna statistički značajna korelacija utvrđena je između sadržaja vlage u sedimentu i gustoće ukupne meiofaune i oblića. Za istu postaju, kao i za emerznu, utvrđena je statistički značajna korelacija između brojnosti praživotinja i gustoće meiofaune te između brojnosti praživotinja i oblića.

Ključne riječi: bakterije, praživotinje, meiofauna, eulitoral, jezero

INTRODUCTION

The assemblage of organisms known as sediment fauna, especially meiofauna, has been investigated in a variety of different lentic and lotic habitats in connection with abiotic and biotic parameters (PREJS, 1977 a, b; WARREN *et al.*, 1995; PLÉNET *et al.*, 1996; HAKENKAMP & MORIN, 2000; ROBERTSON, 2000; VIDAKOVIĆ *et al.*, 2001).

Meiofauna is represented by benthic invertebrates, which are intermediate in size between the macro- and microfauna (ROBERTSON *et al.*, 2000). Functionally, meiofauna is a term that refers to the group of small benthic metazoans that pass through a 1 mm or 0.5 mm sieve and yet are retained on a 0.063 mm sieve, or a 0.045 or 0.042 mm sieve – not all scientists agree on the acceptable range (FENCHEL, 1978; GIERE, 1993). Meiofauna had not been studied much by benthic ecologists until recently, largely due to their small size and to the difficulties in studying organisms that live in sediments. However, this group is now believed to play an important role for the benthic metabolism, both via their own metabolisms and via their feeding and burrowing activity, which increases the activity of microbes in their environment (TRAUNSPURGER, 2000).

The aim of this paper is to provide more information on the relationship between sediment biota (bacteria, protozoa and meiofauna) and the sediment properties known to be important in structuring sediment fauna communities.

MATERIAL AND METHODS

Study area

Lake Sakadaš is located in the protected flooded area known as the Kopački rit Nature Park, about 12 km NE of the city of Osijek, Croatia. The dynamics of inundation determine the basic ecological characteristics of this area. A larger quantity of water flows from the Danube River into Kopački rit, than from the Drava River (MIHALJEVIĆ *et al.*, 1999). Lake Sakadaš, with an average depth of 7 m and a surface area of about 6 ha, is the deepest water depression in Kopački rit, oval in shape and with a relatively steep shore. Lake Sakadaš is almost entirely surrounded by vegetation of willow and poplar (BOGUT, 2000; VIDAKOVIĆ *et al.*, 2001).

Sediment samples for the study of sediment biota were collected from three sites: submerged, at the land-water interface and emergent (marked as A, B and C), all of them placed on the eulittoral of Lake Sakadaš (Fig. 1). The bottom of the lake is without macrophytes at the location investigated.

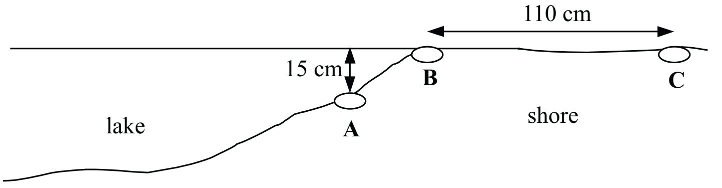

Fig. 1. Diagrammatic illustration of the sites on the eulittoral of Lake Sakadaš.

Field and laboratory investigations

Between February and December 1998, the physical and chemical parameters of the habitat were examined. The mean monthly water levels of the Danube River near the town of Apatin, of the Drava Riiver near the city of Osijek and of Lake Sakadaš in the Kopački rit Nature Park were calculated on the basis of reports of the Croatian Water Resource Management – Osijek. The granulometric composition of the sediment was analysed by sieving fractions ≥ 32 µm through standard mesh sizes (Fritsch, Deutchland), and by counting fractions ≤ 32 µm by Coulter Counter TA II (Coulter Electronic Ltd, England). Various physical and chemical parameters were measured: water temperature, concentration of dissolved oxygen and chemical oxygen demand in the water, the amount of organic matter and moisture content in the sediment (APHA, 1985).

During the period of investigation, sediment samples were collected monthly with a metal hand corer (4 cm internal diameter, length 10 cm) at each of the three sites at the eulittoral of Lake Sakadaš. Sediment for meiofaunal analysis (six replicates) was preserved in 4% formaldehyde and stained with Rose Bengal. In the laboratory each sample was sieved through a 60 µm sieve to collect meiofauna. The protozoa, taken from two replicates of each site, were studied on unpreserved material on permanent slides under a microscope (modified method of UHLIG *et al.*, 1973; FOISSNER & BERGER, 1996). The composition and abundance of sediment bacteria were analysed according to KUZNECOV & DUBININA (1989).

Analysis of data

The number of individuals (ind./100cm^2) and categories of dominance were used to evaluate the community structure in the sediment (ODUM, 1971). The coefficient of correlation (r) was calculated between environmental factors and faunistic variables (PARKER, 1979). Spatial fluctuations of physical and chemical data and biological variables (between sites and within sites) were tested by one-way ANOVA (MS Excel by MICROSOFT CORPORATION, 1997). In order to find »natural groupings« of samples a multivariate statistical method, Cluster analysis, was conducted according to CLARKE & WARWICK (1990), using Statistica 5.5 (MICROSOFT CORPORATION, 1999).

RESULTS

Physical and chemical environment

The lowest average monthly water levels of the Danube River were recorded in February (+106 cm) and in August (+154 cm). The highest average monthly water level of the Danube was recorded in November (+533 cm). The average monthly water levels of the Drava River were considerably lower than of the Danube, and ranged between –76 cm in February and +250 cm in November. The lowest average monthly water level of Lake Sakadaš (Fig. 2) was recorded in February (+26 cm), and the highest in November (+453 cm). In the autumn period of investigation the water level of the rivers and of the lake increased rapidly, and the lake almost completely covered the shore.

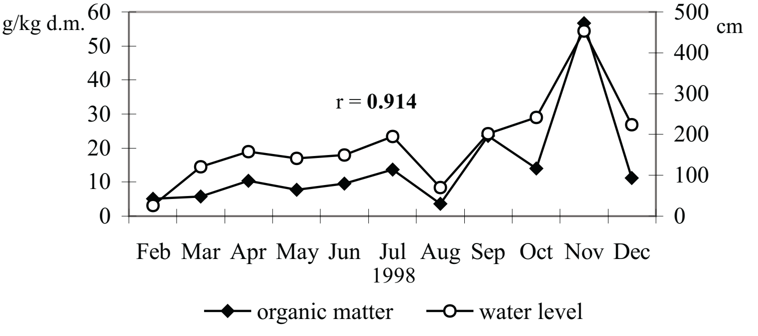

Fig. 2. Correlation between water level fluctuation of Lake Sakadaš and organic matter in the sediment at site A during the period of investigation.

Following SHEPARD's classification (1932), the sediments at the eulittoral of Lake Sakadaš were classified as sandy sediments (Tab. 1); the sediment at each of the three sites contained no pebbles, a high percentage of sand (> 89%) and considerably lower percentages of silt (max. 10%) and clay (< 0.35%). Water level fluctuations did not significantly change the granulometric composition of sediment at the sites.

Tab. 1. Sediment granulometric composition at the eulittoral of Lake Sakadaš.

	1998	% pebble (≥ 2 mm)	% sand (2mm-63 µm)	% silt (63-2 µm)	% clay (≤ 2 µm)
site A	Feb	0	95.04	4.70	0.26
	Apr	0	93.70	6.05	0.25
	Aug	0	94.98	4.88	0.14
	Nov	0	98.57	1.28	0.15
site B	Feb	0	95.68	4.15	0.17
	Apr	0	95.08	4.74	0.18
	Aug	0	96.03	3.63	0.34
	Nov	0	93.59	6.17	0.24
site C	Feb	0	92.20	7.60	0.20
	Apr	0	93.37	6.56	0.07
	Aug	0	96.65	3.14	0.21
	Nov	0	89.59	10.15	0.26

The lowest values of organic matter in sediments (Tab. 2) at the sites were recorded during low water levels and high summer temperatures (in August: at site A 3.66 g/kg of dry matter, at site B 6.46 g/kg of dry matter and at site C 17.14 g/kg of dry matter), whereas the highest amounts of organic matter were recorded in autumn, during the extremely high water levels and lower temperatures (at site A 56.69 g/kg of dry matter in November, at site B 17.55 g/kg of dry matter in October, and at site C 52.01 g/kg of dry matter in September). Correlation analysis indicated a statistically significant relationship between the amount of organic matter recorded in the eulittoral and the water level at site A (Fig. 2) of Lake Sakadaš ($n = 11$, $df = 9$, $p = 0.001$, $r =$ **0.914**).

The sediment moisture content ranged between 22.29% in August and 58.75% in September at site A, between 12.36% in November and 26.17% in February at site B, and between 11.01% in November and 24.71% in October at site C (Tab. 2). A sta-

Tab. 2. Moisture content and organic matter amount in the sediment samples from eulittoral of Lake Sakadaš.

		1998										
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
moisture content (%)	A	24.58	25.96	27.85	23.87	23.95	29.25	22.29	58.75	24.44	34.54	24.94
	B	26.17	21.52	25.92	21.20	25.32	22.94	21.13	18.64	25.61	12.36	18.82
	C	19.52	21.05	24.48	18.62	20.31	22.68	19.85	17.14	24.71	11.01	19.41
organic matter (g/kg dry matter)	A	5.08	5.84	10.31	7.75	9.50	13.64	3.66	23.51	13.97	56.69	11.27
	B	13.69	11.31	10.69	11.19	13.27	10.61	6.46	11.93	17.55	14.10	12.70
	C	14.43	23.39	11.98	5.78	7.56	32.35	5.35	52.01	14.15	8.63	30.37

tistically significant correlation between the organic matter content and the moisture content existed at site A ($n = 19$, $df = 17$, $r =$ **0.467**, $p < 0.05$). Likewise, a statistically significant correlation existed at site B between the moisture content in the sediment and the total meiofauna ($n = 19$, $df = 17$, $r =$ **0.509**, $p < 0.05$) and the nematode abundances ($n = 19$, $df = 17$, $r =$ **0.520**, $p < 0.05$). At emergent site C there was no significant correlation between the moisture content in the sediment and other measured variables.

Cluster analysis based on the measurement of seven ecological parameters pointed to a connection between the moisture content and organic matter in the sediment, and the water level fluctuations of Lake Sakadaš at all three sites (Fig. 3).

Sediment fauna community structure

The highest abundance of total bacteria was recorded in February at site A (94.151 $\times 10^6$ bact./g), in March at site B (183.131 $\times 10^6$ bact./g) and in April at site C (130.836 $\times 10^6$ bact./g). The lowest abundance was recorded in June at all sites: 0.816 $\times 10^6$ bact./g at site A, 0.576 $\times 10^6$ bact./g at site B and 0.344 $\times 10^6$ bact./g at site C.

The highest average density of protozoa was recorded at site B (82860 ind./100 cm^2, on average). At site A the corresponding number was 56786 ind./100 cm^2, and at site C 17834 ind./100 cm^2. In the sediments of all sites the highest densities of protozoa were recorded in February and the lowest in September at sites A and B and in December at site C (Fig. 4). Analysis of variance shows that statistically significant differences in the abundance of protozoa existed between sites A and B ($F_{1,19} =$ **6.35**, $p = 0.05$), and B and C ($F_{1,19} =$ **24.73**, $p = 0.05$) during the eleven months

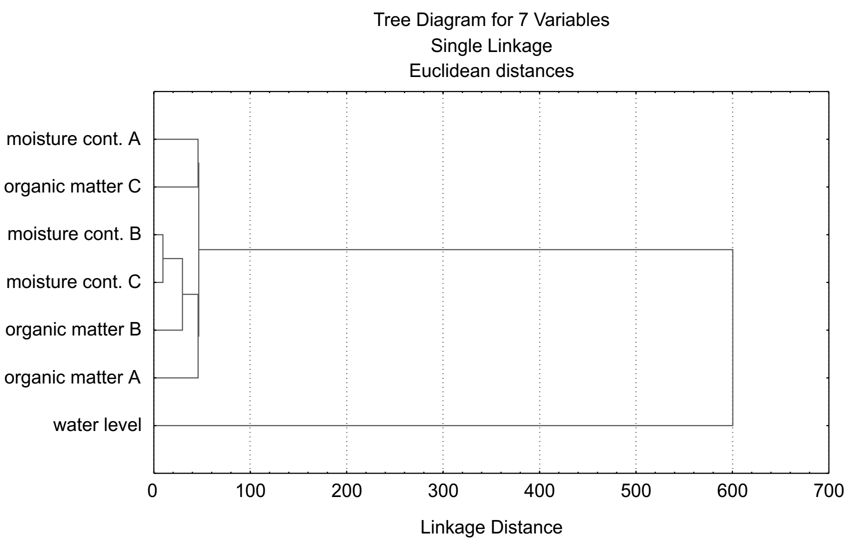

Fig. 3. Cluster analysis based on ecological parameters measured at the three eulittoral sites of Lake Sakadaš.

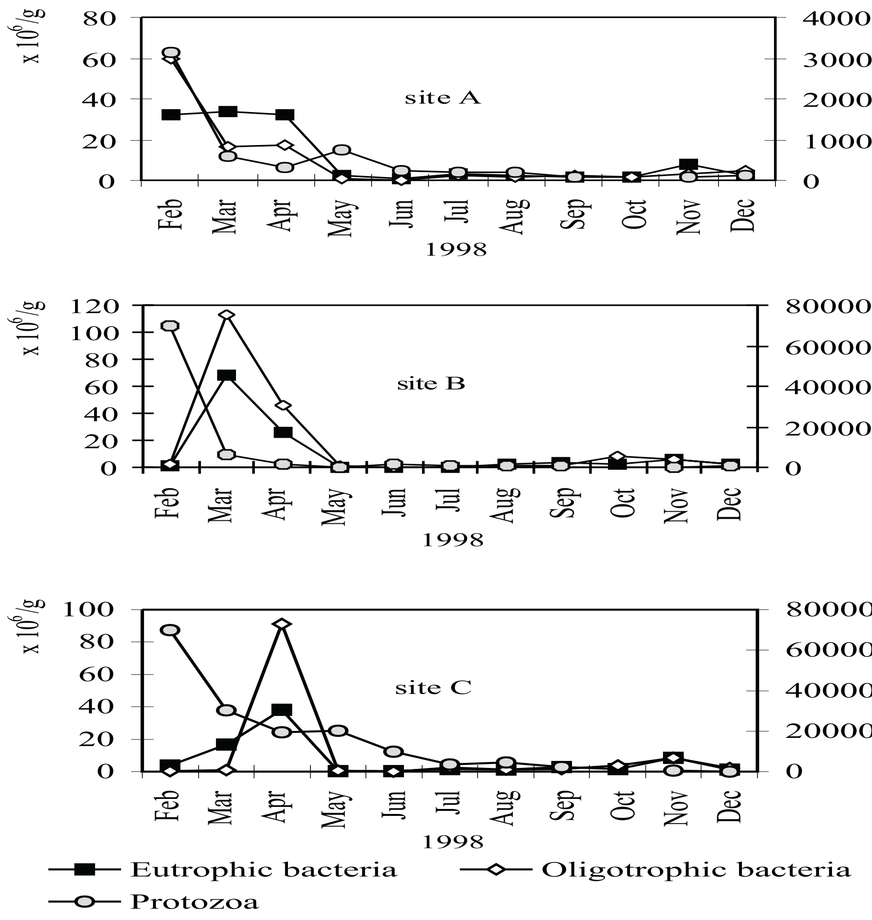

Fig. 4. Abundances of bacteria ($\times 10^6$/g) and protozoa (ind./100 cm^2) in the eulittoral zone of Lake Sakadaš.

of investigation. A statistically significant correlation between the total number of bacteria and the abundance of protozoa was shown at site A only (n = 10, df = 8, r = **0.820**, p = 0.001).

A total of 10 groups of meiofauna was recorded at site A (Nematoda, Copepoda (including nauplii), Rotatoria, Oligochaeta, Gastrotricha, Cladocera, Tardigrada, Turbellaria, Insecta larvae and Acari), nine at site B (Acari were not recorded) and eight at site C (Acari and Turbellaria were not recorded).

Meiofauna density in the sediment at site A ranged between 10 to 1990 ind./100 cm^2, at site B between 10 and 3195 ind./100 cm^2, and at site C between 17 and 3619 ind./100 cm^2. The average meiofaunal density was lowest at site A, and highest at site C. A significant correlation between the abundances of total meiofauna and total protozoa was found at sites B (n = 10, df = 8, r = **0.982**, p < 0.001) and C (n = 10,

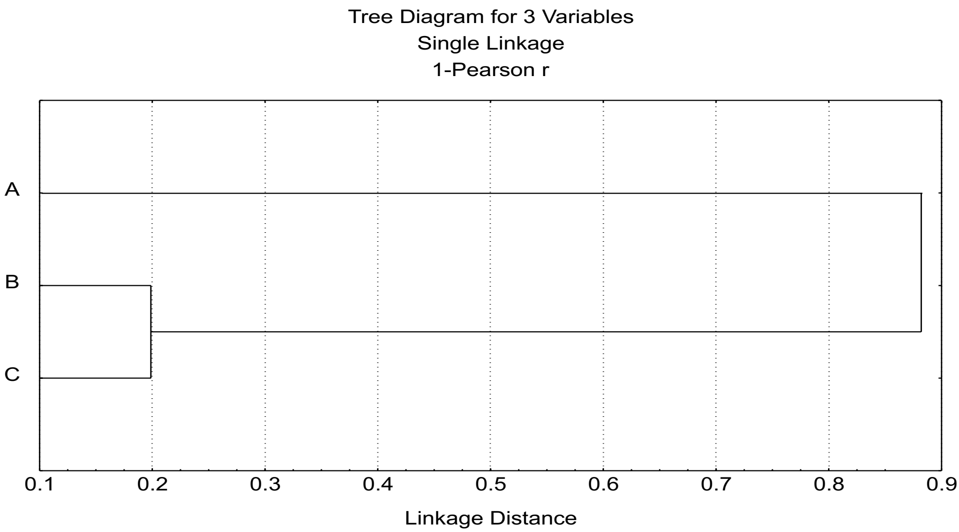

Fig. 5. Cluster analysis based on total abundance of meiofauna groups at the three eulittoral sites of Lake Sakadaš.

df = 8, r = **0.920**, p < 0.001) during the period of investigation, but the relationship was not significant at site A (n = 10, df = 8, r = –0.063). Also, a cluster analysis based on total meiofauna abundance at the three eulittoral sites brought sites B and C closer together, whereas it isolated site A (Fig. 5).

At site A the highest density of meiofauna was recorded in the April of 1998 (1989 ind./100 cm^2), and the lowest in August (119 ind./100 cm^2). The highest number was recorded for the following groups: Nematoda (256 ind./100 cm^2, on average; or > 75% of the total meiofauna) and Oligochaeta (23 ind./100 cm^2).

In the sediment of site B the highest density was recorded in February 1998 (3195 ind./100 cm^2) and the lowest in November (only 8 ind./100 cm^2). At the same site Nematoda was dominant (84% of the total meiofauna) with 391 ind./100 cm^2, on average. A significant correlation existed between nematode abundance and protozoa (n = 10, df = 8, r = **0.825**, p < 0.001). At the same site Rotatoria was the dominant group represented by 45 ind./100 cm^2, whereas Oligochaeta was the subdominant group (17.5 ind./100 cm^2). Other recorded meiofaunal groups were represented with a low abundance (< 1% of total meiofauna). The proportion of the major meiofaunal groups at the three eulittoral sites are shown in Figure 6.

In the sediment samples of site C the highest density was recorded for Nematoda (637 ind./100 cm^2; 92% of the total meiofauna) and a significant correlation existed between the nematode abundance and protozoa (n = 10, df = 8, r = **0.890**, p < 0.001). Other meiofaunal groups were represented at a very low abundance (< 2% of the total meiofauna). The minimum meiofauna density at site C was recorded in August (172 ind./100 cm^2). The second lowest density (226 ind./100 cm^2) was recorded in November 1998.

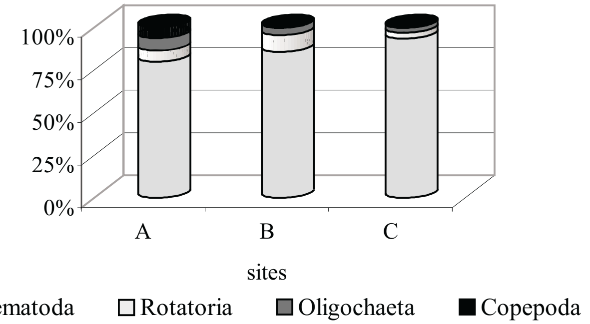

Fig. 6. Percentage rate of the major meiofaunal groups at the eulittoral of Lake Sakadaš.

No obvious seasonal variations were recorded during the investigation of the eulittoral of Lake Sakadaš, and no statistically significant differences in the number of total meiofauna between sites were found.

DISCUSSION

The fluctuation of water level, the intensive changes of water temperature because of the shallowness of the water, the higher input of organic matter because of the fallen leaves from the surrounding vegetation, and the absence of macrophytes influenced our selection of the three sites at the eulittoral zone of Lake Sakadaš.

The water level of Lake Sakadaš was directly dependent on the water levels of the Danube River and the Drava River. The water from these rivers flows into Kopački rit and flood it to a +300 cm water level (MIKUSKA, 1979). The organic matter in Lake Sakadaš is mainly autochthonous: from the remains of dead plants and animals. However, allochthonous matter also enters Lake Sakadaš from the Danube, the Drava and the Old Drava, and from the surrounding area from overland drainage (MIHALJEVIĆ *et al.*, 1999).

In the sediments of all sites the highest numbers of eutrophic and oligotrophic bacteria were found in the winter/spring period of 1998. Later, a lower number of eutrophic bacteria and, especially, the presence of oligotrophic bacteria, indicate a slow processes of remineralisation of organic matter according to ROMANENKO (1985). A statistically significant correlation between the total number of bacteria and the abundance of protozoa at the submerged site of Lake Sakadaš was expected because protozoa are grazers upon bacteria. The emergent site was characterized by the lowest amount of water in the interstitial spaces of the sediment, and, by the highest abundance of nematode species – predators upon protozoa. The highest abundance of protozoa was recorded at the land-water interface. WASILEWSKA (1973) recorded the highest abundance of protozoa in the sediment at the land-water interface on the shore of Mikołajskie Lake, too.

Many authors have recorded a great diversity of meiofauna groups in the eulittoral of different water bodies although the eulittoral seems an unfavourable habitat (SCHIEMER *et al.*, 1969; WASILEWSKA, 1973; FENCHEL, 1975; WHITMAN *et al.*, 1994; YOZZO & SMITH, 1995). In a eutrophic Belje pond in Kopački rit 11 meiofaunal groups were found by VIDAKOVIĆ & DUPAN (1996) – the same groups which were recorded in the sediment at the three eulittoral sites of Lake Sakadaš during our investigation. BOGUT *et al.* (1999) recorded 10 meiofaunal groups in the sediment of the central area of Lake Sakadaš during 1997/98. Acari was the only meiofaunal group that was found in the eulittoral zone of Lake Sakadaš, but not recorded in the central area of the lake. The number of recorded meiofaunal groups and their abundances in the eulittoral sediment of Lake Sakadaš corresponds with data published for sandy sediments, typically characterised by a high diversity, but a low density of meiofauna (PREJS, 1977a).

A density of meiofauna almost ten times higher than in the eulittoral of Lake Sakadaš was recorded at the eulittoral of the eutrophic Lake Mikołajskie by WASILEWSKA (1973). YOZZO & SMITH (1995) recorded a meiofauna density which ranged between 1690 to 138320 ind./100 cm^2 in the sediment of the marsh area of the Chickahominy River (Virginia). The recorded variations in meiofauna abundance may be related to the food resources available and to the abiotic conditions of the habitat, the main factors conditioning the composition and abundance of meiofauna (WETZEL, 1975). In other words, the maximum values of meiofauna densities were recorded at the beginning of the investigation when the abundance of bacteria and protozoa was high, and indicated the presence of a higher amount of food available in the sediment. A significant correlation between the nematode abundance and protozoa at the land-water interface was expected because some nematodes are grazers upon protozoa (TRAUNSPURGER, 1997).

The minimum value of meiofauna density was recorded in August, a consequence of high temperature values and exceptionally low water level. Such conditions cause the withdrawal of meiofaunal individuals into deeper layers of the sediment (MCINTYRE, 1969). The second lowest density, which was recorded in November, could be the result of low temperature and an extremely high water level.

CONCLUSION

During a one-year period of investigation at the eulittoral of Lake Sakadaš the recorded values of physical and chemical parameters were typical of a eulittoral habitat. The sediment of the eulittoral was sandy but with a moderate amount of silt and clay. This sediment type is typically characterised by a low organic matter content, and a high diversity but low density of meiofauna. Significant correlations between the amount of organic matter, total bacteria and protozoa at the submerged site, and between the sediment moisture content, total meiofauna and nematode abundance at the land-water interface indicate the importance of these habitat parameters for sediment biota. In a total of 10 meiofauna groups the most abundant were nematodes, which represented almost 50% of total meiofauna at the submerged site, more than 60% at the land-water point of contact and more than 75% at the emergent site.

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SAŽETAK

Razlike u submerznoj i emerznoj fauni sedimenta eulitorala Sakadaškog jezera (Park prirode Kopački rit, Hrvatska)

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U razdoblju od veljače do prosinca 1998. godine na tri postaje (submerznoj, na kontaktu vode i kopna te emerznoj) u eulitoralu Sakadaškog jezera u Parku prirode Kopački rit u Hrvatskoj određivana su granulometrijska svojstva sedimenta, količina organske tvari i sadržaj vlage u sedimentu radi utvrđivanja njihove važnosti u određivanju strukture faune sedimenta: bakterija, praživotinja, i posebno, meiofaune. Uz navedene fizičko-kemijske čimbenike praćene su i promjene vodostaja, mjerena je temperatura, koncentracija otopljenog kisika i kemijska potrošnja kisika u vodi, a na osnovi tih čimbenika nisu utvrđena odstupanja od već poznatih vrijednosti za eulitoral kao specifično stanište.

Sediment eulitorala Sakadaškog jezera je pjeskovit s vrlo niskim sadržajem gline i silta. Takav tip sedimenta karakteriziraju niže vrijednosti količine organske tvari, veća raznovrsnost, ali manja gustoća meiofaune. Tijekom ovog istraživanja nisu utvrđene jasne sezonske varijacije u gustoći meiofaune. Najniže vrijednosti gustoće zabilježene su u kolovozu za vrijeme visoke temperature i niskog vodostaja te u jesenskom razdoblju za iznimno visokog vodostaja. U sedimentu submerzne postaje utvrđeno je 10 skupina meiofaune: oblići, veslonošci (uključujući nauplije), kolnjaci, maločetinaši, trbodlaci, rašljoticalci, dugoživci, virnjaci, grinje i ličinke kukaca. Na kontaktu vode i kopna utvrđeno je devet skupina meiofaune – nisu utvrđeni predstavnici skupine grinja, a u sedimentu emerzne postaje osam skupina – nije bilo grinja i virnjaka.

Najbrojnija (eudominantna) skupina meiofaune svih triju postaja bili su oblići koji su činili 46.46% ukupne meiofaune submerzne postaje, 60.48% na kontaktu vode i kopna te 75.48% meiofaune emerzne postaje. Maločetinaši i kolnjaci bili su dominantne i subdominantne skupine.

U sedimentu svih triju postaja najveća gustoća eutrofnih i oligotrofnih bakterija kao i protozoa zabilježena je u razdoblju zima/proljeće 1998. godine. Kasnije varijacije manjeg broja bakterija, a posebno prisutnost oligotrofa upućuje na polagane procese remineralizacije organske tvari u sedimentu. Značajno manja gustoća praživotinja karakterizirala je emerznu postaju koja je na samoj obali jezera te s naj-

manje vode u intersticijima, a na toj postaji utvrđena je i najveća brojnost oblića za koje je poznato da su predatori praživotinja.

Na submerznoj postaji statistički značajna korelacija utvrđena je između količine organske tvari u sedimentu i vodostaja Sakadaškog jezera, količine organske tvari i sadržaja vlage u sedimentu te između broja ukupnih bakterija i praživotinja. Na kontaktu vode i kopna statistički značajna korelacija utvrđena je između sadržaja vlage u sedimentu i gustoće ukupne meiofaune i oblića. Za istu postaju, kao i za emerznu utvrđena je statistički značajna korelacija između brojnosti praživotinja i gustoće meiofaune i oblića.

Fig. 1. Geographical position of the island of Mali Drvenik

MATERIALS AND METHODS

The standard methods of floristic research have been used. Identification of plants was carried out using the following keys: TUTIN *et al*. (1964–1993), PIGNATTI (1982) and DOMAC (1994). The names of taxa have been made to comply with those in the Croatian Flora Checklist (NIKOLIĆ, 1994; 1997; 2000). Within higher systematic groups, the taxa are given in alphabetical order (genera in families, species in genera). Detailed designations of finding sites have not been given, because of the smallness of the area of the island.

RESULTS

FLORISTIC LIST

PTERIDOPHYTA

Aspleniaceae

Asplenium ceterach L.