PRODUCTIVITY PROBLEMS OF FRESHWATERS. WARSZAWA — KRAKÓW 1972
Proceedings of the IBP-UNESCO Symposium on Productivity Problems of Freshwaters
Kazimierz Dolny, Poland, May 6—12, 1970
EDITORS: Z. KAJAK, A. HILLBRICHT-ILKOWSKA

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Research on two small trout streams (Czechoslovakia)

The authors give the basic data about the streams and methods of research on production of two trout streams in Moravia with different level of fish population. Benthos, drift and fish were investigated in the course of three years. The study of the primary production, water chemism and fish have been continued up to now. This paper informs about the dynamics and density of larvae of mayflies and midges and of fish. In mayflies, some data on production are presented.

1. INTRODUCTION

In starting the research into quantitative and trophic relations of the community of small running waters we tried to find the most natural type of small streams, in which we might keep different size of fish stock. The aim of the reserach was to find out the production capacity of the streams and, above all, the correlations between benthos and fish.

2. THE STREAMS STUDIED

We chose two trout brooks (Lušová and Brodská), tributaries to the Bečva River in the Beskydy Mountains (Moravia). The region there belongs to the Magura Flysch of the West Carpathians and is characterised by varying layers of sandstone and claystone. Both brooks have approximately the same character in all respects. Both of them flow from the north to the south (Fig. 1). The basic data are stated in Table I. The average yearly discharge in the lower part of Lušová is 145, that of Brodská 176 litres per second. The average yearly rainfall is 1,000 mm. The water discharge is very variable, the maximum being as much as 100 times higher than the minimum. The bottoms of the brooks are stony, the size of stones being 15 to 160 cm^2 (more than 60%). The stones are for the most part of the year covered by periphyton (Diatomae) and in some sections with more light by filamentous algae *Cladophora glomerata* (L.) Kütz.

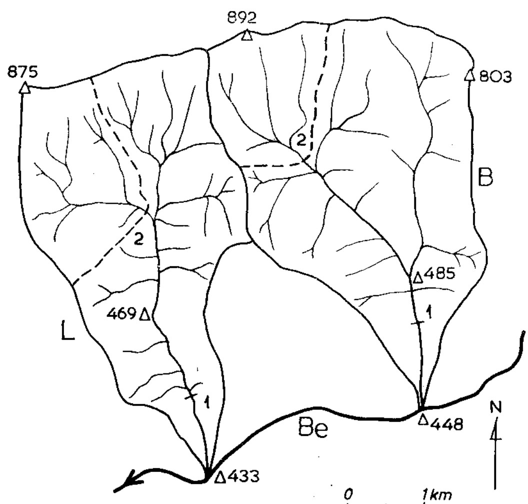

Fig. 1. Situation of the catchment areas of both brooks (according to Zelinka 1969)
L = Lušová, *B* = Brodská, *1-2* = stations, *Be* = Bečva River

In order to decrease the erosive strength of the water during floods the stream bed gradient was lowered by a series of high stony or concrete barriers errected by the Forestry Department few decades ago. In addition, the local angler club improved the stream habitat by constructing low dams, Hewitt ramps or more frequently by simple digger logs. These were often damaged by floods, they ought to be rebuilt every third year on the average. All devices mentioned did not cause an impoundment above the obstacles but in each case a nice plunge pool below was created. These pools provided an excellent shelter for trout. The stream sections between the steps resembled direct open channels with the flow broken by medium to coarse gravel and few pieces of rubble. During low water discharge the average water depth was 10 to 15 cm, the water velocity 20 to 40 $cm \cdot sec^{-1}$.

There is a low human population in both valleys. Steep pastures are replaced by woods in higher altitudes. In lower parts of the streams the banks are covered by planted trees and high brush which give a protective shade to the streams during summer and enrich the water by organic matter through the leaf-fall in the autumn.

Table I

Main data of the brooks under research

	Lušová	Brodská
Elevation a.s.l. St. *1*—St. *2*	460—510 m	480—530 m
Catchment area	9.75 km^2	11.80 km^2
Lenght of main stream	6 km	5.95 km
Mean yearly discharge	145 l sec^{-1}	175 l sec^{-1}
Average width of water surface	St. *2* — 1.5 m St. *1* — 3.0 m	
Mean depth	St. *2* — about 9 cm St. *1* — about 15 cm	
Mean water velocity	St. *2* — 20 cm sec^{-1} St. *1* — 37 cm sec^{-1}	
Mean yearly precipitations	1000 mm	
Mean yearly air temperature	6°C	
Mean yearly water temperature	9°C	

3. METHODS

In both brooks benthos and drift samples were taken. Zoobenthos samples were first collected with a circular net (mesh 0.5 mm) and the bottom surface was measured by the Schräder method (1932). The average bottom surface for one sample was about 1500 cm^2. In later years nets with triangular mouths of 1,000 cm^2 were used. The total area of the sample taken was 2,000 cm^2. The differences in the samples were negligible. The samples were taken both in the current and in the calmer part of the brooks near the banks, where the actual water velocity was lower than 10 to 15 $cm \cdot sec^{-1}$. The samples were sorted on the spot, biomass was weighed after centrifugal drying and fixed by 4% formol (Kubíček 1966).

Phytobenthos was collected only for qualitative analysis by scraping off the periphyton from the stones. Only after 1969 we start to study the periphyton by means of artificial substratum (plastic foil) and to determine the production of algae by the method of white and dark bottles.

Drift was collected by means of a drift pipe into the nets of meshes 0.5 mm (Müller 1966, Kubiček 1969).

From abiotic factors the following were measured: air and water temperatures, water discharge (hydrometric propeller), width and depth and pH (= 7.9 to 8.3). Only in 1969 measurements of the total chemism of both brooks were started. The water is medium hard (7.8 to 11.4 in German degrees) and the contents of the main ions is relatively low (e.g., NO_2 — 0.01—0.045 $mg \cdot l^{-1}$, NO_3 — 2.9—8.45 $mg \cdot l^{-1}$, PO_4 — traces to 0.05 $mg \cdot l^{-1}$). The amount of oxygen varied from 8.93 to 9.10 mg per litre. The main part of the research began in May, 1966, and finished in May, 1969. The research of the primary production, water chemism and fish was continued. In the first year of the investigations biological samples were taken in two places of each brook. In the following years only the lower parts were followed up in detail.

For fishing an electric fish shocker was employed. Only several species of fish were found to be present. Brown trout (*Salmo trutta* morpha *fario* Linné) and Carpathian sculpin (*Cottus poecilopus* Heckel) were abundant. In the lower part of Brodská brook we captured few individuals of European minnow [*Phoxinus phoxinus* (Linné)] and in Lušová brook one specimen of eel [*Anguilla anguilla* (Linné)].

The removal method (Zippin 1958) consisting in three fishing runs was used in order to obtain the quantitative data on the populations. Sub-samples of fish were retained for stomach and fecundity analyses, as well as for determination of caloric value, fat contents, amounts of ashed material and amounts of nitrogen of fish body. All fish released were marked. Fin clipping was used, however, dyeing by liquid latex obtained through the kindness of the River Laboratory in East Stoke, England, proved to be more appropriate for the sculpin. The stains remained visible for the period of two and a half years.

After preliminary fishings made in two different reaches of both streams, the main effort was concentrated on the lower reach of Brodská brook, where a special programme was developed in 1967 and 1968: the density of trout was increased by excessive stocking. The reach in question, 200 m long, was located between two dams, two to three metres high, which prevented the fish to move upstream. Prior to stocking some further alteration of the stream bed was made, viz. errecting wing deflectors and dams by submerged rocks, in order to establish appropriate space to dwell for the additional stock. Most of our habitat improvements, as well as two of the log dams made by anglers, did not last more than one year being damaged by the spring flood in 1968. In 1969 the stocking was stopped and the density of fish was only recorded.

Fish for stocking were taken in the stream section, 507 m long, lying just below the reach under study. Of the trout captured there, all individuals less than 16 cm standard length were transplanted. The fishing was carried out three to four timess a year, in consequence of that the trout stock, being lower than upstream, was considerably eliminated. The removal of trout was almost complete in the distant part of the section. The closer to the reach of stocking, the more fish were present. These were largely fish which after releasing descended downstream. On the other hand, it is known to the authors only one case of a fish which penetrated from the reach of stocking upstream. On the whole, 645 trout and 175 sculpin were transferred and stocked during both years, some of them repeatedly.

In the lower section of Lušová brook all trout present were removed and the sculpin population decimated. In the reach 205 m long, separated from upstream by a high dam, 1,034 and 760 specimens (i.e., 6.8 and 4.3 kg) of sculpin were removed in the course of the year 1967 and 1968 respectively. Though special attention was paid to the sampling, particularly during periods of low discharge, it is difficult to estimate the rate of removal. In any case, the sculpin population in 1968 did not reach the level observed in the previous year.

The upper section of Lušová brook was left without any drastic interferences, unless electrofishings made twice a year can be regarded as one of them (Lusk and Zdražílek 1969).

The water surface of the reaches is related to the normal water discharge.

Our team consists of four hydrobiologists and two fishery biologists, and three technicians. The determination and analyses of material are carried out by ourselves. Only some groups of aquatic organisms are determined by other specialists.

4. RESULTS

In this part of the paper we should like to present the partial results on mayfly larvae (M. Zelinka) and midge larvae (B. Losos), and on fish, and give some notes on the production.

4.1 EPHEMEROPTERA

Altogether 19 species of mayflies were found in both brooks. In the brook Brodská the number of species was 17, in the brook Lušová 19. The two species missing in the Brodská (*Baetis niger* and *Centroptilum luteolum*) belonged, however, to non-dominant species (Tab. II). Also the composition of mayfly populations in the lower and upper parts of the brooks was little different. Out of the 19 species

Table II

Presence of mayfly larvae in the brooks Lušová and Brodská

	Species	Lušová		Brodská	
		Stream	Bank	Stream	Bank
1	*Ephemera danica* Müll.	+	+	+	+
2	*Ecdyonurus* gr. *venosus*	+	+	+	+
3	*Heptagenia lateralis* Curt.	+	+	+	+
4	*Rhitrogena semicolorata* Curt.	+	+	+	+
5	*Epeorus assimilis* Etn.	+	–	+	(+)
6	*Habrophlebia lauta* Etn.	+	+	+	+
7	*Habroleptoides modesta* Hag.	+	+	+	+
8	*Paraleptophlebia submarginata* St.	–	+	–	+
9	*Baetis rhodani* Pict.	+	+	+	+
10	*Baetis bioculatus* L.	+	–	+	+
11	*Baetis alpinus* Pict.	+	–	+	(+)
12	*Baetis pumilus* Burm.	+	+	+	+
13	*Baetis niger* L.	–	+	–	–
14	*Centroptilum luteolum* Müll.	–	+	–	–
15	*Centroptilum pennulatum* Etn.	–	+	–	+
16	*Ephemerella ignita* Poda	+	+	+	+
17	*Chitonophora krieghoffi* Ulm.	+	+	+	+
18	*Torleya maior* Klp.	+	+	+	+
19	*Caenis macrura* Stephn.	+	+	+	+
	Total	15	16	15	17
		19		17	

(+) = atypical presence.

of mayflies 5 species form the substantial part of the population: *Baetis rhodani* 30%, *Rhitrogena semicolorata* 24%, *Ecdyonurus* gr. *venosus* 23%, *Habroleptoides modesta* 4.6% and *Epeorus assimilis* 5.5 (total 87.1%).

Mayfly larvae populate the whole bottom of the trout brook, but there are quantitative and species differences between the streaming and calmer sections of the stream near the bank, where the speed drops below 15 cm per second.

Typical species, living only in the current, are *Rhitrogena semicolorata* most species of the genus *Baetis* and *Epeorus assimilis*.

Only in the calmer sections near the bank live *Heptagenia lateralis*, *Paraleptophlebia submarginata* and *Centroptilum*. Finally, some species live in all sections of the brook, above all *Ecdyonurus* gr. *venosus*, *Habroleptoides modesta* and *Torleya maior*. The presence of the species *Ecdyonurus* gr. *venosus* in sections with different water velocity is conditioned mainly by its life history, as towards the end of their development the bigger larvae migrate towards the bank.

Between the two sections of the brook there are also quantitative differences. These differences are greater in the abundance than in the biomass. The average abundance of mayflies in the current is more than twice as high than at the bank (Fig. 2). This high abundance is caused on the one hand by the species composition, on the other hand by more constant conditions of the milieu throughout the whole year; most of the species live permanently or temporarily in the current. In the quiet sections near the bank live fewer species of mayflies in a less dense population in a more variable milieu.

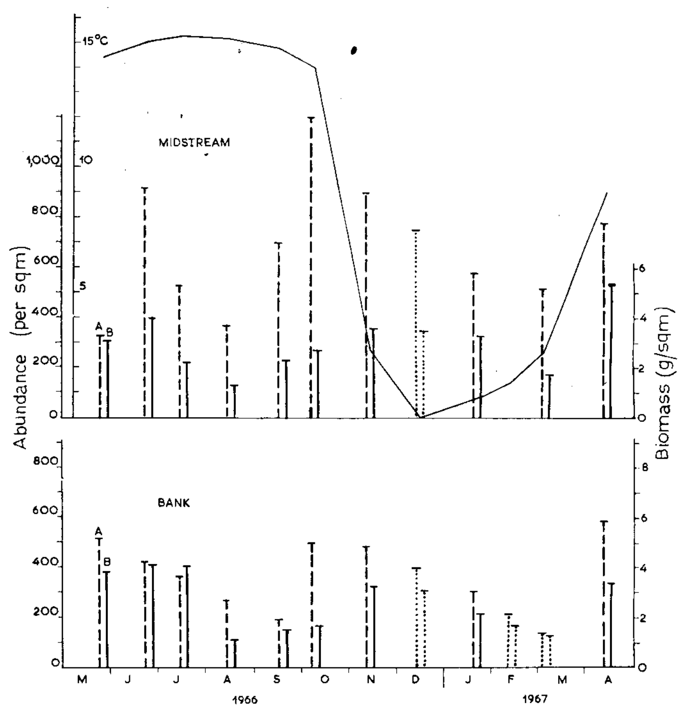

Fig. 2. Changes of abundance (*A*) and biomass (*B*) of mayfly larvae during the year. (An average course related to both streams)

The values expressed in Figure 2 and 4 in a dotted line are assumed values derived from other analogical examples. For technical reasons the samples could not be taken

As to values of biomass the two sections with different water velocity are less different. The average yearly biomass in the current was about 3 g m^{-2}, near the bank 2.58 $g \cdot m^{-2}$. Lower differences in the value of the biomass are caused by a different species composition and by a different relative size of the larvae in the current and near the bank. The larvae of the genera *Heptagenia, Ephemera, Paraleptophlebia* and others have relatively larger body sizes than the more numerous but small types of larvae of the *Beatis* and *Rhitrogena* genera. Also the larvae of the *Ecdyonurus* genus, living at first in the stream, move towards the bank in the period of maturity.

The course of the yearly changes in abundance and biomass (Fig. 2) of mayfly population near the bank and in the current is the same. In spring the species of the first generation of larvae mainly *Baetis rhodani* emerge in the stream middle and *Heptagenia* and *Habroleptoides* near the bank. At the beginning of summer some species, particularly *Rhitrogena* and *Ecdyonurus* emerge. The substantial part of mayfly population in the stream is, however, fo med by the second generation of larvae of the *Baetis* genus. Towards the end of summer and in autumn prevail larvae of the genera *Rhitrogena* and *Baetis* in the stream-line, *Heptagenia* and *Habroleptoides* near the bank. In the course of the winter season there is a general decrease of abundance and retardation of growth. An abrupt increase of abundance at the beginning of spring (April, Fig. 2) can be explained by gradual hatching of larvae from part of the eggs from the preceding year.

The summer depression of the development curve of mayfly population is caused by a break between the completion and the beginning of further development of most of the species.

According to the yearly courses of abundance and biomass[1] of mayfly larvae in the brooks there are:

	Bottom area	Average abundance	Average biomass
Lušová brook	9,946 m^2	6.8 million	34 kg
Brodská brook	10,927 m^2	6.1 million	23 kg

4.1.1 PRODUCTION

On the model of mayfly larvae, important for the production, Zelinka (unpublished data) attempted to estimate the yearly production. The assumptions for the total calculation were the knowledge of the length/weight relations of the main species (the growth curve, see Fig. 3), density of population and size classes of larvae.

By production we understand the sum of the weight increases of all individuals of the respective species, present in each of the following samples, and half the increase of the individuals not present (i.e. the difference in the number of individuals between the preceding and the following samples). The increases are read from the growth curve. In the period of imago emergence it is necessary to take into consideration only the average weight value corresponding to the last size class of the nymphae for summing the increase. The increase of the other individuals,

[1]On this occasion we should like to point out that K u b i č e k (1970) in preliminary papers (p. 237) quoted these values by mistake as the average yearly production rate. The production is substantially higher than biomass, as quoted below.

not tak ng wings so far, is calculated in a normal way. If a new generation is hatched in the interim period between samples, the number of larvae from the second sample is taken into consideration. Larvae up to the size of 1 mm are not considered.

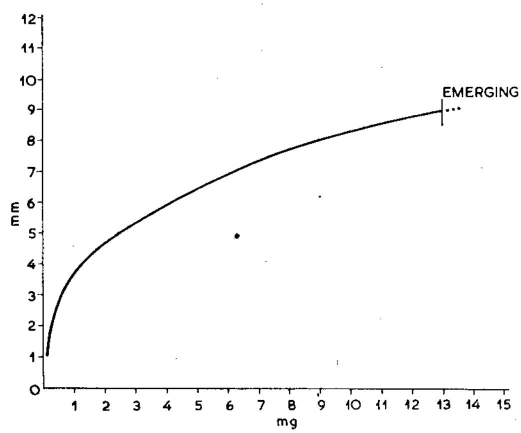

Fig. 3. Length/weight curve of *Baetis rhodani*

An example of the calculation of production of *Baetis rhodani* in the period from 2 Mar. to 14 Apr., 1967, is given in Table III.

Table III

Basic data for the calculation of production rate in *Baetis rhodani*

Size class (mm)	2nd March 1967			13th April 1967		Increase (mg)
	Abundance (per m²)	Total weight (mg)	Mean weight (mg) of one individual	Abundance (per m²)	Total weight (mg)	
—2	60	12.0	0.2	0	0	0
2—3	86	34.4	0.4	14	5.6	6.3
3—4	38	34.2	0.9	63	56.7	33.7
4—5	25	45.0	1.8	17	30.6	23.8
5—6	8	25.6	3.2	29	92.8	75.2
6—7	4	20.0	5.0	23	115.0	94.3
7—8	0	0	7.2	23	165.6	126.9
8+	0	0	11.0	17	187.0	132.4
Total	221	171.2		186	653.3	492.6

The author of this procedure (Zelinka — unpublished data) starts from the biggest size class of larvae found in the following sample (in this case the last stage before emergence, i.e. 8 mm+). The number of individuals reaching this size in April, is 17. Out of them 4 individuals were in the class 6—7 mm (weight increase according to the growth curve for 1 n = 6 mg, the total being 4 times 6), 8 individuals 5—6 mm (= 4 times 7.8) and 5 individuals 4—5 mm (= 5 times 9.2). The total increase was 132.4 $mg \cdot m^{-2}$.

Size class 7—8 mm. In April 23 individuals were found, which had grown since March. There were 20 individuals 4—5 mm (= 20 times 5.4), 3 individuals 3—4 mm (= 3 times 6.3), the total being 126.9 $mg \cdot m^{-2}$.

Size class 6—7 mm. 23 individuals had grown to that size from the preceding sample, when they were 3—4 mm long. The total increase is 23 times 4.1 = 94.3 $mg \cdot m^{-2}$.

Size class 5—6 mm. From the total number of 29 individuals only 12 grew from the size of 3—4 mm (= 12 times 2.3) and 17 individuals from the length 2—3 mm (= 17 times 2.8). The weight increase was 75.2 $mg \cdot m^{-2}$.

Size class 4—5 mm. 17 individuals grew from the size 2—3 mm (= 17 times 1.4), increase 23.8 $mg \cdot m^{-2}$.

Size class 3—4 mm. From 63 individuals 52 had grown since March from the length of 2—3 mm (= 52 times 0.5) and 11 individuals from the size up to 2 mm (= 11 times 0.7), total 33.7 $mg \cdot m^{-2}$.

Size class 2—3 mm. From March to April 14 individuals had grown from the size up to 2 mm (= 14 times 0.2). The difference in the number of 60 individuals is 46 individuals. Out of this number 11 individuals are included in the number of the following size class 3—4 mm; there are 35 individuals left, which are absent (drift, mortality, food). In these larvae only a 50 per cent increase is assumed (= 35 times 0.2 : 2). The increase of this class is 6.3 mg per square meter.

The total increase of mayfly larvae for the period from March 2 up to Apr. 14 is 492.6 $mg \cdot m^{-2}$.

The average yearly production of this species, calculated for 1 hectare of the brook, is 48.442 kg (= 4.8 $g \cdot m^{-2}$). The yearly production of this species is eight times higher than its yearly biomass (0.6 $g \cdot m^{-2}$).

The result of our calculation of the production rate will be further compared with other authors whose opinions are subject to discussion at present (e.g. Hynes and Colman 1968, Fager 1969, Hamilton 1969).

4.2 DIPTERA, CHIRONOMIDAE

In both brooks 13 taxons were found in the first year of the research (Tab. IV). Similarly as in the species composition of mayfly larvae, there are no substantial differences between the two brooks also in the community of midge larvae. To the group of dominant species belong: *Potthastia gaedii* (about 50% of total abundance), *Euorthocladius rivulorum*, *Trichocladius* and *Rheorthocladius*, *Brillia modesta* and others (Tab. V). Greater differences were found between the bank station of the Brodská brook and other stations where samples were taken. In that station only 5 species out of the total number 13 were found. This can be explained by specific hydrological conditions of the Brodská brook in the first year of research. More frequent flushes and higher water level, unlike the conditions in the Lušová, together with the drift activity of midge larvae may have been the cause of absence of most adominant and accidental species.

Like in mayflies, some midges were found living solely or for the most part in the current *Euorthocladius rivulorum*, *Eukiefferiella discoloripes*, *Rheorthocladius*, *Trichocladius* and others (Tab. V). In the calm parts near the bank the following species were predominantly found: *Prodiamesa olivacea*, *Microtendipes chloris*,

Table IV

Presence of midge larvae in the brooks Lušová and Brodská

	Species	Lušová		Brodská	
		Stream	Bank	Stream	Bank
1	*Brillia modesta* Zett.	+	+	+	–
2	*Eukiefferiella discoloripes* Geotgh.	+	+	+	–
3	*Euorthocladius rivulorum* K.	+	–	+	–
4	*Eutanytarsus* Van der Wulp.	+	+	+	–
5	*Microtendipes chloris* Mg.	+	+	–	+
6	*Paratrissocladius fluviatilis* Goetgh.	–	–	+	–
7	*Pentaneura lentiginosa* Fries	+	+	+	+
8	*Potthastia gaedii* Mg.	+	+	+	+
9	*Potthastia longimana* F.	—	+	–	–
10	*Polypedilum* K.	+	+	+	+
11	*Prodiamesa olivacea* (Mg.)	–	+	–	+
12	*Psectrotanypus varius* (Fabr.)	–	+	–	–
13	*Rheorthocladius, Trichocladius* K.	+	+	+	–
	Total	9	11	9	5
		12		11	

Table V

Dominant species (%) of midge larvae in the brooks Lušová and Brodská

Species	Stream		Bank	
	Lušová	Brodská	Lušová	Brodská
Potthastia gaedii	50.7	56.2	46.2	54.7
Euorthocladius rivulorum	15.4	21.1	—	—
Trichocladius, Rheorthocladius	11.4	6.7	9.2	9.4
Brillia modesta	8.1	2.5	14.5	—
Pentaneura lentiginosa	3.1	3.4	9.2	17.4
Eukiefferiella discoloripes	9.6	8.9	1.1	—
Prodiamesa olivacea	—	—	3.4	18.5
Other species	1.7	1.2	16.4	—

Potthastia longimana and *Pentaneura lentiginosa*. The remaining species settle the whole bottom of the brook.

The quantity of midge larvae is different in each brook. Only the abundance of the upper sections is coincident, the density of population there being relatively lower than in the lower sections (Tab. VI). Quantitative differences between the current and the bank parts were low. Biomass and abundance of midge larvae near the bank were about 10% higher than in the current (Fig. 4). In the course of the year most of the midge larvae and pupae occur in spring (April) both near the bank and in the current (mainly *Potthastia gaedii* and *Euorthocladius rivulorum*). In summer midge populations are weak (in the current) or absent at all (near the

Table VI

Abundance and biomass of midges in the brooks Lušová and Brodská

Stations	Abundance per m²		Biomass (g · m⁻²)	
	average	maximal	average	maximal
Lušová 2	28	350	0.036	0.266
Lušová 1	78	520	0.045	0.296
Brodská 2	49	116	0.043	0.074
Brodská 1	58	310	0.063	0.381

(Stadions *1*, *2*–see Fig. 1)

bank). This conspicuous summer absence of midges was extraordinary in the first year of research due to exceptional hydrological conditions; in the following years it was not so conspicuously evident. Only in late summer the spring generation emerges from mid-stream (*Eukiefferiella*, *Brillia*, *Rheorthocladius* and *Trichocladius*). The further course of midge populations development coincides both in the stream and near the bank. The growth in abundance and biomass culminates in January, when larvae, particularly of species *Brillia modesta* of the second generation, *Microtendipes chloris* and *Eutanytarsus* reach the maximum sizes, pupation takes

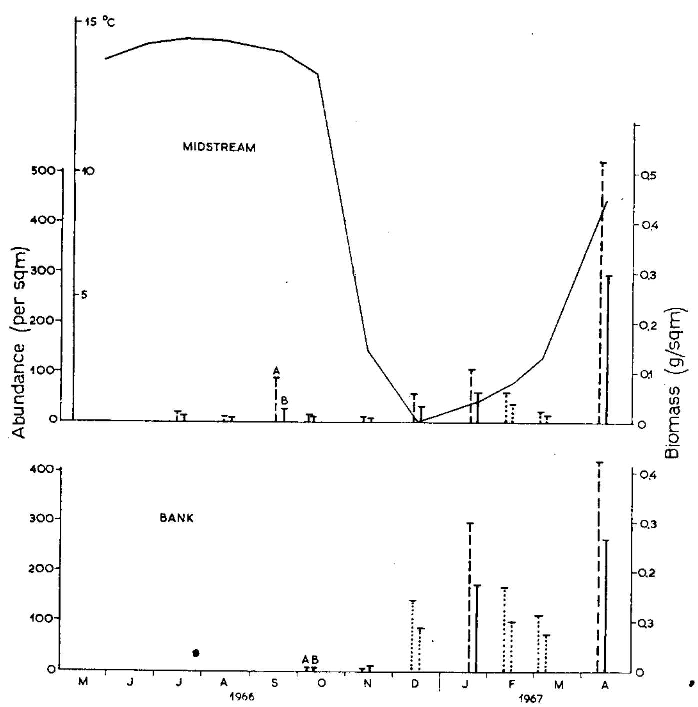

Fig. 4. Changes of abundance (*A*) and biomass (*B*) of midge larvae during the year. (An average course observed in the lower sections of both brooks)

place, and finally they emerge or disappear from the population through mortality, drift, or as food prey. The second yearly depression falls to the end of February and the beginning of March (like in mayflies). The April midge population is formed chiefly by larvae and pupae of *Potthastia gaedii* and *Euorthocladius*. A sudden April rise of abundance can have a number of causes. So far we can say that in our case the time difference of 42 days between two takings of samples is too broad for following the midge population dynamics. The increase in abundance may have taken place in the course of that period. Also Hynes's assumption (1961) about the descent of some benthic animals into deeper layers of the brook bottom might be taken into consideration in midge larvae. These problems, however, will be solved only after the evaluation of the remaining materials.

4.3 FISH

The fish part of the paper is based on preliminary data. Some more field work is scheduled to be done to finish the study. Out of the data collected the information on population size and biomass are available. Most interesting findings are those obtained in the lower reach of Brodská brook (Tab. VII).

Table VII

Population densities and biomasses of brown trout and Carpathian sculpin in the lower reach of Brodská brook

Date	Year	Trout				Sculpin	
		Density at census		Increasesd due to stocking		Density at census	
		n	g	n	g	n	g
May 16,	1966	0.16	7.13	—	—	—	—
Oct. 11,		0.17	6.48	—	—	0.5[a]	2.2[a]
Apr. 12,	1967	0.11	4.46	0.30	13.30	—	—
Jun. 7,		0.24	13.45	0,35	18.40	0.46	1.82
Aug. 29,		0.35	15.46	0.46	22.32	0.56	2.77
Oct. 24,		0.39	17.32	—	—	0.39	2.74
Apr. 23,	1968	0.25	10.60	0.36	15.00	0.70	3.21
Jun. 18,		0.25	11.41	0.37	17.87	1.16	2.88
Aug. 20,		0.22	9.60	0.29	14.33	0.74	2.62
Oct. 22,		0.26	9.63	0.33	12.66	0.51	2.11
Apr. 16,	1969	0.22	7.44	—	—	—	—
Jun. 19,		0.16	7.94	—	—	0.81	2.95
Aug. 20,		0.19	7.96	—	—	0.39	1.80
Oct. 21,		0.18	6.85	—	—	0.29	1.18

[a]Very approximate data.
n — numbers per m^2, g — $g \cdot m^{-2}$

After completing one year of life the trout attained about 80 mm of standard lenght, the sculpin about 40 mm. After another year the lengths reached 125 mm or so in trout and 65 mm in sculpin. Three year old trout measured roughly 160 mm, the average length of sculpin at the same age was 84 mm. No details on the age structure are at hand so far, however, the preliminary data show that the youngs of the year in the autumn and yearlings in the spring formed about one third of the trout population. The youngs of the year appeared for the first time in August catches. The life span was found to be 4 to 5 years in trout and the same in sculpin.

In 1966 the reach in question had an average population of 0.16 trout and biomass of 7.0 g per square metre. The sculpin density approximated at the same time 0.5 individuals and 2.2 $g \cdot m^{-2}$. The original stock of trout was doubled by transplatations in 1967. As to the trout the density increased to 0.32 fish per square metre (biomass = = 15 $g \cdot m^{-2}$). In sculpin the highest density found amounted to 1.16 individuals per m^2 in June 1968. In spite of further transplatations the density of trout decreased in 1968 and remained at the level of about 0.25 individuals and 10 g per square metre. The decrease is felt to be caused by the absence of some of our stream bed alterations which were damaged. In 1969, when the stocking was stopped, the trout density stabilized on the approximate value found before the trials were commenced. The sculpin population dropped substantially between June and August. The August and October levels were found even lower than the initial status. The reasons for this are unknown.

It is the authors' belief that the sculpin assessments are underestimated. The summer estimates are the highest because from summer onwards the collections involved also the yearlings and the low water flow afforded appropriate conditions for sampling. In some limited places of the stream the abundance of sculpin was observed to attain 3 to 4 individuals per m^2.

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