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Spatial changes and succession of carabid communities (Coleoptera, Insecta) in seminatural wetland habitats of the Žitava river floodplain

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Abstract

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The carabid communities in the Žitava river floodplain were studied at four sites in the within-dike zone of the regulated river in 2006–2008. The communities were deteriorated to a considerable degree, characterized by a low number of species and individuals and by predominance of mesohydrophilous open landscape species over hydrophilous species. Occurrence of species was mostly very unstable, with a great between-year differences and no common trend. The representation of open landscape species was higher in the narrow stretch (ca. 150 m) of the within-dike zone than in the wider stretch (340–390 m). Their relative abundance was higher than that in other much narrower line or stripe formation of wooden vegetation in agrarian landscape. In spite of this, the Nature Reserve Alúvium Žitavy plays the role as a wetland biocentrum in the predominantly agrarian landscape.

Key words

Carabidae, Coleoptera, ecosystems, Nature Reserve

Introduction

The wetlands represent a significant regulator of hydrological regime of landscape and its macroclimate. They contribute to spatial and ecological diversity of landscape and provide habitats for many highly specialized species of plants and animals with an indispensable role in circulation of energy and matter in ecosystems. Wetlands belong to ecosystems with the highest species diversity and, simultaneously, to the most productive ecosystems of the moderate climatic zone. In cultural landscape they also increase its ecological stability and provide refuges to many rare species. The modern concepts of landscape protection and planning consider the wetlands as significant elements of the landscape stability skeleton (Naveh and Lieberman, 1983).

At the same time they were and still are subjected to enormous anthropogenic impacts or destructions since the early times of the human culture, especially because of development agriculture. In the recent two centuries, enlarging of settlements, regulation of rivers, navigation, energetic exploitation and spreading of invasive species considerably contribute to their degradation. From this reason they are represented in the landscapes by a wide scale of remnants, whose naturalness and evaluation of their ecosozological significance is an object of discussions (Mucha and Lisický, 2006). While botanists have developed clear concepts of classification of vegetation units of the wetlands (Zlatník, 1976; Michalko, 1986), in zoology many contradicting opinions exist on the matter. Even habitat preference of some species is interpreted completely inadequately in relationship to wetland ecosystems (c. f. Hůrka, 1996).

The floodplain of the Žitava river includes several isolated remnants of more or less preserved natural or rather seminatural wetland ecosystems (Palatická, 2009; Porhajašová et al., 2005). Unlike other rivers in Slovakia (e.g. Morava, Danube river), compact and extensive floodplain forests have not preserved here, the floodplain vegetation being mostly represented by narrow stripes of tree vegetation or by a mosaic of groups of trees, reed swamps or alluvial meadows along the river or around the adjacent water tables.

The Carabid assemblages in different floodplain ecosystems of the Podunajská nížina lowland were studied by Porhajašová et al. (2005) and Šustek (1984, 1994a, 1997), in South Moravia by Obrtel (1971, 1973) and Šustek (1972, 1994b) and in Austria by Zulka (1994). The Carabid fauna of the arable land surrounding the studied locality was recently studied in South Slovakia by Šustek (1994) and Porhajašová (2008a, 2008b).

The aims of this study are the following:
(1) to show the spatial and temporal dynamics of structural changes of carabid communities and, (2) their interaction with communities of other Arthropods, (3) to evaluate ecosozological status of the communities studied, (4) to show the role of the habitats studied as a refuges for the floodplain fauna (5) and to characterize the ecosozological significance of this nature reserve for carabids.

Material and methods

Study area and sampling sites

The Nature Reserve Alluvium of the Žitava river (32.53 ha) was designated in 1993, being provided with the 4th degree of protection (Palatická, 2009). It is situated in the southeastern Slovakia, in the Podunajská nížina lowland, between the town of Hurbanovo and Martovce village (Fig. 1). The surroundings lay in the oak vegetation tier (Raušer and Zlatník, 1966), but the major part of the surroundings is represented by arable land or settlements. The relief of the landscape shows that an extensive system of richly meandering branches of the Žitava and Nitra rivers existed here in the past. At present, the river is partly straightened and limited by protective dikes to a narrow zone with a richly diversified mosaic of aquatic habitats (mostly pleiso- or paleopotamal), reed and cattail swamps and remnants of floodplain forests (*Salici populeta, Populi alneta*) or new plantations.

The beetles and other Arthropods were pitfall-trapped in the years 2006–2008 at four sampling sites (Fig. 1):

A – 47°51'92" N, 18°09'25" E, altitude 117 m, width of the within-dike zone 390 m, a dense growth of *Carex* spp. and a sparse stand of *Salix* spp., coverage of trees layer 35%

B – 47°51'83" N, 18°09'25" E, altitude 116 m, width of the within-dike zone 360 m, a dense growth of *Carex* spp. and *Phragmites australis* a sparse stand of *Salix* spp., coverage of trees 30%, distance from the site A 334 m

C – 47°51'09" N, 18°07'99" E, altitude 116 m, width of the within-dike zone 140 m, a dense growth of *Carex* spp., majority of the site is formed by open water table, the whole site is often flooded, especially in spring and in rainy periods in summer, distance from the site B 2 100 m

D – 47°50'81" N, 18°07'67" E, altitude 121 m, width of the within-dike zone 150 m, a dense stand of *Carex*

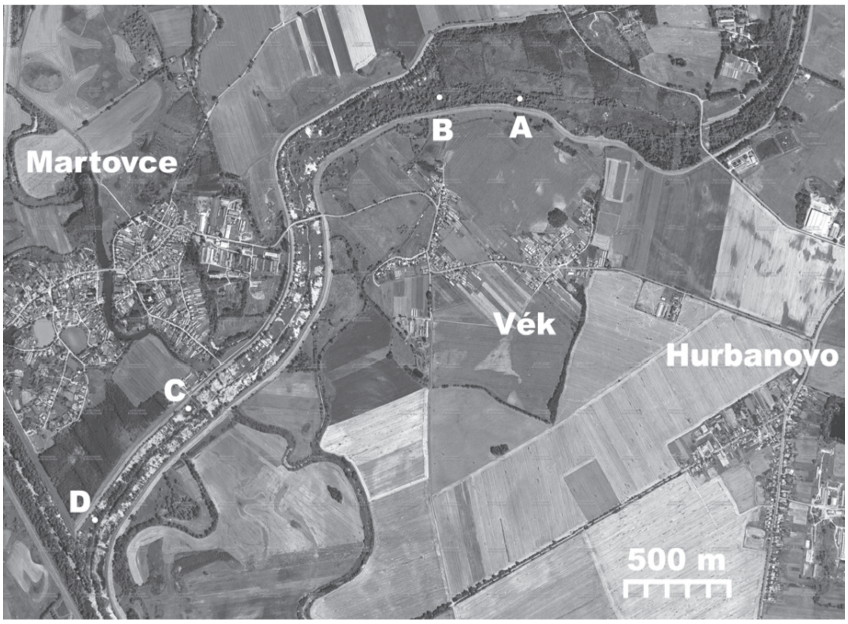

Fig. 1. Localization of four sampling sites in the Nature Reserve Alúvium Žitavy. The light patches in the left part of the alluvium correspond to open water table.

spp., on margins of permanent water tables *Typha latifolia* and *Phragmites australis* and a narrow, but continuous strip of alders and willows, coverage of trees 25%, distance from the site C 710 m.

Sampling Carabids and other Arthropods

One liter glass jars with 4% formalin and protected by a roof served as traps. In each site 1 trap was installed. Each year they were exposed from mid April to late October and emptied monthly.

Data analysis

The Carabids were identified to the species level, while other Arthropods to the level of orders or families. The nomenclature of Carabids was taken from Hůrka (1996). The data on their ecology were taken from Burmeister (1939), Knechtel and Panin (1944), Lindroth (1949) and Freude et al. (1976).The hierarchical classification of one-year samples was carried out by the unweighted average linkage method using the Whitaker's similarity index, the data being standardized by columns. The detrended correspondence analysis (DCA) and principal components analysis (PCA) were used for ordination of the data. The species diversity was expressed by the Shannon-Wienner's index (Poole, 1974). All these calculations were carried out in the program PAST and CAP. The direct ordination of the communities according to preference of species for vegetation cover and humidity was calculated according to Poole (1974). The sample scores were calculated as average of preference index of each species weighted by its abundance. Preference of Carabids for vegetation cover was expressed by a five degree semiquantitative scale (1 – open landscape species with discontinuous vegetation cover, 2 – open landscape species with continuous herbage vegetation species, 3 – eurytopic species, 4 – forests species, 5 – paludicolous species). The humidity preference was expressed by an eight degree semiquantitative scale (1 – extremely xerophilous, …, 4 – mesohydrophilous, …, 8 – polyhydrophilous) proposed tentatively by Šustek (2004).

Results

At all sampling sites we caught a total of 295 individuals and 33 species of Carabids (Table 1). At particular sites number of individuals and that of species fluctuated considerably in individual years, number of species from 2 to 13, number of individuals from 2 to 59. A constantly high number of individuals and species at one site during three years of investigation was recorded at the site C (37–59 individuals and 11–14 species), whereas at the site B their numbers were constantly very low (2–11 individuals and 2–5 species). Fluctuations in number of species and individuals at other sites did not show any coordination in time. At the site A their number dropped suddenly in 2007 and remained on that level in 2008, while at the site D it was continuously increasing from 2006 to 2008. All species (Table 1) are common or very common species in appropriate habitats in Slovakia. Only *Pterostichus cylindricus* (Herbst, 1784), *Diachromus germanus* (Linn., 1758) and *Drypta dentata* (Rossi, 1790) are more or less rare or local.

Representation of individual ecological groups of species in the entire material was very diversified (Figs 2 and 3). In spite of the alluvial character of the study area, the species of open landscape predominated (54.5%) followed by eurytopic species (12.1%), forest species (21.2%) and by paludicolous species (12.1%). Hence two thirds of species can be considered as xenocenous in the ecosystems studied. Similarly xerophilous or mesohydrophilous species represented even 48.5% of all species, while polyhydrophilous species expected to predominate represented only 30.3% of all species recorded.

Occurrence of individual species at particular sites and in particular years was very instable. Among the hydrophilous species, polyhydrophilous *Pterostichus anthacinus* (Illig., 1798) occurred abundantly and predominated (40.0%) only at the site C in 2008 and A in 2006 (10.7%). Hydrophilous *Carabus granulatus* (Linn., 1758) (48.2%) and moderately hydrophilous *Pterostichus melanarius* (Illig., 1758) (30.4%) dominated and simultaneously were also abundantly represented only in the site A in 2006 (Table 1). In 2007 and 2008, *Carabus granulatus* disappeared, being replaced by less hydrophilous *Carabus violaceus* (Linn., 1758) at all sites, especially in 2008. On the other hand, the typical open landscape species *Poecilus cupreus* (Linn., 1758) was abundantly represented and predominated (55.6%) only at the site C in 2007, but solely it occurred almost constantly in other years at the sites C and D. The strongly expansive open landscape species *Pseudoophonus rufipes* (De Geer, 1774) predominated (25.6%) only at site D in 2008, but similarly as *Poecilus cupreus* it occurred in small number of individuals in other years and sites (especially at site C and D). Other typical open landscape species, *Anchomenus dorsalis* (Pontopp., 1763), was more abundantly represented and predominated only in 2008 at the site C (24.4%) and to certain degree also at site D (10.3%).

Values of the Shannon-Wiener's index (Table 1) are very low (0.53–2.25) due a low number of species in most samples and due to a strong predominance of one species in some samples (e.g. *Pterostichus melanarius* at A6, *Poecilus cupreus* at C7, *Pterostichus antharicuns* at C8). Higher values of diversity indices were only in the samples C6 and D8 with more balanced representation of individual species. Equitability of most samples moved from 0.65 (C7) to 0.88 (C6 and D8). In the very poor samples (B6, B7 and D6) it was very high (0.90–1.00)

Table 1. Survey of Carabid species and number of individuals caught at four sites (A – D) in the Nature Reserve Alúvium Žitavy in years 2006–2008, their preference for humidity (H) and vegetation cover (V)

Species	H	V	Site and year											
			A			B			C			D		
			2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
Acupalpus parvulus (Sturm, 1825)	4	1			8						1			
Agonum moestum (Duftschmidt,1812)	8	4	2					1			1			
Amara aenea (De Geer, 1774)	3	1					1		5			1		1
Anchomenus dorsalis (Pontopidan, 1783)	3	1									11			4
Anisodactylus binotatus (FabriciuS, 1787)	6	1	1											
Bembidion biguttatum (Fabricius,1779)	8	4								1				
Bembidion lampros (Herbst, 1784)	3	1							5		4		1	3
Brachinus crepitans (Linnaeus, 1758)	3	1							1	1				
Calathus fuscipes (Goeze, 1777)	4	1							9	1		3	1	
Calathus melanocephalus (Linnaeus, 1758)	3	1								1			1	4
Carabus granulatus (Linnaeus, 1758)	7	2	27											1
Carabus violaceus (Linnaeus,, 1758)	5	4		7	1			5				1		4
*Clivina fosso*r (Linnaeus, 1758)	6	4									3			
Diachromus germannus (Linnaeus, 1758)	7	1								6				
Drypta dentata (RossI, 1790)	8	5			1			2						
Dyschirius globosus (HerbsT, 1783)	8	5	1											
Harpalus latus (Panzer, 1797)	4	1							2					
Harpalus politus (Dejean, 1829)	4	1	1						5					
Harpalus tardus (Panzer, 1797)	2	1					1		1	1			1	1
Chlaenius nigricornis (Fabricius, 1787)	8	5	2							1	1			
Licinus depressus (Paykul, 1790)	2	1								5				
Ophonus azureus (Fabricius, 1799)	2	1							2					
Poecilus cupreus (Linnaeus, 1758)	4	1							1	33	1		1	1
Pseodoophonus rufipes (Panzer, 1797)	4	1	1				3		2	7	2		5	10
Pterostichus anthracinus (Illiger, 1798)	8	4	6		1			1	1		18			1
Pterostichus cylindricus (Herbst, 1784)	4	1					1							
Pterostichus melanarius (Illiger, 1798)	5	2	14									1	7	
Pterostichus niger (Schaller, 1783)	6	4		2				2		2	1			6
Pterostichus vernalis (Panzer, 1796)	8	5				1			1					
Pterostichus oblongopunctatus (Fabricius, 1787)	5	4					1							
Stomis pumicatus (Panzer, 1796)	8	2	1		2	1			1				2	2
Syntomus obscurogutatus (Duftschmidt, 1812)	5	2							1					
Trechus quadristriatus (Schrank, 1781)	4	1									2			1
Number of individuals			56	9	5	2	7	11	37	59	45	6	19	39
Number of species			10	2	4	2	5	5	14	11	11	4	8	13
Shannon-Wienner´ index			1.54	0.53	1.33	0.69	1.48	1.41	2.31	1.55	1.81	1.24	1.73	2.25
Equitability			0.67	0.76	0.96	1.00	0.92	0.88	0.88	0.65	0.75	0.90	0.83	0.88

Explanation of habitat preference scales (humidity scale: 2 – xerophilous, ..., 8 – polyhydrophilous; vegetation cover scale: 1 – open landscape species preferring discontinuous vegetation cover, 2 – open landscape species, 3 – eurytopic species, 4 – forests species, 5 – paludicolous species)

due to individual representation of a very limited number of species. Similar values of the Shannon-Wiener's index and equitability are typical for strongly deteriorated communities in urban parks (Šustek, 1984).

The great temporal instability of community structure is well visible even at the site C, which maintained a constantly high number of species and individuals (Table 1). Even the most abundant species *Amara aenea* (De Geer, 1774), *Anchomenus dorsalis, Diachromus germanus* occurred here only once over the study on period. There was a great difference between their maximum abundance in one year and occurrence in other year (*Calathus fuscipes* (Goeza, 1777), *Poecilus cupreus, Pterostichus anthracinus*).

The described instability of occurrence of species is reflected on patterns of clustering or position of

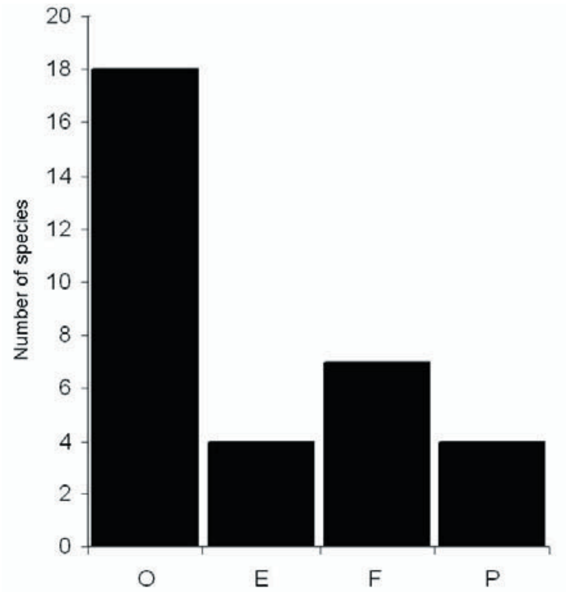

Fig. 2. Representation of species with different preference for vegetation cover in the whole material (O – open landscape species, E – eurytopic species, F – forest species, P – paludicolous species)

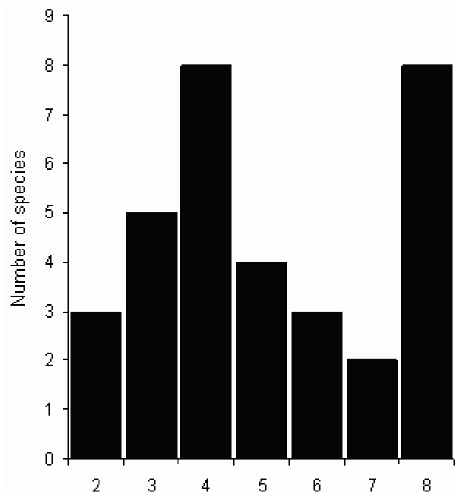

Fig. 3. Representation of species with different preference for humidity in the whole material (2 – moderately xerophilous species – 9 polyhydrophilous species)

samples in ordination spaces. In all cases an occasional coincidence of presence of a species considerably biases result of these analyses. According to Whitaker's index, the samples form the two distinct clusters at dissimilarity level 0.93. The first cluster includes predominantly the samples from the sites C and D and the samples from the site A from 2006 and B from 2007 (Fig. 4). This cluster reflects an increased relative abundance of the open landscapes species *Pseudoophonus rufipes* and *Poecilus cupreus*. The agglomeration of samples within this cluster, especially the separation of subcluster C6 and D6, is dependent on increased relative abundance of *Calathus fuscipes, Bembidion lampros* (Herbst, 1784) and *Amara aenea,* while the subcluster of the samples B7, D7 and D8 results from the absence of these species or their limited representation. The free attaching of the sample C7 and of the separate subcluster of samples A6 and C8 reflects increased relative abundance of the polyhydrophilous species *Pterostichus anthracinus*. The second cluster consists only of the samples from sites A and B with lower representation of open landscape species.

The samples and species in the biplot of the detrended correspondence analysis (Fig. 5) are arranged, in an continuous sequence, along the first axis according to decreasing humidity and along the second axis according increasing shadowing by wooden vegetation. The first axis explains 54.9% of variability of the species data, while the second axis 33.0%.

The PCA biplot (Fig. 6) separates four groups of samples. The sample from the site C from 2006,

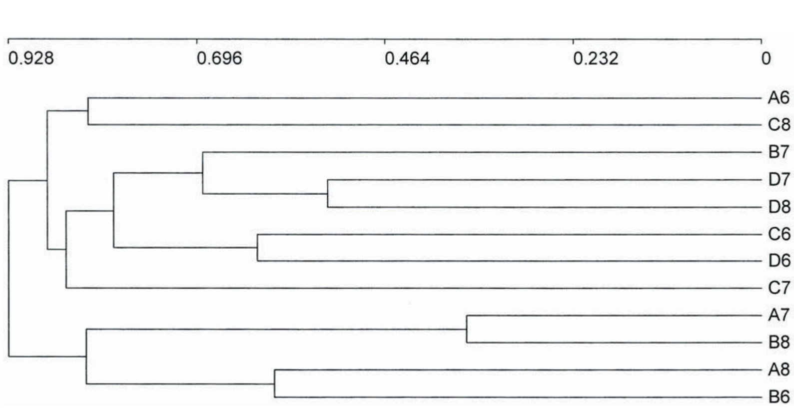

Fig. 4. Hierarchical classification of one-year samples from four sites in the Nature Reserve Alúvium Žitavy in 2006–2008 using Whitaker's index of similarity and data standardization by samples (A6, A7, …. D8 – samples from sites A–D from 2006–2008)

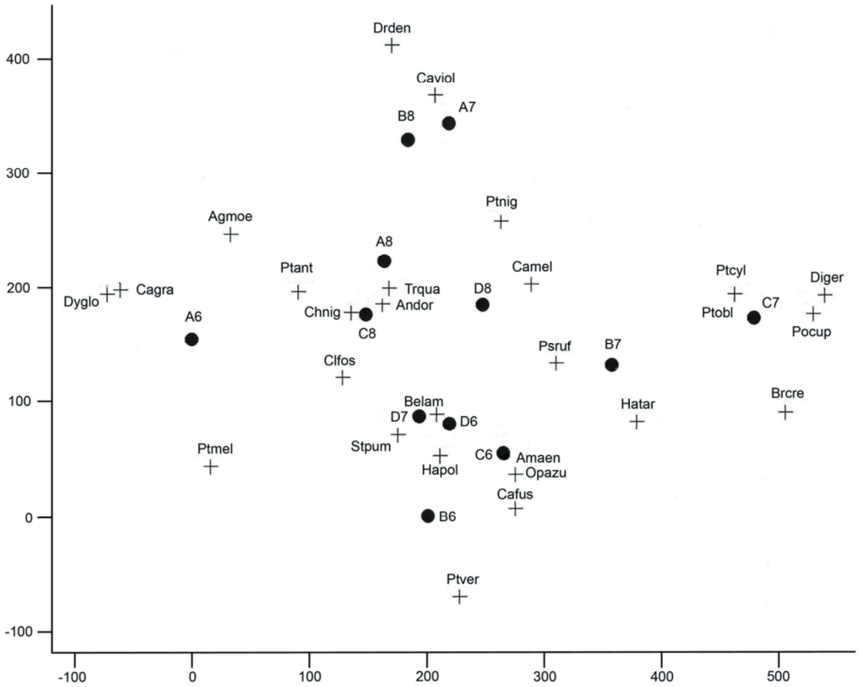

Fig. 5. Detrended correspondence analysis: biplot of the 12 one-year samples and 33 species from four sites in the Nature Reserve Alúvium Žitavy in 2006–2008 (abbreviations for samples and years as in Fig. 4, abbreviations of species consist of the first two letters of generic name and first three letters of specific name given in Table 1). The first axis represents humidity decreasing from left to right, while the second axis the shadowing decreasing from up to down.

characterized especially by a higher abundance of the open landscape species *Bembidion lampros, Harpalus politus* (Dejean, 1829) and *Calathus fuscipes,* takes an isolated position in the left lower part of the ordination space. The samples from the sites A from 2006 and C from 2008, characterized by co-occurrence of two hydrophilous species (*Carabus granulatus, Prerostichus anthracinus*) accompanied at the site A by further hydrophilous species, are situated in the right lower part of the ordination species. The sample from the site C from 2007 characterized by an abundant co-occurrence of *Poecilus cupreus* and *Pseudoophonus rufipes* takes an isolated position in the central upper part of the ordination diagram. In the central part of the diagram a close group of eight samples from the sites A, B and D is situated. Among them, samples from the site D are moderately shifted upwards. This group is characterized by less pronounced differences in quantitative representation of individual species and by a more balanced representation of principal ecological groups of species. Thus, the first axis represents the humidity gradient (increasing from left to right) and the second axis the gradient of vegetation cover preference (shadowing increasing from up to down). The PCA also illustrates the great instability of the community at the site C. The first axis explains 24.1% of variability, while the second axis 18.6%.

The direct ordination (Fig. 7) distinguishes the two groups of samples shown by correspondence analysis (Fig. 5) much clearer, being independent on incidental presence of a species, but integrating occurrence of species according to habitat preference. In the left lower part of the ordination diagram a closed group, including all samples from the sites D, two samples from the site C (2006 and 2007) and one from the site B (2007), may be noticed. This group is characterized by predominance of mesohydrophilous open landscape species. In the right upper part of the diagram a group of freely dispersed from the site A (all), B (2006 and 2008) and C (2008), which is shifted toward the precedent cluster. This group is characterized by a tendency to predominance of hydrophilous or even polyhydrophilous species demanding continuous shadowing by wooden vegetation. Relative position of individual samples shows a general trend to increased representation of more hydrophilous species in 2008 represented especially by *Pterostichus anthracinus* and *Drypta dentata*.

The detrended correspondence analysis (Fig. 6) and the direct ordination (Fig. 7) separate the samples from the narrower and wider part of the studied stretch of the floodplain (Fig. 1).

Among other Arthropod groups (Table 2), occurrence of Carabids showed an unclear positive correlation (r = 0.05–0.25) with *Diplopods*, *Isopods*, other *Coleoptera*, ants and mites (Fig. 8). In the case of *Diplopods*, *Isopods* and other *Coleoptera* this correlation reflects rather a reduced dependence between these groups and Carabids or a slightly similar habitat preference.

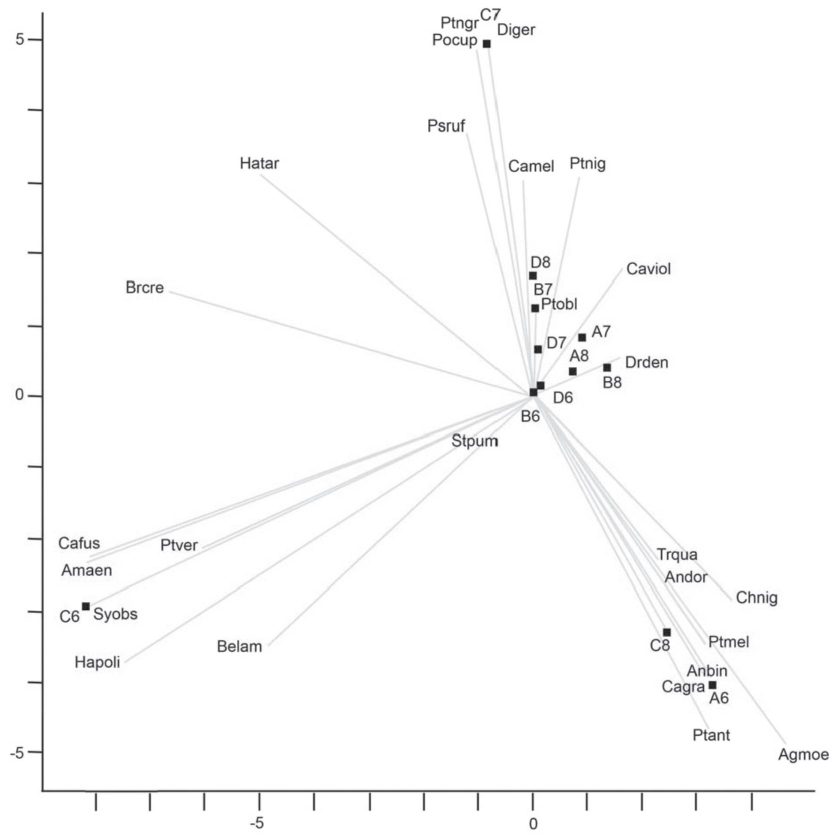

Fig. 6. PCA analysis of the 12 one-year samples and 33 species from four sites in the Nature Reserve Alúvium Žitavy in 2006–2008 (abbreviation of samples, years as in Fig. 4, abbreviations of species as in Fig. 5). The first axis represents humidity increasing from left to right, while the second axis the shadowing decreasing from up to down.

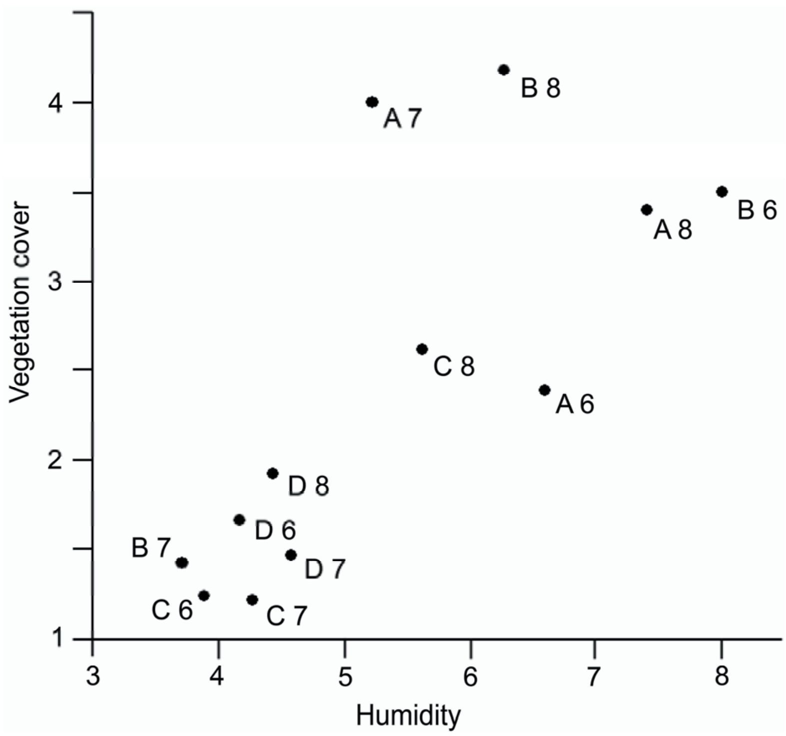

Fig. 7. Direct ordination of one-year samples at four sites in the Nature Reserve Alúvium Žitavy in 2006–2008. (Abscissa – vegetation cover preference: 1 open landscape species, 4 species demanding shadowing by wooden vegetation; ordinate – humidity preference: 3 mesohydrophilous species with reduced requirementsfor humidity, 8 – polyhydrophilos species, abbreviation for samples and years as in Fig. 4.)

A lower correlation between occurrence of Carabids and ants can express a trophic competition of both groups or even predation of Carabid larvae by ants. A stronger negative correlation (r = 0.37 and 0.41) exists between Carabids and spiders and harvestmen (*Opilionidea*), what might indicate a competition between Carabids and other two predatory groups taking a similar position in the trophical pyramid or even a predation of spider and harvestmen by some carabids. The negative correlation between the occurrence of carabids and collembolans might reflect predation of collembolans by carabids, but at any site the species of *Notiophilus*, the highly specialized collembolan-eaters, did not occurred. It is to be interpreted rather as consequence of different habitat preference.

Discussion

The carabid communities at all the study sites showed a very low cumulative abundance in comparison with the natural communities in natural floodplain forests (Obrtel, 1971; Šustek, 1972, 1994a, 1994b; Šustek, 2006; Zulka, 1994) or reed stands (Obrtel, 1973). A similarly low number of species, low cumulative abundance and unpredictable and clearly undetermined ecological structure of community was observed only in extremely deteriorated geobiocenoids of floodplain forests at margins of Bratislava (Šustek, 1984), in the Váh river floodplain (Šustek, 1997) or in remnants of floodplain forests (Dunajské kriviny) most affected by changes in hydrological regime in the area of the

Table 2. Abundance of arthopods at four sites (A–D) in the Nature Reserve Alúvium Žitavy 2006–2008 (6, 7 and 8)

Arthropod group	Site and years											
	A			B			C			D		
	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
Diplopoda	47	19	38	0	3	22	0	0	20	1	7	35
Isopoda	181	35	65	23	109	200	12	12	20	5	25	107
Coleoptera	160	99	57	51	94	23	145	16	32	23	44	57
Opilionida	9	30	18	4	8	5	0	1	0	0	5	4
Carabidae	56	9	5	2	7	11	37	59	45	6	19	39
Formicoidea	72	54	60	34	70	37	210	15	119	136	42	68
Araneidea	88	124	79	91	180	133	103	36	54	30	81	78
Acarina	63	38	85	22	36	204	52	38	248	57	52	145
Collembola	242	162	628	276	266	198	137	30	526	216	71	133

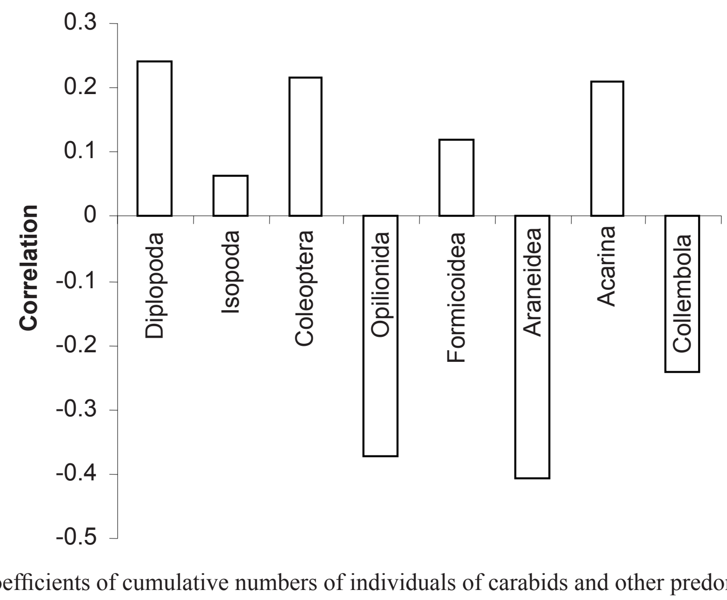

Fig. 8. Correlation coefficients of cumulative numbers of individuals of carabids and other predominant arthropod groups

Gabčíkovo hydraulic structures (Šustek, 2006). The low number of carabids is in an obvious discordance with high number of other arthropods (Table 2) and obviously results from the ecological state of the sites studied. It partly results from a longer overflooding of the studied sites.

Replacement of *Carabus granulatus* by *Carabus violaceus* and its subsequent gradation is one of two characteristic features of qualitative degradation of carabid communities in floodplain forests. It was observed in the Nature Reserve Apáli (about 6–7 km southwesterly from the Nature Reserve Alúvium Žitavy) and also in the Váh river floodplain area (Šustek, 1994a, 1997). Other similar manifestation is a striking gradation of *Carabus coriaceus* in floodplains forests of the Svratka river or the Čičovské mŕtve rameno Nature Reserve (Šustek, 1972, 1994a).

Penetration of open landscape species is obviously connected with the width of the within dike zone. The communities at sites A and B situated in the wide part of the zone (340–390 m) were obviously much less invaded by the xenocoenous species than the communities at sites C and D situated in the narrow part of the zone (140–150 m). However, the larger width of the within dike zone in the sites A and B was not able to compensate other unfavorable factors (probably disintegration of the tree layer and possibly also isolation of the locality), as can be shown by structure of carabid communities in various line formations of wooden vegetation in agrarian landscape, like hedges or windbreaks, where forest species can predominate, of course under favorable conditions, even in 20 m wide stretches (Šustek, 1992, 1994c). Isolation of the locality could influence composition of the carabid communities only in the case of stenotopic species of mesohydrophilous forests (normal and xerophilous hydrical series (Raušer and Zlatník, 1966) that are unable to fly. On the contrary, most species of floodplain forests (group of geobiocoens Salici Alneta) are able to fly and rapidly colonize even considerably isolated wetland localities (Šustek, 1994d).

The instability of representation even of open landscape species, as manifested especially at the site C (Table 1, Fig. 6) shows that the area studied is newly colonized each year from other immigration sources, in dependence of the actual crops in surrounding arable land and in other part of vegetation season. It is manifested, first of all, by mutual relation of *Poecilus cupreus* as a spring breeder and *Pseudoophonus rufipes* as and autumn breeder and seasonal changes of representation of these species in cultures of different crops (Cardamo and Spence, 1994; Porhajašová et al., 2008a). A similar pulse-like colonization by *P. cupreus* was also observed in the carabid communities in High Tatra damaged by wind disaster in November 2004 and additionally affected by fire (Šustek, 2009).

Conclusions

Comparison of the 12 one-year samples from the 4 sites in the Nature Reserve Alúvium Žitavy shows that the Reserve serves, to certain degree, as a refuge for a considerable number of hydrophilous carabid species in the purely agrarian landscape. However, their assemblages are instable over time and suffer from a strong species turnover from year to year. Structure of the carabid assemblages corresponds to the assemblages in the most deteriorated remnants of floodplain forests along the Váh river or in the most affected part of the Danube inland delta in the area of the Gabčíkovo hydraulic structures. From this point of Reserve view, the Reserve has a much greater significance for other plant and animal groups than for the carabids.

The carabid fauna from the surrounding fields or villages obviously interferes with the fauna in the reserve. This influence is particularly evident in the narrow part (140–150 m) of the floodplain (sites C and D), while in the wider part (340–490 m) of the alluvium this interference is limited. This part had a more natural structure of the assemblages over the whole investigation study period in spite of the fact that it was drier than the narrow part, where many standing water bodies could supply favorable conditions for the hydrophilous riverbank species.

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Priestorové zmeny a sukcesia spoločenstiev bystruškovitých (Coleoptera, Carabidae) v poloprirodzených mokradných biotopoch v nive rieky Žitavy

Súhrn

Spoločenstvá bystruškovitých študované v rokoch 2006–2008 na štyroch lokalitách v Prírodnej rezervácii Alúvium Žitavy vykazovali vysoký stupeň narušenia a nestability. Indikoval ho nízky počet druhov a jedincov a prevaha mesohydrofilných druhov otvorenej krajiny nad hydrofilnými druhmi charakteristickými pre mokrade. Spoločenstvá vykazovali veľké medziročné rozdiely v druhovom zložení, bez zrejmého spoločného trendu. Výskyt druhov otvorenej krajiny bol vyšší v úzkom úseku (150 m) alúvia ako v širokom úseku (340–390 m), avšak aj tu bol ich výskyt vyšší ako v líniových formáciách drevinnej vegetácie širokých 10–20 m. Napriek tomu táto prírodná rezervácia plní úlohu biocentra pre mokradné druhy bystruškovitých v intenzívne využívanej poľnohospodárskej krajine.

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