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Mayfly communities (Ephemeroptera) of the Myjava upper stream

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During the years 1977-1978 we investigated mayfly stratocoenoses of the upper part of the Myjava river. We found that substrate influences mayfly stratocoenoses on stabil and complex substrates (gravel-and-stone riffles) than those on unstabil ones (accumulation of mud and tree leaves). Important factors there are riparian trees as the source of detritus, as the protection form excessive growth of algae and their roots are specific substrate for many species.
Head streams have got expressively different mayfly communities from those ones of the rest of a stream, similarly as muddy millbrook and the meadow brooklet.

Key words: Mayfly communities, substrate affinity, numerical classification, White Carpathians, Slovakia.

Many authors (e. g. CHISHOLM, 1976, DE MARCH, 1976, ALLAN, 1975, WILLIAMS, 1978, 1980, KOHLER, 1983 and others) investigate substrate influence on the distribution of macrozoobenthos. Most of them gave their attention mainly to influence of various particles substrate size, which were always gravel and sand, or in case to the impact of clay deposits. Influence of gravel and sandy bottom on benthos was studied also by POMICHAL (1984). Another approach was chosen by KUUSELA (1979) who studied macrozoobentos on various substrate type within one stream profile. Similarly SMOCK, GILINSKI and STONEBURNER (1985) investigated especially bottom, acumulated tree leaves and macrophytes on each profile. Also JANKINS, WADE and PUGH (1984) tried to solve impact of various substrates on macrozoobenthos.

Benthos of investigated flow was studied by DEVÁN and ERTLOVÁ (1984) and DEVÁN (1991, 1992).

Aim of this paper was to study varied stratocenoses on eleven profiles of the Myjava upper stream.

Studied stream

The upper stream of the Myjava river is situated in the White Carpathians and in adjoining part of the Myjava hills. This river rises under Šibenický hill in 707 m above sea level in the beech forest. It runnning throught the forest to the locality No. 5, inclusive of tributaries. Downstream winding through in the woodless- and intensively utilised country. Between localities 10 a 11 the stream is regulated. Closer hydrological characterization can be found in the abovementioned works. Locality characterization (collecting profiles) is in Table 1.

Methods

We collected qualitative samples from single types of substrate (Tab. 2) in the years 1977 (March, May, June, September, November) and 1978 (February, April, June, July). We used round net for collecting. Samples were taken away from all actually flooded types of substrates. They were conserved in formaldehyde solution and processed by common methods.

For each of stratocoenoses (i.i. set of samples from the given substrate and the given locality for the whole period) we calculated index of dominancy acording to KOWNACKI (1971) this one was consequently transformed: 100-10 % - 5, 9.9-1 %-4, 0.9-0.1 %-3, 0.09-0,01 %-2, and less than 0.01 %-1. Numeral matrix of dominancy for single species on single substrates and single localities was used as basis for numerical classification. These were calculated by the means of the N-class programme (PODANI, 1984) when using weighted index of dissimilarity (numerical classification) and by the means of Princomp programme when using covariance (analysis of principal components) (PODANI, 1984).

Table 1. Characteristics of localities

No	mnm	Wide	Depth	v H_2O	stream type	0°C	Notes
1	650	till 30	till 5	–	helocren	7,8	in shaters in beech forest
2	590	till 30	till 15	0,3	cascade brook	8,4	in beech forest
3	560	till 100	10–60	0,1–0,7	waley stream	9,2	in beech forest
4	460	–	20	–	limnocrene	7,9	in alder wood
5	460	till 200	10–50	0,3–1,2	submontane brook	9,1	margin of forest alders
6	360	till 300	10–100	0,1–1,0	submontane brook	10,7	in meadows, alders, willows
7	370	till 70	1–20	till 0,7	meadow brooklete	10,7	drying up in summer
8	350	till 200	5–30	till 0,5	millbrook	10,6	alder riparian trees
9	340	till 300	15–100	0,1–1,5	submontane brook	10,8	in fields, alder riparian trees
10	335	till 400	10–60	0,1–1,5	submontane brook	9,8	in fields, alder riparian trees
11	320	till 500	10–40	0,3–1,5	regulated stream below weir	11,1	withouth riparian trees

Explanatory notes: mnm – above sea level in metres, wide and depth are in centimeters, v H_2O– current velocity in m.s-1, 0 °C– average water temperature calculated on the basis of measurements when samples were collecting.

Results and discussion

From Fig. 1. and 2 and from Table 3, in can be seen, that folloving mayfly communities can be differentiated on the basis of numerical classification:

1) Communities relatively rich in species (stratocoenoses 6, 14, 30, 37, 38, 9, 11, 21, 19, 20 and 34). Species *Electrogena lateralis, Ephemerella mucronata, Habroleptoides modesta, Habrophlebia lauta* and others occur here regularly. This group is divided into three subgroups:

a) Stratocoenoses 6, 14, 30, 37, 38 are characterized by the highest species richness. They differ from the others through more frequent occurence of *Paraleptophlebia submarginata, Baetis fuscatus, Rhithrogena semicolorata, Ecdyonurus submontanus* and *Electrogena quadrilineata*.

b) Stratocoenoses 9, 11, 21 are poorer on species even if they are similar to the former group. The differ from it by the absence of *Baetis gemellus*, nearly absent there are *Rhithrogena iridina, R. semicolorata, Electrogena quadrilineata* and *Ecdyonurus submontanus*. They also differ from the first subgroup through the significant occurrence of *Ephemerella mucronata* and *Centroptillum luteolum*.

c) Stratocoenoses 19, 20, 34 are presented within of the whole group as the poorest community of rather heterogenous composition. Their common sign is undominant position and regular occurence of *Electrogena lateralis* and *Ephemerella ignita*. They differ from the former stratocoenoses by the absence of *Ephemera danica* and *Centroptilum luteolum*.

2) Communities poor on species (stratocoenoses 1, 4, 5, 43, 15, 42, 50, 18, 31, 29, 25, 48, 26, 51, 46, 12, 49, 23, 24, 41, 22, 52, 32, 2, 3, 33, 45, 13, 27, 8, 35, 10, 16, 7, 17, 28, 36, 39, 47, 40, 44, - see the table 3). It is considerably heterogenous group and it is noted for an absence of following-mostly rare species: *Electrogena quadrilineata, Epeorus sylvicola, Ephemerella (Torleya) major, Caenis macrura, Heptagenia fuscogrisea* and *H. sulphurea*. *Baetis alpinus* was present only in this group. It is divided into following subgroups:

a) Stratocoenoses 1, 4, 5, 43 are characterized by the species combination *Ecdyonurus starmachi, Rhithrogena iridina, R. ferruginea,* and *Baetis alpinus*. Regular significant presence of species from the family Heptagenidae distinguishes these stratocoenoses from the others within group 2.

b) Stratocoenoses 15,42 and 50 are typical by the regular significant occurrence of *Ephemerella ignita* and *Habrophlebia fusca* together with *Baetis vernus* along with absenting of the family Heptagenidae species.

c) Stratocoenoses 18, 31, 29, 25, 48, 26, 51 and 46 noted by the expresive and even behalf of two species only - *Baetis vernus* and *B. rhodani*.

Table 2. Substrate types, index of species diversity (H) and equitability (e–sensu Pielou) of single stratocoenoses

Loc. No.	Substr. No.	Substrate	H'	e
2	1	gravel	1,57	0,67
	2	moss	1,50	0,99
	3	tree leaves	–	–
	4	upgrowth on stones (periphyton)	1,89	0,81
3	5	gravel and sand, detritus	2,22	0,64
4	12	floating tree leaves	–	–
	13	detritus and mud	0,92	0,58
5	6	stones, gravel, pebbles–riffle	2,63	0,61
	7	flat stones	1,97	0,75
	8	accumulated tree leaves	1,58	0,99
	9	mud, sand, fine particle detritus	2,48	0,71
	10	periphyton on stones	0,58	0,25
	11	submerged macrophytes	2,46	0,68
6	14	gravel, pebles and flat stones–riffle	1,83	0,43
	15	filamentous algae	2,02	0,72
	16	fine mud in shallows	1,38	0,87
	17	mud and sand in pools	1,46	0,52
	18	vertical clay bank	1,10	0,69
	19	flat stones	1,80	0,57
	20	accumulated tree leaves	1,18	0,34
	21	roots of riparian trees	2,53	0,60
7	22	mud in non–drying up part	1,79	0,89
	23	macrophytes	–	–
	24	mud in drying up part	–	–
8	25	fine mud and detritus	0,82	0,52
	26	mud and coarse particle detritus	1,28	0,64
	27	accumulated tree leaves	0,73	0,73
	28	roots of riparian trees	2,27	0,81
	29	boards of weir	0,50	0,25
9	30	gravel and pebles–riffle	1,59	0,37
	31	vertical clay bank	1,0	0,99
	32	sandy mud in shalows	1,15	0,72

Table 2. (Continuation)

Loc. No.	Substr. No.	Substrate	H'	e
9	33	filamentous algae	–	–
	34	flat stones	2,17	0,65
	35	accumulated tree leaves	1,76	0,88
	36	mud in pools	2,09	0,66
	37	roots of riparian trees	2,83	0,69
10	38	gravel and pebles	1,29	0,31
	39	sandy mud and fine particle detritus in pool	1,87	0,80
	40	non–flying filamentous algae	1,73	0,67
	41	semi–submerged algae	–	–
	42	flying algae and moos	1,71	0,66
	43	diatome periphyton on stones	1,77	0,68
	44	roots of riparian trees	1,66	0,71
	45	accumulated tree leaves	–	–
	46	submerged macrophytes	1,12	0,43
11	47	mud with diatoms	1,63	0,70
	48	algae and moss	1,66	0,71
	49	mud below the outflow of warm water	–	–
	50	stones	1,20	0,46
	51	submerged macrophytes	0,94	0,47
	52	gravel	–	–

Explanatory notes: Loc. No. – number of the locality – compare with Table 1. Substr. No. – stratocoenosis number – compare with Table 3 and Figs. 1, 3, 4.

d) Stratocoenoses 12, 49, 23, 24, 41 are always characterized by the occurence of one mayfly species only (however not *B. rhodani*) nevertheles different species is typical for each group. Only stratocoenoses 23 and 24 have got the same species *H. fusca.*

e) Stratocoenoses 22, 52, 32 are characterized by the significant behalf of *Baetis rhodani* without *B. vernus.*

f) Stratocoenoses 2, 3, 33, 45, 27, 8, 35, 10 and 16 are characterized by the significant reprezentation *B. rhodani* without occurence of *B. vernus*, but still with considerable share of the genus *Habrophlebia.*

g) Stratocoenoses 7 and 17 are characteristic by the species combination of *Rhithrogena ferruginea, Habroleptoides modesta, Baetis rhodani* and *Ephemerella ignita* in balanced proportion.

h) Stratocoenoses 28 and 36 are characteristic by the significant representations of *Electrogena lateralis, Habrophlebia fusca, Baetis rhodani, Ephemerella ignita* and *Centroptilum luteolum.*

i) Stratocoenoses 39, 40, 47, 44: *Baetis rhodani, Habrophlebia fusca, Ephemerella ignita* and *Centroptilum luteolum* have here significant share during the absence of the family Heptagenidae species.

On the basis of principal component analysis (PCA) we concluded to results demonstrated in Figs. 3 and 4.

The first axis which is concentrating, 24.9 % of variability divides stratocoenoses after the amount of occured species. On the affirmative semiaxis there are concentrated richer on species, on the negative semiaxis there are communities poor on species (with a few exceptions). Stratocoenoses of the heat stream - 1, 4, 5 a 43 lie outside in view of this trend, as wel as the group of stratocoenoses 28, 36, 39, 47, 40, 44 is separated, but on the opposite side of axis 2 (it is all about substrates more or less influenced by the swamp).

axis are then characterized by them. They are stratocoenoses of not only stone-and-gravel riffle parts and flat stones but also those ones of stabil deposits from tree leaves and macrophytes (comp. Tab. 2 and 3). On the negative part of the axis species *Baetis alpinus* and *B. melanonyx* weight the most, they are characteristic for highest placed localities of the examined flow.

Spreading of sample sets along the second axis which is expresing 14.6 % of variability is shown up well on the reflect into planes of axes 2 and 3 (Fig. 4). On the affirmative side of semiaxis species *Centroptilum luteolum, Habrophlebia fusca, Ephemerella danica* and *Siphlonurus lacustris* affect the most, it means

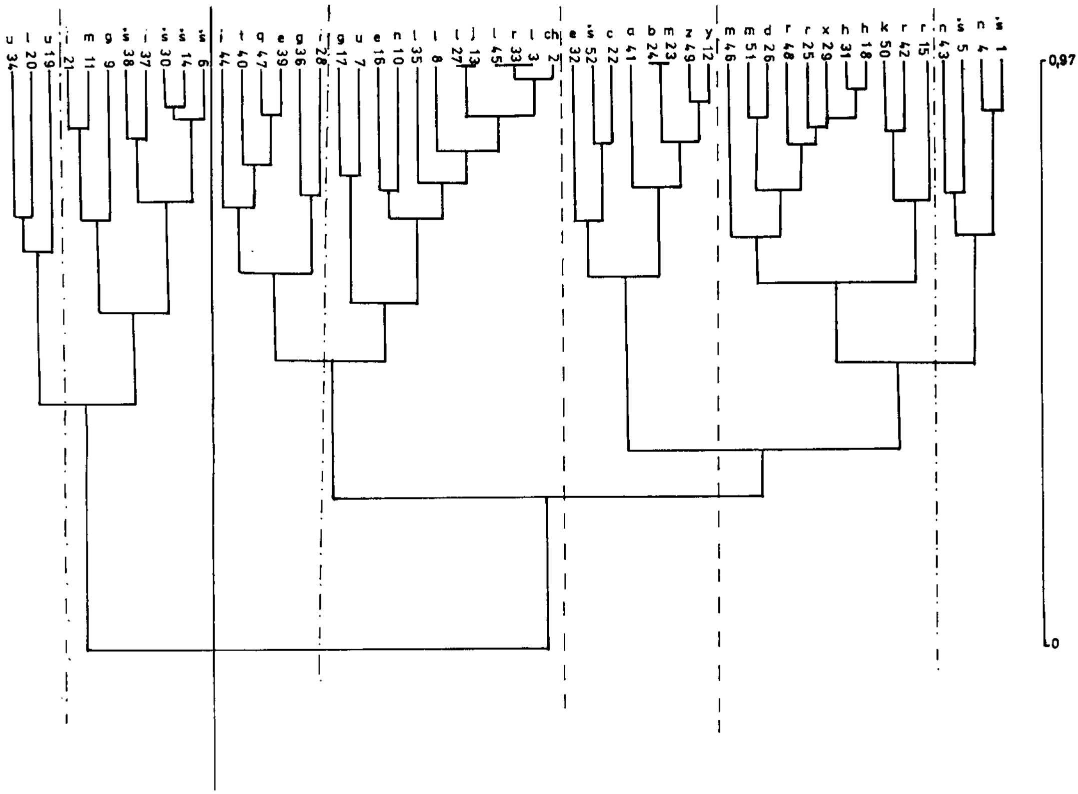

Fig. 1: Stratocoenosis dendrograme. Marks as in Table 3.
Explanatory notes: š – gravel, n – upgrowth, u –flat stones, k – stones on the bottom of the regulated part, lv – accumulated tree leaves, y – floating leaves, in limnocrene, i – roots of riparian trees, m –submerged macrophytes, g – mud, sand with fine particle detritus, q – mud covered with diatoms, e – sandy mud, j – detritus and mud, c – mud in non–drying up part of the meadow brooklet, z – mud below the outlow of warm water, d – mud and coarse particle detritus, h – vertical clay bank, t – non–flying filamentous algae, r – flying filamentous algae, a – semisubmerged algae, ch – moss, x – boards of weir.

On the affirmative side of the first axis species *Habroleptoides modesta, Ephemerella ignita, Rhithrogena ferruginea, Baetis muticus* and *Ecdyonurus starmachi* weight the most after correlation components. Communities on the affirmative semiaxis of the first

for all species living on mud, macrophytes and on roots of riparian trees. On the negative semiaxis species *Ecdyonurus starmachi, Rhithrogena iridina, R. ferruginea, B. alpinus, B. lutheri* and *B. melanonyx* weight, so then species inhabiting stony substrates, clear streamy

Table 3. Mayfly communities of upper Myjava river

Loc.	No.	2	2	3	10	6	10	11	6	9	8	8	11	8	11	10	4	11	7	7	10	7
Str.	No.	1	4	5	43	15	42	50	18	31	29	25	48	26	51	46	12	49	23	24	41	22
Spec.	substra.	š	n	š	n	r	r	k	h	h	x	j	r	d	m	m	y	z	m	b	a	c
1	*E. starmachi*	4	4	4	4	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	*R. ferruginea*	4	–	5	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8	*B. muticus*	–	–	3	–	4	–	–	–	–	–	–	3	–	–	3	–	–	–	–	–	–
9	*B. vernus*	–	–	3	5	4	4	5	5	5	3	4	4	3	4	4	–	–	–	–	–	4
10	*H. lauta*	–	–	3	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–
11	*B. gemellus*	–	–	3	4	–	3	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–
12	*H. modesta*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
19	*E. lateralis*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
17	*E. danica*	–	–	–	–	–	–	–	–	–	–	4	–	–	–	3	–	–	–	–	–	–
15	*E.mucronata*	–	–	–	–	–	3	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–
2	*B. rhodani*	4	5	5	5	5	5	4	5	5	5	5	5	5	5	5	–	–	–	–	–	–
13	*H. fusca*	–	–	–	–	3	3	4	–	–	–	–	–	–	–	3	–	–	5	5	–	5
18	*E. ignita*	–	–	–	–	5	5	4	–	–	–	–	–	4	–	–	–	–	–	–	–	–
3	*R. iridina*	4	4	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16	*E. quadrilineata*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
21	*E. submontanus*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
20	*R. semicolorata*	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6	*B. lutheri*	3	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7	*B. melanonyx*	–	4	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
22	*B. fuscatus*	–	–	–	–	–	–	4	–	–	–	–	3	–	–	–	–	–	–	–	–	–
25	*P. submarginata*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5	*B. alpinus*	3	5	3	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–
14	*E. sylvicola*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
26	*P. bifidum*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
30	*S. lacustris*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
32	*C. horaria*	–	–	–	–	–	–	4	–	–	–	–	4	–	4	–	–	–	–	–	–	–
27	*E. major*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
29	*H. fuscogrisea*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
28.	*C. macrura*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
31.	*H. sulphurea*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
24.	*E. smalorum*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–
23.	*C. luteolum*	–	–	–	–	–	–	–	–	–	–	–	–	3	3	3	–	–	–	–	–	4

Explanatory notes: compare Fig. 1

11	9	2	2	9	10	4	8	5	9	5	6	5	6	8	9	10	11	10	10	5	6	9	9	10	5	5	6	6	6	9
52	32	2	3	33	45	13	27	8	35	10	16	7	17	28	36	39	47	40	44	6	14	30	37	38	9	11	21	19	20	34
š	c	ch	l	r	l	j	l	l	l	n	e	u	g	i	g	e	q	t	i	š	š	š	i	š	g	m	i	u	l	u
–	–	–	–	–	–	–	–	5	–	–	–	4	–	–	3	–	–	–	–	4	3	4	3	4	–	2	2	4	–	4
–	–	–	–	–	–	–	–	–	–	–	4	4	3	–	–	–	–	–	–	5	4	4	2	4	3	2	2	4	3	4
–	–	–	–	–	–	–	–	–	4	–	–	–	3	–	–	–	–	–	–	–	5	4	4	3	–	4	3	3	4	–
5	4	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–	3	3	4	4	4	–	4	4	3	5	4
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	2	3	3	3	3	3	–	4	–	2	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	3	3	2	3	–	–	–	–	2	4
–	–	–	–	–	–	–	–	–	5	–	–	4	3	5	3	–	–	–	4	3	4	3	4	3	3	3	4	–	–	3
–	–	–	–	–	–	–	5	–	–	–	–	–	–	3	3	–	–	–	–	2	2	2	3	2	3	4	3	3	3	4
–	5	–	–	–	–	–	–	–	–	3	5	–	–	–	4	4	–	–	–	3	1	2	3	2	5	3	3	–	–	–
–	–	–	–	–	–	–	–	5	4	3	–	–	–	–	–	–	–	–	–	4	2	1	2	–	4	4	2	–	2	–
–	–	4	5	5	5	4	5	5	5	4	4	5	5	5	4	4	4	5	4	5	5	5	5	5	4	5	5	5	5	5
–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	5	4	4	4	5	2	4	4	5	4	3	2	5	–	4	3
–	4	–	–	–	–	–	–	–	–	5	–	5	3	4	4	5	4	4	–	4	4	4	4	4	4	5	4	3	3	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	2	–	1	–	–	2	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	1	1	2	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	3	2	2	–	1	–	–	–	–	–	–
–	—	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	–	–	–	–	–	–
–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	2	1	–	2	2	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	1	2	2	–	–	–	–	3	–	–
–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	2	–	2	3
–	–	–	–	–	–	–	–	–	–	–	–	–	5	3	5	4	5	–	5	–	–	–	4	1	4	3	4	–	–	–

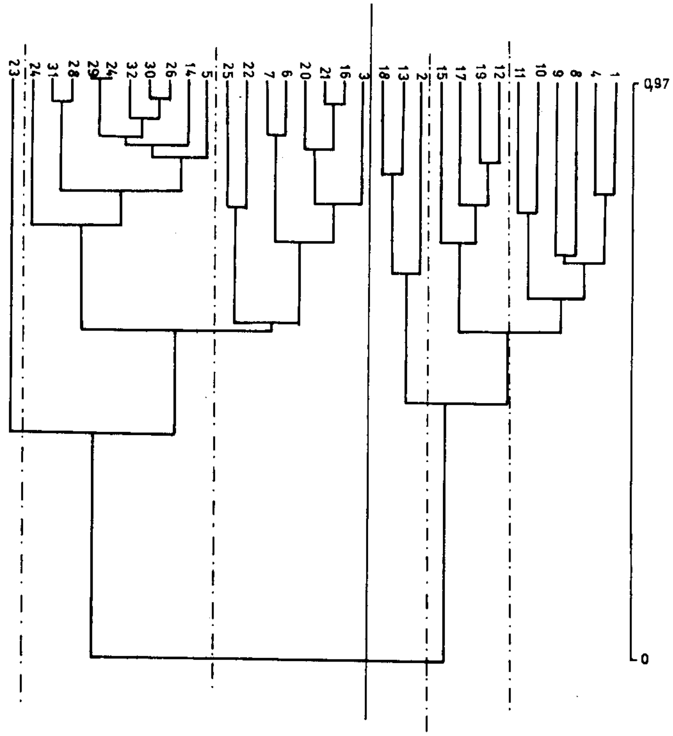

Fig. 2. Species dendrograme: Numbering of species as in Table 2

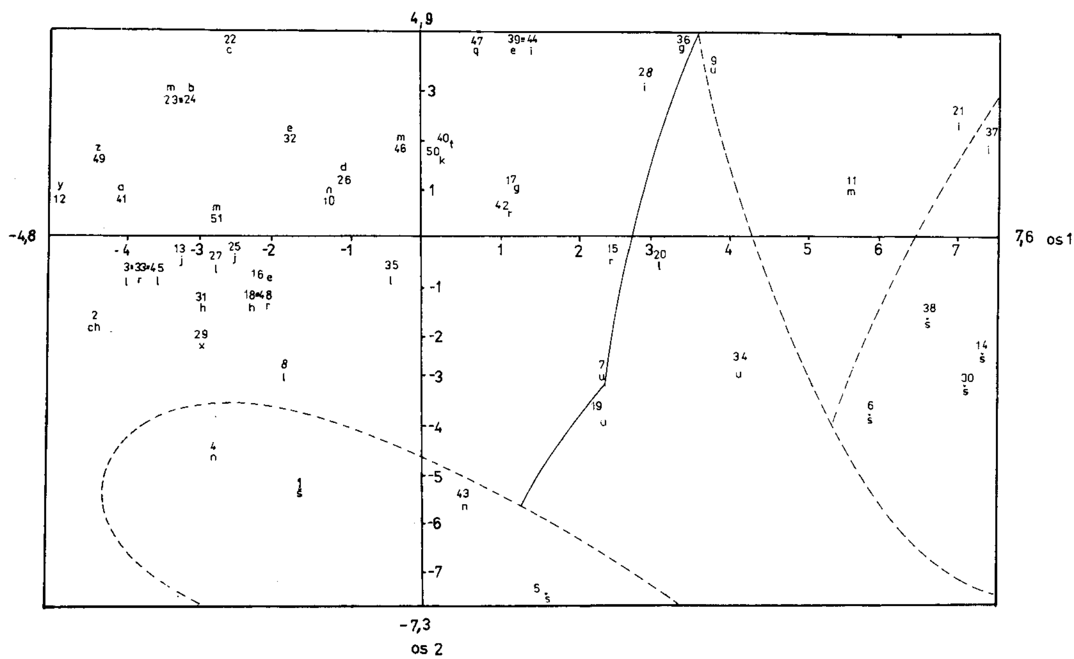

Fig. 3. Principal components analysis (PCA). Reflect into axis planes 1 and 2. Explanatory notes as in Fig. 1.

water. Concentration of stratocoenoses from the plant bed around the middle of the plane is conspicious: from tree leaves stratocoenoses 3, 45, 35, 20, stratocoenoses from macrophytes - 21, 45, 51 and so on. The second axis then can be interpreted as substrate axis, but this reality still must be understood more freely, with some exceptions (e. g. stratocoenosis 16 - the points are thin deposits on gravel shalow with significant occurence of *Rhithrogena ferruginea*).

WILLIAMS (1980) says that substrate can be the main factor of microdistribution for some benthic species but secondary for others. He also came to conclusion (WILLIAMS, 1978) when experimenting with various substrate mixtures that benthic organisms prefer bottom particles of various size.

RABENI and MINSHALL (1977) attack the great role to substrate in microdistribution of stream invertebrates. HART (1879) affirms that growth of substrate diversity goes to increasing of species richness and this corresponds with the first Thienemans principle (THIENEMANN, 1954). ALLAN (1975) makes known that substrate is the most basic aspect of a stream habitat reflecting stream velocity and determining hiding places, food distribution and so on. He also says that for some species the abundance is more varied from one microhabitat to other microhabitat than from one locality to other locality. We also were successful in proving this when it is showed that on one locality many species occur only on some substrates although they are abundant on almost all localities of the examined flow.

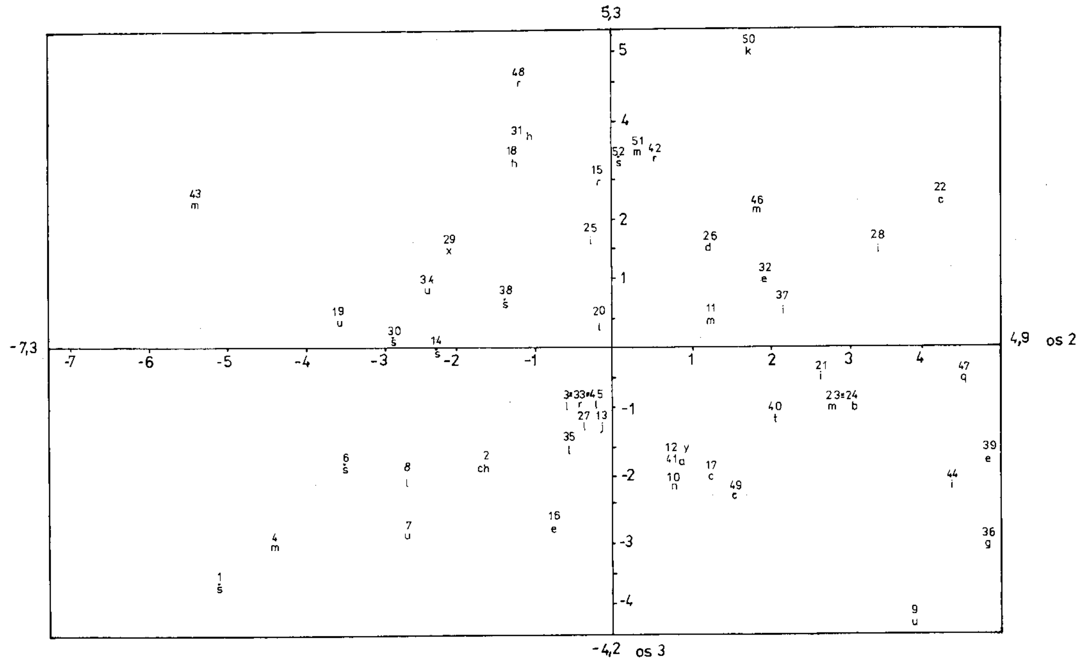

Fig. 4: Principal component analysis (PCA). Reflect into axis planes 2 and 3. Explanatory notes as in Fig. 1.

On the third axis which concentrates 8.9 % of variability species *B. vernus* and *B. fuscatus* weight the most on the affirmative part of axis. Here poorer communities with the dominancy of *B. vernus* and stratocoenoses from soiled localities (e. g. 50) are found. On the negative semiaxis many species weight but none of them in a sufficiently outstanding way - most communities from higher placed and clear parts of examined flow are concentrated here. With regard to the low per cent of concentrated variability this axis cannot be interpreted by any ecological factor.

Method of sample collecting caused that were inclued also species living in upgrowths and filamentous algae as well as species living under stones into samples from stramy stone-gravel parts. This is quite important reason of the great species variety of stratocoenoses from this kind of substrate.

When comparing communities on single substrate types (Tab. 2 and 3) we can see that stratocoenoses on more stabil substrates are much more richer in species. GURZ and WALLACE (1984) found that more coarse substrates are physically more stabil but they are less suitable for depositing of fine particle detritus. After them the biological stability is connected with the physical stability. That's why species feeding on upgrowth or on coarse particle detritus are more frequent on more coarse substrates.

After HAWKINS, MURPHY and ANDERSON (1982) species feeding on coarse particle detritus a filtrating species (and such species cannot be found among by onselves discovered mayfly species) are influenced for all. After them for species feeding on upgrowth of Diatoms is water stream more important. KOHLER (1983) discovered that Baetidae prefer rather living on the surface of substrate, while Heptagenidae and Leptophlebidae among them and on the bottom side of stones (we also verify this fact). After KOWNACKI (1982) and HOOPES (1974) forceful water spouts strenghten mayfly share of genus *Baetis* on the benthos composition consequently. All these data help us to understand possible reasons for eudominant position of the species *Baetis rhodani* in most communities ascertained by ourselves. Great swings in throgh-flow, earth flushes in lower laid sections and the way of living of this species (scraper-ULFSTRAND, 1975) obviously cause its strong numerous representation.

SLOBODCHIKOFF and PARROT (1977) proved that benthos communities on riffle are more stabil and richer than those in pools, which is given into continuity with the stability of stone-and-gravel bottoms of riffles. It corresponds with our affirmation that communities on unstabil substsrates are poor on species. (compare Tabs. 2 and 3). SMOCK, GILINSKI and STONEBURNER (1985) also remind that tree leaves accumulations are temporary and unstabil and that's why they are settled little by benthic organisms. After HART (1983) slight destruction of stream communities increases the diversity because it enables existence of species which would not bear competition in undisturbed communities. Though there are „cleanings" of bottom from excessive upgrowth of filamentous algae, shifting of the detritus and so on during periodical spring downpours, in wiev of the fact that there are very unbalanced through-flow conditions characteristic for flysh belt (see also DEVÁN, 1991) it is very difficult to assume, if they have favourable influence on the richness of maxfly species. In our case localities 5, 6, 9 and 10 are exhibited to the great fluctuation of water level and temperature, however here it is also the greatest substrate diversity, which is the function of the stream order and its hydraulic conditions. On the locality 10, however, the negative influence of the clay particle deposition appears in consequence of the local reducing of flow slope. After TEBO (1955) clay deposits can lower doth diversity and density of makrozoobenthos (e. g. at the stratocoenosis 44 on the lokality 10 there is the conditioned difference from the stratocoenosis 37 on the locality 9, although both are stratocoenosees on riparian tree roots. Howewer, we did not notice this influence at the gravel- stony bottom on the lover placed localities. The current velocity is obviously slowed down more in roots, macrophytes and so on, than on the bottom of riffles.

It shows up well from the Table 2, that there are considerably different communities on localities 2 and 3, as if it was another flow zone. It is determined by the different flow hydraulicity below the water spring. STATZNER and HIGHLER (1986) state that the spring part of a stream is characterized by the small hydraulic stress and substrate is also more stable here. Also for this reason communities are poorer on species here, but they are specific.

BITUŠÍK and ERTLOVÁ (1985) when studying chironomid taxocoenoses similararly came to the conclusion that communities within one locality differ after the substrate but there are no specific communities (with exception of sediments) on any substrate (it means typical for it) along the whole lenght of a stream.

MALMQUIST and others (1987) and SHORT and others (1980) proved that microdistribution of macrozoobenthos depends on qualitative character of food and on its distribution. Rich sources of food can (after other conditions) either cause relative uniformity of animal distribution (RABENI and MINSHALL, 1977, WILLIAMS, 1980) - mud deposits rich on detritus, or cause mosaic occurence (HART, 1981) - in our case the complex substrate of gravel-stony riffles. HAMILTON and CLIFFORD (1983) set out that food of many mayfly species changes during both the year and onthogenesis. At the scrapers (*Baetis*) the most share of diatoms appears in autumn and in spring, when their upgrowths are maximum. So-called winter species grow just thanks to this source of food. After the same authors food is uniform for the whole year at scrapers. CULP and DAVIES (1985) experimentaly found that the maximum abundance of macroinvertebrates was on the substrate with detritus from the alder leaves. After HAEFNER and WALLACE (1981) detritus of the first quality is provided by trees which are capable to bunch nitrogen with the help of symbionts. And alders are just such trees. Just for this reason mayfly communities are also richer in the lower part of a stream, (where there are riparian trees with alders), than in the upper stream in beech forest. At the same time riparian trees block excessive run wild of algae, which would start view of the fact that nutrients from the farmed area are flushed into the stream. In consideration to the lock of riparian trees there is occuring the wild run of filamentous algae on localities 10 and 11. It leads then to the simplifing of the species spectrum.

It can be see from the table 2 that there is a difference on many localities in mayfly communities of muddy stream bends, places at the banks and streamy stony parts. This fact must be taken into consideration when collecting samples for investigation of quantitative relations and saprobity. Methodical question is the way of eventual evaluation of roots stratocoenoses of riparian trees, which are considerably intensively settled by mayflies and which form great part of bottom in relation to the mineral bottom, and sample collecting from them by classical benthometers.

If we wanted to classify the examined stream after traditional river articulation into zones, it is quite difficult. Only the sub-spring part differs expressively, the rest of investigated stream could by possibly with some restrictions regarded as metarithral however with exception of the millbrook and meadowbrook.

References

ALLAN, J. D., 1975: The distributional ecology and diversity of benthic insects in Cement Creek, Colorado.-Ecology, **56:** 1040-1053.

BITUŠÍK, P., ERTLOVÁ, E. 1985: Chironomid communities (Diptera, Chironomidae) of the river Rajčianka (North-Western Slovakia).-Biológia, Bratislava, **40:** 596-608.

CHISHOLM, P., 1976: Effects of latering streambed material size on a specific measure of biological diversity.-Can. J. civil engineering, **3:** 563-570.

CULP, J. M., DAVIES, R. W., 1985: Responses of benthic macroinvertebrate species to manipulation of interstitial detritus in Carnation Creek, British Columbia.-Can. J. Fish. and Aquat. Sci. **42:** 139-146.

DE MARCH, B. G. E., 1976: Spatial and temporal patterns in macrobenthic stream diversity.-J. Fish. Res. Bd. Can. **33:** 1261-1270.

DEVÁN, P., 1991: Abundancia a biomasa makrozoobentosu horného toku rieky Myjavy.-Ochrana prírody **11**: 213-229.

DEVÁN, P., 1992: Podenky horného toku Myjavy. I. Baetidae a Caenidae. Biológia, Bratislava, **47:** 97-105.

DEVÁN, P., ERTLOVÁ, E., 1984: Makrozoobentos znečistenej a regulovanej časti horného toku rieky Myjavy.-Biológia, Bratislava, **39**: 957-964.

GURTZ, M. E., WALLACE, J. B., 1984: Substrate medial response of stream invertebrates to disturbance.-Ecology **65:** 1556-1559.

HAEFNER, J. D., WALLACE, J. B., 1981: Shifts in aquatic insects populations in a first-order southern Appalachian stream following a decade of old field succesion.-Can. J. Fish. Aquat. Scie. **38**: 353-359.

HAMILTON, H. R., CLIFFORD, H. F., 1983: The seasonal food habits of mayfly (Ephemeroptera) nymphs from three Alberta, Canada, streams, with especial reference to absolute volume and size of particle ingested.-Arch. Hydrobiol., Suppl. **65** (2/3): 197-234.

HART, D. D., 1978: Diversity in stream insects: regulation by rock size and microspatial complexity.-Verh. Internat. Verein. Limnol. **20:** 1376-1381.

HART, D. D., 1981: Foraging an resource patchines: field experiments with a grazing stream insects.-Oikos **37:** 46-52.

HART, D. D., 1983: The importance of competitive interactions within stream populations and communities. Stream Ecol.: Appl. and test. gen. ecol. theory. Proc. Plenary symp. test. gen. ecol. theory lotic ecosyst., 29 annu. meet. Provo, Utah, 29, Spr. 1981, New York, London, p. 99-126.

HAWKINS, CH. P., MURPHY, M. L., ANDERSON, N. H., 1982: Effects of canopy, substrate composition, and gradient on the structure of macroinvertebrate communities in Cascade range streams of Oregon.-Ecology, **63:** 1840-1856.

HOOPES, R. L., 1974: Flooding, a result of huricane Agnes, and its effect on macrobenthic community in a infertil headwater in central Pennsylvania.-Limnol. Oceanogr. **19:** 853-857.

JENKINS, R. A., WADE, K. R:, PUGH, E., 1984: Macroinvertebrate-habitats relationships in the River Teifi catchment and the significance to conservation.-Freshwater biology **14:** 23-42.

KOHLER, S. L., 1983: Positioning on substrates, positioning changes, and diel drift periodicities in mayflies.-Can. J. Zool. **6:** 1326-1368.

KOWNACKI, A., 1971: Taxocenes of Chironomidae in streams of the Polish High Tatra Mts.-Acta hydrobiol. **13:** 439-463.

KOWNACKI, A., 1982: Stream ecosystems in mountain grassland (West Carpathians). 8. Benthic invertebrates.-Acta hydrobiol. **24:** 375-390.

KUUSELA, K., 1979: Early summer ecology and community structure of the macrozoobenthos on stones in the Jäväjänkoski rapids on the river Lestijoki, Finland.-Acta Univ. Oulensis, Series a, Sci, rer. nat., Biologica **6:** 123 pp.

MALMQUIST, B., NILSSON, L. M., SVENSSON, B. S., 1978: Dinamics of detritus in a small stream in southern Sweden and its influence on the distribution of the bottom animal communities.-Oikos **31:** 3-16.

PODANI, J., 1984: Syn-Tax II. Computer program for data analysis in ecology and systematics.-Abstracta botanica **8:** 73-84.

POMÍCHAL, R:, 1984: Spoločenstvá vodného hmyzu Malých Karpát so zreteľom na potočníky (Trichoptera). [Kandidátska dizertačná práca] Prírodovedecká fak., Bratislava.

RABENI, C. F., MINSHALL, G. W., 1977: Factors affecting microdistribution of stream benthic insects.-Oikos **26:** 33-43.

SHORT, R. A., CANTON, S. P., WARD, J. V. 1980: Detailed processing and associated macroinvertebrates in a Colorado mountain stream.-Ecology, **61**: 727-732.

SLOBODCHIKOFF, C. N., PARROT, J. E., 1977: Seasonal diversity in aquatic insects communities in all-year stream system.-Hydrobiologia, **52:** 143-151.

SMOCK, L. A., GILINSKI, E., STONEBURNER, D. L., 1985: Macroinvertebrate production in a southern United states blackwater stream.-Ecology, **66:** 1491-1503.

STATZNER, B., HIGLER, B., 1986: Stream hydraulics as a major determinant of benthic invertebrate zontion patterns.-Freshwater biology **16:** 127-139.

TEBO, L. B., 1955: Effects of siltation resulting from improrer logging on the bottom fauna of a small trout stream in the southern Appalachians.-Progr. fish-cult. 17: 64-70.

THIENEMANN, A., 1954: Ein drittes biozönotisches Grundprinzip.-Arch. Hydrobiol. **49:** 421-422.

ULFSTRAND, S., 1975: Diversity and some others parameters of Ephemeroptera and Plecoptera communities in subarctic running waters.-Arch. Hydrobiol. **76:** 499-520.

WILLIAMS, D. D., 1978: Substrate size selection by stream invertebrates and the influence of sand.-Limnol. Oceanograf., **23**: 1130-1133.

WILLIAMS, D.D., 1980: Some relationships between stream benthos and substrate heterogeneity.-Limnol. Oceanograf., **25:** 166-172.

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