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CHANGES IN STRUCTURE OF THE PHYTOPLANKTON IN THE BARJE RESERVOIR (SERBIA)

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ABSTRACT. The paper presents results of investigating phytoplankton of the Barje Reservoir during 1998/99 and in 2001. Changes in the qualitative and quantitative structure of phytoplankton are followed by comparing the obtained results with results of investigations conducted in 1996 (one year after formation of the reservoir). Initially (in 1996) an oligotrophic water body in which Bacillariophyta were dominant, this reservoir during 1998/99 exhibited traits of a mesoeutrophic lake and was characterized by the presence of a large biomass of phytoplankton (Bacillariophyta and Pyrrophyta). Investigations of the phytoplankton community repeated in 2001 showed decline in the abundance of phytoplankton, but further processes of eutrophication too, as reflected in the appearance of Cyanophyta.

INTRODUCTION

Hydrological investigations of reservoirs on the territory of Serbia were initiated after World War II. In order to get a picture of the complex processes of functioning of these ecosystems, the structure of communities in them, and the dynamics of biological successions, investigations have been conducted on their floristic, faunistic, productive, microbiological, and other characteristics (Čomić et al., 2003).

Following final formation of the Barje Reservoir and attainment of its maximal volume (in April of 1995), investigations were carried out that included determination of morphometric, chemical, and biological parameters (phytoplankton, zooplankton, benthic fauna, and ichthyofauna) (Cibulić et al., 1996; Kalafatić et al., 1997; Simić et al., 2001, 2002).

In the present paper, we trace changes in the qualitative and quantitative composition of the phytoplankton community and processes of gradual eutrophication of the Barje Reservoir from its formation and attainment of maximal volume (in 1996) to 2001.

Description of investigated area

The Barje Reservoir (at a latitude of 42^0 58' 5" N and longitude of 21^0 57' 4" E) was formed after constructed dam in the Veternica River 30 km upstream from the city of Leskovac. Morphometric characteristics of the reservoir are presented in Tab.1.

Tab. 1. Morphometry of the Barje Reservoir

Latitude (N)	42^{0} 58' 5"
Longitude (E)	21^{0} 57' 4"
Elevation (m.a.s.l.)	370.50
Greatest width of reservoir (m)	400
Least width of reservoir (m)	80
Area of water surface (km^2)	1.3
Greatest depth (m)	61
Least depth (m)	20.6
Total volume (m^3)	40 670 000
Volume reserved for sediment (m^3)	6 070 000
Volume of area useful for water supply (m^3)	13 600 000
Volume for flood wave reception (m^3)	236

The main purpose of this reservoir is to protect the city of Leskovac from flood waters and sediment, equalize uneven water flow, and ensure an inviolable and guaranteed biological minimum. It was planned that the reservoir also be used for water supply. With this purpose in mind, the humus layer was removed and the ground cleaned up at the site of the future reservoir before it was formed. Barriers in the guise of small as were erected on the Veternica and lateral tributaries to retain sediment and prevent accumulation of the latter in the lake, thereby avoiding its filling, i.e., shrinkage of its useful volume. In order to clean the reservoir, water has been released from time to time subsequently. Unscheduled release of water from the reservoir was carried out during the period from March to June of 1999 (when the territory of Serbia was bombed).

MATERIAL AND METHODS

Field investigations on the Barje Reservoir were carried out in 1998 (November), 1999 (June, August), and 2001 (April, June, August). Investigations were performed at three sampling sites: *Dam* (D-next to the dam) where its depth varied from 25 to 34m, *Center* (C-in the middle of the lake) where its depth varied from 18 to 25m and *Mouth* (M- where the Veternica River empties into the lake) (max. depth is 2m). Samples were taken at three depths: 0.5 m from the surface, in the middle of the water column, and 0.5 m from the bottom. For qualitative analysis of plankton, samples were taken by drawing a plankton net (with pore diameter of 25 ìm) from the bottom to the surface of the water column. Samples for quantitative analysis were taken with a 2-l Ruttner bottle at the same sites as for qualitative analysis from the depths already mentioned. Quantitative processing of phytoplankton was performed in vessels for counting of planktonic organisms ("Hydro-bios" vessels) by examination in an inverting microscope according to the Uthermöl method.

The earlier investigations (whose data are used to monitor changes of phytoplankton community of the Barje reservoir) were carried out bimonthly (in May, July, September, and November) in 1996 (Kalafatić et al., 1997). Sampling and processing of material was conducted at the same sites by standard hydrobiological methods.

In comparing the floristic composition of phytoplankton was in different periods of investigation (1996-1998/99, 1996-2001, and 1998/99-2001), we used the Sørenson similarity index (S) (Schwerdthfeger, 1975):

$$S=2C/A+B,$$

where A is the number of species present in one population, B is the number of species present in the other population, and C is the number of species present in both populations. as control we use Jaccard index (C_j) (Schwerdthfeger, 1975):

$$C_j= j/\ a+b-j$$

where a is the number of species present in one population, b is the number of species present in the other population, and j is the number of species present in both populations.

RESULTS AND DISCUSSION

Qualitative analysis of phytoplankton during the period from 1996 to 2001 indicates the presence of 78 taxa (Tab. 2). Pyrrophyta, Bacillariophyta, Euglenophyta, and Chlorophyta were constantly recorded, while Cyanophyta were found only in 1996 and 2001, and Chrysophyta only in 1996. In all periods of investigation, silicate algae were dominant with respect to the number of taxa. In comparing the qualitative composition of phytoplankton during the periods 1998/99 and 2001, 25 taxa were found that appeared in both periods. The index of similarity caluculated according to Sørensen for these periods of investigation likewise indicates great similarity in the qualitative composition of phytoplankton (S = 68%). Significantly lower values are obtained when the qualitative composition of phytoplankton is compared for the periods 1996 and 1998/99 (19 taxa found in both periods, S = 42,7%); and 1996 and 2001 (20 taxa, S = 43,5%). Similar relations were obtained using the Jaccard index (Tab.3).

Comparison of the qualitative composition of phytoplankton in the Barje Reservoir and the number of species found in 1996 (Kalafatić et al., 1997), 1998/99, and 2001 reveals a gradual decrease in the biodiversity of phytoplankton (Tab. 3). It occurred primarily due to decline in the number of species of pennate silicate algae, which were characteristic of the initial investigations of the reservoir in 1996. These species (originating from the periphyton and benthos of the Veternica River) in the beginning found favorable conditions for survival and development in water of the Barje Reservoir, thereby indicating the then-existing lower trophic level of this aquatic ecosystem (Kalafatić et al., 1997; Cibulić et al., 1997). In recent years, the number of these species has declined at the expense of true planktonic forms of the group Bacillariophyta, but also as a result of increase in the number of species of Chlorophyta and Cyanophyta (in 2001 eutrophic forms of *Anabaena* and *Microcystis* appeared which were absent in the reservoir at the time of the investigations conducted in 1999). Blue-green algae (*Chrorococcus* sp., *Merismopedia* sp., *Anabaena* sp., and *Spirulina* sp.) were only sporodically present during the first year after formation of the reservoir (Kalafatić et al., 1997).

Especially noticeable are changes in the ratio of abundance of certain species recorded in the phytoplankton of the Barje Reservoir from its formation to 2001.

Phytoplankton of the Barje Reservoir in 1996 was characterized by relatively low values of population abundance. Absolute abundance at different sites fluctuated as follows: 0-53000 ind/l at the *D site* (next to the dam); 4000-254000 ind/l at the *C site* (in dthe middle of the lake); and 179000-3738,000 ind/l at the *M site* (where the Veternica River empties). These values point to a low trophic level of the ecosystem. With one exception (the surface layers of water at the M site in September), Bacillariophyta were dominant at all sites throughout the year, with representati-

Tab. 2. Floristic composition of phytoplankton of Barje Reservoir

Taxa	1996 (Kalafatić et al., 1997)	1998/99	2001
Cyanophyta			
Anabaena sp.	+	-	+
Chroococcus limneticus Lemm.	+	-	
Merismopedia sp.	+	-	
Mycrocistis aeruginosa Kütz.	-	-	+
Oscillatoria sp.	-	-	+
Spirulina sp.	+	-	
Pyrrophyta			
Ceratium hirudinella (O. F. M.) Schrank	+	+	+
Glenodinium sp.	+	-	-
Gymnodinium palustre Schilling	+	+	+
Peridinium bipes Stein	+	-	-
Peridinium incoscopicuum Lemm.	+	+	+
Peridinium pusillum (Pénard) Lemm.	+	-	-
Peridinium willei Huif.-Kass	-	+	+
Chrysophyta			
Dinobryon sp.	+		
Bacillariophyta			
Achnanthes minutissima Kütz.	+	-	-
Amphora ovalis Kütz.	+	+	+
Asterionella formosa Hass.	+	+	+
Cocconeis pediculus Ehr.	+	-	+
Cocconeis placentula Ehr.	+	-	-
Cyclotela glomerata Kütz.	+	+	+
Cyclotella comensis Kütz.	+	+	+
Cymatopleura elliptica (Breb.) W. Sm.	-	+	+
Cymatopleura solea (Breb.) W. Sm.	+	+	+
Cymbella affinis Kütz.	-	+	+
Cymbella lanceolata (Ehr.) Kirch.	-	+	-
Cymbella naviculiformis (Auers.)Cl.	+	-	-
Diatoma elongatum (Lyngb.) Ag.	-	+	-
Diatoma vulgaris Bory	+	+	+
Fragilaria crotonensis Kitton	+	+	+
Fragilaria ulna (Nitz.) L.-B. Sippen *acus* sensu Krammer & L.-B. (= *Synedra acus* Kütz.)	+	-	+
Fragilaria ulna (Nitz.) Lang.-Bert. ((= *Synedra ulna* (Nitz.) Ehr))	+	+	+
Gomphonema olivaceum (Horn.) Breb.	+	-	-
Gyrosigma sp.	+	+	+
Melosira granulata v. *angustissima* (Müll.) Hust.	+	-	+
Melosira varians Ag.	+	+	+
Navicula cuspidata (Kütz.) Kütz.	-	-	+

Tab. 2. Continued

Navicula pupula Kütz.	+	-	-
Navicula sp.	-	-	+
Navicula tripunctata (O. F. Mull) Bory	+	+	+
Nitzschia acicularis W. Sm.	+	-	-
Nitzschia palea (Kütz.) W. Sm.	+	-	-
Nitzschia radiosa Kütz.	+	-	-
Nitzschia sigmoidea (Nitzsch.) W.Sm.	+	+	+
Nitzschia viridula Kütz. (Ehr.)	+	-	-
Nitzschia. vermicularis (Kütz.) Grun.	+	-	-
Pinnularia sp.	+	+	-
Rhoicosphaenia abbreviata (C. Ag.) Lang.- Bert.	+	+	-
Rhopalodia gibba (Ehr.) Müll.	+	-	-
Surirella minuta Bréb and Kütz. (=S. *ovata* Kütz.)	-	+	-
Surirella capronii Bréb	-	+	+
Surirella sp.	+		
Euglenophyta			
Euglena sp.	-	-	+
Lepocinclis sp.	+		
Phacus caudatus Hübn.	+		
Trachelomonas hispida (Perty) Stein em Defl.	+		
Trachelomonas oblonga Lemm.	+		
Trachelomonas volvocina Ehr.	+	+	+
Chlorophyta			
Chlamidomonas sp.	-	+	-
Closterium parvulum Näg.	-	+	+
Coelastrum microporum Näg.	-	-	+
Coenochloris pyrenoidosa Korš.	-	+	-
Coenococcus planctonicus Korš.	-	+	-
Cosmarium sp.	-	-	+
Eudorina elegans Ehr.	+	+	+
Gonium pectorale Müller	+		
Pandorina morum (O. F. Müller) Bory	+	-	-
Pediastrum duplex Meyen	-	+	+
Pediastrum simplex Meyen	-	+	+
Scenedesmus alternans Reinsch	+	-	-
Scenedesmus bicaudatus (Hansg.) Chod.	+	-	-
Scenedesmus ecornis (Ralfs) Chod.	+	-	-
Scenedesmus quadricauda (Turp.) Bréb	-	+	+
Scenedesmus tenuispina Chod.	+	-	-
Sphaerocystis schroeteri Chod.	-	+	-
Spirogyra sp.	-	-	+
Staurastrum sp.	-	+	
Tetraëdron minimum (A. Br.) Hansg.	+	-	-
Ulothrix zonata (Web. et Mohr) Kütz	+	-	-
Volvox aureus Ehr.	-	-	+
Total of number taxa	54	35	38

Tab. 3. Indices of similarity (according to Sørensen and Jaccard) of phytoplankton of Barje Reservoir for the periods 1996-1998/99, 1996-2001, and 1998/99-2001

Year / Value of index	1996-98/99	1996-2001	1998/99-2001
Sørensen similarity index (S)	42.7	43.5	68
Jaccard similarity index (C_j)	27	28	43

on varying in different layers. The occasional peaks in abundance indicate that the reservoir was then an oligotrophic lake with pronounced mesotrophic tendencies (Cibulić et al., 1997). Increased abundance of phytoplankton at the *M site* is attributable to the direct eutrophicating influence of the Veternica River (Simić et al. 2002). Overall decrease of planktonic production (which was especially pronounced at the *D site*) was influenced in large measure by astaticism of the reservoir (Reynolds & Lund, 1988). Periodic release of water from the reservoir leads to settling of planktonic organisms because the evacuation current pulls them with it and accelerates their settling, while also disturbing stable stratification of layers in the thermic and chemical sense (Cibulić et al., 1997).

The investigations conducted in 1998/99 revealed a pronounced increase of phytoplankton abundance, which indicated an increase of the trophic level from oligo-mesotrophic to mesotrophic. Absolute abundance at different sites fluctuated within the following limits: 13000-3233000 ind/l at the *D site*; 20000-1514000 ind/l at the *C site*; and 12000-2899000 ind/l at the *M site*. Intensive development of true planktonic Bacillariophyta (*Fragilaria crotonensis*) occurred that year (Fig. 1). Silicate algae were dominant in November and August.

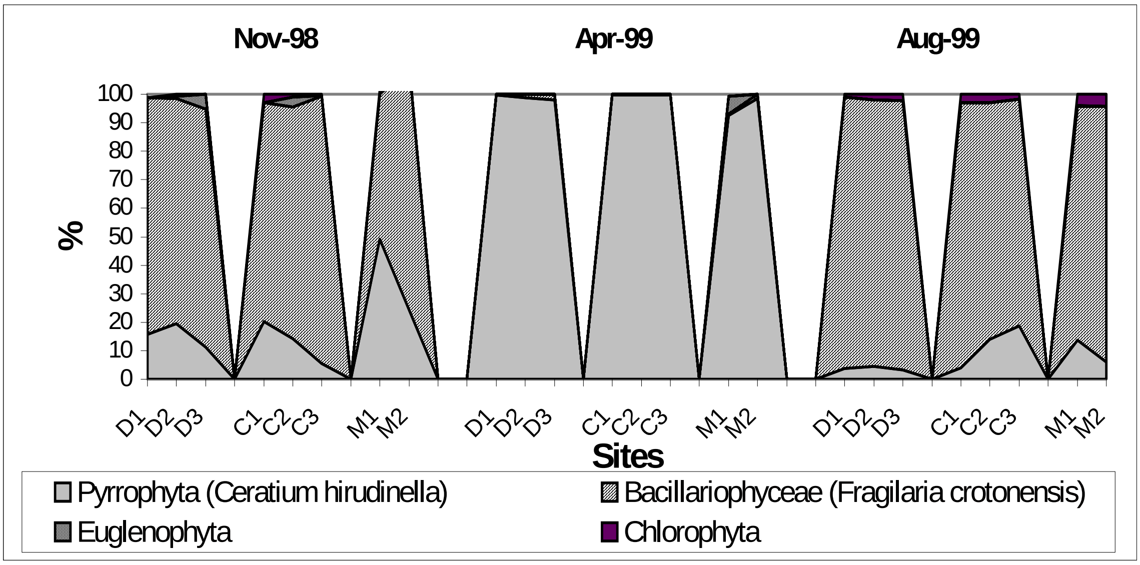
Bacillariophyta are known to be especially good competitors during periods of turbulence or establishment of stratification and under conditions of low light intensity, low temperature, and an environment not particularly deficient in nutrients (Willén et al., 1992; Sommer et al., 1986). This to some extent can also explain the presence and greatest abundance of silicate algae in the hypolimnion of the Barje Reservoir, especially of the species *Fragilaria crotonensis* in August at the *D site.* During the year 1999 (in the month of June), the abundance of planktonic forms of Pyrrophyta (*Ceratium hirudinella* and species of the genus *Peridinium*) was also high. Sommer et al. (1986) assert that in summer a significant role in building of the plankton community is played precisely by the numerous dinoflagellates (of the genera *Ceratium*, *Peridinium*, and *Peridinopsis*). This is corroborated by investigations of phytoplankton in other reservoirs of Serbia (Laušević & Cvijan, 1994; Ranković et al., 1999). Heaney & Talling (1980) indicate that the species *C. hirudinella* prefers higher water temperatures and stronger light. In the Barje Reservoir, this alga in June was dominant at all sites (with from 92.4 to 99.8% of the total number of all algae), in all layers of water (from 0.5 to 34 m).

New changes in the composition of phytoplankton occurred in 2001. In the qualitative sense, the most pronounced change was the appearance (and dominance in the late summer months) of the eutrophic alga *Anabaena* sp., whereas decline of phytoplankton abundance was the most pronounced quantitative change (Fig. 1) It fluctuated as follows at different sites: 800-53000 ind/l at the *D site*; 2000-27700 ind/l at the *C site*; and 3800-37100 ind/l at the *M site*.

Dominance of the species *Asterionella formosa* was established in April of 2001 (Fig. 1). This species is characteristic of open water (Lund, 1949) and attains maximum development in spring and fall during periods of low temperatures. Spring dominance of Bacillariophyta (especially large pennate forms, which have a high ratio of cell volume to lake volume) is characteristic of many lakes in Serbia (Laušević & Cvijan, 1994; Ranković et al., 1999), but also of lakes in other regions with a continental climate characterized by low water temperature in the indicated period (Reynolds, 1984).

Decline of total abundance during 2001 in relation to 1999 (in the late spring and summer months) occurred due to decrease in the abundance of Pyrrophyta (in June) and Bacillariophyta (in August). At the same, the presence of algae of the group Chlorophyta--which were not recorded in June of 1999--was evident (Fig. 1).

The most pronounced changes were noticed at the end of the summer of 2001, when the phenomenon of "water bloom" was observed in the surface layers at the *D site* (*Anabaena* sp. comprised 85% of the total number of specimens). The presence of green algae, especially speci-



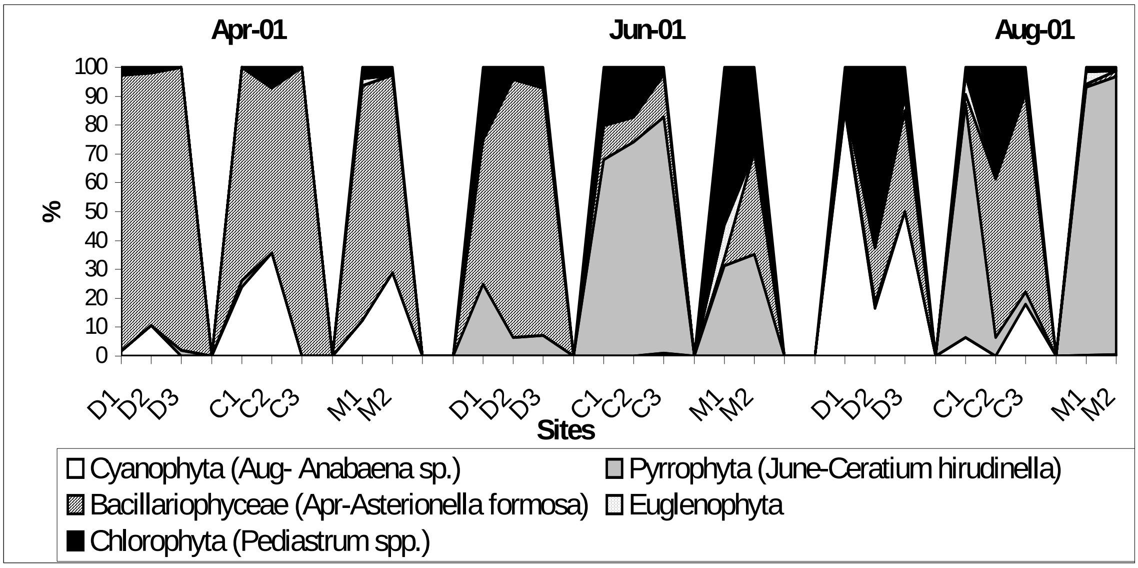


Fig. 1. Dinamics of participation (%) of groups of algae in total abundance of phytoplankton in the Barje Reservoir at sampling sites (*D-Dam*; *C-Center*; *M-Mouth*) and depth (1-0.5 m from water surface; 2-middle of water column; 3-0.5 m from bottom) during 1998/99 (November, April and August) and 2001 (April, June and August).

es of the genus *Pediastrum*, was also intensified during this month at the *D* and *C sites.* (Fig. 1). The situation was completely different in August of 1999: Bacillariophyta then compri-sed 95.3%, and Cyanophyta were not recorded. In August of 2001, Bacillariophyta appeared with 1.5% of the total number of specimens (Fig. 1). Distinct dominance of blue-green algae and the phenomenon of "water bloom" invariably accompany pronounced increase in the trophic level of a lake (Seki & Iwami, 1984). Vardaka et al. (2000) link the phenomenon of overmultiplication of *Anabaena* sp.--which most often occurs in the summer months--with good illumination of the surface layers of eutrophic lakes, a situation which corresponds to the conditions that prevailed in August of 2001 (Simić et al., 2002).

Gradual increase in the trophic level of the Barje Reservoir is also indicated by values of different physicochemical parameters monitored (Cibulić et al. 1997; Simić et al., 2002).

Comparison of the data for 1996 (Cibulić et al., 1997) with the values obtained during the periods 1998/99 and 2001 reveals gradual increase in the concentration of nitrates. Since the Barje Reservoir is poor in macrovegetation, utilization of nitrates by macrophytes was not present. The absence of macrovegetation in the littoral of the Barje Reservoir is caused by considerable oscillations in the level of the lake, which occur due to relatively frequent and sudden release of its water. Macrophytic vegetation has a very important role in aquatic ecosystems (Wetzel, 1983). The complex of littoral macrophytes and epiphytes functions as a metabolic "filter" whose activity strongly modifies the intake of allochthonous nutrients and dissolved organic substances. They also represent important competitors of phytoplankton for nutrients (Wetzel, 1983; Jankovic et al., 1988; Martinovic-Vitanovic, 1996; Blaženčić & Blaženčić, 1997), while leaves of floating plants reduce penetration of light, thereby preventing "algal blooms" (Wetzel, 1983).

Values of phosphate concentration also indicate a high trophic level of the Barje Reservoir. A high concentration of phosphates (orthophospates) was measured in this reservoir immediately after its formation too (Cibulić at al., 1997). Elevated phosphate concentrations were recorded in the initial shallowest part of the reservoir, as well as in the Veternica River (Simić et al., 2002). The Veternica River and other smaller tributaries are unquestionably the principal suppliers of the lake with this biogenic sustance and the cause of increased production. Phosphate content in 2001 was on average lower (and phytoplankton production then was also lower) than during 1998/99, but the values measured are still high and without doubt remain one of the significant factors affecting the level of primary production in the reservoir (Simić et al., 2002). Measuring the concentration of phosphates in the Veternica River and other smaller tributaries of the lake showed that during the spring of 2001 they on average introduced 0.95 mg/l of phosphates into water of the reservoir (Simić et al., 2002). This source of phosphates is not negligible, regardless of the small flow volume of the these tributaries. Also significant was copious rainfall during the summer months of 2001, which led to eluviation of allochthonous material and thereby to introduction of a certain amount of phosphates by the tributaries. Another thing that must be kept in mind is that the reservoir had an increased volume of water in the second half of 1999 and during 2001 (Simić et al., 2002). This led to flooding of shoreline zones that were overgrown with terrestrial macrovegetation during the period of low water in the first half of the year (Simić et al., 2002). Decomposition of plant mass--which is a cause of increased content of nutrients in water (Wetzel, 1983)--occurred in the reservoir as a result.

Comparison of the parameters monitored reveals that a complex of different factors is responsible for processes of production and changes in the phytoplankton community of the Barje Reservoir. It turned out that the phytoplankton community is controlled by various abiotic factors, namely nutrients, above all N and P (Sommer, 1989; Olden, 2000); physical factors of the external environment, namely temperature and light (Lund, 1949); and changes of the water level (Reynolds & Lund, 1988), although in certain cases incompatibility is evident between the composition and succession of the phytoplankton community on the one hand and prevailing values of the indicated factors on the other. Biotic factors also exert significant influence on changes in the phytoplankton community (Reynolds, 1984; Sommer, 1989; Olden, 2000).

Characterized by the absence of a zone with dominant plants in the littoral, the Barje Reservoir consequently represents an unstructured habitat with a simple linear food chain: nutrients-phytoplankton-zooplankton-fish (Scharf, 1999). The effect of zooplankton on the phytoplankton community is very significant in determining the succession of phytoplankton (Sommer, 1989; Olden, 2000). The greatest visible influence stems from utilization of phytoplankton as food by zooplankton, which directly results in reduction of the mass of phytoplankton (Lambert et al., 1986; Sterner, 1989). The composition of zooplankton is also of potential influence (Bergquist et al., 1985). It is generally held that mesoplankters (for example daphnias of the group Cladocera) exert greater influence on phytoplankton biomass than do small species (Copepoda) (Hall et al., 1976; Lynch & Shapiro, 1981). Also, phytoplankton can manifest a certain resistance to being consumed as food, which is a consequence of morphological differentiation in regard to cell size and shape, possession of hard shells, or the presence of gelatinose coatings (De Bernard & Guissan, 1990).

According to the data Kalafatić et al. (1997), zooplankton of the Barje Reservoir in 1996 was characterized by low abundance (from 2 to 6821 ind/l). Protozoa, Rotatoria, Cladocera, and Copepoda were present. Maximal values were recorded in surface layers of water in the middle of the reservoir in May (2473 ind/l) and around the M of the Veternica River in September (6821 ind/l). Minimal abundance of zooplanktonic organisms was recorded in layers of water next to the bottom.

The data of Simić et al. (2002) indicate that zooplankton during 1998/99 was characterized by the presence of taxa of the groups mentioned, but also by significantly greater abundance (from 273 to 37000 ind/l). The lowest density of zooplankton occurred in the fall, while densities during the spring and summer were considerably higher. During the autumn period, Copepoda and Rotatoria were the most abundant. Rotatoria were the most abundant in the late spring period, while in summer large species of Copepoda and Cladocera were the most abundant, and Rotatoria were dominant only in the shallowest part of the lake. The increased abundance of zooplankton constituted a good trophic base for planktivorous species of fish and fish fry (Simić et al., 2002).

According to the data of Simić et al. (2002), zooplankton in 2001 was not much changed in the qualitative sense, but significantly altered in the quantitative sense. A general decrease in overall density of zooplankton was evident in relation to 1998/99 (absolute abundance fluctuated from 500 to 15,900 ind/l), but also significantly increased abundance of zooplanktonic forms from the group Cladocera, above all the eutrophic species *Bosmina longirostris* Müller during the summer period (August). Increase in the density of Cladocera--which have been characterized as mesoplankters and more capable feeders (Olden, 2000)--during this period unquestionably affected decline in the density of edible groups of phytoplankton and made possible dominance of the alga *Anabaena* sp. Cyanophyta are known to be relatively inedible (Olden, 2000). In keeping with increase in the density of larger forms of zooplankton during this period, an increase was also evident in the desnsity of fish fry, primarily fry of *Alburnus alburnus* (Linnaeus 1758) (Simić et al., 2002), which resulted in decline of zooplankton density.

CONCLUSION

On the basis the phytoplankton community, it can be seen that the Barje Reservoir is a dynamic community subject to changes. The status of this ecosystem is influenced by both abiotic factors (especially the concentration of nutrients and changes of the water level) and biotic factors (deficiency of macrovegetation in the littoral zone and phytoplankton—zooplankton—fish relationships). Initially (in 1996) an oligotrophic reservoir, the lake underwent gradual transformation into a mesotrophic one (its status in 1998/99) and was then characterized by great biomass of phytoplankton (*Fragilaria crotonensis*, *Asterionella formosa*, and to some extent *Ceratium hirudinella*). Reiterated investigation of the phytoplankton community in 2001 showed a marked decrease of phytoplankton density, a consequence of decline in abundance of precisely those species that were in expansion during 1988/99, but also revealed further processes of eutrophication as reflected in the appearance of eutrophic Cyanophyta. Decrease of phytoplankton abundance is a consequence of the more significant influence of herbivorous zooplanktonic forms and to some extent of fish fry as well.

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