Kragujevac J. Sci. 28 (2006) 115-122.

ZOOPLANKTON OF THE BOVAN RESERVOIR

Aleksandar Ostojić

Institute of Biology and Ecology, Faculty of Sciences, University of Kragujevac
Radoja Domanovića 12, 34000 Kragujevac, Serbia and Montenegro
e-mail: ostojic@kg.ac.yu

(Received April 6, 2006)

ABSTRACT. Qualitative analysis of zooplankton of the Bovan Reservoir showed that the identified species are common forms that are also found in other reservoirs of Serbia. Most of the identified species are cosmopolitan. Saprobity analysis based on study of its zooplankton indicates that water of the Bovan Reservoir belongs to the category of β-mesosaprobic water (1.91 in spring, 1.90 in fall).

INTRODUCTION

The first investigations of zooplankton in reservoirs of Serbia were carried out on the country's oldest reservoirs, namely the Grošnica [1, 2] and Vlasina Reservoirs [3, 4]. After that period, most investigations of zooplankton in Serbian reservoirs were fragmentary [5-7], although some were more comprehensive [8-13], especially the Iron Gate Reservoir [14-16]. Subject to accelerated eutrophication, so-called microaccumulations in the Vojvodina Providence constitute a special group of reservoirs [17-22].

In view of the sparseness of data on the distribution of zooplankton, even one-time investigations are significant because they enable us to gain insight, even if superficial, into the diversity of zooplankton in Serbia.

DESCRIPTION OF STUDIED RESERVOIR

The Bovan Reservoir was constructed on the river Sokobanjska Moravica in the middle of its course near the village of Bovan. The reservoir is about 1 km long under low-water conditions and near the dam has a width of more than 500 m in conditions of high water. It was built for several purposes: flood control, irrigation, and generation of electricity [23].

MATERIAL AND METHODS

In the spring of 2005, only samples for qualitative analysis were taken (next to the dam and in the central part of the lake). During November of 2005, in addition to samples for qualitative analysis, samples were also taken for quantitative analysis (from the same localities as before, plus one in the shallowest part of the lake).

Qualitative samples of plankton were taken with a No. 25 plankton net, while quantitative samples were collected with 2-liter Ruttner hydrobiological bottles and then filtered across a plankton net. Samples were preserved with 4% Formalin at the collection site.

For each taxon in spring, dominance (*d*) was calculated according to the formula given by Tischler [24]:

$d = \frac{a_i}{\sum_{i=1}^{n} a_i}$ where a_i is number of individuals of given species and Σa_i the number of individuals of all species.

RESULTS AND DISCUSION

Qualitative analysis of zooplankton showed that the identified species are common forms that are also found in other reservoirs of Serbia. Most of the identified species are cosmopolitan. It should be noted that qualitative composition of the zooplankton fauna in spring differs from its qualitative composition in fall. Considerably more taxa (on the species or genus level) of the group Rotatoria were recorded in spring than in fall (20 versus eight), fewer taxa of the group Cladocera were recorded in spring than in fall (five versus seven), while the number of taxa of the group Copepoda was the same in these two seasons (three in both, but they are not the same ones) (Tables 1 and 2). Identification of Protozoa was not performed in the samples taken in spring.

As far as dominance is concerned, Rotatoria exhibited absolute dominance (primarily due to the species *Keratella cochlearis*) in spring (Tab. 1), whereas Copepoda (primarily larval forms) were most abundant in fall.

In regard to density (i.e., production) of zooplankton, unevenness is evident in its horizontal and vertical distribution. The least abundance was in the deepest layer (the layer of contact between water and sediment just above the bottom of the reservoir) at all three of the investigated localities (next to the dam, in the middle of the reservoir, and where the lake begins). Such a situation is normal and was to be expected, inasmuch as the most unfavorable conditions (lower oxygen content, unfavorable gas regime, etc.) prevail in the deepest layers of water. The indicated situation was especially pronounced next to the dam, where the minimal number of organisms (only 20 ind/l) was recorded just above the bottom.

The greatest production was in the surface layers (Tab. 2), which is a normal phenomenon. The uneven vertical distribution of zooplankton and enormous production in the surface layers indicate that the process of mixing of water layers is not yet complete. Enormous zooplankton production was recorded in the shallowest part of the reservoir (where the lake begins) and indicates that conditions there are favorable for the development of species. The production and species composition of zooplankton at this locality have

characteristics similar to those observed in lowland reservoirs and on lowland fish farms. The obtained results indicate intensive processes of eutrophication.

A situation favoring eutrophication is created by the fact that representatives of planktonic crustaceans (primarily of the group Copepoda) are dominant in regard to production. Such a situation indicates the existence of conditions favorable for development of fish fry and planktivorous species of fish. The situation is much more unfavorable when minute forms (such as Rotatoria, for example) are dominant in plankton [25]. The presence of zooplanktonic forms also indicates a probably balanced ratio of planktivorous and piscivorous fish species, which is favorable as far as trophic relations are concerned.

It is characteristic that in the shallowest part of the lake, together with a large number of individuals of the species *Eudiaptomus gracilis* (both adults and larval stages), an enormous number of individuals of the epibiontic protozoan form *Epistylis* sp. was recorded. The abundance of this species at the given locality strongly influences the dynamics of abundance of total zooplankton.

Saprobity analysis based on study of its zooplankton indicates that water of the Bovan Reservoir belongs to the category of β-mesosaprobic water (1.91 in spring, 1.90 in fall).

CONCLUSION

Considerably more extensive and longer-lasting investigations are needed for a proper estimation of the condition of the Bovan Reservoir. However, even such a preliminary investigation indicates that conditions favorable for eutrophication exist in it, which is evident in the very great production of zooplankton during autumn. On the basis of these data, it can be indirectly concluded that conditions favorable for development of phytoplankton exist during summer (no data are available on the quantity of nutrients), a circumstance which represents an excellent basis for the development of other components of the lake biocenosis. It is therefore imperative that measures be taken to reduce the influx of nutrients, which would make it easier to control the development of phytoplankton.

Table 1. Qualitative compostion and dominance of zooplankton in spring of 2005 in the Bovan Reservoir (Eudominant taxa (Ed), d≥10.0%; Dominant taxa (D), 5.0≤d<9.9%; Subdominant taxa (Sd), 2.0≤d<4.9%; Recedent taxa (R), 1.0≤d<1.9; Subrecedent taxa (Sr), d<1.0%)

Taxa	Dam		Centre		Whole reservoir	
	%	dominance	%	dominance	%	dominance
ROTATORIA						
Asplanchna sp.			0.3	Sr	0.1	Sr
Ascomorpha sp.	0.1	Sr	0.3	Sr	0.2	Sr
Brachionus angularis (Gosse)	0.1	Sr			0.1	Sr
Cephalodella sp.			0.3	Sr	0.1	Sr
Colurella obtusa (Gosse)	0.1	Sr	1.1	R	0.5	Sr
Euchlanis dilatata Ehrenberg	1.6	R	1.9	R	1.7	R
Filinia longiseta (Ehrenberg)			0.3	Sr	0.1	Sr
Hexarthra mira Hudson	0.1	Sr			0.1	Sr
Kellicotia longispina (Kellicott)	0.5	Sr	1.4	R	0.9	Sr
Keratella cochlearis (Gosse)	44.9	Ed	47.9	Ed	46.0	Ed
Lecane (L.) luna (O.F. Müller)			0.6	Sr	0.2	Sr
Lecane (M.) closterocerca (Schmarda)	0.9	Sr	0.6	Sr	0.7	Sr
Lepadella patella (O.F. Müller)	0.3	Sr			0.1	Sr
Philodina sp.	0.5	Sr	0.8	Sr	0.6	Sr
Polyarthra dolichoptera Idelson	21.3	Ed	19.3	Ed	20.5	Ed
Polyarthra vulgaris Carlin	6.5	D	4.8	Sd	5.9	D
Squatinella rostrum (Schmarda)	1.7	R	1.9	R	1.8	R
Synchaeta sp.	1.4	R	1.9	R	1.6	R
Trichocerca (D.) similis (Wierzejski)	1.0	R	0.6	Sr	0.9	Sr
Trichotria tetractis			0.3	Sr	0.1	Sr
CLADOCERA						
Alona guttata G.O. Sars			0.6	Sr	0.2	Sr
Bosmina longirostris (O.F. Müller)	1.6	R	1.4	R	1.5	R
Chydorus sphaericus (O.F. Müller)	1.9	R	2.2	Sd	2.3	Sd
Daphnia cucullata G.O Sars	0.1	Sr	0.3	Sr	0.5	Sr
Leptodora kindti (Focke)			0.3	Sr	0.1	Sr
COPEPODA						
Acanthocyclops robustus (G.O. Sars)			0.6	Sr	0.2	Sr
Canthocamptus staphylinus Jurine			0.3	Sr	0.1	Sr
Cyclops sp.	0.3	Sr			0.1	Sr
Eudipatomus gracilis (G.O. Sars)	0.5	Sr	0.6	Sr	0.5	Sr
nauplii	9.2	D	9.7	D	9.4	D

Table 2. Qualitative and quantitative (ind/l) composition of zooplankton in the Bovan Reservoir – 04.11.2005.

Taxa	Dam				Centre				Shallow part				Whole reser-voir
	0.5m	15m	33m	mean	0.5m	4m	7m	mean	0.5m	1m	2m	mean	
PROTOZOA													
Carshesium polypinum L.	12			4						783		261	1.3
Cyphoderia margaritacea Ehrenberg							2	0.7	4			1.3	0.7
Difflugia sp.						4	8	4		63		31	8.3
Epistylis sp.	328			109.3	328			109.3	544	6880		1088	897.8
Tintidinnium fluviatile Kent.					4	8		4	36	48	14	37.7	12.2
Tintinnopsis lacustris Entz							2	0.7					0.2
Vorticella sp.										45	12	19	6.3
Ukupno Protozoa	340			113.3	332	12	12	118.7	584	7819	26	2809.7	1013.9
ROTATORIA													
Ascomorpha sp.									26	9	6	13.7	4.6
Kellicotia longispina (Kellicott)	72	1		24.3	64	4	50	39.3	540	945	10	498.3	187.3
Keratella cochlearis (Gosse)	6			2	16	2	4	7.3	112	504	10	208.7	72.7
Keratella cochlearis tecta (Lauterborn)											2	0.7	0.2
Keratella quadrata (O.F.Müller)	2			0.7	4			1.3					0.7
Polyarthra dolichoptera Idelson			1	0.3		2		0.7	8			2.7	1.2
Polyarthra vulgaris Carlin											2	0.7	0.2
Pompholyx complanata Gosse									48	117	6	57	19
Ukupno Rotatoria	80	1	1	27.3	84	8	54	48.7	734	1575	36	781.7	285.9
CLADOCERA													
Alona guttata G.O. Sars										18	2	6.7	2.2
Bosmina coregoni Baird	438	64	8	170	32	90	116	79.3	8	9	6	7.7	85.7
Bosmina longirostris (O.F. Müller)			1	0.3									0.1
Chydorus sphaericus (O.F. Müller)		1		0.3		2		0.7		9		3	1.3
Daphnia cucullata G.O Sars	8	2		3.3	84	2	4	30	12	54	8	24.7	19.3
Diaphanosoma brachyurum (Lievin)	2			0.7	16			5.3	28		2	10	5.3
Leptodora kindti (Focke)							4	1.3	4	9		4.3	1.9
Ukupno Cladocera	448	69	9	175.3	132	94	124	116.7	52	99	18	56.3	116.1
COPEPODA													
Cyclops vicinus Ulianine	4			1.3	36			12					4.4
Cyclops sp.	14	2	1	5.7		4	2	2	224	891	22	379	128.9
Eudipatomus gracilis (G.O. Sars)	192	4	3	66.3	372	18	46	145.3	448	2250	42	913.3	375

Table 2. continue

Taxa	Dam				Centre				Shallow part				Whole reser-voir
	0.5m	15m	33m	mean	0.5m	4m	7m	mean	0.5m	1m	2m	mean	
nauplii Cyclopoida	218	13	1	77.3	332	16	70	139.3	520	468	22	336.7	184.4
nauplii Calanoida	448	8	4	153.3	1632	60	122	604.7	4052	6840	70	3654	1470.7
copepodit Cyclopoida	28		1	9.7	104		6	40	344	675	6	341.7	129.3
copepodit Calanoida	134	6		46.7	556	30	26	204	216	333	34	191	148.4
Total Copepoda	1038	33	10	360.3	3032	128	272	1144	5804	11457	196	5819	2441.1
Total zooplankton	1906	103	20	676.3	3580	242	462	1428	7174	20950	276	9374.7	3857

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