ASSESSMENT OF IMPACT OF AGROECOSYSTEMS ON MACROZOOBENTHOS COMMUNITIES OF IMPORTANT PROTECTED AREAS IN SOUTHWESTERN PART OF THE SLOVAK REPUBLIC

J. NOSKOVIČ, Alena RAKOVSKÁ, Jana PORHAJAŠOVÁ, Mária BABOŠOVÁ, Terézia ČERYOVÁ

Department of Environmental Science and Zoology, Faculty of Agrobiology and Food Resouces, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 76 Nitra , Slovak republic
Jaroslav.Noskovic@uniag.sk

Abstract. *Macrozoobenthos as an important component of all aquatic habitats is very diverse community of aquatic invertebrates, which are either throughout its life, or during the developmental stages bound to the water. Representatives of this community are extremely sensitive to environmental conditions in which they live, but especially to the qualitative properties of water. They are suitable bioindicators of any characteristics changes of their habitat. Therefore, permanent occurrence, but, for the majority of the representatives of the benthic fauna, relatively long development cycle conducted in water, can significantly influence not only natural factors, but also human activities. In this work we present results of the occurrence of macrozoobenthos communities in two nature reserves in southwestern part of the Slovak Republic: Žitavský luh and Alluvium Žitavy, while also evaluate the potential impacts of agricultural activities on the species and numerous representations in the monitored habitats. In 2006 and 2007, we are on each monitored aquatic habitats, in six sampling sites at regular quarterly intervals collected total of 48 water samples, together with biological material. In Nature Reserve Žitavský luh we recorded in 24 taken samples 25, 966 individuals, determinate to be 135 species of benthic fauna. In Nature Reserve Alluvium Žitavy by collecting of 24 samples of water we obtained only 12, 708 individuals, 126 species of this ecological group of individuals. Determined species were included in the 15 systematic groups: Turbellaria, Gastropoda, Bivalvia, Oligochaeta, Hirudinea, Isopoda, Amphipoda, Ephemeroptera, Odonata, Heteroptera, Megaloptera, Coleoptera, Trichoptera, Diptera (without Chironomidae) and Chironomidae. Of these, the numerically and percentage the most involved on the structure of macrozoobenthos community Gastropoda, Isopoda, Ephemeroptera and individuals of families Chironomidae. The contrary, the lowest share in numerous, species and percentage representation had Megaloptera, Turbellaria and Odonata. From the total number of 177 determined species of benthic fauna in the territory of Slovakia is 23 species protected by law under the legislation of the State Nature and Landscape Conservation, included primarily to the species categories: VU – vulnerable and LR: nt – near threatened. In the monitored period were structure and biodiversity of macrozoobenthos communities of Nature Reserve Žitavský luh compared with structure and biodiversity of Nature Reserve Alluvium Žitavy richer and more balanced. Significant negative impact of agriculture on the macrozoobenthos community in that period in monitored aquatic habitats was not recorded.*

Key words*: Agroecosystems, macrozoobenthos, water, protected area, Slovak Republic*

INTRODUCTION

Water biotopes are natural or artificial origin, located within various climatic geographical areas of the Earth includes wetlands which existence and function is mainly conditioned by availability of water. Extremely rare, by law of protection nature and landscape type of wetlands ecosystems located in southwestern part of Slovakia are Nature Reserves Žitavský luh and Alluvium Žitavy. In different periods are in selected biotopes of protected areas from their creation realized research of various groups of plants and animals. In their territory was carried out not only extensive floristic survey (SVOBODOVÁ, 1992; SÁDOVSKÝ, 2004), but was also observed the incidence of animals, especially birds, because

mentioned natural reserves are from international perspective rare areas of birds, significant in terms of nesting of water-birds and for migratory birds are significant in terms of migration. Avifauna of wetlands in Podunajská nížina was monitored by BABÓ (1983); HORA, KAŇUCH (1992); LENGYEL (1997; 2004), MURÁNSKY ET AL., (2004), IMRICHOVÁ (2012). The occurrence of amphibians in this area was monitored by RYBANIČOVÁ (2006), RESEARCH OF MAMMALS OF ŽITAVSKÝ LUH DEALT BALÁŽ, JANČOVÁ, NOGA (2003); NOGA ET AL., (2004). ICHTHYOLOGICAL SURVEY CARRIED OUT HAJDÚ, PEKÁRIK (2009). Communities of aquatic macroevertebrata in monitored nature reserves were observed sporadically. From wide variety of invertebrates in this area for example ČEJKA (2007) monitored mollusks, ŠÁCHA (2000) AND ŠÁLEK (2003) monitored dragonflies. In this contribution we have tried to improve knowledge about important group of aquatic animals, which is macrozoobenthos - individuals visible with the naked eye, smaller or larger sizes (from 0.5 mm to few cm), mobile and sessile, occurring on the bottom of aquatic biotopes (ŘÍHOVÁ-AMBROŽOVÁ, 2007;BARTÍK, et al., 2008). They have different sensitivity to the purity of the aquatic environment and environmental stress; they are excellent bioindicators of water quality but may also indicate negative human intervention in agroecosystems.

MATERIAL AND METHODS

Hydrobiology research was realized in south-western part of Slovakia, in Danube lowland, which is one of the most fertile intensively used agricultural territorial units of Slovakia but also is locality with important localities in terms of nature conservation.

Nature Reserve Žitavský luh is in the floodplain of the river Žitava, at the foot of the Hron uplands, in an area with an average altitude of 133 meters, with total area of 74.69 ha. In the year 1980 was declared as national nature reserve and in the year 1994 was categorized as nature reserve. Located is in Nitra region, district Nové Zámky, cadastral area of villages Maňa, Kmeťovo and Michal nad Žitavou. Part of this area of northwest engages periodically waterlogged grasslands. The southern border is formed by residual of the original meandering flow of the river Žitava. In the east is road Žitavce – Maňa. The part between the road and alluvial is agricultural land, which is usually from March to June waterlogged. Northern border of national reserve are districts of Nitra and Nové Zámky. Water is into the reservation supplied through the former bed of the river Žitava, which is in this area adjusting, therefore has created new bed, which forming the western border of nature reserve. In summer period is NR artificially flooded and after the filling the alluvial by water usually there was decrease to declining in water level. In the spring season the water depth was in average 200 to 300 mm, in summer season sometimes drops to 100 mm. Territory belongs to the warm and dry climate areas with mild winters and with average annual temperature of 9.5°C. The average annual rainfall is 530 to 650 mm. Water samples were carried out from these sampling sites: 1st sampling site – regulated river flow of Žitava with grassy bank; 2nd sampling site – the top of the old riverbed of river Žitava; 3rd sampling site – southern side of old riverbed of river Žitava; 4th sampling site – southern and south-east side of old meandering stream of riverbed, without tree vegetation; 5th and 6th sampling sites – both located on the edge of the water area of east part of the nature reserve, where are small lakes with open water surface and areas of aquatic plant communities. Bottom of all sampling sites were mostly mud,. sometimes boulders or mud.

Nature reserve Alluvium Žitavy is territory located in an area with an average altitude of 122 meters, in area of month of the river Žitava into the river Nitra, Nitra region, district Komárno, cadastral area of village Martovce and city Hurbanovo. As protected area, 32.53 ha were declared in 1993. It is the territory of preserved floodplain forest with many of different species of plants and animals. Reservation is located in river Žitava area, surrounding with

agicoenose respectively in some places with remnants of original meanders of the river Nitra and Žitava. In central part is open water surface of channel with rich vegetation of various plants species. There are also some smaller wetland ecosystems. In Slovakia is Alluvium Žitavy nature reserve with the warmest climate and the longest growing season. Winter is mild and windy, with small snow cover. Annual rainfall is 550 – 750 mm. A significant part of NR is flooded during the year, especially in spring. Water samples were carried out from these sampling sites: 1st sampling site – inflow of river Žitava into the Alluvium. On the bottom is mud with dead parts of aquatic plants and leaves of trees; 2nd and 3rd sampling sites – both with trees, on bank with *Typha latifolia* and *Phragmites australis*. On the water surface is duckweed. On the muddy bottom are algae, aquatic plants and leaves of trees; 4th sampling site – situated near the bridge, with road to the village Martovce. On the bottom were large stones covered by algae; 5th sampling site – typical wetlands ecosystem with open water surface, on the bank with vegetation of trees. Bottom is moody with algae and aquatic plants; 6th sampling site – located between the trees. On the bottom was mud, algae and aquatic plants with predominance of *Typha latifolia*.

Both nature reserves were declared mainly to protect of wetlands biotopes and water-birds. As important bird territories are part of the NATURA 2000. Water samples were collected with biological material ie larvae and adults individuals of benthic fauna. Water samples were carried out at regular intervals, quarterly in March, June, August and October by conventional hydrobiology methods, especially by method called „kicking“, technique and individual collection of benthic fauna. Obtained macrozoobenthos organisms have been in laboratory cleaned, free form deposits of fine mud, leaves and other contaminants and then preserved with 4% formaldehyde solution, which is used for fast killing of organisms, while retaining the original shape and color. Cleaned and fixed material on Petris dishes using binocular loupe, stereomicroscope and determination keys was determined. In obtained community of benthic fauna was evaluated: species composition, number of species, number of individuals, dominance. Dominance which in zoocoenoses denotes the percentage proposition of species populations on the quantitative structure of whole community was calculated from the formula: $D = \frac{n.100}{s}$ [%] ;

Where: D = dominance of species; n = number of individuals of species on the locality;
s = sum of individuals of zoocenoses on the locality.

When evaluating the different species we used the scale by RAJCHARD et al. (2002): Eudominant (ED) more than 10%; Dominant (D) 5 - 10%; Subdominant (SD) 2 - 5%; Recedent (R) 1 - 2%; Subrecedent (SR) less than 1%.

RESULTS AND DISCUSSION

Biological material necessary to assess the structure of the macrozoobenthos communities in Nature Reserves Žitavský luh and Alluvium Žitavy we obtained by taking 48 water samples, their quantitative and qualitative analysis and subsequent determination of fauna located in taken samples. In the 24 samples that were collected at six selected sampling sites of Nature Reserve Žitavský luh presence of 25,966 individuals of 135 species of the 15 systematic groups: Turbellaria, Gastropoda, Bivalvia, Oligochaeta, Hirudinea, Isopoda, Amphipoda, Ephemeroptera, Odonata, Heteroptera, Megaloptera, Coleoptera, Trichoptera, Diptera (without Chironomidae) and Chironomidae. From these systematic groups in number and percentages the most participate in the composition of macrozoobethos representatives of systematic groups Gastropoda (30.61 %). Smaller proportion on structure of the ecological group of aquatic animals had Ephemeroptera (16.22%), Trichoptera (8.60%), Isopoda (8.23%)

and individuals of family Chironomidae (7.74%). In the waters of Nature Reserve Alluvium Žitavy represented macrozoobethos only 12,708 individuals of 126 species of 14th systematic groups. Results presented in Table 1 show that in the water of Nature Reserve Alluvium Žitavy was except of Megaloptera (spongeflies) recorded the occurrence of benthic fauna of the same taxonomic groups as in the water of Nature Reserve Žitavský luh. On the total composition of macrozoobenthos are the most involved Gastropoda (35.10%) and Isopoda (20.44%), smaller proportion had Ephemeroptera (8.09%), Coleoptera (6.88%) and individuals of family Chironomidae (6.31%). The proportion of representatives of other systematic groups on the structure of macrozoobenthos of monitored wetland types of nature reserves ranged from 0.26% (Turbellaria) to 5.88% (Oligochaeta) in Nature Reserve Žitavský luh and from 0.61% (Trichoptera) to 5.08% (Heteroptera) in Nature Reserve Alluvium Žitavy.

From the total number of 177 determinate species of fauna, which are in terms of systematic competence, body size and lifestyle known as the „macrozoobenthos, ", i.e. colonize the bottom of aquatic habitats, during the monitored period was identical in the water of both monitored protected areas recorded 82 species. The remaining 95 species i.e. 46.33% occurred in water of one nature reserve sporadically. Number of 177 species of macrozoobenthos of monitoring and evaluation protected areas does not reflect the overall structure of macrozoobenthos communities, because some systematic groups were not monitored, as well as, because from these 177 taxa was 176 determined on the level of species respectively gender and only one on the level of family. Significant numbers of individuals represented by larvae of the family Chironomidae were not included in the total number of individuals of the order Diptera. The number shown in Table 1 as „Chironomidae" expresses only the number of pieces of that family found in the taken samples.

During the whole monitored period the systematic group with the largest number of individuals was representatives of the phylum Mollucsa – class Gastropoda. Although that, this systematic groups in the water of Nature Reserve Žitavský luh was the most numerous and percentage representation on the structure of zoobenthos (7, 948 jedincov, e.i. 30.61 %), was also systematic group with lower numerous representation of species (14) compare with some other systematic groups. In the water of Nature Reserve Alluvium Žitavy was the proportion of individuals of that systematic group on the structure of macrozoobethos higher because from total number of 12,708 determined individuals to 4,460 individuals e.i. 35.10% represented Gastropoda. Of these the most common and also the largest number was recorded occurrence of species: *Gyraulus albus*, *Valvata cristata*, *Bithynia leachi*, *Valvata piscinalis* and *Gyraulus laevis* (Table 3). Smaller species representation of mollusks in comparison with our results found ČEJKA (2007). In the examined aquatic and semiterrestrial stations of Nature Reserve Žitavský luh we recorded total only 9 species of mollusks, of which five species are characterized as aquatic mollusks. The dominant one was species *Anisus spirorbis*, generally regarded as the typical species of periodic wetlands. Its occurrence during our monitoring was observed almost in all sampling sites, but in small number of individuals. Therefore, in contrast to referred author characterized as species recendent (Žitavský luh 1.34%) to subrecedent (0.55% Alluvium Žitavy). Large proportion on the structure of benthic fauna communities of monitoring nature reserves had also Ephemeroptera. Despite of fact that HAVIAR (2006) their ranks among the indispensable part of communities of flowing waters from results of our observations show that there are an important part not only flowing waters but also of wetlands and stagnant waters.

Important bioindicators of environmental quality are considered dragonflies (Odonata). However their occurrence was in two nature reserves very rare, with share on the structure of macrozoobenthos from 0.54 to 0.71%. During the reference period was in NR Žitavský luh

reported incidence only these seven species of Dragonflies larvae: *Calopteryx splendens, Coenagrion pulchellum, Lestes sponsa, Pyrrhosoma nymphula, Platycnemis pennipes, Somatochlora metallica and Sympetrum vulgatum*. In the NR Alluvium Žitavy was in addition to those species recorded occurrence of larvae species *Aeschna grandis, Anax imperator, Coenagrion puella, Sympetrum danae* and *Sympetrum flaveolum*. Those species however in different sampling sites do not occur regularly. ŠÁCHA (2000) and ŠÁLEK (2003) in the NR Žitavský luh reported the presence of 18 species of larvae of dragonflies, this group of animals will be necessary pay more attention in future research. Because animals are extremely sensitive to the quality characteristics of biotope will be particularly necessary to confirm or refute contrary refute impact of agroecosystems to their occurrence in aquatic biotopes and thus explain the absence of certain species in waters of monitoring protected areas.

The systematic group with lowest share (0.12%) on the structure of macrozoobenthos was Megaloptera. In the water of NR Žitavský luh was represented only one species *Sialis lutaria*, which larvae in the number of 30 individuals were recorded. The occurrence of larvae of this species nor representatives of other species of Megaloptera in the water of NR Alluvium Žitavy was not recorded.

Table 1

Numerous and percentage representation of monitored systematic groups of macrozoobenthos

Systematic group	**Žitavský luh**		**Alúvium Žitavy**	
	Number (pc)	**%**	**Number (pc)**	**%**
Turbellaria	66	0.26	336	2.64
Gastropoda	7,948	30.61	4,460	35.1
Bivalvia	550	2.12	348	2.74
Oligochaeta	1,528	5.88	448	3.53
Hirudinea	146	0.56	230	1,81
Isopoda	2,138	8.23	2,598	20.44
Amphipoda	1,752	6.75	372	2.93
Ephemeroptera	4,212	16.22	1,028	8.09
Odonata	140	0.54	90	0.71
Heteroptera	455	1.75	646	5.08
Megaloptera	30	0.12	0	0
Coleoptera	1,460	5.62	874	6.88
Trichoptera	2,232	8.60	78	0.61
Diptera (bez Chironomidae)	1,298	5.00	398	3.13
Chironomidae	2,011	7.74	802	6.31
Total	**25,966**	100	**12,708**	100

In the waters of NR Žitavský luh and Alluvium Žitavy not been recorded occurrence of typical representatives of benthic invertebrates such as Plecoptera. Found results thus confirm the view of some authors (HELEŠIC, SOLDÁN, ŠPAČEK,2005; KRNO,2006), that Plecoptera are highly vulnerable group of macrozoobenthos with low ecological valence and important factors significantly affecting their occurrence may be for example changes in properties of biotope bottom caused by natural factors but in intensively used agricultural land also by human activity. Therefore probably poor site conditions of monitored wetlands were the main cause of their absence.

From the ecological point of view the most of species of benthic fauna, which occurrence in both NR was recorded are considered for species euryvalent, commonly found in aquatic biotopes of southern Slovakia. Rare respectively legally protected species with

predominance of vulnerable and near threatened species were from total a relatively large number of determined species represented by very small number – only 23species (Table 2). The largest number of protected species (6) was represented animals from two systematic groups, namely: Gastropoda (*Anisus spirorbis, Bithynia leachii*, *Gyraulus laevis, Segmantina nitida, Viviparus acerosus* and *Viviparus contectus*) and Bivalvia (5 species: *Pisidium millium*, *Pisidium obtusale, Pisidium supinum, Sphaerium lacustre* and *Sphaerium rivicola*). Small number of identified protected respectively threatened species from representatives of Trichoptera , which are committed with their evolution only on aquatic environment probably corresponds to the degree of disturbance of monitored biotopes. In the waters of monitored natural reserves one of protected species was recorded – *Lithax obscurus*, it is considered as the species „vulnerable"(VU).

Table 2

Protected species of the macrozoobenthos

Species	Žitavský luh	Alúvium Žitavy
	Category threats	**Category threats**
Anisus spirorbis (LINNÉ, 1758)	VU	VU
Aplexa hypnorum (LINNÉ, 1758)	-	LR : nt
Atherix ibis (FABRICIUS, 1798)	VU	-
Bithynia leachii (SHEPPARD, 1823)	VU	VU
Glossiphonia verrucata (O.F.MÜLLER, 1844)	-	VU
Glossiphonia slovaca (KOŠEL,1972)	-	VU
Gyraulus laevis (ALDER,1838)	-	LR : nt
Lithax obscurus (HAGEN, 1859)	VU	-
Paraleptophlebia cincta (RETZIUS,1783)	VU	-
Physa fontinalis (LINNÉ, 1858)	LR : nt	-
Pisidium milium (HELDEN, 1836)	LR : nt	LR : nt
Pisidium obtusale (LAMARCK, 1818)	LR : nt	LR : nt
Pisidium supinum (SCHMIDT, 1850)	LR : nt	-
Rhantus latitans (SHARP, 1882)	-	VU
Segmentina nitida (O.F.MÜLLER, 1774)	-	VU
Somatochlora metallica (LINDEN, 1825)	LR : lc	LR : lc
Spercheus emarginatus (SCHALLER, 1783)	VU	VU
Sphaerium lacustre (O.F.MÜLLER, 1774)	LR : nt	-
Sphaerium rivicola (LAMARCK, 1818)	LR : nt	-
Stratiomys chamaeleon (LINNÉ, 1758)	EN	EN
Sylvicola fenestralis (SCOPOLI, 1763)	VU	VU
Viviparus acerosus (MILLET, 1813)	EN	-
Viviparus contectus (MILLET, 1813)	-	VU

VU – vulnerable; LR: nt – near threatened; LR: lc – leastendangered; EN – endangered.

For extremely rare can be considered occurrence of species *Atherix ibis* (Diptera), which is protected in several European countries. The presence of several individuals of this species only in two sampling sites of NR Žitavský luh (1 and 3) was recorded, despite of the relatively low water level in this biotopes. As mentioned for example DEVÁN (1990) AND KUBÍK AND ŠPITZER (2005), aquosity of biotope is one of the main environmental factors, influencing not only the incidence but also the frequency of individuals in this population. Decline in water

level could be one of the consequences of the fact that monitored area is located in intensively used agricultural landscape.

In the waters of both monitoring nature reserves in particular by number of individuals were the most represented animals of phylum Arthropoda. From the class Crustacea of this phylum numerically very rich bur poor in species was systematic group of benthic fauna Isopoda. Were represented by one species *Asellus aquaticus*, which is animals inhabiting particular stagnant water and slightly flowing water in which on the bottom is decomposes plant organic matter. In number of several hundred individuals were recorded their occurrence mainly in sampling sites with muddy bottom with greater incidence of aquatic plants and residues of fallen leaves which are source of their food. In the waters of NR Žitavský luh and Alluvium Žitavy it belongs to the species eudominant to dominant (Table3). Individuals from other order of class Crustacea – Amphipoda was also in each from evaluated small protected areas represented only by one species. In National Reserve Žitavský luh it was typical species of stagnant and polluted waters (DEVÁN, 1999), characterized by lack of oxygen - *Gammarus roeseli.* In monitored sampling sites was recorded their increased incidence therefore we consider it as subdominant species. In National Reserve Alluvium Žitavy where water is probably compared to water of NR Žitavský luh more pure, we only recorded occurrence of the species that have high demands on the water quality and avoiding to unstable substrate and polluted waters - *Gammarus fossarum* (Table 3). The presence of any of these species was not significantly affected by management and use of nearby land by farmers. Addition to the referred species are in Table 3 listed other species which have been in terms of significant representation by number of individuals included to the category of species eudominant, dominant and subdominant.

Table 3

Share of the eudominant, dominant and subdominant species of macrozoobenthos

Druh	Žitavský luh			Alúvium Žitavy		
	Počet	%	Stupeň dominancie	Počet	%	Stupeň dominancie
Asellus aquaticus (LINNÉ, 1758)	**2,138**	**8.93**	**D**	**2,598**	**21.00**	**ED**
Bithyniaa leachi (SCHEPPARD, 1823)	10	0.04	SR	**574**	**4.64**	**SD**
Caenis robusta (EATON,1884)	8	0.03	SR	**368**	**2.97**	**SD**
Cloeon dipterum (LINNÉ, 1761)	**3,112**	**12.99**	**ED**	**288**	**2.33**	**SD**
Eiseniella tetraedra (SAVIGNY, 1826)	**906**	**3.78**	**SD**	**326**	**2.64**	**SD**
Ephemerella ignita (PODÁ, 1761)	**846**	**3.53**	**SD**	2	0.02	SR
Gammarus fossarum (KOCH,1835)	-	-	-	**372**	**3.00**	**SD**
Gammarus roeseli (GERVAIS, 1835)	**954**	**3.98**	**SD**	-	-	-
Gyraulus albus (O.F.MÜLLER, 1774)	**1,296**	**5.41**	**D**	**672**	**5.43**	**D**
Gyraulus laevis (ALDER, 1838)	-	-	-	**466**	**3.77**	**SD**
Gyraulus riparius (WESTERLUND, 1865)	**5,934**	**24.77**	**ED**	82	0.66	SR
Chironomidae	**2,011**	**7.74**	**D**	**802**	**6.48**	**D**
Micronecta minutissima (LINNÉ, 1758)	-	-	-	**438**	**3.54**	**SD**
Valvata cristata (O.F.MÜLLER, 1774)	-	-	-	**640**	**5.17**	**D**
Valvata piscinalis (O.F.MÜLLER, 1774)	96	0.40	SR	**528**	**4.27**	**SD**

D – dominant; ED – eudominant; SD – subdominant; SR – su brecedent species.

On the basis of the total species and numerical representation of organisms of macrozoobenthos, but also on the basis of the proportion of representation of monitored systematic groups on the structure of monitored and evaluated ecological group of aquatic invertebrate, community of Nature Reserve Žitavský luh evaluated as species more richness compared with same community of fauna found in waters of Nature Reserve Alluvium Žitavy.
brecedent species;

CONCLUSIONS

By monitoring of communities of aquatic invertebrates of two important protected areas of southwestern part of Slovakia we estimated approximately same species composition, but different numerous representation of organisms of macrozoobenthos. In Nature Reserve Žitavský luh was by taken of 24 samples obtained 25,966 individuals, 135 species of benthic fauna, while in Nature Reserve Alluvium Žitavy was also in 24 taken samples was present only 12,708 individuals of 126 species of this ecological group of organisms. From determined 15 systematic groups was numerically and percentage on the structure of community of macrozoobenthos of both wetlands the most involved Gastropoda, Isopoda, Ephmeroptera and Chironomidae. On the contrary, sporadically has been reported the incidence of Megaloptera, Turbellaria, Hirudinea and Odonata. Despite fof fact that monitoring was realized in waters of protected areas, form 177 determined species of macrozoobenthos just 23 is according to Slovak legislation protected by law, classified primarily to the species categories: VU – vulnerable and LR:nt – near threatened. Presented results suggest that the structure of communities of aquatic invertebrates of Nature Reserve Žitavský luh was compared to Nature Reserve Alluvium Žitavy more abundant and more balanced. Found differences were not probably caused by management of near agro-ecosystems.

ACKNOWLEDGEMENT

This research was supported by the VEGA 1/0275/08 and 1/0124/13 grants projects.

BIBLIOGRAPHY

1. BABÓ,T.1983.Príspevok k avifaune Gedrianskych mokrých lúk na strednom toku rieky Žitavy. In: Muzeálny spravodaj. Západoslovenské múzeum Trnava. s.9 – 16.
2. BALÁŽ,I – JANČOVÁ,A – NOGA,M.2003.Drobné zemné cicavce (Rodentia, Insectivora) prírodnej rezervácie Žitavský luh.Msc.,4 s. Dostupné na internete: < http:// www.zitava .sk/zl/zl-zivocistvo/html>.
3. BARTÍK, I. et al. 2008. Hodnotenie ekologického stavu vodných tokov v Slovenskej republike. In: Vodohospodársky spravodajca. Bratislava: ZZVHS.,51(9/10), s.8-10. ISSN 0322-886X.
4. ČEJKA, T**.** 2007. Výskum mäkkýšov Žitavského luhu v minulom roku. Dostupné na internete: < http:// www.zitava.sk/zl/zl_novinky_makkyse2005/html>.
5. DEVÁN, P. 1990. *Atherix marginata* (Fabricius, 1781) v hornom toku rieky Myjava. In: Ochrana prírody. 11, s. 290-297. ISSN 1210-258-X.
6. DEVÁN, P. 1999. O našich krivákoch. Chránené územia Slovenska.40, s.22.ISSN 1335-1737.
7. HAJDÚ, J. – PEKÁRIK, L. 2009. Ichtyofauna dolného úseku povodia Žitavy. Folia faunistica Slovaca, 14 (11). s.81-87, ISSN 1335-7522.
8. HAVIAR, M**.** 2006. Druhové bohatstvo a odhad druhovej diverzity podeniek (Insecta, Ephemeroptera) v monitorovacích a referenčných vzorkách zo Slovenska. Praha: Vodárenská biológie Sborník konference, s. 22 – 29. ISBN 80-86832-17-1.
9. HELEŠIC,J.–SOLDÁN,T.–ŠPAČEK,J.2005.Plecoptera.s.128-131. In:Farkač,J.,Král,D.,Škorpík,M.[eds] Červený seznam ohrožených druhů České republiky. Bezobratlí. List of threatened species in the Czech republic. Invertebrates.Praha: Agentura ochrany přírody a krajiny ČR. Vydání první. 760 s. ISBN 80-86064-96-4.
10. HORA, J. – KAŇUCH, P. 1992.Významná ptačí území v Evropě - Československo. Praha: Československá sekce ICBP. 114 s.
11. IMRICHOVÁ,H.2012. Vtáky sútoku Nitry a Žitavy v mimohniezdnom období. Folia faunistica Slovaca, 17 (2). s.159-172, ISSN 1335-7522.
12. KRNO, I. 2006. Dlhodobé zmeny biodiverzity pošvatiek a ich eklogické metriky signalizujúce antropogénne vplyvy v rieke Hron. In: Sborník příspěvků 14. konference České limnologicke

společnosti a Slovenskej limnologickej spoločnosti: Nečtiny: s. 112 – 114, ISBN 80-239-7257-X.

13. KUBÍK, Š. – ŠPITZER, K.2005. Athericidae (hnízdotvorkovití).s.274. In: Farkač,J.,Král,D.,Škorpík,M. [eds] Červený seznam ohrožených druhů České republiky. Bezobratlí. List of threatened species in the Czech republic. Invertebrates. Praha: Agentura ochrany přírody a krajiny ČR, Vydání první. 760 s. ISBN 80-86064-96-4.
14. LENGYEL, J. 1997. Analýza ornitocenóz Prírodnej rezervácie Žitavský luh a využitie výsledkov pre aktualizáciu manažmentu PR Žitavský luh. Diplomová práca, PRI FUK Bratislava. Katedra Ekosozológie a fyziotaktiky.108 s.
15. LENGYEL, J, 2004: Príspevok k poznaniu avifauny lúčneho spoločenstva v okolí obce Žitavce (okres Nitra) a poznámky k manažmentu územia z hľadiska ochrany prírody. Rosalia. 17. Nitra, s. 123–132.
16. MURÁNSKY, P. – LENGYEL, J. – SÁDOVSKÝ, M. – KRČMÁR, M. 2004**.** Program záchrany a starostlivosti o PR Žitavský luh. 10 s. (unpubl.)
17. NOGA M.– AMBROS M. – BALÁŽ I. – JANČOVÁ A. 2004: Poznámky k faune cicavcov (Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora, Artiodactila) Prírodnej rezervácie Žitavský luh a blízkeho okolia. Rosalia. 17.Nitra. s. 153-164
18. RAJCHARD, J. – KINDLMANN, P. – BALOUNOVÁ, Z. 2002. Ekologie II. České Budějovice: Kopp nakladatelství. 120 s. ISBN 80-7232-190-0.
19. ŘÍHOVÁ-AMBROŽOVÁ, J.2007.Bentos.From Encyklopedie hydrobiologie: výkladový slovník [online]. Praha: VŠCHT Praha.2007. Dostupné na internete:<http://www.vydavatelstvi.vscht.cz/knihy/uid_es-006/ebook.html?p=P030>.
20. RYBANIČOVÁ, J.2006. Obojživelníky (Amphibia). Nitra (Slovensko):FPV UKF, edícia Prírodovedec č.233.182 s. ISBN 80-8094-066-5.
21. SÁDOVSKÝ, M. 2004. Predbežný zoznam cievnatých rastlín v PR Žitavský luh II. In: Rezervačná kniha - PR Žitavský luh. Správa CHKO Dunajské luhy. (http://www.zitava.sk/zl/zl_rastlinstvo.html.).
22. SVOBODOVÁ, Z.1992. Flóra a vegetácia Gedrianskych lúk a priľahlých lokalít. In: Spravodaj podunajského múzea v Komárne. 10. s.93 – 108.
23. ŠÁCHA, D. 2000. Príspevok k poznaniu vážok (Odonata) stredného Požitavia. Rosalia. Nitra. s.105 – 112.
24. ŠÁLEK, P. 2003. Žitavský luh – k. ú. Maňa, okr. Nové Zámky. cca 74 ha. Co bylo pozorováno při pochůzce terénem v této velmi pozoruhodné lokalitě. Dostupné na internete: <http:// /www.zitava.sk/zl/zl_zivocistvo.html>.