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Harvestman (Phalangida) assemblages in the Czech Republic

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Abstract. A database of harvestman assemblages from the Czech Republic was built up, using both literature and not yet published data. At 117 sites included in the database, nearly 41 000 specimens of 30 species and species aggregates were collected. Only two species of harvestman known from the Czech Republic were not represented in the data. Using TWINSPAN, a divisive multivariate classification method, and CCA ordination basic types of harvestman assemblages were delimited and the main environmental factors determining their species composition were identified. Much variation in the data was explained by altitudinal and temperature gradients, another important factor was human impact. The last significant factor was soil moisture which was negatively correlated with human impact. Distribution of individual species along the main environmental factors was compared to literature data and discussed in detail.

Phalangida, communities, multivariate analysis

INTRODUCTION

Harvestmen belong to a prevailingly epigeic group of arachnids colonizing most habitat types in Central Europe. Their abundance reaches high values especially in mesic and wet environments, both in lowlands and in mountains. The species richness of harvestmen is relatively low in Central Europe. For example, the number of species known from the Czech Republic is 32 (Martens 1978, Šilhavý 1981, Klimeš & Bezděčka 1995).

In spite of the long tradition of faunistic research on phalangids in the Czech Republic and former Czechoslovakia (Bárta 1869, Nosek 1900, Šilhavý 1956) the distribution of individual species is so far relatively poorly known. New and unexpected findings have been published recently or are in press (Klimeš & Bezděčka 1995, Bezděčka 1996, Klimeš & Roušar in press, Roušar in prep.). Moreover, some species are spreading in recent times, such as *Opilio canestrinii* (Klimeš 1995, Klimeš & Roušar in press) so that the overall picture is still very incomplete. Similarly, our knowledge of the biology of individual species and their participation in harvestman assemblages is also poor. So far, some data have been published on the species composition of harvestmen collected in forests (Obrtel 1976, Šmaha 1983, 1984, Klimeš & Špičáková 1984, Křístek 1985, 1991, Sechterová-Špičáková 1988, Sechterová 1990), grasslands (Šmaha 1983, 1984, Klimeš & Sechterová 1989) and ruderalized habitats (Sechterová 1987, Sechterová-Špičáková 1989), and on dynamics of individual species throughout the year (Borek 1958, Obrtel 1976, Klimeš & Špičáková 1984, Klimeš 1990). However, there has been no attempt to summarize the data on harvestman assemblages in the Czech Republic.

The aim of this paper is 1) to put together all material on harvestman assemblages from the Czech Republic available both from literature and from unpublished data of the author and to delimit individual types of harvestman assemblages using their species composition, 2) to identify the main environmental gradients along which the assemblages are differentiated and 3) to find out the position of individual species along the main environmental gradients.

MATERIAL AND METHODS

The material used in this study includes all literature sources on harvestman assemblages sampled in the Czech Republic and the author's unpublished data (see Fig. 1 and Appendix). Most data sets included in the database were based on year- round sampling, mostly by pitfall traps. In several cases two- or three-year data were at disposal. Data based on short-term sampling were used only when most species had their maximum abundance period during the collecting period, so that longer periods of collecting would hardly significantly change the participation of individual species in the whole material. This was the case of harvestman assemblages collected on walls in towns. These were the only samples collected by hand. The samples which included a few individuals only were excluded from the database.

Leiobunum rupestre was lumped with *L. tisciae* to *L. rupestre* agg., as most specimens belonging to these two taxa were small juveniles in which species identification was impossible. The two species are geographical vicariants (Šilhavý 1981) with approximately the same environmental demands. Reversely, *Nemastoma lugubre* was treated separately from its melanistic variant even if the taxonomic value of the latter type is low (Kratochvíl 1934, Bartoš 1949, Martens 1978). However, there is a clear difference in distribution along the altitudinal gradient between the two varieties. Nomenclature of harvestmen species follows Martens (1978), except *Zachaeus crista* (Crawford 1992).

The data in the database were analysed using multivariate approaches. For ordination of stands and species canonical correspondence analysis was used (ter Braak 1987, Jongman et al. 1995) in which ln(x+1) transformation of species abundance was applied to suppress strongly dominating species. Classification of the material was performed using Two Way INdicator SPecies ANalysis (TWINSPAN – Hill 1979).

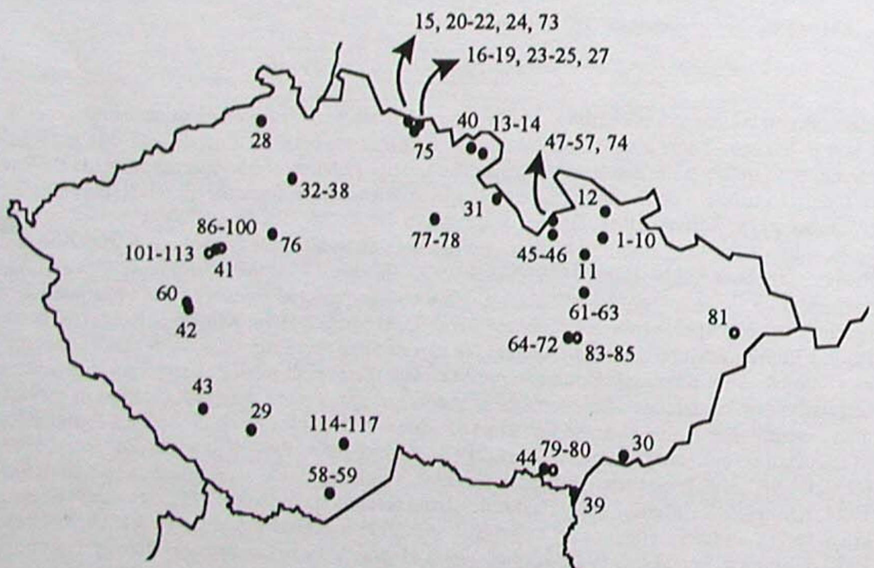

Fig. 1. Location of 117 sampling sites in the Czech Republic. Full circle – unpublished material, open circle – data from literature. For a complete list of sites see Appendix.

RESULTS

The database of harvestman assemblages included 30 species collected at 117 sites (Tables 1–2). Altogether 40 838 individuals were collected. *Oligolophus tridens* was the most frequent species, found at 75.5% of sites, followed by *Lacinius ephippiatus* and *Mitopus morio*. Considering the number of captured individuals *Oligolophus tridens* with more than 11 000 individuals was the most abundant species. *Mitopus morio* (7034) and *Platybunus bucephalus* (6405 individuals) occupied second and third positions, respectively.

The variation explained by the first two axes of CCA was 38 and 21%, respectively. Using several environmental factors as explaining variables six habitat types were distinguished in the CCA biplot (Fig. 2). Sites in alpine and upper mountain vegetation belts represented the first group. A high altitude and cold climate characterize the environment of these sites situated in upper vegetation belts (Fig. 2). Within the cluster a small, clearly separated subgroup of sites

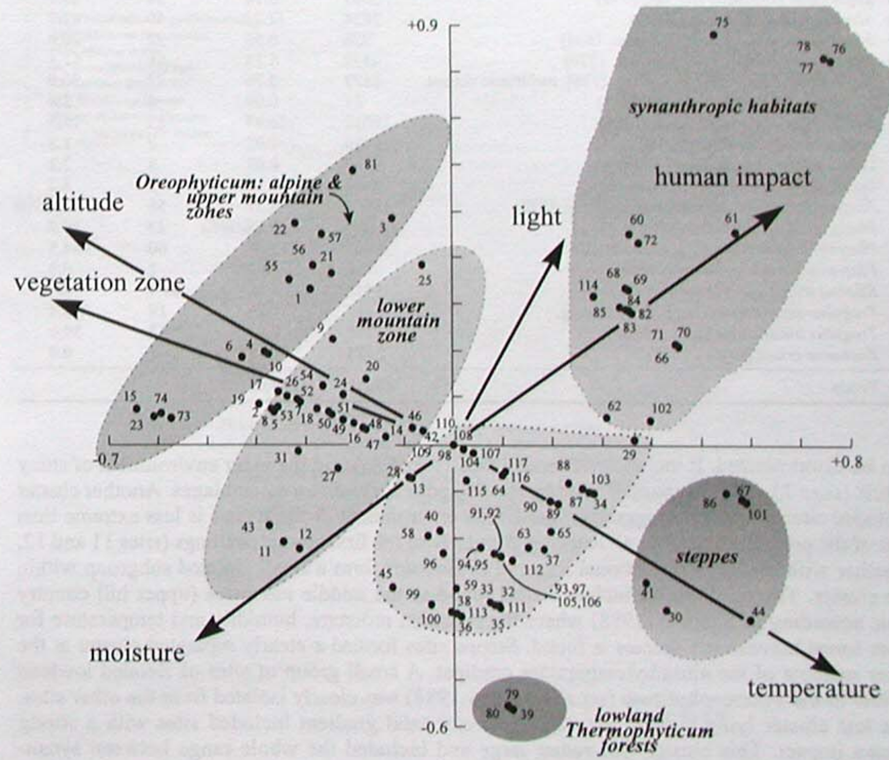

Fig. 2. CCA ordination of 117 sampling sites based on ln transformed abundance data. Individual clusters of sites from the same habitat type are in ellipses and envelopes, shading indicates an environmental gradient.

Table 1. List of species, number and percentage of individuals, and number and percentage of sites (n = 117) at which particular species were collected

No.	Name	No. of individuals	% of individuals	No. of localities	% of localities
1	*Astrobunus laevipes* (Canestrini, 1872)	440	1.08	4	3.6
2	*Egaenus convexus* (C. L. Koch, 1835)	12	0.03	1	0.9
3	*Gyas titanus* Simon, 1879	3	0.01	2	1.8
4	*Ischyropsalis hellwigi* (Panzer, 1794)	39	0.10	13	11.8
5	*Ischyropsalis manicata* L. Koch, 1865	180	0.44	1	0.9
6	*Lacinius dentiger* (C. L. Koch, 1848)	1	0.00	1	0.9
7	*Lacinius ephippiatus* (C. L. Koch, 1835)	4845	11.86	70	63.6
8	*Lacinius horridus* (Panzer, 1794)	520	1.27	24	21.8
9	*Leiobunum blackwalli* Meade, 1861	4	0.01	1	0.9
10	*Leiobunum limbatum* L. Koch, 1861	33	0.08	3	2.7
11	*Leiobunum rotundum* (Latreille, 1798)	63	0.15	10	9.1
12	*Leiobunum rupestre* (Herbst, 1799) agg.	51	0.12	7	6.4
13	*Lophopilio palpinalis* (Herbst, 1799)	2507	6.14	54	49.1
14	*Mitopus morio* (Fabricius, 1799)	7034	17.22	69	62.7
15	*Mitostoma chrysomelas* (Hermann, 1804)	228	0.56	22	20.0
16	*Nemastoma lugubre* (O. F. Müller, 1776)	2179	5.34	68	61.8
17	*Nemastoma lugubre* (O. F. Müller, 1776), melanistic variant	1127	2.76	22	20.0
18	*Nemastoma triste* (C. L. Koch, 1835)	37	0.09	4	3.6
19	*Oligolophus tridens* (C. Koch, 1836)	11012	26.97	83	75.5
20	*Opilio canestrinii* (Thorell, 1876)	30	0.07	2	1.8
21	*Opilio parietinus* (De Geer, 1778)	20	0.05	8	7.3
22	*Opilio saxatilis* C. L. Koch, 1839	56	0.14	9	8.2
23	*Paranemastoma quadripunctatum* (Perty, 1833)	1865	4.57	58	52.7
24	*Phalangium opilio* Linné, 1761	360	0.88	23	20.9
25	*Platybunus bucephalus* (C. L. Koch, 1835)	6405	15.68	60	54.5
26	*Platybunus pallidus* Šilhavý, 1938	1	0.00	1	0.9
27	*Rilaena triangularis* (Herbst, 1799)	1412	3.46	53 4	8.2
28	*Trogulus nepaeformis* (Scopoli, 1763) agg.	117	0.29	18	16.4
29	*Trogulus tricarinatus* (Linné, 1767)	183	0.45	33	30.0
30	*Zachaeus crista* (Brullé, 1832)	74	0.18	1	0.9
	Totals	40838	100.00		

can be discriminated. It includes wetlands (sites 15 and 23) and the inner environment of stony debris (sites 73 and 74), characterized by species-poor harvestman assemblages. Another cluster included sites of the lower mountain zone. The environment of these sites is less extreme than that of the previous cluster in all respects. Similarly to the first cluster peatbogs (sites 11 and 12, together with the forested National Reserve of Boubín) form a small isolated subgroup within the cluster. The third cluster included sites found in the middle mountain (upper hill country zone according to Skalický 1988) where the optimum moisture, humidity and temperature for most forest harvestmen species is found. Steppe sites formed a clearly separated cluster at the other extreme of the altitude/temperature gradient. A small group of sites of flooded lowland forests in the Thermophyticum (sensu Skalický 1988) was clearly isolated from the other sites. The last cluster lying outside the main environmental gradient included sites with a strong human impact. This cluster was rather large and included the whole range between synanthropized meadows, field margins and arable land up to man-made habitats, such as walls in cities. This gradient was negatively correlated with soil moisture and partly positively correlated with increasing temperature and light intensity (Fig. 2).

Species ordination with the same explanatory variables indicated environmental demands of individual species (Fig. 3). Most of them were arranged along the altitude/temperature gradient. Only two species, *Platybunus pallidus* and *Ischyropsalis manicata*, fell into the area delimited by alpine and upper mountain sites. In six species most localities were found in mountains, rarely at lower elevations. Of these, *Platybunus bucephalus* and *Mitopus morio* showed a wide range of altitudinal distribution, whereas *Nemastoma triste*, melanistic variant of *Nemastoma lugubre* and *Ischyropsalis hellwigi* were captured in lowland habitats only in narrow valleys and gorges where the local climate is cold and humid. At the other extreme of the altitudinal / temperature gradient were *Zachaeus crista* and *Egaenus convexus*, both known from SE Moravia only. *Astrobunus laevipes* was collected in South Moravia only, on steppe, in forests and halophilous vegetation. Four species showed a high tolerance to human impact (*Leiobunum rotundum*, *Phalangium opilio*, *Opilio saxatilis* and *O. parietinus*). They colonize environments modified by humans, such as field margins, synanthropic vegetation patches near villages and

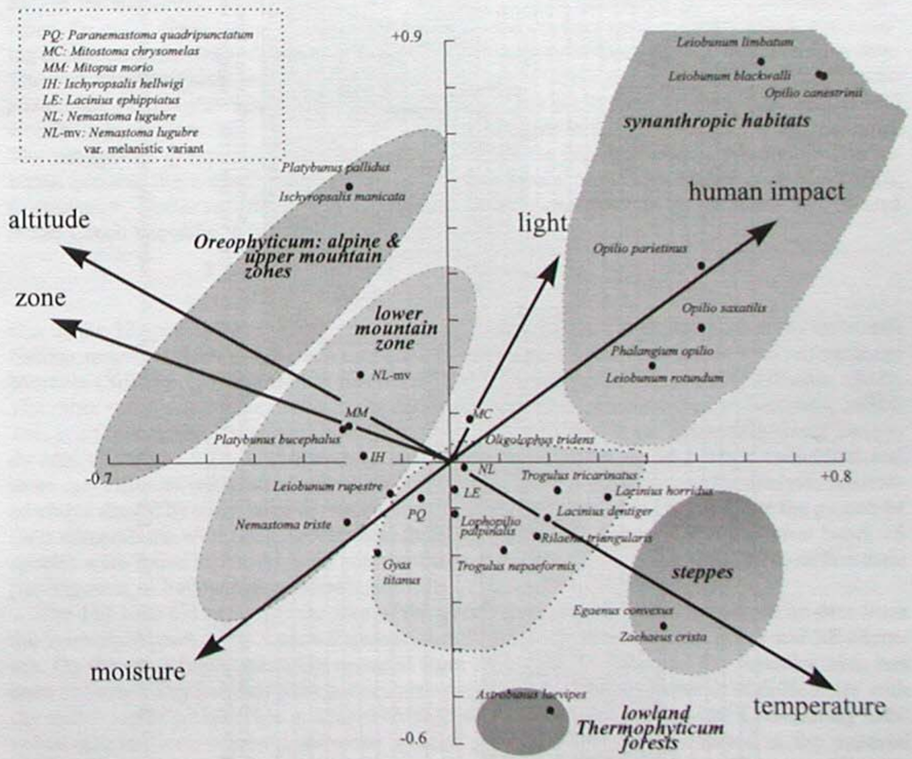

Fig. 3. CCA ordination of 30 harvestmen species. The ellipses and envelopes were copied from Fig. 2, shading indicates an environmental gradient.

Table 2. Synoptic table of harvestmen assemblages in the Czech Republic. Abundances: –: no individual, 1: 1–2, 2: 3–5, 3: 6–10, 4: 11–20, 5: 21–40, 6: 41–80, 7: 81–160, 8: 161–320, 9: >320 individuals

	11 11 1111111 1 11 1 1 1 1
	1147 112244455555557 2222238111224 1411114999990112333445588900011116663788808900890908066783361366733766947777
	238083495923789012345673145601456111677807463012567890229378158935478934571239907916126825344345022406669105278048567
Mitopus morio	546456-57599663364211-577655998989969968612223323551243--1-12----1-63-1---212---------242-2--------------------2--1--
Platybunus bucephalus	522438473676664655465456573477439997995782-23232431-145------1-------1----247-6----1---------------------------------
Mitostoma chrysomelas	---1--2--1------------------41----7-12--5-------2-1-1-1-3-2-21------1-----554--------------2-------------------------
Nemastoma lugubre var. unicolor	33341--1----------------5544-311-59-1--5---------------4---------------8---------------------------1--2----2---------
Ischyropsalis hellwigi	---1---------------1---------22---112-32-3---4--2-2--
Leiobunum rupestre agg.	------31-------------------------------35-3-----1---------2--
Nemastoma triste	-----5--------------------------------2------3-2---
Gyas titanus	------------------------------------1----2---
Ischyropsalis manicata	-----------------------------------8---
Platybunus pallidus	-----------------------------------1---
Lacinius ephippiatus	-1--11------311---1--22-7-11658838872233---13-363666865644356625677852-645477749----222-62----31-212-2---------------
Paranemastoma quadripunctatum	----12---5--223232222-2-5---324-28-955457--18-765343474571-52433--272444--32-----231--2-2-------------1--------------
Lophopilio palpinalis	----1-------11--1--22---1-1----1-21586365533622-22-21122623433-3--43332---5681-9---------2--1------22------42---1----
Oligolophus tridens	677557-2-5-31-1---------77777898489675743122656-642--66-6-5758-46637765945898389--5--55--5-57565373332212-21--7--4---
Nemastoma lugubre	12-22----2-11-322--2211333367435572-2325--5--61--1--23-242736---2141-----895428--1-1---------521-13--454343261-----
Rilaena triangularis	---32-4241-65-54656-122126234635442868-123675-75134-11--4432--1-432--4-----
Trogulus tricarinatus	-------------1--------------------------3------2-421121------2----3--1-----355-2-1--122-221-55-111------11-1--3-2----
Trogulus nepaeformis agg.	--6-3333----1-2------1---------------121-22224----------1---------2----
Astrobunus laevipes	---319--------------------------------3----
Lacinius horridus	---2----1-3-----------5766565233-1--12-------3134--6542----
Phalangium opilio	--3-------3--8-------3-13--1----2423-2-3-321---632-6122
Opilio parietinus	--2-----------------------------1-----------131---312
Zachaeus crista	--6----------
Egaenus convexus	--4----------
Leiobunum rotundum	--12---1-----------22---1--------1--------------------26-2-
Opilio saxatilis	---21--------------1--1245-22
Leiobunum limbatum	--532
Opilio canestrinii	---54
Leiobunum blackwalli	---2-
Lacinius dentiger	---1-----

towns, and arable land. They were found also in man-made environments, such as on walls in towns, where *Opilio canestrinii*, *Leiobunum limbatum* and *L. blackwalli* dominated.

Using TWINSPAN a simple classification of harvestman assemblages was obtained. Species were grouped into six blocks with a high species-to-species correlation. The species groups largely overlapped with those obtained from CCA ordination (Table 2). The first block (*Mitopus morio* to *Nemastoma lugubre*, melanistic variant: the upper left box in Table 2) included species with a high abundance in mountains. Their abundance and frequency decreased towards lower elevations. Some of the species with a wider ecological amplitude were occasionally also found in lowlands (e. g., *Mitopus morio* and *Nemastoma triste*). The second species group included *Paranemastoma quadripunctatum*, *Lacinius ephippiatus* and *Lophopilio palpinalis*. All of them possess a relatively broad ecological amplitude and were collected with a high frequency at many sites. However, their optimum was clearly at medium altitudes and their frequency decreased both towards higher altitudes and lowlands. The third species group included *Nemastoma lugubre* and *Oligolophus tridens*. Their frequency and abundance was high everywhere, except for man-made habitats. Their presence was of little indicative value. *Astrobunus laevipes*, *Trogulus nepaeformis* and *T. tricarinatus* formed the next species group which was missing in mountain forests and above timberline. The frequency of these species was relatively low. The last but one group included five species, *Egaenus convexus*, *Lacinius horridus*, *Opilio parietinus*, *Phalangium opilio* and *Zachaeus crista*. They are typical of open, dry habitats and woods in dry regions. The assignment of *Lacinius dentiger* to this group seems to be uncertain. The last species group included species which reached the highest frequency in man-made habitats. Some of these species can be found also under natural conditions (*Leiobunum blackwalli*, *L. rotundum*, *Opilio saxatilis*). The last species, *Opilio canestrinii*, is, as far as known, limited in the Czech Republic to man-made habitats.

DISCUSSION

Out of the 32 species known from the Czech Republic only two were missing in the database: *Nelima semproni* Szalay, 1951 is a thermophilous species known from a small area in southern Moravia (Šilhavý 1971a) recently discovered in the neighbourhood of Louny (Roušar 1997). The other species not represented in the database was *Paranemastoma kochi* (Nowicki, 1870). This is a Carpathian element reaching its westernmost localities in the Moravskoslezské Beskydy Mts. (Šilhavý 1972). Unfortunately, two species were collected as a single individual and three more species were found on one locality only so that for these species the analysis presented above should be considered as preliminary. Further data are needed to complete the picture of their associations with other species and their environmental demands. On the other hand, 16 species were found at 10 and more sites, so that enough data were at our disposal to define their participation in harvestman assemblages.

The 117 sites did not cover the area of the Czech Republic equally. There were no data from the westermost part of the Czech Republic, nor from a large area between Praha and SE Moravia. On the other hand, extensive material from the Krkonoše Mts. and the Jeseníky Mts. has been collected. Dry habitats were underrepresented in the database as a result of difficulties with the utilisation of pitfall traps at sites with shallow soils and direct sunshine. Considering individual species, long-legged *Leiobunum* species are possibly underrepresented in the material similarly as *Lacinius dentiger*, a species abundant in shrub and tree layers. However, all these species were missing or rare also as juveniles in spite of the fact that young individuals of all harvestmen are living at the soil surface because of their inability to regulate their internal water regime in shrub and tree layers where air humidity is often too low. Therefore, I believe that the material available for the analysis quite well represented harvestman assemblages of the Czech Republic.

The analysis presented in this paper indicated that most harvestmen species have relatively broad ecological amplitudes along the main environmental gradients. However, there were several species assemblages which indicated their habitats quite well, much better than individual species did. In the upper belts of mountains usually relatively species-poor assemblages were found. There were also a few species usually missing at lower elevations, such as *Nemastoma triste*, *Ischyropsalis hellwigi*, *I. manicata* and *Platybunus pallidus*. They are characterized by a scattered distribution over the whole country and relatively low population density. Alpine derivatives of the abovementioned mountain forest fauna are species-poor with no species limited to this belt. There was no difference between species assemblages colonizing the inner environment of stony debris and those occurring in alpine peatbogs. Both of them were species-poor derivatives of the mountain forest species assemblages. This contrasts to a specific spider fauna of stony debris which include several relict species, in Central Europe limited to this environment (Růžička et al. 1989, Růžička & Zacharda 1994, Růžička et al. 1995). In contrast, dry environments in lowlands have a distinct species composition of harvestmen with several species limited to this environment (*Zachaeus crista*, *Astrobunus laevipes*, *Egaenus convexus*, *Lacinius horridus*). The third extreme is represented by synanthropic habitats. All harvestmen species in this environment are annual, with overwintering eggs and with adults in the late summer up to the end of the year. They are long-legged and belong to three independent evolutionary units – the subfamilies Leiobuninae, Opilioninae and Phalangiinae. All of them are evolutionary young and derived lineages (Martens 1978).

The results of CCA ordination of the species suggesting environmental demands and distributional limits caused by the local environment corresponded well to the literature data on individual species (summarized by Martens 1978, for example). Still, there are a few species which require some comments: *Leiobunum limbatum* was found exclusively on walls in cities. This is a species spreading in recent times up to the foot of the mountains (e. g., Pec pod Sněžkou, 700 m a. s. l.) where it reaches very high abundance. So far it has been reported from a few localities from the Czech Republic (Radnice near Plzeň – Martens 1978, Netín near Velké Meziříčí – Kratochvíl 1934, Bílé Karpaty – Bezděčka 1996, the valley of Bezručovo údolí near Chomutov, Hradec Králové, Třeboň, Praha, Pec pod Sněžkou, Trutnov – Klimeš & Roušar in press). Most of them, if not all, are synanthropic. Under natural conditions the species is usually found on rocks in forests of various types (Martens 1978). Its distribution out of towns needs more attention in the Czech Republic. Similarly, the habitat requirements of *L. blackwalli* are poorly known. In Germany this species is less synanthropic than *L. rotundum* (Martens 1978). However, the data from the Czech Republic are too scarce to make any conclusion about habitat preference of this species (Šilhavý 1956, 1971b, Klimeš & Roušar in press). The third synanthropic species in the data set is *Opilio canestrinii*. In the Czech Republic it has been discovered in 1994 and a number of localities has been found since, both in Bohemia and Moravia, up to the feet of mountains (Klimeš & Roušar in press). So far no occurrence out of towns and villages has been recorded even if its high abundance in gardens and reports from Germany (Bliss 1982, Bachmann & Schaefer 1983, Malten 1991) indicate that its spreading to natural habitats can be expected in the near future.

Egaenus convexus and *Zachaeus crista* are species with most localities in the Balkan Peninsula (Starega 1976, Martens 1978). In the Bílé Karpaty Mts. they reach their north-western distributional limit. Their position in the CCA ordination in Fig. 3 is therefore strongly affected by their distributional limits in the Czech Republic which seems to be, at least partly, historically determined, as they are missing in other warm and dry regions of South Moravia. *Astrobunus laevipes* is a thermophilous species and SE European zoogeographical element. In contrast to the two species discussed above it also spread to Bohemia, and along the Labe River to Germany, north up to Halle/Saale. Besides, there are a few isolated localities in Bayern, Hessen and Baden Württemberg (Baumann et al. 1992). Recently a wider distribution in Bohemia has been discovered (Klimeš & Roušar in press). Its distribution along the moisture gradient is wider than those of *Egaenus convexus* and *Zachaeus crista*; *Astrobunus laevipes* has been recorded both at xerothermic localities and in wetlands.

Platybunus pallidus and *Ischyropsalis manicata* are two mountain species with a Carpathian distribution. The first species was represented in the data set by occurrence at a single locality in the Moravskoslezské Beskydy Mts., in spite of the fact that Šilhavý (1947) found it quite common in the Jeseníky Mts. from where I had extensive material at my disposal. *Ischyropsalis manicata* was collected in the Czech Republic only in the easternmost part of North Moravia by Máca (Šilhavý 1973) and Sechterová-Špičáková (1988). In the Carpathians it is a forest species of the mountain belt preferring colder localities with a high air humidity (Avram 1964). Surprisingly, its locality in the Moravskoslezské Beskydy is quite open and close to the top of a mountain. However, stony debris partly covered by soil and shrubby vegetation offer a suitable micro-environment for this species. It occurs there together with *I. hellwigi* (subsp. *hellwigi*), a Central European species scattered over hills and mountains in the whole country and occurring at all localities known to me at low abundance.

Most of the species occupying the central part of the CCA diagram (Fig. 3) colonize a wide range of environments except for several mountain taxa, such as *Nemastoma triste*, *Gyas titanus*, *Mitostoma chrysomelas* and melanistic variant of *Nemastoma lugubre* which strongly prefer environments where cold temperature and high air moisture prevail during the whole year and which are not affected by humans. This kind of habitats sometimes also occurs at lower elevations where these species may survive as relict populations.

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APPENDIX

Survey of material. Quadrangles of the square grid according to Buchar (1982) are given.

No.	Locality	Quadrangle	Collector & Year / Reference
1	Jeseníky, bottom of the Velká kotlina cirque	5969	leg. V. Kavalcová, 1995
2	Jeseníky, Velká kotlina cirque, Daphno-Aceretum	5969	leg. Tajovský, 1994–1995
3	Jeseníky, Velká kotlina cirque, Thesio-Nardetum	5969	leg. Tajovský, 1994–1995
4	Jeseníky, Velká kotlina cirque, Festuco-Vaccinietum	5969	leg. Tajovský, 1994–1995
5	Jeseníky, Velká kotlina cirque, Poo-Deschampsietum	5969	leg. Tajovský, 1994–1995
6	Jeseníky, Velká kotlina cirque, Adenostyletum alliariae	5969	leg. Tajovský, 1994–1995
7	Jeseníky, Velká kotlina cirque, Fagetum	5969	leg. Tajovský, 1994–1995
8	Jeseníky, Velká kotlina cirque, Laserpitio-Dactylidetum	5969	leg. Tajovský, 1994–1995
9	Jeseníky, Velká kotlina cirque, Calamagrostio-Piceetum	5969	leg. Tajovský, 1994–1995
10	Jeseníky, Velká kotlina cirque, Festuco-Vaccinietum	5969	leg. Tajovský, 1994–1995
11	Jeseníky, Skřítek peatbog	6068	leg. I. Chvátalová, 1990–1991
12	Jeseníky, Rejvíz peatbog	5769	leg. V. Kavalcová, 1995
13	Broumovsko, Kovářova rokle	5463	leg. J. Spíšek, 1995
14	Broumovsko, Ostaš and Hejda	5463	leg. J. Spíšek, 1995
15	Krkonoše, Úpská rašelina peatbog	5260	leg. Tajovský, 1989–1991
16	Krkonoše, Třídomí	5259	leg. Tajovský, 1989–1991
17	Krkonoše, Navorská jáma	5259	leg. Tajovský, 1989–1991
18	Krkonoše, V bažinkách	5259	leg. Tajovský, 1989–1991
19	Krkonoše, Schustlerova zahrádka	5259	leg. Tajovský, 1989–1991
20	Krkonoše, Přední Rennerovky, clearing	5260	leg. Tajovský, 1989–1991
21	Krkonoše, Zadní Rennerovky	5260	leg. Tajovský, 1989–1991
22	Krkonoše, Studniční hora	5260	leg. Tajovský, 1989–1991
23	Krkonoše, Pančavská louka peatbog	5259	leg. Tajovský, 1989–1991
24	Krkonoše, Dvoračky	5259	leg. Tajovský, 1989–1991
25	Krkonoše, Dvoračky, the plots treated by Roundup	5259	leg. Tajovský, 1989–1991
26	Krkonoše, Přední Rennerovky – Kostlivčí les	5260	leg. Tajovský, 1989–1991
27	Krkonoše, Pod bažinkami	5259	leg. Tajovský, 1989–1991
28	N Bohemia, Kamenec	5252	leg. V. Růžička, 1993–1994
29	S Bohemia, Dlouhá Ves (incomplete material)	6950	leg. K. Tajovský, 1987–1988
30	Bílé Karpaty Mts., National Reserve of Čertoryje	7170	leg. L. Klimeš, 1994
31	Orlické hory Mts., National Reserve of Bukačka	5664	leg. B. Mocek
32	Kokořínsko, Kokořínský důl, Harasov, *Carex* wetland at the pond of Harasov	5553	leg. L. Beran, 1995–1996
33	Kokořínsko, springs of the Pšovka River, *Carex* wetland	5553	leg. L. Beran, 1995–1996
34	Kokořínsko, Ronov, scree, xerothermic SW slopes and a sparse forest	5553	leg. L. Beran, 1995–1996

No.	Locality	Quadrangle	Collector & Year / Reference
35	Kokořínsko, wetlands near Liběchovka: *Carex* wetland at the Ruprechtice village	5553	leg. L. Beran, 1995–1996
36	Kokořínsko, wetlands near Libýchovka: spring alder carr near Vrabcov	5553	leg. L. Beran, 1995–1996
37	Kokořínsko, Ronov, sparse scree forest and margin of a scree	5553	leg. L. Beran, 1995–1996
38	Kokořínsko, Kokořínský důl, Vojtěchov, alder carr at the Stříbrník fishpond	5553	leg. L. Beran, 1995–1996
39	S Moravia, National Reserve of Ranšpurk	7367	leg. J. Chytil, 1993
40	E Bohemia, the National Reserve of Teplicko-Adršpašské skály	5462	leg. V. Růžička, 1991–1993
41	Křivoklát Landscape Protected Area, Velká Pleš, Vůznice	5949	leg. V. Růžička, 1993–1994
42	Brdy Mts., Strašice, Reserva	6248	leg. L. Klimeš, 1983
43	Šumava Mts., National Nature Reserve of Boubín	7048	leg. V. Růžička, 1989
44	Pálava Protected Landscape Area, Nature Reserve of Slanisko	7166	leg. J. Chytil, 1993
45	Králický Sněžník, valley of the Morava River, 590 m a. s. l.	5866	leg. L. Klimeš, 1985
46	Králický Sněžník, valley of the Morava River, 650 m a. s. l.	5866	leg. L. Klimeš, 1985
47	Králický Sněžník, valley of the Morava River, 720 m a. s. l.	5866	leg. L. Klimeš, 1985
48	Králický Sněžník, valley of the Morava River, 825 m a. s. l.	5867	leg. L. Klimeš, 1985
49	Králický Sněžník, valley of the Morava River, 880 m a. s. l.	5867	leg. L. Klimeš, 1985
50	Králický Sněžník, valley of the Morava River, 930 m a. s. l.	5867	leg. L. Klimeš, 1985
51	Králický Sněžník, valley of the Morava River, 990 m a. s. l.	5867	leg. L. Klimeš, 1985
52	Králický Sněžník, valley of the Morava River, 1060 m a. s. l.	5867	leg. L. Klimeš, 1985
53	Králický Sněžník, S slope of Králický Sněžník, 1150 m a. s. l.	5867	leg. L. Klimeš, 1985
54	Králický Sněžník, S slope of Králický Sněžník, 1220 m a. s. l.	5867	leg. L. Klimeš, 1985
55	Králický Sněžník, S slope of Králický Sněžník, 1300 m a. s. l.	5867	leg. L. Klimeš, 1985
56	Králický Sněžník, S slope of Králický Sněžník, 1375 m a. s. l.	5867	leg. L. Klimeš, 1985
57	Králický Sněžník, S slope of Králický Sněžník, 1420 m a. s. l.	5767	leg. L. Klimeš, 1985
58	Stropnice: peatbog	7254	leg. V. Růžička, 1989
59	Stropnice: meadows	7254	leg. V. Růžička, 1989
60	Strašice: woods and meadow patches surrounded by arable land	6248	leg. L. Klimeš, 1983
61	Pomoraví Protected Landscape Area, Mladeč, arable land within a clearing	6268	Klimeš & Špičáková 1984
62	Pomoraví Protected Landscape Area, Mladeč, ecotone between arable land and a flooded lowland forest	6268	Klimeš & Špičáková 1984
63	Pomoraví Protected Landscape Area, Mladeč, flooded lowland forest	6268	Klimeš & Špičáková 1984
64	Čubernice Nature Reserve, pitfall traps 1, 2 and 5	6568	leg. Klimeš & Špičáková, 1982
65	Čubernice Nature Reserve, pitfall traps 3 and 4	6568	leg. Klimeš & Špičáková, 1982
66	Čubernice Nature Reserve, pitfall traps 7 and B	6568	leg. Klimeš & Špičáková, 1982
67	Čubernice Nature Reserve, pitfall traps 8 to 14,16, A and F	6568	leg. Klimeš & Špičáková, 1982
68	Čubernice Nature Reserve, pitfall trap 19	6568	leg. Klimeš & Špičáková, 1982
69	Čubernice Nature Reserve, pitfall trap S	6568	leg. Klimeš & Špičáková, 1982
70	Čubernice Nature Reserve, pitfall trap 6	6568	leg. Klimeš & Špičáková, 1982
71	Čubernice Nature Reserve, pitfall trap 15	6568	leg. Klimeš & Špičáková, 1982
72	Čubernice Nature Reserve, pitfall trap R	6568	leg. Klimeš & Špičáková, 1982
73	screes in the Krkonoše Mts.	5259, 5260	leg. V. Růžička, 1988–1989
74	screes on Mt. Králický Sněžník	5767	leg. V. Růžička, 1993–1994
75	Pec p. Sněžkou, on walls	5360	leg. L. Klimeš, 1996
76	Praha, on walls	5952	leg. L. Klimeš, 1996
77	Hradec Králové, on walls	5760, 5761	leg. L. Klimeš, 1996
78	Hradec Králové, on walls	5760, 5761	leg. L. Klimeš, 1987
79	Lednice, floodplain forest: soil and herb layer, sifting, sweeping	7166	Křístek 1991
80	Lednice, Ulmi-Fraxineta	7166	Obrtel 1976
81	Beskydy, Smrk Mt.	6476	Sechterová 1988
82	Prostějov, Čechovice, old field	6568	Sechterová 1987
83	Prostějov, Domamyslice, old field	6568	Sechterová 1987
84	Prostějov, Stichovice, old field	6568	Sechterová 1987
85	Prostějov, Ohrozim, old field	6468	Sechterová 1987
86	Křivoklátsko, Festucetalia valesiacae, Alysso-Potentilletum arenariae, Hyperico-Scleranthion, Trifolio-Geranietea	5949	Šmaha 1983
87	Křivoklátsko, Cynancho-Quercetum	5949	Šmaha 1983
88	Křivoklátsko, Cynancho-Quercetum/scree forest	5949	Šmaha 1983
89	Křivoklátsko, Genisto-Quercion	5949	Šmaha 1983
90	Křivoklátsko, Genisto-Quercion	5949	Šmaha 1983
91	Křivoklátsko, Galio-Carpinetum	5949	Šmaha 1983
92	Křivoklátsko, Aceri-Fraxinetum mercurialetosum	5949	Šmaha 1983
93	Křivoklátsko, Aceri-Carpinetum	5949	Šmaha 1983
94	Křivoklátsko, Aceri-Carpinetum	5949	Šmaha 1983
95	Křivoklátsko, Tilio-Acerion	5949	Šmaha 1983
96	Křivoklátsko, fragmens of Acerion	5949	Šmaha 1983
97	Křivoklátsko, Aceri-Carpinetum	5949	Šmaha 1983
98	Křivoklátsko, Tilio cordatae-Fagetum	5949	Šmaha 1983
99	Křivoklátsko, fragments of Alnion	5949	Šmaha 1983
100	Křivoklátsko, fragments of Alnion	5949	Šmaha 1983
101	Křivoklátsko, xerothermic rocky steppe, Hyperico-Scleranthion perennis	6048	Šmaha 1984
102	Křivoklátsko, Quercion pubescentis	6048	Šmaha 1984
103	Křivoklátsko, a scree without vascular plants	6048	Šmaha 1984
104	Křivoklátsko, Aceri-Carpinetum, a scree forest	6048	Šmaha 1984
105	Křivoklátsko, Melampyro nemorosi-Carpinetum, subas. luzuletosum, acid form	6048	Šmaha 1984
106	Křivoklátsko, Melampyro nemorosi-Carpinetum, subas. luzuletosum, typical form	6048	Šmaha 1984
107	Křivoklátsko, Melampyro nemorosi-Carpinetum / Tilio cordatae-Fagetum	6048	Šmaha 1984
108	Křivoklátsko, Tilio cordatae-Fagetum with *Calamagrostis*	6048	Šmaha 1984
109	Křivoklátsko, Tilio cordatae-Fagetum with *Oxalis*	6048	Šmaha 1984
110	Křivoklátsko, Tilio cordatae-Fagetum with *Asperula odorata*	6048	Šmaha 1984
111	Křivoklátsko, the bank of the Prostřední potok stream, with ferns	6048	Šmaha 1984
112	Křivoklátsko, the bank of the Roudný stream with a *Fagus* forest	6048	Šmaha 1984
113	Křivoklátsko, the bank of the Roudný stream with an *Acer* forest	6048	Šmaha 1984
114	Třeboň, Wet meadows, ruderalized canal bank with *Urtica dioica*	6954	Klimeš 1997
115	Třeboň, Wet meadows, *Salix cinerea* shrub	6954	Klimeš 1997
116	Třeboň, Wet meadows, *Alopecurus pratensis*-dominated meadow	6954	Klimeš 1997
117	Třeboň, Wet meadows, wetland dominated by *Carex gracilis*	6954	Klimeš 1997