With compliments
10/X/74
(for Mr Peters)

ACKNOWLEDGEMENTS

I would like to thank Jiří Filip, Director of the District Museum in Šumperk, and Hana Janáčková, prom. biol., Head of the Department of Natural History, District Museum in Šumperk, for their understanding and help. I am also indebted to RNDr. Miloš Zelinka CSc, Zdeněk Gába and Petr Štefan for their kind assistance. I thank Jarmila Kovaříková for drawing the maps of the sampled area.

ACTA HYDROBIOL.	16	3—4	417—429	KRAKÓW 1974

IVAN TUŠA

Larwy jętek (*Ephemeroptera*) w prądowych siedliskach trzech pstrągowych potoków o dnie kamienistym (północno-zachodnie Morawy, Czechosłowacja)

Mayfly larvae (*Ephemeroptera*) in current habitats of three trout streams with stony bottom (North-Western Moravia, Czechoslovakia)

Wpłynęło 29 listopada 1973 r.

Abstract — The three tributaries of the River Morava (Branná, Desná, and Krupa Creeks) and other streams from quoted works were found to contain 8 to 25 taxons (mostly species) of mayflies. The total number of mayflies from all cited papers varies greatly for individual streams (14 to 1700 specimens per sq. m.), from the Moravian streams only 284·6 to 1 323·0 specimens per sq. m. The situation in the biomass was analogous: 0·005 to 5·72 g per sq. m. and 1·24 to 5·72 per sq. m. respectively. Most frequently the number was 500 to 700 individuals per sq. m. and biomass 2—3 g per sq. m. One fifth to one fourth of all the taxons present were significant for production: *Baetis alpinus*, *B. rhodani*, *Rhithrogena semicolorata*, *Epeorus assimilis*, *Eodyonurus* gr. *venosus* and *Leptophlebiidae*. The slight organic pollution (within xeno-oligosaprobity) increases the number and biomass of larvae. Seasonal distribution of mayflies in the streams with stony bottom shows two peaks: in early spring — spring and in late summer — autumn.

The present paper is a continuation of the report on mayfly larvae in Bělá Creek (Tuša 1973), of other studies quoted here, and of Sukop's communication (1973). It summaries the results from manuscript cited as Tuša 1972 in the study Tuša 1973.

The questions discussed are the number, biomass, and species composition of mayflies in Branná, Desná, and Krupá Creeks. Selected habitats and their seasonal changes are analysed, and the degree of pollution is estimated together with the influence of organic pollution on the numbers of mayflies. The results of qualitative and quantitative studies of some other Moravian streams reported by other authors are compared.

Area, material, and methods

Branná Creek rises on the western slope of the Keprník, 1240 m above sea level. It is 23·7 km long. As a left tributary, it empties into the Morava in Hanušovice. The discharge at the mouth is 1·69 cu.m. per sec. The two localities chosen for study lie above the village of Branná, because the lower part, particularly below Jindřichov, is highly polluted. Both habitats are free of pollution so far. It is a normal fishing stream with brown trout (*Salmo trutta* m. *fario* L.), rainbow trout (*Salmo gairdneri irideus* Gib.) (Pohunek et al. 1972), and probably both species of bullheads (*Cottus gobio* L. and *C. poecilopus* Heckel). The character of the habitats is described in Table I.

Seven excursions were made to Branná Creek: In April, June, August, October, and December 1969, and in February and May 1970. They yielded a total of 14 samples containing 1010 mayfly nymphs. The excursions are surveyed in Table IV.

Desná Creek rises on the western slope of the Praděd, 1180 m above sea level. It is 41.5 km long. As a left tributary, it empties into the Morava near the village of Postřelmov. The discharge at the mouth is 4·48 cu.m. per sec. All the examined habitats are slightly affected by organic pollution, which below Šumperk becomes more intensive. Before completion of present paper, a new cleaning plant in Šumperk started to operate so that in 1969 and 1970 the situation improved remarkably. This is a fishing stream with brown trout (*Salmo trutta* m. *fario* L.), rainbow trout (*Salmo gairdneri* Gib.), grayling (*Thymallus thymallus* (L.)), and brock trout (*Salvelinus fontinalis* (Mitchill)) (Pohunek et al. 1972). Zelinka (1951) reports from Desná Creek (*Cottus poecilopus* Heckel), and the bullhead (*C. gobio* L.) occurs with great probability. The character of the habitats is described in Table I.

Six excursions were made to Desná Creek: in March, May, July, September, November 1969 and in February 1970. They yielded a total of 37 samples containing 2145 mayfly nymphs. The excursions are surveyed in Table IV.

Krupá Creek rises west of the Kladské saddle, 980 m above sea level. It is 18·8 km long. As a left tributary it empties into the Morava above Hanušovice. The discharge at the mouth is 2·02 cu.m. per sec. All the habitats are affected by slight organic pollution. It is a fishing stream, the part above the town of Staré Město pod Sněž. being a fishing reserve. The above cited work (Pohunek et al. 1972) does not offer any information on the species of fish living in this stream. Most probably, they are the brown trout (*Salmo trutta* m. *fario* L.) and the bullhead (*Cottus gobio* L.), perhaps also *C. poecilopus* Heckel.

Six excursions were made to Krupá Creek: in April, June, September, and October 1969, in January, and March 1970. They yielded a total of 29 samples containing 4657 mayfly nymphs. The excursions are surveyed in Table IV.

Tabela I. Charakterystyka stanowisk

a - wysokość nad poziom morza w m; b - odległość od ujścia w km; c - szerokość w m; d - prędkość prądu w m/sek.; f - temperatura °C; g - podłoże

Table I. Characteristics of the sampling stations

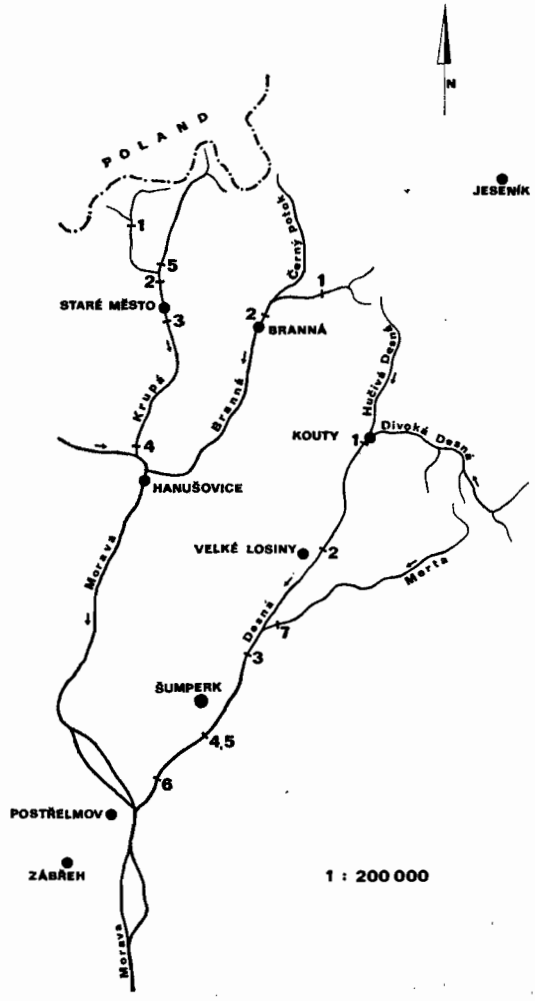
a - m above sea level; b - km from the mouth; c - width in m; d - depth in m; e - speed of the current in m per sec.; f - temperature in °C; g - substratum

Stanowisko Station	Położenie geograficzne Geographical situation	Charakterystyka stanowisk Characteristics of the sampling stations						
		a	b	c	d	e	f	g
Branná Creek 1	około 5 km powyżej gminy Branná about 5 km above Branná Community	780	18	4.4	0.1-0.3	0.8	0.0- 7.5	kamienie - stones
Branná Creek 2	około 0,5 km powyżej gminy Branná about 0.5 km above Branná Community	590	13	7.2	0.1-0.3	0.5	0.5-13.0	
Desná Creek 1	około 100 m poniżej zbiegu potoków Divoká Desná i Hučivá Desna about 100 m below confluence of Divoká Desná Creek and Hučivá Desná Creek	570	29	11.0	0.2-0.3	0.7	0.5-14.0	
Desná Creek 2	około 1 km powyżej Velké Losiny about 1 km above	410	21	8.5	0.2-0.4	0.8	0.0-14.0	
Desná Creek 3*	w Rapotín, 200 m poniżej ujścia potoku Losinka in Rapotín, 200 m below mouth of Losinka Creek	340	13	10.2	0.2-0.6	0.8	5.5-14.5	
Desná Creek 4	1 km poniżej Šumperk, 100 m powyżej ujścia ścieków miejskich 1 km below Šumperk, 100 m above mouth of town sewage	305	5	10.5	0.1-0.3	0.7	0.0-16.0	
Desná Creek 5	1 km poniżej Šumperk, 100 m poniżej ujścia ścieków miejskich 1 km below Šumperk, 100 m below mouth of town sewage	305	5	10.0	0.1-0.5	1.0	0.0-16.5	kamienie i żwir z substancją ściekową stones and gravel with sewage substance
Desná Creek 6	0,5 km powyżej Sudkov 0.5 km above	280	2	12.0-15.0	0.1-0.3	1.0	0.0-16.0	kamienie i żwir stones and gravel
Desná Creek 7**	Potok Merta, dopływ Potoku Desná Merta Creek, tributary of Desná Creek	340	0.5	5.2	0.2-0.4	1.0	5.5-13.0	kamienie stones
Krupá Creek 1	powyżej Nová Seninka above	600	14	2.4	0.1-0.3	0.3	0.0-10.5	
Krupá Creek 2	poniżej ujścia potoku Kunčický below the mouth of the stream	530	11	5.4	0.1-0.4	1.0	0.0-11.0	
Krupá Creek 3	0,5 km poniżej Staré Město p. Sněž. 0.5 km below	510	9	5.2	0.1-0.4	0.7	0.0-12.0	
Krupá Creek 4	100 m powyżej ujścia do rzeki Morawa 100 m above the mouth in River Morava	410	0.1	15.0	0.2-0.5	0.7	1.0-14.0	kamienie i żwir stones and gravel
Krupá Creek 5	potok Kunčický, dopływ potoku Krupá Kunčický stream, a tributary of Krupá Creek	530	0.2	3.4	0.1-0.4	0.4	0.0-10.5	kamienie stones

* Na tym stanowisku w lutym nie mierzono temperatury
At this station the temperature was not measured in February

** Na tym stanowisku w styczniu nie mierzono temperatury
At this station the temperature was not measured in January

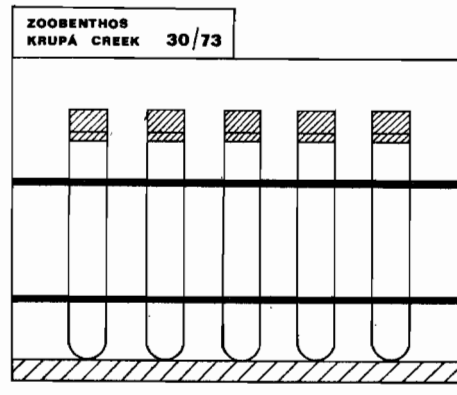
The sampling was carried out by washing the stones in the stream. Their area was measured after the sampling was finished. This method is described in more detail by Schräder (1932) or Albrecht (1959). The following factors were measured: the depth and width of the stream, the speed of the current



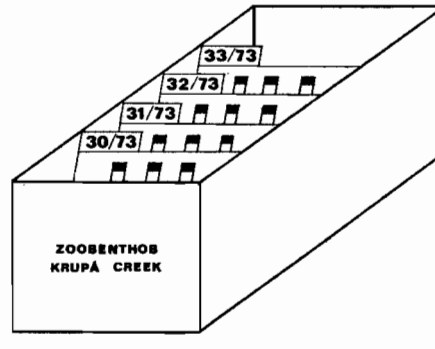
Ryc. 1. Lokalizacja stanowisk poboru w trzech badanych potokach: Branná, Desná i Krupá
Fig. 1. Localization of sampling stations in three investigated streams: Branná, Desná, and Krupá

along the line of current, and the temperature of the water 5 cm below water surface. The values obtained are presented in Table I. The number and biomass values are converted to 1 sq. m. The biomass was not determined by weighing but calculated from the weights reported for individual species by Zelinka (1969). The degree of pollution was calculated after Zelinka and Marvan (Cyrus, Sládeček 1966, 1969).

For the purpose of this work the author designed and used a non-traditional way of storing test tubes with the samples of zoobethos (Figs 2, 3). Instead of the usual binding of test tubes of one sample together with a rubber band and storing them in bottles, we used small panels of sololite. For whole samples in larger test tubes the panels were 25×20 cm, for those in smaller test tubes with species of individual orders and groups the panels were 14×11 cm.



Ryc. 2. Płytka z probówkami testowymi
Fig. 2. Panel with test tubes



Ryc. 3. Płytki z probówkami testowymi w skrzynce. (Wszystkie rysunki wykonała Jarmila Kovaříková)
Fig. 3. Panels with test tubes in the box. (All illustrations were drawn by Jarmila Kovaříková)

On its bottom each panel is fixed with a little list at the front to prevent the test tubes attached to the panels with two rubber loops from falling through. At the back, a label of hard white paper for notes is inserted between the rubber and the panel. The panels are stored one after the other in boxes lined with PVC and supplied with special lids. Some panels have open test tubes containing water (samples in formaldehyde) or alcohol (samples in alcohol)

keeping the inside moist and reducing evaporation from the test tubes with samples. This way of storing test tubes is very lucid and every sample is very quickly found.

Tabela II. Skład gatunkowy jętek na poszczególnych stanowiskach
x - obecny; - nieobecny

Table II. Species composition of the mayflies at the individual stations
x - present; - absent

Stanowisko / Station — Gatunek / Species	Branná Creek		Desná Creek							Krupá Creek				
	1	2	1	2	3	4	5	6	7	1	2	3	4	5
Baetis rhodani (Pictet)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
- vernus (Curtis)	x	-	x	x	x	-	-	-	x	x	x	x	-	x
- alpinus (Pictet)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
- bioculatus (L.) a	-	-	x	x	x	-	x	-	x	x	-	-	x	-
- pumilus (Burm.) b	-	x	x	-	x	-	-	-	-	x	x	x	-	x
Baetis sp.	-	x	x	-	x	x	-	-	x	-	x	-	x	x
Rhithrogena semicolorata (Curtis) c	x	x	x	-	x	x	x	-	x	x	x	x	x	x
- aurantiaca (Burm.) d	-	x	-	-	-	-	-	-	x	-	-	-	-	-
- cf. hercynia Landa	x	x	x	x	x	x	-	-	-	x	x	x	x	x
Rhithrogena sp.	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Epeorus assimilis (Eaton)	x	x	x	x	x	x	-	-	x	x	x	x	x	x
Heptagenia sp.	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ecdyonurus venosus (Fabricius)	x	x	x	x	x	-	-	-	-	x	-	-	x	x
Ecdyonurus sp.	x	x	-	-	x	-	-	-	-	x	x	x	-	-
Ephemerella ignita (Poda)	-	x	x	x	x	x	x	-	-	-	-	-	x	-
- krieghoffi (Ulmer)	-	x	x	-	x	x	x	-	-	x	x	-	x	x
Habroleptoides modesta (Hagen)	-	x	-	-	-	-	-	-	-	-	x	-	-	-
Ogółem - Total	8	13	13	8	14	8	6	2	8	11	11	8	10	10
Liczba gatunków w całym potoku / Number of species in the whole stream	14		16							14				

a - obecnie - at present: Baetis fuscatus (L.), see Müller-Liebenau 1964
b - obecnie - at present: Baetis muticus (L.), see detto
c - obecnie - at present: Rhithrogena cf. semicolorata, see Sowa 1971
d - obecnie - at present: Rhithrogena diaphana Navás, see Puthz 1973

Results and discussion

The species composition of the mayflies in the studied streams can be seen in Table II, quantitative conditions being summed up in Table III, and seasonal changes in Table IV. The results mostly correspond to conditions found in other Moravian trout streams (Zelinka 1953, Losos, Marvan 1957, Peňáz et al. 1966, Kubíčková 1968, Sedlák 1969, Sukop 1970, 1973, Zelinka 1969, Tuša 1973), see Table V.

The estimation of differences in qualitative and quantitative conditions of the nymphs of mayflies and zoobenthos must take into account the fact that the nature of the streams denoted as "trout streams" is still very varied. Besides, each stream has its own specific features determined by its surroundings.

Tabela III. Charakterystyka stosunków ilościowych i jakościowych jętek na poszczególnych stanowiskach i ich stopień zanieczyszczenia
a - ilość na 1 m^2; b - biomasa w g/m^2; c - ilość gatunków; d - stopień zanieczyszczenia: x - ksenosaprobowość; o - oligosaprobowość

Table III. Characteristic of the quantitative and qualitative relations of the mayflies at individual stations and degree of pollution
a - number in 1 m^2; b - biomass in g/m^2; c - number of species; d - degree of pollution; x - xenosaprobity; o - oligosaprobity

Potok Stream	Stanowisko Station	Ilość i biomasa (Zakres i średnie wartości) Number and biomass (Range and mean values)	c	d	Gatunki dominujące i ich ilość na 1 m^2 Predominant species and their number in 1 m^2
Brannó Creek	1	a 11 - 685; 221.9 b 0.20 - 4.35; 1.84	8	x	Baetis alpinus 105.8; Epeorus assimilis 47.1; Baetis rhodani 33.3; Rhithrogena cf. hercynia 45.4.
	2	a 142 - 1003; 347.3 b 1.31 - 4.70; 2.50	13	x	Baetis rhodani 120.3; Baetis alpinus 105.0; Epeorus assimilis 49.7; Rhithrogena semicolorata 45.4.
Desná Creek	1	a 61 - 1202; 468.3 b 0.25 - 6.59; 2.81	13	x	Baetis alpinus 320.8; Epeorus assimilis 67.8; Baetis rhodani 49.3; Rhithrogena cf. hercynia 14.6.
	2	a 20 - 467; 190.0 b 0.24 - 2.12; 1.07	8	x	Baetis alpinus 90.6; Baetis rhodani 30.8; Epeorus assimilis 26.0; Baetis bioculatus 20.4; Baetis vernus 17.2.
	3	a 229 - 762; 438.0 b 0.90 - 2.75; 1.83	14	o	Baetis rhodani 252.2; Baetis bioculatus 54.8; Baetis alpinus 44.8; Baetis vernus 21.0; Ephemerella ignita 18.3.
	4	a 8 - 568; 166.1 b 0.03 - 2.52; 0.68	8	o	Baetis alpinus 67.7; Baetis rhodani 52.7; Ephemerella ignita 25.5.
	5	a 0 - 631; 147.1 b 0.00 - 2.44; 0.60	6	?	Baetis rhodani 120.3.
	6	a 0 - 28; 7.2 b 0.00 - 0.09; 0.03	2	?	Baetis alpinus 4.4; Baetis rhodani 2.8.
	7	a 12 - 827; 309.8 b 0.05 - 3.30; 1.24	8	o	Baetis rhodani 237.1; Baetis alpinus 42.0; Baetis bioculatus 11.5; Baetis vernus 10.0.
Krupá Creek	1	a 109 - 975; 554.5 b 0.48 - 7.00; 4.20	11	x	Baetis alpinus 231.5; Rhithrogena semicolorata 156.7; Epeorus assimilis 67.8; Baetis vernus 29.7; Rhithrogena cf. hercynia 25.3; Baetis rhodani 20.3.
	2	a 269 - 1408; 740.6 b 1.68 - 9.60; 4.32	11	x	Baetis alpinus 356.7; Baetis rhodani 181.0; Rhithrogena semicolorata 93.7; Rhithrogena cf. hercynia 49.0; Epeorus assimilis 45.5.
	3	a 0 - 3198; 761.0 b 0.00 - 10.94; 3.53	8	x	Baetis alpinus 413.7; Baetis rhodani 237.3; Rhithrogena semicolorata 90.5; Epeorus assimilis 15.7.
	4	a 229 - 941; 443.6 b 1.33 - 6.97; 3.02	10	x	Baetis rhodani 160.3; Rhithrogena semicolorata 157.4; Baetis alpinus 67.6; Rhithrogena cf. hercynia 20.0; Epeorus assimilis 15.7.
	5	a 313 - 1826; 1149.5 b 1.89 - 7.05; 4.68	10	x	Baetis alpinus 827.0; Baetis rhodani 194.5; Rhithrogena semicolorata 72.6; Epeorus assimilis 22.9.

a) Specific composition, number, and biomass

The trout streams with stony bottom described here and in the other quoted works were found to contain 8 to 25 taxons (mostly species) of mayflies. Most frequently there were, however, about 15 taxons. The number of taxons

Tabela IV. Sezonowa charakterystyka stosunków ilościowych i jakościowych jętek w trzech badanych potokach
a - ilość na 1 m^2; b - biomasa w g/m^2; c - ilość gatunków
Dane dla potoku Desná obliczono tylko ze stanowisk 1, 2, 3 i 7

Table IV. Seasonal characteristic of quantitative and qualitative relations of the mayflies in the three investigated streams
a - number in 1 m^2; b - biomass in g/m^2; c - number of species
Data from Desná Creek were calculated only from stations 1, 2, 3, and 7

Potok Stream	Data Date	Ilość i biomasa (Zakres i średnie wartości) Number and biomass (Range and mean values)	c	Gatunki dominujące i ich ilość na 1 m^2 Predominant species and their number in 1 m^2
Brannó Creek	1969			
	2.IV.	a 35 - 165; 100.0 b 0.46 - 1.90; 1.18	7	Rhithrogena semicolorata 36.0; Epeorus assimilis 26.0; Rhithrogena cf. hercynia 13.0; Baetis alpinus 10.5.
	10.VI.	a 125 - 384; 254.5 b 0.93 - 2.59; 1.76	7	Baetis alpinus 119.0; Rhithrogena semicolorata 68.5; Baetis rhodani 30.5; Epeorus assimilis 20.5; Ecdyonurus venosus 10.0.
	14.VIII.	a 303 - 1003; 653.0 b 3.40 - 4.70; 4.05	8	Baetis rhodani 355.0; Baetis alpinus 186.5; Epeorus assimilis 94.5; Rhithrogena semicolorata 6.5.
	29.X.	a 208 - 218; 213.0 b 2.02 - 2.56; 2.29	9	Epeorus assimilis 74.5; Baetis rhodani 47.0; Baetis alpinus 47.0; Rhithrogena cf. hercynia 15.0.
	29.XII.	a 310 - 685; 497.5 b 2.60 - 4.35; 3.48	9	Baetis alpinus 274.0; Epeorus assimilis 67.0; Baetis rhodani 56.0; Rhithrogena cf. hercynia 50.0; Rhithrogena semicolorata 19.5.
	1970			
	27.II.	a 181 - 209; 195.0 b 1.51 - 1.86; 1.69	8	Baetis alpinus 76.0; Epeorus assimilis 34.0; Baetis rhodani 24.0; Rhithrogena cf. hercynia 24.0; Rhithrogena semicolorata 16.5.
	28.V.	a 11 - 142; 76.5 b 0.20 - 1.31; 0.76	7	Epeorus assimilis 22.5; Baetis alpinus 22.0; Baetis rhodani 14.5; Rhithrogena semicolorata 10.0.
Desná Creek	1969			
	4-6.III.	a 20 - 142; 81.0 b 0.36 - 1.33; 0.85	6	Epeorus assimilis 31.3; Baetis alpinus 29.0.
	13-15.V.	a 61 - 467; 233.3 b 0.25 - 1.42; 0.81	5	Baetis alpinus 184.7; Baetis rhodani 37.0.
	15,16.VI.	a 114 - 762; 365.3 b 0.51 - 2.75; 1.41	11	Baetis rhodani 182.6; Baetis bioculatus 76.0; Baetis alpinus 32.3; Baetis vernus 29.3; Ephemerella ignita 24.0.
	9,10.IX.	a 318 - 1018; 666.2 b 1.22 - 4.15; 2.72	10	Baetis rhodani 353.4; Baetis alpinus 212.5; Baetis bioculatus 35.3; Baetis vernus 30.5; Epeorus assimilis 18.5.
	14,18.XI.	a 12 - 273; 165.8 b 0.05 - 4.00; 1.97	9	Epeorus assimilis 65.8; Baetis rhodani 53.6; Rhithrogena cf. hercynia 20.8.
	1970			
	24,26.II.	a 26 - 1202; 614.0 b 0.24 - 6.59; 3.42	6	Baetis alpinus 472.0; Epeorus assimilis 71.0; Baetis rhodani 31.0; Rhithrogena cf. heroynia 27.5.
Krupá Creek	1969			
	22,24.IV.	a 109 - 695; 390.6 b 0.57 - 3.60; 1.92	7	Baetis alpinus 271.5; Rhithrogena semicolorata 75.3; Baetis rhodani 25.2.
	11.VI.	a 312 - 1644; 889.0 b 2.60 - 7.35; 4.95	11	Baetis alpinus 497.6; Rhithrogena semicolorata 240.4; Baetis rhodani 60.4; Bastis vernus 35.6; Epeorus assimilis 28.2.
	2.IX.	a 139 - 3198; 1261.8 b 0.48 - 10.94; 4.42	11	Baetis alpinus 820.2; Baetis rhodani 416.8; Baetis vernus 4.8.
	23,25.X.	a 195 - 728; 398.8 b 1.60 - 5.80; 3.46	10	Baetis rhodani 124.2; Baetis alpinus 106.6; Epeorus assimilis 85.0; Rhithrogena cf. hercynia 39.6; Rhithrogena semicolorata 31.8.
	1970			
	7.I.	a 20 - 1423; 633.0 b 0.20 - 5.71; 3.26	9	Baetis alpinus 417.0; Baetis rhodani 82.7; Rhithrogena semicolorata 62.2; Epeorus assimilis 40.5; Rhithrogena cf. hercynia 17.0.
	10.III.	a 0 - 1408; 844.0 b 0.00 - 9.60; 5.74	9	Rhithrogena semicolorata 252.6; Baetis alpinus 232.2; Baetis rhodani 227.9; Rhithrogena cf. hercynia 66.5; Epeorus assimilis 34.2.

Tabela V. Stosunki ilościowe i jakościowe jętek w pstrągowych potokach morawskich o dnie kamienistym

Table V. Quantitative and qualitative relations of the mayfly larvae in Moravian trout streams with stony bottom

Potok - Autor Stream - Author	Ilość na $1 m^2$ Number in	Biomasa w g/m^2 Biomass in	Liczba gatunków Number of species	Gatunki dominujące Predominant species
Rzeka - River Moravice Zelinka 1953	-	-	23	Ecdyonurus gr. venosus; Baetis rhodani; Baetis sp.; Baetis alpinus; Ephemerella ignita.
Rzeka - River Moravice Losos, Marvan 1957	-	-	23	Baetis rhodani; Ecdyonurus gr. venosus; Rhithrogena semicolorata; Epeorus assimilis; Ephemerella ignita.
Rzeka - River Svratka powyżej zapory Vír above Vír dam Peňáz 1966	703	1.265	11	Rhithrogena semicolorata; Baetis rhodani; Ecdyonurus gr. venosus; Habroleptoides modesta; Ephemerella ignita.
Rzeka - River Svratka poniżej zapory Vír below Vír dam Peňáz 1966	1323	2.209	15	Baetis rhodani; Ephemerella ignita; Ecdyonurus gr. venosus; Habroleptoides modesta.
Rzeka - River Morava górny odcinek upper sector Kubíčková 1968	-	-	17	Baetis alpinus; Baetis rhodani; Baetis bioculatus/ /scambus.
Potok - Creek Loučka Sedlák 1969	691	2.970	25	Baetis; Ecdyonuridae; Leptophlebiidae.
Strumyk- Brook Lušová Zelinka 1969 (na prądzie - in current)	670	3.438	15	Baetis rhodani; Rhithrogena semicolorata; Ecdyonurus gr. venosus.
Strumyk - Brook Brodská Zelinka 1969 (na prądzie - in current)	547	2.278	15	Baetis rhodani; Rhithrogena semicolorata; Ecdyonurus gr. venosus.
Potok - Creek Bobrava Sukop 1970 (dno kamieniste) (stony bottom)	587	2.06	8	Ecdyonurus gr. venosus; Heptagenia flava; Baetis; Ephemerella ignita.
Potok - Creek Křtiny Sukop 1973	612	3.35	18	Baetis alpinus; Baetis rhodani; Rhithrogena semicolorata.
Potok - Creek Bělá powyżej - above Jeseník Tuša 1973	1088.5	5.72	12	Baetis rhodani; Baetis alpinus; Ephemerella krieghoffi; Epeorus assimilis; Rhithrogena semicolorata; Rhithrogena aurantiaca.
Potok - Creek Bělá poniżej - below Jeseník Tuša 1973	232.0	1.03	9	Baetis rhodani.
Potok - Creek Branná	284.6	2.17	14	Baetis alpinus; Baetis rhodani; Epeorus assimilis; Rhithrogena semicolorata; Rhithrogena cf. hercynia.
Potok - Creek Desná powyżej Šumperk above	365.3	1.90	15	Baetis alpinus; Baetis rhodani; Epeorus assimilis; Baetis bioculatus; Baetis vernus.
Potok - Creek Desná poniżej Šumperk below	106.8	0.44	9	Baetis rhodani; Baetis alpinus; Ephemerella ignita.
Potok - Creek Merta	309.8	1.24	8	Baetis rhodani; Baetis alpinus.
Potok - Creek Krupá	624.9	3.77	14	Baetis alpinus; Baetis rhodani; Ehithrogena semicolorata; Epeorus assimilis; Rhithrogena cf. hercynia.
Potok - Stream Kunčický potok	1149.5	4.68	10	Baetis alpinus; Baetis rhodani; Rhithrogena semicolorata.

wg autora - according to author

in individual habitats is usually lower than the total number of taxons in the whole stream, this being due to the presence of unique species in some habitats. The total number of mayflies, considering some previous papers and reports from abroad (Zelinka 1969), varies greatly for individual streams (14 to 1 700 specimens per sq. m.). Comparing, however, only the values obtained from Moravian streams in the last years, we get a rather narrower range of numerical values (284·6 *—1 323·0 specimens per sq. m.), most frequently about 500 to 700 specimens per sq. m. (Table V). Extremely high numerical values of mayflies of over 1 000 specimens per sq. m. were found by Peňáz (1966) in the Svratka below the Vír Dam and by Tuša (1973) in Bělá Creek above the town of Jeseník, as well as in the Krupá 5 habitat (i. e. Kunčický stream) described here. The biomass of mayflies from all the compared streams ranges from 0·005 to 5·72 g per sq. m., while for Moravian streams only in the last years the values are 1·24 to 5·72 g per sq. m., for streams examined by other authors the range being narrower (owing particularly to lower maximum values) than those found by the present author. It must be mentioned, however, that the biomass for the streams examined by us was obtained from the weights of individual species reported elsewhere (Zelinka 1969), while the other authors weighed it themselves.

The proportion of number to biomass in individual habitats depends on species structure, on the proportion of large and small species. For this reason the Krupá Creek 5 habitats (Kunčický stream) have the highest number and relatively low biomass. The predominant species here was *Baetis alpinus*.

The proportion of individual species of mayflies in the total number and biomass varies. What Kubíček et al. (1971) reports on zoobenthos is true about a part of it, i.e. mayflies: the total number and biomass is for the most part formed by only some species, while all the others are productively insignificant. For the zoobenthos, Kubíček et al. (1971) indicate one tenth of taxons as significant. In mayflies, one fourth to one fifth of all the taxons present (most of them species) can be regarded as productive.

In the streams studied by the present author (Branná, Desná, Krupá Creeks) and Bělá Creek (Tuša 1973), the most common species were *Baetis alpinus*, *B. rhodani*, *Rhithrogena semicolorata*, and *Epeorus assimilis*. The other species were important only for some habitats or for a certain period of the year, this being due to the nature of development cycles in individual species (Landa 1968, 1969). They were the following: *Rhithrogena* cf. *hercynia*, *Rh. aurantiaca*, *Baetis bioculatus*, *Ephemerella ignita*, and *E. krieghoffi*. Besides, the species *Rhithrogena aurantiaca* and *Rh.* cf. *hercynia* are interesting faunistically, the nymphs of *Rh.* cf. *hercynia* also taxonomically (Tuša 1973). In addition to the mentioned species the trout streams with stony bottom contain other locally productive significant species, such as *Ecdyonurus* gr.

* Without the values from the more polluted habitats below Jeseník (Tuša 1973) and below Šumperk.

venosus and representatives of the family *Leptophlebiidae* (Zelinka 1953, 1969, Sedlák 1969). In our streams the mentioned taxons could be found only exceptionally, most probably because all the examined habitats belong to the upper part of the trout area and because the samples were taken only in the current.

b) Influence of organic pollution

The results of our work and observations made in sampling indicate the need to study the influence of organic substances, particularly not original ones, contained in the water, upon quantitative data concerning mayflies and the zoobenthos. Slight organic pollution (from the houses along the streams) within xenosaprobity probably increases the number of mayflies. This is evident from the fact that the highest numerical and biomass values were in just such places (Bělá Creek above Jeseník, see Tuša 1973, the whole of Krupá Creek including Kunčický stream). Too much non-original organic pollution obviously reduces the number of mayflies (Bělá Creek below Jeseník, see Tuša 1973, Desná Creek below Šumperk). The discovered regeneration of these more intensively polluted parts is probably due to their strong turbulence. Otherwise, the mayfly larvae would have suffered very badly. It is also highly probable that some mayflies found do not originate in these habitats. They may have been washed down from the upper unpolluted parts of the streams and survive here for some time.

An increase in the number of mayflies owing to slight organic pollution was also reported by Zelinka (1973) from Bílý stream below the town of Velká Bíteš. He studied the quantitative and qualitative conditions of mayflies below the source of organic pollution. Thanks to the self-purifying capacities of the stream, conditions corredsponding to beta-mezosaprobity were formed below the totally polluted part and lower even to oligosaprobity. In this secondary oligosaprobity, the number of mayfly larvae is three times greater than in the primary oligosaprobity of the Beskid streams (Zelinka 1969), even if the former has more dissolved substance and five times more mineral nitrogen and phosphorus, than primary oligosaprobity. The species composition is on the whole the same as in trout streams from the Beskids.

c) Degrees of pollution of the individual habitats

Considering the species composition of mayfly larvae, all the studied habitats are xenosaprobic (Branná 1, 2, Desná Creek 1, 2, Krupá Creek 1 to 5), the habitats Desná Creek 3, 4 and 7 being oligosaprobic. The saprobity of the habitats Desná Creek 5 and 6 cannot be determined, because the number of species and individuals is very small. Kubíčková (1968) estimated the purity of water in Desná Creek before it empties into the Morava as beta-

mezosaprobity. The survey of saprobity of individual habitats is presented in Table III. Comparing Kubíčková's data (1968), based on samplings from 1961 to 1963, and the conditions found by the author in 1969/1970 in Krupá Creek it is clear that there was a great decrease in the pollution of the stream with graphite sediment. The deposits reported by Kubíčková were gone. Only the water below the mouth of Vrbenský stream a source of this pollution, is sligthly disturbed. The results reported in the present paper show that this pollution has no negative effects on the nymphs of mayflies.

d) Seasonal changes

A study of the seasonal changes in the quantitative conditions of mayflies (Table IV) in the examined streams shows that the number and biomass of mayflies varies throughout the year, this being due to the development cycles, particularly of the more common species (Landa 1968, 1969, Sukop 1973). However, the proportion of mayflies in the zoobenthos of a trout stream with stony bottom is significant practically all the year round. It does not normally fall below 100 specimens per sq.m., in some stream the minimum values discovered being even higher — 300 to 400 specimens per sq.m., (Zelinka 1969, Tuša 1973).

Seasonal changes in the number of mayflies are usually characterized by a curve of two peaks, because in the mentioned kind of stream the commonest types belong to the species *Baetis alpinus* and *B. rhodani*, with two generations per year (Landa 1968, 1969, Sukop 1973). Maximum numerical values of mayflies in the streams studied by the author were found in early spring — spring and late summer — autumn, this corresponding to development cycles of both the mentioned species of *Baetis*, seasonal changes, and differences in the stream studied by other authors (Zelinka 1969, Sukop 1973) who also reported on the predominance of mayfly larvae of the two mentioned types or at least one of them.

To some extent, seasonal changes in the total number of mayflies are also influenced by species appearing in greater quantities only during part of the year. In our streams these were *Rhithrogena* cf. *hercynia* and *Ephemerella krieghoffi* (only in Bělá Creek, Tuša 1973), remarkably productive in the period autumn — spring, and *Baetis bioculatus*, *Rhithrogena aurantiaca* and *Ephemerella ignita*, productive only in the warmer parts of the year. These species appeared only in some of the habitats (Table IV) (Tuša 1973).

The reports on seasonal changes in the number of mayflies in regard to the development cycles of individual species must take into account the papers by Illies (1959, 1961), on retarded hatching and development of certain species of benthic animals, e.g. of the species *Baetis*. How far this property is reflected in seasonal changes of quantitative proportions remains to be proved in further experiments.

Table IV also shows that the changes in species composition of mayflies all the year round are mainly determined by changes in the proportional occurrence of the four commonest species (*Baetis alpinus*, *B. rhodani*, *Rhithrogena semicolorata*, and *Epeorus assimilis*), joined later by other, seasonal species, as mentioned above.

STRESZCZENIE

W okresie od marca 1969 do maja 1970 badano stosunki jakościowe i ilościowe larw jętek w trzech pstrągowych potokach: Branná, Desná i Krupá o dnie kamienistym na terenie północnozachodnich Moraw. Wyniki porównano z wartościami stwierdzonymi na innych morawskich ciekach podobnego typu.

Materiał do niniejszej pracy zbierano powszechnie przyjętym sposobem polegającym na opłukiwaniu obróconych w prądzie wody kamieni przed ustawionym sitem. Kamienie ułożone były po każdym poborze na brzegu i sumarycznie mierzone.

Charakterystykę poszczególnych stanowisk poboru przedstawiono w tabeli I, uzyskane zaś wyniki w tabelach II, III i IV. W tabeli V zestawiono dla porównania własne wyniki z wartościami uzyskanymi w innych morawskich ciekach.

W badanych i cytowanych morawskich potokach o dnie kamienistym stwierdzano 8—25 taksonów (w większości gatunków) jętek, najczęściej jednak około 15. Ilość mieściła się w zakresie 284,6—1 323,0 okazów/m^2, biomasa od 1,24 do 5,72 g/m^2. Liczebność dochodziła najczęściej do wartości 500—700 okazów/m^2, a biomasa około 2—3 g/m^2.

Wśród wszystkich znalezionych gatunków tylko około 1/5—1/4 było ważnych dla produkcji. W zoobentosie według Kubička i współaut. (1971) — tylko 1/10. Do najliczniejszych gatunków w ciekach badanych przez autora należały larwy jętek: *Baetis alpinus*, *B. rhodani*, *Rhithrogena semicolorata*, a na dalszym miejscu *Epeorus assimilis*. W potokach badanych przez innych autorów wśród przeważających liczebnie gatunków spotykano jeszcze jętki *Ecdyonurus* i przedstawicieli rodziny *Leptophlebiidae*.

Wydaje się, że niewielkie zanieczyszczenie organiczne (w zakresie kseno-oligosaprobowości) zwiększa liczebność larw jętek.

Na podstawie składu gatunkowego jętek większość stanowisk można uznać za ksenosaprobowe, niektóre (Desná 3, 4, 7) za oligosaprobowe.

Larwy jętek praktycznie przez cały rok stanowią ważny składnik zoobentosu, a ich ilość przeważnie nie spada poniżej 100 okazów/m^2, nawet w niektórych ciekach stwierdza się jeszcze wyższe minimalne wartości.

Zmiany sezonowe wykazują najczęściej dwa maksima w ciągu roku, wywołane przede wszystkim cyklami rozwojowymi najliczniejszych gatunków *Baetis rhodani* i *B. alpinus*. Maksima pojawiania się larw jętek przypadają na okres przedwiośnia-wiosny i na okres późnego lata-jesieni.

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