THE DENSITY VARIATION OF PLANKTONIC CRUSTACEAN POPULATIONS (COPEPODA AND CLADOCERA) FROM THE IZVORU MUNTELUI – BICAZ RESERVOIR

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Key words: density, crustacean populations, reservoir, pattern, dominant species.

Introduction

The studied area concerns the Izvoru Muntelui – Bicaz reservoir created in 1960 on the main Bistrița River stream. The lake has 34 km in length, 2 km maximum width, a surface of 3.105 ha, a maximum depth of 90 m in the dam area and a maximum volume of water of 1.200.000.000 m^3. The main tributaries are the rivers Bistrița and Bistricioara, but important tributaries are smaller streams like Largu, Hangu, Buhalnița, Potoci, Schitu, Izvoru Alb and Secu too (Miron, 1983, Băncilă, 1989).

From the beginning, the lake recorded an evolution process, where the flowing water ecosystems have been replaced by lacustrine ones, with peculiar biota. Therefore, this reservoir has been a very interesting study area right from the beginning. It was studied intensely by a series of researchers in order to see how the ecosystem evolves from all the biological components point of view (benthic fauna, fish fauna, phytoplankton and zooplankton).

Researchers like Rodica – Ileana Rujinschi, Constantin Rujinschi and Miron Ionel studied the zooplankton communities and therefore, the planktonic crustacean populations, which were studied from the qualitative composition, quantitative development (density, biomass), horizontal distribution, vertical distribution and also ecological point of view.

Regarding the density, it has been observed that, at the level of this reservoir during a one year time period, the density of the zooplankton communities and therefore the density of the planktonic crustacean populations evolved after a regular pattern with two peaks in spring and autumn followed by time periods with low density. The evolution pattern of the density is the following: in winter the density is low but starts to increase slowly in March and in May the density registers the first peak, after this peak the density decreases in June but starts to increase again in July and in September rises the second density peak after which the values of density decreases as the winter comes in (Miron, 1983).

I wanted to see if this tendency maintained over the years, also if the present day's density values are comparable with the ones registered in the first ten years of the reservoirs life and to find if the dominant species are the same species presented in the literature.

Matherials and methods

This study has been conducted between March and October 2007.

For this study, I established nine sampling sites using the same criteria as in the previous studies (Rujinschi & Rujinschi, 1971, Corneanu, 1979, Miron, 1983,), meaning the ecological areas criteria. Based upon this criteria, there are 3 ecological areas in the Izvoru Muntelui – Bicaz reservoir: gulf areas (areas of tributaries confluence with the lake – Potoci, Buhalnița, Hangu, Coada lacului, Izvoru Alb and Secu), open water areas (water areas with great width and small depths – Şes Hangu (middle of the lake) and deep water areas (areas where the depth of the water is over 50m – Baraj (dam) and Rugineşti).

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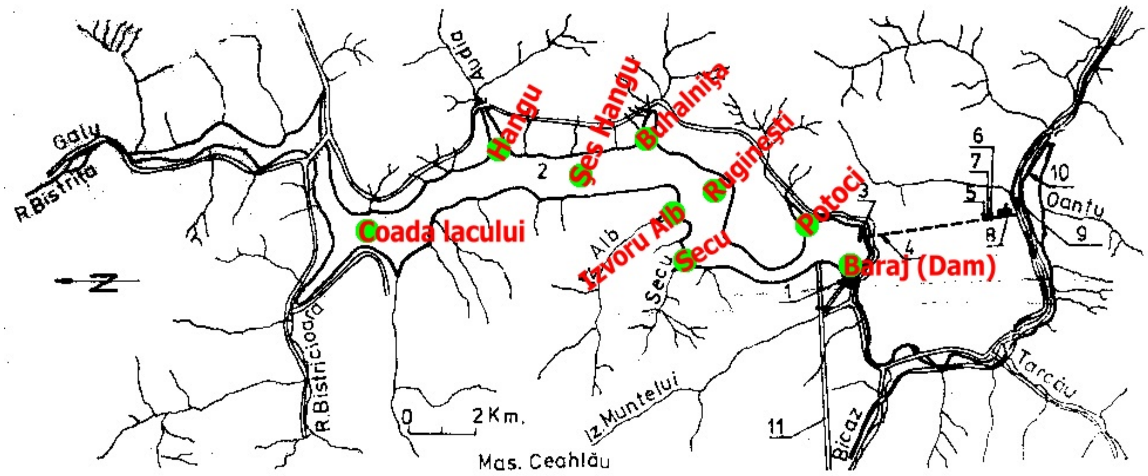

Figure 1 – The position of the sampling points on the surface of Izvoru Muntelui – Bicaz reservoir.

Sampling was made using plankton net, according to Apstein (with the mesh size of 100 μm) which makes possible vertical sampling on water layers. From each sampling site I have taken multiple quantitative samples from different depths starting from the surface and ending at the bottom of the lake. Samples were put in clean bottles and temporary preserved in 96% alcohol. Each bottle was labeled with the sampling point name, date, depth and other identification data. In the laboratory, the samples were concentrated through a filtering process during which all the remaining water was taken out from the sample and after this procedure the samples were definitively fixed in pure 96% alcohol. After the procedure mentioned above, all the samples were processed, meaning that I have identified all taxa and counted the organisms. Because in the samples the number of individuals was too large and a counting of all individuals was not physically possible, I extracted three sub-samples of 5 or 2 ml from each of the big samples using a Hensen pipette. The density has been expressed in ind./c.m.[1].

Results and discussions

We obtained a great amount of data regarding all three objectives established for this study and the analysis of this data is presented as it follows through graphic representation for a better understanding.

The subject of the study is the plankton crustacean populations (Copepoda and Cladocera) from the Izvoru Muntelui – Bicaz reservoir.

In Figure 2 we are presenting the data obtained for the Baraj (dam) sampling site and as it can be seen, the situation differs from the data already published by the various researchers. The first peak of the numerical development has been found like it was supposed to be in May, but the second one has been recorded in July. It can be said that the density evolution in this point is normal for the first four months of the study but starting from August the density evolution is totally different from the one described in literature, meaning that instead of rising slowly and in September to explode, the density gradually decreases during August, September and October. The second peak of the numerical development has been identified in July two months earlier than it should have been.

[1] ind./c.m. – individuals per cubical meter (of water).

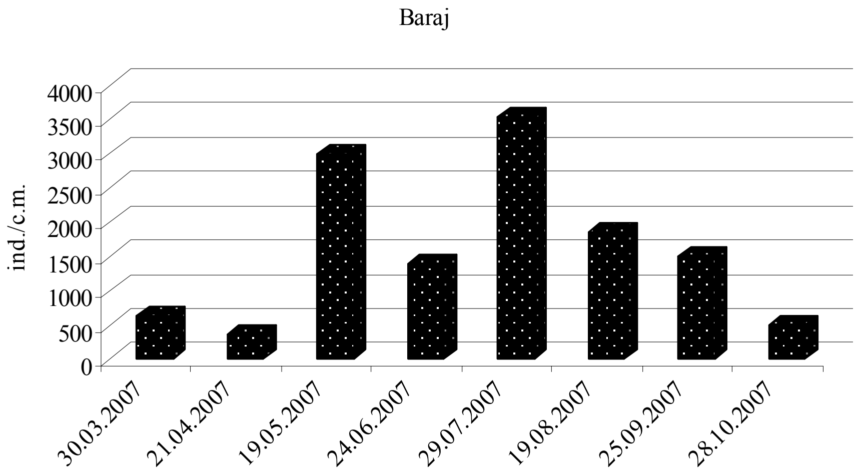

Figure 2 – Density evolution in the Baraj (dam) sampling site during the study period.

In Figure 3 I present the data for the Potoci sampling point, where as it can be seen, the situation in the first four months of the study is a normal one with a density peak in May and a decrease in density in June. Even if the second peak of the numerical development has been identified as it was supposed (in September) the general situation is not similar with the literature data because it can be observed a third peak of density in July.

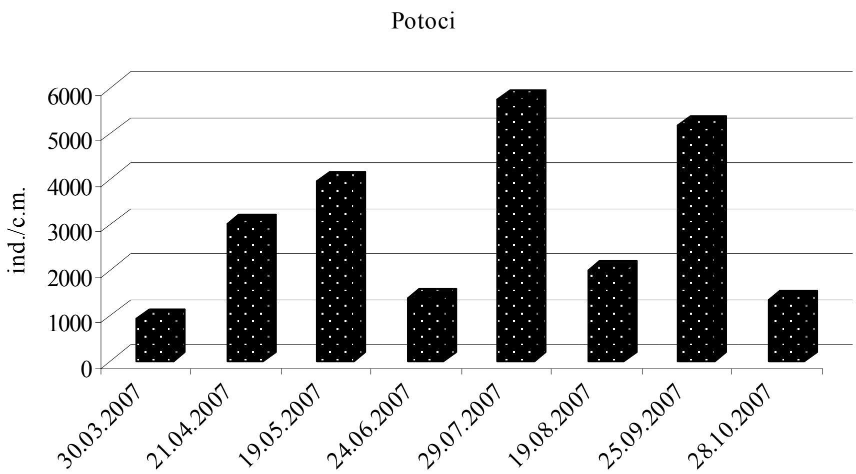

Figure 3 - Density evolution in the Potoci sampling site during the study period.

The figure number 4 is presenting the density evolution for the Ruginești sampling site. Analyzing the graph one can see that the first peak of density has been identified not in May like it should have been but in June, which differs from the situation already reported in literature. In the last four months of the study, the data shows a normal pattern of the numerical development with the second density peak in September followed by the decreasing of density values in October.

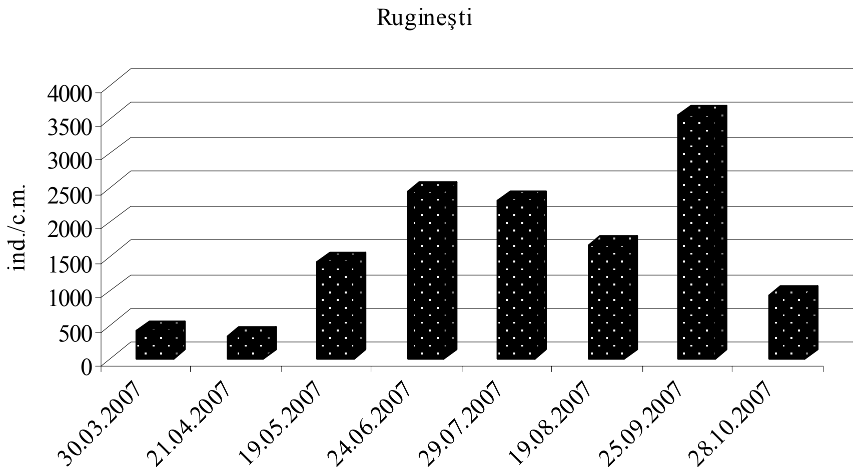

Figure 4 - Density evolution in the Rugineşti sampling site during the study period.

In the Buhalniţa sampling site the evolution of the density values is totally out of the normal pattern described in the literature. The present data shows a peak of density in June, not in May, and also the density increased gradually from July until October without revealing a peak in September. The maximum of the numerical development has been reached in October, when normally it should have been reached in September followed by the decrease in the number of organisms in the next month.

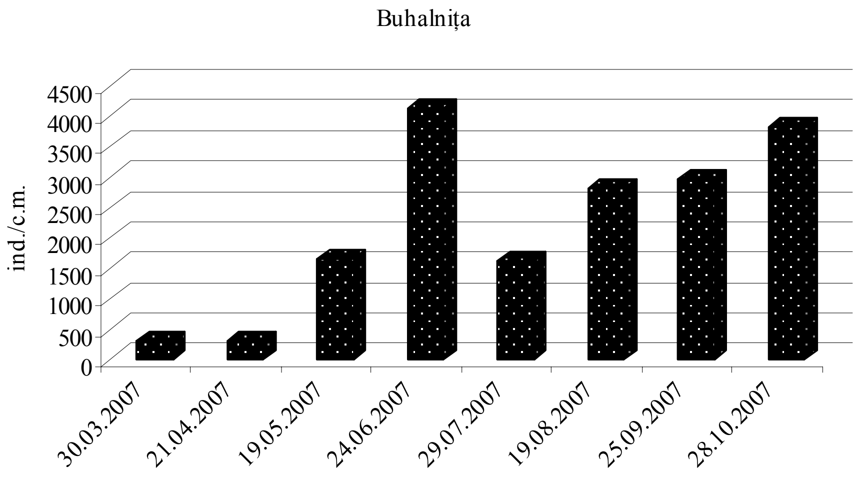

Figure 5 - Density evolution in the Buhalniţa sampling site during the study period.

Data obtained for the Şes Hangu sampling site is showing just one peak of the numerical development over the entire study period in August. The density gradually increased starting from May until has reached the maximum value in August and after that decreased also gradually until October.

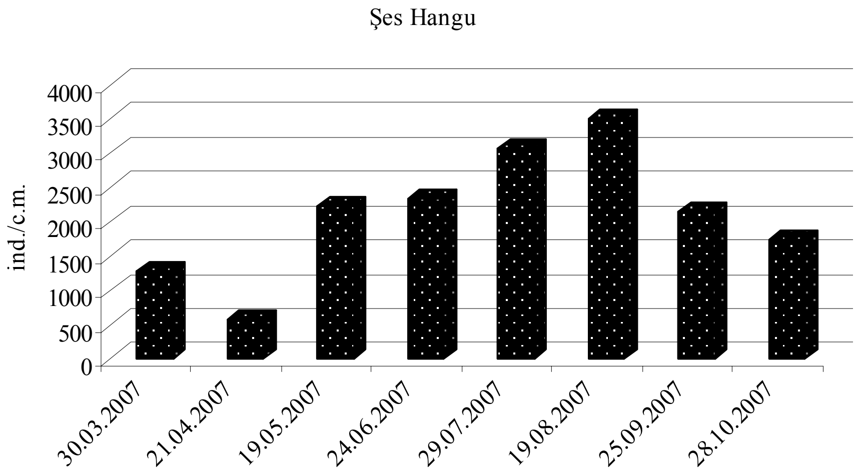

Figure 6 - Density evolution in the Şes Hangu sampling site during the study period.

The results for the Hangu sampling point are presented in Figure 7. Analyzing the Hangu site graph one can see that in the first three months, including May (when we should have been identifying the first density peak), the density maintained at very low values and the first peak of numerical development has been identified in June. In July the density decreased and continued to decrease in August but in September we found the second density peak followed by the decrease in density in October.

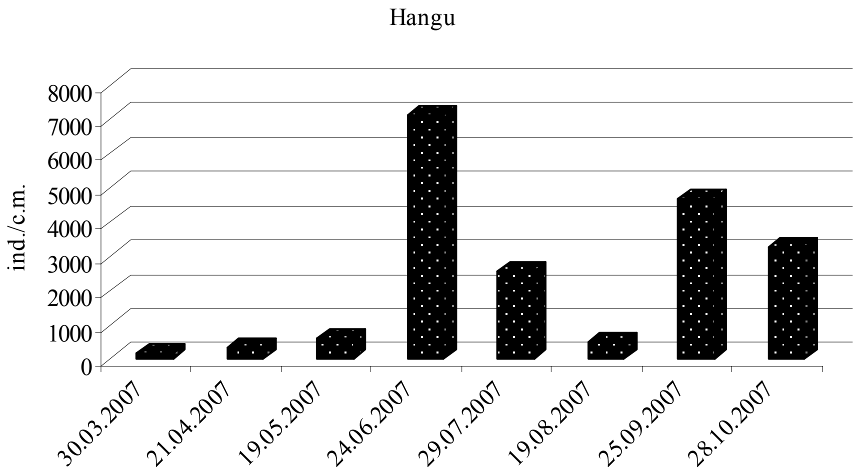

Figure 7 - Density evolution in the Hangu sampling site during the study period.

At Coada lacului I identified three density peaks in June, August and October, which expose a very different pattern than the one already mentioned in literature. In fact, it can be seen that the density fluctuates like a wave, starting from a high value in March, decreasing and increasing through all the study period.

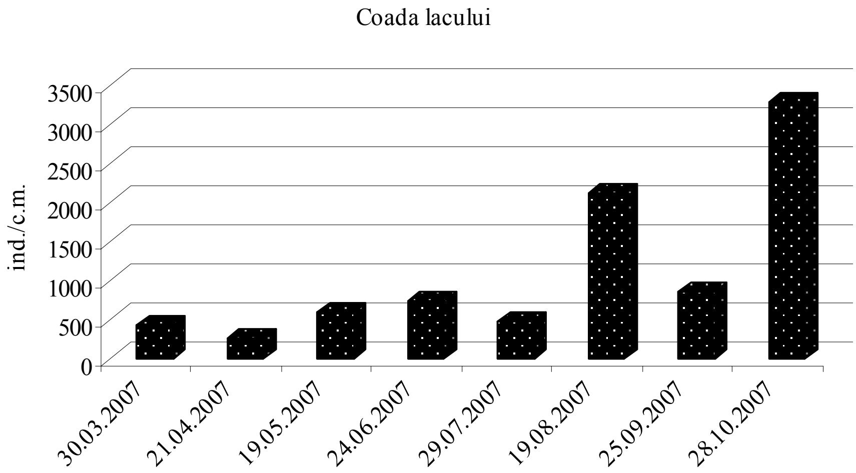

Figure 8 - Density evolution in the Coada lacului sampling site during the study period.

At Izvoru Alb the data shows the same situation like in the case of the Şes Hangu sampling point with a graduate increasing of density from May until August when I identified the first and only density peak. In the next two months the density values decreased gradually until the end of the study period in October.

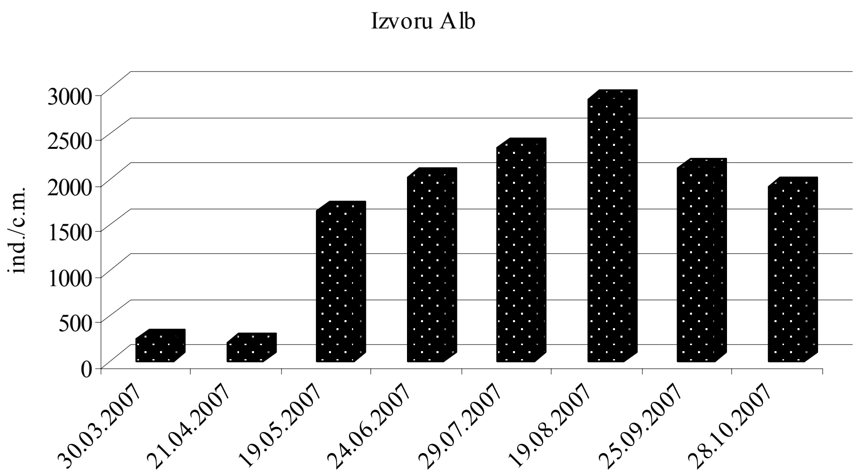

Figure 9 - Density evolution in the Izvoru Alb sampling site during the study period.

The results presented in Figure 10 are for the Secu sampling site. Analyzing the graph one can easily see that I have identified just the density peak from May, after this month, the density values decreased constantly through the rest of the study period until September when the density value was almost equal with the one from April. The density evolution pattern is very different from the one described in the literature.

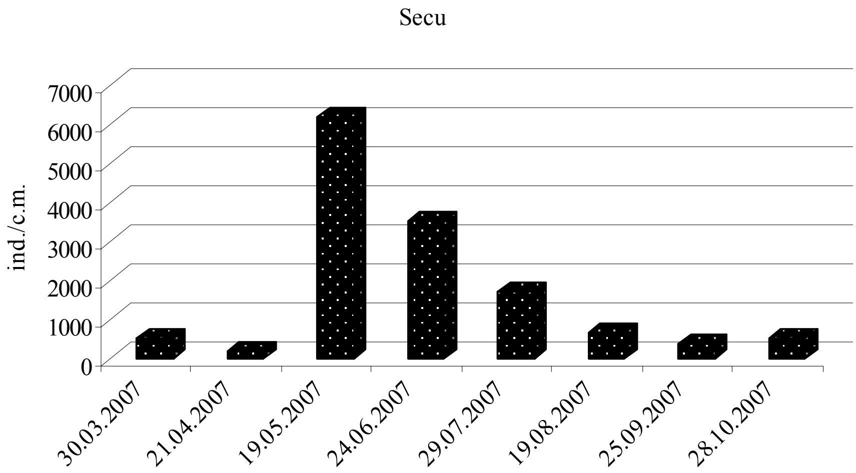

Figure 10 - Density evolution in the Secu sampling site during the study period.

Looking back to the data obtained for all the sampling sites, it can be seen that the density evolution pattern over one year period of time described in literature for the zooplankton communities and therefore, for the planktonic crustacean populations from this reservoir, has not been identified in none of the sampling sites. In some cases like at Baraj, Potoci, Rugineşti, Hangu and Secu the density evolution partially followed the pattern described in literature. The closest density evolution pattern to the one described in literature was identified at Potoci, where in over 85% of the study period, the density followed that pattern. The only problem is that in July I identified a third density peak with the highest values from the entire study time period.

Knowing that the water level from the Izvoru Muntelui – Bicaz reservoir normally varies over a one year time period with 30 to 40 meters between summer (in summer the water level is high, sometimes maximum) and winter (the water level is low) one explanation for these results could be that in 2007 the water level of the lake was maintained low artificially because of the renovation works at the bridge crossing the lake's tail and in this way, all the organic substances from the shores did not entered back in the biological circuit, therefore the algal populations did not have the resources to develop high densities and further the planktonic crustacean populations didn't had the optimum conditions for developing high densities (a so called "chain reaction").

The highest density value recorded for the entire reservoir was of 7.112,48 ind./c.m. and it was found in Hangu sampling site in June. The smallest density value was identified in the same sampling point and it was of 178,34 ind./c.m. in March.

For comparison we have the maximum density values of the planktonic crustacean populations given by Corneanu (1979) – 381 ind./c.m. for copepods (07.02.1967 at Baraj) and 4955 ind./c.m. for cladocerans (17.08.1966 at Rugineşti). We can see that at that time the planktonic crustaceans reached a combined density of 5.336 ind./c.m.

As it can be seen, the present maximum density value is bigger with almost 2.000 ind./c.m. than the one presented in literature but this difference is not very important due to the ever changing life conditions from this reservoir.

The species *Bosmina longirostris*, *Daphnia hyalina* and *Cyclops vicinus* are presented in literature as dominant ones in the planktonic crustacean populations from this reservoir. *Bosmina longirostris* had densities over 20.000 ind./c.m. but in some cases has reached densities of 60.000 ind./c.m., *Daphnia hyalina* had densities between 1.500 and 5.400 ind./c.m. and *Cyclops vicinus* reached densities of aproximatively 500 ind./c.m. (Miron & Grasu, 1964, Rujinschi & Rujinschi, 1971, Miron, 1983).

Analyzing the data gathered during the present study, one can see that in the present days the dominant species of planktonic crustaceans are *Eudiaptomus gracilis*, *Cyclops vicinus* and *Bosmina longirostris* with the following medium density values 684,76 ind./c.m., 363,16 ind./c.m. and 148,11 ind./c.m.. The maximum values of density reached by the species mentioned above are

3.487,28 ind./c.m. for *Eudiaptomus gracilis*, 2.229,29 ind./c.m. for *Cyclops vicinus* and 2.356,65 ind./c.m. for *Bosmina longirostris*.

Comparing the literature data and data gathered during this study we can see that the actual dominant species are not the same with the ones once reported. The nowadays dominant species are *Eudiaptomus gracilis*, *Cyclops vicinus* and *Bosmina longirostris* and not *Bosmina longirostris*, *Daphnia hyalina* and *Cyclops vicinus*. Two of the former dominant species are still dominant (*Bosmina longirostris* and *Cyclops vicinus*) but the situation changed from the point of view of density values developed by the species. If in the past *Bosmina longirostris* was developing the highest densities (over 20.000 ind./c.m.), in the present days the species is responsible for just the third medium density value (148,11 ind./c.m.) and the second maximum density value (2356,65 ind./c.m.). *Cyclops vicinus* was responsible for the lowest maximum density value but now is responsible for the second medium density value (363,16 ind./c.m.) and for the third maximum density value (2229,29 ind./c.m.). The biggest change that took place at the dominant species level is the installation of *Eudiaptomus gracilis* in the ecosystem, species which became responsible for the highest density values (684,76 ind./c.m.) on the entire reservoir surface. In the present days is the best adapted species for the life conditions from this reservoir. From the data that we have, the highest density reached by this species was of 112.400 ind./c.m. found during another study in November 2006 at Bistricioara.

Conclusions

The data analysis shows that the previous density evolution pattern of the planktonic crustacean species from the Izvoru Muntelui – Bicaz reservoir described in literature is no longer respected.

Further researches are needed for establishing if the data gathered about the density evolution pattern during a one year period are real and have not been influenced by the special life conditions present during the study time period.

The overall densities of the planktonic crustacean populations haven't suffered great changes from the previous studies.

The time passed from the previous studies had important influences on the structure of the dominant species group, both at qualitative and quantitative level.

BIBLIOGRAPHY

1. Băncilă, I., 1989, *Geologia amenajărilor hidrotehnice*, Editura Tehnică, Bucureşti, 264 p.
2. Damian, Georgescu, A., 1963. *Familia Cyclopidae (forme de apă dulce)*, *Fauna Republicii Socialiste România, Crustacea – Copepoda*, vol. IV, Fascicula 6; Editura Acad. R. P. R., Bucureşti, 204 p.
3. Damian, Georgescu, A., 1966. *Calanoida (forme de apă dulce)*, *Fauna Republicii Socialiste România, Crustacea – Copepoda*, vol. IV, Fascicula 8; Editura Acad. R. S. R., Bucureşti, 130 p.
4. Damian, Georgescu, A., 1970. *Harpacticoida (forme de apă dulce)*, *Fauna Republicii Socialiste România, Crustacea – Copepoda*, vol. IV, Fascicula 11; Editura Acad. R. S. R., Bucureşti, 248 p.
5. Miron, I., 1983. *Lacul de acumulare Izvorul Muntelui – Bicaz, Monografie limnologică*; Editura Acad. R. S. R., Bucureşti, 224 p.
6. Miron I.; Grasu, M., 1964 b – *Zoplanctonul lacului de acumulare Bicaz în al III - lea an de la formarea sa*. An. Şt. Univ. „Al. I. Cuza" Iaşi, **X**, Fasc. 2, Secţi. II a. Biol., p. 265-270.
7. Negrea, Ş., 1983. *Cladocera*, *Fauna Republicii Socialiste România, Crustacea*, vol. IV, Fascicula 12; Editura Acad. R. S. R., Bucureşti, 399 p.
8. Rujinschi, C.; Rujinschi, R.-I., 1971 – *Observaţii asupra răspândirii cladocerelor şi copepodelor în Lacul de acumulare Bicaz în cursul anului 1969.* Lucr. Staţ. „Stejarul", **4**, p. 341-355.
9. Corneanu, G., 1979 – *Observaţii privind răspândirea spaţială a zooplanctonului în lacul Izvorul Muntelui – Bicaz (1966-1967) şi în lacurile Pângăraţi, Vaduri şi Bîtca Doamnei (1966).* Lucr. Staţ. „Stejarul", **7**, p. 185-192.