HYDROBIOLOGICAL PARTICULARITIES OF MAGLAVIT LAKE (ROMANIA) – THE PLACE AND ROLE OF GASTROPOD POPULATIONS

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Abstract. The research on Maglavit Lake, which is located within the floodplain of the Danube, emphasized the water physical-chemical characteristics, as well as the structure of planktonic and benthonic biocoenoses. The gastropod populations have an important place due to their numerical and biomass density. There was also established the taxonomic structure, age structure and distribution according to the benthal facies.

Keywords: Maglavit lake, biocoenoses, populations, Gastropods.

Rezumat. Particularităţi hidrobiologice ale lacului Maglavit (România) – locul şi rolul populaţiilor de gastropode. Cercetările efectuate asupra lacului Maglavit din zona inundabilă a Dunării au pus în evidenţă caracteristicile fizico-chimice ale apei, structura biocenozelor planctonice şi bentonice. Populaţiile de gastropode ocupă un loc important prin densitatea numerică şi de biomasă. S-au stabilit componenţa taxonomică, structura pe vârste şi repartiţia în funcţie de faciesul bental.

Cuvinte cheie: lacul Maglavit, biocenoze, populaţii, gastropode.

INTRODUCTION

Within the floodplain of the Danube, between Cetate and Calafat settlements, on former meanders or branches of the river, there formed certain lakes, such as: Fântâna Banului, Hunia, Maglavit, Golenţi (Fig. 1). Within this sector, the Danube was diked, but it represents an area that still preserves the biocoenotic structures specific to wetlands (TOMESCU, 1998; PLENICEANU, 2003; BREZEANU et al., 2011).

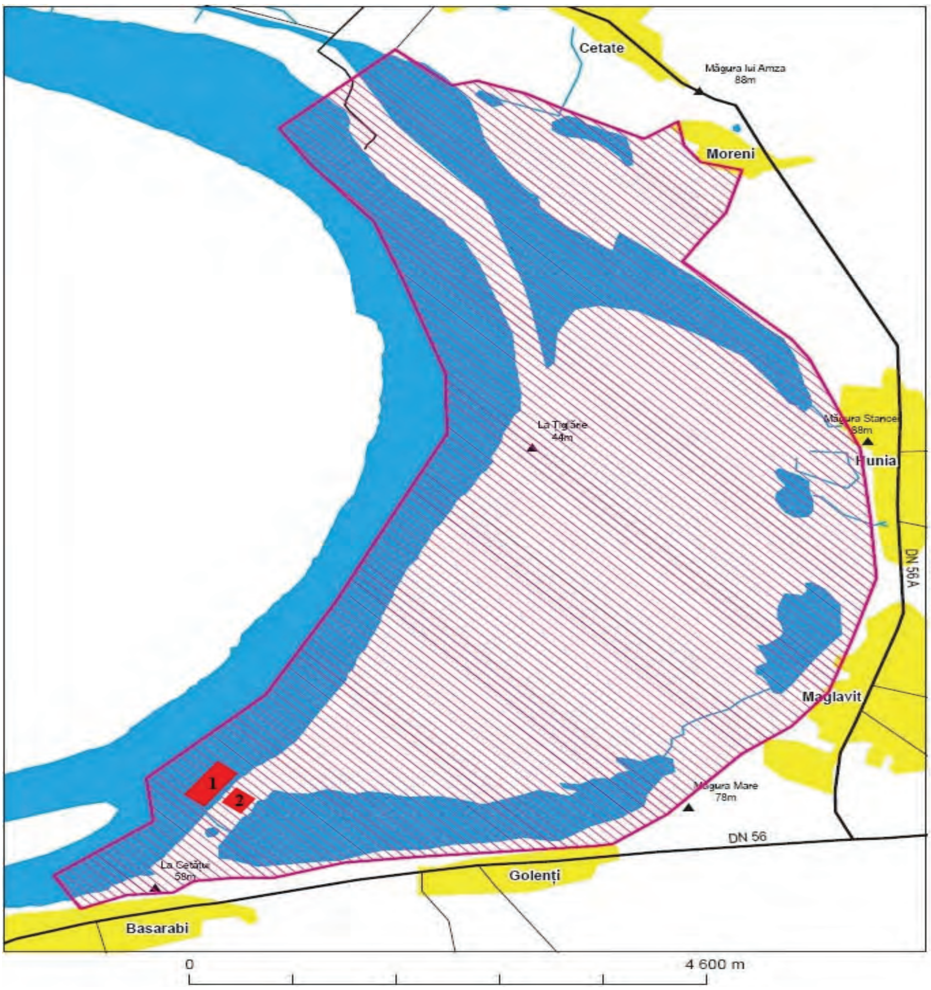

Figure 1. The floodplain of the Danube in the sector Cetate – Calafat (according to MMDD).

MATERIAL AND METHODS

The research studies were performed between 2012 and 2014. There were taken samples in order to render the physical-chemical characteristics of water and the planktonic and benthonic structures. There were collected 1,932 specimens of gastropods based on which the significant statistic parameters were determined (CIOBOIU, 2002; 2014).

RESULTS AND DISCUSSIONS

Maglavit Lake, with a surface of 48 ha and a maximum depth 2.5 m, is located between the lakes Hunia and Golenţi. As compared to Maglavit Lake that still preserves its natural features, Hunia and Golenţi lakes are used for pisciculture. The lithological structure is made up of fluvial-lacustrine and loess-like deposits, characteristic to the floodplain, aeolian sands covering the alluvial deposits.

Water chemistry is characteristic to eutrophic ecosystems. Based on the ionic balance and the content of anions and cations, the water belongs to the bicarbonatate-sulphate-calcic-magnesium category, being characteristic to the mixt stage of mineralization (Table 1).

Table 1. Water physical-chemical composition (average values).

No.	Analysed indicators	Measured values	Admitted values Ord. 161/2006 - Quality Class II	Analysis method	Used equipments
1.	Concentration of hydrogen ions (pH), unit. pH	7.2	6.5 – 8.5	STAS 6325-75	pH-meter WTW 330i, series 08090178
2.	Electric conductivity µS/cm, max.	1100	-	STAS 7722-84	Cond WTW 340i, series 08082507
3.	Total hardness, German degrees, max.	27.50	-	STAS 3026-76	-
4.	Fixed residue, mg/dm^3, min./max.	550	750	STAS 3638-76	Analytic balance type KERN 770 Series 17308244
5.	Ammonia (NH_4), mg/dm^3, max.	0.102	1.0	STAS 6328-85	Spectrophotometer DR 2000, series no. 930700025411
6.	Calcium (Ca^{2+}), mg/dm^3, max.	55	100	STAS 3662-62	-
7.	Magnesium (Mg), mg/dm^3, max.	87	50	STAS 6674-77	-
8.	Nitrites (NO_2), mg/dm^3, max.	<0.01	0.1	Method 571	Spectrophotometer Lovibond PC spectro Series 100510
9.	Nitrates (NO_3), (mg/dm^3, max.	108	13	Method 355	Spectrophotometer DR 2000, series no. 930700025411
10.	Chlorides (Cl), mg/dm^3, max.	64	50	STAS 3049-86	-
11.	Oxidizable organic substance CCOCr (O_2) mgO_2/dm^3,max	4.3	25	STAS 3002-85	-

The pH values vary between 6.5 and 8.5 (slightly alkaline). The large amount of nitrates and nitrites is induced by the nutrient input as mineral and organic fertilizers are intensively used in the neighbouring agricultural fields. Among the cations, we mainly remark calcium (Ca^{2+}) that originates in the sedimentary rocks found at the bottom of the lake and in the treatments applied to the agricultural plots from the area (BUCURESCU et. al., 2008; CIOBOIU, 2014; GAVRILESCU & BUZATU, 2014).

The structure of planktonic and benthonic biocoenoses. A general analysis of the biocoenotic structures emphasizes that the lake belongs to the category of continental aquatic eutrophic ecosystems. This is a character specific to the aquatic ecosystems from the floodplain of the Danube that present an increased degree of trophicity reflected by the quantitative and qualitative composition of the planktonic and benthonic communities (BREZEANU, 1967).

There were identified the following species belonging to phytoplankton - *Diatoma elongatum, Synedra acus, S. ulna, Amphora ovalis, Ceratoneis arcus, Gyrosigma acuminatum, Scenedesmus quadricauda, Pediastrum duplex, P. boryanum*, with an average numerical density of 86 specimens / l (DINU & BREZEANU, 2014).

Besides the primary phytoplankton producers, macrophytes hold an important share of the biological production within the studied ecosystem. About 25 % of the lake surface is covered by paludous macrophytes, which mainly grow in shallow water (5 – 25 cm) at *the end of the lake* (Figs. 2, 3). At the same time, there should be added that aquatic plants form abundant populations within the lake being directly fixed on the bottom, in the solid layer (CIOBOIU, 2004; DIHORU & ARDELEAN, 2009). There were identified 34 species, among which we mention *Phragmites communis, Typha angustifolia, Scirpus lacustris, Mentha aquatica, Carex riparia, Lemna minor, Nuphar luteum, Potamogeton crispus, P. natans, Myriophyllum spicatum* (Table 2).

Table 2. Species of paludous and aquatic macrophytes.

SPECIES	
PALUDOUS	**AQUATIC**
Phragmites communis Trin.	*Lemna minor* L.
Typha angustifolia L.	*Nimphaea alba* L.
Typha latifolia L.	*Nuphar luteum* L.
Scirpus lacustris L.	*Polygonium amphibium* L.
Heleocharis palustris L.	*Potamogeton natans* L.
Juncus effusus L.	*Potamogeton crispus* L.
Mentha aquatica L.	*Potamogeton perfoliatus* L.
Mentha longifolia L.	*Potamogeton pectinatus* L.
Iris pseudacorus L.	*Salvinia natans* L.
Carex riparia L.	*Stratiodes aloides* L.
Carex hirta L.	*Schoenoplectus mucronatus* L.
Ranunculus aquatilis L.	*Myriophyllum spicatum* L.
Ranunculus repens L.	*Ceratophyllum submersum* L.
Polygonium hydropiper L.	*Hydrocharis morsus-ranae* L.
Pastinaca sativa L.	*Glyceria maxima* L.
Vicia peregrina L.	*Rorripa amphibia* L.
Equisetum arvense L.	
Euphorbia palustris L.	

Figures 2, 3. The end of the lake displaying a rich macrophyte vegetation (original).

The zooplankton is made up of the following groups: Ciliata, Rotifera, Cladocera, Copepoda (MOLDOVEANU & FLORESCU, 2013).

The main groups of the zoobenthos are: Crustacea (*Gammarus roeselli, Dikerogammarus bispinosus*), Bivalvia (*Dreissena polymorpha, Anodonta cygnaea, Sphaerium riviculum, Unio pictorum*), Gastropoda, Trichoptera (*Hydropsyche* sp.). The average numerical density of the benthonic biocoenoses is 89 specimens / m^2 (CIOBOIU, 2003; BREZEANU et al., 2011). Within this biocoenotic structure, a special role is played by the gastropod populations due to their numerical and biomass density (CIOBOIU, 2014).

The structure of gastropod populations. The taxonomic structure of the gastropods from the studied ecosystem is generally close to the distribution of this group within the floodplain of the Danube (GROSSU, 1993; CIOBOIU 2002; 2008). Thus, the total number of identified species is 21 (Table 3).

Table 3. Gastropod species present in the lake.

CLASS GASTROPODA Cuvier 1798	
SUBCLASS PROSOBRANCHIA Milne Edward 1848	
ORDER ARCHAEOGASTROPODA (Thiele 1952)	
Family Neritidae Rafinesque 1815	*Theodoxus danubialis* C. Pfeiffer 1828 *Theodoxus fluviatilis* Linnaeus 1758
ORDER MESOGASTROPODA (Thiele 1925)	
Family Viviparidae Gray 1847	*Viviparus acerosus* Bourguignat 1870 *Viviparus viviparus* Linnaeus 1758
Family Valvatidae Thomson 1840	*Valvata (Cincina) piscinalis* O. F. Muller 1774
Family Lithoglyphidae Troschel 1857	*Lithoglyphus naticoides* C. Pfeiffer 1828
Family Bithyniidae Gray 1849	*Bithynia tentaculata* Linnaeus 1758
Family Thiaridae Troschel 1857	*Esperiana esperi* (Ferussac 1829) *Esperiana (Microcolpia) daudebardii acicularis* Ferussac 1823
SUBCLASS PULMONATA Cuvier 1817	
ORDER BASOMMATOPHORA A. Schmidt 1855	
Family Physidae Fitzinger 1833	*Physa fontinalis* (Linnaeus 1758) *Physella (Costatella) acuta* (Draparnaud 1805)
Family Lymnaeidae Rafinesque 1815	*Lymnaea stagnalis* (Linnaeus 1758) *Stagnicola palustris* (O. F. Muller 1774) *Stagnicola corvus* Gmelin 1788 *Radix auricularia* (Linnaeus 1758) *Radix ampla* (Draparnaud 1805) *Radix balthica* (Linnaeus 1758) *Galba truncatula* (O. F. Muller 1774)
Family Planorbidae Rafinesque 1815	*Planorbis planorbis* (Linnaeus 1758) *Anisus (Anisus) spirorbis* (Linnaeus 1758) *Planorbarius corneus* (Linnaeus 1758)

With reference to the rapport between groups and species (Table 4; Fig. 4), it results that the family Lymnaeidae is dominant in terms of number of species (7 species), followed by the family Planorbidae (3 species), the lowest values being registered by the other families.

Table 4. Numerical and percentage distribution of species on families.

No.	FAMILY	NUMBER OF SPECIES	%
1	Neritidae	2	9.52
2	Viviparidae	2	9.52
3	Valvatidae	1	4.76
4	Lithoglyphidae	1	4.76
5	Bithyniidae	1	4.76
6	Thiaridae	2	9.52
7	Physidae	2	9.52
8	Lymnaeidae	7	33.34
9	Planorbidae	3	14.30

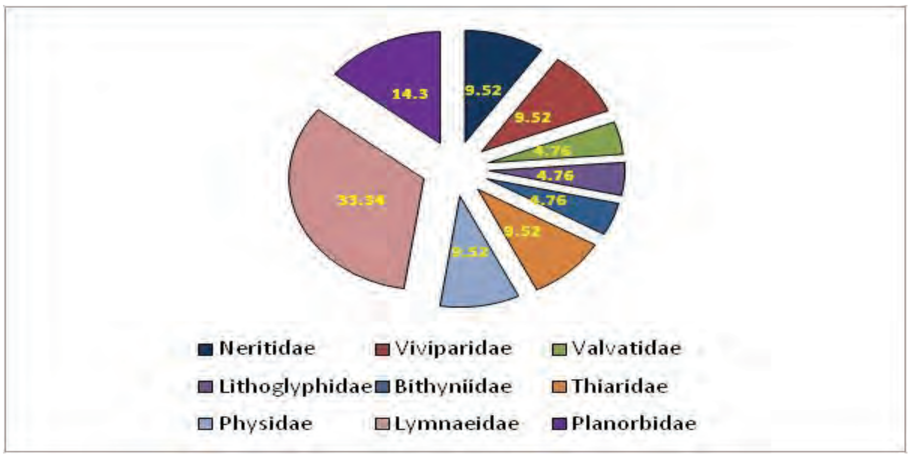

Figure 4. Percentage of the gastropod families present in the lake.

As illustrated in Table 5, referring to the taxonomic composition according to the benthal facies, it results that 17 species were identified in the silty facies, 13 species in the detritic facies and 8 species in the sandy facies. It can be noticed that the highest number of species populates the silty-detritic bottom near the shores of the lake, where water is shallow (Fig. 5). These areas display the best feeding conditions. Gastropods find a rich source of food on the coarse detritus, on the fallen leaves that are not putrefied but rich in periphyton, on the silt pellicle where organic substances are abundant (NEGREA & NEGREA, 1975; RUSSEV, 1998; CIOBOIU, 2014).

The lowest diversity of species was registered in the areas where the bottom layer is predominantly sandy. Of course, their distribution according to the characteristic facies is relative, as species belonging to a certain category may appear (in a reduced number) in the other types of facies taking into account that there is a certain interference degree among the typical categories of facies.

Table 5. Taxonomic composition according to the benthal facies.

SPECIES	BENTHAL FACIES		
	SANDY	SILTY	DETRITIC
Theodoxus danubialis	+	+	
Theodoxus fluviatilis	+		
Viviparus acerosus		+	+
Viviparus viviparus	+	+	
Valvata (Cincina) piscinalis		+	+
Lithoglyphus naticoides		+	+
Bithynia tentaculata		+	
Esperiana esperi	+	+	
Esperiana (Microcolpia) daudebardii acicularis	+	+	+
Physa fontinalis			+
Physella (Costatella) acuta		+	+
Lymnaea stagnalis		+	+
Stagnicola palustris	+	+	
Stagnicola corvus			+
Radix auricularia		+	+
Radix ampla		+	+
Radix balthica	+		+
Galba truncatula	+	+	
Planorbis planorbis		+	+
Anisus (A.) spirorbis		+	
Planorbarius corneus		+	+

Figure 5. The lake shore – areas preferred by gastropods (original).

Analysing the numerical and percentage rapport of the species (Table 6), it results that *Lymnaea stagnalis*, *Physella acuta*, *Planorbarius corneus*, *Viviparus acerosus*, *V. viviparus* și *Radix ampla* present the highest frequency; *Theodoxus danubialis*, *Th. fluviatilis*, *Valvata piscinalis*, *Lithoglyphus naticoides*, *Bithynia tentaculata*, *Stagnicola palustris*, *Radix auricularia*, *R. ampla*, *Physa fontinalis*, *Planorbis planorbis* registered lower values, while *Esperiana esperi* and *Anisus spirorbis* may be considered as accidental in the structure of the biocoenosis.

Table 6. The numerical and percentage rapport of the identified species.

No.	Species	Number of specimens	%
1	*Lymnaea stagnalis*	296	15.33
2	*Physella (Costatella) acuta*	290	15.01
3	*Planorbarius corneus*	273	14.13
4	*Viviparus acerosus*	184	9.52
5	*Viviparus viviparus*	172	8.90
6	*Radix ampla*	145	7.51
7	*Radix auricularia*	95	4.92
8	*Radix balthica*	93	4.81
9	*Planorbis planorbis*	69	3.57
10	*Physa fontinalis*	50	2.59
11	*Stagnicola palustris*	40	2.07
12	*Lithoglyphus naticoides*	39	2.02
13	*Theodoxus danubialis*	35	1.81
14	*Bithynia tentaculata*	31	1.60
15	*Theodoxus fluviatilis*	27	1.40
16	*Esperiana (M.) daudebardii acicularis*	26	1.35
17	*Valvata (Cincina) piscinalis*	20	1.04
18	*Galba truncatula*	17	0.88
19	*Stagnicola corvus*	16	0.83
20	*Esperiana esperi*	9	0.47
21	*Anisus spirorbis*	5	0.25

According to their dimensions, the gastropod species were classified in three groups: pre-reproductive, reproductive and post-reproductive. Thus, there were measured the height (h) and width (w) of the shell.

According to the measurements, it resulted that the dimensions of the pre-reproductive specimens of the species *Theodoxus danubialis*, *Th. fluviatilis*, *Physa fontinalis*, *Physella acuta*, *Radix auricularia*, *R. ampla*, *R. balthica, Valvata piscinalis*, *Galba truncatula*, *Planorbis planorbis* vary between h = 0.1 and 8-9 mm; w = 0.1 and 2-8 mm, the dimensions of the reproductive specimens between h = 5.1 and 8-18 mm; w = 1-18 mm, while for the post-reproductive specimens the dimensions are h= 1.4-15 mm and w = 5-18 mm.

The dimensions of the other species vary as it follows: for pre-reproductive specimens h = 5-15 mm; w = 19-22 mm, reproductive h = 10-42 mm; w = 15-40 mm, and post-reproductive h = 20-55 mm; w = more than 40 mm (Table 7).

Table 7. Dimensions for different age categories of the gastropod populations present in the lake.

SPECIES	BODY DIMENSIONS CHARACTERISTIC TO DIFFERENT AGE CATEGORIES (h, w = mm)		
	Pre-reproductive	Reproductive	Post-reproductive
Theodoxus danubialis	h = 2-4; l = 7-8.5	h = 4.5-5; l = 9-10	h = > 5; l = > 10
Theodoxus fluviatilis	h = 4-5; l = 5-6.5	h = 5.4-6; l = 7-9	h = > 6; l = > 9
Viviparus acerosus	h = 10-20; l = 7-15	h = 20.1-40; l = 15.1-30	h = > 40; l = > 30
Viviparus viviparus	h = 5-15; l = 3-10	h = 15.1-35; l = 10.1-25	h = > 35.1; l = > 25.1
Valvata (Cincina) piscinalis	h = 1.5-5; l = 1-3	h = 5.1-8; l = 3.1-5	h = > 8; l = > 5
Lithoglyphus naticoides	h = 6-7.5; l = 5-6.5	h = 8-9; l = 7-8.5	h = > 10; l = > 9
Bithynia tentaculata	h = 8-9.5; l = 3-4.5	h = 10-11; l = 5-7	h = > 11; l = > 7
Esperiana esperi	h = 11-14.5; l = 5-6.5	h = 15-20; l = 7-8	h = > 20; l = > 8
Esperiana (M.) daudebardii acicularis	h = 14.5-16; l = 3-4.5	h = 17-20; l = 5-7	h = > 20; l = > 7
Physa fontinalis	h = 0.1-5; l = 0.1-3	h = 5.1-9; l = 3.1-7.5	h = > 9; l = > 7.5
Physella (Costatella) acuta	h = 0.1-5; l = 0.1-4	h = 5.1-11; l = 4.1-6	h = > 11.1; l = > 6.1
Lymnaea stagnalis	h = 18-42; l = 9-22	h = 42.1-55; l = 18-22.1	h = > 55; l = > 22
Stagnicola palustris	h = 0.1-15; l = 0.1-8	h = 15.1-28; l = 8.1-15	h = > 28; l = > 15
Stagnicola corvus	h = 0.1-20; l = 0.1-10	h = 20.1-35; l = 10.1-18	h = > 35; l = > 18
Radix auricularia	h = 0.1-15; l = 0.1-10	h = 15.1-21.1; l = 10.1-15	h = > 21; l = > 15
Radix ampla	h = 0.1-5; l = 0.1-4	h = 5.1-11; l = 4.1-6	h = > 11.1;l = > 12
Radix balthica	h = 0.1-15; l = 0.1-10	h = 15.1-20.9; l = 10.1-11.5	h = > 20; l = > 4
Galba truncatula	h = 0.5-7; l = 0.8-3	h = 7-8; l = 3-4	h = > 8; l = > 4
Planorbis planorbis	h = 0.1-1.5; l = 0.1-9	h = 1.6-3.5; l = 9.1-17	h = > 3.5; l = > 17
Anisus (A.) spirorbis	h = 0.1-0.6; l = 0.1-2.5	h = 0.7-1.6; l = 2.6-5.5	h = > 1.4; l = > 5.5
Planorbarius corneus	h = 5-10; l = 5-20	h = 11-14; l = 21-29	h = > 14; l = > 29

With regard to the distribution of species according to the age categories (Table 8), it can be noticed that in case of most of the species, the reproductive and pre-reproductive age categories are dominant, which indicate the numerical increase of the gastropod populations within Maglavit Lake. At the species *Radix auricularia* and *Valvata piscinalis,* post-reproductive specimens predominate, while at the species *Anisus spirorbis*, the absence of post-reproductive individuals illustrates a decrease of the population (BOTNARIUC & VĂDINEANU, 1982; CIOBOIU, 2002, 2014).

The share of young specimens (from the pre-reproductive category) as well as of mature specimens (736 respectively 1,046 specimens) is illustrative. This proves that the abiotic and biotic (food-related) environmental factors are favourable for the development of the gastropod populations. It is also obvious that, in spite of the fact that the pre-reproductive category predominates, the difference compared to the other groups (reproductive and senescent specimens) is not increased, which underlines the balance between the different age categories, an essential factor for a constant increase of the populations.

Table 8. Age distribution of the gastropod population (total and percentage value).

SPECIES	AGES					
	Pre-reproductive		Reproductive		Post-reproductive	
Lymnaea stagnalis	100	13.58 %	176	16.82 %	20	13.33 %
Physella (Costatella) acuta	104	14.13 %	165	15.77 %	21	14.00 %
Planorbarius corneus	103	13.99 %	160	15.29 %	10	6.66 %
Viviparus acerosus	75	10.19 %	98	9.36 %	11	7.33 %
V. viviparus	70	9.51 %	90	8.60 %	12	8.00 %
Radix ampla	60	7.17 %	75	7.86 %	10	6.66 %
Radix auricularia	37	5.02 %	47	6.33 %	11	7.33 %
Radix balthica	40	5.43 %	50	6.75 %	3	2.00 %
Planorbis planorbis	25	3.39 %	40	4.82 %	4	2.06 %
Physa fontinalis	16	2.58 %	27	4.66 %	7	2.17 %
Stagnicola palustris	15	2.43 %	20	3.33 %	5	2.11 %
Lithoglyphus naticoides	15	2.43 %	16	3.03 %	8	2.19 %
Theodoxus danubialis	12	2.39 %	15	3.00 %	8	2.19 %
Bithynia tentaculata	10	2.13 %	16	3.03 %	5	2.11 %
Theodoxus fluviatilis	10	2.13 %	12	2.25 %	5	2.11 %
E. d. acicularis	11	2.27 %	12	2.25 %	3	2.00 %
Valvata piscinalis	7	1.64 %	9	1.94 %	4	2.01 %
Galba truncatula	11	2.27 %	5	0.52 %	1	0.09 %
Stagnicola corvus	10	2.13 %	5	0.52 %	1	0.09 %
Esperiana esperi	3	0.41 %	5	0.52 %	1	0.09 %
Anisus spirorbis	2	0.27 %	3	0.28 %	-	-

CONCLUSIONS

Taking into account the present state of the Danube within the territory of Romania, state induced by diking, and the disappearance of the largest part of its natural floodplain, Maglavit Lake and the other neighbouring lacustrine ecosystems represent an *area* that still preserves the specific biocoenotic structures. The presented data emphasize the characteristics of such types of ecosystems pre-existent within the floodplain of the Danube, which greatly disappeared because of the damming and diking works of the Romanian sector of the river. The gastropod populations represent a group that characterizes and particularizes the functionality of these ecosystems that preceded the diking works. The predominance of the specimens belonging to the reproductive and pre-reproductive categories at most of the species highlights the upward tendency of the populations present in the lake.

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Received: March 31, 2015
Accepted: May 23, 2015