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CHANGES IN CARABID (COLEOPTERA, CARABIDAE) COMMUNITIES ALONG A MOISTURE GRADIENT

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Abstract:

Carabid beetles in the Jurský Šúr nature reserve were studied in three plots whit different hydrological regimen. The community in the alder forest locally flooded over the major part of vegetation period was characterised by presence of strongly hydrophilous *Carabus clathratus* and by the highest number of species and individuals, but by the lowest dry biomass of the whole one year catch. The community in the non flooded alder forest preserved a high number of species and individuals, but showed an increased cumulative biomass. Both these communities were not penetrated by xenocoenous species. In contrast, the community in oak-hornbeam forests had little common species with communities in both alder forests, showed the lowest number of species and individuals and exhibited the highest cumulative biomass. It was penetrated by a considerable number of xenocoenous species while many typical forest species occurring in other oak-hornbeam forests were absent. The communities in both alder forests showed, that the partial artificial drying of this floodplain ecosystem in the resulted only in moderately quantitative differences in representation of the species continuing. The reduction of floods was, in this case, compensated by a high level of ground water.

Introduction

Monitoring of environmental changes, irrespectively of natural or anthropogenous origin, is of a great importance for an effective environment management, nature protection and care at natural resources. One of the most suitable model animal groups for such monitoring are the Carabid beetles. Their great species diversity and large scale of adaptations to different ecological conditions enables them to inhabit almost all terrestrial ecosystems and to sensitively reflect any environmental changes, often much earlier then other organisms, particularly the plants. However, the correct interpretation of field data must be based on a rich comparative material and the knowledge of autecology and synecology of these beetles must be continuously deepened and enlarged.

The aim of this contribution is description of structural differences between three communities in an almost natural permanently locally inundated floodplain forest, in an adjacent rarely inundated floodplain forest and in a nearly situated xerotermophilous forest.

Material and Method

The beetles were pitfall trapped in three sites in the Jurský Šúr nature reserve at the northern margin of Bratislava (E 17° 14′ 10″, N 48° 13′ 38″, altitude 132-133 m) and eastern margin of the Svätý Jur village. In each site, 10 pitfall traps (opening diameter 75 mm, 4% formalin as conservation solution) were exposed since 25 April until 28 October 1988 and emptied in one month intervals.

One sampling site was situated at the shores of the Blahutov kanál channel in a natural alder forest (group of geobiocoens *Salici Alneta* in sense of the Zlatník's typological system, in MÁLEK (1983)), This site was very moist and locally flooded over the whole vegetation period. This site approximated to the original natural state of this forest before its regulation in 1940-ies. The second site was situated

in the rarely inundated mature alder forest (also belonged to the group of geobiocoens *Salici Alneta*), about at mid-distance between the Blahutov kanál channel and the Biological Station of the Comenius University of Bratislava. This site was drier (also belonged to the group of geobiocoens *Salici Alneta*), never flooded during the investigation period. In both sites, a high and richly developed herbage stratum consisted almost exclusively of *Urtica dioica*. The shrub stratum was developed locally. The third site was a mature oak-hornbeam forest (group of geobiocoenes *Carpini Querceta*), with locally developed shrub and herbage strata.

The names of Carabid species are adopted according to HŮRKA (1996). The ecological characteristics of species were taken from LINDROTH (1949), THIELE (1977), ŠUSTEK (1984, 2004) and partly from HŮRKA (1996). The ecological indices were calculated and direct ordination of the communities were made according to methids descrided by Šustek (2002).

Results

The species number (Tab. 1) ranged from 24 in the oak-hornbeam forest to 31 in the permanently locally submerged alder forest. Cumulative abundance (Tab. 1, Fig. 1) ranged from 379 individuals in the oak-hornbeam forest to 964 in the non-flooded alder forest and 1092 in the flooded forest. The cumulative dry biomass showed an inverse trend - 298.5 g in the permanently flooded site, 428.7 g in the non-flooded site and 513.2 g in the oak-hornbeam forest (Fig. 2). This difference was caused by predominance of small sized species in both alder forests and a high dominance (42.7% of individuals and 54,8% of biomass) of *Carabus nemoralis* in the oak-hornbeam forests.

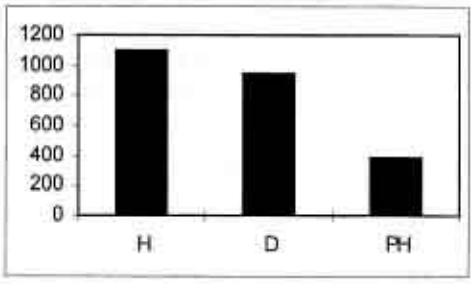

Fig. 1. Number of individuals of Carabids (ordinate) in one year catch in three sites in the Jurský Šúr forest (H - more humid alder forest, D - drier alder forest, PH - Panonský háj oak-horrnbeam forest).

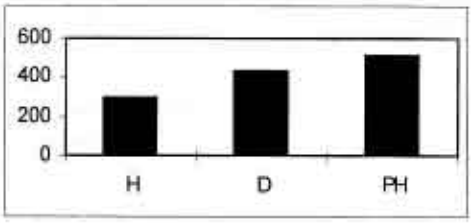

Fig. 2. Dry biomass in grams of Carabids (ordinate) in one year catch in three sites in the Jurský Šúr forest (abbreviations as in Fig. 1).

As to the species composition, the communities in both alder forests had 21 common species (Sorensen´s index 71.2%), among which three eudominant species, *Agonum moestum, Carabus granulatus* and *Pterostichus anthracinus* strongly contributed to the high dominance identity (59.2%) of these communities. However, individual species showed an obvious inverse trend in preference of moisture (Tab. 1).-*Agonum moestum, Pterostichus anthracinus, Pterostichus nigrita, Platynus assimilis* and *Patrobus excavatus* preferred the moister site, while *Platynus krynickyi* and *Carabus granulatus* the drier site. The strongly hygrophilous *Bembidion biguttatum, Elaphrus uliginosus* and particularly *Carabus clathratus* occurred only in the muddy moist site. Preference of *Agonum*

krynickyi for the drier site is in contradiction with experience from other localities, where this species seems to be more hygrophilous than *Platynus assimilis.*

The community in the oak-hornbeam forest consisted of only two highly eudominant species (*Abax ater* - 39.1% individuals and 33.2% of biomass, *Carabus nemoralis* - 42.7% individuals and 54.83% of biomas). All other species were represented only individually (1-10 ind.) but the large sized *Carabus coriaceus* considerably contributed to the biomass of the whole catch (10.3%). So, only three species represented 98.3% of the total biomass.

Tab. 1. Survey of species abundance and biomass in three sampling sites along a moisture gradient in the Jurský Šúr forest and their ecological characteristics (H - humid site, D - drier site, PH - Panonský háj xerothermophilous forest, I - individuals, B - biomass, W - average weight of individuals in g, M - moisture preference of species: 1 = most xerophilous, 8 = most hydrophilous, V - relation to vegetation cover: 1 = open landscape species, 2 = eurytopic species, 3 = forest species, = ripicolous species).

Species	Ecology			H		D		PH	
	W[g]	M	V	I	B	I	B	I	B
Abax ater (Villers, 1789)	1.1521	3	3					148	170.5
Abax paralellus (Duftschmidt, 1812)	0.5124	4	3					1	0.51
Acupalpus meridianus (Linnaeus, 1761)	0.0064	6	1			1	0.01		
Agonum moestum (Duftschmidt, 1812)	0.0764	8	3	399	30.48	143	10.92		
Amara aulica (Panzer, 1797)	0.2961	3	1					1	0.29
Amara consularis (Duftschmidt, 1812)	0.031	3	1					6	0.18
Amara ovata (Fabricius, 1792)	0.0213	3	1					2	0.04
Amara saphyrea Dejean, 1828	0.0224	3	2.5					3	0.06
Amara similata (Gyllenhal, 1810)	0.0221	3	2.5					5	0.11
Anchomenus dorsalis (Pontoppidan, 1763)	0.0419	3	1					5	0.21
Badister meridionalis (Puel, 1925)	0.0061	6	2	1	0.01	2	0.01		
Badister peltatus (Panzer, 1797)	0.0265	8	2	4	0.11	18	0.48		
Badister sodalis (Duftschmidt, 1812)	0.0212	7	2	8	0.17	5	0.11	1	0.02
Badister unipustulatus Bonelli, 1813)	0.0286	7	2			12	0.34		
Bembidion articulatum (Panzer, 1796)	0.0172	8	4						
Bembidion biguttatum (Fabricius, 1779)	0.0181	8	3	83	1.5				
Bembidion lampros (Herbst, 1784)	0.0172	3	1	1	0.02			1	0.02
Bembidion minimum (Fabricius, 1792)	0.0041	8	4	1	0.01				
Bembidion punctulatum Drapiez, 1820	0.0168	8	4	1	0.02				
Bembidion tetracollum Say, 1823	0.0171	8	4	3	0.05				
Carabus clathratus Linnaeus, 1761	1.8231	8	2		0				
Carabus coriaceus Linnaeus, 1758	6.595	5	3		0			8	52.76
Carabus granulatus Linnaeus, 1758	1.1215	7	2	173	194	315	353.3		
Carabus nemoralis O. F. Müller, 1764	1.737	4	3		0		0	162	281.4
Dyschirius globosus (Herbst, 1783)	0.0035	8	4	9	0.03	5	0.02		
Elaphrus uliginosus Fabricius, 1792	0.0624	8	4	16	0.99	9	0.56		
Europhilus fuliginosus (Panzer, 1809)	0.0364	8	3	2	0.07	7	0.25		
Europhilus micans (Nicolai, 1822)	0.0313	7	3	4	0.13	10	0.31		
Harpalus atratus Latreille, 1804	0.1561	4	3			18	2.81		
Harpalus latus (Linnaeus, 1758)	0.1773	4	1			1	0.18		
Leistus ferrugineus (Linnaeus, 1758)	0.053	4	2	1	0.05				
Lorocera pilicornis (Fabricius, 1775)	0.0428	4	2	6	0.26				
Notiophilus biguttatus (Fabricius, 1799)	0.024	4	2		0			1	0.02
Notiophilus palustris (Duftschmidt, 1812)	0.0241	4	2	2	0.05				
Notiophilus rufipes Curtis, 1829	0.0239	4	2		0			7	0.17

Oodes gracilis A. et G. B. Villa, 1833	0.0921	8	2		0	1	0.09		
Oodes helopioides (Fabricius, 1792)	0.0814	8	2	14	1.14	51	4.15		
Oxypselaphus obscurus (Herbst, 1784)	0.0321	7	3	16	0.51	10	0.32		
Panageus bipustulatus (Fabricius, 1775)	0.023	4	1			1	0.02	1	0.02
Paranchus albipes (Fabricius, 1796)	0.0561	8	4			2	0.11		
Patrobus atrorufus (Stroem, 1768)	0.0791	7	3	67	5.3	14	1.11		
Platyderus rufus (Duftschmidt, 1812)	0.052	3	3				0	1	0.05
Platynus assimilis (Paykull, 1790)	0.0825	7	3	32	2.64	1	0.08		
Platynus krynickyi (Sperk, 1835)	0.0782	8	3	24	1.88	82	6.41	1	0.08
Platynus livens (Gyllenhal, 1810)	0.0755	8	3	1	0.08	47	3.55	1	0.08
Poecilus cupreus (Linnaeus, 1758)	0.271	4	1					4	1.08
Pseudoophonus rufipes (De Geer, 1774)	0.4995	3	1					7	3.49
Pterostichus anthracinus (Illiger, 1798)	0.0831	8	3	122	10.14	113	9.39		
Pterostichus diligens (Sturm, 1824)	0.557	7	2			5	2.78		
Pterostichus minor (Gyllenhal, 1827)	0.0522	8	4			13	0.68		
Pterostichus niger (Schaller, 1783)	1.06	6	3	27	28.62	13	13.78		
Pterostichus nigrita (Paykul, 1790)	0.0812	8	2	44	3.57	34	2.76		
Pterostichus oblongopunctatus (Fabricius, 1787)	0.1942	5	3	1	0.19			10	1.94
Pterostichus ovoideus (Sturm, 1824)	0.0521	4	2					1	0.05
Pterostichus strenuus (Panzer, 1797)	0.51	7	2	19	9.69	14	7.14		
Pterostichus vernalis (Panzer, 1796)	0.532	8	4	8	4.26	15	7.98		
Stenolophus mixtus (Herbst, 1784)	0.389	8	1	1	0.39				
Stomis pumicatus (Panzer, 1796)	0.052	6	2	2	0.11	2	0.11		
Parachys bistriatus (Duftschmidt, 1812)	0.0042	8	4					1	0.01
Trechus quadristriatus (Schrank, 1781)	0.062	4	1					1	0.06
Number of individuals				1092	296.5	964	429.7	379	513.2
Number of species				31		28		24	

When compared with other communities in similar conditions (e. g. ŠUSTEK 1983a), the community in oak-hornbeam forest was poorer, particularly in regard to representation of other species of genera *Carabus, Abax* and *Pterostichus*.

The composition of the community in the oak-hornbeam forest strongly differed from both alder forests. There where only three species common with both communities in alder forests and three species common with one of them. All these species were represented only individually on the oak-hornbeam forests. (Tab. 1). Some of them (*Badister sodalis, Platynus livens*) only penetrated to the oak-hornbeam forest from the alder forests or from other wetland habitats in surroundings. *Bembidion lampros* was a xenocoenous species in all three localities.

As to species composition, the community in the oak-hornbeam forest, unlike both alder forests, exhibits a considerable number of xenocoenous open landscape species (*Amara* spp., *Pseudoophonus rufipes, Bembidion lampros, Trechus quadristriatus, Poecilus cupreus,* tab. 1). These species represented almost 35% of the species spectrum, 7% of individuals and about 1% of the total biomass (Fig. 3). On the contrary, in both alder forests they do not exceed 10% of species and their quantitative representation, as in terms of number of individual as biomass, is negligible (Fig. 3).