SMALL RESERVOIRS VALEA PREAJBA (ROMANIA) – STRUCTURAL BIOCOENOTIC INDICES OF GASTROPOD POPULATIONS

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Abstract. The research made within some small reservoirs from the hydrographical basin of the Jiu emphasized the structure of the biocoenosis, an important role being played by the Gastropod populations. Thus, there have been established the structural biocoenotic indices. Their values highlight the distribution of gastropod populations within the reservoirs.

Keywords: Gastropods, the Preajba Valley, Oltenia, structural parameters.

Rezumat. Lacurile de baraj Valea Preajba (România) - indicii structurali biocenotici ai populaţiilor de gastropode. Cercetările efectuate asupra unor lacuri mici de baraj din bazinul hidrografic al Jiului au pus în evidenţă structura biocenozelor în care un rol important îl au populaţiile de gastropode. În acest scop au fost stabiliţi indicii structurali biocenotici. Valorile acestora reflectă distribuţia populaţiilor de gastropode în lacuri.

Cuvinte cheie: gastropode, Valea Preajba, Oltenia, indicii structurali.

INTRODUCTION

The small reservoirs Preajba Valley, located in the plain area from the hydrographical basin of the Jiu, are characterized by the great diversity of ecosystems (springs, streams, rivers, basins and swamps) (Fig. 1). In these ecosystems, there have been identified 18 species of Gastropods, 5 of which are new for Oltenia fauna: *Esperiana esperi* (A. Ferussac 1829), *E. (Microcolpia) daudebardii acicularis* (A. Ferussac 1829), *Aplexa hypnorum* Linnaeus 1758, *Segmentina nitida* (O. F. Muller 1774) and *Stagnicola corvus* Gmelin 1788 (CIOBOIU, 2002).

An important role in the structure of the reservoirs biocoenoses is played by the gastropods through their specific diversity, numerical and biomass density, as well as biocoenotic structural indices (BOTNARIUC et al., 1964; BREZEANU & GRUIŢĂ, 2002; BREZEANU et al., 2011; CIOBOIU, 2011). There have been calculated the following indices: frequency, relative abundance, indices of ecological significance, affinity, diversity and equitability (BOTNARIUC & VĂDINEANU, 1982; CIOBOIU, 2003; STĂNICĂ & NEACŞU, 1998).

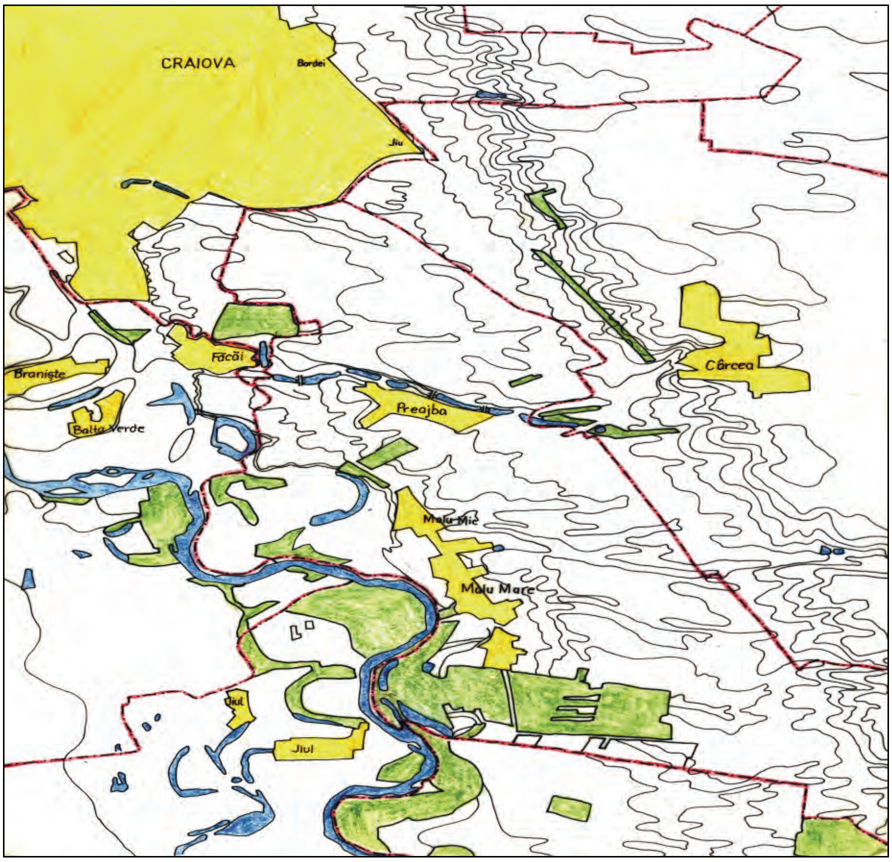

Figure 1. Location of the small reservoirs Preajba Valley in the lower sector of the Jiu (after CIOBOIU, 2011).

MATERIAL AND METHODS

In order to emphasize the qualitative and quantitative structures, there were taken samples each season. Within the framework of a vast research program, there were analysed more than 4,000 gastropods (CIOBOIU, 2002; 2011). The laboratory works included: taxonomic determinations, distribution within the habitat, structure according to age, dynamics of the populations increase and of the structural indices, determination of the production. The structural indices were established on the basis of statistical calculation.

RESULTS AND DISCUSSIONS

The structure of the gastropod populations displays certain specific features characteristic to each reservoir, features that are illustrated by the structural indices of the populations of this group. Some species were identified in only one reservoir or in two or three reservoirs at most, as it is the case of the species *Esperiana esperi* (A. Ferussac 1829), *Stagnicola corvus* Gmelin 1788 and *Oxyloma (O.) elegans* (Risso 1826). The main cause is the specificity of the microhabitat these species prefer, which are specific to the studied reservoirs - areas without decaying organic silt, with a sandy bottom washed by a slow water flow. They present a more or less uniform distribution, most of them being present in all the reservoirs; they are relatively ubiquist, adapted to the varied conditions characteristic to an eutrophic environment, such as the ones of these reservoirs, specific to the ecosystems from both stagnant waters and streams.

It was noticed that the greatest number of species populates the silty-detritic bottom of the shallow near-shore areas. These areas present the best feeding conditions. Gastropods find abundant food on the coarse detritus, on the leaves fallen into the water which are not decayed but covered by a rich periphyton, on the silt pellicle rich in organic substances. The lowest species diversity was determined in those areas characterized by a preponderantly sandy bottom or exclusively silty bottom (Table 1).

Table 1. The taxonomic composition of the Gastropod species within the studied reservoirs.

SPECIES	RESERVOIRS								
	V	VI	VII	VIII	IX	X	XI	XII	XIII
Viviparus acerosus Bourguignat 1870					+	+	+	+	
Viviparus viviparus Linnaeus 1758					+	+	+	+	
Valvata (Cincina) piscinalis O. F. Muller 1774						+	+	+	
Esperiana esperi (A. Ferussac 1829)	+			+					
E. (Microcolpia) daudebardii acicularis (A. Ferussac 1823)	+	+	+			+			
Physa fontinalis (Linnaeus 1758)				+				+	+
Physella (Costatella) acuta (Draparnaud 1805)	+	+	+	+	+	+	+	+	+
Aplexa hypnorum Linnaeus 1758	+	+	+	+	+			+	+
Stagnicola palustris (O. F. Muller 1774)	+								
Stagnicola corvus Gmelin 1788				+					
Radix auricularia (Linnaeus 1758)	+	+	+	+	+	+	+	+	
Radix ampla (Hartmann 1821)	+		+	+	+		+	+	+
Radix balthica (Linnaeus 1758)	+	+	+	+	+	+	+	+	+
Planorbis planorbis (Linnaeus 1758)			+			+	+		+
Anisus (A.) spirorbis (Linnaeus 1758)			+						
Segmentina nitida (O. F. Muller 1774)	+		+			+		+	
Oxyloma (O.) elegans (Risso 1826)	+								

The calculated indices emphasize that the reservoirs can be classified into two groups: those located in the upper and in the lower river. This grouping reflects the distribution of gastropods within the reservoirs (CIOBOIU, 2002; 2011; CIOBOIU & BREZEANU, 2009).

In the first group of reservoirs, the population *Physella (Costatella) acuta* (Draparnaud 1805), followed by *Radix balthica* (Linnaeus 1758) registered the highest frequencies: up to 72.22% in the first case, 50-55% in the second. In these reservoirs, the diversity index is the highest, as a direct consequence of the diversity of the habitat types: vast areas with paludous and aquatic macrophytes, while nearshore there is found a detritic and sandy facies (Fig. 2).

With regard to the second group of reservoirs, the highest frequency index is registered by the species *Viviparus acerosus* Bourguignat 1870 and *V. viviparus* Linnaeus 1758. Both of them are stagnant species that prefer especially the eutrophic lake ecosystems. Mostly inhabiting the nearshore areas with macrophytes, where a rich periphyton develops, as well as the submerged part of the concrete panels securing the shores, the two species, but also other accompanying species, find abundant sources of food here (Fig. 3). Characteristic to this area is the appearance of the species *Valvata (Cincina) piscinalis* O. F. Muller 1774 for the first time, the frequency index of which is 34.61 %; this species is considered to be oligotope (CIOBOIU & BREZEANU, 2002).

Taking into account their distribution and frequency in the studied reservoirs, it results that the species *Viviparus acerosus* Bourguignat 1870, *V. viviparus* Linnaeus 1758, *Physella* (*Costatella*) *acuta* (Draparnaud 1805) and *Radix balthica* (Linnaeus 1758) have a relative abundance and an important role in the functioning of the benthic biocoenosis. Besides these species, *Aplexa hypnorum* Linnaeus 1758 and *Radix auricularia* (Linnaeus 1758) are the dominant species accounting for over 74% of the total, the other species having a share of 25.9% (Fig. 4).

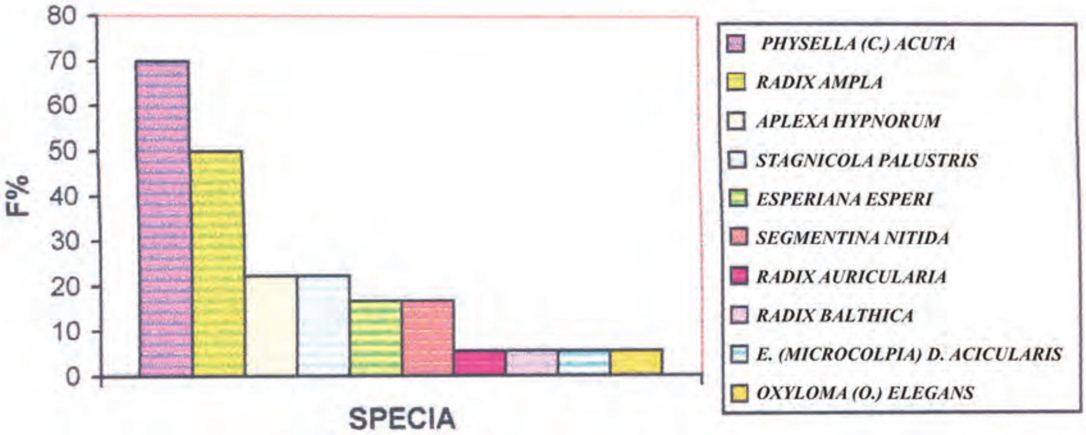

Figure 2. The frequency of the Gastropod species within the upper sector of the river (reservoir V).

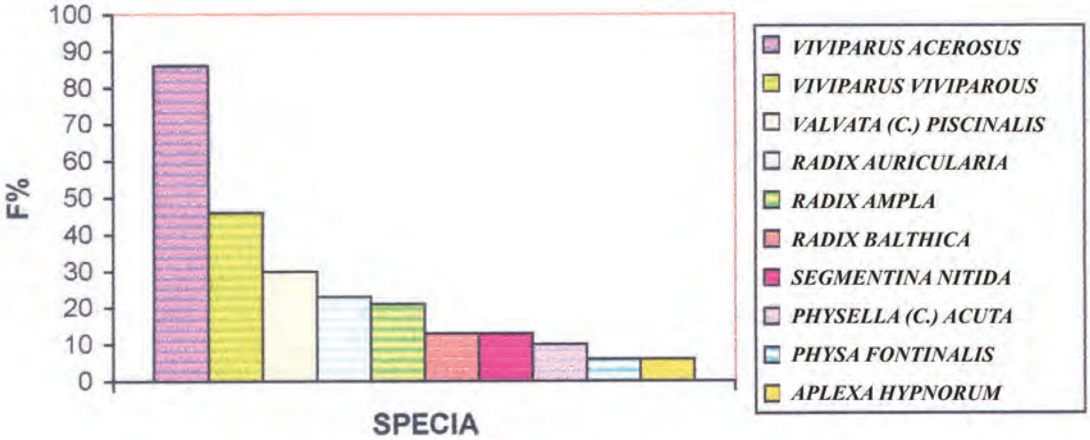

Figure 3. The frequency of the Gastropod species within the lower sector of the river (reservoir XII).

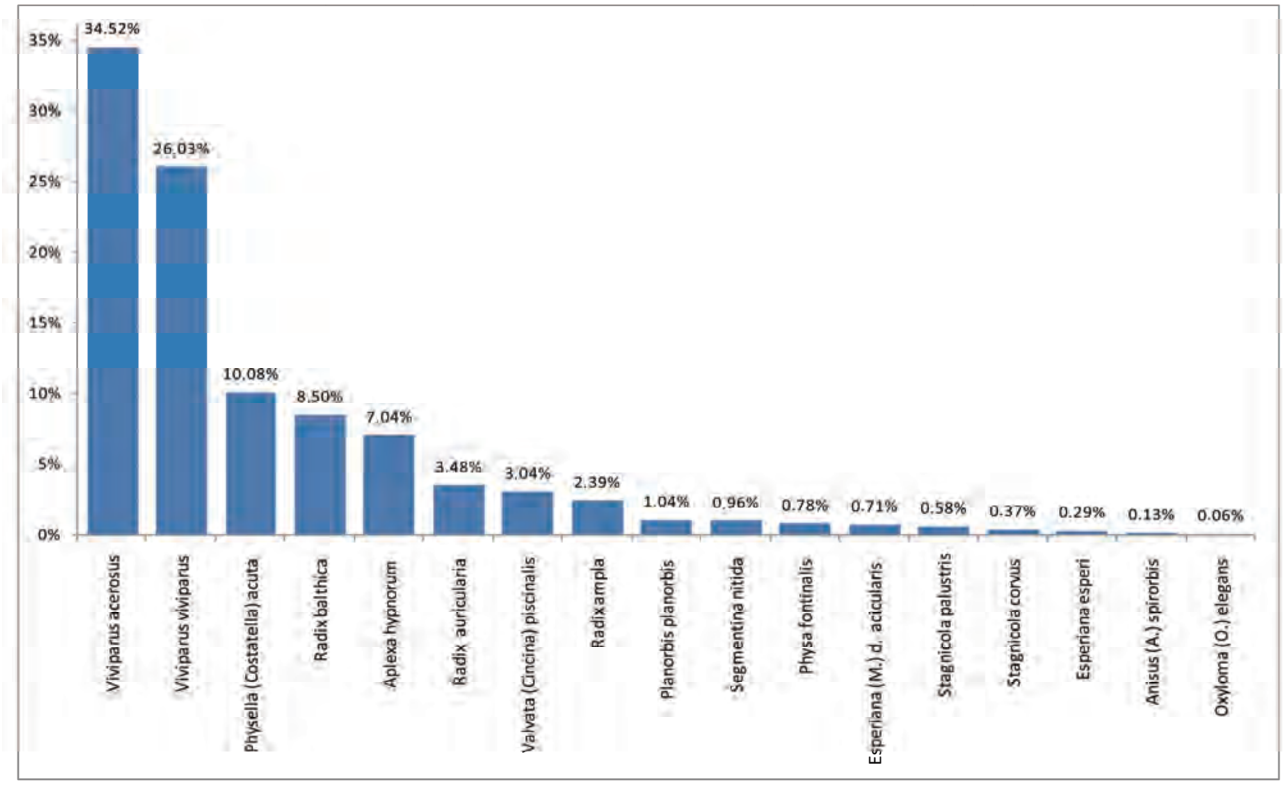

Figure 4. Gastropod numerical abundance within the reservoirs.

In order to calculate the affinity index, the species were classified according to the index of ecological significance (Table 2) (STĂNICĂ & NEACŞU, 1998). The affinity index, calculated according to Jaccard formula:

$$q = \frac{c}{a+b-c} \times 100$$

in order to establish to what degree the different Gastropod species are characteristic for the biocoenosis they populate, emphasized that there is a certain link or association degree among the species.

Table 2. The distribution of Gastropod species according to the index of ecological significance (W). (reservoir V)

SPECIES	W	TYPE OF SPECIES
Physella (Costatella) acuta	22.27	characteristic
Radix ampla	17.29	characteristic
Stagnicola palustris	2.28	accessory
Aplexa hypnorum	1.76	accessory
Esperiana esperi	0.78	accessory
Segmentina nitida	0.78	accessory
Radix balthica	0.34	accessory
Oxyloma (O.) elegans	0.08	accidental
Radix auricularia	0.03	accidental
E. (Microcolpia) daudebardii acicularis	0.03	accidental

(reservoir XII)

SPECIES	W	TYPE OF SPECIES
Viviparus acerosus	44.37	characteristic
Viviparus viviparus	14.52	characteristic
Valvata (Cincina) piscinalis	1.73	accessory
Radix ampla	0.85	accessory
Radix auricularia	0.79	accessory
Segmentina nitida	0.42	accessory
Radix balthica	0.15	accessory
Physella (Costatella) acuta	0.11	accidental
Aplexa hypnorum	0.04	accidental
Physa fontinalis	0.02	accidental

The maximum affinities that oscillate between 70.1 and 100 % have been registered to a reduced number of species: *Physa fontinalis* + *Radix ampla*, *Physa fontinalis* + *Physella (Costatella) acuta*, *Radix ampla* + *Physella (Costatella) acuta*; *Viviparus acerosus* + *V. viviparus*, *Viviparus acerosus* + *Radix balthica*; *Physella (Costatella) acuta* + *Stagnicola corvus*. It is known that the affinity between species does not always directly depend on each other, but also on the environment conditions (GROSSU, 1993; BREZEANU & GÂŞTESCU, 1996; VĂDINEANU, 2004). This is the case of the species *Viviparus acerosus* Bourguignat 1870 and *V. viviparus* Linnaeus 1758, that have similar conditions and thus, their affinity oscillates between 70 and 100 %. In fact, these two species, due to the high numerical and biomass density, play an important role in the functioning of the biocoenosis they populate, in transferring the matter and energy (GROSSU, 1986; 1987).

A much lower affinity can be noticed between *Physella (Costatella) acuta* (Draparnaud 1805) that populates all reservoirs as it finds optimum development conditions and *Oxyloma (O.) elegans* (Risso 1826), that rarely appeared; the affinity between them is only 7.7 %. If the first species can be considered eurytopic, as it is present within all the reservoirs, the other is an accidental species as it was identified within only one reservoir.

We can conclude that the affinity has increased values among the Gastropod species that are well established within the reservoirs and present a maximum number of individuals, as is the case of the species *Viviparus acerosus* Bourguignat 1870, *V. viviparus* Linnaeus 1758, *Physella (Costatella) acuta* (Draparnaud 1805), *Radix balthica* (Linnaeus 1758) and *Aplexa hypnorum* Linnaeus 1758 and low or null affinity values between the poorly ecologically consolidated species, characterized by a reduced number of individuals: *Anisus (A.) spirorbis* (Linnaeus 1758) and *Oxyloma (O.) elegans* (Risso 1826) (Table 3).

The calculation of the diversity and equitability indices demonstrates to what extent and which are the causes that triggered the differences of diversity at the Gastropod populations located within the reservoirs. The diversity index varied between 1.68 and 2.49 (Table 4).

According to the two groups of reservoirs, diversity indices highlight greater species diversity in the large areas with macrophytes. In the second group of reservoirs, where the bottom of the reservoirs is covered by sapropelic silt rich in organic substance, the dominant species are *Viviparus acerosus* Bourguignat 1870, *V. viviparus* Linnaeus 1758 and *Radix balthica* (Linnaeus 1758).

For the Gastropod populations, the equitability presents values between 0.59 and 0.88 (Table 5), the lowest value being registered within certain reservoirs located downstream, where the anthropogenic impact is greater.

Table 3. Affinity coefficients of the Gastropod populations.

0 – 10 %		10.1 – 30 %		30.1 – 50 %		50.1 – 70 %		70.1 – 100 %

Reservoir V

	Physella (C.) acuta	***Radix ampla***	***Stagnicola palustris***	***Aplexa hypnorum***	***Esperiana esperi***	***Segmentina nitida***	***Radix balthica***	***Oxyloma (O.) elegans***	***Radix auricularia***	***E.(Microcolpia) daudebardii acicularis***
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1		53.3	21.42	6.25	14.3	23.07	0	7.7	0	16.6
2			27.3	0	18.2	44.4	0	10	10	22.2
3				0	0	0	25	0	0	0
4					0	0	0	0	0	0
5						50	0	0	0	0
6							0	0	0	0
7								0	0	0
8									0	0
9										0
10										

Reservoir XII

	Viviparus acerosus	***Viviparus viviparus***	***Valvata (C.) piscinalis***	***Radix ampla***	***Radix auricularia***	***Segmentina nitida***	***Radix balthica***	***Physella (C.) acuta***	***Aplexa hypnorum***	***Physa fontinalis***
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1		61.5	34.2	23.1	26.9	15.4	11.5	11.1	3.7	7.7
2			33.3	16.6	29.4	11.8	5.9	11.8	6.3	0
3				15.4	33.3	18.9	0	8.3	0	22.2
4					0	0	0	25	0	14.3
5						10	25	0	12.5	0
6							0	0	0	0
7								0	25	0
8									20	0
9										0
10										

Table 4. The diversity of Gastropod species within the reservoirs.

REAL DIVERSITY								
RESERVOIRS								
V	VI	VII	VIII	IX	X	XI	XII	XIII
2 .49	2 .04	2.45	2 .02	2 .36	2 .33	1 .81	1 .98	1 .68

Table 5. The equitability of the Gastropod species within the reservoirs.

EQUITABILITY (E)								
RESERVOIRS								
V	VI	VII	VIII	IX	X	XI	XII	XIII
0 .83	0 .88	0 .82	0 .87	0 .82	0 .83	0 .65	0 .66	0 .59

CONCLUSIONS

The distribution of the Gastropod populations depends on the location of the reservoirs along the schemed Preajba Valley course and their classification into two groups: the reservoirs located on the upper sector of the river and the ones located on its lower sector. According to the analyses of the populations structural indices, there resulted that *Physella (Costatella) acuta* (Draparnaud 1805), *Radix balthica* (Linnaeus 1758) and *Aplexa hypnorum* Linnaeus 1758 species register the highest frequencies, as they are constant species; *Radix auricularia* (Linnaeus 1758), *Segmentina nitida* (O. F. Muller 1774) and *Anisus (A.) spirorbis* (Linnaeus 1758) are accidental species. In the second group of the reservoirs, *Viviparus acerosus* Bourguignat 1870 and *V. viviparus* Linnaeus 1758 displaying the highest frequency index, represent constant populations and present the most increased abundance. The calculation of the affinity index emphasizes that *Viviparus acerosus*, *V. viviparus*, *Physella (Costatella) acuta*, *Radix balthica* and *Aplexa hypnorum* are the best ecologically consolidated species.

REFERENCES

BOTNARIUC N. & VĂDINEANU A. 1982. *Ecologie*. Edit. Didactică şi Pedagogică. Bucureşti. 440 pp.

BOTNARIUC N., NEGREA ALEXANDRINA, TUDORANCEA CL. 1964. Rolul moluştelor în economia complexului de bălţi Crapina – Jijila. *Hidrobiologia*. Edit. Academiei R. P. R. Bucureşti. **5**: 95-104.

BREZEANU GH. & GÂŞTESCU P. 1996. Ecosistemele acvatice din România. Caracteristici hidrogeografice şi limnologice. *Revista Mediul înconjurător*. Bucureşti. **7**(2): 12-21.

BREZEANU GH. & GRUIŢĂ S. ALEXANDRA. 2002. *Limnologie generală*. Edit. H.G.A. Bucureşti. 287 pp.

BREZEANU GH., CIOBOIU OLIVIA, ARDELEAN A. 2011. *Ecologie acvatică*. Vasile Goldiş University Press. Arad. 406 pp.

CIOBOIU OLIVIA. 2002. *Gasteropodele lacurilor mici de baraj din Câmpia Olteniei*. Edit. Sitech. Craiova. 120 pp.

CIOBOIU OLIVIA. 2003. Structura populaţiilor de gastropode din bazinul hidrografic Valea Preajba; particularităţi ecologice. *Oltenia. Studii şi comunicări. Ştiinţele Naturii*. Craiova. **19**: 25-30.

CIOBOIU OLIVIA. 2011. Biodiversity of a protected lacustrine complex within the lower hydrographical basin of the Jiu. *International Journal of Ecosystems and Ecology Sciences (IJEES)*. Tirana. **1**(1): 56-62.

CIOBOIU OLIVIA & BREZEANU GH. 2002. Hidrobiological Peculiarities of some small Eutrophic Reservoirs within the Hydrographical Basin of the Jiu. *Limnological Reports. Proceedings of the 34th Conference*. Tulcea. **34**: 275-287.

CIOBOIU OLIVIA & BREZEANU GH. 2009. Hydrobiological and piscicultural features of certain small basins within the Oltenia Plain. *AACL Bioflux*. Cluj-Napoca. **2**(2): 133-136.

GROSSU AL. V. 1986. *Gastropoda Romaniae. 1. Subclasa Prosobranchia şi Opistobranchia*. Edit. Litera. Bucureşti. 525 pp.

GROSSU AL. V. 1987. *Gastropoda Romaniae. 2. Subclasa Pulmonata I. Ordo Basommatophora II. Ordo Stylommatophora.* Edit. Litera. Bucureşti. 445 pp.

GROSSU AL. V. 1993. The catalogue of the molluscs from Romania*. Travaux Museum d'Histoire Naturelle «Grigore Antipa»*. Bucureşti. **33**: 291-366.

STĂNICĂ E. D. & NEACŞU P. 1998. *Sisteme ecologice*. Edit. Universal Cartfil. Ploieşti. 225 pp.

VĂDINEANU A. 2004. *Managementul dezvoltării – o abordare ecosistemică*. Edit. Ars Docendi. Bucureşti. 325 pp.

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Received: March 31, 2014
Accepted: May 12, 2014