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Studies on the microphyto-and microzoobenthos of the preimpoundment basin of Piva Lake, Reservoir in Crna Gora Jugoslavia

Abstract

This paper presents the results of studies conducted on the composition and character of microphyto-and microzoobenthic communities of the rivers and streams within the preimpoundment basin of the Piva Reservoir, near Mratinje and Plužine in Crna Gora. Investigations were begun withim the scope of the federal Project »Limnological Preimpoundment Studies of Jugoslavian Reservoirs«. This subqroject was undertaken to asses the environmental impact of the reservoir on the riverine ecosystems. Sampling was conducted at seasonal intervals from 1970 to 1975.

Introduction

The study area was characterized by very mountanous terrain and included the river canyons of the Piva and Komarnica, and their tributary streams, the Vrbnica, Mratinje spring, Tušina, Bukovica (Šavnička rijeka), (Pridvorica) and Bijela. The hydrology, especially the flow velocity of these rivers is the most important factor in understanding the annual variations in the composition and character of their biological communities.

These investigations have also contributed to the knowledge of the flora and fauna of carst waters. Previous studies of karst waters include those of Petković and Petković, 1971; Matoničkin et al., 1975; Nedić, 1975; Pavletić and Pulević, 1975, and others.

After impoundment studies on the new reservoir will be conducted as a logical continuation of this study.

It is true that on the basis of the complex metabolic processes of all aquatic and terrestrial ecosystems, regardless of their size or type, the photosyntethic component is of primary importance and must be studied in detail in order to begin to understand the interrelationships of the ecosystem in question. It was with this concept in mind that we begun our studies of the microphytobenthic community and also microzoobenthic ones of the preimpoundment basin of Piva Lake.

Materials and methods

In the period of 1970-1975 this biotope was worked on. It represents a rather branchy and ecologically very various hydrographic net of the drenage basin of the Piva Lake. Investigations were carried out byBiological Station — Titograd in the framework of its programme. Numerous biological samples were taken in seasonal intervals on many characteristc sampling stations (Fig. 1). Special stress was put on the analysis of the primarysecondary producent's life components of these rivers.

Algal and microfaunistic material was collected in the space extending from the Piva springs, Komarnica both its and Piva's tributaries, coming to the dam of the hydroelectric power station »Mratinje«, i. e. to the mouth of the Piva and Tara rivers in Drina nearby Ścepan Polje. Modified plankton nets No 25 and 11 made of Müller — gaze, were used for sampling. Washing off and scraping of inorganic and organic deposits was done from the following substrate: stones, sand, mud, submerged parts of trees, stems and leaves of various aquatic plants- *mosses, Ranunculus fluitans* and others. Attention was paid to some representatives of pleiston (filamentous forms of *Chlorophyta, Cyanophyta* and rare *Rhodophyta).* After collecting the whole material was preserved in 10% formaldehyde. Detailed examination was done in the laboratories of Biological Station in Titograd using standard optics and other standard methods and thechniques.

The localities and dates of sampling in period 1970-1975

S_1 ..... 30. VII 1970; 23. X i 16. XII 1971; 9. III, 18. VII, 28. IX i 14. XII 1972; 23. I 1973; 18. II 1975.

S_2 ..... 29. VII i 3. X 1974; 18. II 1975.

S_3 ..... 29. VII i 3. X 1974; 18. II 1975.

S_4 ..... 29. VII i 3. X 1974.

S_5 ..... 3. X 1974.

S_6 ..... 30. VII 1970; 23. X i 16. XII 1971; 9. III, 18. VII, 28. IX i 14. XII 1972; 23. I, 26. XI 1973; 19. II i 3. X 1974; 18. II 1975.

S_7 ..... 30. VII 1970; 24. IV, 23. X i 16. XII 1971; 9. II, 18. VII, 28. IX i 14. XII 1972; 23. I 1973; 19. II i 3. X 1974; 18. II 1975.

S_8 ..... 30. VII 1970; 24. IV, 17. VIII, 23. X i 16. XII 1971; 9. III, 18. VII, 28. IX i 14. XII 1972; 23. I, 23. X i 26. XI 1973; 19. II 1974; 18. II 1975.

S_9 ..... 29. VII i 6. X 1974;

S_{10} ..... 29. VII i 6. X 1974.

S_{11} ..... 29. VII i 6. X 1974.

S_{12} ..... 2. X 1974.

S_{13} ..... 30. VII i 7. X 1974; 13. IX 1975.

S_{14} ..... 13. IX 1975.

S_{15} ..... 13. IX 1975.

S_{16} ..... 6. X 1974; 13. IX 1975.

S_{17} ..... 13. IX 1975.

S_{18} ..... 13. IX 1975.

Names of sampling stations

S_1 = the Piva — by Šćepan Polje; S_2 = the Mratinjski potok (stream nearby Mratinje); S_3 = the Vrbnica below Plužine; S_4 = the Vrbnica over Plužine; S_5 = the Vrbnica by Stabna; S_6 = Piva by Plužine; S_7 = Komarnica in front of mouth; S_8 = the Piva springs — Pivska oka; S_9 = Bijela at Šavnik; S_{10} = Bukovica at Šavnik — Šavnik, Bukovica — bridge; S_{11} = Šavnik below spring; S_{12} = Komarnica in front of canyon Nevidio; S_{13} = Bukovica at village Donja Bukovica, by bridge; S_{14} = the Tušina, a tributary of the Bukovica near mouth; S_{15} = the Tušina, near spring; S_{16} = the Bijela, by bridge; S_{17} = the Komarnica, entering canyon Nevidio; S_{18} = the Pridvorica, a tributary of the Komarnica.

Results

a) Microphytobenthos

Results on the composition, character and development of the microphytobenthos the study area clearly indicate that it is composed of two specific community associations. In more rapidly flowing waters various colonial and filamentous algae were found attached to stones, wood, the stems of macrophytes, and other substrates. Altogether 124 algal taxa were identified from both the lentic and lotic zones, representing seven divisions: *Bacillariophyta, Cyanophyta, Pyrrophyta, Chlorophyta, Chrysophyta, Euglenophyta,* and *Rhodophyta.* Most species are forms of broad ecological tolerance, being widely distributed geographically and capable of colonization of various aquatic habitats. It should be emphasized that the micro-

phytobentos has the greatest species diversity of any of the biotic communities in the study area.

The *Bacillariophyta* is the dominant group of this community both in numbers of species and organisms. Sixtysix species of diatoms were found in the study area (Table 1). The microphytobenthos is most well developed in quiet waters characterized by very low flow rates and dense macrophyte growth. This lentic community is found on the mud bottom and on stones, as well as on submerged parts of terrestrial vegetation and on the stems and leaves of aquatic macrophytes. Numerous facultatively planktonic algae were also found in the iterstitial waters. The most abudant and characteristic populations were: *Achnanthes lanceolata, A. gibberula, Diatoma vulgare, Surirella spiralis, Meridion circulare, Melosira varians, Cymatopleura eliptica, Synedra ulna, Campilodiscus noricus, Diatoma vulgare var. capitulata, Girosigma acuminatum, Rhoicosphaenia curvata, Cymatopleura solea, Gomphonema acuminatum var. coronata, Nitzschia sigmoidea.* Less abundant but common species were: *Diatoma hiemale var. mesodon, Cocconeis placentula, Cymbella ventricosa, Cocconeis pediculus, Gomphonema constrictum, Synedra capitata, Melosira arenaria* and occassionaly other genera. The diatom flora was usually more of less uniformly distributed on the substrate throughout the study area. On the basis of studies performed on the benthic diatom communities of other Crna Gora water bodies of known trophic state (i. e. high mountain lakes, mountain springs, Skadar Lake, Šasko Lake, and others- Petković and Petković, 1968, 1971, 1972, 1975), the diatom community of the study area is primarily orientated toward the oligotrophic end of the trophic spectrum. About forty two % of the total diatom species are characteristic of oligotrophic conditions, and the remainder can be classed as beta-saprobic to oligotrophic species. Species which are designated as good indicators of cold stenothermic and (or krenobiotic oligotrophy include: *Amphora ovalis, Melosira distans Ceratoneis arcus, Denticula elegans, Eunotia faba, E. praerupta, Fragilaria bicapitata, F. pinnata, Gomphonema angustatum, Opephora martyi, Pinnularia gibba, Surirella didyma,* and *Tabellaria flocculosa.* The diatom species composition did not change significantly throughout the year, as was also the case for the entire algal community. However, the diatom numbers were very low during the winter rainy period from October to early May. Exceptionally dense blooms of *Melosira varians* and other *Melosira* species were observed in the Piva springs in December of 1971 and 1972 and November, 1973.

Species of *Cyanophyta* and *Chlorophyta* (Tab. 2) were present in large numbers (21-26) only in spring and summer when higher temperatures and nutrient concentrations prevailed. The divisions *Chrysophyta, Pyrrophyta, Euglenophyta* and *Rhodophyta* were represented by only 11 species (Tab. 3). The chrysophytan algal spe

cies *Hydrurus foetidus* and *Characiopsis pyriphormis* were often very numerous at most of the sampling sites during spring and summer. The red alga *Batrachospermum moniliforme* was often a conspicuous member of the stream communities.

In addition to the algal species present, an aquatic fungus, *Asterotrix (Cerasterias) raphidioides* belonging to the *Fungi Inperfecti* was occasionally found on the decaying parts of various plants and animals. This organism is not common in Crna Gora and was first recorded there in 1968 by Milovanović from the River Mareza near Titograd.

Based on previous observations of similar lotic and lentic habitats in the region (Petković and Petković, 1971 and later Filipović et al., 1976- personal comunications), the commynity structure and composition of the study area is very characteristic of stream waters with relativly high concentrations of calcium bicarbonate, in which the pH ranges from 7.9-8.4 and carbonate hardness up to 9.85 (German degrees).

The microphytobenthic community is of great importance in the biological processes of the lotic systems because photosynthesis by these organisms contributes substantially to the dissolved oxygen content of these waters. This is especially true since higher plant groups vere not numerous and were represented only by aquatic mosses *(Bryophyta)* and occasionally by other plant families including aquatic *Ranunculaceae*. Mountain rivers of this area are routinely characterized by high concentrations of dissolved oxygen (Filipović et al., 1976). High oxygen concentracions result not only from photosynthetic activity but also from solution from the atmosphere enhanced by turbulent flow and low oxygen uptake by suspended organic material which is normally present in very small quantities. The inportance of temperature in aquatic ecosystems is a well established principle. During summer periods water temperatures ranged from 9.5 to 13.O°C, whereas during the autumn period, of low water levels and velocities, temperatures from 6.8 to 10.8°C were recorded; during winter periods of high water levels and velocities water temperatures ranged from 3.2-5.2°C.

b) Microzoobenthos

The most intensive development of the microzoobenthos communities coincided with that of the microphytobenthos and macrophyta communities in both lentic and lotic zones during the summer and autumn periods, when atmospheric and hydrologic conditions were most stable.

Altogether 62 microzoan taxa were identified from studied area, reprezenting four divisions: *Rotatoria, Cladocera, Copepoda*

and *Protozoa* (Tab. 4). The most abundant and characteristic microzoobenthic populations were: *Eucyclops serrulatus, Notholca labis, N. squamula, Trichotria tetractis, Vorticella campanulla Bryocamptus pygmaeus,* and *Chydorus sphaericus.* Less abundant but very common species were: *Lecane closterocerca, L. bulla, Trichotria pocillum, Colurella uncinata, Euchlanis dilatata* and occassionaly other genera. The microbenthic fauna was usually more of less uniformly distributed on the substrate troughout the study area. On the basis of studies performed on the benthic microzoan communities of other Crna Gora water bodies of known trophic state (i. e. high mountain lakes, mountain springs, Skadar Lake, Šasko Lake, and others, Petković and Petković 1968, 1971, 1972, 1975), the rotatorian community (40 species) of the study area was primarily interesting.

Discussion

Within the study area the aquatic habitat is characterized by a mosaic of microecosystems, which allow for the most efficient use of space under varying environmental condintions. Such distributions are very common in nature and are typical of most biological communities. In this way organisms of different size and ecological requirements can live together, each occupying niches which are best suited for their population development. These mosaic communities in the study area consist largely of sessile organisms or ones capable only of limited locomotion. Producers and consumers are entwined in a complex web which comprises the living community of the stream.

From a trophic standpoint the waters of the study area can in general be characterized as ranging from oligotrophy to alpha and beta meso saprobity. Many of the streams vary greatly in trophic condition depending on the time of the year and water depth and flow.

For instance, the Piva spring as well as part of the adjacent Piva stream can occasionally become beta — mesosaprobic, due to the presence of large quantities of organic materials of autochthonous and allochthonous origins. At such times large blooms of *Melosira varians* and dense populations of *Eucyclops serrulatus* and *Chydorus sphaericus* were noted. Similar situations have also been observed in portions of other rivers and streams in the study area, especially where they pass through places of human habitation. Examples of these were seen in the Bukovica, Bijela, Šavnik, and Vrbnica rivers and Mratinje spring. The increased imput of organic materials causes an increase in the level of eutrophication and the coincident appearence of certain organisms (primarily algal species) which are indicators of eutrophic conditions. It seems quite possible that with the construction of the Mratinje dam and the subsequent

formation of Piva Lake that eutrophic conditions would first be seen in the headwater streams and from their spread to other parts of reservoir.

These studies have been conducted to obtain basic information on the life conditions of the streams and rivers within the area of the reservoir sight before impoundment. This information will be of great importance in assesing the impact of the reservoir on the biological communities and in observing the composition and evolution of the reservoir ecosystem in the future.

LITERATURE CITED

Fott, B. (1971): Algenkunde. Jena.

Lazar, J. (1943): Vegetacija limnokrenih izvirkov Ljubljanskego barja. Zbornik Prirodoslovnog društva, 3, Ljubljana.

Liebmann, H. (1962): Handbuch der Frischwasser und Abwasser Biologie. Band I.

Milovanović, D. (1968): Flora alga u nekim limnokrenim izvorima. Poljoprivreda i šumarstvo, XIV, 4, Titograd.

Matoničkin, I. i Pavletić, Z. (1959): Životne zajednice na sedrenim slapovima rijeke Une i brzacima pritoke Unca. Acta Muz. Maced. sci. nat. T. VI.

Matoničkin, I., Pavletić, Z., Žunjić, K. i Habdija, I. (1975): Ekosistem rijeke Pive i biologijska valorizacija njenih voda. Glasn. Republ. zavoda zašt. prirode — Prirodnjačkog muz. Titograd, 8: 61-79.

Nedić, D. (1975): Neki aspekti gustine populacija faune dna rijeka Pive i Komarnice i njihovih najvažnijih pritoka. Glasn. Republ. zavoda zašt. prirode — Prirodnjačkog muz. 8: 81-91.

Petković, Sm. i Petković, St. (1971): Neka hidrobiološka istraživanja Pive i Komarnice. Poljoprivreda i šumarstvo XVII, 3: 61-71.

Petković, St. (1972/73): Prilog poznavanju faune Rotatoria Crne Gore IIa. — Fam. Trichotriidae. Glasn. Republ. zavoda zašt. prirode — Prirodnjačkog muz.

Petković, St. (1974): Zapažanja na strukturi i karakteru zooplanktonskog kompleksa u nekim veštačkim jezerima Jugoslavije. Poljoprivreda i šumarstvo XXI, 1: 25-55.

Petković, Sm. (1975): Prilog poznavanju taksonomije i distribucije Bacillariophyceae nastanjenih u slatkim vodama Crne Gore. Poljoprivreda i šumarstvo, XXI, 3 (u štampi).

Petković, St. (1975): Prilog poznavanju faune Rotatoria Crne Gore IIb. — Fam. Branchionidae, Genera: Notholca, Kellicottia, Argonotholca i Anuraeopsis. Poljoprivreda i šumarstvo XXI, 4 (u štampi).

Pavletić, Z. i Pulević, V. (1975): Preakumulacijski aspekt briofita u kanjonu rijeke Pive, Glasn. Republ. zavoda zašt. prirode — Prirodnjačkog muz Titograd, 8: 93-99.

Petković, Sm. (1975): Euglenaceae u slatkim vodama Crne Gore (u štampi).

Thienemann, F. (1925): Binnengewässer Mitteleuropas. Binnengewässer 1. Stuttgart.

Steimann, P. (1915): Praktikum der Süsswasserbiologie. 1. Die Organismen des flussenden Wassers. Berlin. Borntrager.

Petković, Sm. (1976): Prilog poznavanju taksonomije i distribucije Chlorophyta: Chlorococcales (rodova Pediastrum i Scenedesmus) u slatkim vodama Crne Gore. Poljoprivreda i šumarstvo XXII, 1 (u štampi).

Vojbaša, M. (1976): Hemijske karakteristike vodâ slivnog područja Pivskog jezera (manuskript).

Douglas, B. (1958): The ecology of the attached diatoms and other algae in asmall stony stream. J. Ecol. 46: 295-322.

Hum, J. L. (1956a): The application of the climax concept to tlgal communities of streams. Ecology 37: 603-604.

SASTAV I KARAKTER MIKROFITO- I MIKROZOOBENTOSKIH ZAJEDNICA SLIVNOG PODRUČJA PIVSKE AKUMULACIJE U CRNOJ GORI PRE PODIZANJA BRANE

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Rezime

U osnovi kompleksnog procesa metabolizma svakog akvatičnog i terestričkog ekosistema, bez obzira na njegovu veličinu i tip, prisutna je komponenta primarnih producenata — akvatične i terestrične više biljke i alge. Ova činjenica je ukazala na nužnost i opravdanost mikrofloristićkih i mikrofaunističkih istraživanja u vodama slivnog područja Pivske hidroakumulacije.

Istraživanja započeta u okviru saveznog projekta »Limnološke studije jugoslovenskih vodenih akumulacija u izgradnji«, odnosno podprojekta istog naziva sa poentom na Pivskoj hidroakumulaciji u Crnoj Gori (1970-1973), bila su nastavljena u toku 1974-1975. i vršena su u sezonskim intervalima.

U radu su prikazani rezultati mikrofloristićkih (mikrofitobentoskih) i mikrofaunističkih (mikrozoobentoskih) istraživanja reka i njihovih pritoka u slivnom području buduće akumulacije blizu Mratinja i Plužina.

Prilično nepodesna konfiguracija terena istraživanih biotopa, naročito kanjonski tip korita reka Pive i Komarnice i pritoka: Vrbnice, Mratinjskog potoka, Tušine, Bukovice — odnosno Šavničke rijeke, Pridvorice i Bijele, zatim njihova hidrologija, posebno brzina vode u njima, dozvolili su da se u toku rada obuhvate samo najvažniji aspekti u godišnjem razviću osnovnih grupa alga i mikrofaune, i da se prate njihove sezonske smene. Ovim istraživanjima učinjen je još jedan pokušaj da se dobije bolji pregled stanja živog sveta ovih kraških voda, o kojima su neka ranija proučavanja već objav-

ljena (Petković i Petković, 1971; Matoničkin et al., 1975; Nedić, 1975; Pavletić, Pulević, 1975; Petković, 1975; a, c; Petković, 1975; Petković, 1976), i da se mogu nastaviti dalja istraživanja posle formiranja akumulacije, što predstavlja logičan kontinuitet započetog rada.

Mikrofitobentos

Rezultati analiza kompozicije, karaktera i toka razvića mikroflorističke komponente u fitocenozama istraživanih rečnih tokova nedvosmisleno ukazuju da se među njima mogu izdvojiti neke osnovne i karakteriktične mikrofitocenoze.

One se obično razvijaju na dnu mirnih mesta, naročito u plićacima ili na kamenju, zatim u pojasu makrofitske akvatične submerzne i na delovima pod vodom emerzne vegetacije, među kojima u slabijoj vodenoj struji žive brojni slobodni i epibiontski oblici mikroflore, zatim na kamenju ili potopljenim delovima drvenastih podloga, i stabljikama makrofita na kojima se u nešto bržoj i jačoj vodenoj struji razvijaju makroskopski primetni končasti i kolonijalni oblici iz raznih grupa alga.

U istraživanim mikro i makrostaništima lentičke i lotičke zone ustanovljena su 124 oblika alga iz grupa: *Bacillariophyta, Cyanophyta, Pyrrophyta, Chlorophyta* u širem smislu reči, *Chrysophyta, Euglenophyta* i *Rhodophyta*. To su mahom oblici velikih ekoloških mogućnosti, i u spektru biogeografskog rasprostranjenja pokazuju odlike širokog biološkog i prostornog potencijala. Ovde najpre treba istaći, što su istraživanja i pokazala, da u ispitivanim biotopima postoji velika raznovrsnost živog sveta. Posebno se ovo odnosi na organizme sa različitim asimilirajućim pigmentima.

Dominantno mesto među njima po raznovrsnosti pripada grupi *Bacillariophyta* u kojoj je registrovano 66 vrsta. Najabundantnije i najkarakterističnije bile su populacije *Achnanthes lanceolata, A. gibberula, Diatoma vulgare, Surirella spiralis, Meridion circulare, Melosira varians, Cymatopleura eliptica, Synedra ulna, Campilodiscus noricus, Diatoma vulgare var. capitulata, Girosigma acuminatum, Rhoicosphaenia curvata, Cymatopleura solea, Gomphonema acuminatum var. coronata*, i *Nitzschia sigmoidea*. Manje abundantne ali često prisutne vrste bile su: *Diatoma hiemale var. mesodon, Cocconeis placentula, Cymbella ventricosa, Cocconeis pediculus, Gomphonema constructum, Synedra capitata, Melosira arenaria* i druge povremene vrste. Diatomejska flora bila je obično više ili manje uniformno raspoređena na substratu po čitavom istraživanom području.

Na osnovu izvršenih istraživanja bentoskih diatomejskih zajednica drugih vodenih basena u Crnoj Gori poznatog trofičnog stupnja, npr. visokoplaninska jezera, planinske reke, Skadarsko jezero, Šasko jezero i drugi (Petković i Petković, 1968, 1971, 1972, 1975)

diatomejska zajednica proučavanog područja prvenstveno je orijentisana prema oligotrofnom kraju trofične skale: 42% svih Diatomeae karakteristične su za oligotrofne uslove, a ostale bi mogle da se klasificiraju kao prelazne od beta-mezosaprobnih do oligotrofnih vrsta. Vrste označene kao dobri hladno-stenotermni indikatori i (ili) krenobiontni oligotrofi mogle bi ovde da budu: *Amphora ovalis, Melosira distans, Ceratoneis arcus, Denticula elegans, Eunotia faba, E. praerupta, Fragillaria bicapitata, F. pinnata, Gomphonema angustatum, Opephora martyi, Pinnularia gibba, Surirella didyma* i *Tabellaria flocculosa.*

Sastav vrsta *Diatomeae* nije se bitno menjao tokom godine, što je, uostalom, slučaj i sa celom zajednicom alga. Međutim, broj diatomea bio je vrlo nizak za vreme kišnog perioda — od oktobra do početka maja. Izuzetno gust »vodeni cvet« bio je zapažen u izvorima Pive u decembru 1971. i 1972. i u novembru 1973. Njega je činila *Melosira.*

Vrste *Cyanophyta* i *Chlorophyta* bile su predstavljene u prilično broju (21-26) samo u proleće i leto kada su preovlađivale nešto više temperature i povećane koncentracije hranljivih soli. Grupe *Chrysophyta, Pyrrophyta, Euglenophyta* i *Rhodophyta* bile su predstavljene samo sa 11 vrsta. Hrizofitska alga *Hydrurus foetidus* i *Characiopsis pyriformis* bile su često vrlo brojne na većini mesta sa kojih su uzimani uzorci za vreme proleća i leta. Crvena alga *Batrachospermum moniliforme* bila je čest i upadljiv član ovih rečnih zajednica.

Za cenotičku strukturu mikro-fitobentosa značajno je bilo i prisustvo oblika iz nekih drugih grupa biljaka, kao što je bio slučaj sa inače vrlo rasprostranjenom vodenom gljivom iz *Fungi Imperfecti — Asterotrix (Cerasterias) raphidioides.* Nađena je na potopljenim u vodu organskim podlogama — fragmentima raznih biljaka i životinja. Predstavlja veoma interesantnu mikroflorističu retkost u ovim vodama. Prvi put zabeležena je u Crnoj Gori (Milovanović, 1968) u reci Marezi kod Titograda.

Na osnovu ranijih zapažanja sličnih lotičnih i lentičkih staništa u regionu (Petković i Petković, 1971; Matoničkin et al., 1975, i kasnije Filipović, Bojbaša i Burić, 1976. — na osnovu ličnih kontakata), struktura zajednice proučavanog područja veoma je karakteristična za rečne vode ovoga tipa, sa relativno visokom koncentracijom kalcijum-bikarbonata, u kojima su se vrednosti pH kretale od 7,9-8,4 a karbonatna tvrdoća iznosila i 9,85 nemačkih stepena.

Mikrozoobentos

Za razliku od mikrofitobentosa, u kome su vodeću ulogu imale alge iz grupe Bacillariophyta, najznačajnije mesto u pogledu cenotske strukture i karaktera u mikrozoobentosu imale su *Rotatoria,* ko-

jih je u periodu istraživanja registrovan prilično velik broj vrsta (40). Za njima slede *Protozoa* (16), dok su u ostalim grupama (Copepoda i Cladocera) zabeležene samo po tri vrste. Ukupno su određena 62 taksona mikrozoobentosa na proučavanom prostoru.

Najabudantnije i najkarakterističnije populacije u ovoj životnoj komponenti bile su: *Eucyclops serrulatus; Notholca labis, N. squamula, Trichotria tetractis, Vorticella campanula; Bryocamptus (Br.) pygmaeus; Chydorus sphaericus.* Manje zastupljene bile su: *Lecane closterocerca, L. bulla, Trichotria pocillum, Colurella uncinata, Euchlanis dilatata,* i još ređe — druge.

Mikrobentoska fauna bila je uglavnom više-manje ravnomjerno raspoređena po substratu na čitavom proučavanom prostoru.

Na osnovu istraživanja bentoskih mikrozoonskih zajednica drugih vodenih bazena u Crnoj Gori poznatog trofičnog stupnja (planinska jezera, planinske reke, Skadarsko jezero, Šasko jezero i druga (Petković i Petković, 1968, 1971, 1972, 1975), rotatorijska zajednica proučavanog područja je prvenstveno interesantna.

U proučavanom području akvatično stanište odlikuje se mozaikom mikroekosistema, malim životnim prostorima koji se maksimalno i veoma funkcionalno iskorišćavaju. Ovakav raspored je običan u prirodi i tipičan za mnoge biološke zajednice u kojima organizmi različitih veličina i ekoloških zahteva zauzimaju adekvatan prostor, srazmeran njihovim dimenzijama, i za svoj opstanak uzimaju iz najbliže okoline — vode onoliko koliko zahteva njihovo razviće. Ove mozaične zajednice u proučavanom području sastoje se pretežno od sesilnih organizama više-manje pasivnih ili ograničenih u svojoj lokomociji. To je mikrokompleks živog sveta producenata i konzumenata organskih materija bez kojih bi jedna reka ili jedno jezero bili mrtve vode. U saprobiološkom pogledu može se reći da se istraživani rečni tokovi mogu svrstati u katarobni, oligo i alfa do beta-mezosaprobni tip slatkih voda. Pojedini tokovi pokazuju gotovo sve prelaze od jednog do drugog tipa u zavisnosti od godišnjeg doba i karaktera vodostaja. Tako, Pivska oka, kao i manji deo toka Pive nizvodno od okā, karakterišu se u pojedinim trenucima čak i beta-mezosaprobnošću, što je bilo posledica prisustva veće količine suspendovanih organskih materija dospelih iz drugih nepoznatih biotopa, dakle alohtonog porekla, ali u dobroj meri i takvih organskih materija koje se stvaraju uglavnom od raspadnute vodene vegetacije u samom oku, dakle autohtonog porekla, što se ogledalo u masovnom razviću poput »vodenog cveta« *Melosira varians,* i u prilično dobro razvijenoj populaciji *Eucyclops serrulatus* i *Chydorus sphaericus.* Slične pojave zapažene su i u delovima drugih tekućica naročito onih koje prolaze kroz naseljena mesta. Takve su reke Bukovica, Bijela, Šavnik, Vrbnica i Mratinjski potok. Povećana količina organskih materija izaziva u izvesnoj meri povećanje trofičnosti, što je

praćeno pojavom određenih indikatora, u prvom redu algenskog tipa. Vrlo je verovatno da se, pri formiranju Pivske hidroakumulacije, prvi začeci eutrofikacije mogu očekivati upravo u ovim regionima, odakle će se širiti i na ostale delove jezera.

Izvršena istraživanja daju osnovne informacije i predstavu o prethodnoj fizionomiji, stanju i životnim uslovima voda na ovom području pre njegovog potapanja, što će biti od velikog značaja za razumevanje uticaja novonastalog ekosistema na biološke zajednice u njemu. Od samog početka pratiće se sastav i evolucija novog ekosistema u budućnosti.

Tab. 1 Composition and frequency of Bacillariophyceae in the waters of drenage basin of Pivsko Lake during the period 1970-1975

Bacillariophyceae	1970	1971	1972	1973	1974	1975
*1.Achnanthes lanceolata Breb.	4+	11+	16+	7+	22+	12+
2.Achnanthes gibberula Grun	4+	11+	16+	7+	22+	12+
*3.Amphora ovalis Kütz.	2+	5+	4+	6+	11+	3+
*4.Cocconeis placentula Ehrb.	4+	10+	14+	5+	7+	9+
5.Cocconeis pediculus Ehrb.	4+	9+	12+	4+	6+	10+
6.Ceratoneis arcus Kütz.	2+	5+	7+	3+	8+	6+
7.Ceratoneis arcus v.amphioxis (Rbh.)	1+	2+	3+	2+	5+	4+
*8.Cymbella ventricosa Kütz.	2+	10+	7+	4+	17+	8+
9.Cymbella caespitosa Kütz.	3+	5+	8+	2+	9+	3+
10.Cymbella cistula (Hemprich)Grun.	2+	3+	6+	4+	10+	7+
*11.Cymbella helvetica Kütz.	3+	7+	5+	3+	4+	5+
12.Cymbella lanceolata(Ehrb)Van Heurek	4+	5+	6+	4+	9+	6+
13.Cymatopleura eliptica (Breb)W.Smith	4+	11+	15+	6+	20+	9+
*14.Cymatopleura solea (Breb) W.Smith	4+	10+	14+	5+	18+	7+
15.Campilodiscus noricus Ehrb.	4+	11+	16+	7+	15+	8+
*16.Diatoma vulgare Bory	4+	11+	16+	7+	22+	12+
*17.Diatoma vulgare v. capitulata Grun.	4+	10+	14+	5+	17+	10+
18.Diatoma hiemale v. mesodon(Ehrb.)Grun	3+	9+	10+	4+	15+	8+
19.Diatoma elongatum Agardh.	2+	5+	4+	2+	8+	3+
20.Denticula elegans Kütz.	2+	3+	2+	4+	4+	2+
21.Eunotia faba (Ehrb.)Grun.	3+	7+	8+	3+	10+	5+
22 Eunotia praerupta Ehrb.	2+	3+	5+	3+	4+	2+
23.Epithemia zebra (Ehrb)Kütz.	2+	1+	1+	2+	3+	1+
24.Epithemia turgida (Ehrb)Kütz.	1+	1+	2+	3+	2+	1+
25.Fragilaria virescens Ralfs.	2+	3+	5+	3+	2+	4+
26.Fragilaria bicapitata A.Mayer	2+	2+	3+	3+	2+	3+
*27.Fragilaria crotonensis Kitton	2+	3+	1+	2+	4+	5+
28.Fragilaria pinnata Ehrb.	1+	1+	2+	2+	3+	2+
29.Gomphonema intricata Kütz.	3+	2+	3+	4+	3+	5+
*30.Gomphonema olivaceum(Lyngb.)Kütz.	3+	4+	2+	3+	2+	3+
31.Gomphonema angustatum (Kütz)Rabh.	2+	3+	4+	2+	5+	2+
32.Gomphonema augur Ehrb.	1+	2+	2+	3+	2+	2+
33.Gomphonema constrictum Ehrb.	3+	7+	9+	5+	13+	8+

	1970	1971	1972	1973	1974	1975
34.Gomphonema acuminatum v.coronata Ehrb	4+	8+	12+	4+	17+	9+
35.Gomphonema tergestinum(Grun) Tricke	2+	3+	5+	2+	8+	10+
36.Gomphonema longiceps fa.gracilis Hust	2+	2+	3+	1+	5+	4+
37.Gyrosigma acuminatum(Kütz) Rabh.	4+	10+	14+	5+	19+	8+
38.Melosira varians Ag.	4+	11+	16+	7+	20+	9+
39.Melosira arenaria Moore	2+	7+	10+	6+	9+	8+
40.Melosira distans (Ehrb) Kütz.	2+	2+	3+	5+	4+	2+
*41.Meridion circulare Agardh.	4+	11+	16+	7+	20+	10+
*42.Navicula viridula Kütz.	2+	5+	6+	4+	9+	7+
43.Navicula subtilissima Cleve	2+	2+	3+	2+	2+	2+
44.Nitzschia sigmoidea(Ehrb) W.Smith	4+	9+	14+	4+	15+	6+
45.Nitzschia linearis W.Smith	3+	8+	6+	2+	11+	3+
46.Nitzschia vermicularis(Kütz) Grun.	2+	3+	2+	3+	2+	2+
47.Nitzschia gracilis Hantzsch.	1+	2+	2+	4+	3+	2+
48.Opephora Martyi Heribaud.	2+	2+	3+	3+	2+	2+
49.Pinnularia gibba Ehrb.	3+	5+	4+	2+	8+	5+
50.Pleurosigma angulatum(Quekett)W.Smith	2+	3+	3+	4+	5+	3+
*51.Rhoicosphaenia curvata (Kütz) Grun	4+	10+	12+	5+	18+	9+
*52.Synedra ulna (Nitzsch.)Ehrb.	4+	11+	15+	5+	19+	8+
53.Synedra ulna v.biceps (Kütz.)	2+	4+	5+	3+	10+	5+
54.Synedra ulna v.danica(Kütz) Grun	2+	2+	1+	1+	2+	3+
55.Synedra actinastricides Lemm.	1+	2+	1+	2+	3+	2+
56.Synedra acus Kütz.	3+	3+	4+	5+	6+	3+
57.Synedra pulchela Kütz.	2+	2+	3+	3+	5+	2+
58.Synedra capitata Ehrb.	3+	8+	8+	2+	14+	9+
*59.Surirella spiralis Kütz.	4+	11+	16+	7+	20+	10+
60.Surirella linearis W.Smith	2+	3+	2+	4+	5+	2+
61.Surirella " v.constricta(Ehrb)Grun	1+	1+	2+	3+	4+	4+
62.Surirella didyma Kütz.	-	1+	1+	-	2+	1+
63.Stauroneis dilatata Ehrb.	3+	4+	2+	2+	1+	2+
64.Stauroneis anceps Ehrb.	2+	4+	3+	3+	5+	3+
65.Tabellaria fenestrata (Lyngb)Kütz.	1+	2+	2+	3+	2+	2+
66.Tabellaria flocculosa (Roth) Kütz.	3+	5+	7+	2+	12+	5+

* Previously registered

Tab. 2 Composition and frequency of Cyanophyta and Chlorophyta in the waters of drenage basin of Pivsko Lake during the period 1970-1975.

Cyanophyta	1970	1971	1972	1973	1974	1975
1.Aphanotheca sp.	1+	1+	2+	2+	3+	3+
2.Anabaena sp.	2+	3+	3+	2+	4+	3+
3.Chroococcus turgidus(KÜtz)NÄg	2+	2+	3+	2+	5+	5+
4.Chroococcus limneticus Lemm.	2+	3+	2+	2+	3+	3+
5.Dactylococcopsis sp.	1+	1+	1+	2+	2+	1+
6.Lyngbia epiphytica Hieron	3+	7+	6+	2+	10+	4+
7.Lyngbia sp.	1+	1+	2+	1+	2+	2+
8.Merismopedia tenuissima Lemm.	2+	1+	2+	2+	1+	3+
9.Merismopedia elegans A.Braun	1+	1+	2+	2+	3+	3+
10.Merismopedia sp.	1+	1+	-	2+	-	1+
11.Microcystis sp.	-	1+	-	1+	-	1+
12.Nostoc linckia(Roth)Bornet et thuret	3+	2+	3+	4+	4+	5+
13.Nostoc zetterstedtii Aresch.	1+	2+	2+	2+	2+	3+
14.Oscillatoria formosa Bory	1+	3+	2+	2+	3+	4+
15.Oscillatoria Agardhii Gomont	1+	1+	2+	1+	1+	2+
16.Phormidium foveolarum (Mont) Gom.	1+	2+	3+	2+	1+	1+
17.Plectonema notatum Schmidle	1+	1+	1+	1+	1+	2+
18.Rivularia minutula (KÜtz)Bornet et Fla	1+	2+	2+	1+	1+	1+
19.Rivularia sp.	1+	1+	1+	1+	1+	-
20.Spirulina sp.	1+	1+	1+	2+	2+	1+
21.Nostoc verucosum Vaucher.	1+	2+	2+	3+	3+	3+

Chlorophyta	1970	1971	1972	1973	1974	1975
1.Bulbochaete setigera (Roth)	3+	3+	4+	5+	4+	5+
*2.Closterium moniliferum (Bory)Ehrb.	2+	2+	3+	4+	5+	6+
*3.Closterium Leibleinii Kütz.	2+	3+	3+	5+	5+	7+
4.Closterium sp.	1+	1+	1+	1+	1+	2+
*5.Cladophora glomerata (L.)Kütz.	4+	9+	14+	5+	19+	10+
6.Cosmarium depressum v.achondrum West	1+	2+	5+	2+	11+	5+
7.Cosmarium sp.	1+	3+	4+	1+	3+	2+
8.Gonatozigon Brebissonii De Bary	2+	3+	3+	2+	2+	3+
9.Hyalotheca dissiliens (Sm.)Breb.	2+	5+	6+	4+	7+	8+
*10.Mougeotia sp.	2+	2+	3+	3+	3+	2+
11.Oedogonium undulatum(A.Br.)Hirn.	1+	1+	2+	2+	1+	1+
12.Oedogonium sp.	2+	2+	1+	2+	3+	2+
13.Pediastrum duplex Meyen	1+	2+	3+	2+	2+	3+
14.Pediastrum tetras (Ehrb)Ralfs	1+	1+	2+	2+	1+	3+
15.Pleurotaenium trabecula (Ehrb) Näg.	1+	1+	2+	1+	2+	2+
16.Spirogyra tenuissima (Hass.)Kütz.	2+	2+	3+	3+	4+	5+
17.Spirogyra majuscula Kütz.	2+	2+	1+	1+	1+	2+
18.Sorastrum spinulosum Näg.	1+	1+	1+	1+	1+	1+
19.Stigeoclonium tenue Kütz.	-	2+	1+	3+	2+	2+
20.Scenedesmus quadricauda (Turp.)Breb.	1+	2+	3+	5+	5+	4+
21.Scenedesmus dimorphus (Turp.)Kütz.	-	3+	1+	1+	1+	2+
22.Ulotrix zonata(Weber et Mohr.)Kütz.	1+	2+	2+	1+	2+	2+
23.Ulotrix sp.	1+	2+	2+	1+	2+	2+
24.Zygnema sp.	1+	2+	3+	3+	1+	2+
25.Characium acuminatum A.Braun	2+	2+	3+	4+	4+	5+
26.Characium falcatus Schr.	3+	3+	4+	4+	3+	2+

* Previously registered

Tab. 3 Composition and frequency of Chrysophyta, Pyrrophyta, Euglenophyta and Rhodophyta in the waters of drenage basin of Pivsko Lake during the period 1970 - 1975.

Chrysophyta	1970	1971	1972	1973	1974	1975
1. Hydrurus foetidus (Vill.)Kirch.	2+	7+	9+	4+	13+	8+
2. Vaucheria geminata(Vauch.)De Candolle	2+	5+	4+	2+	7+	3+
3. Vaucheria sp.	2+	5+	4+	2+	7+	3+
4. Characiopsis pyriformis (A.Braun)Borzi	2+	8+	9+	4+	11+	7+
5. Characiopsis lageniformis Pascher	2+	8+	7+	5+	8+	6+
6. Bumilleria sp.	-	2+	3+	2+	5+	4+
7. Tribonema sp.	-	3+	4+	3+	2+	3+
Pyrrophyta						
1. Ceratium hirundinella(O.F.Mull) Schr.	3+	5+	7+	2+	4+	5+
2. Peridinium sp.	-	2+	1+	1+	2+	2+
Euglenophyta						
1. Euglena acus Ehrb.	-	-	2+	2+	3+	2+
Rhodophyta						
1. Batrachospermum moniliforme(L.)Roth.	2+	5+	8+	3+	17+	6+

Tab. 4 Composition and frequency of microzoobenthos in the waters of drenage basin of Pivsko Lake during the period 1970 - 1975.

Rotatoria	1970	1971	1972	1973	1974	1975
1.Ascomorpha minima Hofst.	2+	1+	3+	2+	5+	1+
2.Adineta sp.	1+	1+	1+	2+	1+	1+
3.Colurella uncinata uncinata (Müll.)	4+	8+	9+	3+	15+	5+
4.Colurella adriatica Ehrb.	2+	3+	3+	3+	12+	6+
5.Colurella obtusa obtusa (Gosse)	1+	5+	7+	3+	7+	4+
6.Colurella sp.	2+	1+	2+	3+	2+	1+
7.Cephalodella gibba gibba Ehrb.	2+	3+	5+	2+	7+	4+
8.Cephalodella huilca Myers	2+	2+	1+	1+	1+	1+
9.Cephalodella sp.	2+	1+	2+	1+	1+	1+
10.Diesotrocha aculeata Ehrb.	2+	2+	3+	4+	5+	4+
11.Euchlanis pyriformis Gosse	2+	2+	2+	1+	3+	3+
12.Euchlanis dilatata dilatata(Ehrb.)	4+	7+	9+	4+	11+	10+
13.Habrotrocha sp.	1+	2+	1+	2+	1+	1+
14.Keratella cochlearis cochlearis (Gosse)	1+	1+	1+	2+	1+	2+
15.Keratella valga valga (Ehrb.)	1+	1+	2+	2+	2+	1+
16.Lecane/s.str./pusilla Harr.et Myers	2+	3+	2+	1+	1+	2+
17.Lecane/M/ lunaris (Ehrb.)	2+	5+	9+	3+	10+	7+
18.Lecane/M/closterocerca (Schm.)	2+	9+	8+	5+	17+	8+
19.Lecane /s.str./flexilis (Gosse)	2+	7+	5+	3+	11+	6+
20.Lecane /M/ bulla bulla (Gosse)	3+	9+	8+	4+	13+	7+
21.Lecane /M/ hamata (Stokes)	3+	3+	4+	6+	11+	6+
22.Lecane sp.	1+	2+	1+	3+	4+	5+
23.Lepadella patella patella (Müll.)	2+	4+	3+	3+	7+	5+
24.Lepadella(Heterolepadella)ehrenbergii (Perty)	2+	2+	2+	2+	3+	3+
25.Lepadella sp.	1+	1+	1+	1+	1+	1+
26.Mytilina mucronata spinigera(Ehrb)	2+	3+	2+	3+	4+	5+
27.Mytilina ventralis ventralis(Ehrb)	3+	4+	5+	5+	10+	5+
28.Mniobia sp.	1+	1+	1+	1+	1+	1+
29.Notholca labis labis Gosse	4+	8+	14+	5+	19+	9+
30.Notholca squamula squamula (Müll)	4+	10+	14+	5+	14+	7+
31.Philodinia roseola Ehrb.	3+	4+	4+	4+	5+	2+
32.Proales sp.	1+	1+	1+	1+	1+	1+
33.Rotaria rotatoria rotatoria (Pall.)	2+	3+	2+	2+	4+	3+
34.Trichocerca/s.str./rattus rattus(Müll)	3+	7+	6+	2+	14+	5+

	1970	1971	1972	1973	1974	1975
35.Trichocerca /D/ porcelus (Gosse)	2+	3+	4+	2+	9+	4+
36.Trichocerca sp. I,II	2+	2+	3+	1+	6+	3+
37.Trichotria tetractis tetractis (Ehrb)	4+	8+	9+	5+	17+	8+
38.Testudinella patina (Herm.)	1+	-	1+	1+	-	2+
39.Trichotria pocillum pocillum(Müll)						
Protozoa						
1.Amoeba sp.	1+	2+	3+	2+	2+	3+
*2.Arcella conica (Playf.) Defl.	3+	4+	5+	4+	18+	9+
3.Arcella vulgaris Ehrb.	2+	5+	4+	3+	12+	6+
4.Arcella sp.	2+	-	1+	2+	-	-
5.Coleps hirtus Nitzsch.	1+	2+	3+	1+	2+	1+
6.Centropyxis aculeata(Ehrb) Stein	1+	2+	2+	2+	2+	1+
7.Centropyxis platystoma(Penard)Defl.	2+	1+	3+	3+	2+	2+
8.Difflugia limnetica Levand.	1+	3+	5+	2+	7+	4+
9.Difflugia oblonga Ehrb.	1+	2+	4+	2+	9+	5+
10.Difflugia sp.	1+	1+	1+	1+	1+	1+
11.Nebella collaris (Ehrb)Leidy	-	2+	4+	-	5+	2+
12.Nebella dentistoma Penard.	1+	1+	2+	1+	7+	3+
13.Nebella tubulosa Penard	-	2+	3+	-	6+	1+
14.Quadrirurella simetrica(Wall)Schulz.	1+	1+	2+	-	5+	4+
15.Vorticella campanula Ehrb.	3+	7+	11+	5+	19+	10+
16.Vorticella sp.	1+	1+	1+	1+	1+	1+
Cladocera						
1.Allona costata Sars.	2+	3+	7+	3+	5+	2+
2.Bosmina/Bosmina/ longirostris (Müll)	1+	1+	2+	-	3+	2+
*3.Chydorus sphaericus (Müll.)	4+	9+	11+	5+	17+	8+
Copepoda						
1.Bryocamptus/Bryocamptus/pygmaeus Sars	3+	8+	14+	5+	20+	9+
*2.Eucyclops serrulatus (Fisch.)	4+	11+	16+	7+	22+	12+
3.Heterocope sp.	1+	1+	-	1+	2+	1+

* Previously registered

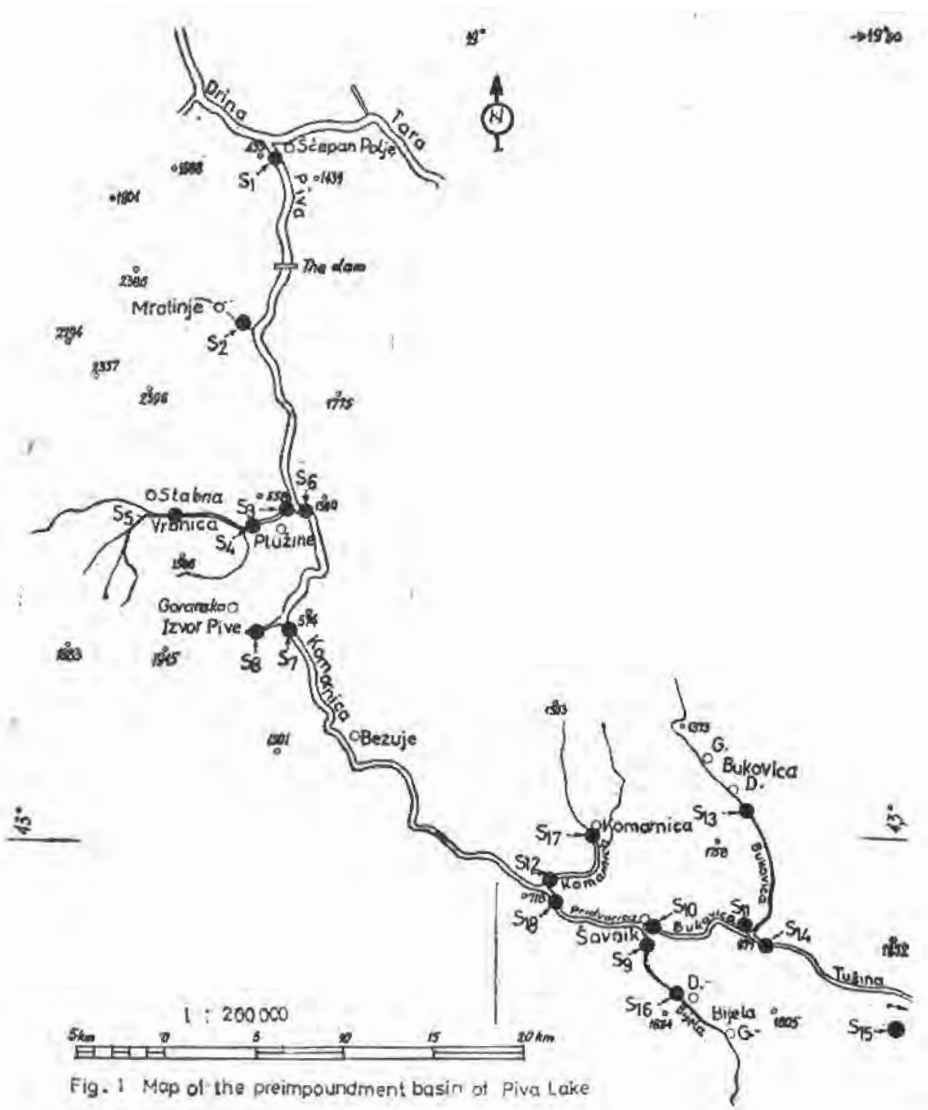

Fig. 1 Map of the preimpoundment basin of Piva Lake

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Chromosome morphology of Pachychilon pictum (Heckel et Kner, 1858) (Cyprinidae, Pisces) from Skadar Lake

Monografija hromosoma Pachychilon pictum (Heckel et Kner, 1858) (Cyprinidae, Pisces) iz Skadarskog jezera

INTRODUCTION

Pachychilon pictum is endemic to the waters of the Adriatic drainage systems. The largest populations are found in Lakes Ohrid and Skadar. This species was first described under the name *Squalius pictus* by HECKEL et KNER (1858) from specimens taken from the Crnojević River, a tributary of Skadar Lake. GÜNTER (1866) redescribed the species as *Leuciscus pictus*. STEINDACHER (1882) revised the genus *Leuciscus* and placed the species *pictus* in the subgenus *Pachychilon*. KARAMAN (1924) agreed with STEINDACHER that *Pachychilon* was a distinct group. However, he believed that it should be given generic status, recognized its close relationship to *Leucos* and *Barbus*. According to BERG (1933) *Pachychilon* is distributed in the Skadar Lake and Ohrid Lake regions. TALER (1954), SKET (1967), VUKOVIĆ and IVANOVIĆ (1971), and IVANOVIĆ (1973) agreed on the name *Pachychilon pictum* and described various aspects of its morphology and ecology. The close phylogenetic relationship between *P. pictum* and *Rutilus rubilio* has allowed

for the experimental production of hybrids between individuals of the two species from Skadar Lake IVANOVIĆ (1967).

Furthemore, KAVARIĆ (1974) commented on the similarity of blood cell morphology between *P. pictum*, *Rutilus rubilio rubilio* and *Alburnus alburnus alborella*. On the basis of these studies, *Pachychilon* must be placed in the subfamily *Leuciscinae*.

In surveying the literature, we found that the only karyological work on the species *P. pictum* has been that of BERBEROVIC' and SOFRADŽIJA (1972), who stated that its population in the Skadar Lake had a diploid chromosome number of 2n = 50. However, they gave only the chromosome number. In our paper we give a complete description of the morphology of the chromosome complement.

MATERIAL AND METHODS

Freshly captured specimens (two males and two females) were brought alive to the laboratory from the Skadar Lake, on May 1975. Each fish was injected intramusculary with 0.3 ml/100 g of Colcemid Ciba 3 hours prior to sacrifice. The cephalic kidney was removed and miced in 0.6% sodium citrate solution. The cells were collected by centrifugation and fixed with acetic alchool (1:3). Slides were made by the air-drying method and stained with the Giemsa solution.

RESULTS

We studied 60 metaphases of 4 specimens of *P. pictum*; all of them show the same diploid chromosome number 2n = 50. Figs. 1 and 2 show the karyotypes of a male and a female. No heteromorphic chromosomes could be detected.

The chromosmes of the karyotype can be subdivided into three groups according to the centromere position: group A with 4 pairs of medium size metacentric chromosomes, group B which consists of 11 pairs of submetacentric chromosomes arranged in order of decreasing size, group C which includes 10 pairs of acrocentric chromosomes also ordered in decreasing size. On the basis of this description the number of chromosome arms — NF, fundamental numbe r— is 80.

DISCUSSION

The Cyprinidae are caracterized by a striking stability of the somatic chromosome number. If a few cases of poliploid species with 100-104 chromosomes are excluded, the range is from 2n = 44 to 2n = 52 with a sharp modality of 2n = 50 (PARK 1974). On the

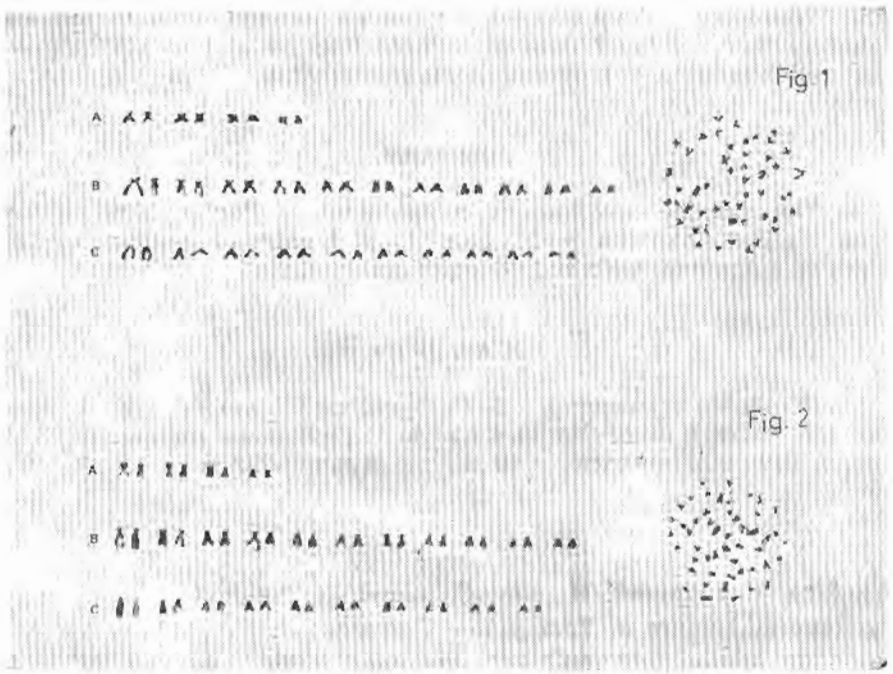

FIGURE LEGENDS

Fig. 1. Karyotype reconstruction and metaphase plate of a kidney cell of a male of *P. pictum.*

Sl. 1. Rekonstrukcija kariotipa i metafazni oblik bubrežne ćelije mužjaka *P. pictum.*

Fig. 2. Karyotype reconstruction and metaphase plate of a kidneö cell of a female of *P. pictum.*

Sl. 2. Rekonstrukcija kariotipa i metafazni oblik bubrežne ćelije ženke *P. pictum.*

basis of our work *Pachychilon picium* is included in this list. However, besides a constant chromosome number, the Ciprinidae display a considerable variety of NF values (NYGREN et al. 1975). Among the know NF values, the karyotype of *P. pictum* has the same number of chromosome arms of *Tribolodon ezoe* Okada et Keda and *T. hakonensis* Günther, Cyprinidae of the Far East (see PARK 1974). The related species of Europa, so far know for NF, differ at rather large extent: *Rutilus rutilus* L. has NF = 76 (NYGREN et al. 1975); *Alburnus albidus alborella* De Filippi NF = 87, *Leuciscus cephalus* L. NF = 90, *L. aula* Bonaparte NF = 88, *L. suoffia muticellus* Bonaparte NF = 88 (FONTANA et al. 1970). This comparison give evidences of a karyotypic variation possibly through Robertsonian type traslocation among species of the same family and genus.

Therefore a deep analysis of the karyological data of the related species and their natural hybrids may be of rilevant help on the understanding the evolutionary relationship.

SUMMARY

The somatic chromosome complement of *Pachychilon pictum* from Skadar Lake (2n = 50) consists of 4 pairs of metacentric, 11 pairs of submetacentric and 10 pairs acroc entric

RIASSUNTO

Il corredo cromosomico di *Pachychilon pictum* del lago di Scutari (2n = 50) é costituito da 4 coppie di cromosomi metacentrici, 11 coppie di submetacentrici e 10 coppie di acrocentrici.

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MORFOLOGIJA HROMOSOMA PACHYCHILON PICTUM (HECKEL ET KNER 1858) (CYPRINIDAE, PISCES) IZ SKADARSKOG JEZERA

Rezime

Diploidna hromosomska garnitura *Pachychilon pictum* iz Skadarskog jezera (2n=50) se sastoji od 4 para metacentričnih, 11 pari submetacentričnih i 10 pari akrocentričnih hromosoma.

REFERENCES

Berberović, Lj., Sofradžija, A. (1972): Pregled podataka o hromosomskim garniturama slatkovodnih riba jugoslavije. Ichthyologia 4, 3, 1-21.

Berg, L. S. (1933): Ryóypresnykh vod SSSR i sopredel'nykh stran. Leningrad.

Fontana, F., Chiarelli, B., Rossi, A. C. (1970)· Il cariotipo di alcune specie di Cyprinidae, Characidae studiate mediante colture »in vitro«. Caryologia 23: 549-564.

Günter (1886): cited by Ivanović, B. M. (1973).

Heckel, J., Kner, R. (1858): Die Süsswasserfische der Östereichischen Monarchie Leipzig.

Ivanović, B. (1967): Xibridizacija *Pachychilon pictum* x *Rutilus rubilio*. Poljoprivreda i šumarstvo, 13, 1-2, Titograd.

Ivanović, B. M. (1973): Ichthyofauna of Skadar Lake. Titograd.

Karaman, S. (1924): Pisces Macedonie. Split

Kavarić, M. (1974): Morfologija krvnih elemenata nekih vrsta ciprinida iz Skadarskog jezera. Magistarski rad-master degree.

Nygren, A., Andreasson, J., Jonsson, L., Jahnke, G. (1975): Cytological studies in Cyprinidae (Pisces). Hereditas, 81: 165-172.

Park, E. H. (1974): A list of the chromosome numbers of fishes. College Review of College of liberal arts and Sciences, Seul 20: 346-372.

Sket, B. (1967): Kliuc za dolocevanje zivali Slatkvovodne ribe Pisces. Ljubljana.

Steindachner, F. (1882): Sitzungsberichte der Kaiserlichen Akademie der Wissenchaften Matematisch-nat Classe 86. Band I Hett. erste Abtheilung. s., Wien.

Taler, Z. (1954): Rasprostranjenje i popis slatkovodnih riba Jugoslavije. Glasnik Prir. muz. Srpske zem. Sez. B, Knj. 5-6, Beograd.

Vuković', T., Ivanović', B. (1971): Slatkovodne ribe Jugoslavije. Sarajevo.