

THE COMPARISON OF THE CARABIDAE AND STAPHYLINIDAE (INS.,
COL.) IN THE SELECTED GEOBIOCENOSES OF PAVLOVSKÉ KOPCE
HILLS DURING THE YEARS 1971—1981

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The comparison of the *Carabidae* and *Staphylinidae* during the years 1971—1981 indicates the start of extinction of less anthropotolerant species and their substitution by more tolerant species. All cenoses became mutually more similar during 1981 than during 1971. The principal reasons of the observed changes is the local nitrification of the soil by the ungulate excrements, on one hand, and the general humidization of climate in Pavlovské kopce hills on other hand. On the basis of the present material, it is impossible to decide if the humidization is an effect of natural climatological changes or if it is a result of the finishing two large water dams. Irrespective the remaining open question, the fact that Pavlovské kopce hills lose the character of an ecologically differentiated and valuable macrohabitat represents a serious warning for future.

The limited area, the neighbourhood of agricultural lands subjected to the influence of the intensive agriculture, constructions of large water dams, high stands of game animal and the pressure by the tourism, are the factors responsible for the changes in the geosystem of Pavlovské kopce hills at present. These changes are so extensive that the questions arise, if the protection measures may correspond the expected effect. Several efforts to solve the above question occur in the discussions of specialists and in literature (Grulich, 1979; Povolný, Šustek, 1982) as well. The aim of present paper is to contribute to this discussion by some concrete data based on a comparison of Carabid and Staphylinid communities in five geobiocenoses of Pavlovské kopce hills, where both families were studied during the vegetation periods 1971 and 1981.

Material and methods

The beetles were sampled in the segments of geobiocenoses belonging to the following groups of geobiocenoses: *Corni Querceta* deg. (oak vegetation tier), *Carpini Querceta* [oak veg. tier], *Fagi Querceta* (Beech-oak veg. tier), *Tiliae Acereta* inf.

and *Tiliae Acereta* sup. (pech-oak and oak beech vegetation tier), (Zlatník, Raušer, 1966). The segments were placed as shows fig. 1. No changes in the plant communities composition and in their spatial structure were observed in the geobiocenoses CoQ deg., CaQ, FQ and in TAc sup. if comparing their state during 1971 and 1981. The original vegetation cover in the TAc inf., however, was displaced by continuous cover of *Urtica dioica* in herbaceous stratum and by *Sambucus nigra* in shrub stratum. This change can be interpreted as a consequence of washing the ungulate excrements down from the slopes above this geobiocenosis and of the nitrification of the soil.

The pitfall trapping was applied for sampling beetles. Ten traps with 2 % solution of formalin were exposed in the middle of each geobiocenosis, in one line, in about 10 m distance. The traps were stationed on same places during both seasons. The maximum error of the stationing of the traps corresponds about 5–10 m. The beetles dropping into the traps were sampled during one month intervals.

The following indices were applied for the mathematical evaluation of the results: Jaccard's index of similarity, Renkonen's index dominance identity, Shannon-Wiener's index of diversity, Simpson's Index of dominance concentration. Weight average clustering was applied for the classification of species spectra.

The differences in the spectra studied

The comparison of all *Carabidae* and *Staphylinidae* communities is based on 13 875 individuals belonging to 130 species (tab. 1). The number of individuals and the biomass were larger during 1981 than during 1971 (tab. 2). The only exception is CoQ deg. where the number of individuals was lower 1981 than during 1971 but the biomass was much larger due to immigration of two large sized species, viz. *C. coriaceus* and *C. hortensis*, from the surrounding forest geobiocenoses. The species number observed during 1981 was larger than during 1971. The higher number of species was proportional to the higher number of individuals. The low value of the sum of dominances in such species, the limited numbers of individual and the low dominance of the species which occurred either during the year 1971 or during the year 1981,

indicate that these species could be expected to occur in every geobiocenosis studied during a correspondingly long period. In our samples the occasional immigrants from the surrounding agricultural land (*Amara* spp., *Harpalus* spp.) and from the lowland forests (*B. multipunctata*, *P. anthracinus*), (tab. 1) were found.

The striking change in the species spectra observed was the decrease of abundance in the myrmecophilous Staphylinid *Z. humeralis* in TAc inf. It was caused by a total destruction of the nest of *Formica* sp. The high number of individuals of psychrophilous *F. sulcata* in TAc inf. observed during 1981 is probably due to the increase in the humidity of mesoclimate of the Pavlovské kopce hills. The occurrence and the surprisingly high abundance of the Staphylinid *O. mus* might be interpreted as an effect of its general expansion to the northwest direction. Its

occurrence was known from only a few localities in south Slovakia until 1971. Its first findings in Moravia were registered during the year 1971 (Šustek, 1977). In view of its present extensive occurrence in the immediate parks of centrum of Bratislava during 1981 (Šustek, unpublished) the question, arises, if this species is a cultural follower, expanding in a similar way as some ruderal plants do.

The most striking change observed in CaQ, TQ, TAc inf. and TAc sup. is the absence or an extreme decrease in the abundance of *C. cancelatus* and *C. ulrichi*. The ecological niche left by them has been occupied by *C. hortensis* and, in a limited scale, also by *C. coriaceus*, *C. nemoralis* and *A. ater*. The proportion of the biomass dominance of *C. cancelatus* and *C. ulrichi* during 1971 and of *C. hortensis* during 1981 is approximately equal (fig. 2). This change could be seemingly interpreted as typical effect of the interspecific competition between the equally sized species in the same trophical level. This interpretation is, however, not acceptable because of the high abundance of *C. hortensis* which it reaches in some anthropogenous influenced forests, in coniferous monocultures, clearing and in some urban parks. Consequently this phenomenon is not an effect of the preference of such biocenoses but an effect of a high degree of tolerance of anthropically changed habitats. *C. hortensis* reaches high abundance in such habitats due to the lacking competition pressure by less tolerant species. Contrary, *C. cancelatus* and *C. ulrichi* are the first Carabids in Central Europe disappearing from the disturbed ecosystems (idealized transect Železná studienka, Sitniny, Horský park and Kalvária in Bratislava, Šustek, unpublished; Kohoutov, Šustek, 1981; some parks in Brno, Šustek, Vašátko, in press). They do not occur in the present urban ecosystems. From the above facts it follows that the disappearance of these species represents a start of the extinction of less anthropotolerant species and of their substitution by more tolerant ones.

The species spectrum in CoQ deg. included only characteristic xerothermophilous species (*L. cassideus*, *D. rufipes*, *H. picipes* and *S. erichsoni*) and the species of cultural

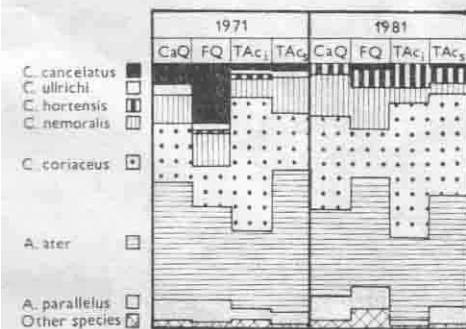


Fig. 2. Relations of the dominance of biomass of the large sized *Carabidae* and of other species in four forest geobiocenoses during the year 1971 and 1981. (Abbreviations as in fig. 1.)

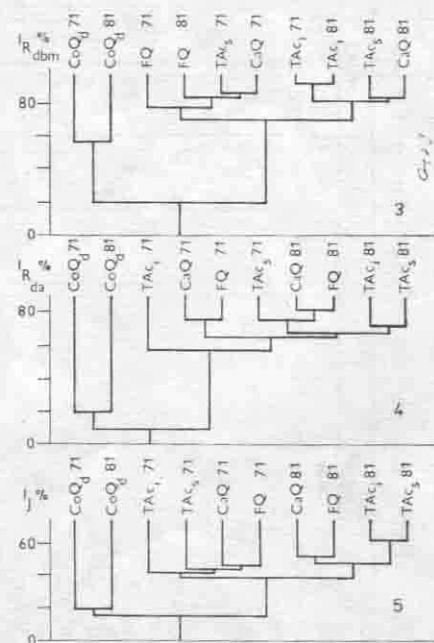


Fig. 3–5. Clustering of the species spectra observed during 1971 and 1981 after their dominance of biomass (fig. 3), dominance of activity (fig. 4) and after the similarity of species composition (fig. 5). (Abbreviations as in fig. 1.)

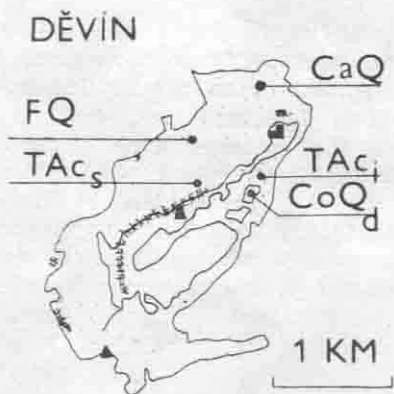


Fig. 1. Dislocations of the geobiocenoses studied in the Pavlovské kopce hills [CaQ — *Corni Querceta*, FQ — *Fagi Querceta*, TAc s. — *Tilliae Acereta superiora*, TAc i. — *Tilliae Acereta inferiora*, CoQ deg. *Corni Querceta degener*].

Table 1

Actively abundance of Carabidae and Staphylinidae during the years 1971 and 1981, and mean biomass per individual (M)

Species occurred	Group of geob. year		CoQd		CaQ		FQ		TACI		TAcS		M 9-5
	71	81	71	81	71	81	71	81	71	81	71	81	
<i>Carabidae:</i>													
<i>Carabus cornexus</i>							1	1	19	7		2	11212
<i>Carabus cancellatus</i>					49		259	29	2		19		13600
<i>Carabus ulrichi</i>					26		30	1	13			1	15132
<i>Carabus hortensis</i>			5			39	5	62	18	143	15	67	17800
<i>Carabus nemoralis</i>					54	152	102	152	70	97	90	42	17370
<i>Carabus coriaceus</i>	3	49			29	92	35	43	150	230	36	107	65950
<i>Calosoma inquisitor</i>									1				17457
<i>Leistus rufomarginatus</i>					2	10	64	10	4	11	2	1	16412
<i>Leistus ferrugineus</i>					4			10	7	2	7	17	795
<i>Notophilus palustris</i>						10	10	15	4	3	10	4	500
<i>Blethisa multipunctata</i>						1							241
<i>Loricera cearulescens</i>									1				834
<i>Dyschirius rufipes</i>	1	1							1				428
<i>Asaphidion flavipes</i>									12	18			32
<i>Bembidion lampros</i>									1	1			192
<i>Bembidion biguttatum</i>	1									1			172
<i>Trechus quadristriatus</i>					2	5	4	4	2	3	1	1	110
<i>Trechus secalis</i>							1		1				120
<i>Chlaenius tristis</i>									1				4236
<i>Bodes helopioides</i>									1				814
<i>Badister bispulvatus</i>									1	1			381
<i>Licinus cassideus</i>	2	1							1				1680
<i>Harpalus azureus</i>							1		79	6		1	1002
<i>Harpalus punctatulus</i>										16			1290
<i>Harpalus rufibarbis</i>					7	-30	3	5	1	3	1	2	1000
<i>Harpalus rufipes</i>						1				3			4126
<i>Harpalus distinguendus</i>						1				3			1873
<i>Harpalus latus</i>						1	3	5	71	67	1		1779
<i>Harpalus atratus</i>	2	2											1561
<i>Harpalus pictipennis</i>	3					1	1						240
<i>Harpalus tardus</i>						1							350
<i>Harpalus luteicornis</i>						1	1						329
<i>Amara cursitans</i>	1					2					2		206
<i>Amara similata</i>													211
<i>Amara curia</i>													200

<i>Amara cursitans</i>	1													206
<i>Amara similata</i>														211
<i>Amara curia</i>	4													200
<i>Amara aenea</i>	1					5		1		1		1		208
<i>Amara familiaris</i>										2				102
<i>Amara onata</i>										15	1			213
<i>Stomis pumicatus</i>														520
<i>Pterostichus cupreus</i>														2125
<i>Pter. vulgaris</i>														421
<i>Pter. oblongopunctatus</i>	4	2			1	1	8	3	67	19	1	10	1921	831
<i>Pter. anthracinus</i>														520
<i>Pter. ovoideus</i>	2	1				1	7	3	4	3		1		812
<i>Pter. nigrita</i>														443
<i>Pter. melas</i>														510
<i>Pter. strenuus</i>														10600
<i>Pter. niger</i>														11521
<i>Abax ater</i>	1	1			343	495	484	594	512	11	547	684	05140	
<i>Synuchus tibialis</i>					136	259	249	282	162	109	132	248	400	
<i>Agonum moestum</i>									4	10	1	3		
<i>Agonum muelleri</i>							1		1					
<i>Cymindis angularis</i>	1													
<i>Staphylinidae</i>														
<i>Acrolocha amabilis</i>														
<i>Omalium rivulare</i>														
<i>Omalium caesum</i>	22				21	246	30	138	8	298	6	141	41	
<i>Omalium ferrugineum</i>					46	40	27	61	20	84	43	27	28	
<i>Oxytelus sculpturatus</i>						2		1					30	
<i>Oxytelus rugosus</i>					35	104	63	160	246	142	71	34	623	
<i>Oxytelus tetracarinatus</i>									1			2	612	
<i>Piatystethus sp.</i>	1							2					41	
<i>Stenus erichsoni</i>														
<i>Rugilus rufipes</i>	1													
<i>Medon brunneus</i>							1	3	6	16		14	111	
<i>Lathrobium brunnipes</i>														
<i>Lathrobium rufipenne</i>														
<i>Lathrimaemum unicolor</i>														
<i>Xantholinus linearis</i>	1	1			26	1	2	15	2	3	5	7	113	
<i>Xantholinus tricolor</i>														
<i>Xantholinus longiventris</i>	22				2	9	17	1	3	9	3	7	296	
<i>Othius punctulatus</i>						5	6	19	5	13	11	3	416	
<i>Philonthus decorus</i>						7	1	10	51	46	1	35	645	
<i>Phil. fumarius</i>						2	1	5		4	2		425	
<i>Phil. fuscipennis</i>	7												526	

Species occurred	Group of geob. year		CoQd		CaQ		FQ		TACI		TAcS		M 9-5
	71	81	71	81	71	81	71	81	71	81	71	81	
<i>Phil. varius</i>	1												100
<i>Phil. laminatus</i>		22							1				748
<i>Phil. fulvipes</i>							2		1				543
<i>Phil. spermophilii</i>		2											602
<i>Phil. chalcoccephalus</i>						4							620
<i>Phil. corruscus</i>													305
<i>Gabrius vernalis</i>													258
<i>Staphylinus fulvipes</i>													2440
<i>Staph. chalcoccephalus</i>													3985
<i>Staph. stercorarius</i>	2	3				42			1			8	4011
<i>Staph. caesareus</i>	3	21											5102
<i>Ocyopus ophthalmicus</i>													4127
<i>Ocyopus ater</i>													1180
<i>Ocyopus tenebricosus</i>	1												5114
<i>Ocyopus similis</i>	48	19				115			28				1641
<i>Ocyopus melanarius</i>						1			2				1221
<i>Ocyopus pedator</i>	1					1			2				1312
<i>Ocyopus mus</i>	4					15			2				1211
<i>Ocyopus compressus</i>									1				2222
<i>Ontholestes tessellatus</i>									2				1390
<i>Heterothops dissimilis</i>									2				350
<i>Quedius ochripennis</i>	24								2				89
<i>Quedius scitus</i>									1				321
<i>Quedius umbrinus</i>													303
<i>Quedius molochinus</i>													309
<i>Quedius fuliginosus</i>													240
<i>Mycetoporus sp.</i>							1		1				300
<i>Bryocharis formosa</i>									3				013
<i>Conosoma pubescens</i>													120
<i>Conosoma litterea</i>									1				140
<i>Tachyporus chrysomelinus</i>													102
<i>Tachyporus hypnorum</i>									5				55
<i>Tachyporus nitidulus</i>	33								3				52
<i>Tachyporus solutus</i>	4								7				49
<i>Tachinus rufipes</i>													50
<i>Atheta sp.</i>									104	8	27		193
									23	17	27		374

Species occurred	Group of geob. year		CoQd		CaQ		FQ		TACI		TAcS		M 9-5
	71	81	71	81	71	81	71	81	71	81	71	81	
<i>Atheta sp.</i>													250
<i>Atheta sp.</i>													180
<i>Drusita canaliculata</i>													59
<i>Zyras collaris</i>													170
<i>Zyras humeralis</i>													180
<i>Zyras plicatus</i>													175
<i>Zyras sp.</i>													176
<i>Falagria sulcata</i>													16
<i>Gyrophana sp.</i>													327
<i>Sipalia sp.</i>													410
<i>Oxypoda sp.</i>													431
<i>Aleochara curtula</i>													782
<i>Aleochara sp.</i>													210
Number of individuals	198	137	970	1820	1537	1985	1949	2605	1070	1604			
Biomasse	3,7	35	88	174	153	165	195	305	116	184			
Number of species	29	18	37	48	39	58	57	59	37	52			

Table 2

Changes in number of species and individuals and in the biomass during the years 1971 and 1981

Group of geobiocens	CoQ deg.		CaQ		FQ		TAc inf.		TAc sup.	
	71	81	71	81	71	81	71	81	71	81
Year										
Number of species occurring only either 1971 or 1981	23	11	15	23	11	19	21	23	12	28
Sum of the dominance degrees of species occurring only in one of samling years (%)	70.3	45.3	9.1	6.2	11.8	8.9	3.1	9.1	11.5	5.6
Increase of individuals number during 1981 in comparison with 1971 (%)		-40.8		87.6		29.1		72.6		49.9
Increase of biomass during 1981 in comparison with 1971		948.8		99.9		8.5		56.2		58.4

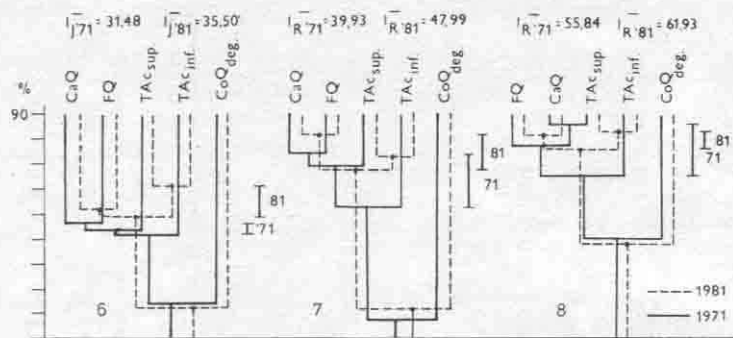


Fig. 6-8. Clustering of species spectra separately for the years 1971 and 1981 after the similarity of species composition (fig. 6), dominance of activity (fig. 7) and after dominance of biomass (fig. 8). [Abbreviations as in fig. 1.]

steppe (*P. cupreus*) during the year 1971 (tab. 1). The large individual number of *C. coriaceus* and *C. hortensis* was sampled there during the year 1981. This seems to be a consequence of the humidization of the climate enabling the immigration of typically arboreal mesohydrophilous species into this extremely warm and dry habitat. This immigration is major not only during the autumn, when the annual dynamics of *C. coriaceus* and of *C. hortensis* reaches their maximums but it increases considerably also during high summer months.

Biocenotic relations of the communities compared

Two groups of geobiocenoses corresponding to the sampling years 1971 and 1981 can be distinguished on the basis of the similarity of the species spectra. This two groups are observed even if the identity index applied for their comparison (fig. 4 and 5). The clustering according to the identity of activity dominance and biomass dominance is influenced also by the topographical distance between the geobiocenoses.

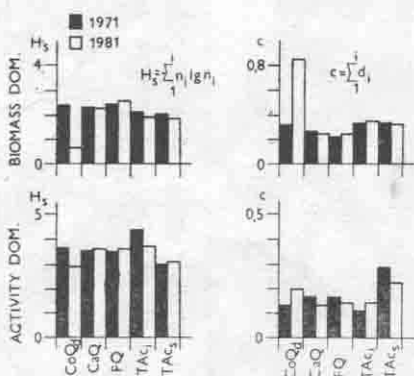


Fig. 9. Alpha-diversity of *Carabidae* and *Staphylinidae* calculated after dominance of activity and dominance of biomass in individual geobiocenoses during 1971 and 1981. [Abbreviations as in fig. 1.]

The less distant geobiocenoses form the clusters on a higher level of similarity than the more distant do. If we exclude the extremely xerothermous CoQ deg.; all geobiocenoses form the clusters on relatively high levels of similarity and in a close variability range of the values of similarity indices. The changes in each of these four geobiocenoses resulting during the ten years period are so important that none of them forms a cluster itself, e.g. FQ 1971 with FQ 1981 etc. Only the CoQ deg. forms such a cluster on very low level of similarity due to its extreme ecotopical conditions. The low level of clustering demonstrates that the CoQ deg. 1981 starts to become more similar to the remaining four geobiocenoses than to CoQ deg. 1971 due to an extensive immigration of *C. coriaceus* and *C. hortensis*. It may be expected that the CoQ deg. will

form a common cluster with the forest geobiocenoses during the following years, if the present trend will continue.

The similarity dendrograms (fig. 6-8) computed separately for each year of sampling (1971, 1981) show that all compared communities were mutually more similar during 1981 than during 1971. The exchange in the placing of the TAc inf. and TAc sup. in the dendrograms of dominance identity is due to decrease in dominance of *A. ater* in TAc sup. and due to the general increase in dominance of *C. hortensis*. All three dendrograms evidence that the fauna of *Carabidae* and *Staphylinidae* was much less differentiated during the year 1981 than during the year 1971.

Alpha-diversity of compared communities

The changes in the alpha-diversity were observed only in three geobiocenoses, viz. CoQ deg. TAc inf. (fig. 9). The decrease in the alpha-diversity of the CoQ deg. is caused by the immigration of a high individual number of *C. coriaceus* and *C. hortensis* and by the decreasing of individual number of all species occurring in this geobiocenosis ten years ago. The decrease in the alpha-diversity in TAc inf. is caused by the extinction of *C. ulrichi*, *C. cancelatus*, *Z. humeralis* and by the increase in the abundance of *C. hortensis*. The alpha-diversity in CaQ, FQ and TAc sup. increased slightly during the period 1971-1981, if applying the activity dominance as a criterium for the calculation of alpha-diversity. It decreases slightly during this period, if applying the biomass dominance as such criterium due to higher numbers of large sized species, viz. *C. coriaceus*, *C. hortensis*. The changes of alpha-diversity expressed by Simpson index of dominance concentration are more conspicuous from the same reason than those expressed by Shannon Wiener's index. The geobiocenoses in which the alpha-diversity decreased are situated on the southeastern slope of Pavlovské kopce hills. The geobiocenoses with increased alpha-diversity are situated on the northern slope which is more close to the new water dams.

Discussion and conclusions

All these facts, viz. extensiver immigration of typical forest mesohydrophilous Carabids into the grass steppe (CoQ deg.), the increase in abundance and biomass of both families in the samples from all geobiocenoses, the nivellization of abundance and biomass in CaQ on the level existing in the remaining three forest geobiocenoses indicate the increase in humidity of the whole area of the Pavlovské kopce hills and a more intensive secondary production at the trophical level of *Carabidae* and *Staphylinidae*. Consequently it can be concluded that the life condition of Pavlovské kopce hills became more favourable for the majority of Carabids and Staphylinids during the period 1971 and 1981. Contrary, the extensive number of arboreal immigrants into the CoQ deg. represents a potential endangerment by extinction and destruction of the characteristic xerothermous fauna in this geobiocenose. The increase of abundance of *Carabidae* and *Staphylinidae* in CaQ must also be viewed upon from a similar point of view. According to its geobiocenological characteristics this geobiocenosis suffer from the lacking humidity during the summer period. So, the obvious humidization of this geobiocenosis appears to be responsible for the changes in its natural abiotic condition. These facts, viz. the tendency of disappearing differences between the individual geobio-

cenoses, the starting extinction of some species and the occupation of the left ecological niches by some species tolerant even to the conditions of some urban ecosystems indicate that Pavlovské kopce hills lose the properties of a biotically valuable and ecologically differentiated geosystem. The decrease in the alpha-diversity common to both communities of Carabids and Staphylinids in the southeastern slope on one hand and the stability or a slight increase of alpha-diversity on the northern slope on the second hand show that there does not exist any general trend in changes common to the whole area studied. The most extensive changes were observed in the places where the soil was nitrified and where, consequently, the vegetation cover was changed. All changes observed in the communities of both families appear still to be of a more quantitative character and, more or less reversible. A final reply to this question can be responsibly given only on the basis of a continuous monitoring of these communities. On the basis of the present material, it is rather difficult to decide if the increasing humidity is caused by the construction of the adjacent dams or if is only a result of natural climatological changes during the period 1971—1981. It is impossible, at present, to decide which of these two possible factors prevails. Only a continuous monitoring may consequently decide whether the changes observed in the species spectra and in the dominance structure are persistent or whether the reducing populations of existing species resistant to all these changes may survive due to selectively active pressures. We may imagine that segment of such resisting populations might occupy the left ecological niches in the future, so that the original species composition could be preserved even under a continuing pressure by some anthropogenic factors. Irrespective of the remaining open questions the fact that the macrohabitat of the Pavlovské kopce hills loses its original character offering reasons for its legal protection is a serious warning for the future.

Translated by author

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POROVNANIE FAUNY ČELADÍ CARABIDAE A STAPHYLINIDAE VO VYBRANÝCH GEOBIOCENÓZACH PAVLOVSKÝCH KOPCOV R. 1971 A 1981

Zbyšek Šustek

Porovnanie fauny bystruškovitých a drobčkovitých r. 1971 a 1981 ukázalo, že na Pavlovských kopcoch antropotolerantnejšie druhy bystrušiek začínajú vytlačovať menej tolerantné druhy. Rozdiely medzi porovnávanými spoločenstvami sa r. 1981 zmenšili. Za hlavné príčiny zistených zmien možno považovať lokálnu nitrifikáciu pôdy exkrementami lovných zvier a všeobecnú humidizáciu klímy Pavlovských kopcov. Podľa dosiaľ získaného materiálu však nie je možné jednoznačne rozhodnúť, či je humidizácia klímy prejavom prirodzených klimatických výkyvov alebo dôsledkom dokončenia dvoch nádrží Novomlýnskeho vodného diela. Hoci táto otázka zostáva otvorená, možno konštatovať, že Pavlovské kopce strácajú vlastnosti ekologicky diferencovaného a hodnotného celku, čo predstavuje varujúci podnet na revíziu doterajších spôsobov ich ochrany.

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СОПОСТАВЛЕНИЕ ФАУНЫ СЕМЕЙСТВ CARABIDAE И STAPHYLINIDAE В ИЗБРАННЫХ ГЕОБИОЦЕНОЗАХ ПAVLOVSKИХ ХОЛМОВ (PAVLOVSKÉ KOPCE) В 1971 И 1981 ГГ.

Збышек Шустек

Сопоставление фауны жувелиц и коротконадкрылых жуков в 1971 и 1981 гг. показало, что на Павловских холмах более антропоотолерантные виды жувелиц начинают вытеснять менее толерантные виды. Разницы между сопоставляемыми сообществами в 1981 году уменьшились. Основными причинами обнаруженных изменений можно считать локальную нитрификацию почвы экскрементами дичи и общую гумидизацию климата Павловских холмов. На основе до сих пор полученного материала невозможно, впрочем, однозначно разрешить, является ли гумидизация климата проявлением естественных климатических колебаний, или представляет собой последствие завершения строительства двух бассейнов Новомыльнского гидротехнического сооружения. Хотя этот вопрос остается открытым, можно констатировать, что Павловские холма теряют свойства экологически дифференцированного и ценного комплекса, что является предостерегающим предзнаменованием и толчком для ревизии предыдущих способов их охраны.