

IVAN TUŠA

**Larwy jętek w prądowych siedliskach potoku Bělá
(północno-zachodnia część Moraw, Czechosłowacja)****Mayfly larvae in current habitats of Bělá Creek
(the Northwestern part of Moravia, Czechoslovakia)**

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Abstract — Vertical and seasonal distribution of the specific composition, number and biomass of mayfly larvae in Bělá Creek was studied in the period between May, 1969 and March, 1970. The specific composition gives the degree of pollution in individual habitats.

From the results it follows that the greater pollution under Jeseník has a negative influence upon the specific composition and individual abundance of mayfly larvae. The slight pollution (within xeno-oligosaprobity) from individual houses scattered along the banks increases the number of larvae. Seasonal distribution of these larvae produced above all by the fluctuating occurrence of the most frequent species (*Baetis alpinus* and *B. rhodani*) shows two peaks: in December — March and in July.

In the Northwestern part of Moravia (the Hrubý Jeseník Mts, the Králický Sněžník Mts, the Rychlebské Hory Mts and their vicinity) the zoobenthos was investigated in the rivers Morava and Moravice. The zoobenthos of the River Morava was studied by Pohlídal (1951) and that of the River Moravice by a number of authors from the Brno Institute of Agriculture (Losos, Marvan 1957). The mayfly larvae from the streams of this territory were investigated by Zelinka (1953) in the Moravice, Zelinka and Skalníková (1959) in the drainage area of the Morava, and Kubičková (1968) in the upper Morava. The mayfly larvae from the tributaries of the upper Morava were investigated by the author (Tuša 1972).

This study presents the results of investigation of the number, biomass

and species composition of the mayfly larvae in Bělá Creek. It concerns the vertical and seasonal distribution and gives the degrees of pollution of the individual habitats.

The data are based on collections made approximately every two months between May, 1969 and March, 1970.

Area, material and methods

Bělá Creek springs below the Videlské Saddle in the Hrubý Jeseník Mts, 900 m above sea level. Its length is 56 km; up to the frontier between Czechoslovakia and Poland, 32 km (fig. 1) The yearly mean discharge at the frontier is 3.5 cu. m/sec. Bělá Creek empties into the Nysa Kłodzka on Polish territory. It is normally fished by anglers. Four sampling sites were chosen from this stream (fig. 2). In all of them



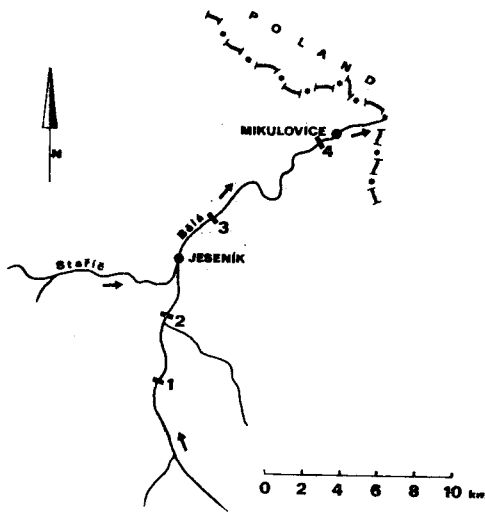
Ryc. 1. Rejon Šumperk z czterema przebadanymi potokami: Bělá, Brannaá, Děsná i Krupá (Tuša 1972)

Fig. 1. District of Šumperk with four investigated streams: Bělá, Branná, Děsná, and Krupá (Tuša 1972)

it is necessary to assume at least slight organic pollution. A survey of the localities and their characteristics are presented in Table I.

Five excursions to Bělá Creek were made, viz. in May, July, September, and December, 1969 and in March, 1970. In all of them twenty samples were taken containing 2 490 mayfly larvae.

The sampling was performed in the usual way (Albrecht 1959, and others) from the current zone. At the same time the depth, width, and velocity of the stream and the water temperature were measured. The data are presented in Table I.



Ryc. 2. Lokalizacja stanowisk poboru prób w potoku Bělá
 Fig. 2. Localization of sampling stations in Bělá Creek

Tabela I. Charakterystyka stanowisk w potoku Bělá. + - Wartości mierzone tylko w czasie pobierania prób

Table I. Characteristics of the stations on Bělá Creek. + - The values were measured only when sampling

Dane Data	Stanowisko Station	Potok Bělá - Bělá Creek			
		1	2	3	4
Wysokość n.p.m. Altitude m		510	470	390	340
Położenie geograficzne Geographical situation		w in Domášov	w in Adolfovice	w in Česká Ves	powyżej - above Mikulovice
Odległość od ujścia Distance from the mouth km		46	43	36	27
Szerokość + Width m		8.6	12.0	12.0	15.0
Głębokość + Depth m		0.10 - 0.30	0.15 - 0.30	0.10 - 0.30	0.20 - 0.30
Szybkość prądu + Velocity of the current m/sek		1.1	1.0	0.8	0.9
Temperatura + Temperature °C		0.5 - 16.5	0.5 - 17.0	1.5 - 16.5	0.5 - 16.0
Substrat Substratum		kamienie stones	kamienie stones	kamienie (z organiczną allochtoniczną materią) stones (with the organic allochthonous matter)	kamienie stones

The data on the number of the mayfly larvae are expressed as the number of individuals per square metre. The biomass is expressed as the weight in the grams per sq. m., and was calculated from the weights of individual species given by Zelinka (1969). The degrees of pollution were calculated according to Zelinka and Marvan (Cyrus, Sládeček 1966, 1969).

Results

Species compositions

Vertical distribution (Table II).

A total of 14 taxa was found in all sampling sites. In the more polluted habitat below Jeseník (Bělá Creek 3) the number of taxa was half those found in other habitats (9 to 11). All sites included the following species: *Baetis rhodani*, *B. alpinus*, *Rhithrogena semicolorata*, *Epeorus assimilis*, and *Ephemerella ignita*. Most numerous in all the sites was *Baetis rhodani* (133.0—691.4 n/sq. m), in the habitats Bělá Creek 1 and Bělá Creek 2 accompanied by *B. alpinus* (187.4—251.4 n/sq. m.).

Tabela II. Skład gatunkowy larw jętek na poszczególnych stanowiskach potoku Bělá. Średnie wartości ze wszystkich prób

Table II. Species composition of the mayfly larvae at the individual stations on Bělá Creek. Average values from all samplings

Stanowisko Station	Potok Bělá - Bělá Creek			
	1	2	3	4
Gatunek Species	ilość/m ² - number/sq.m.			
<i>Baetis rhodani</i> (Pictet)	323.8	691.4	133.0	199.4
<i>Baetis vernus</i> (Curtis)				50.8
<i>Baetis alpinus</i> (Pictet)	187.4	251.4	14.0	2.2
<i>Baetis bioculatus</i> (Linné) *		6.8		
<i>Baetis pumilus</i> (Burmeister)	8.0	6.4		
<i>Baetis</i> sp.	28.2	56.2		
<i>Rhithrogena semicolorata</i> (Curtis) **	66.6	49.6	14.6	9.6
<i>Rhithrogena aurantiaoa</i> (Burmeister)	35.4	40.0		1.2
<i>Rhithrogena</i> cf. <i>hercynia</i> Landa	28.6	7.8		
<i>Epeorus assimilis</i> Eaton	85.8	35.6	2.0	0.4
<i>Ecdyonurus venosus</i> (Fabricius)	5.0	9.2		
<i>Ephemerella ignita</i> (Poda)	14.6	61.6	6.0	27.8
<i>Ephemerella krieghoffi</i> (Ulmer)	93.6	84.0		
<i>Paraleptophlebia</i> sp.				1.6
Ogółem - Total	877.0	1300.0	169.6	294.4

* syn. *Baetis fuscatus* (L.) lub-or *Baetis scambus* Etn. (Müller - Liebenau 1969)

** syn. *Rhithrogena ferruginea* Nav. (Sowa 1971)

Comparison of the specific structure of the mayfly larvae in the individual habitats shows considerable difference between the habitats above and below Jeseník, between Bělá Creek 1 and 2, and Bělá Creek 3 and 4. This difference is due to strong pollution below Jeseník.

Degrees of pollution.

According to the specific structure of the mayfly larvae Bělá Creek 1 is xenosaprobic, Bělá Creek 2 xeno-oligosaprobic, Bělá Creek 3 and 4 oligosaprobic. As the degrees of pollution reflect only the occurrence of the mayfly larvae, these values are only approximate.

Seasonal distribution (Table III).

Six out of the total 14 taxa were found in May, nine to ten in the other samples during the year. Most numerous in practically all the samples were *Baetis alpinus* and *B. rhodani*, which was reflected in the total numbers of the mayfly larvae in the habitats. Other species occurring all the year round are *Rhithrogena semicolorata*, *Epeorus assimilis*, and perhaps *Baetis pumilus* and *Ecdyonurus venosus*, missing in one sample. The following species were found only in part of the year: *Baetis vernus*, *B. bioculatus*, *Rhithrogena aurantiaca*, *Rh. cf. hercynia*, *Ephemerella ignita*, and *E. krieghoffi*. *Baetis vernus*, *B. bioculatus*, *Rhithrogena aurantiaca*, and *Ephemerella ignita* occurred in the warmer part of the year (May to September), *Rhithrogena cf. hercynia* and *Ephemerella krieghoffi* were found from September to March.

Tabela III. Skład gatunkowy larw jętek w potoku Bělá w okresie od maja 1969 do marca 1970. Średnie wartości ze wszystkich stanowisk

Table III. Species composition of the mayfly larvae in Bělá Creek, during the period between May, 1969, and March, 1970. Average values from all stations

Gatunek Species	Data Date	22.V.	23.VII.	27.IX.	3.XII.	4.III.
		1969	1969	1969	1969	1970
		ilość/m ² - number/sq.m.				
<i>Baetis rhodani</i> (Pictet)		67.8	738.5	169.6	481.0	227.7
<i>Baetis vernus</i> (Curtis)			16.5	47.0		
<i>Baetis alpinus</i> (Pictet)		195.9	215.5	28.0	100.2	30.0
<i>Baetis bioculatus</i> (Linné)			4.3			
<i>Baetis pumilus</i> (Burmeister)		2.3		1.5	10.8	3.5
<i>Baetis</i> sp.			10.0	9.3	37.8	50.0
<i>Rhithrogena semicolorata</i> (Curtis)		82.5	9.8	3.5	31.3	48.5
<i>Rhithrogena aurantiaca</i> (Burmeister)			95.8			
<i>Rhithrogena cf. hercynia</i> Landa				10.0	12.3	23.3
<i>Epeorus assimilis</i> Eaton		22.8	15.8	49.8	38.8	27.8
<i>Ecdyonurus venosus</i> (Fabricius)			1.3	2.8	10.3	3.5
<i>Ephemerella ignita</i> (Poda)			137.2			
<i>Ephemerella krieghoffi</i> (Ulmer)		7.5			101.5	116.0
<i>Paraleptophlebia</i> sp.				2.0		
Ogółem - Total		378.8	1244.7	323.5	824.0	530.3

Discussion

Fourteen taxa of the mayfly larvae in Bělá Creek correspond to the numbers obtained from other streams of analogous type: Zelinka (1953) found 23 in the Moravice, Kubíčková (1968) 17 in the upper Morava, and Zelinka (1969) 15 in two streams in the Beskid Mts. The greater number of taxa found by Zelinka (1953) in the Moravice is perhaps due to fact that it forms a typical edyonural zone, which has more species of mayfly larvae than the rhithrogenal zone of Bělá Creek. In the highest habitat on the Moravice (above the village Karlov) a considerable number of the larvae *Ecdyonurus* were found also. In Bělá Creek these larvae occurred only rarely (5.0—9.2 n/sq. m.). The occurrence of individual species is mostly analogous to the situation found in the streams studied by others. The most numerous are *Baetis rhodani*, *B. alpinus*, *Rhithrogena semicolorata*, and *Epeorus assimilis*. In the habitats of Bělá Creek 1 and 2 more larvae of *Ephemerella krieghoffi* were found than in the other streams. The number of taxa and the occurrence of the individual species correspond to the other streams studied by the author (Branná Creek, Desná Creek, Krupá Creek; Tuša 1972).

Interesting from the faunistic point of view is the occurrence of the mayfly larvae *Rhithrogena aurantiaca*. This species is reported by Zelinka and Skalníková (1959) from the Bečva near Rožnov. It is also well known from several habitats in Bohemia and Slovakia (Landa 1969).

Only a few (one tenth) of the taxa of the zoobenthos found are of practical significance for production biology (Kubíček et al. 1971). The investigation of Bělá Creek and three other streams (Tuša 1972) confirms that this holds true also for individual groups of the zoobenthos.

Taxonomical attention must be paid to the larvae *Rhithrogena hybrida* and *Rh. hercynia*. The larvae referred to in this study under the term *Rh. cf. hercynia* share features of the two species: the 8th and 9th tergites of their abdomens are mostly lighter than the preceding tergites, with dark longitudinal spots in the middle. The 10th tergite of the abdomen is darker and on the thighs in the light part there is a darker spot.

Seasonal distribution corresponds to reports by Landa (1969) and Kubíčková (1968).

Number and biomass

Vertical distribution (Table IV).

The mean values of the number and biomass were much higher in

the habitats of Bělá Creek 1 and 2 (877.0—1 300.0 n/sq. m.; 5.38—6.05 g/sq. m.) than of Bělá Creek 3 and 4 below Jeseník (169.6—294.4 n/sq. m.; 0.78—1.17 g/sq. m.). This difference is due to the greater organic pollution below Jeseník.

Seasonal distribution (Table IV).

From the values of the number of mayfly larvae in individual samples during the year it is possible to judge that the mayfly larvae in Bělá Creek have two peaks of occurrence: in March and in July. These changes are mainly given by the fluctuating occurrence of the larvae *Baetis alpinus* and *B. rhodani*. These species are in most samples the most numerous.

Tabela IV. Ilość/m² i biomasa (g/m²) larw jętek w potoku Bělá

Table IV. Number/sq.m. and biomass (g/sq.m.) of the mayfly larvae in Bělá Creek

Stanowisko Station Data Date	Potok Bělá - Bělá Creek									
	1		2		3		4		Średnia Average	
	ilość number	biomasa biomass	ilość number	biomasa biomass	ilość number	biomasa biomass	ilość number	biomasa biomass	ilość number	biomasa biomass
22.V. 1969	451	2.91	745	3.64	250	1.53	69	0.58	378.8	2.17
23.VII. 1969	1102	6.00	2439	10.44	477	1.90	961	3.70	1244.7	5.51
27.IX. 1969	331	3.13	443	3.41	116	0.46	404	1.42	323.5	2.11
3.XII. 1969	1482	8.30	1790	7.68	0	0.00	24	0.10	824.0	4.02
4.III. 1970	1019	6.57	1083	5.10	5	0.02	14	0.07	530.3	2.94
Średnia Average	877.0	5.38	1300.0	6.05	169.6	0.78	294.4	1.29		

Tabela V. Porównanie ilości i biomasy larw jętek w potoku Bělá z wartościami innych potoków przebadanych przez autora (Tuša 1972 a,b,c). Średnie wartości z poszczególnych stanowisk

Table V. Comparison of the number and biomass of the mayfly larvae in Bělá Creek with the values of other streams investigated by the author (Tuša 1972 a, b,c). Average values from the individual stations

Potok - Stream	Ilość/m ² Number/sq.m.	Biomasa g/m ² Biomass g/sq.m.
Bělá Creek	169.6 - 1300.0	0.78 - 6.05
Branná Creek	221.9 - 347.3	1.84 - 2.50
Děsná Creek	199.0 - 468.3	1.02 - 2.81
Krupá Creek	443.6 - 1151.3	3.02 - 4.69

Discussion

The values of the number of the mayfly larvae (169.6—1 300.0 n/sq. m.) found in Bělá Creek correspond to those reported by other authors

(14—1 700 n/sq. m.). A survey of these values from several streams was made by Zelinka (1969). However, the values of the biomass of the mayfly larvae from Bělá Creek (calculated from the weights of individual species given by Zelinka 1969) are higher (0.78—6.05 g/sq. m.) than those of other authors (0.01—3.44 g/sq. m.).

The values of the number and biomass of the mayfly larvae obtained from three other streams studied by the author (Tuša 1972 a, b, c) (see Table V) are analogous also. The values from Bělá Creek and Krupá Creek are higher than those from Branná Creek and Desná Creek. From the character of the habitats it is possible to assume that slight organic pollution from individual houses scattered along the bank increases the number of the mayfly larvae. This assumption is based on the observation of such pollution in Bělá Creek and Krupá Creek. Greater pollution, of course, reduces the number and biomass (Bělá Creek 3 and the habitats in Desná Creek below Šumperk, Tuša 1972).

The seasonal distribution of the number and biomass of mayfly larvae in Bělá Creek is also analogous to the other streams studied by the author. In all four streams there are two peaks of occurrence: in spring and in summer-autumn. In the upper Morava Kubíčková (1968) between May and September found the most mayfly larvae in July and the fewest in August. Zelinka (1969) reports the greatest number from Lušová Brook in April, June, and October (1 004—1 090 n/sq. m.), from Brodská Brook in June 638 n/sq. m) and September—October and March 775—1047 n/sq. m.). In other periods of the year the number of the mayfly larvae was: in Lušová Brook 321—807 n/sq. m. and in Brodská Brook 409—542 n/sq. m.

From this study and from the results of other authors it follows that practically all the year round the mayfly larvae form an important component of the zoobenthos of trout streams. The values of the number of these larvae from the periods of their minimum occurrence are not negligible (300—400 n/sq. m.). This kind of balance is perhaps due to the fact that the larvae of some species do not come out at once but that one hatch is delayed up to 300 days (Illies 1959) hence the mayfly larvae community is supplied with new individuals all the year round.

STRESZCZENIE

W okresie od maja 1969 do marca 1970 przebadano w potoku Bělá pionowe i sezonowe rozmieszczenie larw jętek, strukturę gatunkową, liczebność i biomasę (tabela I, ryc. 1 i 2). Ze składu gatunkowego wyliczono stopień zanieczyszczenia poszczególnych stanowisk.

Na wszystkich czterech stanowiskach stwierdzono 14 taksonów larw jętek (tabela II). Na najsilniej zanieczyszczonym stanowisku Bělá 3 znaleziono zaledwie połowę taksonów aniżeli na pozostałych stanowiskach (9—11). Na wszystkich stano-

wiskach występowały gatunki: *Baetis rhodani*, *B. alpinus*, *Rhithrogena semicolorata*, *Epeorus assimilis* i *Ephemerella ignita*. Na wszystkich stanowiskach najliczniejszymi były larwy *Baetis rhodani* (133,0—691,4 okazów/m²) a na stanowiskach Bělá 1 i 2 jeszcze larwy *B. alpinus* (187,4—251,8 okazów/m²). Z powyższego wynika, że istnieją znaczne różnice pomiędzy stanowiskami Bělá 1, 2 a Bělá 3, 4.

W oparciu o skład gatunkowy larw jętek poszczególne stanowiska można zeseregować do następujących stopni czystości: Bělá 1—ksenosaprobowe, Bělá 2—kseno-oligosaprobowe, Bělá 3 i 4—oligosaprobowe. Ponieważ wyliczono wartości jedynie z części składu gatunkowego, są one orientacyjne.

Z pięciu poborów prób w ciągu roku (tabela III) stwierdzono w maju w potoku Bělá 6 taksonów larw jętek, w pozostałych trzech miesiącach 9—10. We wszystkich próbach, w większości przypadków najliczniej występowały gatunki: *Baetis rhodani* i *B. alpinus*. We wszystkich próbach w ciągu roku występowały ponadto gatunki: *Rhithrogena semicolorata* oraz *Epeorus assimilis*. Gatunki *Ecdyonurus venosus* i *Baetis pumilus* nie występowały w jednej z prób. Gatunki: *Baetis vernus*, *Rhithrogena aurantiaca* i *Ephemerella ignita* znajdowały się w bentosie potoku Bělá w cieplejszej porze roku (maj—wrzesień), a gatunki *Rhithrogena cf. hercynia* i *Ephemerella krieghoffi* spotykano we wrześniu—marcu (maj).

Liczebność i biomasa jętek była znacznie wyższa na stanowiskach Bělá 1 i 2 aniżeli na stanowiskach 3 i 4 (tabela IV).

Z danych ilościowych i biomasy z poszczególnych prób w ciągu roku (tabela IV) można sądzić, że pojawianie się jętek ma w potoku Bělá dwa szczyty: w lipcu i grudniu. Różnice w liczebności pojawiania się w ciągu roku są wynikiem wahanja liczebności najczęstszych gatunków: *Baetis rhodani* i *B. alpinus*.

Podobne badania nad występowaniem larw jętek prowadzili różni autorzy także na dalszych trzech ciekach objętych badaniami autora.

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Adres autora — Author's address

Dr Ivan Tuša

Vlastivědný ústav v Šumperku (District Museum in Šumperk), Sady 1, máje 1, 787—34 Šumperk, ČSSR.