

BRONISŁAW SZCZĘSNY

## **Czuściki (*Trichoptera*) rzeki Raby**

### **Caddis-flies (*Trichoptera*) of the River Raba**

Wpłynęło 9 listopada 1973 r.

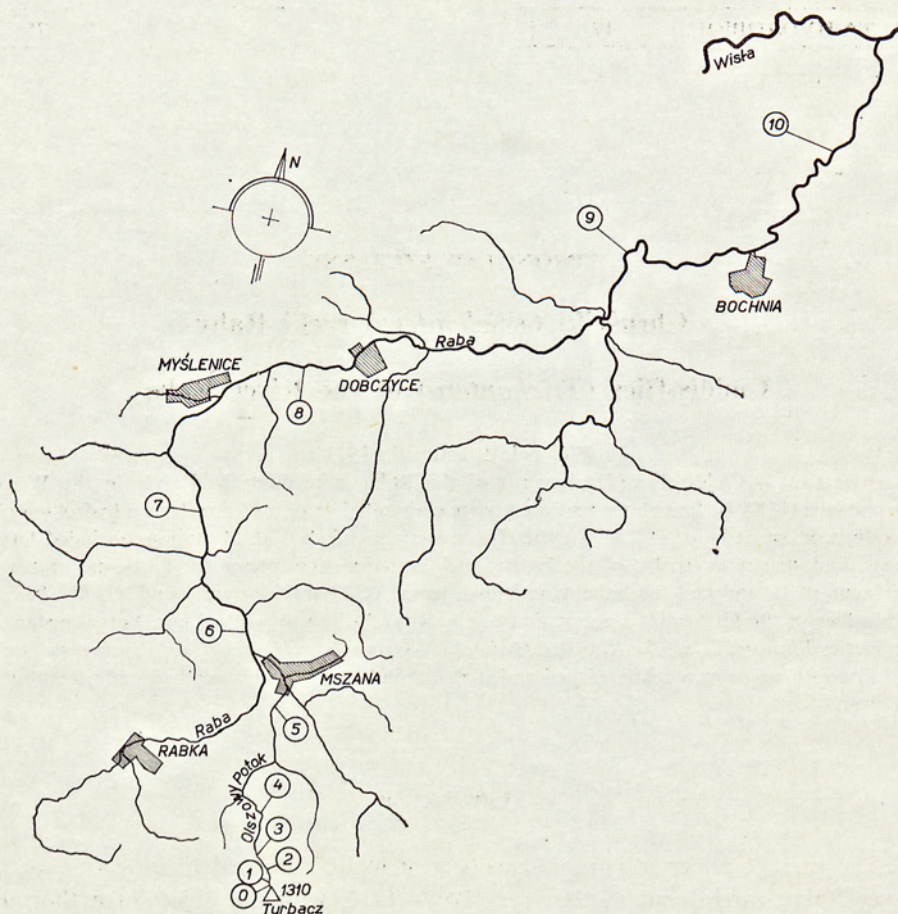
**Abstract** — Caddis-flies (*Trichoptera*) of the Raba, a medium-sized river in the Western Carpathians (185—1220 m above sea level), were elaborated as part of a collective hydrobiological investigation carried out in 1969—1970. The materials collected at 11 stations included larvae, pupae, and imagines. The list of species and their zonation were presented. Three species new to the fauna of Poland and the hitherto unknown larvae of 14 species were found. On the basis of caddis-flies of the lotic habitat a zonation of the River Raba was worked out. Larval instars for the species *Rhyacophila nubila*, *R. tristis*, *Hydrophysyche instabilis*, *H. pellucidula*, *Psychomyia pusilla*, and *Drusus discolor* were distinguished and it was found that these species had one generation in the year.

#### **Introduction**

The present paper is part of a collective hydrobiological investigation of the River Raba, carried out in the years 1967—1970, with the object of a thorough study of the flora and fauna inhabiting the river and in order, also, to trace future changes in the river biocenosis under the influence of man's activity. It is anticipated that this activity will be visible in the enrichment of the river water with biogenic substances, perhaps even in its considerable pollution, and, after the construction of the retention reservoir below Myślenice, in the disturbance of the hydrological and thermic conditions of the river below the dam.

#### **Territory and method of investigation**

The Raba is a not very large Carpathian river (129 km in length), a right hand side tributary of the River Vistula, draining waters from the northern mountain regions of the Western Beskid Mountains: the High Beskid (Gorce), Island Beskid, and Middle Beskid Mts, and from the sub-montane regions of Wieliczka and Ciężkowice (fig. 1). A great part of the catchment basin lies at the altitude interval of 300—500 m above sea level, the highest mountain being Mt Turbacz (1310 m above sea level). The highest springs within the territory of the catchment basin lie at 1240 m



Ryc. 1. Mapa rzeki Raby

Fig. 1. Map of the River Raba

above sea level (northern slopes of Mt Turbacz) and give origin to the Olszowy Potok. The out-flow of the River Raba to the Vistula lies at about 180 m above sea level. Five small towns, Rabka, Mszana, Myślenice, Dobczyce, and Bochnia are situated in the vicinity of the river and indirectly or directly feed their sewage to it, but, nevertheless, the river is regarded as clean.

Field investigations were conducted in the course of the streams lying at the highest altitude above sea level in the whole catchment basin: the springs of the Olszowy Potok, the Olszowy Potok, the Poręba, and the Raba, 11 stations being determined there. The description of the stations is given in Table I.

The samples were collected in the following periods: 25th-26th July 1969 (stations 0—10); 4th-5th September 1969 (stations 0—10); 21st-22nd October 1969 (stations 0—10); 16th-17th December 1969 (stations 2—10); 9th-10th March (stations 2—8); 10th-12th May 1970 (stations 2—10); 8th April 1970 (station 1); 25th-27th June

Tabela I. Charakterystyka stanowisk  
Table I. Description of stations

Stanowiska Stations	Wysokość npm Altitude above sea level	Odległość od źródeł Distance from the springs of km		Szerokość koryta maksymalna Maximum width of the riverbed m		Głębokość wody maksymalna Maximum depth of the water m		Szybkość prądu wody maksymalna Maximum speed of the water current
		Olszowego Potoka the Olszowy Stream	Raby the Raba	w nurcie in the water current	poza nurtem outside the current	w nurcie in the water current	poza nurtem outside the current	m/sec m/sek
0 reokren	1220	0,0-0,01		0,1 - 0,3		0,05 - 0,1		0,4
1	1180	0,2		0,4 - 0,7		0,1 - 0,2		0,7
2	990	0,7		1,2 - 2,0		0,2 - 0,4		1,3
3	780	2,3		1,5 - 3,0		0,3 - 0,4		1,3
4	580	7,1		4,0 - 8,0		0,4 - 0,9		1,0
5	460	13,6		8,0 - 15,0		0,6 - 1,0		1,5
6	370	22,0	37,0	15,0 - 25,0		0,8 - 1,0		1,3
7	315		48,0	20,0 - 30,0		0,8 - 1,0		1,5
8	250		65,0	25,0 - 30,0		1,0 - 1,5		1,2
9	210		96,0	30,0 - 40,0		1,2 - 1,2		1,0
10	185		119,0	30,0 - 35,0		1,5 - 1,0		1,0

1970 (stations 2—7, 9, 10); 8th July 1970 (stations 8). In the period of spring and winter the stations 0 and 1 were inaccessible and wholly covered with snow. No samples were taken from stations 9 and 10 in March because of a sudden thaw connected with rainfall and an increased water level in the river. At the stations from 0—4 five quantitative samples were taken each time while at the other stations ten quantitative samples and only in December and March five or six quantitative samples were collected.

Similarly as in the majority of West Carpathian streams and rivers, in the sector of the stations from 2—8 the bottom of the Raba is chiefly composed of oval stones of a diameter not greater than 10—30 cm (most often 15—20 cm). At stations 0 and 1 flat stones of smaller size prevail and at station 9 the bottom is more and more gravelly. Thus the most favourable sampling was performed using a square sampler with a side length of 22.5 cm. Bolting cloth of 0.3 mm. mesh was used for the net of the sampler. The volume of a collected sample was measured with the volume of displaced water in a calibrated vessel. The samples were fixed with 4—6 per cent formalin. The fauna was calculated per 2 l of volume of the substrate.

### Qualitative composition

73 species (Table II) were found in the investigated territory, among them 13 species in the larval stage only and 14 species in the stage of imagines only. Many species of this last group undoubtedly live in the investigated stream, e. g. hygropteric species of the genus *Wormaldia* or *Philopotamus variegatus*. The absence of their

larvae probably resulted from the way of taking samples which in too small a measure considered the hypopetric habitat. Some other species, e. g. of the genus *Athripsodes* or *Limnephilus*, could have got there from numerous old riverbeds situated along the river, where they had probably passed the full development cycle.

In the investigated territory the fauna of caddis-flies is fairly rich and varied both with regard to ecology and to zoogeography. Oligostenothermal alpine and montane species, such as *Rhyacophila glareosa*, *R. philopotamoides*, *Synagapetus armatus*, *Drusus carpathicus*, *Acrophylax vernalis*, *Melampophylax nepos*, and *Lithax niger*, occur here as well as eurythermal lowland ones, e. g. *Ithytrichia lamellaris*, *Hydropsyche contubernalis*, *Cyrnus trimaculatus*, *Mystacides azurea*, and *M. longicornis*. Rheobiontic species of the genus *Rhyacophila*, and *Drusus discolor* and rheophilous species of the genera *Glossosoma*, *Philopotamus*, and *Drusus* may be also encountered. The species which avoid a strong water current, e. g. of the genera *Athripsodes* and *Mystacides*, also occur here. Carpathian endemites (*Polycentropus schmidi*, *Apatania carpathica*, *Drusus carpathicus*, *Acrophylax vernalis*, and *Psilopteryx carpathica*) and the species of wide geographical distribution: European, Palearctic, and even Holarctic (*Synafophora intermedia*) are found here. On the one hand this variability is connected with considerable differences in the altitude above sea level in the interval in which the investigated water course flows (180—1240) and on the other with differentiated gradient and substratum: solid rock, stones, gravel, sand, mud, vegetation.

The number of species found in the investigated territory amounts to over 25 per cent of the total number of caddis-flies occurring in the territory of Poland. As compared with the neighbouring chain of Mt Babia Góra (Sowa, Szczęsny 1970) the number of species caught in the River Raba and Olszowy Potok is only 9 less but the lists from these two areas have only 47 species in common. Mt Babia Góra has more alpine elements while in the course of the streams Olszowy Potok Raba more lowland elements are encountered. The following alpine species were found in the Olszowy Potok *Apatania fimbriata* (Pict.), *Drusus monticola* McLach., *Potamophylax carpathicus* Dz., *Acrophylax zerberus* Brau., and *Chaetopteryx polonica* Dz.

A comparison of the fauna of caddis-flies in the middle and lower part of the Raba with the fauna of caddis-flies from other West Carpathian rivers, e. g. the Dunajec (Dratnal, Szczęsny 1965) or the Soła (Zaćwilichowska 1969), shows their strong similarity in the qualitative and quantitative composition, the representatives of the genera *Rhyacophila*, *Hydroptila*, *Hydropsyche*, and *Psychomyia* dominating among them.

#### Distribution of caddis-flies along the course of the River Raba

In Table II the numbers of caddis-fly larvae found in the hydrobiological samples of the River Raba are presented with the use of symbols. This Table gives a general orientation in the distribution of the fauna of caddis-flies along the course of the

river but does not satisfactorily inform one about the quantitative interrelations of the larvae of separate species in the successive sectors of streams, since these relations change both with the course of the river and in any cross-section of it, depending on the conditions of the substratum, water course, or the season of the year. Two groups of stations with similar fauna of caddis-flies may be distinctly seen in Table II: these are stations 1—3 and 4—10, station 4 having a transitional character. The sector which includes stations 1—3 is characterized by a fairly large number of species (26 at stations 2 and 3) with a considerable share (about 50 per cent) of alpine species among them. The sector which includes stations 4—10 has a smaller number of species, usually about 10, no alpine forms occurring there. The fauna of caddis-flies of these sectors differs in such great measure that, e. g., the stations 2 and 7 have only two common species, of which one, *Philopotamus ludificatus*, was most probably found accidentally in a sample from station 7 (1 larva).

A more detailed investigation of regularities in the settlement of the river by caddis-flies along its course was made on the basis of the lotic habitat with chiefly stony substratum. For this habitat the mean numbers of larvae and pupae of individual species from every catch and from each station were counted per 2 l of the volume of the substrate, their percentage share then being calculated. The results are presented in fig. 2.

On the basis of the scheme of dominating caddis-flies species of the lotic habitat the investigated course of the streams may be divided into three main zones:

I — the spring and the out-flow from the spring in the form of a small stream on a steep afforested slope (stations 0 and 1) with the dominance of *Drusus*, *Apatania*, and *Melampophylax*;

II — a rapid mid-forest stream formed by the confluence of spring out-flows (stations 2 and 3) with the dominance of *Rhyacophila*, *Glossosoma*, *Drusus discolor*, and *Philopotamus*,

III — a large montane stream and a montane river flowing amidst cultivated fields (stations 4—10) with the dominance of *Hydroptila*, *Hydropsyche* and *Psychomyia*.

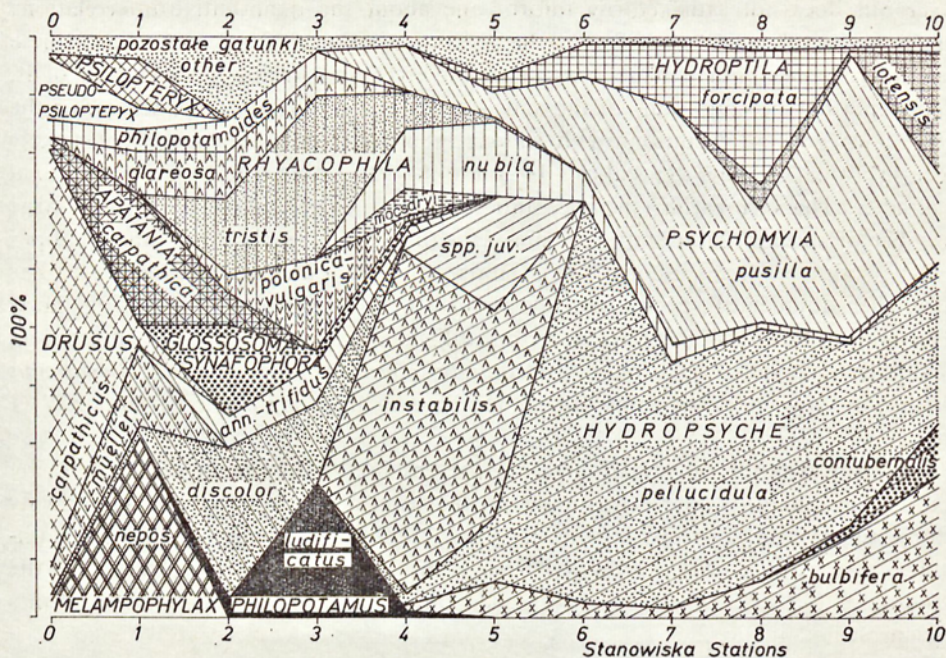
Zone I is additionally characterized by the occurrence of *Allogamus uncatius*, *Psilopteryx carpathica*, and *Pseudopsilopteryx zimmeri*, which avoid a strong current and gather in the parts of the bottom with quiet water. Similarly Zone II is characterized by *Allogamus auricollis* and *Halesus rubricollis*.

Within these three main zones seven sub-zones may be distinguished on the basis of the dominance structure of species:

I — 1 — the spring (station 0) with the dominance of *Drusus carpathicus*;

2 — the out-flow from the spring on a steep slope (station 1) with the dominance of *Apatania carpathica*, *Drusus muelleri*, and *Melampophylax nepos*;

II — 3 — a rapid montane stream formed by the confluence of spring out-flows (station 2) with the dominance of *Rhyacophila glareosa*, *Glossosoma conformis*, *Drusus discolor*;



Ryc. 2. Czuściki (*Trichoptera*) siedliska lotycznego rzeki Raby. Udział procentowy larw i poczwerek gatunków liczniejszych. Uwaga: Gatunki *polonica-vulgaris* obejmują *Rhyacophila polonica*, *R. fasciata*, *R. obliterata*, *R. vulgaris*, natomiast *annulatus-trifidus* obejmują gatunki: *Drusus annulatus*, *D. biguttatus*, *D. trifidus*, a także z pokrewnego rodzaju *Eclisopteryx madida*

Fig. 2. Caddis-flies (*Trichoptera*) of the lotic habitat of the River Raba. The percentage share of larvae and pupae of more numerous species. Note: The *polonica-vulgaris* species include: *Rhyacophila polonica*, *R. fasciata*, *R. obliterata*, and *R. vulgaris*, while *annulatus-trifidus* include the species: *Drusus annulatus*, *D. biguttatus*, *D. trifidus*, and also of the allied genus *Eclisopteryx madida*

4 — a montane mid-forest stream of fairly great yield at the foot of the mountains (station 3) with the dominance of the representatives of the genus *Rhyacophila* (*R. tristis*, *R. vulgaris*) and *Philopotamus ludificatus*;

III — 5 — a montane stream amidst cultivated fields (stations 4 and 5) with the dominance of *Hydropsyche instabilis*, *Rhyacophila nubila*, and *R. mocsaryi*;

6 — a montane river (stations 6—9) with the dominance of *Hydropsyche pellucidula*, *Psychomyia pusilla*, and *Hydroptila forcipata*;

7 — a sub-montane river (station 10) with the dominance of *Hydropsyche bulbifera*, *H. contubernalis*, and *Hydroptila lotensis*.

One may try to compare the above-mentioned structure of zones with the classification suggested by Illies and Botosaneanu (1963), taking into consideration the distribution of some species or the hydrological character of the water course. Zone I would correspond to krenon (eukrenon — I1, hypokrenon — I2) because of the hydrological character of the water course and also because of the

Tabela II. Lista gatunków chrzączek (Trichoptera) rzeki Raby. Oznaczenia: I - imagines; P - poczwarki; L - larwy; -1-10; = 11-100; + powyżej 100 okazów; x - gatunek nowy dla fauny Polski; /"/ - forma larwalna gatunku nie była dotychczas znana

Table II. List of species of caddis-flies (Trichoptera) and the number of specimens caught in the River Raba. Denotations: I - imagines; P - pupae; L - larvae; -1-10; = 11-100; + above 100 specimens; x - species new for Polish fauna; /"/ - the larval form of species hitherto unknown

Stanowiska - Stations	0		1		2		3		4		5		6		7		8		9		10		
	IP	L	IP	L	IP	L	IP	L	IP	L	IP	L	IP	L	IP	L	IP	L	IP	L	IP	L	
Liczby złowionych okazów Numbers of caught specimens																							
Gatunki Species	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	
<i>Rhyacophila fasciata</i> Hag.			3	1	1	-	-	-	-	2	2	-	-	-	-	4	-	-	-	-	-	-	
- <i>mocsaryi</i> Klap.										3	-	1	+	-	-	-	-	-	-	-	-	-	
- <i>nubila</i> Zett.																							
- <i>obliterata</i> McLach.			4	1	8	-	5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- <i>polonica</i> McLach.				69	8	-	53	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- <i>vulgaris</i> Pict.							1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- spp. juv. <i>gr. fasciata</i>			3	2	1	1	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- <i>glareosa</i> McLach.			2	1	6	7	7	2	-	20	7	-	-	-	-	-	-	-	-	-	-	-	
- <i>philopotamoides</i> McLach.	1	-					3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- <i>tristis</i> Pict.							2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Glossosoma conformis</i> Neboiss																							
<i>Synaophora intermedia</i> Klap.																							
<i>Synagetus armatus</i> McLach.																							
<i>Agapetus fuscipes</i> Curt.																							
<i>Ithytrichia lamellaris</i> Eat.																							
<i>Ithytrichia forcipata</i> Eat.																							
x /"/ - <i>lotensis</i> Mos.																							
x /"/ - <i>sparsa</i> Curt.																							
<i>Philopotamus ludificatus</i> McLach.																							
- <i>variegatus</i> Scop.																							
<i>Wormaldia copiosa</i> McLach.																							
- <i>occipitalis</i> Pict.																							
- <i>pulla</i> McLach.																							
<i>Hydropsyche contubernalis</i> McLach.																							
- <i>instabilis</i> Curt.																							
- <i>pellucidula</i> Curt.																							
- <i>saxonica</i> McLach.																							
/"/ - <i>bulbifera</i> McLach.																							
<i>Electrocnemia conspersa</i> Curt.																							
<i>Polycentropus flavomaculatus</i> Pict.																							
- <i>irroratus</i> Curt.																							
x /"/ - <i>schmida</i> Bots. Novak																							
<i>Cyrmus trimaculatus</i> Curt.																							
<i>Psychomyia pusilla</i> Fabr.																							
<i>Lype phaseps</i> Steph.																							
<i>Trichopterus rostocki</i> McLach.																							
<i>Brachycentrus subnubilus</i> Curt.																							
<i>Microserena minima</i> McLach.																							
<i>Microserena</i> sp.																							
/"/ - <i>Apatania carpathica</i> Schmid																							
<i>Drusus annulatus</i> Steph.																							
/"/ - <i>biguttatus</i> Pict.?																							
/"/ - <i>carpathicus</i> Dz.	2	1																					
/"/ - <i>discolor</i> Ramb.																							
/"/ - <i>muelleri</i> McLach.																							
- <i>trifidus</i> McLach.																							
<i>Ecdiopteryx madida</i> McLach.																							
<i>Limnephilus affinis</i> Curt.																							
<i>Grammotaulius nitidus</i> Mwl.																							
<i>Anabolia laevis</i> Zett.																							
<i>Potamophylax nigricornis</i> Pict.																							
- <i>stellatus</i> Curt.																							
/"/ - <i>Acrophylax vernalis</i> Dz.																							
/"/ - <i>Halesus rubricollis</i> Pict.																							
/"/ - <i>Melampophylax nepos</i> McLach.																							
<i>Parachlona picicornis</i> Pict.																							
<i>Allogamus auricollis</i> Pict.																							
/"/ - <i>uncatus</i> Brau.																							
/"/ - <i>Chaetopteryx fusca</i> Brau.																							
<i>Chaetopteryx</i> sp.																							
<i>Amittella</i> sp.																							
/"/ - <i>Pseillopteryx carpathica</i> Schmid																							
/"/ - <i>Pseudopseillopteryx zimmeri</i> McLach.																							
<i>Chaetopterygini</i> , <i>Stenophylacini</i> juv.																							
<i>Geera pilosa</i> Fabr.																							
<i>Lithax niger</i> Hag.																							
<i>Silo pallipes</i> Fabr.																							
<i>Crunoecia irrorata</i> Curt.																							
<i>Athripsodes albifrons</i> L.																							
- <i>aterrimus</i> Steph.																							
- <i>commutatus</i> Stetck.																							
- <i>dissimilis</i> Steph.																							
<i>Athripsodes</i> sp.																							
<i>Hystacides azurea</i> L.																							
- <i>longicornis</i> L.																							
<i>Notidobia ciliaris</i> L.																							
<i>Sericostoma personatum</i> Spence																							
<i>Odontocerum albicorne</i> Scop.																							
Liczba gatunków Number of species	9	14	26	26	26	22	19	13	9	11	10	10	13	11	9	10	10	11	10	10	13		

presence of *Apatania carpathica*, which is regarded by Botosaneanu (1967) as a species characteristic for krenon. Zone II would correspond to epiritron with *Drusus discolor*, the leading species of this zone (Schmitz (1957), dominating here. Almost exclusively in this sector of the stream the presence of the representatives of the genus *Philopotamus* is also striking, though the species *Ph. montanus* Don., typical for epiritron, is absent.

Metaritrion would probably include the sub-zone III5, the presence of *Notidobia ciliaris* and also of the first representatives of the genus *Hydropsychae* indicating this. Hyporitrion would correspond to the sub-zones III6 and III7, small numbers of *Goera pilosa* being encountered here. In the sub-zone III7 (station 10) certain elements of potamon may be found in the form of, e. g., *Brachycentrus subnubilus*, though *Hydropsyche guttata* Pict. is absent here. According to Martynov and Lepneva (Illies, Botosaneanu 1963), they are real representatives of potamon for the area of Europe and East Palearctics.

As may be seen from the facts mentioned above, it is difficult to compare the division of the River Raba on the basis of *Trichoptera* with the classification of Illies and Botosaneanu, partly because of the limited area of the occurrence of some species. Perhaps it would be more advisable to stop at the classification based on genera only.

In the distribution of caddis-flies of lotic habitat along the river course an interesting phenomenon of the replacement of individual species within the genera may be observed. In the genus *Drusus* (Table II, fig. 2) the following structure occurs: *carpathicus* — *muelleri* — *discolor*, *annulatus* — *discolor*, *trifidus* — *biguttatus*. Among the species of this genus only *D. discolor* is rheobiontic, other species being rather rheophilous, hence probably this deviation from distinct regularity may originate. A similar succession is observed in the genus *Rhyacophila* (*polonica* — *vulgaris* — *mocsaryi* — *nubila*), *Hydropsyche* (*instabilis* — *pellucidula* — *bulbifera* — *contubernalis*), and *Hydroptila* (*forcipata* — *lotensis*). Considering the fact that within a genus the larvae of particular species have the same or similar size, structure of the body, way of taking food, moving, etc., one may conclude that the decisive factor of the distribution of individual species along the water course is the thermics of the water in a given sector.

#### Distribution of the morphological types of caddis-flies along the course of the River Raba

The following morphological types of caddis-flies may be distinguished with regard to the way in which their larvae feed (Décamps 1967): A — predatory freely living larvae, chiefly the species of the genus *Rhyacophila*; B — omnivorous larvae, which build nets, the species of the genera *Philopotamus*, *Wormaldia*, *Hydropsyche*, *Plectrocnemia*, *Polycentropus*, and *Cyrrnus*; C — larvae feeding on algae, building flattened cases, the species of the genera *Glossosoma*, *Synagapetusa*, *Synagapetus*, *Agapetus*, *Ithytrichia*, *Hydroptila*, *Apatania*, *Lithax*, and *Silo*, or building small



channels of fine sand on the surface of stones: *Psychomyia pusilla*, *Lype phaeopa* and *Tinodes rostocki*; D — omnivorous larvae but with the prevalence of plant food, they build cylindrical cases of sand, detritus, or of a mixture of sand and detritus. In the individual genera of this last group of larvae some food selectivity occurs: e. g. the larvae of the genera *Drusus*, *Acrophylax*, and *Melampophylax* feed chiefly on algae while the species of the genera *Potamophylax*, *Allogamus*, *Chaetopteryx*, *Psilopteryx*, *Pseudopsilopteryx*, and *Sericostoma* prefer detritus.

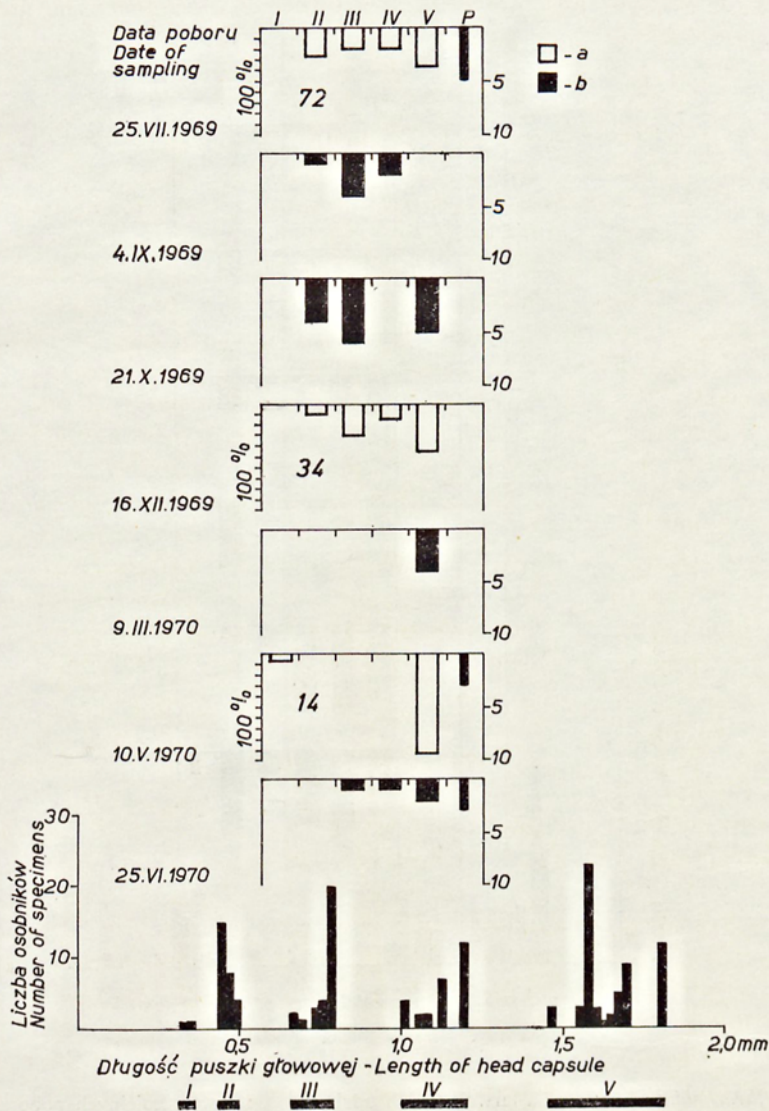
The share of separate morphological type of the larvae of caddis-flies is fairly variable in the distinguished zones of the River Raba. In the highest zone algaephagous larvae of groups C and D dominate, while down river predators of the group A (reaching maximum numbers at station 3) and the omnivorous forms which build nets, of group B, begin to prevail. In Zone III, which lies at the lowest level and is the longest one, omnivorous forms of group B (building nets) and forms of the group C (feeding on algae) with a small number of predators of group A dominate. The absence of the larvae of group D is particularly striking in this zone. This fact is undoubtedly connected with frequent and strong rises in the river waters, bringing about the drifting of that type of larvae which among caddis-flies shows the smallest adaptability to the conditions of the water current. Such adaptability is shown by the larvae which dominate here, e. g. *Hydroptila* very strongly attaches its cases to the stones, *Psychomyia* builds pathways in the crevices of stones, the larvae of *Hydropsyche* and *Rhyacophila* are rheobiontic their optimal current rate being within values above 40 cm (Scott 1958). In the structure of their body they show a number of adaptabilities, among others strong clinging limbs etc.

#### Phenological remarks

The collection of samples carried out 7 times throughout the year was enough to determine the number of generations of some species of caddis-flies in the year. Several of the most numerous and in early larval stages most easily identified species: *Rhyacophila nubila*, *R. tristis*, *Hydropsyche instabilis*, *H. pellucidula*, *Psychomyia pusilla*, and *Drusus discolor*, were selected for this purpose. In order to reduce errors in the identification of early larval stages of *Rhyacophila nubila* with respect to other species of this genus as well as of *Hydropsyche instabilis* with respect to *H. pellucidula*, counts were made in selected stations, i. e. in those where the above-mentioned species either occurred in homogeneous populations or dominated. The population of *Rhyacophila nubila* came from station 5, *Hydropsyche instabilis* from stations 4 and 5, and *H. pellucidula* from station 7.

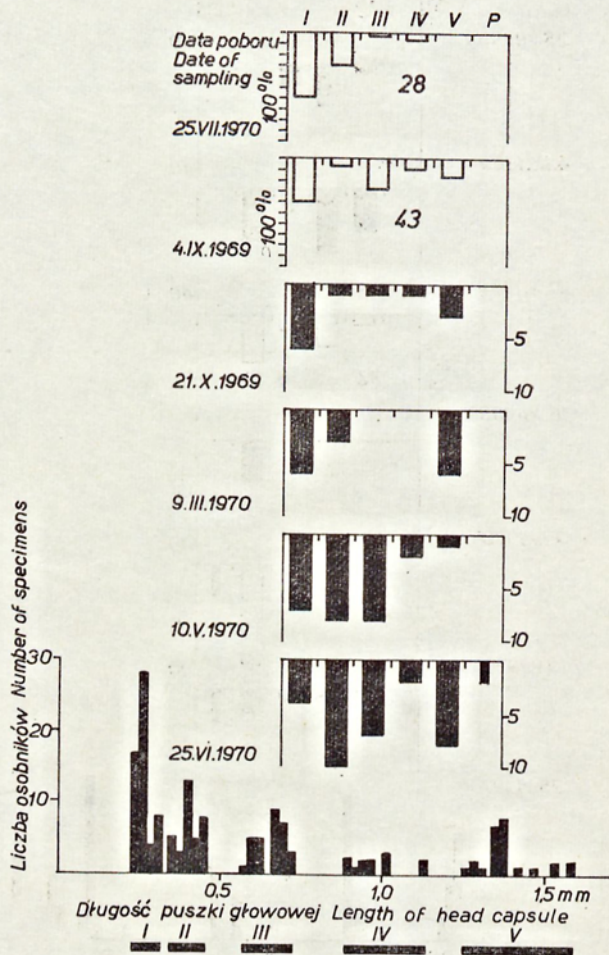
With individual species the number of instars was determined by measuring the length (*Rhyacophila*) or width (other species) of the head capsule of each larva.

One may claim on the basis of diagrams (figs 3—8) that all investigated species have 5 larval instars and 1 generation throughout the year. Taking as a basis the author's field observations only, probably all other caddis-flies of the River Raba



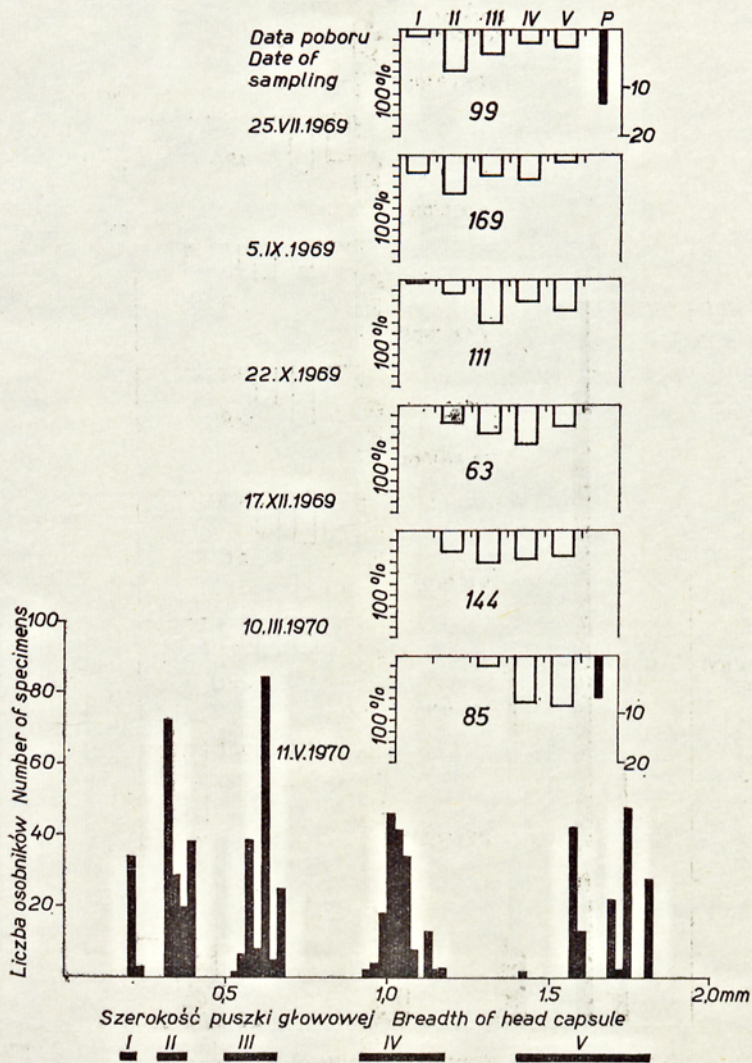
Ryc. 3. *Rhyacophila nubila*, stadia larwalne i ich udział procentowy w kolejnych poborach na stanowisku 5. a — procenty; liczby pod diagramami — ilość zebranych okazów; b — ilość zebranych okazów; I do V — stadia larwalne; P — poczwarki

Fig. 3. *Rhyacophila nubila*, larval instars and their percentage share in the successive catches at station 5. a — percentage; figures under diagrams denote the number of specimens caught; b — number of collected specimens; I—V — larval instars; P — pupae



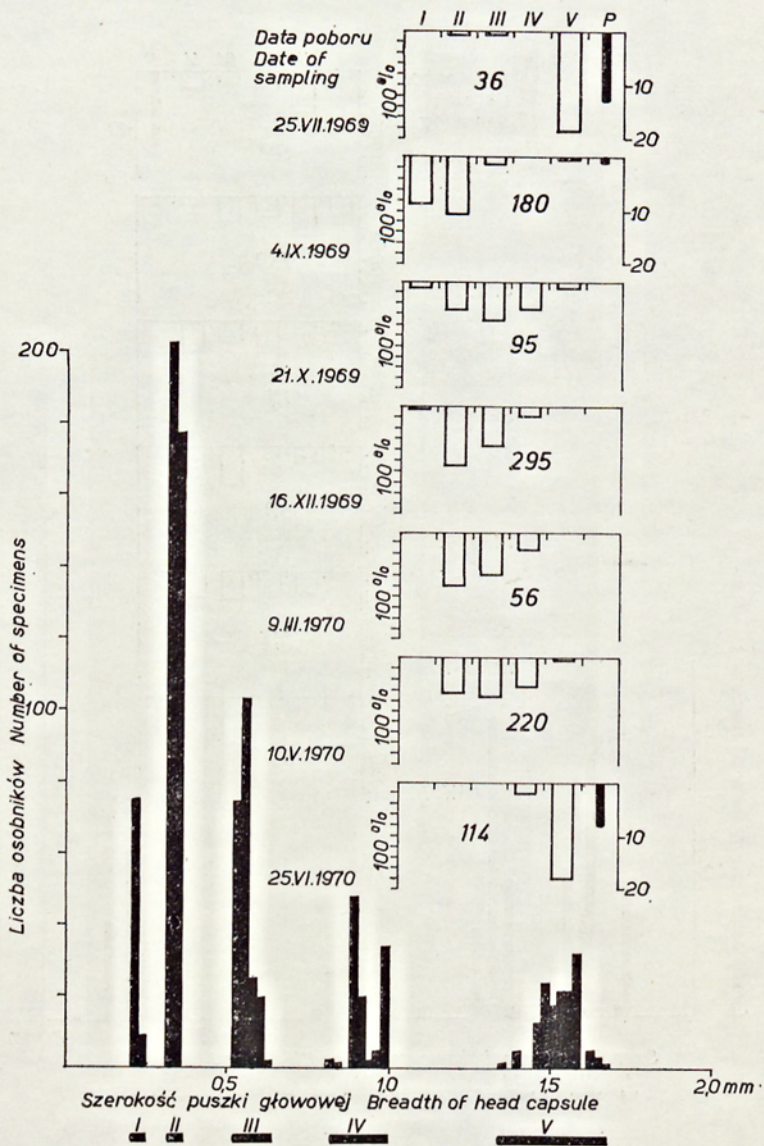
Ryc. 4. *Rhyacophila tristis*, stadia larwalne i ich udział procentowy w kolejnych poborach na odcinku stanowisk 2 do 4. Oznaczenia jak na ryc. 3

Fig. 4. *Rhyacophila tristis*, larval instars and their percentage share in the successive catches in the sector of the stations from 2 to 4. Denotations as in fig. 3



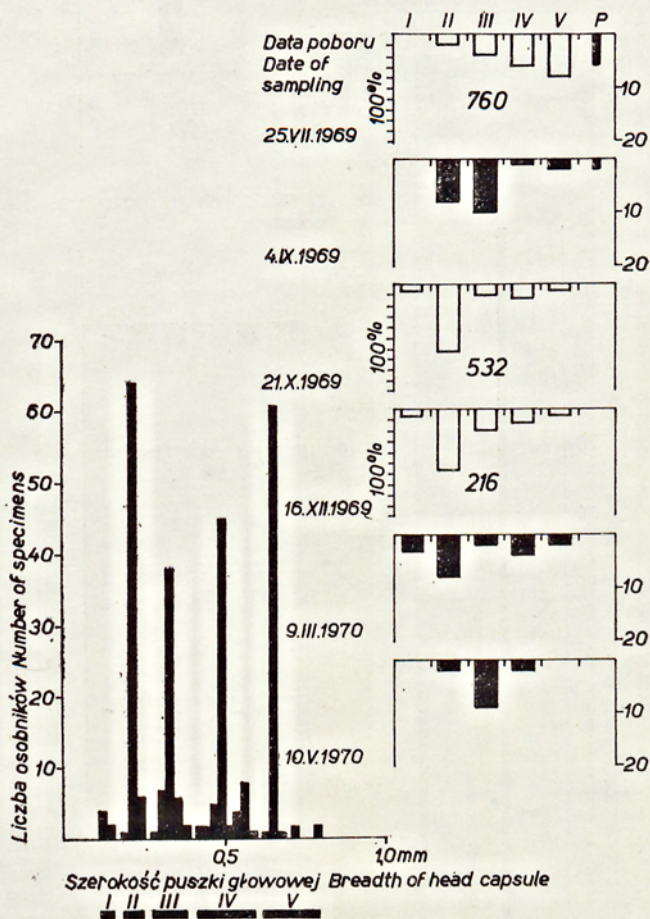
Ryc. 5. *Hydropsyche instabilis*, stadia larwalne i ich udział procentowy w kolejnych poborach na odcinku stanowisk 4 do 5. Oznaczenia jak na ryc. 3

Fig. 5. *Hydropsyche instabilis*, larval instars and their percentage share in the successive catches in the sector of the stations from 4 to 5. Denotations as in fig. 3



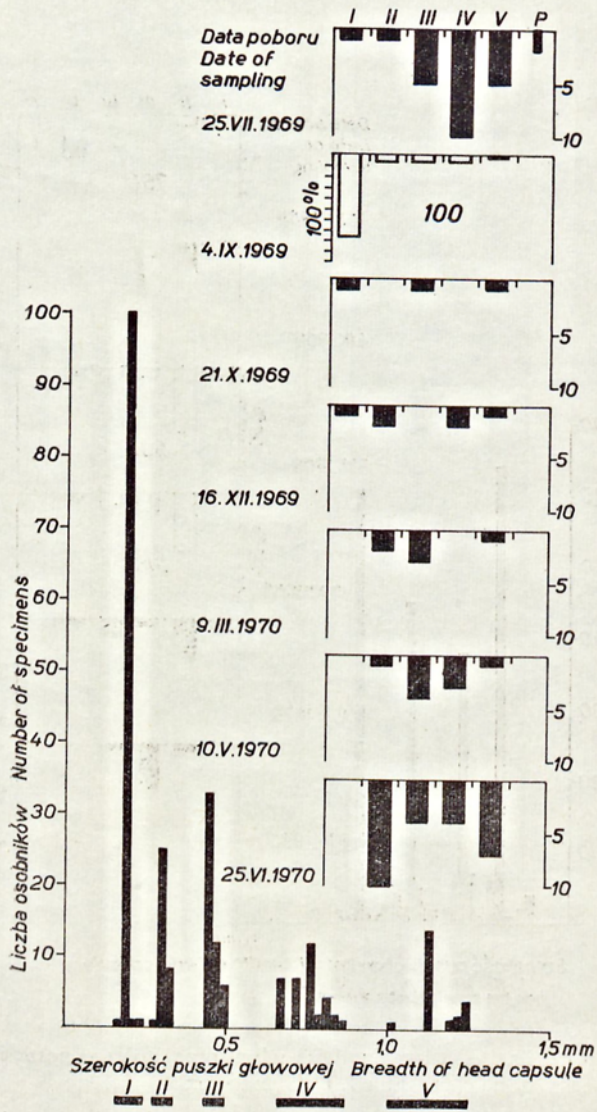
Ryc. 6. *Hydropsyche pellucidula*, stadia larwalne i ich udział procentowy w kolejnych poborach na stanowisku 8. Oznaczenia jak na ryc. 3

Fig. 6. *Hydropsyche pellucidula*, larval instars and their percentage share in the successive catches at station 8. Denotations as in fig. 3



Ryc. 7. *Psychomyia pusilla*, stadia larwalne i ich udział procentowy w poszczególnych poborach na stanowisku 7. Oznaczenia jak na ryc. 3

Fig. 7. *Psychomyia pusilla*, larval instars and their percentage share in the individual catches at station 7. Denotations as in fig. 3



Ryc. 8. *Drusus discolor*, stadia larwalne i ich udział procentowy w kolejnych poborach na odcinku stanowisk 2 do 3. Oznaczenia jak na ryc. 3

Fig. 8. *Drusus discolor*, larval instars and their percentage share in the successive catches in the sector of stations 2 and 3. Denotations as in fig. 3

also have one generation throughout the year, with the possible exception of some species of the genus *Rhyacophila* (*R. glareosa*, and *R. philopotamoides*) and *Drusus carpathicus*. This, is a supposition only, however, since the author did not manage to investigate their life cycles on account of the small numbers of materials collected or because of difficulties in the identification of early larval instars.

On the basis of the above results a conclusion is suggested, with regard to the methodology of investigation of Carpathian streams and rivers, that three collections of samples throughout the year are enough to complete the list of caddis-flies, the most favourable times being April, June, and September. In April and June adult larvae are caught of the species which emerge in spring and summer, and in September of those which emerge in autumn, e. g. *Chaetopterygini*, and early spring species, e. g. *Acrophylax vernalis*.

### Taxonomic remarks

*Rhyacophila* spp. gr. *fasciata* includes early larval instars, difficult to identify, of the following species: *fasciata*, *mocsaryi*, *nubila*, *obliterata*, and *vulgaris*, and sometimes also of *polonica*.

*Synagapetus armatus*, probably from these territories was mentioned by Racięcka (1933) under the name of *S. insons*. *S. insons*, being a West European species, should not occur here.

*Micrasema* sp.: the larvae collected probably belong to *M. minimum*.

*Drusus muelleri*: no pupae of this species were found, thus there was no certainty that the larval forms distinguished were rightly classified to this species.

*Psilopteryx carpathica* and *Pseudopsilopteryx zimmeri*: two larval forms were determined, undoubtedly belonging to both these species. However, their identification to individual species was not certain, since no pupae were encountered.

### STRESZCZENIE

Opracowanie niniejsze stanowi część zespołowych badań hydrobiologicznych rzeki Raby prowadzonych w latach 1967—70. Raba jest niedużą rzeką karpacką (129 km długości), prawobrzeżnym dopływem Wisły (ryc. 1). Odprowadza wody z terenów górskich (Beskidów) w przedziale wysokości 185—1240 m n. p. m. Do badań wytypowano 11 stanowisk (tabela I), na których pobierano zwykle po 10 prób, siedmiokrotnie w ciągu roku (VII. 69—VI. 70). Uzyskane dane przeliczono na 2 l objętości podłoża.

W materiałach znaleziono 73 gatunki (tabela II), w tym 13 gatunków tylko w postaci larwalnej, a 14 tylko w postaci imagines. Nie wszystkie gatunki znalezione w postaci imagines żyją w Rabie, niektóre z nich prawdopodobnie przechodzą pełny cykl rozwojowy w licznie rozmieszczonych wzdłuż rzeki starorzeczach.

Znaczna różnica wysokości w przedziale, której płynie rzeka, w powiązaniu ze znacznym spadkiem jednostkowym i różnorodnością podłoża powoduje, że fauna chrzączków Raby jest dość bogata i różnorodna. Są tu gatunki wysokogórskie zasiedlające odcinek stanowisk od 0 do 3 oraz górskie, a także nizinne spotykane głównie na stanowisku 10.



W oparciu o układ dominacji rodzaju i gatunków chruścików siedliska lotycznego dokonano podziału Raby na strefy (tabela II, ryc. 2). Wydzielono 3 strefy i 7 podstref:

I-1 — źródło (stanowisko 0) z dominacją *Drusus carpathicus*;

2 — odpływ ze źródła na stromym zboczu (stanowisko 1) z dominacją *Apatania carpathica*, *Drusus muelleri*, *Melampophylax nepos*;

II-3 — wartki potok górski powstały z połączenia się odpływów ze źródeł (stanowisko 2) z dominacją *Rhyacophila glareosa*, *Glossosoma conformis*, *Drusus discolor*;

4 — górski potok źródłowy o dość znacznym przepływie u podnóża gór (stanowisko 3) z dominacją przedstawicieli rodzaju *Rhyacophila* (*R. tristis*, *R. vulgaris*) i *Philopotamus ludificatus*;

III-5 — górski potok wśród pól uprawnych (stanowisko 4—5) z dominacją *Hydropsyche instabilis*, *Rhyacophila nubila*, *R. mocsaryi*;

6 — rzeka górska (stanowisko 6 do 9) z dominacją: *Hydropsyche pellucidula*, *Psychomyia usilla*, *Hydroptila forcipata*;

7 — rzeka podgórska (stanowisko 10) z dominacją: *Hydropsyche bulbifera*, *H. contubernalis*, *Hydroptila lotensis*.

Powyższy układ stref przyrównano do podziału wód biejących Illiesa i Botosaneanu (1963): Strefa I odpowiada prawdopodobnie krenonowi (I-1) eukrenon, I-2 hypokrenon);

„ II „ „ epiritronowi;

„ III-5 „ „ metaritrtonowi;

„ III-6-7 „ „ hyporitrtonowi (z cechami potamonu — stanowisko 10).

W rozmieszczeniu chruścików siedliska lotycznego z biegiem rzeki daje się zauważyć interesujące zjawisko zastępowania się poszczególnych gatunków w obrębie rodzajów. Np. w rodzaju *Drusus* (tabela II, ryc. 2): *carpathicus* — *muelleri* — *discolor*, *annulatus* — *discolor*, *trifidus* — *biguttatus*; w rodzaju *Rhyacophila*: *polonica* — *vulgaris* — *mocsaryi* — *nubila*; *Hydropsyche*: *instabilis* — *pellucidula* — *bulbifera* — *contubernalis*; *Hydroptila*: *forcipata* — *lotensis*. Czynnikiem decydującym o takim rozmieszczeniu jest prawdopodobnie termika wody.

Ze względu na sposób odżywiania się larw można wyróżnić wśród chruścików Raby następujące typy morfologiczne: A — larwy drapieżne, wolnożyjące (*Rhyacophila*); B — larwy wszystkożerne, budujące sieci (*Philopotamus*, *Wormaldia*, *Hydropsyche*, *Plectrocnemia*, *Polycentropus*, *Cyrnus*); C — larwy glonożerne, budujące spłaszczone domki (*Glossosoma*, *Synafophræa*, *Synagapetus*, *Agapetus*, *Ithytrichia*, *Hydroptila*, *Apatania*, *Lithax*, *Silo*) albo budujące kanaliki z drobnego piasku na powierzchni kamieni (*Psychomyia*, *Lype*, *Tinodes*); D — larwy wszystkożerne, jednakże z przewagą pokarmu pochodzenia roślinnego, budujące domki cylindryczne z piasku, z detritusu bądź mieszane piasek z detritusem. Spośród larw tej ostatniej grupy glony preferują: *Drusus*, *Acrophylax*, *Melampophylax*, natomiast detritus preferują: *Potamophylax*, *Allogamus*, *Chaetopteryx*, *Psilopteryx*, *Pseudopsilopteryx*, *Sericostoma*. W pobliżu źródeł dominują glonożercy z grup C i D, niżej w otoczeniu stanowiska 3 dominują drapieżcy z grupy A i formy budujące sieci z grupy B. Na pozostałym najdłuższym odcinku Raby dominują formy wszystkożerne, budujące sieci z grupy B i glonożercy z grupy C z niewielką ilością drapieżców z grupy A. Larwy tych ostatnich grup wykazują szereg przystosowań do warunków prądowych rzeki górskiej o częstych i znacznych wahaniami w poziomie przepływu wód.

Dla najliczniejszych gatunków: *Rhyacophila nubila*, *R. tristis*, *Hydropsyche instabilis*, *H. pellucidula*, *Psychomyia pusilla*, *Drusus discolor* wydzielono stadia larwalne i ustalono, że wyżej wymienione gatunki posiadają po jednym pokoleniu w ciągu roku (ryc. 3 do 8). W oparciu o obserwacje terenowe autora przypuszcza się, że prawie wszystkie gatunki chruścików zasiedlających Rabę posiadają nie więcej niż jedno pokolenie w ciągu roku.

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## ERRATA

Strona Page	Wiersz — Line		Zamiast — Instead of	Winno być — Ought to be
	od góry	od dołu		
	from above	from below		
1		13	buli ding	building
2		13	eficient	efficient
2		14	wuld	would
5	15		presesence	presence
5		16	<i>aculealus</i>	<i>aculeatus</i>
21		3	fremes	fermes
23	21		individuens oscillait	individus oscillaient
23		10	donne	donné
25	19		B i c k (1960)	B i c k (1968)
27		6	<i>Ophyroglena</i>	<i>Ophryoglena</i>
30	10		différentés	différents
33	3		B o v e c	B o v e e
33	8		holozoïque	holozoiique
33		5	infusoizes	infusoires
33		5	Bid.	Biol.
35	11		<i>Hydrophysyche</i>	<i>Hydropsyche</i>
35		1	teriritory	territory
37		20	stations o	stations 0
50		21	<i>Synafophræa</i>	<i>Synafophora</i>
51	1		delavalée	de la vallée
57		16	<i>Microspectra</i>	<i>Micropsectra</i>
63	11		<i>Gastropodo</i>	<i>Gastropoda</i>
65	1		butit	but it
68	2		liczebności	liczebność
68		19	279—304.	111—132.
68		17	261—277.	279—304.
71	12		condtion	condition
Content Insert		4	<i>aeruginos</i>	<i>aeruginosa</i>
(Klimeczyk- Janikowska)	1, 4		<i>erythroptthalmus</i>	<i>erythrophthalmus</i>
	6		<i>erythroptthalmus</i>	<i>erythrophthalmus</i>