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On the Development and Productivity of Mayfly Larvae (Ephemeroptera, Insecta) in a Stretch of the Iskar River

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The inland water productivity studies have achieved considerable results particularly after the efforts of various limnologists, institutes and research groups were coordinated under the IBP-PF (International Biological Programme — Productivity of Freshwaters) programmes of UNESCO.

Because of the limited number of limnologists working in various limnological fields, the Bulgarian studies of freshwater productivity are lagging behind. A few papers have been published by Найденов (1964, 1977) on the zooplankton productivity of the Batak Reservoir, by Russev (1972) and Русев (1976) on the zoobenthic productivity of the Bulgarian stretch of the Danube, and by Найденов and Сайс (1984) on the lake plankton productivity.

This paper reports on the monthly (over a period of one year) assays of the development, abundance, biomass and growth of mayfly larvae along a relatively unpolluted stretch of the Iskar River and the estimation of the productivity of this important benthic group. These studies contribute to the improvement of methods and to evaluating the fish carrying capacity of a relatively short stretch of the river. Another aim is to calculate the P/B coefficient that can be used for the same species in other rivers without detailed productivity studies.

Material and Methods

Materials were collected monthly from April of 1981 to March of 1982 in two localities — one above the Vedena Rivermouth and another above Kokalyane village. The stretch was selected for its mayfly fauna, limited human influence and limited water level fluctuation.

The samples were collected in two points at each locality — near the left bank and in the middle of the stream, thus covering the specific and numerical variations across the river. The river width and depth at the 1st locality are 7 and 0.5 m and at the 2nd locality — 9 and 0,5 m, respectively. The distance between the two localities is 2,5 km. Because of the gravel and rock-covered bottom, most species are lithorheophilous. The river banks are co-

vered by a deciduous forest and water temperature varies between 0°C in January and 19,3°C in August, the lower locality's temperature being by 1—2° higher (Fig. 1).

In order to compare the results, larvae were collected by a silk sack attached to a square metal frame measuring 0,5 m (after S c h w o e r b e l, 1979).

A total of 8380 individuals were collected and their lengths and wet body weights (0,1 mg accurancy) were measured. Individuals of genera *Baetis* and *Ecdyonurus* were not

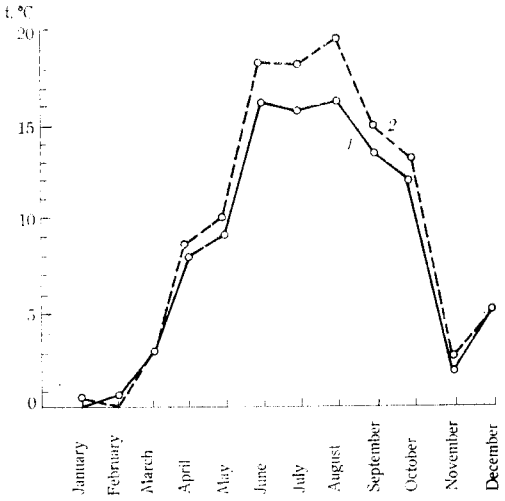

Fig. 1. Water temperature in the Iskar River stretch studied in 1981-1982
1 — first locality; *2* — second locality

given specific determination, because larvullae were not adequate, and larvae and nimphs could be determined only after destroying their mouth organs which would spoil the accuracy of the body weight measurements.

The data on the mayflies' abundance and biomass during the various months were used to determine the productivity by the Z e l i n k a (1973) and Z e l i n k a and M a r v a n (1976) method. Production estimates were based on the correlation between the length and weight increments, with mortality estimated at 50% of the weight. The annual production was calculated by summing up the monthly estimates. The data on body lengths in two consecutive months were divided into size groups with each group's average body weight calculated too. The body weight differences between each two adjacent size groups showed the weight increments used to determine the productivity (P, mg/m^2) of each size group over a certain period by the formula

(1) $$P_j = b_{j+1}(w_{j+1} - w_j), \quad \text{when } b_{j+1} > a_j,$$

or by the formula

(2) $$P_j = a_j(w_{j+1} - w_j) + (b_{j+1} - a_j)\frac{1}{2}(w_{j+1} - w_j)$$

$$= \frac{1}{2}(w_{j+1} - w_j)(a_j + b_{j+1}), \quad \text{when } b_{j+1} \leqslant a_j,$$

where a_j, b_j are the number of individuals in two consecutive samples; w_j is the average weight of individuals; j is the size group index.

The calculation starts at the largest j value provided that at least one member of the pair a_j, b_{j+1} is not 0.

A computer can be used according to the scheme of Z e l i n k a and M a r v a n (1976, p. 27).

Data on the Mayflies' Development and Ecology

The life history of mayflies has not been fully studied so far. The common mayfly species in colder countries have somewhat different life histories compared to those from warmer countries. For these reasons the life histories at least of the abundant species should be further studied.

Our monthly assays provided some data on the mayflay larval development in the Iskar River regardless of the short period of study and the fluctuating hydro-meteorological conditions.

Of the 16 lithorheophilous species found the most abundand ones were *Baetis* (*B. rhodani* (P i c t.), *B. alpinus* (P i c t.), *B. muticus* (L.) and *B. niger* (L.) accounting for 68,7% of the mayflies abundance and 47,3% of the biomass at the 1st locality, and 49,4% and 30,6%, respectively, at the 2nd one. The combined data showed that the four species accounted for 60% of the abundance and 37,8% of the biomass, with the frequency of occurence being 75,6.

They were present round the year with the maxima occuring in April, July and September (Table 1).

The two *Ecdyonurus* species (*E. venosus* (F.) and *E. dispar* (C u r t.) were present January through November with the abundance and biomass maxima occuring in July and November. They accounted for 5,1% of the mayflies' abundance and 12,2% of the biomass with the frequency of occurence being 71,1 (Table 2).

M a c a n (1957 a, b; 1960), L a n d a (1968) and S o w a (1975) reported on the life history of *Rhithrogena semicolorata* (C u r t.) This species has one generation a year with the largest larval increments occuring January through May. No larvae were observed in July and August.

M a c a n (1957 b, fig. 3) showed that larvae of this species did not occur regularly at various localities and during various years.

We observed these larvae from January (average body weight 2,5 mg) to July (average body weight 19,7 mg). An average of 54 ind. per m^2 were observed in the middle of the stream at the 2nd locality in September. The abundance and biomass maxima occured in April and May, and the largest increments — May through July. This was the commonest species, next only to the Baetis representatives. It accounted for 17,6% of the biomass (27,7% at the 1st locality) and 12,6% of the abundance (16,2% at the 1st locality). The frequency of occurence was 51,1.

As *Rh. semicolorata* prefers somewhat colder water, its abundance and biomass at the 1st locality were greater. In July, when the species leaves the river, some individuals could be observed in the middle of the stream, as well as at the bank of the 1st locality, while they are already missing at the bank of the 2nd locality (Table 3).

M a c a n (1957 a), P l e s k o t (1958, 1961), L a n d a (1968) and S o w a (1975) reported one generation a year and diapausing eggs of *Ephemerella ignita* (P o d a). The first larvulae appear in May (in June, according to Macan and Pleskot). They grow intensively and emerge in the same month. Landa and Macan observed the last individuals in August, Pleskot in October and Sowa observed single emerging nymphs in the Raba River as late as the beginning of November.

M a c a n (1979) reviewed the references on this species' life history with some of the results being at variance with those reviewed above.

This species occured in the Iskar localities studied May through September (August at the mank), but still accounted for 10,8% of the abundance and 16,9% of the biomass, and the frequency of occurence was 31,1 (Table 4). At

Table 1

Abundance, Biomass and Productivity of Genus *Baetis* in a Stretch of the Iskar River in 1981-1982

Index	January	February	March	April	May	June	July	August	September	October
				First locality						
Abundance, ind. per m²	8* —**	28 144	4 12	2076 1800	380 924	— 84	1656 1312	136 428	1420 2184	— 56
Biomass, mg/m²	16 —	109,2 374,4	22 7,2	2283,6 1620	874 2494,8	— 302,4	1490,4 2492,8	625,6 1968,8	4402 6333,6	— 84
Average weight of individuals, mg	2 —	3,9 2,6	5,5 0,6	1,1 0,9	2,3 2,7	— 3,6	0,9 1,9	4,6 4,6	3,1 2,9	— 1,5
Production, mg/m²	21,6 81,6	17,8 76,6	476 565,2	817,2 1350,8	219,4 730	407,6 1757,4	125,8 1103,6	1566,6 2172,8	956,6 1572	— —
				Socond locality						
Abundance, ind. per m²	4 —	60 32	20 24	404 1028	52 40	72 64	212 1392	244 624	1800 1400	— —
Biomass, mg/m²	4 —	36 44,8	20 24	1090,8 4831,6	161,2 236	129,6 64	339,2 2088	488 748,8	9180 2520	— —
Average weight of individuals, mg	1 —	0,6 1,4	1 1	2,7 4,7	3,1 5,9	1,8 1	1,6 1,5	2 1,2	5,1 1,8	— —
Production, mg/m²	12 10,4	26 2	477,6 1429,2	378,4 1172,2	88,8 49,2	95 861,2	205,2 652,6	2867,6 681,2	1802,6 517,8	— —
				P/B coefficient 6,3						

Notes: No representatives of the genus were observed during the months November and December; * bank; ** middle of the stream.

Table 2

Abundance, Biomass and Productivity of Genus *Ecdyonurus* in a Stretch of the Iskar River in 1981—1982

Index	March	April	May	June	July	August	September	October
				First locality				
Abundance,	—*	—	—	—	96	28	120	—
ind. per m^2	—**	40	44	76	164	156	148	—
Biomass,	—	—	—	—	931,2	179,2	2388	—
mg/m^2	—	6,4	110	197,6	934,8	1544,5	1139,6	—
Average weight of	—	—	—	—	9,7	6,4	19,9	—
individuals, mg	—	1,6	2,5	2,6	5,7	9,9	7,7	—
Production,	—	—	—	822	379	705	586,2	—
mg/m^2	24	81,4	138,4	363	624,2	599	291,6	—
				Second locality				
Abundance,	—	—	24	20	32	68	204	24
ind. per m^2	—	16	4	—	96	76	116	8
Biomass,	—	—	1144,8	396	294,4	1033,6	1326	43,2
mg/m^2	—	899,2	8	—	1420,8	1071,6	324,8	10,4
Avarage weight of	—	—	47,7	19,8	9 2	15,2	6,5	1,8
individuals, mg	—	56,2	2	—	14'8	14,1	2,8	1,3
Production,	—	952	441,8	302,4	749'	917,4	473,2	9
mg/m^2	—	433,8	—	856,8	803 8	236,4	110,4	12
				P/B coefficient 8,2				

Notes. No representatives of the genus were observed during the months January, February, November and December; * bank; ** middle of the stream.

Table 3

Abundance, Biomass and Productivity of *Rhithrogena semicolorata* in a Stretch of the Iskar River in 1981-1982

Index	January	February	March	April	May	June	July
				First locality			
Abudance	—*	—	—	696	700	28	8
ind. per m²	12**	292	84	664	436	52	8
Biomass,	—	—	—	2992,8	3850	114,8	80,8
mg/m²	30	1138,8	260,4	3026,8	2659,6	676	80
Average weight of	—	—	—	4,3	5,5	4,1	10,1
individuals, mg	2,5	3,9	3,1	4,7	6,1	13	10
Production,	—	—	961,2	1917	1036,8	122,8	—
mg/m²	393,6	342,4	978	1339,4	858,1	128,4	—
				Second locality			
Abundance	—	16	4	124	172	84	—
ind. per m²		16	8	340	76	76	20
Biomass.	—	51,2	28	1240	550,4	1520,4	—
mg/m²	—	24	24	1394	722	1269,2	394
Average weight of	—	3,2	7	10	3,2	18,1	—
individuals, mg	—	1,5	3	4,1	9,5	16,7	19,7
Production,	12	12	958	224,8	818	315,6	—
mg/m²	2,8	21,6	250	439,2	645,8	261,4	58
				P/B coefficient 6,4			

Notes. No representatives of the species were observed during the months August, September, October, November and December; * bank; ** middle of the stream

Table 4

Abundance, Biomass and Productivity of *Ephemerella ignita* in a Stretch of the Iskar River in 1981-1982

Index	May	June	July	August	September
		First locality			
Abundance,	—*	20	52	24	—
ind. per m²	—**	88	76	24	4
Biomass,	—	20	327,6	235,2	—
mg/m²	—	396	357,2	144	50
Average weight of	—	1	6,3	9,8	—
individuals, mg	—	4,5	4,7	6	12,5
Production,	16	222,6	199,4	42,6	—
mg/m²	138	191,6	171,8	59,4	—
		Second locality			
Abundance,	—	912	100	8	—
ind. per m²	—	1892	384	16	8
Biomass,	—	6201,6	640	65,6	—
mg/m²	—	10973,6	1728	99,2	65,6
Average weight of	—	6,8	6,4	8,2	—
individuals, mg	—	5,8	4,5	6,2	8,2
Production,	1911,6	1381,8	65,4	—	—
mg/m²	3699,2	2968,2	549,8	53	—
		P/B coefficient 7			

Notes. No representatives of the species were observed during the months January, February, March April, October, November and December ; * bank ; ** middle of the stream.

the 2nd locality where the temperature was higher *E. ignita* larvae accounted for 22% of the abundance and 27,5% of the biomass, reaching in June 1982 ind. per m² in the middle of the stream.

Single larvae were observed in May, but the abundance and biomass maxima occured in June. The different biomass growths at the bank and in the middle are probably due to the migration of small larvae towards the middle of the stream (Fig. 2). For this reason the middle stream larval growth curve starts at an average larval weight of 4,5 mg.

This species' total abundance and biomass at the bank were lower than those in the middle of the stream, but the body weight increments in the middle were smaller, because of the higher stream speed and unfavourable nutrition conditions. In August and September, when all nymphs at the bank had already emerged, the larval growth in the middle was faster (Table 4). The larval length showed the most rapid growth in July and August.

In her monograph on the ecology of family Leptophlebiidae P l e s k o t (1953) reported very interesting and complete data on the effects of temperature and stream speed on the larval development, parasites, habitats, nutrition, metamorphosis, as well as life history of adults. P l e s k o t (1958) reported year round monthly numerical fluctuations data on various groups, with the maxima occuring in May (356) and September (150 larvae) in the Schwechat River.

L a n d a (1968) and S o w a (1975) as well as Pleskot, listed this species among those having one generation a year. Pleskot observed round the year as did Landa (except for June and July) and Sowa (except for June).

In the present study *H. modesta* was found to be of the most frequent by encountered species (62,2%), next only to the representatives of *Baetis* and *Ecdyonurus,* but its abundance percentage was 2,3% and of the biomass — 1,5%. The species was present round the year (except for December), with the highest abundance (63 ind.) occuring in September.

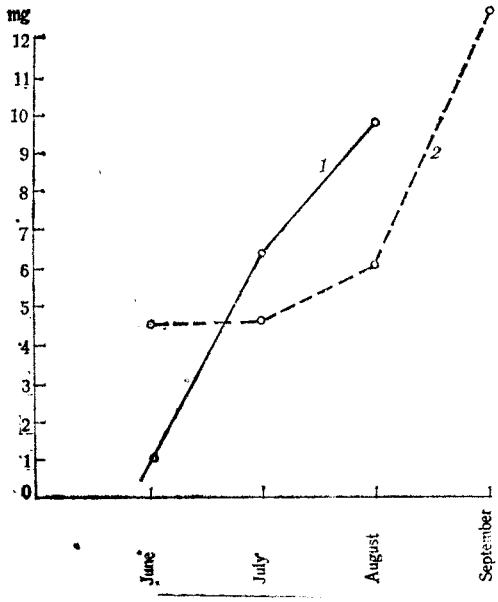

Fig. 2. Average individual weight growth of *Ephemerella ignita* (1st locality)

L a n d a (1968) listed *Caenis macrura* S t e p h. in group B, yielding two generations a year. S o w a (1975) observed its larvae round the year in the Carpathian rivers, but did not know for sure whether it had more than one generation a year.

We observed *C. macrura* round the year (except for April and June). The frequency of occurence was 44,4 and the highest abundance (143 ind.) was observed in July. It accounted for 3,7% of the abundance and 1,3% of the biomass. At the 1st locality it was much less abundant.

According to L a n d a (1968), S o w a (1975) and M a c a n (1979) *Ephemera danica* M ü l l. yields one generation every two years, while P l e s k o t (1958, 1961) using insufficient material suggested one generation a year

In the present study *E. danica* was observed round the year at a frequency of occurence of 48,9. Being a basic species of the psammorheophilous zoocenosis, it was scarce in the lithorheophilous one and had insignificant abundance and biomass there.

Ephemerella mucronata B g t s s. appears in September. The larvae we collected at that time weighed 0,1 mg and in November reached 1-2 mg, in March and April – 7-8 mg and in Nay – 10 mg. In June it was replaced by *Ephemerella ignita. E. mucronata* accounted for 1,7% of the mayflies' biomass and 1,1% of the abundance. The highest abundance was observed in May (104 ind.) and the frequency of occurence was 40 (Fig. 3).

P l e s k o t (1958) reported a rapid larval and nymphal development of *Habrophlebia lauta* E t n. in April and May, maturation and emergence in June and July. During the rest of the year this species was missing from the tributaries of the Schwechat River. L a n d a (1968) suggested that the species

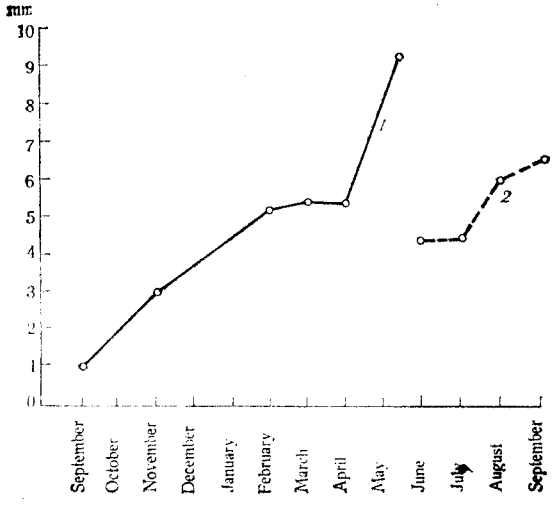

Fig. 3. Body length growth of *Ephemerella ignita (1)* and *E. mucronata (2)*

had one generation a year and did not observe it only in August and September, while S o w a (1975) found it in the Carpathian rivers round the year.

We did not observe *H. lauta* in November, December, January and August. Its highest abundance was in April (28 ind.) and the frequency of occurence was 37,8.

M a c a n (1957 a, 1979), L a n d a (1968) and S o w a (1975) observed *Paraleptophlebia submarginata* (S t e p h.) round the year (except for July, and sometimes end of June and beginning of August as well) and supposed that it had one generation a year.

We did not observe this species' larvae in June, July, August, as well as in April. The highest abundance was reached in October and November (50 and 72 ind., respectively) and the frequency of occurence was 28,9.

L a n d a (1968) and S o w a (1975) assumed that *Epeorus sylvicola* P i c t. yielded one generation a year. The latter observed it round the year while the former did not find it at the end of July, August and beginning of September.

We observed few individuals in the course of four months, with the maximum being in April (23 ind.) and the frequency of occurence 15,6. This species prefers rapid mountain streams with low water temperature.

L a n d a (1968) observed *Oligoneuriella rhenana* (I m h.) at the end of May through the beginning of August and S o w a (1975) — from April through August.

We found few (1 to 8) individuals from April through July, at a frequency of 20 and very low (0,2 and 2,1, respectively) abundance and biomass percentages.

Here we report on the porductivity of the lithorheophilous cenosis only, but it is worth noting that in the phytorheophylous (on roots, stems and leaves of partially submerged higher plats) the larvae of *Centroptilum luteolum* (M ü l l.), *C. pennulatum* E t n., *Cloeon dipterum* (L.) and *Procloeon pseudorufulum* K i m m. were constantly present. Some of them may appear temporarily in the lithorheophilous cenosis.

The mayflies in the Iskar River stretch studied contain 20 species of 14 genera and 7 families.

Productivity

Z e l i n k a (1973) evaluated the productivity of *Baetis* and *Ecdyonurus,* as well as of *Rhithrogena semicolorata* in a trout stream and computed their *P/B* coefficients (8,2, 8,84 and 8,25 respectively). The total annual production of the order Ephemeroptera, as calculated by the average value of the *P/B* coefficient, was 271,52 kg/ha.

We obtained the following results on the productivity of order Ephemeroptera.

Genus *Bactis* was the most productive one, because of its abundance. In both localities two maxima were observed (April and July-August at the 1st one and March-April and August-September at the 2nd one) (Table 1). The annual production at the 1st locality was 76,5 and at the 2nd one — 56,6 kg/ha, with an average of 66,1 kg/ha.

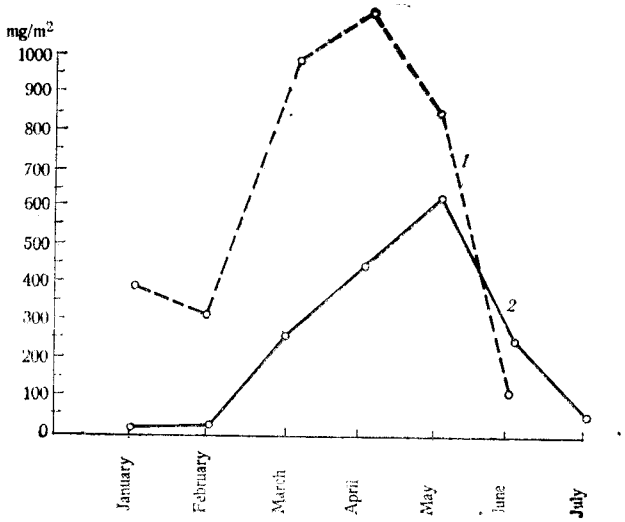

Fig. 4. Production of larvae of *Rhithrogena simicolorata* at the 1st *(1)* and 2nd *(2)* localities (middle of the stream)

The *Ecdyonurus* production comes from the great weight and length of the individuals, exceeding several fold the largest individuals of the other species. Maxima were observed in July-August at the 1st locality and June-July at the 2nd one. The annual production was 23,1 and 31,5 kg/ha respectively, with an average of 27,3 kg/ha (Table 2).

The difference in production maxima timing at the two localities is due mostly to the higher temperature at the 2nd one (Fig. 1).

The highest average productivity of *Rhithrogena semicolorata* was observed in April and May (Fig. 4). The individual body weights at the 2nd locality were higher, but because of its greater abundance, the annual production at the 1st locality was double (40,4 kg/ha) of that at the 2nd one (20,3 kg/ha) with an average of 30,3 kg/ha (Table 3).

Larvae of *Ephemerella ignita* have a relatively limited life duration. The highest productivity was observed in June (5,2 kg/ha) at the 1st locality and in May (53,1 kg/ha) at the 2nd locality with an average of 29,2 kg/ha (Table 4).

The four taxa studied accounted for 91,6% of the abundance and 91,7% of the biomass at the 1st locality and 83,4% and 79,2% respectively at the 2nd one, of all 16 taxa of the order Ephemeroptera present in the river.

As a monthly study on the biomass, abundance, growth, and productivity of mayflies over a period of one year is too labour-consuming, it is not worth doing it in each river used for sports and commercial fishing. For this reason it is sought to develop coefficients for use in production estimates, based on average biomass data.

In his publication on the nutrition resources and fish productivity of the Kahov Reservoir, Щеев (1966, Table 2) estimated the "soft" invertebrates production during 1956-1959 using the biomass and *P/B* coefficient (6) computed by him. Zelinka (1973) computed a *P/B* coefficient of 8,37 for mayflies in a relatively uninfluenced river.

We obtained different *P/B* coefficients for mayflies of different taxa with the highest for *Ecdyonurus* at the 1st locality — 9,5, and the lowest for *Baetis* at the 2nd locality — 6,2 (Tables 1, 2).

The average *P/B* coefficient computed by us is of greater practical significance. It can be used for mayflies production estimates in similar, relatively uninfluenced rivers, provided that biomass data are available.

The production of the other species (as calculated by the *P/B* coefficient) amounted to 13,9 kg/ha at the 1st locality and to 43,5 kg/ha at the 2nd one, accounting for 8,8% and 21,2% of each locality's total mayfly production. The total production was 158,1 and 205,1 kg/ha, respectively, with an average of 181,6 kg/ha for the entire stretch studied (Table 5).

Using reference data, Russev (1972) concluded that in the Danube River fishes consume some 30% of the "soft" invertebrates' production. If the

Table 5

Quantitative Characteristics of Order Ephemeroptera in a Stretch of the Iskar River in 1981-1982

Taxon	Abundance		Biomass		*pF*	Production	
	Ind. per m²	%	mg/m²	%		mg/m²	%
Baetis	5031	60	11876,7	37,8	75,6	6611,9	36,4
Caenis macrura	308	3,7	419,6	1,3	44,4	254,2	1,4
Ecdyonurus	428	5,1	3851	12,2	71,1	2728	15
Epeorus sylvicola	37	0,4	1056,2	3,4	15.6	601,8	3,3
Ephemera danica	103	1,2	1062,2	3,4	48,9	620.6	3,4
Ephemerella ignita	902	10,8	5325.9	16,9	31,1	2917,6	16,1
E. mucronata	93	1,1	544	1,7	40	324,8	1,8
Habroleptoides modesta	192	2,3	484,8	1,5	62,2	291,8	1,6
Habrophlebia lauta	104	1,2	79.6	0,2	37,8	50	0,3
Oligoneuriella rhenana	21	0,2	651,4	2,1	20	400,6	2,2
Paraleptophlebia submarginata	155	1,8	556,8	1,8	28,9	325,6	1,8
Rhithrogena semicolorata	1006	12	5531,8	17,6	51,1	3034,2	16,7

same per cent is applied in the Iskar River stretch studied, fishes would consume 54,48 kg/ha of mayfly larvae.

If we accept the nutrition coefficient of 5 for "soft" macrobenthos suggested by Щ е е б (1966), the fishproduction, based only on the mayflies larvae in the river studied would amount to 10,9 kg/ha.

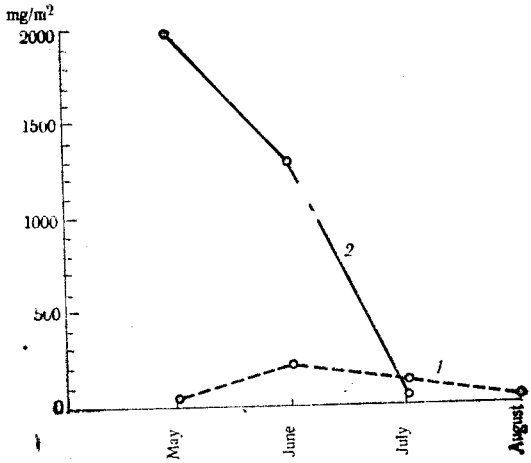

Fig. 5. Production of *Ephemerella ignita* at the 1st *(1)* and 2nd *(2)* localities (bank)

The error of the method used is negligible (Z e l i n k a, 1973). The method generally stiks to the Hamilton (1969) formula, except for the use of the actual individual weight according (Z e l i n k a, 1973).

Conclusions

A total of 20 species of mayfly larvae were found in the Iskar River between the Vedena River mouth and Kokalyane village.

Representatives of genus *Baetis* (mostly *B. rhodani*), followed by *Ephemerella ignita, Rhithrogena semicolorata* and genus *Ecdyonurus* (mostly *E. venosus*), have the largest shares in both abundance and biomass of the benthic lithorheophilous zoocenosis.

Rhithrogena semicolorata reached its highest abundance in April-May, *Ephemerella ignita* and *Caenis macrura* — in June, Paraleptophlebia submarginata — in October-November etc.

In the detritophagous family of Ephemerellidae the summer species *Ephemerella ignita* (occuring June through September) is replaced by *E. mucronata* (occuring September-May) showing a trend towards a complete, yearround detritus utilization.

Rhithrogena semicolorata larvae are present January through July, when they are of primary importance in the lithorheophilous zoocenosis where they often dominate.

Ephemerella ignita develops much better in the middle of the stream than at the banks, while other species do not show such a difference.

The larval development of *Ephemerella ignita, Baetis* and *Ecdyonurus* at the 2nd locality is much better, leading to higher abundance and biomass,

mostly because of the higher temperature, while *Rhithrogena semicolorata* finds better conditions at the 1st one.

The most productive mayfly larvae are those of genus *Baetis* followed by *Rhithrogena semicolorata*, *Ephemerella ignita* and genus *Ecdyonurus*.

The four taxa listed account for 87,9% (7367 ind. per m^2) of the abundance, 84,5% of the biomass (267,8 kg/ha) and 84,2% of the annual production (152,9 kg/ha) in the stretch studied.

The production of the other mayfly species (15,8% of the total one) amounts to 28,7 kg/ha.

The total annual mayfly production at the 1st locality is 158,1 and at the 2nd one — 205,1 kg/ha.

The total annual (1981-1982) production of larvae of the order Ephemeroptera in the stretch studied amounts to 181,6 kg/ha and the fish-consumed mayfly production is 54,48 kg/ha.

The possible mayfly-derived fish production in the stretch studied is 10,9 kh/ha.

The *P/B* coefficient for the Iskar River stretch studied is 7.

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Развитие и продуктивность личинок поденок (Ephemeroptera, Insecta) в участке реки Искыр

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(Р е з ю м е)

Приводятся результаты ежемесячных исследований в течение года (апрель 1981—март 1982) развития, численности, биомассы, роста и продуктивности личинок поденок в сравнительно незагрязненном участке реки Искыр.

В лито-, псаммо- и фитореофильных зооценозах р. Искыр между устьем р. Ведена и Кокаляне (г. София) установлено в общей сложности 20 видов личинок поденок. Наибольшее значение как для численности, так и для биомассы зообентоса литореофильного зооценоза имеют представители р. *Baetis* (в основном *B. rhodani*), следуемые видами *Ephemerella ignita, Rhithrogena semicolorata* и представителями р. *Ecdyonurus* (в основном E. venosus). Численность *Rhithrogena semicolorata* наиболее велика в апреле—мае, *Ephemerella ignita* и *Caenis macrura* — в июне, *Paraleptophlebia submarginata* — в октябре—ноябре и т. д. У детритоядного семейства *Ephemerellidae* наблюдается смена летнего вида *Ephemerella ignita* (июнь—сентябрь) видом *E. mucronata* (сентябрь—май). Личинки *Rhithrogena semicolorata* развиваются в реке только с января по июль, но в этот период они имеют первостепенное значение для литореофильного зооценоза, где нередко являются доминантными.

Представители р. *Baetis,* следуемые личинками *Rh. semicolorata, E. ignita* и представителями р. *Ecdyonurus,* составляют 87,9% численности (7367 экземпляров на 1 m^2), 84,5% биомассы (265,8 kg/ha) и 84,2% продукции исследованного участка (152,9 kg/ha). Подсчитанная продукция остальных 15,8% поденок составляет 28,7 kg/ha. Продукция личинок отряда Ephemeroptera в исследованном участке р. Искыр составляла 181,6 kg/ha за год (1981—1982). Использованная рыбами продукция личинок поденок составляла 54,48 kg/ha, а возможный прирост ихтиомассы в исследованном участке — соответственно 10,9 kg/ha. Коэффициент $P/B=7$.