Composition and diversity of psocid (*Insecta*: *Psocoptera*) taxocoenoses in forest ecosystems of the *Abieti-fageta* s. lat. zone in the Western Carpathian Mts.

O. Holuša

Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry in Brno, Brno, Czech Republic
Forest Management Institute, Brandýs nad Labem, branch office Frýdek-Místek, Czech Republic

ABSTRACT: Psocid (Psocoptera) taxocoenoses were studied in forest ecosystems of the Western Carpathian Mts. in 1997–2001. As a study frame, vegetation tiers (VT = altitudinal vegetation zones) of geobiocoenological or forest-typological system were used. Lower units of forest typological system (forest type complexes) were used for the classification of ecological conditions and the material found in forest ecosystems of *Abieti-fageta* s. lat. communities (5th fir-beech VT) was evaluated in detail. This VT is the most widespread in the regions under study (the Moravskoslezské Beskydy Mts., the Vsetínské vrchy Hills and Javorníky). 2,023 adults comprising 28 species were found in the 5th VT. *Caecilius burmeisteri* was found as eudominant species; *Philotarsus picicornis, Caecilius flavidus* and *Peripsocus subfasciatus* were found as dominant species. In natural geobiocoenoses with the level of naturalness 1 or 2, the following species were found: *Mesopsocus unipunctatus, Caecilius flavidus,* and *Caecilius burmeisteri* as eudominant and *Caecilius despaxi* as dominant. Taxocoenoses of psocids were evaluated by Detrended Correspondence Analysis (DCA) and Divisive Cluster Analysis (DvClA). The axes were interpreted in DCA-analysis as follows: the x-axis denotes the influence of VTs and the q-axis refers to the influence of hydricity. This material was compared with other material obtained from various vegetation tiers in the Western Carpathians Mts. The characteristic species composition of psocids in the 5th VT was as follows: *Caecilius flavidus – C. burmeisteri – C. despaxi – Metylophorus nebulosus – Philotarsus picicornis.*

Keywords: *Psocoptera*; taxocoenoses; diversity; forest ecosystems; vegetation tier; *Abieti-fageta* s. lat.; Moravskoslezské Beskydy Mts.; Vsetínské vrchy Hills; Javorníky Mts.; Western Carpathian Mts.

The psocids were studied only in some areas of the Czech Republic, mostly in various mountains of Moravia and Silesia, e.g. in the Hrubý Jeseník Mts., Kralický Sněžník Mt. (Obr 1949) and the Moravskoslezské Beskydy Mts. (Obr 1952, 1965). Only occasional captures were published from other areas of the Czech Republic. A complex psocopterological research was initiated in the territory of the Czech Republic and Slovakia in 1997 (cf. Holuša 2003a).

Mostly faunistic data are available in this country at present. However, Holuša (2001) studied an ecological problem of the dependence of psocid taxocoenoses composition on vegetation tier (VT = altitudinal vegetation zone) in the Smrk Nature Reserve, Holuša (2003b) in the Mazák Nature Reserve and the same author (Holuša 2007b) in the V Podolánkách Nature Reserve. All these reserves are located in the Moravskoslezské Beskydy Mts. In

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the Podbeskydská pahorkatina Hills psocid occurrence was also evaluated in the framework of forest type complexes in the Kamenec Nature Reserve (Holuša 2005) and in the alluvium of the Odra River (Poodří Protected Landscape Area) (Holuša 2007a). Moreover, Mückstein and Holuša (2003) studied the composition of psocid taxocoenoses in different ecosystem types and its dependence on the naturalness level of forest ecosystems in the region of the Žďárské vrchy Hills. The latest ecological study brings data on the composition of psocid taxocoenoses of 7th (*Fageti-piceeta* s. lat.) and 8th (*Piceeta* s. lat.) VT in the Moravskoslezské Beskydy Mts. and the Oravské Beskydy Mts. in Slovakia (Holuša 2007c).

The aim of the systematic study of psocids conducted in the Western Carpathian Mts. in 1997–2001 was to define species diversity and characteristic species composition of psocids in particular vegetation tiers (vegetation tiers according to Plíva 1971, 1991 were used) and to prove an applicability of vegetation tiers or lower units of geobiocoenological or forest-typological systems in zoocoenological studies.

METHODS

The net of equally distributed geobiocoenological research plots was situated in regions of eastern Moravia, eastern Silesia and northern Slovakia in the territory of Polonic and West Carpathian biogeographical subprovinces (i.e. in the region of the Western Carpathian Mts.). Plots were selected in all VTs occurring in this region, i.e. from the 3rd (communities of *Querci-fageta* s. lat.) to the 9th tier (communities of *Pineta mugi* s. lat.) (cf. Holuša, Holuša 2008). Plots were located in such parts of forest stands that represent a particular VT and where it was possible to collect a representative material of psocids. Approximately the same number of permanent plots was located in all VTs. Permanent plots were marked out in the best-preserved parts of nature reserves [with the level of naturalness 1 or 2 according to Ellenberg (1973, 1978)] and additional plots were selected in modified parts of nature reserves or in managed forests with the level of naturalness 3 or 4 according to Ellenberg (1973, 1978).

Sampling was carried out in the same way in all VTs during the research and the material from the 5th (i.e. *Abieti-fageta* s. lat.) VT is presented in this study. The research was conducted in 1997–2001.

Material was obtained from permanent sampling sites during the vegetation period (from the beginning of May to the middle of September). The samples were collected by sweeping with a sweep net of 50 cm mouth in diameter. Branches of trees and bushes were beaten with the same sweep net in the extent of about 1 m from the branch end and up to approximately 2.5 m height, 30 sweepings or beatings were carried out in each locality. Individual collecting of adults also complemented these methods. Caught psocids were sucked into an exhauster and stored in a small test tube with 70% alcohol in the author's collection. All samples were collected and identified by the author. Monographs by Günther (1974) and Lienhard (1998) were used for identification; nomenclature, zoogeographical distribution and ecological demands were commented according to Lienhard (1977, 1998). Samples were sorted into vectors which represent "habitats of psocids". The following factors were taken into account for the purpose of sorting: biogeographical region, ecological conditions (according to the forest type complexes) and tree or shrub species from which the material was obtained (samples were also distinguished according to the capture method, i.e. captured either in a herb layer or by the Malaise trap). For example: *BE5Ssm*, where *BE* denotes the Beskydský biogeographical region (No. 3.10, cf. Culek 1996), *5S* represents forest type complexes *Abieto-Fagetum mesotroficum* and *sm* is an acronym for the tree species *Picea abies*.

Diversity was evaluated by Shannon-Wiener (H_S) and Brillouin diversity index (H_B), which were computed according to Kaesler and Mulvany (1976a,b). Diversity indexes of individual habitats were calculated from the total number of captured specimens, however, in the case of a higher number of specimens these were reduced to a constant number (30, 60, 120, 240 and 480) (Table 1). Some material was excluded from statistical processing because of a small number of collected specimens in some plots (i.e. species with a lower number than 5 specimens or 2 species even less than 3 specimens) to prevent data distortion.

The material was evaluated by Detrended Correspondence Analysis (DCA) and by Divisive Cluster Analysis (DvClA) in modification – Twinspan algorithm. Modified SW Decorana was used to process the DCA analysis, which was adapted for zoocoenological data processing (Povolný, Znojil 1990).

Acronyms of trees and shrubs (investigated tree species): sm – *Picea abies* (L.) Karsten, bk – *Fagus sylvatica* L., jd – *Abies alba* Mill., jb – *Malus sylvestris* Mill., jiv – *Salix caprea* L., pod – copse.

Table 1. Values of indices of diversity and equitability for the particular psocid biotopes in the zone of *Abieti-fageta* s. lat. vegetation tier

Biotope	***Nsp***	***N***	***N_c***				30				60				120				240				480			
			H_S	E_S	H_B	E_B	H_S	E_S	H_B	E_B	H_S	E_S	H_B	E_B	H_S	E_S	H_B	E_B	H_S	E_S	H_B	E_B	H_S	E_S	H_B	E_B
BE5Bbk	5	11	0.816	0.694	1.160	0.720																				
BE5Bjd	9	40	1.607	0.854	1.878	0.855																				
BE5Bsm	5	59	0.602	0.408	0.690	0.429	0.487	0.414	0.595	0.444																
BE5Ejb	6	20	0.920	0.639	1.190	0.664																				
BE5Fbk	5	42	0.423	0.294	0.524	0.325																				
BE5Fjd	8	39	1.320	0.736	1.546	0.744																				
BE5Fpod	2	5	0.322	0.699	0.500	0.722																				
BE5Fsm	6	70	1.074	0.651	1.177	0.657	0.993	0.800	1.149	0.807																
BE5Hsm	14	176	1.710	0.689	1.829	0.693	1.307	0.763	1.583	0.772	1.558	0.766	1.768	0.773												
BE5Nsm	6	37	1.002	0.641	1.184	0.661																				
BE5Sbk	6	33	0.922	0.597	1.108	0.618																				
BE5Sjd	6	33	1.253	0.812	1.460	0.815																				
BE5Sjiv	3	5	0.680	1.000	1.055	0.960																				
BE5Ssm	17	1,234	0.924	0.331	0.950	0.335	0.655	0.461	0.814	0.492	0.734	0.391	0.871	0.417	0.807	0.377	0.905	0.395	0.890	0.362	0.964	0.375	0.882	0.332	0.930	0.340
VS5Asm	2	8	0.260	0.489	0.377	0.544																				
VS5Bbk	1	35	–	–	–	–																				
VS5Bjd	4	13	0.953	0.885	1.231	0.888																				
VS5Bsm	12	136	1.612	0.695	1.740	0.700	1.269	0.797	1.512	0.803	1.482	0.728	1.682	0.734												
VS5Dbk	1	8	–	–	–	–																				
VS5Dsm	3	12	0.718	0.825	0.918	0.836																				
VS5Dsm	3	3	0.597	1.000	1.099	1.000																				

Nsp – number of species, *N* – number of specimens, H_S – Shannon-Wiener index of diversity, E_S – equitability to Shannon-Wiener index of diversity, H_B – Brillouin index of diversity, E_B – equitability to Brillouin index of diversity

Indexes of diversity for individual habitats out of the total number of captured specimens (*N*), in the case of a higher number of specimens they were reduced for the constant number of specimens – 30, 60, 120 and 240

The characteristics of the 5th vegetation tier (*Abieti-fageta* s. lat.)

The 5th vegetation tier (*Abieti-fageta* s. lat.) (cf. Holuša, Holuša 2008) represents geobiocoenoses where *Fagus sylvatica* is a dominant species in natural conditions, it creates the main level and also fills the overtopped level (of the height ca 47–48 m). Significant edificators – *Abies alba* has its optimum there (with the representation up to 40%, of the height in the co-dominant level up to 60 m) and *Picea abies* occurs only individually (with the representation reaching up to 10%, of the height up to 60 m). *Acer pseudoplatanus* L. and *Ulmus glabra* Huds. occur as additional tree species mostly in the overtopped level. They increase their representation at debris sites. There are *Tilia cordata* Mill., *Tilia platyphyllos* Scop., *Acer platanoides* L. and also *Padus avium* L. as individual additions (generally in the overtopped level). The occurrence of these species ends in the 5th VT, they do not occur in higher VTs. Localities with the 5th VT can be characterized as higher uplands and parts of mountains. The 5th VT occurs at the altitude from 460 to 920 m a.s.l. with the centre of occurrence in the interval of 640–660 m a.s.l. Soil types were formed on the flysch series of rocks of sandstones, claystones and shales, sporadically on deluvial loams. Cambisols are the prevailing soil type; less frequently there are podzols or rankers. The 5th VT takes up large areas in Natural Forest Area (= NFA) 40 and 41. It fills the territory of ca 18.0% in the north-eastern Moravia and Silesia. A greater part of the 5th VT area was changed to monoculture or stands with dominance of *Picea abies*. *Abies alba* and other tree species are mostly missing also in stands of *Fagus sylvatica*. *Abies alba* is represented relatively commonly only in NFA 41 (the Hostýnsko-vsetínské vrchy Hills and Javorníky Mts.) (mostly within the Czech Republic). The Salajka National Nature Reserve was characterized by Průša (1985) as the best-preserved virgin forest of the 5th VT, both with tree species composition and spatial structure. With a high probability, there are the best-preserved geobiocoenoses in the whole Czech Republic. This locality was studied also in the framework of this work. Natural geobiocoenoses are represented in the Mazák National Nature Reserve (Holuša, Holuša 2003) in the Moravskoslezské Beskydy Mts.

The following forest type complexes were classified at the study plots (ranked according to the system): 5N – *Abieto-Fagetum lapidosum acidophilum*, 5S – *Abieto-Fagetum mesotrophicum*, 5B – *Abieto-Fagetum eutrophicum*, 5F – *Abieto-Fagetum fastigiosum lapidosum mesotrophicum*, 5H – *Abieto-Fagetum illimerosum trophicum*, 5D – *Fagetum acerosum deluvium*, 5A – *Acereto-Fagetum lapidosum*, "5E" – code is used for solitaire trees outside forests, without sorting into forest type complexes.

RESULTS AND DISCUSSION

2,023 adults comprising 28 species were found in total – only *Caecilius burmeisteri* was a eudominant species, and *Philotarsus picicornis*, *Caecilius flavidus* and *Peripsocus subfasciatus* were dominant species. In natural geobiocoenoses with the level of naturalness 1 or 2, *Mesopsocus unipunctatus*, *Caecilius*

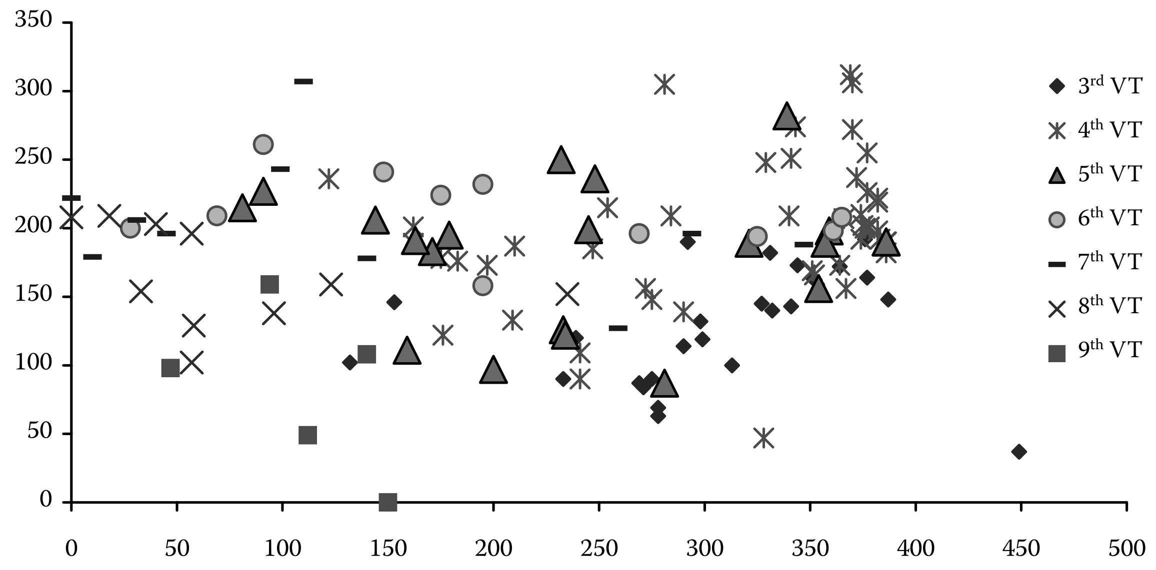

Fig. 1. DCA analysis of psocid biotopes with marked biotopes of *Abieto-fageta* (5th VT) tier (axis x – gradient of vegetation tiers, axis q – gradient of hydricity)

	PB4Bjd	OD1Lolx	PB1Ldbl	PB1Ljlv	PB3Los	PB4Ajlh	PB4Ajv	VS3Bjs	VS4Bdbz	VS4Esv	PB4Bpod	VS4Bjb	BE4Bdbl	BE4Bbk	BE4Bhb	BE4Blpm	BE5Fbk	BE5Ubk	BE6Fbk	OR6Bbk	PB3Hhb	PB3Hpod	PB4Ajs	PB4Bbk	PB4Bhb	PB4Blpm	PB4Dbk	PB4Wsvk	VS4Bbb	VS4Bbk	VS4Bhb	VS4Blpm	VS4Ejb	VS4Fbk	VS5Bbk	VS5Dbk	VS5Dsm
Groups of biotopes	A-I-b																																				
Elipsocus moebiusi	1	1	1	2	1	1	1	-	1	2	3	3	4	1	3	1	1	-	1	-	1	1	-	1	1	1	-	-	-	1	-	-	1	-	-	-	-
Mesopsocus laticeps	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Stenopsocus immaculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Stenopsocus stigmaticus	-	1	1	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius flavidus	-	2	1	2	1	1	1	1	1	1	1	1	3	2	4	3	4	3	4	2	3	3	4	4	4	3	3	4	2	4	5	3	2	2	4	2	2
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psococerastis gibbosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus phaeopterus	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus parviceps	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus subfasciatus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius atricornis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus parvulus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichadenotecnum majus	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kolbia quisquiliarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epipsocus lucifugus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liposcelis corrodens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus abdominalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enderleinella obsoleta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemineura dispar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reuterella helvimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius piceus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Peripsocus didymus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus alboguttatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metylophorus nebulosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Loensia fasciata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Loensia variegata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius fuscopterus	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Elipsocus hyalinus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus lachlani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius burmeisteri	1	-	-	1	-	-	-	1	-	-	-	-	1	-	1	-	-	1	1	-	-	-	-	1	-	1	1	-	-	-	1	-	-	-	-	-	1
Loensia pearmani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus picicornis	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cuneopalpus cyanops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphigerontia bifasciata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Mesopsocus unipunctatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2
Caecilius despaxi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	BE6Bbk	BE7Sbk	BE7Sjr	BE7Zbk	VS4Ddbz	VS5Fsm	BE4Sdbl	BE5Fpod	BE5Sjiv	OD1Uvrk	OP3Hpod	PB3Oma	PB4Ddbl	VS4Bdbl	VS4Bpod	PB4Hsm
Groups of biotopes	A-I-b															
Elipsocus moebiusi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mesopsocus laticeps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus immaculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius flavidus	2	2	1	3	2	1	1	1	1	1	1	1	1	2	1	1
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psococerastis gibbosa	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-
Peripsocus phaeopterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus parviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus subfasciatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius atricornis	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-
Peripsocus parvulus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Trichadenotecnum majus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kolbia quisquiliarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epipsocus lucifugus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liposcelis corrodens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus abdominalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enderleinella obsoleta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemineura dispar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reuterella helvimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius piceus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus didymus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus alboguttatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metylophorus nebulosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loensia fasciata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loensia variegata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius fuscopterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus hyalinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus lachlani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius burmeisteri	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-	-
Loensia pearmani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus picicornis	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Cuneopalpus cyanops	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Amphigerontia bifasciata	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-
Mesopsocus unipunctatus	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Caecilius despaxi	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1

	BK2Ctrn	OP1Lvrk	PB3Lkl	VS4Bos	BE6Obk	BK2Cdbp	BK3Bdbz	OD1Lkl	OP3Hbk	OP3Hkro	PB3Hbk	PB3Hdbl	VS3Lols	VS3Lolx	BE5Ejb	PB4Djd	PB1Tkro	PB1Toll	PB1Tvrp	PB2Ltrn	PB3Hlpm	PB3Loll	BE5Hsm	PB2Lsm	VS5Bsm	VS4Bsm	BE6Psm	BE6Rsm
Groups of biotopes	A-II-a-2																											
Elipsocus moebiusi	-	-	-	-	-	-	-	-	1	-	1	2	-	-	3	1	2	1	1	1	1	-	-	-	-	-	-	-
Mesopsocus laticeps	-	1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	2	4	1	1	1	1	-	-	-	1	-	-
Stenopsocus immaculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	2	-	-	-	-
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	2	-	-	-	-	-	-	-	-
Caecilius flavidus	1	1	1	1	1	1	1	1	1	1	1	1	2	1	-	-	1	1	1	-	3	-	-	1	1	2	-	-
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Graphopsocus cruciatus	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psococerastis gibbosa	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Peripsocus phaeopterus	1	1	1	2	1	1	1	-	1	-	1	1	1	1	-	-	2	1	1	1	2	-	-	1	-	4	-	-
Philotarsus parviceps	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3	1	-	-	1	2	3	1	-	2	1	4
Peripsocus subfasciatus	-	-	-	-	-	-	1	1	1	1	-	1	1	1	-	1	1	1	1	-	-	1	5	3	5	5	3	6
Caecilius atricornis	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus parvulus	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	-	3	-	-
Trichadenotecnum majus	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	1	-	-	-	-	1	1	-	2	-	3
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kolbia quisquiliarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epipsocus lucifugus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liposcelis corrodens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus abdominalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Enderleinella obsoleta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	5	4	6
Hemineura dispar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Reuterella helvimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius piceus	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	3	3	1	5	5	5
Peripsocus didymus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	4	3	3
Peripsocus alboguttatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	4
Metylophorus nebulosus	-	-	-	-	-	-	1	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-	3	1	1	4	2	2
Loensia fasciata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	1	2	-	-
Loensia variegata	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius fuscopterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus hyalinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Stenopsocus lachlani	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	1	2	4	5
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius burmeisteri	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	2	2	4	6	6	6
Loensia pearmani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Philotarsus picicornis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	4	6	4	6
Cuneopalpus cyanops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	1	-
Amphigerontia bifasciata	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3	5	2	-	-	-	-	-	-	1	2	3
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-
Mesopsocus unipunctatus	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	1	-	1	-	1	4	1	-
Caecilius despaxi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	1	3	6
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	0	0	1	0	0

Fig. 2. Results of DvClA-analysis – Twinspan algorithm; biotopes of the 5th VT are marked by vertical columns of grey colour (with regard to the table size the central part of the graph is shown only)

Groups of biotopes	B-I-b										B-II-a-1										B-II-a-2					B-II-b-1																										
	BE5Lsm	BE5Ssm	BE6Osm	BE5Bjd	BE5Bsm	BE5Nsm	BE6Pbk	PB4Bsm	PB3Hma	PB3Hsm	VS4Dsm	VS4Emd	BE5Sbk	BE6Sbk	PB4Dsm	BE4Ssm	OR8Zjan	VS3Ltrn	VS5Asm	VS5Bjd	BE6Spod	BE7Spod	OR5Sjd	BE8Zpod	OR8Zkos	OR6Bsm	BE5Fjd	BE5Fsm	BE6Gsm	BE7Fbk	VS4Djd	VS4Sjd	BE5Sjd	BE6Fsm	BE6Sjd	BE6Ssm	BE6Zsm	BE7Fsm	BE7Sjiv	BE7Ssm	BE7Zsm	BE8Zbk	BE8Zkos	BE8Zma	BE8Zsm	OR7Ssm	OR8Sjr	OR8Ssm	OR8Zsm	OR9Kkos	OR9Ksm	
Elipsocus moebiusi	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0001
Mesopsocus laticeps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0001
Stenopsocus immaculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0000
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0000
Caecilius flavidus	-	-	-	-	-	-	1	1	3	1	-	-	4	3	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	1	-	-	1	1	1	1	1	-	-	-	-	-	-	0010
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0010
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0011
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01000
Lachesilla quercus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01000
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01001
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01010
Psococerastis gibbosa	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01010
Peripsocus phaeopterus	-	2	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01011
Philotarsus parviceps	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	01011
Peripsocus subfasciatus	1	1	2	3	-	1	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	01100
Caecilius atricornis	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01101
Peripsocus parvulus	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01101
Trichadenotecnum majus	1	2	1	1	1	-	2	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	0111
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11000
Kolbia quisquiliarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11000
Epipsocus lucifugus	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110010
Liposcelis corrodens	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110010
Elipsocus abdominalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110011
Enderleinella obsoleta	3	2	4	1	1	-	1	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110011
Hemineura dispar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110011
Reuterella helvimaculata	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	110011
Caecilius piceus	1	2	1	-	1	-	1	2	6	2	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1101
Peripsocus didymus	4	4	2	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1101
Peripsocus alboguttatus	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1110
Metylophorus nebulosus	-	4	-	2	-	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111100
Loensia fasciata	-	1	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111101
Loensia variegata	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111101
Caecilius fuscopterus	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11111
Elipsocus hyalinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11111
Stenopsocus lachlani	3	5	1	1	-	-	1	1	6	4	1	-	-	1	-	-	-	-	-	-	-	1	1	-	3	-	-	-	1	-	1	1	1	1	1	5	1	3	-	4	5	1	1	4	5	2	2	6	5	2	5	10100
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10100
Caecilius burmeisteri	2	6	1	3	5	4	3	4	4	3	1	1	2	3	3	2	1	2	2	2	1	1	1	1	1	3	3	4	-	-	-	-	3	2	2	5	1	3	-	4	3	-	1	1	4	-	-	4	5	-	6	10101
Loensia pearmani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10110
Philotarsus picicornis	3	5	2	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2	2	3	3	-	-	-	-	1	-	3	-	3	-	2	2	-	-	-	4	2	-	1	1	-	1	10110
Cuneopalpus cyanops	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10111
Amphigerontia bifasciata	1	2	-	1	-	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5	1	-	-	1	1	-	1	4	1	-	1	1000
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100100
Lachesilla pedicularia	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	1	1	1	1	-	3	-	-	-	1	-	2	100101
Mesopsocus unipunctatus	-	2	-	-	-	-	-	-	-	1	2	-	1	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2	3	1	2	3	4	5	1	5	1	4	5	-	-	1	5	1	-	1	2	-	3	100101
Caecilius despaxi	4	4	3	1	-	1	-	1	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	1	1	1	3	4	-	-	-	-	3	2	2	6	2	5	3	6	6	1	3	6	6	2	2	6	2	1	4	10011
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1	1	1	0	0	0	0	0	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	1	1	1	0	1	1	1	1					1	1	1	0	0	0	0	0	0	0	1			0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Fig. 2 to be continued

flavidus, and *Caecilius burmeisteri* were found as eudominant species and *Caecilius despaxi* was dominant. Resulting from the comparison of tree colonization, *Picea abies* was the most colonized tree species and *Abies alba* and *Fagus sylvatica* were colonized by a lower number of species (Table 1). *Fagus sylvatica* was colonized by psocids in low abundances.

Higher values of diversity indexes were computed for the 5H communities in the BE5Hsm psocid biotope with a reduced number, i.e. $N_{30} - H_S$ 1.31 and H_B 1.58, a high value was also found for the VS5Bsm psocid biotope with a reduced number, i.e. $N_{30} - H_S$ 1.27 and H_B 1.51 (Table 1).

The DCA-analysis might be interpreted as follows: the *x*-axis denotes the influence of VTs and the *q*-axis refers to the influence of hydricity (cf. Holuša 2007c). These factors might increase a presumption of mutual correlation, but all VTs include habitats with high hydricity – flooded habitats, waterlogged and peaty habitats as well as dry or desiccating habitats. As each VT comprehends a large scale of habitats – from dry to peaty habitats, the hydricity of the habitat does not correlate with the altitude within the collected material. Habitats of the 5th VT create a large field in the gradient of VTs (along the *x*-axis, Fig. 1), which has a small shift into higher VTs in comparison with the fields of the 4th or 3rd VTs. From the aspect of hydricity, the field is narrower than the field of the 4th VT and it is placed into the field centre of the 4th VT. Habitats of the 5th VT are "drier" than habitats of the 3rd VT.

Habitats of the 5th VT are represented in more groups in the DvClA-analysis, which is caused by the tree species spectrum in this VT. Habitats of broadleaf trees are sorted into the following groups: A-I-b and A-II-a; habitats of *Picea abies* and *Abies alba* are sorted into the following groups: B-I-b, B-II-a and B-II-B-1 (Fig. 2). There is a clear similarity of broadleaf habitats (i.e. tree species, mainly *Fagus sylvatica*) and habitats of "lower" VTs, i.e. the 3rd and 4th VT.

The characteristic species combination of the 5th VT can be identified as follows: *Caecilius flavidus – C. burmeisteri – C. despaxi – Metylophorus nebulosus – Philotarsus picicornis*. *Elipsocus moebiusi* is missing in this VT, in contrast to the 4th VT. There are numerous representations of psocid species typical of middle altitude – *Enderleinella obsoleta, Cuneopalpus cyanops* and *Caecilius piceus*. The occurrence of *Caecilius despaxi* was found as the differential feature between the 4th and 5th VT.

CONCLUSION

Compositions of psocid taxocoenoses are, as a matter of fact, influenced by the tree species composition, therefore the difference between natural and changed forest geobiocoenoses is clear. It is possible that the diversity of psocid taxocoenoses was "higher" in virgin forests due to the representation of other tree species which are rare or missing at present, and also due to a "better" stand structure.

The results of this work and previous records (Holuša 2007c) verify the hypothesis that vegetation tiers have proved to be a suitable frame for zoocoenological studies. VTs and lower units of geobiocoenological or forest-typological system, together with the description of tree species composition and the level of naturalness form a perfect base for studies focused on the animal taxocoenoses structure. We support the hypothesis that psocids, as a part of forest ecosystem, fully comply with the theorem of geobiocoenoses (Zlatník 1976). Geobiocoenoses consist of specific biocoenoses in relation with abiotic environment; the biocoenosis is formed not only by plants or trees as the main community determinants while the zoocoenosis also constitutes an important part.

Vegetation tiers are units which complexly take into consideration ecological factors of ecosystems in landscape segments and they are an ideal frame for animal studies. According to the results (cf. Holuša 2007c), psocid taxocoenoses are dependent on the main ecological factors of the environment; therefore the VTs are the most appropriate units considering changes in the main ecological factors in landscape segments. This study also confirmed that VT is the main factor with the greatest influence on the variability of psocid taxocoenoses. Finally, the order of psocids can be used for the geobiocoenological classification of ecosystems.

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Složení a diverzita taxocenóz pisivek (Insecta: Psocoptera) v lesních ekosystémech vegetačního stupně jedlových bučin (*Abieti-fageta* s. lat.) v západních Karpatech

ABSTRAKT: Během období 1997–2001 byly v lesních ekosystémech v oblasti západních Karpat studovány taxocenózy pisivek (*Psocoptera*). Jako rámec pro studium byly použity vegetační stupně podle systému geobiocenologie, resp. lesnické typologie. Pro klasifikaci stanoviště, tj. ekologických podmínek, byly použity jednotky – soubory lesních typů lesnicko-typologického systému. V práci jsou vyhodnocena pouze společenstva 5. jedlobukového vegetačního stupně, tedy společenstva jedlových bučin (*Abieti-fageta* s. lat.). 5. jedlo-bukový VS je široce rozšířen v oblasti Moravskoslezských Beskyd, Vsetínských vrchů a Javorníků. Celkově bylo zjištěno 2 023 imag 28 druhů: pro všechny stupně přirozenosti geobiocenóz byl eudominantním druhem *Caecilius burmeisteri,* dominantní druhy byly *Philotarsus picicornis, Caecilius flavidus* a *Peripsocus subfasciatus.* V přírodních a přirozených geobiocenózách (stupeň přirozenosti 1 a 2) byly jako eudominantní zjištěny druhy *Mesopsocus unipunctatus, Caecilius flavidus, Caecilius burmeisteri*, jako dominantní druh *Caecilius despaxi.* Taxocenózy pisivek byly vyhodnoceny statistickými metodami

– detrendovanou korespondenční analýzou (DCA) a shlukovou divizní analýzou (DvClA). V DCA analýze byly osy interpretovány: *x* osa představuje vliv vegetační stupňovitosti, *q* osa vliv hydricity. Materiál byl vyhodnocen v rámci širšího srovnání materiálu pocházejícího i z ostatních VS v rámci vnějších západních Karpat. Charakteristická druhová kombinace pisivek pro 5. VS byla stanovena takto: *Caecilius flavidus* – *C. burmeisteri* – *C. despaxi* – *Metylophorus nebulosus* – *Philotarsus picicornis*.

Klíčová slova: *Psocoptera*; taxocenózy; diverzita; lesní geobiocenózy; vegetační stupeň; *Abieti-fageta* s. lat.; Moravskoslezské Beskydy; Vsetínské vrchy; Javorníky; západní Karpaty

Corresponding author:

Doc. ing. Otakar Holuša, Ph.D., Mendelova zemědělská a lesnická univerzita v Brně, Fakulta lesnická a dřevařská, Lesnická 37, 613 00 Brno, Česká republika
tel.: + 420 606 960 769, fax: + 420 545 211 422, e-mail: holusao@email.cz