THE STRUCTURE OF BENTONIC POPULATIONS FROM THE LOWER SECTOR OF THE OLT RIVER (ROMANIA)

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Abstract. The limnological peculiarities of the dam lakes are largely dependent on the pulsating character of the stationary water circulation, as well as on the economic needs. The ecological balance of the Olt River in the lower sector was drastically affected after the arrangement, there were a number of changes in the morphology of the riverbed and river banks, as well as important changes in the flow of surface and groundwater, soil cover and biotic environment. All these have led to profound changes in the structure of aquatic biocenoses, by reducing some populations to the limit of survival, replacing rheophilic populations with pelophilic, pelophytophilic or phytophilic populations, or even leading to the disappearance of some species, the most affected being the benthic and nectonic fauna. The complex development of the Olt River determined its structural and functional characteristics. The structures of biotopes and biocenoses are specific to both typical rheophilic and stagnophilic ecosystems. In accordance with the determined characteristics of the arrangement, all the specific ecological compartments (planktonic and benthic) can be identified in the structure of the biocenoses. Benthic fauna is represented by 10 groups of invertebrates, dominated by oligochaetes, bivalves, chironomides, gastropods. Gastropods have an important role in the transfer of matter and energy to higher consumers – fish.

Keywords: zoobenthos, rheophilous sector, stagnophilic sector, invertebrates, Olt river.

Rezumat. Structura populațiilor bentonice din sectorul inferior al râului Olt (România). Particularităţile limnologice ale lacurilor de baraj sunt dependente în mare măsură de caracterul pulsatoriu al staţionării şi circulaţiei apei, cât și de necesităţile economice. Echilibrul ecologic al râului Olt în sectorul inferior a fost drastic afectat după realizarea amenajărilor, au apărut o serie de modificări ale morfologiei albiei şi malurilor râului, precum şi modificări importante ale regimului de curgere a apelor de suprafaţă şi freatice, învelişului de soluri şi mediului biotic. Toate acestea au determinat schimbări profunde ale structurii biocenozelor acvatice, prin diminuarea până la limita de supravieţuire a efectivelor unor populaţii, înlocuirea asociaţiilor reofile cu cele pelofile, pelofitofile sau fitofile, sau chiar la dispariţia unor specii, cele mai afectate fiind fauna bentonică şi cea nectonică. Amenajarea complexă a râului Olt a determinat caracteristicile sale structurale şi funcţionale. Structurile biotopilor şi biocenozelor sunt specifice atât ecosistemelor tipic reofile cât şi celor stagnofile. În concordanţă cu caracteristicile determinate de amenajare, în structura biocenozelor pot fi identificate toate compartimentele ecologice specifice (planctonice şi bentonice). Fauna bentonică este reprezentată prin 10 grupe de nevertebrate, dominante fiind oligochetele, bivalvele, chironomidele, gasteropodele. Gasteropodele au un rol important în transferul de materie și energie către consumatorii de ordin superior – peștii.

Cuvinte cheie: zoobentos, sector reofil, sector stagnofil, nevertebrate, râul Olt.

INTRODUCTION

The Olt river basin is located in the central and southern part of the country, between the Eastern Carpathians and the Târnavelor Plateau in the upper part and the Southern Carpathians, the Sub-Carpathian hills and the Danube Plain in the lower part. It runs between 43°47′ - 46°45′ north latitude and 23°35′ - 26°24′ east longitude (DIACONU et al., 1995; FLORESCU, 1996; DIACONU, 1999).

Hydrological arrangements. Thereare 62 accumulations in the Olt river basin, with a complex use and a useful volume of 1800 ml / m^3, of which a number of 33 accumulations have as main use the protection of floods and energetical purpose (***. ISCH 1964; GÂȘTESCU, 1971; SCUTELNICU & DRUȚĂ, 1990; IONESCU, 2001; PLENICEANU, 2003; GAVRILESCU & BUZATU, 2014).

There are 25 accumulations in cascade on the Olt river, with the main purpose of supplying energy, which can be grouped according to location, in the middle Olt waterfall (Voila, Viştea, Arpaşu, Scoreiu, Avrig) and the lower Olt waterfall (Cornetu, Gura Lotrului, Turnu, Calimăneşti, Dăeşti, Râmnicu Vâlcea, Râureni, Govora, Băbeni, Ioneşti, Zăvideni, Dragăşani, Strejeşti, Arceşti, Slatina, Ipoteşti, Dragăneşti Olt, Frunzaru, Rusăneşti, Izbiceni).

The dam lakes in the middle Olt waterfall are located between 325 and 258 km upstream of the confluence with the Danube, the dams having heights between 21 and 22.5 m. The accumulation lakes have an area between 1.9 km^2 (Scoreiu) and 3.32 km^2 (Voila) and volumes from 4.25 to 12.25 ml / m^3, the total accumulated volume being 39.85 ml / m^3.

The dam lakes in the lower Olt waterfall are located between km 218 and 18 upstream of the confluence with the Danube. The dams have heights between 44 m (Gura Lotrului) and 24 m (Slatina). The dam lakes have an area between 0.84 km^2 (Călimănești) and 22 km^2 (Strejești) and a volume content between 4.57 ml / m^3 (Călimănești), 253.9 ml / m^3 (Strejești), the total accumulated volume being 1070 ml / m^3 (Fig. 1).

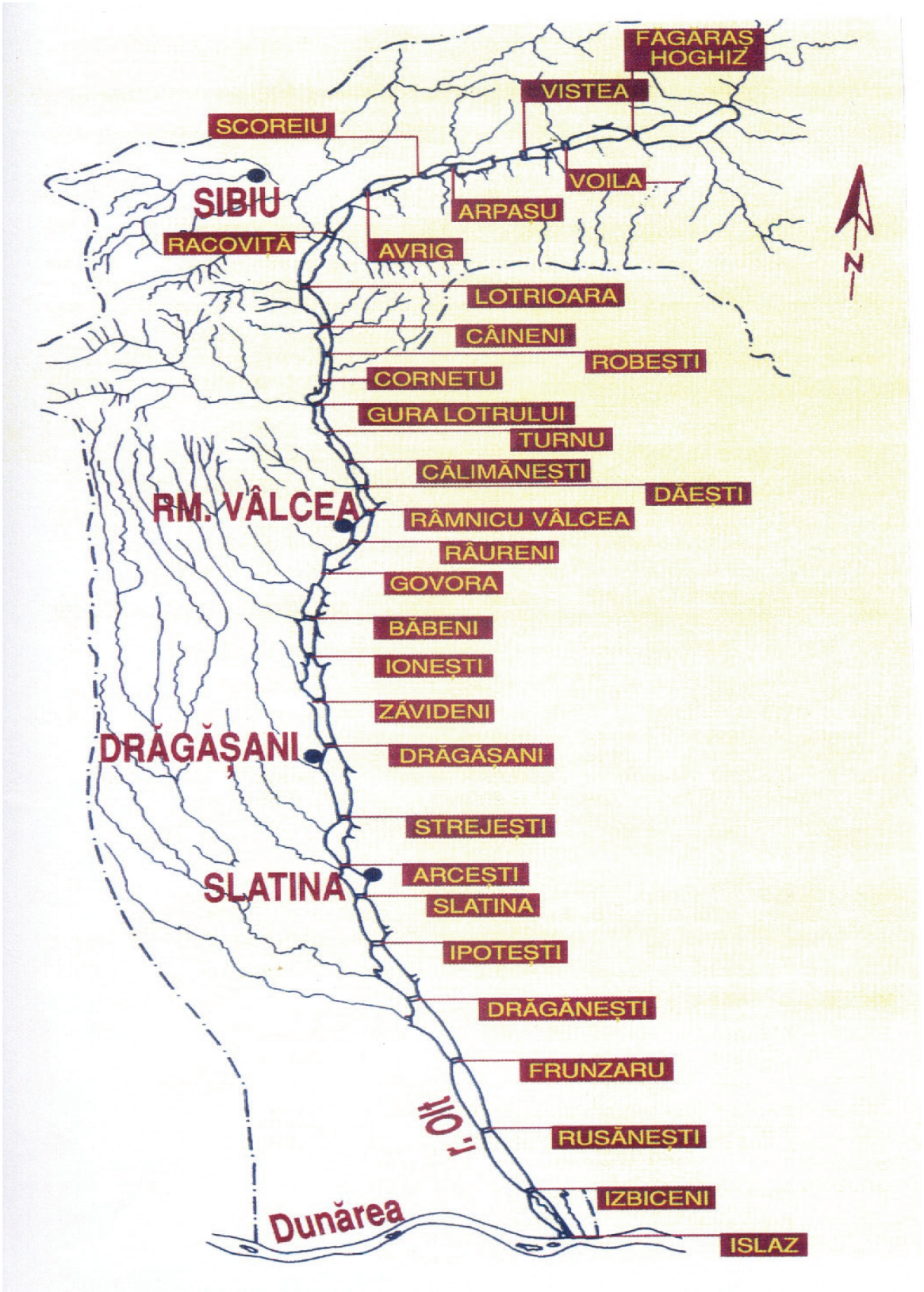

Figure 1. The improvement Hydroenergetical of the Olt River (Source: Olt Waters Direction).

The lower sector of the Olt River between Râmnicu Vâlcea - the confluence with the Danube has the subsectors Râmnicu Vâlcea - Slatina and Slatina - Turnu Măgurele. Leaving the gorge, Olt crosses the hilly area of the sub-Carpathians, where the valley widens, there are well-defined terraces that accompany the course to the confluence. In the plain area, Olt has arms and meanders due to the slope lower than 2‰. As more important tributaries in this sector, Olt receives Olteţ and Teslui on the right side and Topolog on the left. The plain area is characterized by numerous non-permanent watercourses representing about 15.3% of the total length of the courses in the Olt river basin (Fig. 2).

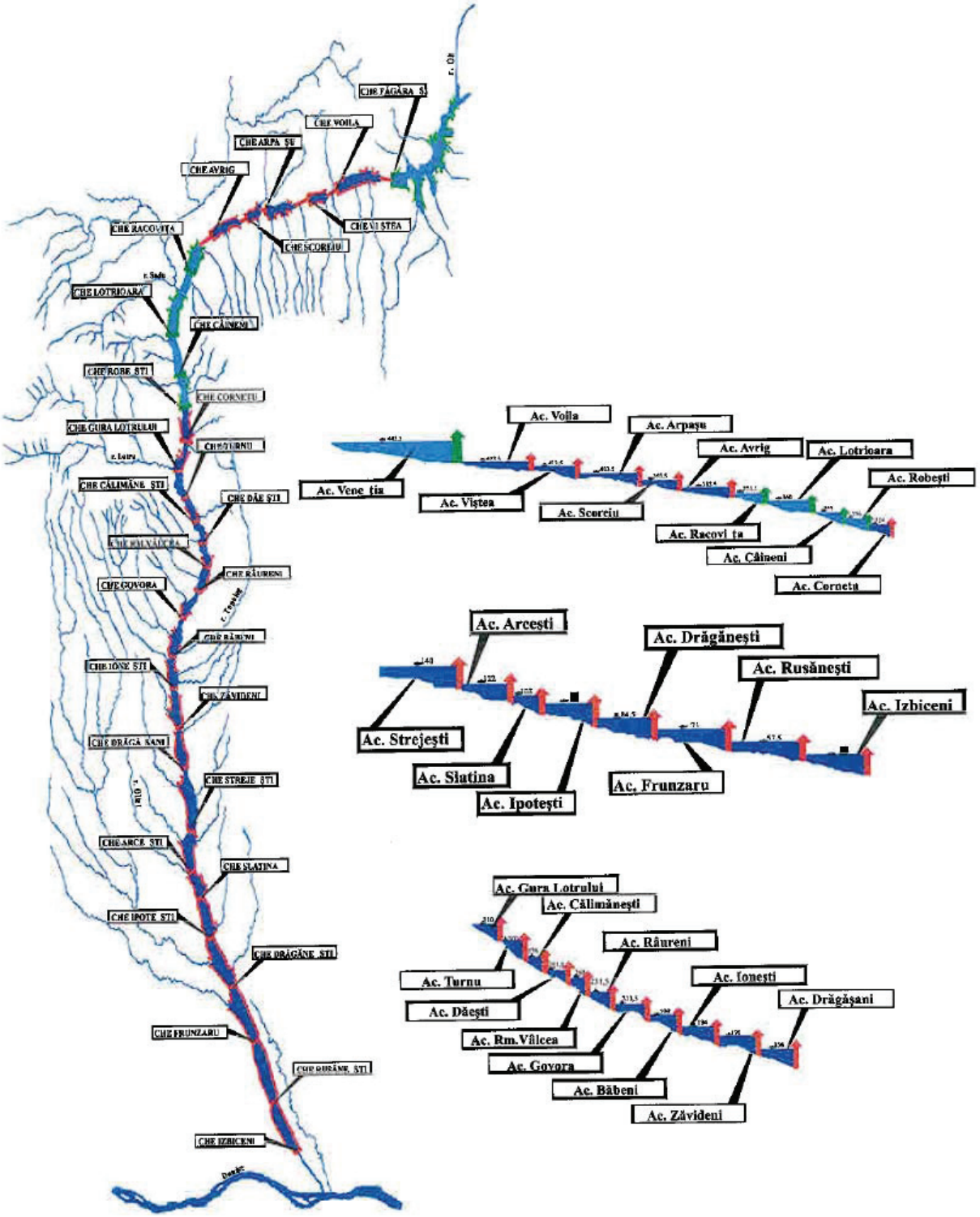

Figure 2. Olt river basin in the lower sector (Source: Olt Waters Direction).

MATERIAL ȘI METHODS

The researches were carried out in years 2006, 2009 and 2012, in the accumulation lakes Strejești, Ipotești, Izbiceni, Islaz from the lower sector of the Olt river, during August-October. Samples were taken in order to establish the physico-chemical characteristics of the water, the planktonic and benthic structures. The quantitative samples consisted in filtering one liter of water for phytoplankton, 50 l of water through the planktonic filter for zooplankton. The Ruthner gas tank was used to take quantitative samples from different depths. In the case of integrated samples, a tube or hose type sampler was used. The depth of the water column sampled with the Secchi disk is the same as the depth of the photic zone (Secchi X 2.5 transparency). Zoobenthos samples were collected with the help of the Ponar bodengraifer (CIOBOIU, 2011; 2014; SURUGIU, 2020).

RESULTS AND DISCUSSIONS

In the lower sector of the Olt River, the structures of biotopes and biocenoses are specific to both typical rheophilic and stagnophilic ecosystems. The construction of the accumulation lakes determined changes of the physico-chemical properties of the water, which left their mark on pre-existing living things, quantitatively reducing a series of species, restricting their area, the consequence being the decrease of their functional contribution in the achievement of biological production (BREZEANU & SIMON-GRUIȚĂ, 2002; BURIAN, 2002; BUCURESCU et al., 2008).

Water chemistry is characteristic of eutrophic ecosystems. The pH values are between 6.5-8.5 (low alkaline range). In the dam lakes Strejești, Ipotești and Izbiceni, the physical indicators (temperature, transparency) fall into the first quality class, the oxygen and nutrients regime falls into the second quality class, the chemical state of the water being good; in terms of the amount of nitrogen and total phosphorus (indicators of the degree of eutrophication), the studied lakes are eutrophic lakes. In the rheophilic sector of the Olt River, from Izbiceni to the Danube, the physical indicators and nutrients fall into the first quality class, while the oxygen regime into the second class (CIOBOIU, 2011; RĂDUCA et al., 2021).

The structure of planktonic and benthic biocenoses. All taxonomic groups were identified in the composition of phytoplankton: Cyanobacteria, Euglenophyceae, Pyrrophyceae, Hetrokontae, Bacillaryophyceae and Chlorophyceae, with a prevalence of chlorophylls (especially summer) and bacillariophytes (spring, summer and autumn). In the rheophilous sector of the Olt River, bacillariophytes predominate throughout the year, with the highest number of species being recorded in April and the lowest in June. The dominant species are *Diatoma elongatum, Synedra acus, S. ulna, Amphora ovalis, Ceratoneis arcus, Gyrosigma acuminatum, Scenedesmus quadricauda, Pediastrum duplex, P. boryanum*, with an average numerical density of 56 specimens / l (DINU & BREZEANU, 2014).

Along with the primary producers' phytoplankton, macrophytes represent an important part of the biological production of the studied ecosystem. In the configuration of the lakes, about 25% of the surface is occupied by paludous macrophytes, developing especially in the shallow areas (5 - 25 cm) at the tail of the lake. At the same time, it should be added that in the water mass and at the bottom, fixed on the substrate, the aquatic plants themselves make up abundant populations (CIOBOIU, 2004; DIHORU & ARDELEAN, 2009). 32 species were identified, including: *Phragmites communis, Typha angustifolia, Scirpus lacustris, Mentha aquatica, Carex riparia, Lemna minor, Nuphar luteum, Potamogeton crispus, P. natans, Myriophyllum spicatum* (Table 1).

Table 1. The 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.

The zooplankton is made up of the groups: Ciliata, Rotifera, Cladocera, Copepoda, having a development that is directly proportional to the development of phytoplankton (MOLDOVEANU & FLORESCU, 2013). The qualitative composition of zooplankton in the studied lakes is relatively poor. Thus, the largest number of species belong to rotifers, followed by ciliates, cladocera and copepods. The low diversity of zooplankton is due to the development in excess of macrophytes.

It is known that through the damming of rivers and the formation of accumulation lakes, profound hydrological, geomorphological, hydrochemical changes of the rheophilic ecosystem take place and, in accordance with these, changes occur in the structure of benthic populations. Such changes are obvious in the case of the lower sector of the Olt River, where we find three main types of facies: sandy, muddy, detritus (CIOBOIU, 2014; MARINESCU & MITITELU-IONUȘ, 2019; MITITELU-IONUȘ et al., 2021).

Depending primarily on the nature of the facies, benthic biocenoses are specific to the muddy facies (mostly lake bottoms), pelophilic biocenoses and sandy, psammophilic facies (on smaller areas). Between the two types of facies there are areas in which they combine, the structure of the zoobenthos acquiring a pelopsamophilous character. In the shore areas where the marshy macrophytes are located, in the structure of the bental facies, an important part is made up of the coarse vegetal detritus. Due to the diversity of the benthic biotope, the structure of the zoobenthos is represented by 10 groups of invertebrates, dominant being oligochaetes, bivalves, chironomides, gastropods. Gastropods have an important role in the transfer of matter and energy to higher consumers - fish.

The main groups in the zoobenthos are: Crustacea (*Gammarus roeselli*, *Dikerogammarus bispinosus*), Bivalvia (*Dreissena polymorpha*, *Anodonta cygnaea*, *Sphaerium riviculum*, *Unio pictorum*), Gastropoda (*Viviparus acerosus, Planorbis planorbis, Lymnaea stagnalis, Physa fontinalis*), Oligochaeta (*Haplotaxis gordioides, Eiseniella tetraedra, Nais barbata, Limnodrilus hoffmeisterii, Tubifex tubifex*), Copepoda (*Cyclops* sp.), Trichoptera (*Leptocerus* sp., *Stenophylax* sp.), Heteroptera (*Corixa* sp.), Diptera (*Cricotopus fuscus, Orthocladius rivulorum, Eukiefferiela* sp., *Chironomus thummi, Cryptochironomus defectus, Polypedium* sp.). The average numerical density of benthic biocenoses is 68 specimens / m^2 (CIOBOIU, 2014; BREZEANU et al., 2011).

From the point of view of the qualitative structure, zoobenthos is represented by 25 species belonging to the following groups: insects (9 species), oligochaetes (5 species), gastropods (4 species), bivalves (4 species), crustaceans (2 species) and copepods (one species). Following the studies carried out in the years 2006, 2009 and 2012diptera predominate (41-52%) in the stagnophyll sectors of the Olt River, during August-October (Fig. 3), followed by oligochaetes (15-18%) and bivalves (11-15%).

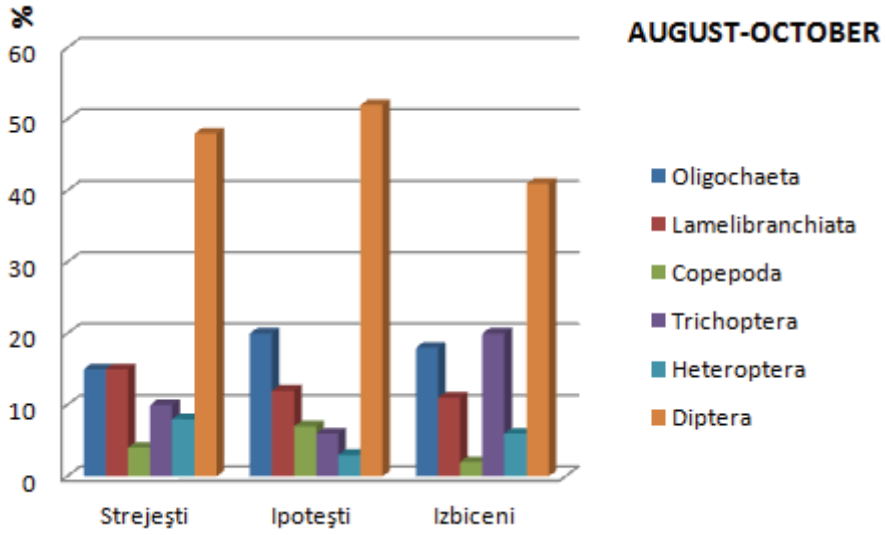

Figure 3. Relative abundance of groups of benthic invertebrates from the Strejeşti, Ipoteşti, Izbiceni accumulation lakes.

In the rheophilic sector of the Olt River, in the year 2006 the molluscs are dominant (gastropods 23-28%, bivalves 22-25%), oligochaetes (30-33%), followed by diptera (17-22%) (Fig. 4). The year 2009 presents similar values: gastropods 25-26%, bivalves 22-24%), oligochaetes 29-37% and diptera 18-22%.

In the year 2012 the situation is similar to the two years, dominant being molluscs (gastropods 20-27%, bivalves 20-21%), oligochaetes (29-37%), followed by diptera (23-25%).

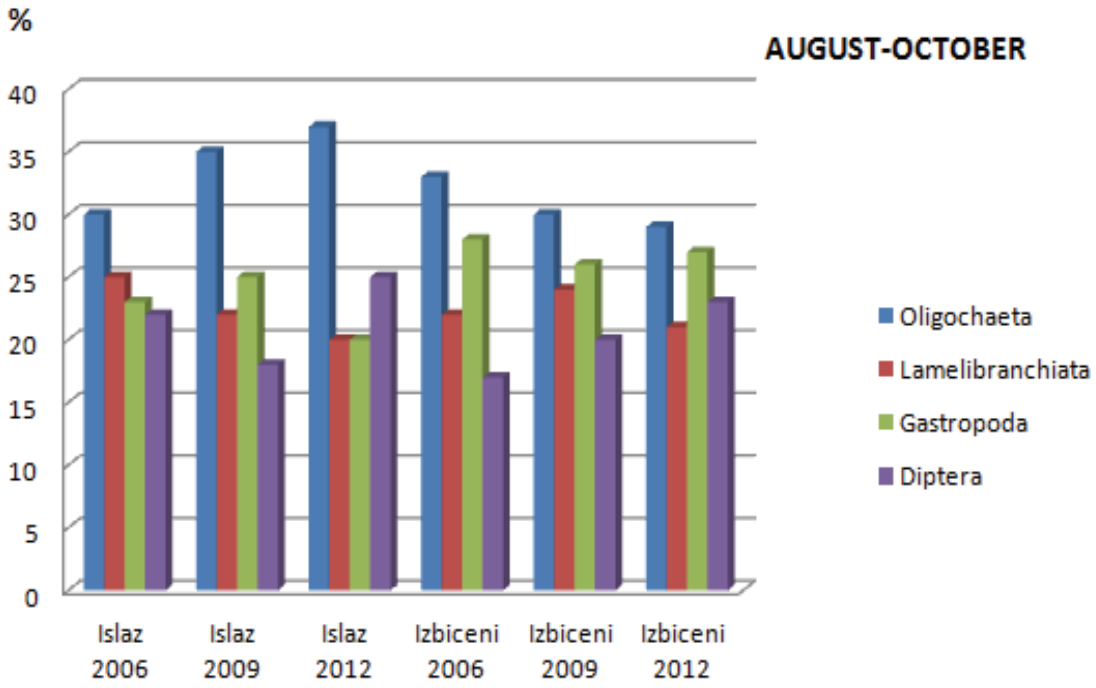

Figure 4. The relative abundance of benthic invertebrate groups in the rheophilic sector of the Olt River.

Analysing figures 5 and 6 in terms of numerical density, in the rheophilic sector of the Olt River, from Izbiceni to Islaz, it is found that the highest number of specimens was recorded in the year 2006 and the lowest in 2012, and the lowest number of specimens being harvested in April and the largest in October, with a similar distribution in the summer months. In Islaz, the number of collected specimens was lower compared to Izbiceni, except for October of the year 2006.

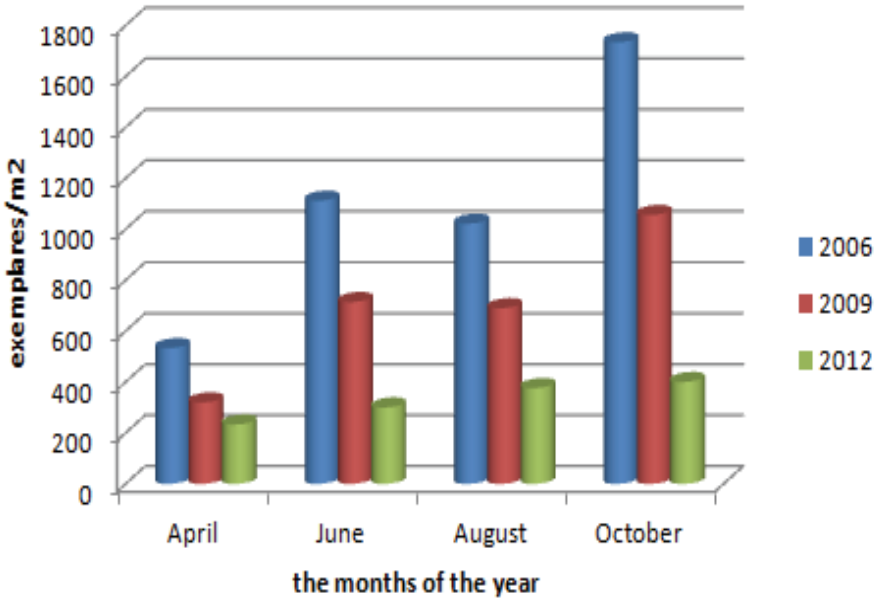

Figure 5. Numerical density of the Olt river zoobenthos at Islaz.

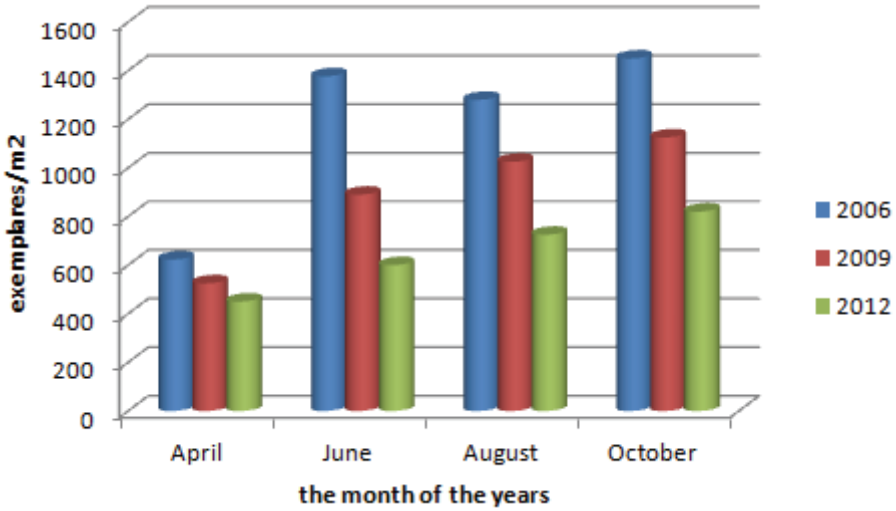

Figure 6. Numerical density of the Olt river zoobenthos at Izbiceni.

CONCLUSIONS

The structure of the benthonic fauna in the lakes is poor, being represented by 25 taxa, with a prevalence of diptera, oligochetes (typical lentic group), followed by molluscs. Heteropterous insects are present in all stagnant waters.

There is a presence of populations belonging to species with high ecological plasticity. Thus, among the oligochaetes, dominant are the species of the genus *Tubifex*, found in all types of waters, but especially in the waters meso- and polysaprobes. The same can be said about *Corixa*, which lives even in acidic waters. Chironomides are also represented by species whose trophic spectrum is mainly detritophagous.

The significant presence of scarcely pretentious species leads to the conclusion that this compartment is deeply influenced by the excessive development of macrophytes, generating the main effects of hypoxia and the presence of excess organic matter.

RFERENCES

BREZEANU GH. & SIMON-GRUIȚĂ A. 2002. *Limnologie generală*, Editura *H*G*A*, Bucureşti. 288pp.
BREZEANU GH., CIOBOIU OLIVIA, ARDELEAN A. 2011. *Ecologie acvatică*. Vasile Goldiș University Press. Arad. 406 pp.
BUCURESCU MARIA, RĂDOANE MARIA, TEODOSIU POPESCU GABRIELA. 2008. *Bazinul hidrografic Prut. Diagnosticul stării ecologice a resursei naturale de apă*. Edit. Univ. Ştefan cel Mare. Suceava. 260 pp.
BURIAN P. V. 2002. *Lacul de acumulare: analiza biologică*. University Press. Târgu-Mureş. 74 pp.
CIOBOIU OLIVIA. 2004. Flora and Fauna Diversity within the Oltenian Sector of the Danube Alluvial Plain (km 811 – 661). *Limnological Reports*. Novi Sad. **35**: 328-332.
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). University Press. Tirana. **1**(1): 57-62.
CIOBOIU OLIVIA. 2014. *Structurile și funcțiile unui sistem bazinal de câmpie. Structura și producția populațiilor de gastropode*. Edit. Antheo. Craiova. 194 pp.
DIACONU C., NICOLICEA M., IONESCU S. 1995. *Ghid metodologic pentru Studii de Impact asupra Mediului, Amenajări Complexe ale Cursurilor de Apă*. Centrul European de Competenţă Profesională Tehnică. Bucureşti. 85 pp.
DIACONU S. 1999. *Cursuri de apă - Amenajare, Impact, Reabilitare*. Edit. *H*G*A*. Bucureşti. 125 pp.
DIHORU GH. & ARDELEAN G. 2009. *Cartea roşie a plantelor vasculare din România*. Edit. Academiei Române Bucureşti. 630 pp.
DINU ALEXANDRA & BREZEANU GH. 2014. Preliminary studies on the structure and dynamics of the phytoplankton in lake Golești (2006 – 2009). *Oltenia. Studii şi comunicări. Ştiinţele Naturii.* Muzeul Olteniei Craiova. **30**(2): 192-197.
FLORESCU GH. 1996. *Pe firul Oltului*. Edit. Meridiane. Bucureşti. 96 pp.
GAVRILESCU ELENA & BUZATU GILDA-DIANA. 2014. *Elemente fundamentale de protecţia mediului*. Edit. Sitech. Craiova. 220 pp.
GÂȘTESCU P. 1971. *Lacurile din România*. Edit. Academiei Române, Bucureşti. 225 pp.
IONESCU S. 2001. *Impactul amenajării hidrotehnice asupra mediului*. Edit. *H*G*A*. Bucureşti. 246 pp.
MARINESCU E. & MITITELU-IONUȘ OANA. 2019. Human impact duet o the capitalization of water resources within the Jiu Gorge National Park. *Forum geografic*. Edit. Universitaria. Craiova. **18**(2): 124-131.
MITITELU-IONUȘ OANA, GOGA IONELIA CLAUDIA, SIMULESCU D. 2021. Lakes Ecosystem Responses to Human Pressures a Case Study in Southwestern Romania. *Polish Journal of Environmental Studies*. University Press. Varshava. **30**(2): 1737-1747.
MOLDOVEANU MIRELA & FLORESCU LARISA. 2013. Long-term analysis of cyanobacterial blooms in lake Roşu (Danube Delta). *Oltenia. Studii şi comunicări. Ştiinţele Naturii*. Muzeul Olteniei Craiova. **29**(1): 252-260.
PLENICEANU V. 2003. *Lacuri şi zone umede*. Edit. Universitaria Craiova. 207 pp.
RĂDUCA C., BOENGIU S., MITITELU-IONUȘ OANA, ENACHE C. 2021. Correlation of the relief conditions, hydrographic network features and human interventions within the Blahnița River Basin (Southwestern Romania). *Carpathian Journal of Earth and Environmental Sciences*. North University of Baia Mare Publisher. Baia Mare. **16**(1): 117-127.
SCUTELNICU R. & DRUȚĂ I. 1990. *Amenajarea complexă a Oltului Inferior pe sectorul Slatina-Dunăre*. Edit. „I. P. Arta grafică". Bucureşti. 98 pp.
SURUGIU V. 2020. *Hidrobiologie generală*. Edit. Universității Alexandru Ioan Cuza. Iași. 300 pp.
***. I.S.C.H. 1964. *Studii de hidrologie, X, Monografia hidrologică a bazinului hidrografic al râului Olt*, Bucureşti. 125 pp.

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Received: April 12, 2021
Accepted: August 11, 2021