ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume LX 15 Number 6, 2012

TAXOCENOSES OF PSOCIDS (INSECTA: PSOCOPTERA) IN THE FOREST ECOSYSTEMS OF BABIA HORA MT. AND PILSKO MT. IN THE ORAVSKÉ BESKYDY MTS. (SLOVAKIA)

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Received: August 22, 2012

Abstract

HOLUŠA, O.: *Taxocenoses of psocids (Insecta: Psocoptera) in the forest ecosystems of Babia hora Mt. and Pilsko Mt. in the Oravské Beskydy Mts. (Slovakia).* Acta univ. agric. et silvic. Mendel. Brun., 2012, LX, No. 6, pp. 117–128

In the Oravské Beskydy Mts. in the National Natural Reserves of Babia hora Mt. and Pilsko Mt. (northern Slovakia) are natural forest and near-natural forest stands in 8th (*Piceeta* s. lat. =Spruce) and in 9th (*Pineta mugo* s. lat. = dwarf pine) vegetation tiers (= altitudinal vegetation zones) (vegetation tiers according Plíva 1971, 1991, Holuša and Holuša 2008, 2010, 2011). During 1999–2000, psocids (*Psocoptera*) were studied from 6th to 9th vegetation tiers. In total, 1,113 adults and 42 larvae in 17 species were found. In 6th VT, 11 species were found (the following species were eudominant: *Caecilius burmeisteri, Philotarsus picicornis* and *Caecilius flavidus*), in 7th VT only 4 species (eudominant *Philotarsus picicornis, Caecilius despaxi* and *Philotarsus picicornis*), in 8th VT 10 species (eudominant *Stenopsocus lachlani, Caecilius despaxi* and *C. burmeisteri*) and in 9th VT 10 species (eudominant *Caecilius burmeisteri, Lachesilla pedicularia* and *Stenopsocus lachlani*). Taxocenoses of psocids in the Oravské Beskydy Mts. were evaluated by Detrend Corespondence analysis (DCA) and Divisive Cluster analysis (DvClA). Material was compared with other material from various vegetation tiers in the Western Carpathians Mts. Characteristic species combination of psocids of 9th VT was designated as follows: *Lachesilla pedicularia – Caecilius despaxi – Stenopsocus lachlani.*

Psocoptera, taxocenoses, diversity, vegetation tiers, *Pineta mugi* s. lat., National Natural Reserves of Babia hora Mt. and Pilsko Mt., the Oravské Beskydy Mts., the Western Carpathian Mts., Slovakia

Order Slovakia, with respect to the knowledge of psocid occurrence, belongs to scarcely investigated territories of Europe. The first records about the occurrence of psocids were published by Klapálek (1904), who found the occurrence of *Enderleinella obsoleta* near Štrbské pleso lake in the High Tatras and the occurrence of *Mesopsocus unipunctatus* in the town of Poprad. Pongrácz (1914) published next records on the occurrence of the 5 following species: *Amphigerontia bifasciata, Loensia fasciata, Graphopsocus cruciatus, Enderleinella obsoleta* and *Peripsocus phaeopterus.* Mocsáry (1918) wrote about the occurrence of 3 following species: *Amphigerontia bifasciata, Loensia fasciata* and *Graphopsocus cruciatus.* None of the authors give a detailed localization, however with respect to the previous investigations, it might be the territory of the High Tatras. Dzierzielewicz (1920) also wrote about the occurrence of *Mesopsocus unipunctatus* in Kriváň Mt. in the High Tatras. The first more extensive work about psocids in the High Tatras was published by Obr (1951), who worked up the material from the years 1947–1949. He published the occurrence of 18 species with the evaluation of the occurrence in 200-m intervals of altitude. In the same work Obr (1951) published a few records from the surroundings of Čilistov u Bratislavy village, collected in 1950, where 6 species were recorded. The list of species from the High Tatras was completed by Obr (1974) with the following species: *Peripsocus phaeopterus* and *Graphopsocus cruciatus.* Obr (1977) published 51 species in the Checklist for Slovakia. Later, records of psocid occurrence in Slovakia were published by Holuša & Holuša (2002a), who have found the occurrence of "new" species *Philotarsus parviceps* in 8th (= spruce, i.e. *Piceeta* s.lat.) vegetation tier at Babia hora Mt. in the Oravské Beskydy Mts. and Holuša & Holuša (2002b) write about "new" species *Elipsocus moebiusi* in the region of the Malá Fatra Mts. in 6th VT (= spruce-beech, i.e. *Picei-fageta* s.lat.) (the system of the vegetation tiers according to forest site classification system (Plíva, 1971, 1991; Holuša & Holuša, 2008, 2010, 2011).

Recent investigations have been carried out in the Czech Republic, e.g. the territory of the Moravskoslezské Beskydy Mts. (Holuša, 2001, 2003b, 2007b, 2007c), also in the Podbeskydský region (Holuša, 2005) or in the Poodří region (Protected landscape area of Poodří) (Holuša, 2007a). Material of psocid taxocenoses in these publications were evaluated in the relation to units of geobicenological and forest site classification systems i.e. vegetation tiers (further VT), groups of geobiocoene types (further GGT, according to Buček & Lacina, 1999) and Forest site type complexes (further FTC, system according to Plíva, 1971, 1991). Moreover, Mückstein & Holuša (2003) studied the composition of psocid taxocenoses in different ecosystem types and its dependence on naturalness level of forest ecosystems in the region of the Žďárské vrchy Hills.

A complex psocopterological research was initiated in the territory of the Czech Republic and Slovakia in 1997. The aim of the systematic study of psocids conducted in the Western Carpathian Mts. in years 1997–2001 was to define the diversity of species and the characteristic species composition of psocids in particular vegetation tiers and to prove the applicability of vegetation tiers or lower units of geobiocenological or forest-site classification systems in zoocenological studies.

The aim of presented article is to analyse composition and diversity of psocid taxocenoses of the 8th and 9th vegetation tiers in the Oravské Beskydy Mts. in Slovakia.

METHODS

Plots were placed in such parts of forest stands that represent a particular vegetation tier and in which it was possible to collect representative material of psocids (mainly they are in state of stemwoods cf. Team, 1994). The communities of research plots were classified according to forest site classification system (Plíva, 1971, 1991) and also according to geobiocenological system (Buček & Lacina, 1999). Material was found in particular layers of the geobiocenoses on the research plots. Material was obtained by sweeping with the sweeping net of 50 cm frame diameter. Branches of trees and bushes were beated with the same sweeping net in extent of about 1 m from the branch end and up to about 2.5 m of height. These methods were complemented also by individual collecting of adults on trunks, litters and stones. When sweeping and beating, 30 sweepings or beatings were done in single localities. Caught psocids were sucked in the exhaustor and stored in small test tube with 70% of alcohol.

Totally were carry out 384 collections, in the year 1999 (3x during vegetation season) and in year 2000 (2x during vegetation season). Material was collected and determined by O. Holuša. Document material is deposited in 70% alcohol in the collection of author. Papers of Günther (1974) and Lienhard (1998) were used for determination; nomenclature, zoogeographical distribution and ecological demands are according to Lienhard (1977, 1998).

Samples were sorted into vectors, which represent "habitats of psocids". Following factors were taken into account for the purpose of material sorting: biogeographical region, ecological conditions (according to the forest type complexes) and tree, shrub species or herb layer, from which was material obtained. For example: *OR9Zsm*, where *OR* denotes the Oravský region, *9Z* represent forest site type complexes 9Z (i.e. *Piceeto-Mughetum*) and *sm* is an acronym for the tree species *Picea abies*.

Diversity was evaluated by Shannon-Wiener (H_S) and Brilouin diversity index (H_B). Both indexes, Shannon-Wiener and Brilouin, were computed according to Kaesler & Mulvany (1976a, 1976b). Diversity indexes of individual habitats were calculated from a total number of captured specimens (Tab. VI). Some material was excluded from statistical processing because of a small number of collected specimens in some plots (i.e. species in a lower number than 5 specimens or 2 species even less than 3 specimens) to prevent data distortion.

Detrended Correspondence Analysis (DCA), according to Gauch (1982), Hill (1974) and Hill & Gauch (1980), proceeds from the method of Principal Component Analysis (PCA), used for non-linear data. Axes were adjusted in order to prevent criteria deformation by the axis ends in the DCA-analysis. The unit length of axes corresponds with the average species dispersion. In different parts of axis it remains unchanged- The DCA ordination method has a quite heuristic character. Interpretation of axes and ordination positions of particular species is based on their ecology with a view to habitat characteristics. Modified SW Decorana was used to process the DCA analysis, which was adapted for zoocenological data processing (Povolný & Znojil, 1990).

Divisive Cluster Analysis (DvClA) represents a method of hierarchic divisive classification (Gower, 1967; Orlóci, 1975). The ordination of groups is performed twice by "Reciprocal averaging" (RA). All vectors are projected into the main axis as a super-ellipsoid. In the second phase, partial complexes of vectors are divided according to species ordinate in particular vectors and according to abundance of particular species (indicators) as well. These indicators are automatically selected by the program in compliance with species spectrum of particular vectors (habitats) for end parts of ordination axis. Used modification – Twinspan algorithm comes from a gradual division of habitats and species. Every processed file is ordinated by RA method, whereupon characteristic species (or biotopes) are associated with axes ends. Central parts of axes are ordinated consequently. On the base of acquired results, it is searched for species combinations, which are characteristic for parts of ordination axes and can be used as appropriate "tools for cuts" (Hill, 1974). This method was modified for the purpose of this study, because the first version was defined for phytocenological studies only. Column heads represent abbreviations of biotopes. Numbers in columns below indicate the division of appropriate algorithm (every habitat is divided, marked 0 or 1). There are species names in the left column and on the right is one algorithm division of species spectrums in groups. The main field represents the semiquantitative relative frequency of particular species in groups corresponding with their biotopes. Explanations: – species does not occur, 1 – rare species, 2 –very scarce, 3 – scarce, 4 – common, 5 – very common to subdominant, 6 – dominant. Groups of psocid species and groups of habitats were organized to increase their clearness so that there is an evident species transfer within biotopes in the diagonal direction from the left upper corner to the right lower corner.

Acronyms of trees and shrubs (investigated tree species): sm – *Picea abies*, bk – *Fagus sylvatica*, kos – *Pinus mugo*, jan – *Juniperus communis nana*, jiv – *Salix caprea*, jr – *Sorbus aucuparia*; pod – under growth, mrs – *Ribes petraeum*.

Classification in consideration naturalness level was done according to Ellenberg (1973, 1978). Classification into units of forest site typology (Plíva, 1971, 1991) was carried out on the base of own investigations. Collecting of material in the National Natural Reserve Babia hora Mt. and Pilsko Mt. was permitted by the exception of the Ministry of environment of Slovakia No. 925/0406/1999-4.1 and exception of Regional office in Žilina – division of environment No. 99/06526/18Ú.

Study area

The research was carried out in the territory of National Natural Reserves Babia hora Mt. (cadastral territory Oravská Polhora, code of grid mapping 6483) and NNR Pilsko Mt. (cadastral territory Oravské Veselé, code of grid mapping 6481-82) during the years 1999–2000.

All localities (see Tab. I), where the research of psocid taxocenosis was carried out, occur in the area of the Protected Landscape Area of Horná Orava which lies in northern part of Slovakia. In accordance to the classification of the geo-ecological regions, the study area belongs to the Oravské Beskydy region (Miklóš *et al.*, 2006). Climatically the interest area belongs to two cold regions: C1 – temperate cold, the peaks belong in to C2 – cold mountain (i.e. the peaks of Babia hora Mt. and Pilsko Mt.) (Team, 1958) with the following climatic characteristics: numbers of days over 10 °C: 80–120 days, peak of Babia hora Mt.: 0–40 days; mean temperature in January: –6– –7 °C, the peaks: –7– –8 °C; mean temperature in April: 4–5 °C, the peaks: 0–2 °C; mean temperature in July: 12–14 °C, the peaks: 8–10 °C; mean temperature in October: 5–6 °C, the peaks: 2–4 °C; precipitation amount during the vegetation period: 600–700 mm, the peaks: 700–800 mm; precipitation amount in winter: 400–500 mm, the peaks: 500–600 mm.

Vegetation tiers and ecosystem classification

Characteristics of the vegetation tiers are used according to Holuša & Holuša (2010, 2011).

6th VT (i.e. *Picei-fageta* s.lat.) creates the communities with dominant tree species (main edificator) of Fa*gus sylvatica*, which creates the main level of stands and it also creates the overtopped tree filling (the maximum height cca 32–33 m). *Abies alba* reaches, in the stand structure, to the main and co-dominant level with the height up to 40 m and the with representation up to 30%. *Picea abies*, with its optimum there, reaches the co-dominant level with maximum height of 55 m. *Picea abies* is represented up to 30–40%. *Acer pseudoplatanus, Taxus bacchata* and *Sorbus aucuparia*, which occur only as additional tree species, reach only the overtopped level.

7th VT (i.e. *Fageti-piceeta* s.lat.) creates the communities with dominant tree species (main edificator) of *Picea excelsa* (with the representation up to 70%) which creates the main and the co-dominant level where it reaches up to maximum 40 m. *Fagus sylvatica* is already subdominant and it creates the overtopped level with the maximum height of 25 m and representation up to 20%. Forest stands visibly consist of twostoreys. *Abies alba* occurs in the main and overtopped level with the representation up to 10%. Also *Acer pseudoplatanus* creates only the admixture occurring in the overtopped level with the maximum height of 20 m.

8th VT (i.e. *Piceeta* s.lat.) creates the communities with dominant tree species of *Picea abies* which reaches the maximum height of 25 m. *Abies alba* occurs in the main and the overtopped level as the admixture. *Fagus sylvatica* occurs only individually reaching a shrub height, exceptionally it reaches the height of 3–4 m. *Acer pseudoplatanus* can occur also in dwarf height. Forest stands are naturally opening up. *Sorbus aucuparica* can occur in these opening places. *Salix caprea, Lonicera nigra, Ribes petraeum* and *Salix silesiaca* can occur in the shrub level.

9th VT (i.e. *Pineta mugi* s.lat.) creates the communities with dominant species of *Pinus mugo*, which very often creates continuous stands. *Picea abies* occurs only as the individual admixture. It creates small groups on the lower border of VT which 2–3x exceed the height of *Pinus mugo*-stands. *Picea abies* can have the representation here up to 50%. The representation of *Picea abies* decreases towards higher places. The admixture of *Picea abies* has its representation up to 10–30% in theses places

I: *Description of catching places*

VT	Forest type complex (code - name)	Group of geobiocoene types (code – name)	Number of area	Geographical coordinates	Altitude (m a.s.l.)	Exposition	Tree composition (%)	Naturalness of forest ecosystem*)	Cover of tree layer (%)	Structure of canopy	Cover of undergrowth layer (%)	Composition of undergrowth layer
6.	6B – *Piceeto-Fagetum eutrophicum*	6B3 – *Abieti-fageta piceae typica*	4	49°32'30.97"N 19°31'37.03"E	920	E	pe 60, aa 30, fs 10	3	90–95	horizontal	50	senfuch, atf, my, o, petalb
	6S – *Piceeto-Fagetum mesotrophicum*	6AB3 – *Abieti-fageta piceae*	5	49°33'05.35"N 19°31'43.04"E	1,040	S-SE	pe 80, aa 20	3	80	horizontal	30–40	my, rui, calar, drys
7.	7S – *Fageto-Piceetum mesotrophicum*	7AB3 – *Picei-fageta abietis*	6	49°33'18.50"N 19°31'32.60"E	1,200	S	pe 99, sa 1	3	90–95	horizontal	80–100	ata, my, pren, ls
8.	8S – *Piceetum mesotrophicum*	8A-AB3 – *Sorbi-piceeta*	1	49°33'32.72"N 19°31'30.49"E	1,300	S	pe 100, rp +	2	30–50	vertical	90–110	senfuch, my, ata, polytrich
			11	49°31'06.17"N 19°20'13.32"E	1,360	E	pe 100	2	70	vertical	80–90	my, desf, nard, ata, homogyn, polytrich, o, ls
			12	49°31'04.95"N 19°20'21.72"E	1,320	E-NNE	pe 100, sa +	2	70–80	vertical	80–90	my, desf, nard, ata, polytrich
			13	49°31'01.36"N 19°20'30.14"E	1,270	E-NNE	pe 100	2	60–80	vertical	90–100	my, desf, nard, ata
	8Z – *Sorbeto-Piceetum*	8A-AB2v – *Sorbi-piceeta humilia*	2	49°33'45.91"N 19°31'27.56"E	1,450	S-SSW	pe 100, jcn +	3	50	gradual	80–100	my, desf, nard, gent, senfuch
			10	49°31'19.12"N 19°19'52.02"E	1,430	NE	pe 50, pm 40, jcn+, sa+	3	70–75	gradual	90	my, desf, nard, senfuch
9.	9K – *Mugheto-Piceetum acidophilum*	9A-AB3 – *Pineta mugo*	9	49°31'22.62"N 19°19'35.85"E	1,480	SE	pe 60, pm 40, jcn +	2	60–70	gradual	80–90	my, desf, nard, gent, ata, homogyn
	9Z – *Piceeto-Mughetum*	9A-AB3 – *Pineta mugo*	3	49°34'6.86"N 19°31'45.85"E	1,550	S-SSW	pm 65, pe 40, jcn +	2	60–80	gradual	110	my, desf, nard, gent, homogyn
			7	49°31'40.46"N 19°19'01.31"E	1,555	-	pm 80, pe 10, jcn 10	1	30–50	gradual	100–120	my, vitis, homog, empetr, nard, desf, polytrich, sphagnum
			8	49°31'34.17"N 19°19'11.04"E	1,520	SE	pm 90, pe 10, jcn +	1	50–60	gradual	80–100	my, desf, nard, gent, homogyn, empetr

Legend:
VT – vegetation tier;
pe – *Picea excelsa*, pm – *Pinus mugo*, aa – *Abies alba*, fs – *Fagus sylvatica*, jcn – *Juniperus communis nana*, sa – *Sorbus aucuparia*, rp – *Ribes petraeum; ata – Ahyrium distendifolium, atf – Athyrium filix–femina, desf – Avenella flexuosa, empetr – Empetrum hermaphroditum, gent – Pneumonanthe asclepiadea, homog – Homogyne alpina, ls – Luzula sylvatica, my – Vaccinum myrtillus, nard – Nardus stricta, o – Oxalis acetosella, petalb – Petasites albus, polytrich – Poltyrichum formosum, pren – Prenanthes purpurea, rui – Rubus idaeus, senfuch – Senecio ovatus, sphagnum – Sphagnum* sp., *drys – Dryopteris carthusiana, calar – Calamagrostis arundinacea, vitis – Vaccinium vitis-idaea, homogyn – Homogyne alpina*; *) – according to Ellenberg (1973, 1978)

and it is created by specimens or small groups with 2–4 specimens with the height of 1–3 m. Dwarf specimens of *Sorbus aucuparia* occur in opening places. There are also shrubs of *Salix caprea* and *Salix silesiaca*. *Juniperus nana* is very common towards to upper border of VT, at some places it creates continuous stands.

8th VT was identified in the NNR of Babia hora Mt. and Pilsko Mt. in the altitude from cca 1,280 up to 1,480 m a.s.l., 9th VT was found in the altitude from 1,450 up to 1,650 m a.s.l. 6th VT was found in the surroundings of the NNRs in the altitude from 900 up to 1,150 m a.s.l. and 7th VT from 1,150 up to 1,300 m a.s.l. The following Forest type complexes were classified at the study plots: 6B – *Piceeto-Fagetum eutrophicum,* 6S – *Piceeto-Fagetum mesotrophicum,* 7S – *Fageto-Piceetum mesotrophicum,* 8S – *Piceetum mesotrophicum,* 8Z – *Sorbeto-Piceetum,* 9K – *Mugheto-Piceetum acidophilum, and* 9Z – *Piceeto-Mughetum.*

Mainly natural stands occur there with respect to the influence on forest geobiocenoses (Tab. I) by human activities. Some parts are without any influences. The peak of Babia hora Mt. and also Pilsko Mt. were under the influence of pasture (Rizman pers. comm.), therefore the stands of *Pinus mugo* were destroyed and then the lower border of 9th VT was significantly influenced. At present it can be said, that geobiocenoses recovering from pasture are returning into their natural state and are at present influenced only by tourism.

RESULTS AND DISCUSSION

In total, 1,113 adults and 42 larvae in 17 species were found. 37 collection samples were negative. In 6th VT, 11 species were found (the following species were eudominant: *Caecilius burmeisteri, Philotarsus picicornis* and *Caecilius flavidus*), in 7th VT only 4 species (eudominant *Philotarsus picicornis, Caecilius despaxi* and *Philotarsus picicornis*), in 8th VT 10 species (eudominant *Stenopsocus lachlani, Caecilius despaxi* and *C. burmeisteri*) and in 9th VT 10 species (eudominant *Caecilius burmeisteri, Lachesilla pedicularia* and *Stenopsocus lachlani*) (Tab. II). Species spectrum and dominancy found in 7th and 8th VTs in the Moravskoslezské Beskydy Mts. differ from the species spectrum in the Oravské Beskydy Mts. by the occurrence of *Mesopsocus unipunctatus* (Holuša, 2001, 2007c). In the Moravskoslezské Beskydy, it was as a eudominant species in 7th VT, in 8th VT *Mesopsocus unipunctatus* was as a dominant species. It was as a dominant species in the Oravské Beskydy Mts. in 7th VT and in 8th VT "only" as a subdominant species. Resulting from the comparison of tree colonization, *Picea abies* was the most colonized tree species in 8th VT and also in 9th VT (Tab. III). *Stenopsocus lachlani*

II: *Presences of psocids in communities of forest ecosystems characterised by the Forest site type complexes*

Complex of forest types		6B	6S	6th VT total	7S	8S	8Z	8th VT total	9K	9Z	9th VT total
Group of geobiocen types	**ECh**	**6B3**	**6AB3**		**7AB3**	**8A-AB3**	**8A-AB2v**		**9A-AB3**	**9A-AB3**	
Caecilius flavidus	folb, herb	x		x							
Caecilius burmeisteri	folc, folb	x		x		x	x	x	x	x	x
Caecilius piceus	folc	x		x		x	x	x		x	x
Caecilius despaxi	folc	x		x	x	x	x	x	x	x	x
Stenopsocus lachlani	folc	x		x	x	x	x	x	x	x	x
Lachesilla pedicularia	ubi						x	x	x	x	x
Peripsocus didymus	cor	x		x		x		x			
Peripsocus subfasciatus	cor									x	x
Cuneopalpus cyanops	folc									x	x
Philotarsus picicornis	cor	x		x	x	x	x	x	x	x	x
Philotarsus parviceps	cor					x		x			
Mesopsocus unipunctatus	cor				x	x	x	x	x	x	x
Amphigerontia bifasciata	cor					x	x	x	x	x	x
Metylophorus nebulosus	cor	x		x							
Loensia fasciata	cor		x	x							
Trichadenotecnum majus	cor		x	x							
Trichadenotecnum sexpunctatum	cor	x	x	x							
Total number of adults		42	4	46	22	410	169	579	238	225	463
Total number of species		9	3	11	4	9	8	10	7	10	10

Legend:
Ecological character (ECh) of psocids: folc – folicolous on coniferous tree, folb – folicolous on broadleaved tree, cor – corticolous, ubi – ubikvist, herb – on undergrowth

III: *Dominance (%) of psocids on Picea excelsa in the forest ecosystems in the vegetation tiers, complexes of forest types and in the groups of geobiocoene types*

Vegetation tier	6	7	8			9		
Complex of forest types	**6B**	**7S**	**8S**	**8Z**	**total**	**9K**	**9Z**	**total**
Group of geobiocen types	**6B3**	**7AB3**	**8A-AB3**	**8A-AB2v**		**9A-AB3**	**9A-AB3**	
Caecilius burmeisteri	50		7	42	16	50	35	45
Caecilius piceus			1					
Caecilius despaxi	9	24	26	3	20	15	4	11
Stenopsocus lachlani		42	57	45	54	26	10	21
Lachesilla pedicularia				2	1	4	37	15
Peripsocus didymus	9		1					
Peripsocus subfasciatus							1	0
Cuneopalpus cyanops							3	1
Philotarsus picicornis	23	24	1	3	1	0	5	2
Philotarsus parviceps			0		0			
Mesopsocus unipunctatus		10	1	4	2	4	2	3
Amphigerontia bifasciata			7	1	6	1	3	2
Metylophorus nebulosus	5							
Trichadenotecnum sexpunctatum	5							
Total number of adults	22	21	395	143	538	228	118	346
Total number of species	6	4	9	7	10	7	9	9

and *Caecilius despaxi* were eudominant species in 7^{th}, 8^{th} and also in 9^{th} VTs. Also *Caecilius burmeisteri* was a eudominant species in 8^{th} and 9^{th} VTs and in addition *Lachesilla pedicularia* became a eudominant species in 9^{th} VT. Less numerous species spectrum (Tab. IV) was found on *Pinus mugo* (totally 6 species); *Stenopsocus lachlani* and *Caecilius burmeisteri* were eudominant species in 8^{th} VT, and beside the above-named species, *Lachesilla pedicularia* was eudominant in 9^{th} VT. Less numerous species spectrum (Tab. V) was also found on *Juniperus communis nana* (totally 5 species) with markedly eudominant species of *Lachesilla pedicularia* (Tab. V). Lower numbers of specimens were found in 6^{th} and 7^{th} VTs due to the characters of the collection plots, as geobiocenoses with "natural" characters do not occur there.

The highest values of diversity indexes were found in the 9Z-community for the OR9Zsm psocid biotope – H_S 1,48 and H_B 1,59, a high value was also found for the OR8Ssm psocid biotope – H_S 1,14 and H_B 1,14 (Tab. I).

The DCA-analysis might be interpreted as follows: the *x*-axis denotes an influence of vegetation tiers and the *q*-axis refers to an 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, water logging and peaty habitats as well as dry or desiccating habitats. Biotopes of the Oravské Beskydy of 8^{th} and 9^{th} VTs are placed in the representation of the *x*-*q* axes (Fig. 1) on the left side of the point field, i.e. where the highest VTs occur. There is also very a clear proportion between particular VTs (i.e. 8^{th} and 9^{th}), the centre of 9^{th} is shifted lower in the point field. The difference is also in the hydricity of biotopes of the Oravské Beskydy

IV: *Dominance (%) of psocids on Pinus mugo in the forest ecosystems in the vegetation tiers, complexes of forest types and in the groups of geobiocoene types*

Vegetation tier	8	9		
Complex of forest types	**8Z**	**9K**	**9Z**	**total**
Group of geobiocen types	**8A-AB2v**	**9A-AB3**	**9A-AB3**	
Caecilius burmeisteri	13		12	10
Caecilius despaxi	6	10		2
Stenopsocus lachlani	81	90	31	42
Lachesilla pedicularia			53	42
Cuneopalpus cyanops			2	2
Amphigerontia bifasciata			2	2
Total number of adults	16	10	42	52
Total number of species	3	2	5	6

V: *Dominance (%) of psocids on Juniperus communis nana in the forest ecosystems in the vegetation tiers, complexes of forest types and in the groups of geobiocoene types*

Vegetation tier	8	9
Complex of forest types	**8Z**	**9Z**
Group of geobiocen types	**8A-AB2v**	**9A-AB3**
Caecilius burmeisteri	11	3
Caecilius piceus	11	3
Caecilius despaxi	11	
Stenopsocus lachlani		3
Lachesilla pedicularia	33	89
Philotarsus picicornis		2
Mesopsocus unipunctatus	34	
Total number of adults	9	65
Total number of species	5	5

Mts. and the Moravskoslezské Beskydy Mts. The Moravskoslezské Beskydy Mts-biotopes of 7th and 8th VTs ("BE"-biotopes in Fig. 1) create an individual aggregation, which is, in the point field, placed "higher" than the aggregation of Oravské Beskydy Mts.-biotopes of 8S, 8Z and 9K FTC. A clearly separate aggregation on the left, in the bottom part of the point field, represents the moistest biotopes of FTC 9Z.

Habitats of the Oravské Beskydy Mts. of 6th VT are represented in the results of the DvClA-analysis (Fig. 2) in the following groups: *Abies alba*-biotope in the group of B-I-a (biotopes of 3rd–6th VTs with predominance of coniferous tree species) and *Picea abies*-biotope of 6th VT and also biotope of 7th VT are placed in the B-II-b-1 group, where the biotopes of the highest VT (i.e. 7th–8th VTs) of coniferous species are mainly concentrated. The biotopes of 8th VT are involved in the following groups: *Juniperus communis nana*-biotope in the B-II-a-1 group, where coniferous biotopes of 4th and 5th VTs are, and *Pinus mugo*-biotope in the B-II-a-2 group, where the biotopes of undergrowth of 6th and 7th VTs are concentrated. Other biotopes of 8th VT and then all biotopes of 9th VT are placed in the following groups: B-II-b-1 and B-II-b-2 (see also below).

Characteristics of the psocid taxocenoses in 9th vegetation tier (*Pineta mugo* s.lat.)

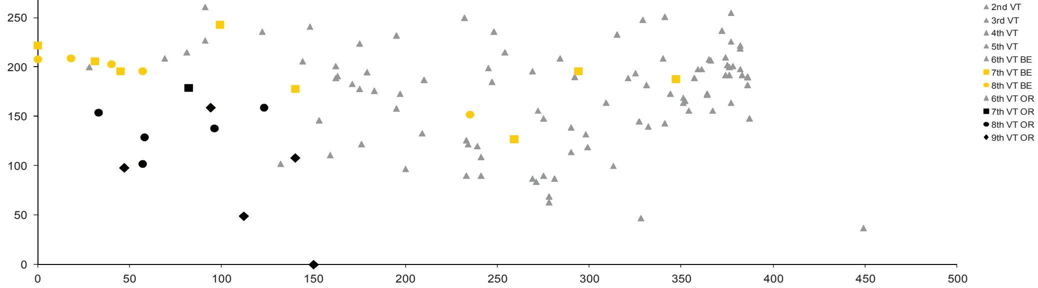
Caecilius burmeisteri, Lachesilla pedicularia and *Stenopsocus lachlani* were found as eudominant in 9th VT. *Caecilius despaxi* was found as a dominant species. The most numerous species spectrum was found on *Picea abies*, however, *Juniperus communis nana* was the most numerously populated species (by *Lachesilla pedicularia).*

The biotopes of 9th VT are represented in the results of the DvClA-analysis in two groups, where they create a larger group of biotopes, i.e. B-II-b-1 (the group of coniferous trees species of 4th–8th VT) and then they create the group of B-II-b-2 (only the biotopes of 9th VT occur there).

In the results of DCA-analysis, the biotopes of 9th VT in the *x-q* axes create a slightly separated point field, which is placed in the gradient of the x-axis together with the fields of 7th and 8th VT in the highest VTs. This point field occupies the place of the moistest localities in the gradient of the *q*-axis (Fig. 2).

The H_S diversity indexes reach the values from 0.23 to 1.48 and the H_B from 0.33 to 1.59. The highest value was found for the OR9Zsm-biotope i.e. H_S 1.48 and H_B 1.59, the *Pinus mugo*-biotopes (as the main edificator of this VT) reach conversely the lowest values.

9th VT has common species with 7th and 8th VTs, however, the characteristic species combination is as follows: *Lachesilla pedicularia – Caecilius despaxi – Stenopsocus lachlani*. The species spectrum is very poor in 9th VT in comparison with lower VTs. Besides the species of the characteristic species combination, the following species occur numerously: *Caecilius burmeisteri* and *Mesopsocus unipunctatus*, as they are typical "attendants" of coniferous tree species. In contrast to the characteristic species composition of 8th AVZ, which is identical with 7th VT (i.e. *Caecilius despaxi – Amphigerontia bifasciata – Mesopsocus unipunctatus – Stenopsocus lachlani*), there is the difference in the characteristic species (cf. Holuša, 2007c).



1: *DCA analysis of psocids biotopes (axis x – influence of vegetation tiers, q – influence of hydricity (biotopes from the Oravské Beskydy Mts. are marked with "OR" letters, from the Moravskoslezské Beskydy Mts. with the "BE" letters)*

VI: *Values of Shannon-Wiener's and Brillouin's indices of diversity and equitability for particular biotopes*

Biotope	Nsp	N	N				N_{30}				N_{60}				N_{120}				N_{240}			
			H_S	E_S	H_B	E_B	H_S	E_S	E_B	H_B	E_B	H_S	E_S	H_B	H_S	E_S	H_B	E_B	H_S	E_S	H_B	E_B
OR6Bbk	3	7	0.534	0.699	0.796	0.725																
OR6Bjd	5	13	1.038	0.854	1.378	0.856																
OR6Bsm	6	22	1.127	0.771	1.400	0.782																
OR7Ssm	4	21	1.062	0.913	1.270	0.916																
OR8Sjr	3	13	0.711	0.810	0.898	0.818																
OR8Ssm	9	393	1.168	0.545	1.206	0.549	0.941	0.726	1.101	0.738	1.038	0.664	1.155	0.675	1.114	0.635	1.191	0.642	1.148	0.570	1.200	0.574
OR8Zjan	5	8	1.015	0.952	1.494	0.928																
OR8Zkos	3	16	0.464	0.512	0.602	0.548																
OR8Zsm	7	143	1.143	0.618	1.217	0.625	1.009	0.696	1.198	0.710	1.113	0.656	1.245	0.666								
OR9Kkos	2	10	0.230	0.416	0.325	0.469																
OR9Ksm	7	227	1.262	0.671	1.314	0.675	1.092	0.798	1.278	0.807	1.146	0.742	1.266	0.749	1.191	0.664	1.272	0.670				
OR9Zjan	5	65	0.412	0.278	0.487	0.303	0.327	0.286	0.416	0.321												
OR9Zkos	5	42	0.999	0.695	1.133	0.704																
OR9Zsm	9	118	1.477	0.718	1.592	0.725	1.227	0.773	1.466	0.782	1.342	0.731	1.505	0.738								

Legend:
Nsp – number of species
N – number of adults
N_{30}, N_{60}, N_{120}, N_{240} – reduced numbers
H_S – Shannon-Wiener's index of diversity
E_S – equitability
H_B – Brillouin's index of diversity
E_B – equitability

Biotopes	VS4Bbo	BE4Bjd	OP3Hsm	VS3Lsm	VS4Bjd	BE6Ojiv	PB4Bma	BE6Pjd	BE6Ppod	BK3Bsm	BK4Bsm	OR6Bjd	OD1Lsm
Groups of biotopes	**B-I-a**												
Elipsocus moebiusi	-	-	1	-	1	-	-	-	-	-	-	-	-
Mesopsocus laticeps	1	-	-	-	-	-	-	-	-	-	-	-	1
Stenopsocus immaculatus	-	-	-	-	-	1	-	-	-	-	-	-	-
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius flavidus	-	-	-	-	1	1	2	-	-	-	-	-	-
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphigerontia contaminata	-	-	-	-	1	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	-	-	-	-	-
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	-	-	-	-	-
Psococerastis gibbosa	-	-	-	-	-	1	-	-	-	-	-	-	-
Peripsocus phaeopterus	-	-	-	-	1	1	-	1	-	-	-	-	1
Philotarsus parviceps	-	-	-	-	-	-	-	-	-	2	-	-	6
Peripsocus subfasciatus	-	-	4	2	1	1	1	-	-	-	1	-	1
Caecilius atricornis	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus parvulus	1	-	-	-	-	-	-	-	-	-	-	-	-
Trichadenotecnum majus	-	-	1	-	1	1	1	-	-	-	-	-	1
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	1
Kolbia quisquiliarum	1	-	-	-	-	-	-	-	-	-	-	-	1
Epipsocus lucifugus	-	-	-	-	-	-	-	-	-	-	-	-	-
Liposcelis corrodens	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus abdominalis	-	-	-	-	-	-	-	-	-	-	-	-	-
Enderleinella obsoleta	-	-	1	-	1	1	-	-	-	-	-	-	-
Hemineura dispar	-	-	-	-	-	-	-	-	-	-	-	-	-
Reuterella helvimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius piceus	-	-	3	-	-	1	1	1	1	-	-	1	1
Peripsocus didymus	-	-	-	1	1	-	-	1	-	-	-	-	-
Peripsocus alboguttatus	-	-	-	-	-	-	-	-	-	-	-	-	6
Metylophorus nebulosus	1	-	1	-	1	-	-	2	1	2	2	1	-
Loensia fasciata	-	-	-	-	-	-	1	-	-	-	-	-	1
Loensia variegata	-	-	-	-	-	-	1	-	-	-	-	-	1
Caecilius fuscopterus	1	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus hyalinus	-	1	4	-	1	-	-	-	-	-	-	-	2
Stenopsocus lachlani	-	-	-	-	-	1	1	1	-	-	-	1	1
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius burmeisteri	-	1	2	-	2	1	1	1	1	1	3	2	3
Loensia pearmani	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus picicornis	1	-	-	-	1	-	-	1	-	-	-	1	1
Cuneopalpus cyanops	-	-	-	-	2	-	-	-	-	-	-	-	-
Amphigerontia bifasciata	-	-	-	-	-	-	-	1	-	-	-	-	-
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	-	-	1	-	-	1	-	-	-	-	-	-	2
Mesopsocus unipunctatus	-	-	2	1	1	-	-	-	-	-	-	-	3
Caecilius despaxi	-	-	-	-	-	-	-	-	-	-	-	-	-
	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	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	0	0	0	0	0	1

Biotopes	BE5Hsm	PB2Lsm	VS5Bsm	VS4Bsm	BE6Psm	BE6Rsm	BE5Lsm	BE5Ssm	BE6Osm	BE5Bjd	BE5Bsm	BE5Nsm	BE6Pbk	PB4Bsm	PB3Hma	PB3Hsm
Groups of biotopes	**B-I-b**															
Elipsocus moebiusi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mesopsocus laticeps	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus immaculatus	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius flavidus	-	1	1	2	-	-	-	-	-	-	-	-	1	1	3	1
Elipsocus pumilis	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Ectopsocus meridionalis	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Psococerastis gibbosa	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
Peripsocus phaeopterus	-	1	-	4	-	-	-	2	-	-	-	-	-	-	1	1
Philotarsus parviceps	3	1	-	2	1	4	1	-	1	-	-	-	-	-	-	-
Peripsocus subfasciatus	5	3	5	5	3	6	1	1	2	3	-	1	-	-	2	1
Caecilius atricornis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Peripsocus parvulus	-	1	-	3	-	-	-	-	1	-	-	1	-	-	-	-
Trichadenotecnum majus	1	1	-	2	-	3	1	2	1	1	1	-	2	1	1	-
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kolbia quisquiliarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epipsocus lucifugus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Liposcelis corrodens	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Elipsocus abdominalis	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Enderleinella obsoleta	1	1	1	5	4	6	3	2	4	1	1	-	1	2	1	3
Hemineura dispar	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Reuterella helvimaculata	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Caecilius piceus	3	3	1	5	5	5	1	2	1	-	1	-	1	2	6	2
Peripsocus didymus	-	1	-	4	3	3	4	4	2	-	-	-	-	1	-	1
Peripsocus alboguttatus	1	-	-	-	2	4	-	-	1	-	-	-	-	-	2	-
Metylophorus nebulosus	3	1	1	4	2	2	-	4	-	2	-	1	1	1	1	1
Loensia fasciata	-	-	1	2	-	-	-	1	-	-	-	-	-	-	-	-
Loensia variegata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Caecilius fuscopterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Elipsocus hyalinus	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus lachlani	1	2	1	2	4	5	3	5	1	1	-	-	1	1	6	4
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius burmeisteri	2	2	4	6	6	6	2	6	1	3	5	4	3	4	4	3
Loensia pearmani	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus picicornis	5	3	4	6	4	6	3	5	2	-	2	1	1	-	-	-
Cuneopalpus cyanops	-	-	2	5	1	-	-	1	-	-	-	-	-	-	-	-
Amphigerontia bifasciata	-	-	-	1	2	3	1	2	-	1	-	-	-	-	-	-
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	1	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Mesopsocus unipunctatus	1	-	1	4	1	-	-	2	-	-	-	-	-	-	-	1
Caecilius despaxi	2	1	-	1	3	6	4	4	3	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
	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	1	1	1	1	1	0	0	0	0	0	1	1
	0	0	0	1	0	0	1	1	1	0	1	1	1	1		

Biotopes	VS4Dsm	VS4Emd	BE5Sbk	BE6Sbk	PB4Dsm	BE4Ssm	OR8Zjan	VS3Ltm	VS5Asm	VS5Bjd	BE6Spod	BE7Spod	OR5Sjd	BE8Zpod	OR8Zkos
Groups of biotopes	**B-II-a-1**										**B-II-a-2**				
Elipsocus moebiusi	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Mesopsocus laticeps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus immaculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius flavidus	-	-	4	3	1	-	-	-	-	1	-	-	-	-	-
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psococerastis gibbosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus phaeopterus	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus parviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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	1	-	-	-	-	-	-	-
Peripsocus didymus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus alboguttatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metylophorus nebulosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loensia fasciata	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Loensia variegata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius fuscopterus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus hyalinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus lachlani	1	-	-	1	-	-	-	-	-	-	-	1	1	-	3
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Caecilius burmeisteri	1	1	2	3	3	2	1	2	2	2	1	1	1	1	1
Loensia pearmani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus picicornis	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
Cuneopalpus cyanops	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-
Amphigerontia bifasciata	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Trichadenotecnum sexpunctatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Mesopsocus unipunctatus	2	-	1	1	-	-	1	-	-	1	-	-	-	-	-
Caecilius despaxi	-	-	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
	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	0	0	1	1	1	1	1	1	1	1	0	0	0	1	1
			1	1	1	0	0	0	0	0	0	0	1		

Biotopes	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	OR9Zjan	OR9Zkos	OR9Zsm
Groups of biotopes	**B-II-b-1**																										**B-II-b-2**		
Elipsocus moebiusi	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mesopsocus laticeps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus immaculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus stigmaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius flavidus	-	1	-	-	-	-	-	1	1	-	-	-	1	-	-	1	1	1	1	1	-	-	-	-	-	-	-	-	-
Elipsocus pumilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphigerontia contaminata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius gynapterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla quercus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectopsocus meridionalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graphopsocus cruciatus	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psococerastis gibbosa	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus phaeopterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus parviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Peripsocus subfasciatus	-	1	-	-	-	1	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Caecilius atricornis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peripsocus parvulus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichadenotecnum majus	-	-	1	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blaste quadrimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kolbia quisquiliarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epipsocus lucifugus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liposcelis corrodens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus abdominalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enderleinella obsoleta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemineura dispar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reuterella helvimaculata	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius piceus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
Peripsocus didymus	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Peripsocus alboguttatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metylophorus nebulosus	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loensia fasciata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loensia variegata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius fuscopterus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elipsocus hyalinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopsocus lachlani	-	-	-	1	-	1	1	1	1	1	5	1	3	-	4	5	1	1	4	5	2	2	6	5	2	5	1	3	3
Trogium pulsatorium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caecilius burmeisteri	3	3	4	-	-	-	-	3	2	2	5	1	3	-	4	3	-	1	1	4	-	-	4	5	-	6	1	2	5
Loensia pearmani	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philotarsus picicornis	2	2	3	3	-	-	-	-	1	-	3	-	3	-	2	2	-	-	-	4	2	-	1	1	-	1	1	-	2
Cuneopalpus cyanops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Amphigerontia bifasciata	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5	1	-	-	1	1	-	1	4	1	-	1	-	1	1
Trichadenotecnum sexpunctatum	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lachesilla pedicularia	-	-	-	-	-	-	-	-	-	-	1	-	3	-	1	1	1	1	-	3	-	-	-	1	-	2	5	4	5
Mesopsocus unipunctatus	-	-	-	-	2	3	1	2	3	4	5	1	5	1	4	5	-	-	1	5	1	-	1	2	-	3	-	-	1
Caecilius despaxi	1	3	4	-	-	-	-	3	2	2	6	2	5	3	6	6	1	3	6	6	2	2	6	2	1	4	-	-	2
	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	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	1	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	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			

2: *Results of DvClA-analysis 'Twinspan algorithm'; biotopes of the Oravské Beskydy Mts. are marked with vertical columns with grey color (with regard to the table extent, only right part of the whole table is illustrated only)*

CONCLUSION

Forest geobiocenoses in the territory of Babia hora Mt. and Pilsko Mt. in the Oravské Beskydy Mts. in 8th (i.e. *Piceeta* s.lat.) and 9th (i.e. *Pineta mugi* s.lat.) VT represent the most valuable and the most well-preserved communities with a minimum human influence in the Western Carpathians Mts. Therefore the data of composition of psocid taxocenoses that have also been collected, give the evidence on the taxocenoses of natural geobiocenoses as well.

The presented results, which are the first records on the occurrence and composition of psocid taxocenoses in the highest parts of the Western Carpathians Mts., prove that vegetation tiers have a significant influence on the composition of psocid taxocenoses. The results of this work and previous records (Holuša, 2007c) verify the hypothesis that vegetation tiers could be a suitable frame for zoocenological studies and for further development of a complex evaluation of changes in zoocenological communities. VTs and also lower units of geobiocenological or forest-typological system, together with the description of tree species composition and the level of naturalness, form an ideal base for studies focused on the animal taxocenoses structure. Presented records support the hypothesis that psocids (cf. Holuša, 2003a), as a part of forest ecosystem, fully comply with the theorem of geobiocenoses (Zlatník, 1976). Finally, on the other hand, the order of psocids can be used for geobiocenological classification of ecosystems.

Acknowledgement

This paper was worked up in the frame of the research project „Strategy of the management of territories with a special protection status“ MSM 6215648902-04 of Faculty Forestry and Wood Technology of Mendel University in Brno.

REFERENCES

BUČEK, A., LACINA, J., 1999: Geobiocenologie II. Scriptum MZLU LDF: 240.

DZIĘDZIELEWICZ, J., 1920: Owady siatkoskrzydłowate ziem Polski (Incenta neuropteroidea Poloniae terrarum). Ropr. i Wiad. z Muz. im. Dzieduszyckich, 4: 1–136.

ELLENBERG, H., (ed.), 1973: Ökosystemforschung. Springer Verlag Berlin – Heidelberg – New York: 282. (sec. rec. In: MÍCHAL, 1994).

ELLENBER, G. H., 1978: Vegetation Mitteleuropas mit dem Alpen in ökologischer Sicht. Eugen Ulmer, Stuttgart: 943. (sec. rec. In: MÍCHAL, 1994).

GAUCH, H. G. jr., 1982: Nose reduction by eigenvector ordinations. Ecology, 63: 1643–1649.

GOWER, J. C., 1967: A comparsion of some methods of cluster analysis. Biometrics, 23: 623–637.

GÜNTHER, K. K., 1974: Die Tierwelt Deutschlands. 61. Teil. Staubläse, Psocoptera. VEB Gustav Fischer, Jena: 314.

HILL, M. O., 1974: Correspondence analysis – a neglected multivariate method. Applied Statistics, 23: 340–354.

HILL, M. O., GAUCH, H. G. jr., 1980: Detrended correspondence analysis: an improved ordination technique. Vegetatio, 42: 47–58.

HOLUŠA, O., 2001: Příspěvek k poznání fauny pisivek (Insecta: Psocoptera) Přírodní rezervace Smrk (Beskydský bioregion, Česká republika). Práce a Studie Muzea Beskyd, 11: 83–97.

HOLUŠA, O., 2003a: Vegetační stupňovitost a její bioindikace pomocí řádu pisivek (Insecta: Psocoptera). [Disertační práce]. Mendelova zemědělská a lesnická Univerzita, Lesnická a dřevařská fakulta, Brno, 258 pp.

HOLUŠA, O., 2003b: Fauna pisivek (Insecta: Psocoptera) Národní přírodní rezervace Mazák (Beskydský bioregion, Česká republika). Práce a Studie Muzea Beskyd (Přírodní Vědy), 13: 83–98.

HOLUŠA, O., 2005: Fauna pisivek (Insecta: Psocoptera) Přírodní památky Kamenec v Podbeskydské pahorkatině (Podbeskydský bioregion, Česká republika). Práce a Studie Muzea Beskyd (Přírodní Vědy), 15: 75–89.

HOLUŠA, O., 2007a: Fauna pisivek (Insecta: Psocoptera) vybraných lokalit Poodří (Pooderský bioregion, Česká republika). Práce a Studie Muzea Beskyd (Přírodní Vědy), 19: 105–126.

HOLUŠA, O., 2007b: Příspěvek k poznání fauny pisivek (Insecta: Psocoptera) Přírodní rezervace V Podolánkách v Moravskoslezských Beskydech (Beskydský bioregion, Česká republika). Práce a Stud. Muz. Beskyd (Přír. Vědy), 19: 127–141.

HOLUŠA, O., 2007c: The influence of tree species composition to the composition of psocid taxocenoses (*Insecta: Psocoptera*) in the 7th (= *Fageti-Piceeta* s. lat.) and 8th altitudinal vegetation zones (= *Piceeta* s. lat.) in the Moravskoslezské Beskydy Mts. Journal of Forest Science, 53, (Special Issue): 3–10.

HOLUŠA, O., HOLUŠA, J., 2002a: New record of psocid Philotarsus parviceps (Psocoptera: Philotarsidae) from Slovakia. Biologia, 57: 148.

HOLUŠA, O., HOLUŠA, J. 2002b: Elipsocus moebiusi (Psocoptera: Elipsocidae) – first record from Slovakia. Biologia, 57: 620.

HOLUŠA, O., HOLUŠA, J. sen., 2008: Characteristics of 3rd (*Querci-fageta* s. lat.) and 4th (*Fageta (abietis)* s. lat.) vegetation tiers of north-eastern Moravia and

Silesia (Czech Republic). Journal of Forest Science, 54: 439–451.
HOLUŠA, O., HOLUŠA, J. sen., 2010: Characteristics of 5th (*Abieti-fageta* s. lat.) and 6th (*Picei-fageta* s. lat.) vegetation tiers of north-eastern Moravia and Silesia (Czech Republic). Acta Musei Beskydensis, 2: 49–62.
HOLUŠA, O., HOLUŠA, J. sen., 2011: Characteristics of 7th (Picei-fageta s. lat.) and 8th (Piceeta s. lat.) vegetation tiers of north-eastern Moravia and Silesia (Czech Republic). Acta Musei Beskydensis, 3: 1–15.
KAESLER, R. L., MULVANY, P. S., 1976a: Fortran IV program to compute diversity indices from information theory. Computer Geosciences, 2: 509–514.
KAESLER, R. L., MULVANY, P. S., 1976b: Fortran IV program to compute replicated diversity indices for random samples of specified size. Computer Geosciences, 2: 515–519.
KLAPÁLEK, F., 1904: Zpráva o výsledcích cesty do Transylvanských Alp a Vysokých Tater. Věst. Čes. Akad. Cis. Fr. Josefa pro vědy, slovesnost a umění, 13: 719–730.
LIENHARD, C., 1977: Die Psocopteren des Schweizerischen Nationalparks und seiner Umgebung (Insecta: Psocoptera). Ergebnisse der wissenschaftlichen Untersuchungen im Schweizerischen Nationalpark, band 14 (Nr. 75): 417–551.
LIENHARD, C., 1998: Psocoptéres Euro-méditerranéens. Faune de France. Vol 83. Fédération Francaise des Sociétes de Sciences naturelles, Paris, 517 pp.
MÍCHAL, I., 1994: Ekologická stabilita. 2. vyd. Veronica a Ministerstvo životního prostředí ČR, Brno, 275 s.
MIKLÓŠ, L., IZAKOVIČOVÁ, Z., KRAMÁRIK, J., PEŤKO, B., ZVARA, I., (ed.) 2006: Atlas reprezentatívnych geosystémov Slovenska. Slovenská akadémia vied, Ministerstvo životného prostredia Slovenskej republiky, Ministerstvo školstva Slovenskej republiky, Esprit, spol. s r. o., Banská Štiavnica, 237 s.
MOCSÁRY, A., 1918: Pseudo-neuroptera. pp. 26–27. In: Fauna regni hungariae. Regia Societas scientarum naturalium Hungarica, Budapest.
MÜCKSTEIN, P., HOLUŠA, O., 2003: Composition of psocid taxocenosis (Insecta: Psocoptera) in dependence of level of naturalness of forest ecosystems in the Žďárské vrchy hills. J. For. Sci., 49 (5): 208–219.
OBR, S., 1951: Pisivky Slovenska: I. Vysoké Tatry, II. Okolí Čilistova u Bratislavy - Spisy vydávané přírodov. fakultou MU Brno, řada M 4, 330: 209–229.
OBR, S., 1974: Psocoptera. Zborník TANAP, 16: 111–114.
OBR, S., 1977: Psocoptera. p. 41–43. In: DLABOLA J. (ed.): Enumeratio Insectorum Bohemoslovakie. Check List Tschechoslovakische Insektenfauna - Acta Faun. Entomol. Mus. Nat. Pragae, 15 (Suppl. 4): 1–158.
ORLÓCI, R., 1975: Multivariate analysis in vegetation research. Dr. W. Junk Publishing, The Hague – Boston, 451 pp.
PLÍVA, K., 1971: Typologický systém ÚHÚL. Ústav pro hospodářskou úpravu lesů Brandýs nad Labem, Brandýs nad Labem, 90 s.
PLÍVA, K., 1991: Funkčně integrované lesní hospodářství. 1 – Přírodní podmínky v lesním plánování. Ústav pro hospodářskou úpravu lesů Brandýs nad Labem, Brandýs nad Labem, 263 s.
PONGRÁCZ, S., 1914: Magyarország Neuropteroidái. Enumeratio Neuropteroidum Regni Hungariae - Rovartani Lapok, 21: 209–219.
POVOLNÝ, D., ZNOJIL, V., 1990: Vergleich zwischen Sarcophagini-Taxozönosen (Insecta, Diptera) Thürigens und der Tschechoslowakei. Rudolstädter Naturhistorische Schriften, 3: 43–61.
TEAM, 1958: Atlas podnebí Československé republiky. Ústřední zpráva geodesie a kartografie, Praha., 13 s., 89 maps 1:1 000 000.
TEAM, 1994: Lesnický naučný slovník. I. díl A–O. Ministerstvo zemědělství, Praha, 743 s.
ZLATNÍK, A., 1976: Přehled skupin typů geobiocénů původně lesních a křovitých v ČSSR. Zprávy Geografického Ústavu ČSAV (Brno), 13: 55–65.

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