INFLUENCE OF AGROECOSYSTEMS ON BIODIVERSITY OF *CARABIDAE* IN THE NATURE RESERVE OF ALÚVIUM ŽITAVY IN THE SOUTHWESTERN PART OF THE SLOVAK REPUBLIC

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Abstract: *The aim of this study was to evaluate the biodiversity of species of the family Carabidae (Caleoptera), which are an important component of biocenosis and also take the place of bioindicators of environment. Biological/Epigeic material was drawn by the earth traps method, during the three years 2006-2008. Earth traps were exposed during the growing season in four selected sampling sites, on the locality of Nature Reserve Alúvium Žitava, which cover an area of 32.53 ha. Altitude is 111-121 m above sea levels. We obtained total of 9 315 ex of epigeic individuals. These were represented by 27 epigeic groups. Dominant were Collembola, Acarina, Formicoidea and Larvae. Monitored order Coleoptera was represented by 1 096 ex, what representing 11.76% representation of the whole set. Within the Coleoptera families were determined with the dominant representation of two families Staphylinidae (27.55%) and monitored family Carabidae (26.92%). The presence of other families, for example: Cryptophagidae, Dermestidae, Silphidae, Chrysomelidae etc. constitutes less than 5% and subdominant respectively recendent representation was recorded. After analyzing the family Carabidae (295 ex) 33 kinds were determined, including seven dominant species (two eudominant): Poecilus cupreus (L.) 12.54% representation, Pseudoophonus rufipes (De Geer) 10.17%, Carabus granulatus (L.) 9.49%, Pterostichus antracinus (Illig.) 9.49 %, Pterostichus melanarius (Illig.) 7.46%,Carabus violaceus (L.) 6.10%, Platynus dorsalis (Pontopp.) 5.08% representation from the group/family Carabidae. Representation of the other species was at less than 5%, ie subdominant level representation. It was a kind Calathus fuscipes (Goeze), Bembidion lampros (Herbst), Pterostichus niger (Schall.), Stomis pumicatus (Panz.), Amara aenea (De Geer), Calathus melanocephalus (L.), Diachromus granulatus (L.) a Harpalus politus (Dej.), and again from Carabidae. Following other species and lower degree of dominance was eleven species, represented only by 1-2 individuals. In terms of frequency of occurrence of the most frequent species were Pseudoophonus rufipes and Poecilus cupreus, which are characterized by wide ecological valence and with other species belonging to the families with a strong bond to the environment. The two dominant species we can evaluate highly significant dependence on rainfall, temperature and year. Based on the calculated index of diversity, can be stability of Nature reserve, despite the fact that is in farmland, assessed as stable, calculated diversity index 2.8709 is evidenced. From the calculated values it is obvious, that the habitat is functional in terms of self-regulation and has remarkably homeostatic capabilities.*

Key words: *agroecosystem, biodiversity, Carabidae, Nature Reserve, Slovak Republic*

INTRODUCTION

Wetland is habitat that is existentially dependent on the constant presence of water levels, respectively high degree of underflooding, also presents a wide range of different types of ecosystems. From an ecological point of view are wetlands one of the species richest and the most productive types of biomes. They are home of many species of flora and fauna. Their importance is enormous, reduce the flow of water, capture the sediments, in which are absorbed nutrients, pesticides, heavy metals and other toxic substances, thereby manifested

their self-cleaning ability. Form a transition between aquatic and terrestrial habitats. They are shelter for species inhabiting the surrounding agroecosystems. In the past, however, they were also deliberately destroyed. For example they being submerged by soil for agricultural or building activities, as well as they were use of illegal waste dump. In terms of conservation of biodiversity definitely play an important role (PORHAJAŠOVÁ, ŠUSTEK, 2011). As a result of human activities gets into the environment large amount of contaminants, which contaminating not only the crop productions but also significantly affect the qualitative and quantitative composition of the present edaphic groups (ŠTYRIAK et al., 2002). Occurrence of epigeal fauna is directly linked with a variety of topical and trophic relationships, is significantly influenced by athropogenic inputs. Species of family *Carabidae* serve as model group for scientific, biocenologic and ecological studies, used are to study of environmental impacts within the different agro-technical measures. For *Carabidae* fauna is typical that any changes in the environment they respond with their ability – reversibility, which shows that these species are not to pollution and interference in the environment so sensitive and they are important bioindicators load of agro-ecosystems. Species of the family *Carabidae* inhabit wide variety of habitats and they are represented by a large number of species. To their environment are closely bound and sensitive react to any changes that take place in it (PORHAJAŠOVÁ et al., 2005 and PORHAJAŠOVÁ et al., 2007). Species of the family *Carabidae* are characterized by broad ecological valence and occur in the forest, grassland, arable ecosystems, but includes there hygrophilous species too. They have specific meaning in the nature (CARDAMO, SPENCE, 1994). The most species from central European is hydrophilic with the night activity (KŘÍSTEK, URBAN, 2004). *Carabidae* represent one of the zoofauna agricoenose and play an important role because they are natural enemies of insect pets in agriculture. Many species are granivorous, acting as predators dispersed seeds (HONEK ET AL., 2005 AND BUKEJS, BALALAIKINS, 2008). ŠUSTEK (1983) deals with the occurrence of the family *Carabidae* in the territory of the Pavlov hills, which are under the intense pressure from agriculture and huge tourism pressure. He found that anthropogenic tolerant species displace less tolerant species. Troubleshooting service of Gabčíkovo dealt ŠUSTEK (2002). Model family was *Carabidae*, and earth traps localized to sites with the suitable conditions, acceptable terms and unfit conditions. Found bioindication measures can be applied in the control of communities. By PETŘVALSKÝ (1997) functional of ecosystems depend on the climatic and edaphic factors, which determine the composition of species, structure and evolution of cenosis. If biocenosis is stable, there is the flow of energy and information between the different trophic elements. Complex trophic relationships are realized in the soil not only by dominant group of microbiocenosis, but also present zooedaphone with populations of herbivorous, carnivorous, saprophagous and coprophagous forms.

On this basis, the aim of the study is to evaluate the biodiversity of species of the family *Carabidae* on the locality Nature Reserve Alúvium Žitava, which is located near the agroecosystems.

MATERIAL AND METHODS

Nature Reserve Alúvium Žitava is located in the southwestern part of the Slovak Republic. It lies along the flow on the flood-plain of the river Žitava. Area of reserve is 32.53 ha, as a protected area was declared in 1993 and for territory is applies 4th degree of protection, for the protection of flood-plain forest with the diversity of different plant and animals' species, including the nesting birds. From the protected species of flora we can found there *Nuphar luthea*, *Salix alba*, *Iris pseudacorus* and other. A large part of the area is flooded during the year. From the protected species of fauna we can found *Osteichthyes* (*Lepomis*

gibbosus, Perca fluviatilis, Carassius carassius), *Amphibia* (*Bombina bombina, Hyla arborea, Rana esculenta*), *Reptilia* (*Natrix natrix*), *Aves* (*Ardea purpura, Falco cherrug, Numenius arguata*), *Mammalia* (*Ondatra zibethica, Marte martes Talpa europaea, Vulpes vulpes*). Soil types are black soils, brown soils, fluvial soils and organosoils. Hight production potential of soils is highlighted by degree of plowing, which is 87.7 %.

The area is characterized by the warmest climate in Slovakia, growing season lasts the longest, annual rainfall is 550-750mm.

Collection of epigeic materials were made during the years 2006-2008 at four sampling sites of Nature Reserve Alluvium Žitava:

1. Sampling sites - 47 ° 51'92" north latitude and 18 ° 09'25" east longitude, 111 m above sea level - typical wetland ecosystem.
2. Sampling sites - 47 ° 51'83" north latitude and 18 ° 09'25" east longitude, 117 m above sea level – dense grassland vegetation and *Phragmites australis* and *Salix alba*.
3. Sampling sites - 47 ° 51'09" north latitude and 18 ° 07'99" east longitude, 116 m above sea level - Dense grassland, river Žitava is poured from the bed after intense rainfall.
4. Sampling sites - 47 ° 50'81" north latitude and 18 ° 07'67" east longitude, 121 m above sea level- Dense grassy vegetation, the presence of *Typha latifolia*, *Phragmites australis, Alnus glutinosa*, *Salix alba*.

Epigeic material was taken off during the growing season (April to October), in monthly intervals, by the earth traps method – it is 1 liter glass bottles, which are filled by fixative 4% formalin and from the top are protected by a roof. Subsequently was the obtained epigeic material conserved in 75% alcohol and in the Department of Environment and Zoology were determined. The following indicators were evaluated: abundance of the species of the family *Carabidae*, calculation of diversity index according to Shannon-Weaver (Schwerdtfeger, 1978) and species identity according to Jaccard (I_J) (Losos et al., 1984) and an overall assessment of biodiversity of *Carabidae* population.

RESULTS AND DISCUSSIONS

During the years 2006-2008 at the area of the Nature Reserve of Alúvium Žitava the collection of epigeic material in four sampling sites was realized. Determinate was 9 315 individuals (ex) from the epigeic component of individuals. These were classified into the 27 systematic groups (*Collembola, Coleoptera, Araneida, Acarina, Formicoidea* and other). Incidence of the individual of epigeic groups as well as analyzed the lower systematic units (families and species) by the climatic conditions, including floods was influenced, which affected the qualitative and quantitative composition of monitored populations. From the total group of 9315 ex belonged to the order *Coleoptera* 1096 ex (11.76%). Of this number of *Coleoptera* 22 families was determinate. As a dominant acted family *Staphylinidae*, *Silphidae*, *Cryptophagydae* and monitored family *Carabidae*, this was represented during the three-year period by 295 exemplars.

After analyzing the family *Carabidae* (295 ex) 33 kinds were determined, including seven dominant species (two eudominant): *Poecilus cupreus (L.)* 12.54% representation, *Pseudoophonus rufipes (De Geer)* 10.17%, *Carabus granulatus (L.)* 9.49%, *Pterostichus antracinus (Illig.)* 9.49 %, *Pterostichus melanarius (Illig.)* 7.46%,*Carabus violaceus (L.)* 6.10%, *Platynus dorsalis (Pontopp.)* 5.08% representation from the group/family *Carabidae*. Representation of the other species was at less than 5%, ie subdominant level representation. It was a species *Calathus fuscipes (Goeze), Bembidion lampros (Herbst), Pterostichus niger (Schall.), Stomis pumicatus (Panz.), Amara aenea (De Geer), Calathus melanocephalus (L.),*

Diachromus granulatus (L.) a Harpalus politus (Dej.), and again from *Carabidae* (Table 1). Folowing other species and lower degree of dominance was eleven species, represented only by 1-2 individuals. In terms of frequency of occurrence of the most frequent species within the sampling sites were *Pseudoophonus rufipes* (De Geer).

Taking into account the ecological claims of present species, the communities consisted mainly from species typical for lowland field ecosystems in which the species is present mainly in close dependence to a coincidence of the reproductive cycle and presence of the relevant crop in the field. Subsequently affect occurrence the local soil and moisture conditions. Only the minor part of the communities formed decidedly hydrophilic species inhabiting floodplain forests and shorelines of different wetland habitats, *Drypta dentata*, *Chlaenius nigricornis*, *Pterostichus anthracinus*, *Pterostichus niger*, *Carabus granulates* or eurytopic species with large incidence in very different types of natural and wholly artificial ecosystems (*Pterostichus melanarius*). Special type of communities' component formed the specie of the center position (*Carabus violaceus*). But even colonize drier types of natural floodplain forests, especially elm ash with hornbeam (RAUŠER, ZLATNÍK 1966; OBERHOLZER, FRANK, 2003). Depending on local conditions often in extremely large numbers of individuals inhabit various fragments of floodplain forests in anthropogenic disturbed floodplain forests.

Table 1

Occurrence of species of family *Carabidae* on the locality of Nature Reserve Alúvium Žitava, during the years 2006-2008

Species	**1. sampling place**	**2. sampling place**	**3. sampling place**	**4. sampling place**	**Total**	**%**	**Dominance**
Acupalpus parvulus (Sturm, 1825)	-	-	*1*	-	*1*	*0,34*	*^{5}SR*
Agonum moestum (Duft., 1812)	*2*	*1*	*1*	-	*4*	*1,35*	*^{4}R*
Amara aenea (De Geer, 1774)	-	*1*	*5*	*2*	*8*	*2,71*	*^{3}SD*
Anchomenus dorsalis (Pontopp., 1763)	-	-	*11*	*4*	*15*	*5,08*	*^{2}D*
Anisodactylus binotatus (Fabr., 1787)	*1*	-	-	-	*1*	*0,34*	*^{5}SR*
Bembidion biguttatum (Fabr., 1779)	-	-	*1*	-	*1*	*0,34*	*^{5}SR*
Bembidion lampros (Herbst, 1784)	-	-	*9*	*4*	*13*	*4,41*	*^{3}SD*
Brachinus crepitans (L., 1758)	-	-	*2*	-	*2*	*0,67*	*^{5}SR*
Calathus fuscipes (Goeze,1777)	-	-	*10*	*4*	*14*	*4,74*	*^{3}SD*
Calathus melanocephalus (L., 1758)	-	-	*1*	*5*	*6*	*2,03*	*^{3}SD*
Carabus granulatus (L., 1758)	*27*	-	-	*1*	*28*	*9,49*	*^{2}D*
Carabus violaceus (L., 1758)	*8*	*5*	-	*5*	*18*	*6,10*	*^{2}D*
Clivina fossor (L., 1758)	-	-	*3*	-	*3*	*1,02*	*^{4}R*
Diachromus germanuus (L., 1758)	-	-	*6*	-	*6*	*2,03*	*^{3}SD*
Dripta dentata (Rossi, 1790)	*1*	*2*	-	-	*3*	*1,02*	*^{4}R*
Dyschirius rufipes (Dejean, 1825)	*1*	-	-	-	*1*	*0,34*	*^{5}SR*
Harpalus azureus (Fabr., 1799)	-	-	*2*	-	*2*	*0,67*	*^{5}SR*
Harpalus latus (L., 1758)	-	-	*2*	-	*2*	*0,67*	*^{5}SR*
Harpalus politus (Dejean, 1829)	*1*	-	*5*	-	*6*	*2,03*	*^{3}SD*
Pseudoophonus rufipes (De Geer, 1774)	*1*	*3*	*11*	*15*	*30*	*10,17*	*^{1}ED*
Harpalus tardus (Panz., 1797)	-	*1*	*2*	*2*	*5*	*1,69*	*^{4}R*
Chlaenius nigricornis (Fabr., 1787)	*2*	-	*2*	-	*4*	*1,35*	*^{4}R*
Licinus depressus (Paykull, 1790)	-	-	*5*	-	*5*	*1,69*	*^{4}R*
Poecilus cupreus (L., 1758)	-	-	*35*	*2*	*37*	*12,54*	*^{1}ED*
Pterostichus anthracinus (Ill.,1798)	*7*	*1*	*19*	*1*	*28*	*9,49*	*^{2}D*

Pterostichus cylindricus (H., 1784)	-	*1*	-	-	*1*	*0,34*	*[5]SR*
Pterostichus melanarius (Ill., 1798)	*14*	-	-	*8*	*22*	*7,46*	*[2]D*
Pterostichus niger (Schall., 1783)	*2*	*2*	*3*	*6*	*13*	*4,41*	*[3]SD*
Pterostichus vernalis (Panz.,1796)	-	*1*	*1*	-	*2*	*0,67*	*[5]SR*
Pterostichus unctulatus (Duftsch., 1812)	-	*1*	-	-	*1*	*0,34*	*[5]SR*
Stomis pumicatus (Panz., 1796)	*3*	*1*	*1*	*4*	*9*	*3,05*	*[3]SD*
Syntomus obscurogutatus (Duft.,1812)	-	-	*1*	-	*1*	*0,34*	*[5]SR*
Trechus quadristriatus (Sch., 1781)	-	-	*2*	*1*	*3*	*1,02*	*[4]R*
Total	*70*	*20*	*141*	*64*	*295*	*100*	-

[1]ED-eudominant; [2]D-dominant; [3]SD-subdominant; [4]R-recedent; [5]SR-subrecedent

Conformity of the species composition of two or more compared Zoocoenoses occurring within the monitored sampling sites expressed Jaccard number (I_J). The calculated values range from 22.58 to 38.88% (Table 2). It can be stated that the similarity of the monitored sampling sites in terms of the occurrence of the species of the family *Carabidae* is relatively low, which results from calculated values of species identity. On the species composition of populations largely applied vegetation cover, abiotic environment factors, but also affect biotic factors, i.e. intraspecies and interspecies relation, which vary according to environmental conditions (KVASNIČÁK, DRDUL, 2004; PORHAJAŠOVÁ, 2011).

Table 2

Results of species identity index according to Jaccard (I_J), during the years 2006 to 2008 on the locality of Nature Reserve Alúvium Žitavy

Comparison of sampling sites according to an index of specific identity according to Jaccard (I_J)			
1. - 2.	38,88 %	**2. - 3.**	27,58 %
1. - 3.	22,58 %	**2. - 4.**	35,00 %
1. - 4.	33,33 %	**3. - 4.**	30,00 %

When assessing the stability of the monitored area of the Nature Reserve Alluvium Žitava diversity index (d) was calculated, this takes into account and indicates the status of biota and homeostatic capabilities rather specific ecosystem. From the calculated index of diversity 2 8709 is clear that in terms of self-regulation is biotope fully functional and need to maintain these types of habitat.

CONCLUSIONS

During the three years 2006-2008 on the locality of Nature Reserve Alúvium Žitava by the earth traps method 9315 ex of epigeic ingredients of individuals was collected. *Collembola, Coleoptera, Acarina* and other acted as a dominant. Of the total sample belonged to the order *Coleoptera* 1096 ex (11.76%). As a part of the order *Coleoptera* 22 families was determinated, with dominant represetation of families *Styphylinidae, Silphidae, Cryptophagydae* and model family *Carabidae*.

After analyzing the family *Carabidae* (295 ex) 33 kinds were determined, including seven dominant species (two eudominant), *Poecilus cupreus* (L.) 12.54% representation, *Pseudoophonus rufipes* (De Geer) 10.17%, *Carabus granulatus* (L.) 9.49%, *Pterostichus antracinus* (Illig.) 9.49 %, *Pterostichus melanarius* (Illig.) 7.46%, *Carabus violaceus* (L.) 6.10%, *Platynus dorsalis* (Pontopp.) 5.08% representation from the group/family *Carabidae*. Representation of the other species was at less than 5%, ie subdominant level representation. It

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