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CARABIDAE AND STAPHYLINIDAE (INSECTA, COLEOPTERA): COMPARISON OF THEIR RESPONSE TO CHANGES IN HYDROLOGICAL REGIMEN IN TWO FLOODPLAIN FORESTS

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Abstract

Ability of two beetle families, Carabidae and Staphylinidae, to indicate changes in hydrological regimen is compared on example of two floodplain forests in South Moravia. It was shown that Carabidae are more sensitive to moisture changes than Staphylinidae. In addition, a more detailed ecological classification of species can considerably contribute to the value of results of ecological monitoring, particularly in the case of very profound changes in the hydrological regimen. Staphylinid taxocoenoses form relatively stabilised taxocoenoses even in the ecosystems in which the changed hydrological regimen causes visible changes in structure of Carabid taxocoenoses.

Introduction

Carabidae (about 550 species in Slovakia) and Staphylinidae (about 1300 species in Slovakia) represent a significant component of edaphon in most types of ecosystems in the Palaearctic region. Most representatives of both families are small predators or scavengers and occupy similar ecological niches and some of them obviously entry in competitive relations or even into the predator/pray relations. Considerable part of Carabid species is unable to fly and is closely bound to the habitat and shows a high tendency to endemism. In contrast, almost all Staphylinids are good flyer, have a stronger dispersal power and their distribution areas are mostly large.

Considering the general features of both families, there arises a question of differences in their bioindicative abilities and possibility of their practical application for bioindication of impacts of human activities on the environment. In addition there is a question to what degree the possible differences in response of both families to environmental changes can be biased by different knowledge of their autecology, which is much better know in Carabids.

The aim of this paper is to compare response of both families to changed hydrological regimen in two hardwood floodplain forests and possible bias resulting from the different accuracy of knowledge of their moisture preferendum.

Material and methods

The material was collected in two forests - in the Horní les forest near Lednica na Morave in 1970 - 1971 and 1985-1988 (Tab. 1-2), after regulation of the Dyja river, as well as in the Ranšpurk forest at confluence of the Dyja and Morava rivers in 1993-1999 (Tab. 3-4). The taxocoenoses in the Ranšpurk forest were studied as late after finishing of regulation of both rivers in 1980-ies. The beetles were

pitfall trapped. The traps were emptied in one-month intervals, but all the samples from one year were pooled and evaluated as one item.

The taxocoenoses from the Horní les forest from 1970-1971 can be taken as characteristic for a natural regularly flooded hardwood floodplain forest with constantly high level of ground water. The samples from 1985-1988 correspond to a situation when the floods were completely eliminated and the ground water level decreased to 2-3 m (ŠUSTEK 1994).

The taxocoenoses in the Ranšpurk forest can taken as an example of secondary communities strongly affected by profound degradation changes caused regulation of both rivers, decrease of ground water level, elimination of floods and, to considerable degree by a series of several hot and dry years. However, in after 1995, the simulation of moderate spring floods stared and in summer 1997 the whole territory was completely flooded for more then one month. It made possible a moderate renaturalisation of this ecosystem (ŠUSTEK 2002).

In spite of the profound ecological changes, the integrity of tree layer in both forests was not affected.

In order to evaluate changes in taxocoenoses of both beetle families, each species was classified according to two criteria – preference for vegetation cover (using a the degree scale: 1 – preferring open landscape, 2 – indifferent to vegetation cover, 3 – preferring shadowing by continuous tree stands) and preference for moisture. In this case two different scales were used: (i) a three-degree scale for both families (1 – xerophilous, 2 – mesohygrophilous, 3 – polyhygrophilous) and (ii) a more detailed eight-degree scale for Carabids (1 – most xerophilous – 8 most hygrophilous) which reflects the better knowledge of their autecology. The three-degree scales were taken from ŠUSTEK (1984) and the eight-degree moisture preferendum scale from ŠUSTEK (2000) and from the author´s unpublished data.

Based on this, the direct ordination (UITTEKER 1980) of all one-year samples was made in order to visualise the processes running in the taxocoenoses studied during the monitored period. The scores of each sample were calculated as average of preference of all species weighted by their abundance. In order to compare the bioindicative potential of both families, the average and variance coefficients of preference of all species to both environmental variables were calculated in both localities.

Results

The variance coefficients of preference to vegetation cover in each locality are always 1.5-times higher in Carabidae than in Staphylinidae (Tab. 1-4). It indicates the higher sensitivity of Carabidae to changes in the vegetation continuity. The variance coefficients of moister preference expressed according to the three-degree scale are almost equal in both families and localities. In contrast the variance coefficients of the eight-degree scale used for Carabids is in both cases about 1.5-times higher then according to three-degree scales. It indicates, that the degree of knowledge of autecology of a family can considerably increase its suitability for bioindication. At the same time, the moderately higher means of preference to both environmental variables (using the three-degree scales) in Carabids (Tab. 1-4) shows that representatives of this family recorded in both localities have a higher affinity to the forests ecosystems than the Staphylinids, in which obviously more euryecious species predominate.

Comparison of ordination diagrams (Fig. 1) constructed on the base of the three-degree scale of preference for environmental variables shows a visibly higher structurisation of the one-year samples of Carabids in both localities. In the Horní les forest, the samples from 1970 and 1971 are visibly sifted left in direction of maximum humidity. Similarly, the samples from Ranšpurk from the two post-flood years 1998 and 1997 are visibly separated from other samples from the drier part of the period monitored. In addition the arrows show a clear developmental trend of both taxocoenoses studied. In contrast the one-year samples of Staphylinids in the Horní les forest from 1970-1971 are much less separated from the samples from 1985-1988. It indicates that their taxocoenoses was much less affected by the absence of floods and decrease in ground water level than the Carabids. In Ranšpurk, the one-year samples of Staphylinids form one compact cluster in which no visible trend

analogous to the trend observed in Carabidae is visible. It indicates that this taxocoenosis was in a stabilized state during the whole period monitored and did not react to the positive changes in moisture caused by simulated floods made since 1995 and a great natural flood of 1997.

The comparison of the ordination diagrams made for Carabids according to the three- and eight-degree scales of moisture preference (Fig. 1 - 2) shows that the results are not principally different.

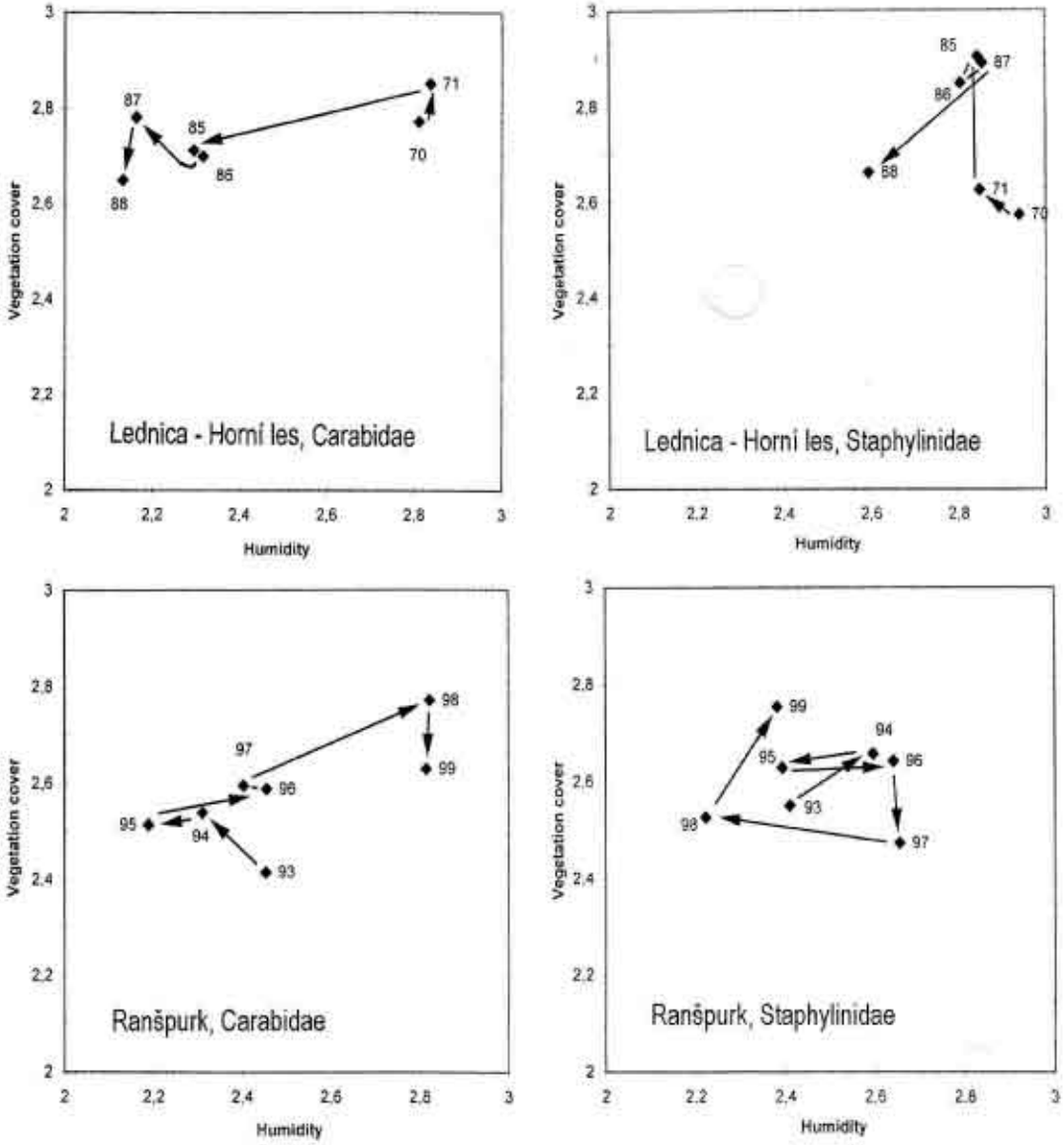

Fig. 1. Direct ordination of Carabid and Staphylinid taxocoenoses in the floodplain forests according preference of species for vegetation cover and moisture. The preference of species to both envoronmental variables is expressed by means of a semiquantitative three-degree scale.

Only in the Horní les, the separation of the one-year samples from 1970-1971 from those from 1985-1988 is much better visible and the difference in mutual position of the samples from 1970 and 1971 is

enhanced. The difference between the ordination diagrams from Ranšpurk and Hroni les is caused by absence of the strongly polyhygrophilous species in Ranšpurk and their presence in Horni les in 1970-1971, when this forest still was regularly and abundantly flooded.

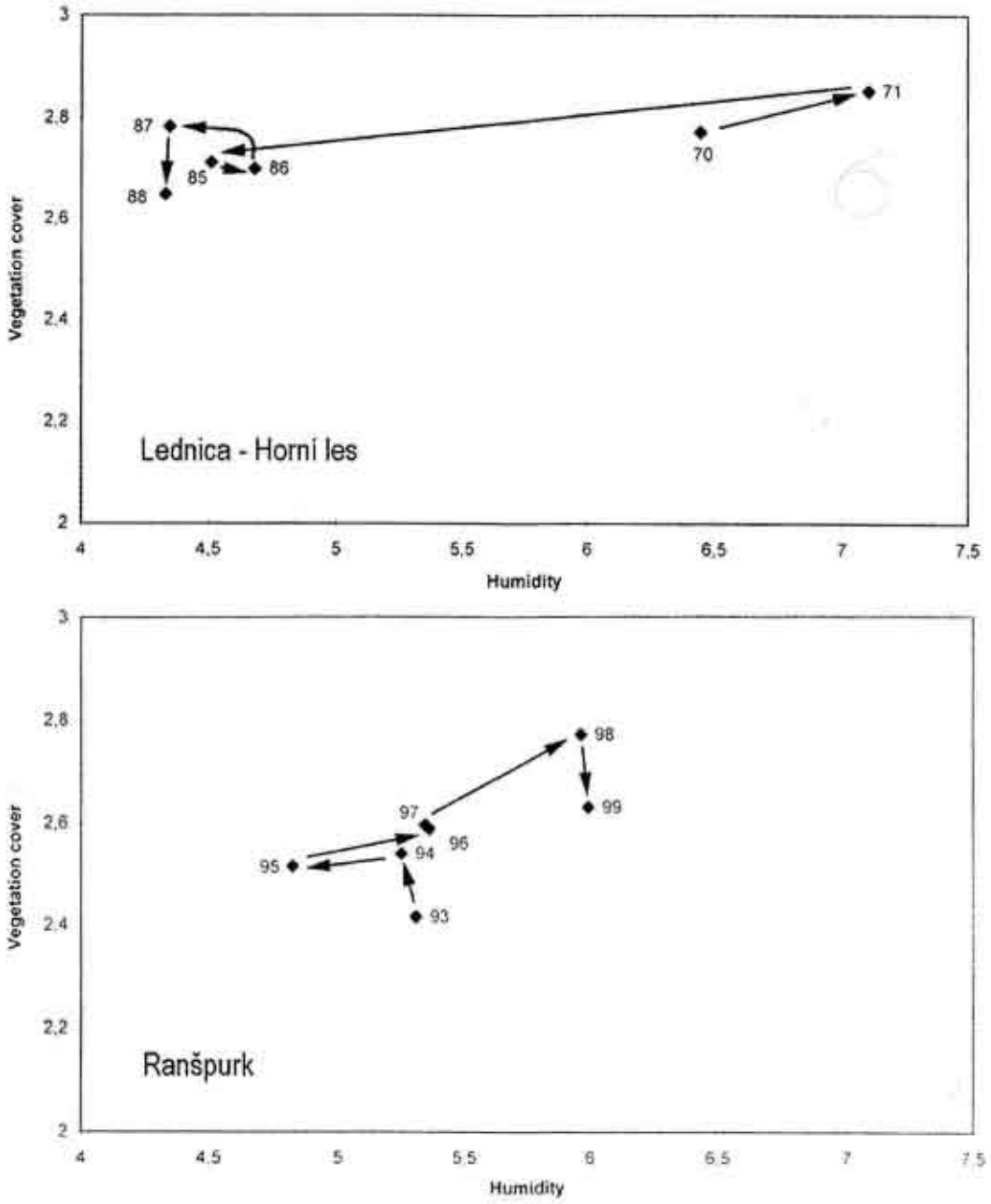

Fig. 1. Direct ordination of Carabid taxocoenoses in the floodplain forests according preference of species for vegetation cover and moisture. The preference of species to vegetation cover is expressed by means of a semiquantitative three-degree scale and preference to moisture by a eight-degree scale.

Conclusions

It can be stated that at the present degree of knowledge of autecology od Carabidae and Staphylinidae the Carabidae have generally a much better ability to indicative environmental changes caused by changed hydrological regimen of floodplain ecosystems than Staphylinidae. At the same time, the more detailed ecological classification of the species may considerably increase indicative value of the obtained results, particularly in the profound changes in an ecosystem are studied. The Carabid taxocoenoses show clearer developmental trends than the Staphylinid taxocoenoses. Staphylinids form a relatively stabilised structure even in evidently changing hydrological regimen.

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Appendix – Tables

Table 1. Survey of number of individuals of Carabidae in one-year samples in the Horni les forest near Lednica na Morave during 1970-1971 and 1985-1988 (symbols: V – preference for vegetation cover, H3 – three degree scale of preference for moisture, H8 – eight degree scale of preference for moisture) and mean and variance coefficients of both environmental variable preference of all species.

Species	Scales			Years					
	V	H3	H8	1970	1971	1985	1986	1987	1988
Abax ater (Villers, 1789)	3	2	3			246	276	226	204
Acupalpus meridianus (Linnaeus, 1761)	1	3	6			1			
Amara aenea (De Geer, 1774)	1	2	3			1			
Amara familiaris (Duftschmidt, 1812)	1	2	3						1
Amara ovata (Fabricius, 1792)	1	2	3					1	
Anisodactylus signatus (Panzer, 1797)	1	2	5			2			
Badister lacertosus (Sturm, 1815)	2	3	6					1	
Badister meridionalis (Puel, 1925)	2	3	6	1	1		3		
Badister sodalis (Duftschmidt, 1812)	2	3	7		4				
Bembidion biguttatum (Fabricius, 1779)	3	3	8	19	19				3
Bembidion mannerheimi C. R. Sahlberg, 1827	3	3	8	128	134				
Calosoma inquisitor (Linnaeus, 1758)	3	2	4	1	43		1	3	2
Carabus granulatus Linnaeus, 1758	2	3	7	44	30	60	73	24	15
Carabus ullrichi Germar, 1824	3	2	4			90	90	183	71
Clivina fossor (Linnaeus, 1758)	3	3	6				1	1	
Dyschirius globosus (Herbst, 1783)	4	3	8	3	3				
Epaphius secalis (Paykull, 1790)	3	3	6			14	7	4	5
Europhilus micans (Nicolai, 1822)	3	3	7		4				
Harpalus atratus Latreille, 1804	3	2	4		5				
Harpalus latus (Linnaeus, 1758)	1	2	4					1	
Harpalus progrediens Schauberger, 1922	2	2	5			5	1	4	
Chlaenius nitidulus (Schrank, 1781)	4	3	8		1				

Lasiotrechus discus (Fabricius, 1792)	4	3	6						1
Leistus rufomarginatus (Duftschmidt, 1812)	3	2	5			4		4	17
Leistus terminatus (Hellwig in Panzer, 1793)	3	2	5		1				1
Lorocera pilicornis (Fabricius, 1775)	2	2	4	9	7		1		
Notiophilus biguttatus (Fabricius, 1799)	2	2	4			1	1		1
Notiophilus palustris (Duftschmidt, 1812)	2	2	4			1	2	2	2
Oodes helopioides (Fabricius, 1792)	2	3	8		2				
Oxypselaphus obscurus (Herbst, 1784)	3	3	7	13	34		1		1
Patrobus atrorufus (Stroem, 1768)	3	3	7	2	3	1	1		
Platynus assimilis (Paykull, 1790)	3	3	7	1	7	2	3	3	
Poecilus cupreus (Linnaeus, 1758)	1	2	4			2		1	
Pseudoophonus rufipes (De Geer, 1774)	1	2	3				8	1	1
Pterostichus anthracinus (Illiger, 1798)	3	3	8	83	208	2			
Pterostichus diligens (Sturm, 1824)	2	3	7				1		
Pterostichus melanarius (Illiger, 1798)	2	2	5	105		36	136	99	153
Pterostichus melas (Creutzer, 1799)	3	2	4				1		
Pterostichus minor (Gyllenhal, 1827)	4	3	8					3	
Pterostichus niger (Schaller, 1783)	3	3	6	345	19	45	162	62	26
Pterostichus oblongopunctatus (Fabricius, 1787)	3	2	5	35	42	34	85	88	37
Pterostichus ovoideus (Sturm, 1824)	2	2	4	5	3	6	5	4	1
Pterostichus strenuus (Panzer, 1797)	2	3	7	10	27	51	26	17	14
Stomis pumicatus (Panzer, 1796)	2	3	6	16	22	3	2	5	10
Number of individuals				820	619	607	887	737	566
Number of species				17	22	21	23	22	23
Mean	2.41	2.52	5.56						
Variance coeficient in %	37.3	20.1	29.8						

Table 2. Survey of number of individuals of Staphylinidae in one-year samples in the Horni les forest near Lednica na Morave during 1970-1971 and 1985-1988 (symbols as in table 1) and mean and variance coefficients of both environmental variable preference of all species

Species	Scales		Years					
	V	H3	1970	1971	1985	1986	1987	1988
Aleochara ruficornis Gravenhorst, 1802	2	2				1	20	28
Atheta fungi (Gravenhorst, 1806)	2	2					1	
Atheta sp.	2	2		25	16	18	8	42
Bolitobius formosus (Gravenhorst, 1806)	2	2				1		
Bolitobius cingulatus Mannerheim, 1831	2	2		5				
Sepedophilus testaceus (Fabricius, 1792)	2	2			1	2		
Drusila canaliculata (Fabricius, 1787)	2	2				1		1
Gabrius osseticus (Kolenati, 1846)	2	2				6	2	1
Habrocerus capilaricornis (Gravenhorst, 1806)	2	2			3			
Paraocyusa rubicunda (Erichson, 1837)	2	2			15			
Illyobates nigricollis (Paykull, 1800)	2	2			15	1		
Illyobates propinquus (Aubé, 1850)	2	2						2
Anthobium atrocephalum (Gyllenhal, 1827)	3	2			46	8	10	39
Lathrobium brunnipes (Fabricius, 1792)	2	3	23	18	3	5		
Lathrobium castaneipenne Kolenati, 1846	2	3			2			
Lathrobium elongatum (Linnaeus, 1767)	2	2	2	7		7	8	3
Lathrobium fulvipenne Gravenhorst, 1906	2	3			2			
Lathrobium volgense Hochhuth, 1851	2	3		3				
Leptacinus pussilus (Stephens, 1833)	2	2				2		
Megarthus sinuaticollis (Boisduval et Lacordaire, 1835)	2	2						1
Mycetoporus lepidus (Gravenhorst, 1802)	2	2			1			
Ocalea badia Erichson, 1837	3	2				12	11	46
Ocypus mus Brullé, 1832	3	2			3	3	3	6
Ocypus pedator Gravenhorst, 1802	3	2						1
Ocypus nero semialatus J. Mueler, 1904	3	2		8	3	2	3	

Ocypus melanarius Herr, 1839	2	2				3	1	1
Ocypus compressus Marsham, 1802	3	2			2	2	1	
Ocypus brunnipes Fabricius, 1781	3	2			2	1	6	
Omalium caesum Gravenhorst, 1806)	2	2		2	19	7	4	10
Omalium rivulare (Paykull, 1789)	2	2			9	68	13	27
Ontholestes haroldi (Eppelsheim, 1884)	2	2			1			
Othius myrmecophilus Kiesenwetter, 1843	3	2			11	1		
Othius punctulatus (Goeze, 1777)	3	2		1	65	39	17	4
Oxypoda abdominalis (Mannerheim, 1830)	3	3				11	10	1
Oxypoda spectabilis Maerkel, 1845	2	2	11	21		25	30	252
Oxytelus rugosus (Fabricius, 1775)	2	3	15	23	31	1	1	1
Oxytelus tetracarinatus (Block, 1799)	2	2			2	5	1	
Oxytelus sculpturatus (Gravenhors, 1806)	2	2	5			13	13	80
Philonthus decorus (Gravenhorst, 1802)	3	3	130	110	521	829	864	601
Philonthus fumarius (Gravenhorst, 1806)	2	3	77	89				2
Philonthus succicola C. G. Thomson, 1860	2	2				2		
Philonthus laminatus (Creutzer, 1799)	2	2			1			
Philontgus quisquiliarius (Gyllenhal, 1810)	2	2			1			
Quedius fuliginosus (Gravenhorst, 1802)	3	2	1	6	7	6	22	1
Quedius paradisianus (Heer, 1839)	2	2						1
Rugilus rufipes Germar, 1836	2	2			4	2	2	
Staphylinus erythropterus Linnaeus, 1758	3	3	22	24	9	2	1	
Staphylinus stercorarius (Olivier, 1795)	2	2				2	1	
Staphylinus fulvipes (Scopoli, 1763)	2	2			1	1		
Stenus humilis Erichson, 1839	2	3	2					
Tachinus signatus (Gravenhorst, 1802)	3	3	28	184	699	197	179	160
Tachyporus chrysomelinus (Linnaeus, 1758)	2	2		1		1		
Tachyporus hypnorum (Fabricius, 1775)	2	2				1		1
Tachyporus solutus Erichson, 1839	2	2		2				1
Xantholinus linearis (Olivier, 1794)	2	2			4	9	3	4
Xantholinus tricolor (Fabricius, 1787)	2	3		6	15	3	20	7
Zyras collaris (Olivier, 1795)	3	2		1				
Zyras haworthi (Stephens, 1832)	3	2					1	
Zyras humeralis (Gravenhorst, 1802)	3	2		2	1			
Number of individuals			316	538	1515	1300	1256	1324
Number of species			11	20	32	38	29	28
Mean	2.27	2.2						
Variance coeficient in %	20.1	18.4						

Table 3. Survey of number of individuals of Carabidae in one-year samples in the Ranšpurk forest at the confluence of the Dyja and Morava rivers during 1993-1999 (symbols as in Table 1) and mean and variance coefficients of both environmental variable preference of all species

Species	Scales			Years						
	V	H3	H8	1993	1994	1995	1996	1997	1998	1999
Abax carinatus (Duftschmidt, 1812)	3	2	5	20	98	139	86	25	12	31
Agonum moestum (Duftschmidt, 1812)	3	3	8	5	5	1	1	7	16	5
Amara aenea (De Geer, 1774)	1	2	3	5			1			
Amara familiaris (Duftschmidt, 1812)	1	2	3		1		1	1	1	1
Amara similata (Gyllenhal, 1810)	1	2	3			3		3		
Anisodactylus binotatus (Fabricius, 1787)	1	3	6	4						
Anisodactylus signatus (Panzer, 1797)	1	2	5	2						
Badister lacertosus (Sturm, 1815)	2	3	6			3				
Badister peltatus (Panzer, 1797)	2	3	8				1			
Badister sodalis (Duftschmidt, 1812)	2	3	7		1			1		
Bembidion biguttatum (Fabricius, 1779)	3	3	8					5	18	22
Bembidion dentellum (Thunberg, 1787)	4	3	8						2	1
Bembidion gilvipes Sturm, 1825	4	3	8	2						

Bembidion lampros (Herbst, 1784)	1	2	3			1				
Bembidion mannerheimi C. R. Sahlberg, 1827	3	3	8	1	19	5	2	39	3	24
Bembidion minimum (Fabricius, 1792)	4	3	8	1						
Bembidion tetracollum Say, 1823	4	3	8			1				
Calosoma inquisitor (Linnaeus, 1758)	3	2	4	18	11			2		
Carabus granulatus Linnaeus, 1758	2	3	7	2	11	18	67	46	104	132
Carabus scheidleri Panzer, 1799	3	2	5	1						
Carabus ullrichi Germar, 1824	3	2	4	59	51	113	73	146	61	77
Carabus violaceus Linnaeus, 1758	3	2	5	11	113	47	80	31	150	131
Clivina fossor (Linnaeus, 1758)	3	3	6		3		1	1	1	1
Dyschirius globosus (Herbst, 1783)	4	3	8	2	6			1		
Epaphius secalis (Paykull, 1790)	3	3	6	2	1		4		6	73
Europhilus micans (Nicolai, 1822)	3	3	7					1	3	3
Harpalus flavicornis Dejean, 1829	1	2	4		4					
Harpalus latus (Linnaeus, 1758)	1	2	4			1	2	1	2	
Harpalus luteicornis (Duftschmidt, 1812)	2	2	5					2		
Harpalus progrediens Schauberger, 1922	2	2	5	10		2				1
Chlaenius nigricornis (Fabricius, 1787)	4	3	8		1		1			
Chlaenius tristis (Schaller, 1783)	4	3	8					1		
Leistus ferrugineus (Linnaeus, 1758)	2	2	4				1			
Leistus rufomarginatus (Duftschmidt, 1812)	3	2	5	5	9	16		2	3	3
Lorocera pilicornis (Fabricius, 1775)	2	2	4		1			2	5	2
Nebria brevicollis (Fabricius, 1792)	2	3	6	101	84	35	37	17	192	442
Notiophilus biguttatus (Fabricius, 1799)	2	2	4						1	
Notiophilus palustris (Duftschmidt, 1812)	2	2	4	1	5	4	4	9	2	
Notiophilus rufipes Curtis, 1829	2	2	4	1	1	2				
Oodes helopioides (Fabricius, 1792)	2	3	8				1		1	
Ophonus nitidulus Stephens, 1828	3	2	3			3				
Oxypselaphus obscurus (Herbst, 1784)	3	3	7		1				1	3
Panageus cruxmajor (Linnaeus, 1758)	2	3	6		1		1			
Patrobus atrorufus (Stroem, 1768)	3	3	7	19	20	8	20	9	80	154
Platynus assimilis (Paykull, 1790)	3	3	7	6	1	1		4	2	
Platynus krynickyi (Sperk, 1835)	3	3	8							4
Poecilus cupreus (Linnaeus, 1758)	1	2	4	14	29	31	23	53	7	16
Pseudoophonus rufipes (De Geer, 1774)	1	2	3	1	20	48	16	6	3	
Pseudophonus griseus (Panzer, 1797)	1	1	2			2				
Pterostichus anthracinus (Illiger, 1798)	3	3	8	2	5	3	2		14	10
Pterostichus diligens (Sturm, 1824)	2	3	7							1
Pterostichus melanarius (Illiger, 1798)	2	2	5	40	80	55	28	17	20	85
Pterostichus minor (Gyllenhal, 1827)	4	3	8							1
Pterostichus niger (Schaller, 1783)	3	3	6	9	33	39	87	121	810	664
Pterostichus nigrita (Paykul, 1790)	2	3	8				1	6		
Pterostichus oblongopunctatus (Fabricius, 1787)	3	2	5	2	7	16	22	11	3	2
Pterostichus ovoideus (Sturm, 1824)	2	2	4		1			6		1
Pterostichus strenuus (Panzer, 1797)	2	3	7	1				5	1	8
Stomis pumicatus (Panzer, 1796)	2	3	6		2	1	2	1		
Synuchus vivalis (Illiger, 1798)	2	2	4				1			
Parachys bistriatus (Duftschmidt, 1812)	4	3	8						1	1
Trechoblemus micros (Herbst, 1784)	3	2	4			1			1	2
Trechus quadristriatus (Schrank, 1781)	1	2	4					1		
Number of individuals				347	625	599	566	583	1526	1901
Number of species				29	31	28	29	33	31	30
Mean	2.43	2.51	5.73							
Variance coeficient in %	39.6	21.3	31.8							

Table 4. Survey of number of individuals of Staphylinidae in one-year samples in the Ranšpurk forest at the confluence of the Dyja and Morava rivers during 1993-1999 (symbols as in Table 1) and mean and variance coefficients of both environmental variable preference of all species

Species	Scales		Years					
	V	H1	1994	1995	1996	1997	1998	1999
Acidota crenata (Fabricius, 1792)	2	2		8	1			
Acrolocha minuta (Stephens, 1834)	2	2					2	4
Achenium humile (Nicolai, 1822)	2	2		1				
Aleochara brevipennis Gravenhorst, 1806	2	3					1	
Aleochara ruficornis Gravenhorst, 1802	2	2	15	2	9	1		1
Arpedium quadrum (Gravenhorst, 1806)	3	2				2	14	7
Atheta fungi (Gravenhorst, 1806)	3	2	1	8				
Atheta triangulum (Kraatz, 1856)	2	3		8			3	
Atheta sp.	2	2	8	3	6	16	35	1
Bolitobius formosus (Gravenhorst, 1806)	2	2			5	3	1	1
Callicerus obscurus Gravenhorst, 1802	2	2		2				
Paraocyusa rubicunda (Erichson, 1837)	2	2						1
Sepedophilus testaceus (Fabricius, 1792)	2	2	1					
Drusila canaliculata (Fabricius, 1787)	2	2	10	15		7	7	1
Falagria sulcatula (Gravenhorst, 1806)	2	3	1					
Gabrius osseticus (Kolenati, 1846)	2	2	1	2	1		1	
Gyrohypnus fracticornis (O. F. Mueller, 1776)	2	2		1				
Gyrohypnus atratus (Heer, 1839)	2	2					1	1
Ischnopoda atra (Gravenhorst, 1806)	2	3				176	6	
Anthobium atrocephalum (Gyllenhal, 1827)	3	2	16	101	3	39	8	14
Lathrobium brunnipes (Fabricius, 1792)	2	3	2	2		1	1	1
Lathrobium elongatum (Linnaeus, 1767)	2	2	3	3		6	4	2
Lathrobium pallidum Nordmann, 1837	2	3				1		
Leptacinus sulcifrons (Stephens, 1833)	2	2						1
Leptacinus pussilus (Stephens, 1833)	2	2			1			
Megarthus depressus (Paykul, 1789)	2	2				1	1	
Mycetoporus nigricollis Stephens, 1835	2	2				1		
Ocalea badia Erichson, 1837)	3	2	5	25	10	53	236	368
Ocypus melanarius Herr, 1839	2	2	13	5	18	14	1	4
Ocypus picipennis Fabrivius, 1792	2	2		2				
Ocypus nero semialatus J. Mueler, 1904	3	2					1	
Olophrum assimile (Paykull, 1800)	2	3			5			
Olophrum piceum (Gyllenhal, 1810)	2	3					11	44
Omalium caesum (Gravenhorst, 1806)	2	2			5	4	7	9
Omalium rivulare (Paykull, 1789)	2	2	13	1		28	47	11
Ontholestes haroldi (Eppelsheim, 1884)	2	2	1					
Othius brevipennis Kraatz, 1857	3	2					2	2
Othius punctulatus (Goeze, 1777)	3	2	1	2		8	1	
Oxypoda abdominalis (Mannerheim, 1830)	2	2		4		2		
Oxypoda sp.	2	2		2	1	4	6	
Oxypoda spectabilis Maerkel, 1845	2	2	65	145	11	41	118	95
Oxytelus rugosus (Fabricius, 1775)	2	3	1		1	48	25	9
Oxytelus sculpturatus (Gravenhors, 1806)	2	2					1	
Oxytelus tetracarinatus (Block, 1799)	2	2	1					
Philonthus agilis (Gravenhorst, 1806)	2	2					1	
Philonthus carbonarius (Gravenhorst, 1802)	2	2						3
Philonthus concinnus (Gravenhorst, 1802)	2	2			1			
Philonthus decorus (Gravenhorst, 1802)	3	3	214	167	90	160	5	12
Philonthus fimetarius (Gravenhorst, 1802)	2	3						1
Quedius boops (Gravenhorst, 1802)	2	2				5		5
Quedius fuliginosus (Gravenhorst, 1802)	3	2	5	3	4	10	7	3
Rugilus rufipes Germar, 1836	2	2	2	1			1	1

Scopaeus cognatus Mulstant et Rey, 1855	2	2						
Staphylinus erythropterus Linnaeus, 1758	3	3	23	39	12	48		15
Staphylinus fulvipes (Scopoli, 1763)	2	2	1					
Staphylinus stercorarius (Olivier, 1795)	2	2				1		1
Stenus biguttatus Linnaeus, 1758	2	3					1	
Stenus calcaratus W. Scriba, 1864	2	3				2		
Stenus pallipes Gravenhorst, 1802	2	3					19	
Stenus similis (Herbst, 1784)	2	3		1				
Stenus humilis Erichson, 1839	2	3	1		8	9		15
Tachinus signatus (Gravenhorst, 1802)	3	3	3	8	2	24	66	235
Tachyporus nitidulus (Fabricius, 1781)	3	3						1
Tachyporus chrysomelinus (Linnaeus, 1758)	2	2		1				
Thalasophila sp.	2	2				3		
Troglophloeus bilineatus (Stephens, 1834)	2	3				8	4	
Xantholinus linearis (Olivier, 1794)	2	2	2	4		1		1
Xantholinus longiventris Heer, 1839	2	2						1
Xantholinus tricolor (Fabricius, 1787)	2	3	1	1	2	3	2	1
Zyras funestus (Gravenhorst, 1806)	3	2			3	1	1	
Zyras humeralis (Gravenhorst, 1802)	3	2	3	8	10	2		1
Number of individuals			413	575	209	733	648	873
Number of species			28	31	23	35	35	35
Mean	2.19	2.29						
Variance coeficient in %	18.2	20.1						