

Carabid communities (Coleoptera, Carabidae) in differently managed forage legume stands in the Podpoľanie region (Central Slovakia)

Vladimír Vician^{1*}, Karol Kočík¹, Branko Slobodník², Marek Svitok², Slavomír Stašiov²

¹Department of Landscape Design and Planning, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T. G. Masaryka 24, SK–960 53 Zvolen, Slovak Republic

²Department of Biology and General Ecology, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T. G. Masaryka 24, SK–960 53 Zvolen, Slovak Republic

Abstract

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The paper presents the results of studies on the communities of Carabids from the land registry area of the Očová village (Podpoľanie region, Central Slovakia). The research was carried out in two consecutive vegetation periods on two different agricultural plots with alfalfa (*Medicago sativa* L.): the first of them (locality Náhajníkova) was managed intensively, and the second one (locality Koteľnice) was characterized by a nature-friendly, low-input agro-environmental management form, without application of synthetic fertilizers and pesticides. On the studied sites, the observed species composition of Carabidae was similar. Nevertheless, the higher total number of individuals and the higher species richness were typical for the nature-friendly managed plot in Koteľnice. On both plots, the highest abundances were reached in *Poecilus cupreus*, *Pterostichus melanarius* and *Pseudoophonus rufipes*. On the intensively managed plot in Náhajníkova, however, the abundances of all these species were markedly lower. Our results suggest that the studied component of epigeic fauna finds better ecological conditions on the sites with the nature-friendly management form.

Keywords

agricultural management, agriculture, edaphon, epigeic fauna, ground beetles

Introduction

Nowadays, alternative landscape management forms are increasingly promoted in agriculture. They are considered environment-friendly and respecting the wider ecological patterns. The agro-environmental agriculture enables utilization of soil without reducing its production ability. In particular, the sustainable production ability of soil could be achieved by applying optimization measures during selection of management modes and processes in individual segments of the agricultural landscape (DEMO et al., 1998;

DEMO and BIELEK, 2000). The emphasis is laid not only on the production, but also on the maintenance or eventually, the enhancement of the adequate ecosystem diversity. Above all, the sufficient diversity of ecosystems is an important assumption for the conservation of the important semi-natural biotopes (SLÁVIKOVÁ and KRAJČOVIČ, 1996). On the arable land, the sufficient ecosystem diversity can also prevent rapid invasions of secondary succession and weed infestation. In this form of the agroecosystem management, the importance of epigeic fauna is not limited to the decomposition of the dead organic matter, but is

*Corresponding author:

e-mail: vician@tuzvo.sk

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perceived in a wider context. Besides the processes of decomposition, the accent is also laid on the role of the soil organisms in pedogenesis and in formation of the soil properties, and also in stabilization of these properties and the maintenance of the production performance of soil.

The beetles from the family Carabidae are sensitive, to several factors such as environmental contamination, organic matter content, soil pH-value, etc. Therefore, these factors are considered as important bioindicators of the environmental load and they represent the significant model group for the assessment of ecosystems (HŮRKA, 1996).

Ecology of Carabid beetles was studied by numerous authors. In agricultural ecosystems of Bulgaria, the structure and dynamics of these beetle communities were investigated by SHISHINOVA et al. (2001). COLE et al. (2002) studied the trophic relationships of Carabidae under conditions of Scotland. THOMAS et al. (2006) were concerned with the density of Carabid communities in relationship to the vegetation cover. Carabid beetles in agricultural ecosystems were also objects of interests of O'ROURKE et al. (2008). Under conditions of South-Eastern Sweden, the impact of landscape elements in agroecosystems upon the populations of Carabidae and other invertebrates was studied by WEIBULL et al. (2003). Carabid beetles of urban and agricultural biotopes of Central Europe were examined by ŠUSTEK (1992, 1994, 1999 and 2012). In Central and East European forests, ecology and bioindication role of Carabids were investigated e.g. by ŠUSTEK (1984), KULA and PURCHART (2004), PODRÁZSKÝ et al. (2010a, 2010b) and BRYGADYRENKO (2015). Communities of Carabids from peatland, pine forest and meadow were compared by IGONDOVÁ and MAJZLAN (2015).

In agroecosystems, the influence of intensive and ecological (nature-friendly) management on the epigeic activity of Carabidae is not unambiguous. According to the results of WEIBULL et al. (2003), the higher species richness of Carabid beetles is characteristic for the intensive agricultural management. Contrariwise, more species of Carabids on the ecologically managed farms are mentioned by SHAH et al. (2003). The negative impact of intensive agricultural measures on the abundance and diversity of various components of epigeic fauna (including Carabidae) was also demonstrated by ABEL and HEIMBACH (1992), PURVIS and BANNON (1992), ASTERAKI et al. (1995, 2004), MARASAS et al. (2001), PORHAJAŠOVÁ et al. (2004, 2013, 2018), BARANOVÁ et al. (2013), EYRE et al. (2013), BADIERITAKIS et al. (2016) and others.

The epigeic activity of Carabid beetles in agricultural landscape is related to several relatively complicated ecological (especially trophic) relationships and is markedly influenced not only by the structure of agricultural crops, but also by the quantity and quality of anthropogenic measures applied. The positive influence of the soil organic matter on the epigeic activity of Carabid beetles in agroecosystems is mentioned by PETŘVALSKÝ and PETERKOVÁ (2000), PETŘVALSKÝ et al. (2005, 2007) and PORHAJAŠOVÁ et al. (2005, 2008, 2018).

In 2003, the conceptual framework of agro-environ-

mental programs was designed for the territory of Slovakia. It is aimed at the protection of soil and the maintenance of the production potential of soil, the conservation of species diversity in ecosystems, and the optimization of use and management of agricultural landscape. Within the frame of implementing the agro-environmental programs, the administration of the agricultural cooperative in the Očová village (Podpoľanie region, Central Slovakia) delimited the model plots for monitoring and assessing the influence of different management forms upon the basic components of agricultural ecosystems and generally, upon the entire agricultural landscape.

In the presented paper, we summarise the results of studies on the structure of Carabid communities from the land registry area of Očová. Our research was carried out during two consecutive vegetation periods on two differently managed plots, sowed with alfalfa (*Medicago sativa* L.).

Studied area

The Očová agricultural cooperative is located in the administrative district of Zvolen and its territory extends into the land registry areas of the municipalities Detva, Dúbravý, Očová, Víglaš and Zolná. It incorporates two geomorphological units (Poľana and Zvolenská kotlina) in a flat or only moderately undulated basin with an altitude of 395 to 500 m asl. According to the Data bank of the Slovak fauna, it falls under the quadrants 7381, 7382, 7481 and 7482.

From the viewpoint of geology, this territory is composed of Neogene and Post-Tertiary bedrocks, deposited on ancient Palaeozoic and Mesozoic layers, typical for the adjacent Veporské Rudohorie Mts (DUBLAN, 1993). The soil conditions are heterogeneous – due to the complicated geological and geomorphological structure. According to the Morphogenetic soil classification system of Slovakia (ANONYMUS, 2000), the four occurring basic groups of soils (fluvisols, luvisols, gleys/pseudogleys and cambisols) are represented here by corresponding soil types and subtypes.

The territory of the Očová agricultural cooperative belongs to the catchment area of the river Hron. Namely, its individual tributaries in this area are the local creeks named Očovský, Želobudský and Dúbravský potok. The local hydrological network is relatively complicated, composed of numerous erosion furrows and smaller or larger valleys. Those are frequently branched, especially in woody or grassy slopes of the Detsvianske pohorie hills or in the undulated parts of the Zvolenská kotlina basin, near to the spring areas of the local creeks (except for Očovský potok). The slope gradient of studied territory is negligible. Therefore, many localities are frequently inundated.

The climatic conditions of the studied area were evaluated using the data of Slovak Hydrometeorological Institute in Bratislava, collected at the nearest meteorological station Víglaš.

The studied area is characterized by an average annual air temperature of 7.8 °C. The lowest average monthly temperature falls on January (−4.6 °C), the highest one

(18.5 °C) on July. The average annual amount of precipitation is 669 mm. From that value, 399 mm fall in the vegetation period (April to September). On average, the lowest precipitation (34 mm) falls in February and the highest one (81 mm) in June.

Our research was carried out on two plots grown with the same crop (alfalfa) and the common past (both sites were originally the maize fields), but with the different agricultural management forms. The first site (locality Nadhájniková – Na) is intensively managed, with the use of the artificial fertilizers and pesticides, whereas the second one (locality Koteľnice – Ko) was delimited for testing the agro-environmental, nature-friendly, low-input management scheme. The basic characteristics of both research plots are summarized in Table 1.

Materials and methods

The studies were carried out in two consecutive vegetation periods. The soil invertebrates were trapped by the pitfall method. We used PVC bottles with a height of 11 cm, opening diameter of 10 cm and volume of 0.75 l. The traps were filled with a 10% solution of formaldehyde. Five traps were placed on each of the two study sites. They were placed in line, with a mutual distance of 5 m. Therefore, the total length of each line was 20 m. The distance of traps from the field border (ecotone) was 50 m at least. The traps were checked at monthly intervals from April to

October. The achieved biological material was placed in 4% formaldehyde and determined in the laboratory. The determined individuals were preserved in jars with 70% ethanol, labelled with the collection date. They are deposited at the Department of Biology and General Ecology, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen. The species diversity and similarity of communities were assessed using the Shannon-Weaver and Sorenson index, respectively. The equitability of species occurrence was quantified using the Sheldon evenness.

Results

The list of collected species and the basic characteristics of the compared Carabid communities are in Table 2 and Table 3.

In total, 3,004 individuals from 34 species and 21 genera were collected in the locality Nadhájniková (intensive agricultural management) and 9,325 individuals from 36 species and 22 genera in Koteľnice (nature-friendly management form). On both study sites, 13,329 individuals from 44 species and 26 genera were trapped during the two seasons of investigations.

In both seasons, the highest abundances were typical in *Poecilus cupreus*, *Pseudoophonus rufipes* and *Pterostichus melanarius*.

Table 1. Survey of chosen parameters of study sites

Parameter	Nadhájniková	Koteľnice
Northern latitude	48°35'09"	48°34'04"
Eastern longitude	19°18'51"	19°20'47"
Area (ha)	20.30	7.19
Management form	Intensive	Nature-friendly
Soil type	Luvisol pseudogleic	Luvisol pseudogleic
Crop (1st year)	Alfalfa	Alfalfa
Crop (2nd year)	Alfalfa	Alfalfa
Altitude (m)	401.0	382.0
Slope (°)	1.4	4.9
pH (KCl)*	6.3	6.9
N (mg kg ⁻¹)*	4,375.0	4,112.5
N (%)*	0.4	0.4
P (mg kg ⁻¹)*	53.3	51.1
K (mg kg ⁻¹)*	423.3	156.5
Ca (mg kg ⁻¹)*	1,170.0	1,559.3
Mg (mg kg ⁻¹)*	258.8	426.3
Cu (mg kg ⁻¹)*	8.8	6.7
Mn (mg kg ⁻¹)*	252.5	186.0
Zn (mg kg ⁻¹)*	7.7	6.3
Cr (mg kg ⁻¹)*	1.9	1.6
Pb (mg kg ⁻¹)*	11.2	14.1
Cd (mg kg ⁻¹)*	0.2	0.2
Ni (mg kg ⁻¹)*	2.1	2.6
Oxidable carbon – C _{ox} (%)*	1.4	2.1
C:N*	3.2	5.2
Humus (%)*	2.4	3.7

*The characteristics of soil are related to the surface horizon (A).

Table 2. Main characteristics of ground beetle communities of studied sites (Na: Nádhájníková, intensive management; Ko: Koteřnice, nature-friendly management)

Characteristic	Site		Sum
	Na	Ko	
Number of genera	21	22	26
Number of species	34	36	44
Number of individuals	3,004	9,325	12,329
Diversity index H'	2.13	1.41	
Equitability E	0.60	0.39	

Table 3. Total numbers of trapped individuals (Na: Nádhájníková; Ko: Koteřnice)

Taxon	Na	Ko	Sum
<i>Cylindera geramnica</i> (Linnaeus, 1758)	2	1	3
<i>Carabus scheidleri</i> (Panzer, 1799)		4	4
<i>Carabus scabriusculus</i> (Olivier, 1795)		1	1
<i>Carabus convexus</i> (Fabricius, 1775)		1	1
<i>Carabus violaceus</i> (Linnaeus, 1758)	2	9	11
<i>Leistus ferrugineus</i> (Linnaeus, 1758)		1	1
<i>Loricera pilicornis</i> (Fabricius, 1775)	4	71	75
<i>Clivina fossor</i> (Linnaeus, 1758)	83	110	193
<i>Brachinus crepitans</i> (Linnaeus, 1758)	18	4	22
<i>Trechus obtusus obtusus</i> (Erichson, 1837)	1	2	3
<i>Trechus quadristriatus</i> (Schränk, 1781)	3	7	10
<i>Trechoblemus micros</i> (Herbst, 1784)		4	4
<i>Asaphidion flavipes</i> (Linnaeus, 1761)	1	2	3
<i>Bembidion pygmaeum</i> (Fabricius, 1792)	6	5	11
<i>Bembidion lampros</i> (Herbst, 1784)	59	19	78
<i>Bembidion properans</i> (Stephens, 1828)	2	10	12
<i>Bembidion tetragrammum</i> (Netolitzky, 1914)	12		12
<i>Stomis pumicatus</i> (Panzer, 1796)	2	4	6
<i>Poecilus cupreus</i> (Linnaeus, 1758)	1,880	5,097	6,977
<i>Pterostichus longicollis</i> (Duftschmid, 1812)	3	1	4
<i>Pterostichus macer macer</i> (Marsham, 1802)	11		11
<i>Pterostichus melanarius</i> (Illiger, 1798)	256	2,680	2,936
<i>Pterostichus nigrita</i> (Paykull, 1790)	5		5
<i>Pterostichus strenuus</i> (Panzer, 1797)	2		2
<i>Pterostichus unctulatus</i> (Duftschmid, 1812)		2	2
<i>Calathus fuscipes fuscipes</i> (Goeze, 1777)	52	16	68
<i>Calathus melanocephalus</i> (Linnaeus, 1758)	3	1	4
<i>Dolichus halensis</i> (Schaller, 1783)		1	1
<i>Synuchus vivalis</i> (Illiger, 1798)		1	1
<i>Anchomenus dorsalis</i> (Pontoppidan, 1763)	32	73	105
<i>Agonum viridicupreum</i> (Goeze, 1777)		1	1
<i>Amara plebeja</i> (Gyllenhal, 1810)	1		1
<i>Amara aenea</i> (De Geer, 1774)	43	10	53
<i>Amara crenata</i> (Dejean, 1828)	1	1	2
<i>Zabrus tenebrioides</i> (Goeze, 1777)	1		1
<i>Anisodactylus signatus</i> (Panzer, 1797)	8	9	17
<i>Bradycellus caucasicus</i> (Chaudoir, 1846)	3		3
<i>Acupalpus meridianus</i> (Linnaeus, 1761)	1		1
<i>Ophonus azureus</i> (Fabricius, 1775)	1	3	4
<i>Ophonus brevicollis</i> (Audinet-Serville, 1821)		1	1
<i>Pseudoophonus rufipes</i> (De Geer, 1774)	406	1,129	1,535
<i>Harpalus affinis</i> (Schränk, 1781)	38	21	59
<i>Harpalus distinguendus</i> (Duftschmid, 1812)	60	22	82
<i>Harpalus latus</i> (Linnaeus, 1758)	2	1	3
Sum	3,004	9,325	12,329

Some species were characterized by lower abundances, but the remarkably high regularity of their occurrence. In particular, this holds for *Clivina fossor*, *Bembidion lampros*, *Calathus fuscipes*, *Anchomenus dorsalis*, *Amara aenea*, *Anisodactylus signatus*, *Harpalus affinis* and *H. distinguendus*.

Only in the locality Nadhájniková, subject to intensive agricultural management, we registered *Bembidion tetragrammum*, *Pterostichus macer*, *P. nigrita*, *P. strenuus*, *Amara plebeja*, *Zabrus tenebrioides*, *Bradycellus caucasicus* and *Acupalpus meridianus*.

Another group of species, represented by *Carabus scheidleri*, *C. scabriusculus*, *C. convexus*, *Leistus ferrugineus*, *Trechoblemus micros*, *Pterostichus unctulatus*, *Dolichus halensis*, *Synuchus vivalis*, *Agonum viridicupreum* and *Ophonus brevicollis* was found only in the locality Koteľnice with the nature-friendly management form.

Unlike the species richness and total abundance of individuals, the Shannon-Weaver index of species diversity and Sheldon evenness were higher on the intensively managed plot in Nadhájniková (Table 2).

Based on the Sorenson similarity index (Table 4), the presence of Carabid beetles on studied localities is characterized by relatively high inter-annual differences.

Discussion

The observed species richness and especially the total number of individuals were higher in the locality Koteľnice, characterized by a more nature-friendly form of the agricultural management. The highest abundances were typical for *Poecilus cupreus*, *Pseudoophonus rufipes* and *Pterostichus melanarius*. All of these species have a strong relation to the agricultural landscape and their occurrence on both research plots is characterized as eudominant. The presented results show, however, that these abundances were much higher on the plot with the nature-friendly management form. The high dominance and abundance of the mentioned species in agricultural land were also confirmed by ANDERSEN (1991), PETŘVALSKÝ and PETERKOVÁ (2000), PETŘVALSKÝ et al. (2005, 2007), PORHAJAŠOVÁ et al. (2005, 2008), HUREJ and TWARDOWSKI (2006), TWARDOWSKI et al. (2006) and others.

The relation to the agricultural landscape was also relatively strong in *Clivina fossor*, *Bembidion lampros*, *Calathus fuscipes*, *Anchomenus dorsalis*, *Amara aenea*, *Anisodactylus signatus*, *Harpalus affinis* and *H. distinguendus*. The epigeic activity of these species was lower, but their occurrence on the studied plots was relatively regular.

This finding corresponds to the results of PETŘVALSKÝ et al. (2007), PORHAJAŠOVÁ et al. (2008) and other authors.

A remarkable finding is, according to our opinion, the detected presence of *Carabus scabriusculus* at the site with the nature-friendly agricultural management form. On the territory of Slovakia, this species is known from the warm and dry open biotopes, grasslands, steppes, vineyards and lowlands in southern regions.

In the presented paper, we do not evaluate the direct influence of the particular agrotechnical measures on the Carabid beetle communities. Our results suggest, however, that the more nature-friendly agricultural management forms are more acceptable for the studied part of the epigeic fauna. The intensively managed plot (Nadhájniková) has the soil with the lower content of organic matter and lower pH-value. Simultaneously, it is also characterized by the lower species richness and especially, the much lower total number of individuals.

Although the management form, content of the organic matter and pH-value of soil need not to be crucial for the epigeic activity of Carabidae altogether, some species prefer these factors very distinctly. In particular, the eudominant species *Poecilus cupreus*, *Pterostichus melanarius* and *Pseudoophonus rufipes* were much more abundant in the locality Koteľnice with a nature-friendly agricultural management form, higher content of soil organic matter and almost neutral soil pH-value. The higher abundances of *Pterostichus melanarius* on the plots with a nature-friendly management form are also mentioned by SHAH et al. (2003).

According to some authors, the influence of intensive and ecological (nature-friendly) management on the epigeic activity of Carabidae is ambiguous. WEIBULL et al. (2003) found more species of Carabids on intensively managed farms. Contrariwise, SHAH et al. (2003) point to the higher species richness on the plots with nature-friendly management form. O'ROURKE et al. (2008) suggest that the communities of Carabid beetles are more influenced by crop than by the form of the agricultural management. Nevertheless, they refer to the higher density of individuals and higher richness of species on a plot managed nature-friendly. STAŠIOV et al. (2006) mention, that some components of the epigeic fauna seem to be resistant to the influences of the intensive agricultural measures. According to other authors (PORHAJAŠOVÁ et al., 2008), the species richness of Carabids can be reduced by intensive cultivation of soil and therefore, the biotopes of these beetles should be preserved. This argument corresponds to the implications derived by LACKO-BARTOŠOVÁ et al. (2005).

Table 4. Sorenson index of similarity (Na 1: Nadhájniková 1st year; Na 2: Nadhájniková 2nd year; Ko 1: Koteľnice 1st year; Ko 2: Koteľnice 2nd year)

	Na 1	Na 2	Ko 1	Ko 2
Na 1		0.68	0.75	0.64
Na 2	0.68		0.78	0.66
Ko 1	0.75	0.78		0.64
Ko 2	0.64	0.66	0.64	

According to them, the negative influence of intensive soil cultivation involves the reduced abundance of the beneficial organisms. The adverse consequences of some intensive agricultural measures are also mentioned by ABEL and HEIMBACH (1992) and ASTERAKI et al. (1995, 2004). The negative effect of pesticide application on the total activity of the population of Carabids was tested by PURVIS and BANNON (1992). Similarly, GOULET (2003) evaluated the importance of Carabid beetles in agroecosystems and recommended to decrease the dosages of used pesticides. According to the results of PORHAJAŠOVÁ et al. (2004), the higher abundances of epigeic species (including Carabidae) are typical on the plots fertilized by barnyard manure, treated by the nature-friendly plant protection methods, and spared from the application of pesticides. Other authors, BADIERITAKIS et al. (2016), studied the epigeic activity of Carabidae in differently managed stands of alfalfa. Each of the compared sites was characterized by a specific interval of mowing and one plot was treated by insecticide. Nevertheless, the significant differences among the compared plots were not demonstrated.

Several authors suggest the fact that the structure of Carabid communities is more significantly influenced by the organic matter in soil and the soil acidity (pH) than by the agricultural management form. The positive influence of the organic matter in soil and the neutral value of pH on the structure of Carabid communities is mentioned e.g. by PEŘVALSKÝ and PORHAJAŠOVÁ (1999), PORHAJAŠOVÁ et al. (2005, 2008, 2018) and PETŘVALSKÝ et al. (2007).

Besides the agricultural management (intensive vs. nature-friendly), the structural characteristics of epigeic fauna are also strongly affected by composition and rotation of crops. The fact that the epigeic activity, species richness and number of individuals are higher in areas with more frequent crop rotation and more frequent agrotechnical inputs, is mentioned e.g. by SHISHINIOVA et al. (2001). As it follows from their findings, the abundance of several species of Carabidae is markedly positively influenced by the frequency of the agrotechnical measures. Contrariwise, their occurrence was not markedly affected by harvesting. The similar results were also achieved by VICIAN et al. (2015). They stated that the agricultural areas with cereal crops, characterized by the frequent crop rotation and agrotechnical measures, were favoured by Carabid beetles more than the legume stands, where the agrotechnical measures were relatively rare and the intervals of the crop rotation were much longer.

To a high degree, the differences in the occurrence of Carabid beetles in agricultural landscape are influenced by ploughing. Ploughing as the basic agrotechnical measure markedly affects the physical, chemical and biological regime of soil and, together with many other factors, determines the epigeic activity of various invertebrate species.

In most cases, the regularly ploughed fields are also characterized by the more frequent rotation of crops. The influence of crops upon the epigeic fauna is expressed through their biological properties (allelopathy etc.), but above all, through the agrotechnical measures (inputs of

organic matter, regulation of pH value, regulation of bioenergetic potential through soil cultivation, total dynamics of the biomass transformation and so on).

PORHAJAŠOVÁ et al. (2008) point out to the influence of the agrotechnical measures on the epigeic fauna. They state that the disturbance of the soil environment could even have a positive effect on the activity of the soil invertebrates on intensively managed plots. The attention of authors is also drawn to the regulation of the bioenergetic potential of soil through the antropic activity. Agrotechnical measures have a strong impact on the biological activity of soil and thus, on the occurrence of various components of epigeic fauna. This impact is frequently expressed regardless of the agricultural management form (intensive or nature-friendly). It could be stated, however, that the regular rotation of agricultural crops and/or their suitable combining in common area support the enhanced epigeic activity and biodiversity of Carabids. At the same time, regularly ploughed areas are characterized by more frequent agrotechnical inputs than the areas where ploughing is absent for several years (e.g. legume stands). The above mentioned facts could support the assumption that the arable soils with the frequent and regular ploughing and crop rotation display more species of Carabid beetles than the plots where ploughing is carried out only once a 3–4 years (e.g. plots sowed by alfalfa). Anyway, the more detailed monitoring of Carabidae in agricultural landscape is necessary in the future. The importance of continual ecological studies on this family is also accentuated by HELENUS et al. (2001).

Besides the epigeic activity, the bioindication role of the volume of the Carabid bodies seems to be very important as well (LANGRAF et al., 2017).

Concerning our data we can admit the assumption, that the Carabid beetles find better ecological conditions at the sites with nature-friendly agricultural management, sufficient organic matter content, and pH near to the neutral value. Similar results are also presented by the numerous studies of the above cited authors. They emphasize that the organic matter supports the activity of epigeic fauna, trophic relationship among its components and affects both abundance and dominance of the studied organisms.

Conclusions

During two seasons of our investigations, we registered 3,004 individuals from 34 species in the intensively managed locality Nadhájniková and even 9,325 individuals from 36 species in the locality Koteřnice with the nature-friendly agricultural management form. In total, we identified 12,329 individuals from 44 species and 26 genera.

The highest abundances were regularly achieved by *Poecilus cupreus*, *Pseudoophonus rufipes* and *Pterostichus melanarius*.

The species composition in the studied localities was similar. Nevertheless, more species and, above all, higher abundances of these species, were ascertained for the lo-

cality Koteľnice with the nature-friendly agricultural management. At the same time, this site was characterized by a higher content of organic matter and an approximately neutral pH value. A more marked preference for the nature-friendly managed site was demonstrated in *Poecilus cupreus*, *Pseudoophonus rufipes* and *Pterostichus melanarius*.

The nature-friendly agricultural management, the sufficient content of organic matter in soil and the neutral pH-value seem to be the main factors exhibiting the highest positive effects on the epigeic activity in Carabids.

The occurrence of Carabid beetles is directly connected with a number of relatively complex ecological relationships. There are direct effects induced not only by the composition of crops, but also by the quantity of the anthropogenic inputs. The knowledge of ecological connections in agroecosystems could be extended by long-lasting research on the interactions between the different agricultural management forms and the biodiversity. Due to the contemporary trend of the „ecological agriculture“, agroecosystems are growing into the very important concerns for scientific activities.

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