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Wodopójki *(Hydracarina)* rzeki Raby i niektórych jej dopływów *

Hydracarina of the River Raba and some of its tributaries

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Abstract — The paper contains the results of investigations carried out in the years 1969—1971 on *Hydracarina* of the River Raba and some of its tributaries. 92 species of *Hydracarina* were listed, among them 46 species new for the Polish fauna, 61 new for the Polish part of the Carpathians, and 10 new species for the whole territory of the Carpathians. The author indicated zones of *Hydracarina* populations of the River Raba, distinguishing the "zone of *Sperchon*" and the "zone of *Hygrobates-Lebertia*". He also characterized the occurrence of *Hydracarina* in various environments.

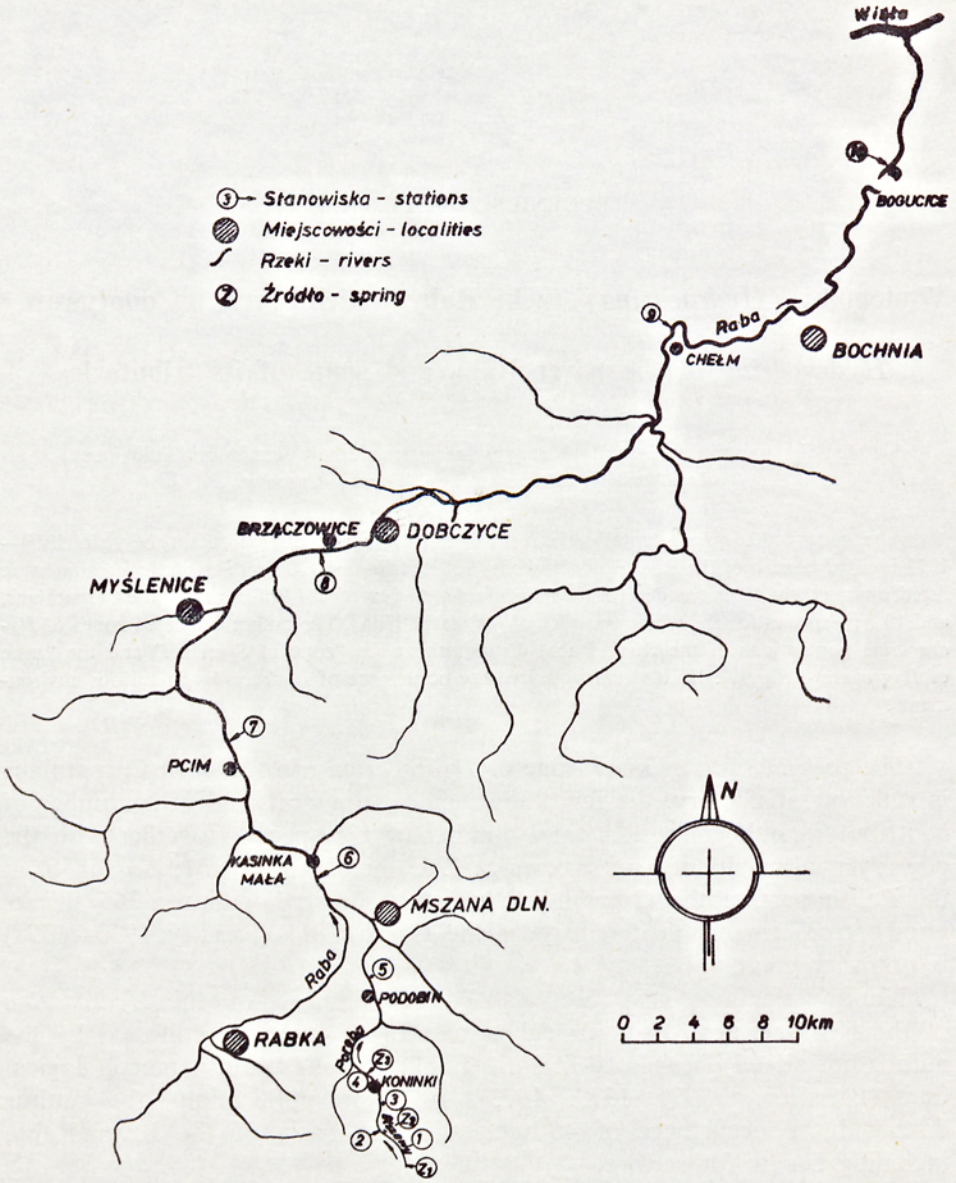
The present state of knowledge of *Hydracarina* of the Polish Carpathians is still not satisfactory, the few known data being scattered in a number of contributory publications. A total number of 126 species (together with the controversial results of Kupiszewska 1965) has been recorded so far from the Polish part of the Carpathians, which, compared with the 365 species known from the whole territory of the Carpathians (Szalay 1970—1971) is not very great.

No investigations have been carried out till now on the *Hydracarina* of the River's Raba basin, though a part of the material collected by the author has already been used in some publications, especially morphological ones (Biesiadka 1971, 1972, 1973). In these publications the author discussed the occurrence of 46 species in the basin of the River Raba, including 5 new for science.

General character of the terrain

The examined part of the River Raba basin is a typical Carpathian river. It includes the whole Olszowy Potok and the lower part of the streams Koninka, Poręba, and Mszanka, as well as the River Raba from Kasinka Mała

* Praca wykonana w ramach problemu resortowego PAN Nr 21.



Ryc. 1. Mapka dorzecza Raby

Fig. 1. Map of the basin of the River Raba

to the confluence of the Raba with the River Vistula. The River Raba basin is shown on the map (fig. 1). Field investigations were carried in the years 1969—1971 with special intensity in 1970. Qualitative methods generally applied in hydrobiological investigations were used, with different variations

in connection with the great variety of the environments. Samples were taken at the following stations:

Z_1. The springs of the Olszowy Potok, lying at the top of Mount Turbacz at an altitude of 1230 m above sea level, are of rheohelokren character, a great number of mosses being symptomatic. The wooded territory in which they lie provides favourable conditions for maintaining a constant low temperature.

Z_2. The spring-rheokren lying in the valley of the Olszowy Potok on its left bank, at an altitude of 950 m above sea level. In the outflow of the spring mosses and agglomerations of dead leaves; territory covered with woods.

Z_3. Springs — rheohelokren and limnokren, in the valley of the Koninka stream at an altitude of 600 m above sea level. The spring area lies on a mossy meadow in open territory. The limnokren has an area of 1×2 m, average depth 20—30 cm.

1. The Olszowy Potok in its upper course, altitude of 1180 m above sea level. The valley cut sharp. Steep gradient. The rock material poorly worked, some stones sparsely overgrown with mosses. The water level low.

2. The Olszowy Potok in its middle part, an altitude of 990 m above sea level. In character similar to that at previous stations but water more abundant. Average width about 1 m, depth 5—10 cm.

3. The Olszowy Potok in its lower course, at an altitude of 780 m above sea level. The rock material with evident traces of rolling. Small marginal water bodies are formed, the valley of the stream becoming wider.

4. The Koninka stream in its lower course, at an altitude of 580 m above sea level. Marginal water bodies more developed. Width about 2 m, depth variable.

5. The Poręba stream at Podobin, at an altitude of 460 m above sea level. The valley of the stream distinctly becoming wider, no woods, width of the stream 5—10 m. Side marginal water bodies well developed. Stones abundantly covered with periphyton.

6. The River Raba at Kasinka Mała, at an altitude of 370 m above sea level. The valley wide, greatly flattened. Stones abundantly overgrown with periphyton. At this station a sample of *Hydracarina* was taken from interstitial waters by means of the Chappuis (1942) method.

7. The River Raba at Pcim-Łuczany, at an altitude of 315 m above sea level. The river similar as at the previous station but wider. In the valley interesting old river beds having contact with the river at times of high water level.

8. The River Raba at Brzączowice, at an altitude of 250 m above sea level. The character of the river as at Pcim-Łuczany.

9. The River Raba at Chełm, at an altitude of 210 m above sea level. In the aluvia of the river gravel and sand appear. The old river beds lying on the flood terrace were also considered in these investigations.

10. The River Raba at Bogucice, at an altitude of 185 m above sea level. The station situated about 8 km from the mouth of the Raba on the territory of the Sandomierz lowlands. Rubble in the form of pebbles, much gravel, and sand. Periphyton on stones poorly developed.

A more detailed description of the River Raba basin can be found in a number of publications; among the more recent ones those of Punzet (1969) and Pasternak (1969) should be mentioned.

General character of the material

In the course of the two years' investigations 92 species of *Hydracarina* were found to occur in the examined territory of which 47 were found in the river itself, 32 in the springs, and 22 in flood reservoirs. The fauna of *Hydracarina* of the River Raba should thus be regarded as very rich, even for the conditions of a montane river. None of the so far examined Carpathian rivers demonstrated such a number of species as the River Raba. The cause of such an abundance of fauna is not accounted for by the different character of the river but only by the great variety of environments considered.

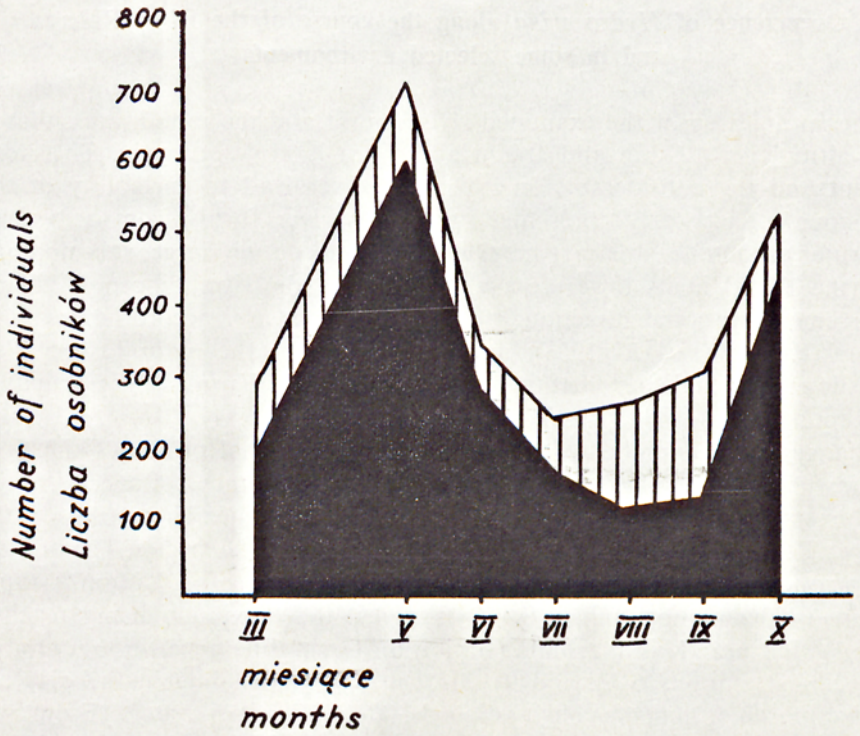
A quantitative specification of the collected material is given in Table I., *Hygrobates fluviatilis* (Ström) — the commonest rheophilous species in Poland — being the most numerous. In the second place is *Limnesia koenikei* Piersig, a species characteristic of waters of the flood terrace of montane and sub-montane rivers, and the third place is held by the krenobiont *Partnunia steinmanni* Walter. Numbers of more than 100 specimens were reached by *Lebertia violacea* Viets, *Sperchon brevirostris* Koenike and *Lebertia circularis* Viets. In the class between 20 and 100 specimens there were 10 species. In the class from 5 to 19 specimens there were 22 species, while 53 species occurred in numbers of less than 5 specimens from which 35 species were represented by single specimens only.

The greatest frequency was demonstrated by *Lebertia circularis*, *Hygrobates fluviatilis*, and *Atractides nodipalpis* (Thor), which occurred at more than half the stations. Great frequency was shown by *Lebertia fimbriata* Thor, *L. porosa* Thor, *L. violacea*, *Torrenticola barsica* (Szalay), *T. elliptica* Maglio, and *Axonopsis rotundifrons* Viets. There were 57 very rare species which occurred at one station only, constituting 62 per cent of the total number of species.

Phenological remarks

Field investigations on *Hydracarina* of the River Raba were carried out from March till October. This permitted analysis of the occurrence of *Hydracarina* in the annual cycle. Figure 2 gives a general picture of the course of

variations in the occurrence of imagines and nymphs in the year 1970. Nymphs were found all the year round and their quantitative level was always fairly low. Nymphs showed one distinct maximum in August and September correlated in time with the minimum of occurrence of imagines. The second half of the summer is thus the period of more intensive development of *Hydracarina* in montane rivers. It should be added that at this time nymphs occurred most numerously in the middle and lower parts of the river. The majority of the nymphs belonged to *Hygrobates fluviatilis* and to the genus *Lebertia* Neuman, most numerously represented in this place.



Ryc. 2. Występowanie imagines (powierzchnia zaczerniona) i nimf (powierzchnia kreskowana) wodopójek w cyklu rocznym

Fig. 2. Occurrence of imagines (dark area) and nymphs (hatched area) of *Hydracarina* in the annual cycle

In the occurrence of nymphs another peak was observed, though much smaller, in May. This period was characteristic of the upper, colder, part of the river and of the reproduction of the most numerously genus represented there, *Sperchon* Kramer. At that time nymphs of *Sp. brevirostris* dominating in this part of the stream were found in the greatest numbers.

In May a peak of the occurrence of nymphs was also observed in the springs of the Olszowy Potok lying on Mount Turbacz.

From the above-given facts an interesting conclusion can be drawn. The *Hydracarina* populating the middle and lower parts of the river, characterized by great variations of temperature in the summer season, develop later than those occurring in the springs and the upper, colder, part of the river. It should be stressed, however, that this regularity is of statistic character and it is possible that with another composition of dominating species it would appear slightly different.

Occurrence of *Hydracarina* along the course of the River Raba and in some selected environments

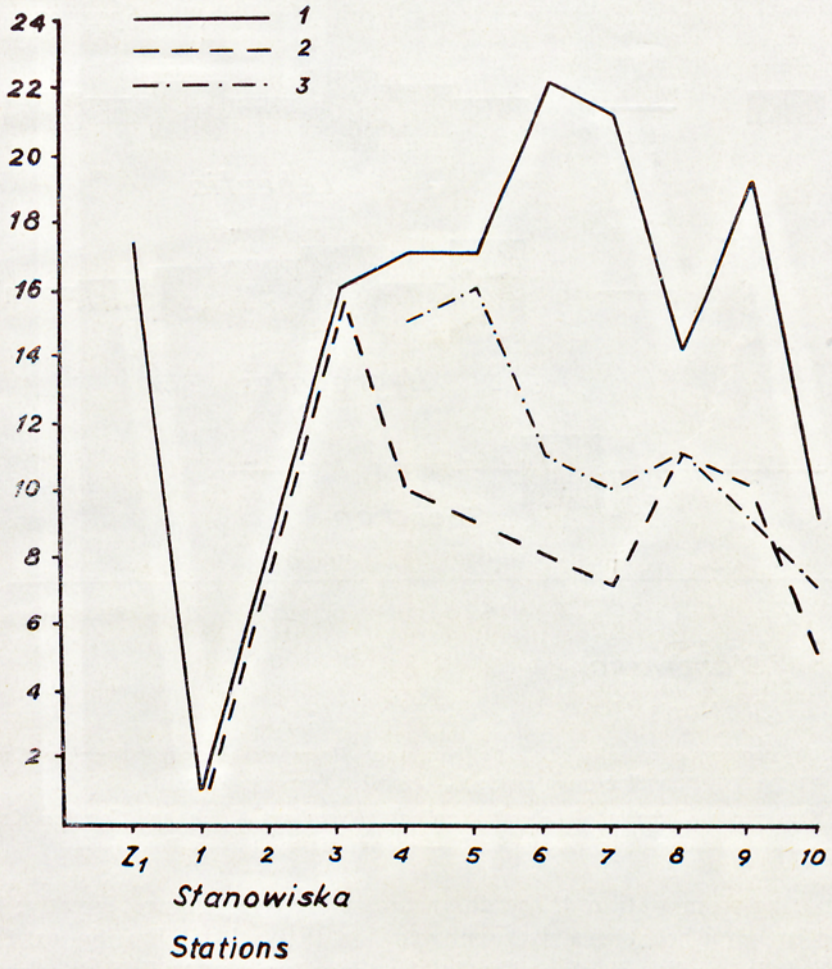
The spring area of the examined river course and the mouth are situated at an altitude of 1220 m and 180 m above sea level respectively. The steep gradient and the considerable length of the river lead to variability of the water-course. Here are represented numerous river forms from a typical, cold-water, montane stream (the Olszowy Potok) to a large sub-montane river (the Raba) in its lower course. Changes in the river biocenoses being in agreement with the direction of the water flow are, according to some authors (e. g. Mikulski 1958), a representation of the natural succession of the flow. This finds justification also in the fauna of *Hydracarina* populating the Raba.

Changes in the number of species in the longitudinal profile of the river are shown in the diagram (fig. 3) in which the total number of species found at the examined stations is marked with a continuous line. The springs of the Olszowy Potok (Z_1) are characterized by a great variety of species. The poorest in *Hydracarina* was station 1 (1 species). Starting from this station a rapid increase in the number of species took place, the maximum being reached at the station near Kasinka Mała (station 6). Great differences in the number of species at stations 6, 7, and 9 were caused by including in the diagram the riverine environments, old river beds, and interstitial waters. From station 6 on the number of species in the River Raba gradually decreased, falling to 9 species only near Bogucice (station 10).

Very similar changes occurred in the general intensity of occurrence (number of species) of *Hydracarina*. The maximum population was recorded at the middle stations (5—8), decreasing in both directions, to the spring and to the mouth, the springs themselves being characterized by a numerically very rich fauna.

The same diagram (fig. 3) shows the dynamics of the number of species in the current environment (broken line) and in marginal water bodies (broken line with dots). The general course of the curves is in agreement; in the simplified presentation of the environment the richest fauna was also found at the middle stations.

The distribution of the three most numerous species — *Sperchon*, *Hygrobates* Koch and *Lebertia* (fig. 4) — in the River Raba is very interesting. A more numerous occurrence of the genus *Sperchon* Kramer is very charac-

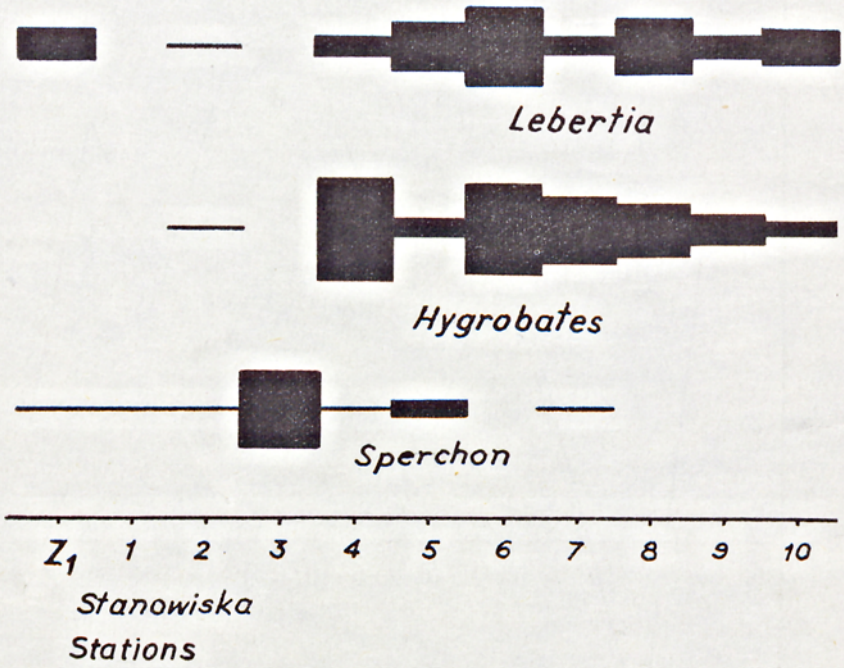


Ryc. 3. Zmiany liczby gatunków wodopójek wzdłuż biegu rzeki: 1 — ogólna liczba gatunków na stanowiskach; 2 — w środowiskach prądowych; 3 — w zastoiskach; Z_1 — źródła Olszowego Potoku

Fig. 3. Numerical variations of species of *Hydracarina* along the river course: 1 — total number of species at stations; 2 — in current environments; 3 — in marginal water bodies; Z_1 — springs of the Olszowy Potok

teristic of the upper part of the river, the greatest intensity of occurrence being recorded at station 3. *Sp. brevirostris*, a petrorheobiontic species, was most numerously represented. The severe winter conditions of the cold montane streams are very favourable for its development. The upper part

of the examined river course (the Olszowy Potok) is characterized by a dominance of petrorheophilous environments, hence evident dominance of the genus *Sperchon*, and especially *Sp. brevirostris*. For this reason the sector of the river bounded by stations 1 and 3 can be called "the *Sperchon* zone".



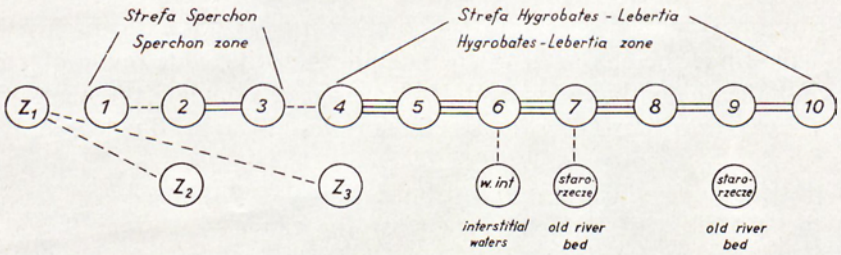
Ryc. 4. Występowanie rodzajów *Lebertia* Neuman, *Hygrobates* Koch i *Sperchon* Kramer wzdłuż biegu rzeki; Z_1 — źródła Olszowego Potoku

Fig. 4. Occurrence of genera of *Lebertia* Neuman, *Hygrobates* Koch, and *Sperchon* Kramer along the river course; Z_1 — springs of the Olszowy Potok

Starting from station 4, the character of the river changes greatly: from a cold stream it becomes a river with very low thermal stabilization, extremely eurythermic conditions prevailing in the lower course. A distinct numerical dominance of *Hygrobates* and *Lebertia* was observed. Antagonism, especially between the species *Sperchon* and *Hygrobates*, could be observed. A small rise in the number of *Sperchon* at station 5 corresponded with a great fall in the number of *Hygrobates*. Increased occurrence of the genus *Lebertia* Neuman was characteristic of the springs, *Lebertia polonica* Biesiadka and species of the subgenus *Hexalebertia* Thor being mainly found there. The middle and lower course of the river, characterized by a more numerous occurrence of the species *Hygrobates* and *Lebertia*, was also distinguished by the development of the water bodies of the flood terrace — especially of old river beds with their typical and rich fauna. It is suggested that the

sector of the river lying below station 4 should be called the "*Hygrobates-Lebertia* zone".

The distinguished zones are clearly separated, this being seen in the diagram (fig. 5). This diagram shows the similarities between the neighbouring stations



Ryc. 5. Schemat podobieństwa (P) sąsiadujących ze sobą stanowisk (1—10). Linia przerywana — $0 < P < 0{\cdot}1$; linia podwójna — $0{\cdot}2 < P < 0{\cdot}5$; linia potrójna — $P > 0{\cdot}5$; Z — źródła

Fig. 5. Scheme of the similarity (P) of the stations (1—10) neighbouring with each other. Broken line $0 < P < 0{\cdot}1$; double line — $0{\cdot}2 < P < 0{\cdot}5$; triple line — $P > 0{\cdot}5$; Z — springs

calculated according to Jaccard's formula $P = \frac{c}{a+b-c}$ where a, b are the numbers of species (individuals) found at the compared stations, and c — the number of species (individuals) common to the two compared stations. The similarity for the species (P_1) and for the individuals (P_2) were calculated. The stations were compared on the basis of the mean similarity, which was higher or lower than P_1, and which in the author's opinion characterized the examined stations more accurately. The calculated similarities were divided into classes. The discussed diagram is the final effect of these operations and at the same time a clear "model" of the examined river system. Different kinds of lines — from broken to triple — correspond to the classes of similarity. Relations between the stations are either very loose as, for instance, between the springs, between the initial stations, or between old river beds and the river or they may be close, as between two neighbouring stations of the middle course and lower course of the river. It is interesting that the fauna of the springs (Z_1), from which the Potok Olszowy originates, differs distinctly from that of the upper part of the Potok Olszowy, which in turn is characterized by a poorly stabilized fauna. Hence there is a slight difference between the upper and the lower part of the Potok Olszowy. The sector between stations 1 and 3, determined previously as the "*Sperchon* zone", can be divided into two sub-zones:

a) the sub-zone of fauna formation — the region of station 1,

b) the sub-zone of stabilization of the fauna — stations 2 and 3.

The "*Hygrobates-Lebertia* zone", characterizing the longest sector of the river, is of a fairly uniform character. The typical fauna of the old river beds, with the dominating species *Limnesia koenikei*, completes the fauna of the river itself. The fauna of *Hydracarina* changes basically only from

station 9 on, these changes consisting in its quantitative and qualitative reduction. This may be caused by pollution, especially at station 10 where the fauna may be influenced, to a certain extent, by the pollution from Bochnia. Another cause lies most probably in the zoogeographical relations. The terminal stations (station 10) lie beyond the Carpathians, hence the partial disappearance of the typical montane forms is quite comprehensible; at the same time, the character of the river does not provide favourable conditions for the rheophilous lowland *Hydracarina* to populate this part of the river. The "*Hygrobates-Lebertia* zone" can thus also be divided into two sub-zones:

a) the sub-zone of stabilization of the fauna — stations 4—8,

b) the sub-zone of impoverishment of the fauna — stations 9 and 10.

This division into two zones and four sub-zones has, apart from a faunistic justification also a hydrographic one.

In close connection with the problem of zones remains the distinction of environments characterized, with reference to *Hydracarina*, by different faunistic structures. The following environments were distinguished:

springs,

"the *Sperchon* zone"

— the petrorheic environment,

— mosses overgrowing the stones in the stream,

"the *Hygrobates-Lebertia* zone":

— the current environment,

— marginal water bodies,

— interstitial waters,

— old river beds.

is The participation of individual species in the distinguished environments shown in Table I.

Springs

Hydracarina collected in individual springs are listed in Table II. From the three examined springs two supplied the majority of material. These were the springs of the Olszowy Potok lying below the head of Mt. Turbacz and those lying at the foot at Koninki. The fauna of those springs is very rich, though the groups of *Hydracarina* in the two springs developed differently. The springs on Mt. Turbacz are especially interesting. *Partnunia steinmanni*, an alpine cold-stenothermic species occurring in great numbers, was the dominant. The second with regard to number was the new species *Limnesia polonica* which, taking the present data as a basis, can be supposed to be a krenobiont. Fairly numerous were: *Soldanellonyx chappuisi* Walter, the only representative in the investigated territory of *Porohalacaridae*, and *Sperchon mutilus* Koenike and *Hydrovolzia placophora* (Monti). Of the 17 species occurring in the springs of the Olszowy Potok as many as 13 can

be regarded as krenobionts. The only krenoxen was *Brachypoda versicolor* (Müller) and the collection of this species in springs distant from larger stagnant waters is particularly worth mentioning. The species *Pseudofeltria quadriscutata* Biesiadka had so far been found nowhere except in the springs of the Olszowy Potok. Some other species (*Thyasella mandibularis* (Lundblad)), *Lebertia cuneifera* Walter, *L. sefvei* Walter, *L. tenuicollis* Victs, *Pseudofeltria scourfieldi* (Soar) have here their only known place of occurrence in the Carpathians.

The springs at Koninki represent a different faunistic type. Only *Arrenurus conicus* Piersig, *Hygrobates norvegicus* (Thor), *Dartia borneri* Walter, *Lebertia stigmatifera* Thor, and *Arrenurus cylindratus* Piersig appeared here in large numbers, other species occurring only as single specimens. The springs at Koninki are so far the only place where *Sperchon carpaticus* Biesiadka and *Atractides gorcensis* Biesiadka, described from there, were found. Species from the genus *Arrenurus* Dugès are characteristic of the limnokren part of the spring.

Only *Sperchon mutilus* and *Lebertia stigmatifera* occur simultaneously in the springs of the Olszowy Potok at Koninki. The springs of the Olszowy Potok are near in type to the alpine springs for which a great number of *Partnunia steinmanni* is symptomatic. Similar springs were described by Schwoerbel (1959) from the Schwarzwald. It may be supposed that in the Carpathians this type of spring is common. The springs at Koninki are probably characteristic for lower altitudes.

Surface of stones in the current — petrorheic environment

The petrorheic environment covers almost the whole Olszowy Potok, stenothermy being a factor associated with its occurrence. In this environment 18 species of *Hydracarina* were found, *Sperchon brevirostris* being collected most frequently directly from the stones, where it found shelter in numerous small crevices. It cannot be excluded that, besides occupying cracks and crevices, it has the ability of dissolving limestone. Eggs in the form of red clusters are laid directly on stones and can only with the greatest difficulty be separated from the breeding ground. Larvae parasitize on *Chironomidae* (Lundblad 1930). Among other representatives of the genus *Sperchon*, *Sperchon glandulosus* Koenike, *Sp. thienemanni* Koenike, *Sp. denticulatus* Koenike, and *Sp. hispidus* Koenike also occurred here, but only as accompanying species. Rheophilous species of the genus *Aturus* Kramer and *Feltria* Koenike were found there too, though not in great numbers. Exclusive for this environment were 8 species. It was interesting to find *Kongsbergia dentata* Walter, which is considered to be associated with interstitial waters (Walter 1947).

Tabela I. Ilościowe zestawienie wodopójek i ich występowanie w różnych środowiskach. + - 1 do 5 osobników; ++ - 6 do 20; +++ - 21 do 100; ++++ - ponad 100 osobników; (+) - z aluwiów przy źródle w Koninkach

Table I. Quantitative comparison of Hydracarina and their occurrence in various environments + - 1 to 5 specimens; ++ - 6 to 20; +++ - 21 to 100; ++++ - over 100 specimens; (+)- from alluvia by the spring at Koninki

Gatunek Species	Liczba osobników Number of specimens	Frekwencja Frequency: % na stanowiskach in at stations	Frekwencja Frequency: % w próbach in samples	Dominacja % Domination	Rzeka River: środowiska petroreiczne petroreic environments	Rzeka River: mchy mosses	Rzeka River: zastoiska marginal water bodies	Rzeka River: środowiska prądowe current environments	Rzeka River: wody interstycjalne interstitial waters	Źródła Springs	Starorzecza Old river beds
Soldanellonyx chappuisi Walter	15	18.75	7.57	0.64			+			++	
Hydrovolzia placophora (Monti)	11	6.25	6.06	0.47						++	
Hydrachna globosa (Geer)	1	6.25	1.51	0.04							+
- processifera Koenike	1	6.25	1.51	0.04							+
Eylais extendens (Müller)	1	6.25	1.51	0.04							+
Protzia eximia (Protz)	6	6.25	4.54	0.25						++	
- invalvaris (Piersig)	2	6.25	3.03	0.08	+						
- cabardinica (Sokolov)	2	6.25	3.03	0.08	+						
Partnunia steinmanni Walter	224	12.50	12.12	9.53						++++	
Thyopsis cancellata (Protz)	1	6.25	1.51	0.04						(+)	
Thyas rivalis Koenike	1	6.25	1.51	0.04						+	
Thyasella mandibularis (Lundblad)	1	6.25	1.51	0.04						+	
Hydrodroma despiciens (Müller)	1	6.25	1.51	0.04							+
Teutonia cometes (Koch)	7	18.75	6.06	0.30			+				++
Sperchon turgidus Viets	1	6.25	1.51	0.04						+	
- brevirostris Koenike	132	18.75	13.64	5.51	+++	+					
- glandulosus Koenike	3	12.50	3.03	0.13	+						
- thienemanni Koenike	4	6.25	1.51	0.17	+						
- mutilus Koenike	13	12.50	7.57	0.55						++	
- clupeifer Piersig	1	6.25	1.51	0.04			+				
- denticulatus Koenike	2	6.25	1.51	0.08	+						
- hispidus Koenike	26	25.00	9.09	1.10	+		+	++			
- carpaticus Biesiadka	1	6.25	1.51	0.04						(+)	
Sperchonopsis verrucosa (Protz)	3	6.25	1.51	0.13					+		
Dartia borneri Walter	7	6.25	3.03	0.30						++	
- longipora Walter	1	6.25	1.51	0.04						+	
Lebertia apposita Láska	2	6.25	1.51	0.08						+	
- fimbriata Thor	75	46.15	24.24	3.19	+		++	+++			+
- inversa Koenike	9	18.75	9.09	0.38			+	+			
- polonica Biesiadka	46	6.25	10.61	1.91						+++	
- circularis Viets	106	43.75	33.33	4.50			+++	+++			+
- insignis Neuman	3	12.50	3.03	0.13							+
- porosa Thor	48	31.25	12.12	2.04			++	+++			
- violacea Viets	169	37.50	24.24	7.19			+++	+++			
- crenophila Viets	1	6.25	1.51	0.04						+	
- cuneifera Walter	1	6.25	1.51	0.04						+	
- sefvei Walter	4	6.25	3.03	0.17						+	
- stigmatifera Thor	10	12.50	6.06	0.42						++	
- tenuicollis Viets	1	6.25	1.51	0.04						+	
- dubia Thor	1	6.25	1.51	0.04						+	
Torrenticola anomala (Koch)	4	12.50	3.03	0.17			+				
- barsica (Szalay)	25	25.00	12.12	1.06			+	++	+		
- bicincta Láska	7	18.75	9.09	0.30			+	+			+
- dudichi (Szalay)	1	6.25	1.51	0.04					+		

Tabela I. c.d.
Table I. cont.

Gatunek Species	Liczba osobników Number of specimens	Frekwencja Frequency		Dominacja Domination	Rzeka River							
		na stanowiskach w % at stations in	w próbach w % in samples	w %	środowiska petroreiczne petroreic environments	mchy mosses	zastoiska marginal water bodies	środowiska prądowe current environments	wody interstycjalne interstitial waters	źródła Springs	Starorzecza Old river beds
Torrenticola elliptica Maglio	41	31.25	12.12	1.74			++	+++	+		+
- ungeri (Szalay)	1	6.25	1.51	0.04			+				
Limnesia fulgida Koch	9	6.25	3.03	0.38							++
- koenikei Piersig	260	18.75	7.57	11.06							++++
Hygrobates calliger Piersig	1	6.25	1.51	0.04				+			
- fluviatilis (Ström)	711	43.75	48.48	30.24	+		++++	+++			
- foreli (Lebert)	5	6.25	1.51	0.21	+						
- longipalpis (Hermann)	3	6.25	3.03	0.13							+
- longiporus Thor	21	18.75	6.06	0.89			++	+			
- porrectus Koenike	44	37.50	10.61	1.87			+++	++			+
- norvegicus (Thor)	18	6.25	4.54	0.76						++	
Atractides barsiensis (Szalay)	2	6.25	3.03	0.08						+	
- barbarae Biesiadka	1	6.25	1.51	0.04					+		
- diastema (Szalay)	11	18.75	7.57	0.47			+	++			
- gorcensis Biesiadka	1	6.25	1.51	0.04						(+)	
- fluviatilis (Szalay)	2	6.25	1.51	0.08				+			
- latipes (Szalay)	2	12.50	3.03	0.08				+	+		
- mitisi (Walter)	1	6.25	1.51	0.04			+				
- nodipalpis (Thor)	83	43.75	30.30	3.53	+	+	+	+++			
- phreaticus (Motas et Tanasachi)	1	6.25	1.51	0.04			+				
- acutirostris (Motas et Angelier)	4	12.50	3.03	0.17			+	+			
- magnirostris (Motas et Tanasachi)	2	6.25	1.51	0.08			+				
Neumania deltoides (Piersig)	5	6.25	3.03	0.21							+
Feltria minuta Koenike	13	18.75	7.57	0.55	+	+				++	
- rubra Piersig	7	12.50	4.54	0.30	+	+					
- zschokkei Koenike	16	18.75	7.57	0.64	++	++					
Azugofeltria mira Motas et Tanasachi	1	6.25	1.51	0.04					+		
Wettina podagrica (Koch)	1	6.25	1.51	0.04						+	
Piona discrepans (Koenike)	13	6.25	4.54	0.55							++
Pseudofeltria quadriscutata Biesiadka	4	6.25	3.03	0.17						+	
- scourfieldi Soar	7	6.25	4.54	0.30						++	
Lethaxona cavifrons Szalay	1	6.25	1.51	0.04						(+)	
Brachypoda versicolor (Müller)	1	6.25	1.51	0.04						+	
Axonopsis gracilis (Piersig)	5	12.50	4.54	0.21			+	+			
- rotundifrons Viets	13	31.25	9.09	0.55			++	+			
Aturus crinitus Thor	12	12.50	4.54	0.51	+	++					
- scaber Kramer	14	25.00	7.57	0.59	++	+	+				
- spatulifer Piersig	1	6.25	1.51	0.04	+						
- paucisetus Motas et Angelier	1	6.25	1.51	0.04					+		
Kongsbergia dentata Walter	1	6.25	1.51	0.04	+						
Stygomomonia latipes Szalay	1	6.25	1.51	0.04					+		
Neoacarus hibernicus Halbert	1	6.25	1.51	0.04					+		
Arrenurus cuspidator (Müller)	1	6.25	1.51	0.04							+
- conicus Piersig	30	6.25	4.54	1.28						+++	
- cylindratus Piersig	4	6.25	3.03	0.17						+	
- globator (Müller)	1	6.25	1.51	0.04							+
- membranator Thor	1	6.25	1.51	0.04						+	
- zachariae Koenike	1	6.25	1.51	0.04							+

Mosses

This is an environment usually very interesting in montane conditions but unfortunately in the examined flow poorly developed. Small accumulations of mosses (apart from springs) were found only in the Olszowy Potok, hence the moss-loving fauna did not play here any great role. A total number of 7 species were found in the mosses, all of them occurring simultaneously in petrorheic environments. Only *Feltria zschokkei* Koenike and *Aturus crinitus* Thor were more numerous.

Current environment of a stony and stone-gravel bottom of the "*Hygrobates-Lebertia* zone"

The discussed environment corresponds, to a certain extent, to the petrorheic environment of the "*Sperchon* zone". It is characterized by a great variety of the *Hydracarina* fauna, 20 species being found here. Most numerously represented were *Atractides nodipalpis*, *Lebertia circularis*, *L. fimbriata*, *L. porosa*, *L. violacea*, and *Hygrobates fluviatilis*, the remaining species being found in small numbers. The small specificity of the fauna should be stressed. Only one species of *Atractides fluviatilis* (Szalay) occurred in this environment. As concerns quantity, the fauna of the current environments was poorer than that of the marginal water bodies.

Marginal water bodies with muddy bottom of the "*Hygrobates-Lebertia* zone"

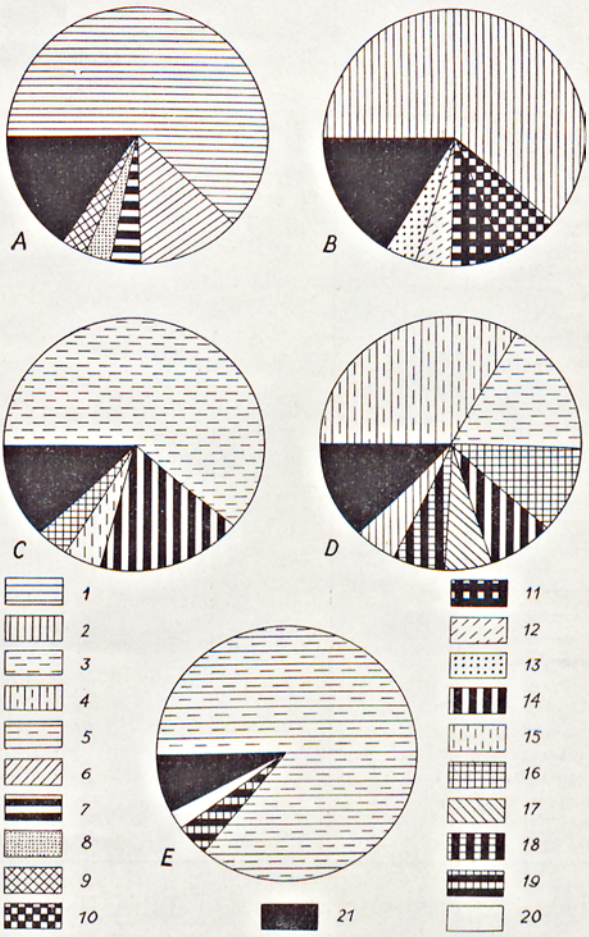
In the middle and lower parts of the river the greatest number of *Hydracarina* were concentrated in the marginal water bodies. A vigorous development of the periphyton on the stones is without doubt favourable for the development of the small fauna which constitutes a nutrition base for *Hydracarina*. The extremely eurythermic conditions prevailing in shallow marginal water bodies of the River Raba eliminate, of course, the cold-loving species of the upper course. A total number of 26 species was found in these waters. *Hygrobates fluviatilis* dominated decisively in the samples, *Lebertia circularis*, *L. violacea*, and *Hygrobates porrectus* Koenike also being numerous. Many species were represented by a few specimens only.

The marginal water bodies showed the greatest resemblance to current environments of the "*Hygrobates-Lebertia* zone", as many as 17 species occurring simultaneously in the two environments. Basic differences consist in a different development of the structure of the species dominance (fig. 6C, D). Species associated with flood waters, such as *Limnesia koenikei*, were sometimes encountered in the marginal water bodies.

Interstitial waters

Interstitial waters are an environment very poorly investigated in Poland. The only data from this country concerning *Hydracarina* can be found in the author's previous papers (Biesiadka 1972, 1973) and these also

concern the materials from the River Raba. The list of *Hydracarina* occurring in this environment covers 10 species out of which 7 are typical for that environment only. From the aluvia at the springs at Koninki a sample was



Ryc. 6. Zasadnicze typy w faunie wodopójek dorzecza Raby: A — źródła (źródła Olszowego Potoku położone na Turbaczu); B — środowisko petroreiczne (stanowisko 3); C — zastoiska (stanowisko 5); D — środowisko prądowe (stanowisko 5); E — starorzecze (w Pcimiu-Łuczanach)

Fig. 6. Basic types in the fauna of *Hydracarina* of the basin of the River Raba. A — springs (springs of the Olszowy Potok lying on Mt. Turbacz); B — petrorheic environment (station 3); C — marginal water bodies (station 5); D — current environment (station 5); E — old river bed (at Pcim-Łuczany)

1 — *Partnunia steinmanni*; 2 — *Sperchon brevirostris*; 3 — *Hygrobates fluviatilis*; 4 — *Atractides nodipalpis*; 5 — *Limnesia koenikei*; 6 — *Lebertia polonica*; 7 — *Soldanellonyx chappuisi*; 8 — *Sperchon mutilus*; 9 — *Hydrovolzia placophora*; 10 — *Feltria zschokkei*; 11 — *Aturus crinitus*; 12 — *Feltria rubra*; 13 — *Aturus scaber*; 14 — *Lebertia violacea*; 15 — *L. circularis*; 16 — *L. fimbriata*; 17 — *Sperchon hispidus*; 18 — *Torrenticola elliptica*; 19 — *Piona discrepans*; 20 — *Limnesia fulgida*; 21 — pozostałe gatunki — other species

Tabela II. Zestawienie wodopójek znalezionych w źródłach
Table II. Comparison of Hydracarina found in springs

Gatunek Species	Źródła - Springs		
	Olszowy Potok	w dolinie Olszowego Potoku in the valley of the Olszowy Potok	w Koninkach at Koninki
Soldanellonyx chappuisi Walter	13		
Hydrovolzia placophora (Monti)	11		
Protzia eximia (Protz)	5	1	
Partnunia steinmanni Walter	223	1	
Thyopsis cancellata (Protz)			1
Thyas rivalis Koenike			1
Thyasella mandibularis (Lundblad)	1		
Sperchon turgidus Viets			1
- mutilus Koenike	12		1
- carpaticus Biesiadka			1
Dartia borneri Walter			7
- longipora Walter			1
Lebertia apposita Láska	2		
- polonica Biesiadka	46		
- crenophila Viets			1
- cuneifera Walter	1		
- sefvei Walter	4		
- stigmatifera Thor	5		5
- tenuicollis Viets	1		
- dubia Thor			1
Hygrobates norvegicus (Thor)			18
Atractides barsiensis (Szalay)	2		
- gorcensis Biesiadka			1
Feltria minuta Koenike	9		
Wettina podagrica (Koch)			1
Pseudofeltria quadriscutata Biesiadka	4		
- scourfieldi Soar	7		
Lethaxona cavifrons Szalay			1
Brachypoda versicolor (Müller)	1		
Arrenurus conicus Piersig			30
- cylindratus Piersig			4
- membranator Thor			1

collected in which 4 species were present (in Table II marked by crosses in brackets). In the interstitial environment as many as 3 species new for natural science were found: *Sperchon carpaticus*, *Atractides gorcensis*, and *A. barbarae* Biesiadka. The fauna of *Hydracarina* of the interstitial waters is characterized by a fairly great variety of species, these however, being, usually represented by single specimens only. Great faunistic dispersion is very characteristic of interstitial waters.

Old river beds

According to Žadin (1940) old river beds are an integral part of the river. Their faunistic composition is made up of two components:

1) species typical for old river beds,
2) species which migrated from the river during periods of high water.

From the total number of 22 species occurring in old river beds as many as 13 are in montane river conditions typical for them, *Limnesia koenikei* dominating decisively. A more numerous occurrence of this species is connected with the flood reservoirs of sub-montane rivers. The second as to number was *Piona discrepans* (Koenike), also characteristic for this kind of water body. Fortuitous species, mainly from the genus *Lebertia* and *Torrenticola* Piersig, occurred only as single specimens.

It is interesting that the specificity of the old river beds is a permanent feature, in spite of frequent floods spreading over the whole vast river valley.

In summing up the above considerations concerning environments, it should be noted that the greatest role in the fauna of the *Hydracarina* of the River Raba is played by the 5 environments presented in the diagrams (fig. 6): springs, petroreic environments, marginal water bodies and current environments of the "*Hygrobates-Lebertia* zone", and old river beds.

Another problem are the frequent floods of montane rivers. Usually they have no great influence on the intensity of occurrence of *Hydracarina*, but a great swelling of the river, such as took place in summer 1971, cause great damage. At that time about 80 per cent of the fauna of *Hydracarina* was destroyed in the lower and middle course of the River Raba; while the stream sector did not suffer any serious damage. In the upper part the flood waters passed quickly and did not reach such a scale. Regeneration of the fauna after greater floods would be an interesting problem for investigation.

The Raba against the background of other Carpathian rivers

From the Carpathian rivers the *Hydracarina* of the Orawa (Láska 1953, 1954, 1963) and the Nitra (Láska 1959, 1962) are relatively the best known. A comparison of *Hydracarina* of these two rivers and the River Raba shows many common elements. The faunistic composition of the River Orawa and the lower course of its tributaries as well as the Nitra recalls the "*Hygrobates-Lebertia* zone" of the River Raba, the only more essential difference lying in a more numerous occurrence of *Atractides nodipalpis* in the Slovakian rivers. The high quantitative level of *Hygrobates fluviatilis* and species of the genus *Lebertia* is in both cases symptomatic. Great differences are observed in the composition of concomitantly occurring species, especially those occurring as single specimens, though it should be noted that in the River Raba the composition of concomitant species is at almost every station different.

The fauna of the *Hydracarina* of the cold upper sectors of the tributaries of the River Orawa tends to that of the "*Sperchon* zone" of the examined river course, numerous specimens of *Sperchon brevirostris* and of other species of this genus being a common feature.

In summing up, it may be stated that the Carpathian rivers show, as far

as *Hydracarina* are concerned, great similarities between one another. Unfortunately, having at our disposal only a few detailed elaborations, a fuller comparison is difficult to make. The general poor state of knowledge of *Hydracarina* in the Carpathians, especially in the Polish part, makes it impossible, at least at present, to classify the rivers on the basis of the fauna of *Hydracarina*, which are specially well suited for this purpose.

Summary

1. The River Raba is characterized by a great variability of environments, hence it is no wonder that the fauna of *Hydracarina* living in it is very rich. From the species recorded here as many as 46 were new for Poland. From the basin of the River Raba 5 species new for science were described, one of them — *Lebertia polonica* — occurring also in the proximate Pieniny mountains (Biesiadka 1972). Investigations carried out in the River Raba enrich the fauna of *Hydracarina* of the whole Carpathians by 10 species and the Polish part of the Carpathians by 61 species.

2. In the collected material a distinct quantitative dominance of *Hygrobates fluviatilis*, a species characteristic for marginal water bodies of the middle and lower course of the River Raba, was noted.

3. In characterizing in general the occurrence of nymphs and imagines of *Hydracarina* in the annual cycle, the author distinguished two periods of more intensive development (occurrence of nymphs): an earlier one — characteristic of the stream sector — and a later one — characteristic of the lower course of the river.

4. On the basis of the occurrence of *Hydracarina* the author divided the examined river course into 2 zones:
a) the "*Sperchon* zone"
b) the "*Hygrobates-Lebertia* zone".
The above — mentioned zones are characterized by typical *Hydracarina* fauna, each of them being subdivided into two sub-zones.

5. The author characterized the *Hydracarina* of the following environments:
— springs,
— petrorheic environments of the "*Sperchon* zone",
— mosses,
— marginal water bodies,
— current environments of the "*Hygrobates-Lebertia* zone",
— interstitial waters,
— old river beds.

The main role in the whole fauna of *Hydracarina* is played by 5 environments: the exceptional specificity of the springs of the petrorheic environment of the "*Sperchon* zone", interstitial waters, and old river beds should be tressed.

STRESZCZENIE

W pracy przedstawione są wyniki badań nad *Hydracarina* rzeki Raby i niektórych jej dopływów. Badania terenowe były prowadzone w latach 1969—1971. Połowów dokonywano na 11 stanowiskach stałych rozmieszczonych wzdłuż biegu rzeki i stanowiskach dodatkowych położonych na terasie zalewowej. Z badanego ciągu rzecznego wykazano 92 gatunki wodopójek, spośród których 46 jest nowych dla Polski. W poprzednich pracach autora (Biesiadka 1971, 1972) opisano z badanego terenu 5 gatunków nowych dla nauki: *Sperchon carpaticus*, *Lebertia polonica*, *Atractides gorcensis*, *A. barbarae* i *Pseudofeltria quadriscutata*. Wykazano 61 gatunków nowych dla polskiej części Karpat i 10 nowych dla całych Karpat.

Ilościowa analiza materiału zestawiona w tabeli I wskazuje, że zdecydowanym dominantem jest *Hygrobates fluviatilis*, który jest gatunkiem reofilnym i w całej Polsce pospolitym. Dużą liczebnością wyróżniają się *Partnunia steinmanni*, *Sperchon brevirostris*, *Lebertia fimbriata*, *L. circularis*, *L. violacea*, *Limnesia koenikei* i *Atractides nodipalpis*. Znaczny procent gatunków występuje w niewielkiej liczbie osobników, gatunków łowionych pojedynczo jest aż 35.

Autor analizuje dynamikę występowania imagines i nimf wodopójek w cyklu rocznym. Zaznaczają się dwa okresy liczniejszego spotykania nimf. Okres wcześniejszy (maj) odnosi się do górnego — potokowego odcinka rzeki, okres późniejszy (sierpień, wrzesień) do środkowego i dolnego odcinka rzeki.

Fauna wodopójek badanego ciągu rzecznego wykazuje wyraźną strefowość. Wyodrębnione są dwie strefy: "strefa *Sperchon*" i "strefa *Hygrobates-Lebertia*". W każdej z nich autor wydziela po dwie podstrefy. "Strefa *Sperchon*" obejmuje Olszowy Potok. Znamienna dla niej jest przewaga środowisk petroreicznych. Gatunkiem dominującym jest *Sperchon brevirostris*. "Strefa *Hygrobates-Lebertia*" obejmuje cały środkowy i dolny odcinek rzeki. Odznacza się innymi warunkami termicznymi (eurytermia), większym zróżnicowaniem środowiskowym i silnym rozwojem perifitonu. Najliczniej występują tutaj gatunki z rodzajów *Hygrobates* Koch i *Lebertia* Neuman.

Autor wyróżnia i charakteryzuje następujące środowiska: źródła, środowiska petroreiczne. mchy, zastoiska, środowiska prądowe, wody interstycjalne i starorzecza. Każde z tych środowisk charakteryzuje się specyficzną fauną *Hydracarina*.

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