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# 8 Comparison of the ephemeropteran fauna of the Swietokrzyskie Mountains and Roztocze Upland, Poland

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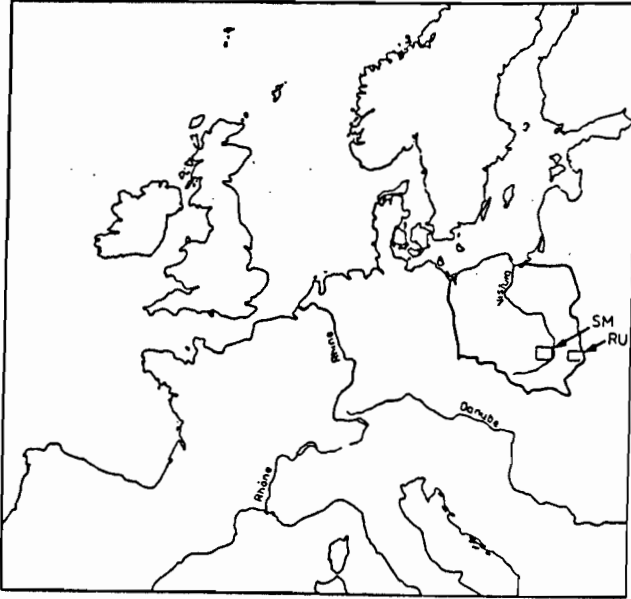
*Research on the Ephemeroptera of two low elevation regions is described: the Swietokrzyskie Mountains (maximum altitude 612 m) and Roztocze Upland (maximum 390 m). An analysis of species distribution indicates that the ephemeropteran fauna in these regions, separated by the Vistula Valley, is clearly different.*

## **Introduction**

Between the vast lowlands of northern and central Poland and the Carpathians, a chain of heights (hills and low mountains) stretches. The Vistula River valley divides this chain into a western part, the Swietokrzyskie Mountains, and an eastern one, Roztocze Upland (Fig. 1). Both of these regions are interesting from touristic and scientific points of view. National parks were founded in order to protect the most valuable parts of these physiographic units in areas least affected by human activity — the Swietokrzyski National Park and Roztoczanski National Park, respectively. Studies in various natural sciences were undertaken, including hydrobiological ones. Previously published studies include Piechocki (1981; 1992), Kittel (1982), Glapska (1986), Kahl (1986), Krajewski (1986), Labedzki (1987), Wegner (1991) and Jurasz (1992). Ephemeroptera of both regions in question were partly elaborated in papers by Sowa (1961a), Jazdzewska (1984), Szczesny (1990) and Jazdzewska and Górczynski (1991).

The aim of the present preliminary study is a comparison of the ephemeropteran fauna of running waters flowing through these two chains of hills or low mountains.

Figure 1. Location of study areas: SM = Swietokrzyskie Mountain;; RU = Roztocze Upland, Poland.



### Study Areas

Both regions were uplifted during the Laramian orogeny at the turn of the Cretaceous and Tertiary periods, and later were strongly eroded.

The Swietokrzyskie Mountains (maximum elevation 612 m above sea level (a.s.l.)) constitute several parallel northwest-southeast oriented ridges built of Cambrian quartzites and Devonian sandstones and limestones, usually covered by younger Pleistocene formations. Samples of Ephemeroptera were collected from streams and rivulets (Lubrzanka, Koprzywianka, Belnianka), the primary or secondary left-side tributaries of the Vistula River. The sources of these waterbodies are usually situated between 350 and 340 m a.s.l. Upper courses most often flow through coniferous (fir dominated) or mixed forests, changing downstream into meadow courses that are usually bordered by alders. In the upper courses, the bottom is usually composed of stones and gravel with much detritus consisting of dead leaves. In meadow courses, sand and gravel predominate, whereas lower courses contain sandy or muddy bottom. In the Koprzywianka rivulet, which flows partly through a loess area, at several stations stones on the bottom were covered

with a thin, clayey layer. Detailed description of the Swietokrzyskie Mountains streams is given by Piechocki (1981, 1986), Jazdzewska (1984) and Kahl (1987).

Roztocze Upland is a similarly oriented chain of heights (maximum altitude 390 m a.s.l.) situated at the edge of the Precambrian East-European Plate. The oldest, locally exposed bedrocks are of Upper Cretaceous origin. Usually, they are covered by Tertiary serpulid and lithothamnium limestones, conglomerates and sandstones as well as by younger Pleistocene sand and loess formations. Mayflies were collected from upper parts of drainage systems of the Wieprz and Tanew rivers, right-side tributaries of the middle Vistula River. Headwaters of these streams were situated at about 250-300 m a.s.l. Upper stream courses flow through forests of beeches, firs and pines, or through meadows. Several streams flowing to the south from the southern escarpment zone of the Roztocze Upland form rather steep and deep canyons with characteristic rocky, flat cataracts or stony rapids; otherwise their bottom is generally of sand and detritus. Descriptions of streams of the Roztocze Upland can be found in papers by Jazdzewska and Górczynski (1991), Liana et al. (1992) and Piechocki (1992).

## Materials and Methods

Mayflies were collected throughout the spring-to-autumn period from March until November. Collections were made from 1970 to 1980 in the Swietokrzyskie Mountains and between 1980 and 1990 in the Roztocze Upland. Qualitative sampling with a Surber-net was the major method of collection. Usually, collecting and picking out nymphs lasted about one hour at each station. Imagines were caught using an entomological hand net. In total, 12,388 nymphs and 554 winged forms were collected (Table 1). Dominance (percentage) of individual taxa was calculated for each region separately, and only for nymphs.

## Results

Fifty-one taxa of Ephemeroptera were found in the two regions investigated. Forty-nine taxa were identified to the species level: the only specimen of *Rhithrogena* Eaton and some specimens of *Pseudocentropilum* Bogoescu (*P. nemorale* or *P. pennulatum*) and *Procloeon* Leach remained unidentified.

Forty-four taxa were identified in material from the Swietokrzyskie Mountains (42 species, *Rhithrogena* sp. and *Pseudocentropilum* sp.), whereas 32 taxa were recognized in material from the Roztocze Upland (31 species and *Procloeon* sp.). Twenty-five taxa were common to both regions, seven species were recorded only from Roztocze Upland and 19 taxa were found only in Swietokrzyskie Mountains.

Table 1. Ephemeropteran fauna of the investigated regions: W = winged forms; N = number of nymphs; N<sub>w</sub> = numbers of winged forms: (\*) (#) = see in the text.

Species	Region	Świętokrzyskie Mountains			Roztocze Upland		
		Stage		W	W		
		N of samples		Nymphs	Nymphs	W	
		N	D%	N <sub>w</sub>	N	D%	N <sub>w</sub>
• Siphonurus aestivalis (Etn.)		20	0,3	146	55	1,1	
Siphonurus sp.		146	2,0		3	0,06	
Baetis beskidensis Sowa					1	0,02	
# Baetis buceratus Etn.		2	0,02				
• Baetis calcaratus Keff.		6	0,01				
Baetis fuscatus (L.)		152	2,0		16	0,3	
# Baetis fuscatus (L.) and B. scambus Etn.		70	0,9				
• Baetis liebenauae Keff.					338	6,7	
Baetis lutheri Mull.-Lieb.					9	0,2	
# Baetis muticus (L.)		21	0,3		194	3,9	
# Baetis niger (L.)		25	0,3		247	5,5	
• Baetis pentapleobodes Ujh.					58	1,1	
# Baetis rhodani (Pict.)		590	8,0	2	1869	37,5	
# Baetis scambus Etn.		17	0,2		2	0,4	
# Baetis vernus Curt.		232	3,1	5	1129	22,6	6
Baetis sp.		1845	25,0	3	104	2,1	4
# Centroptilium luteolum (O. F. Mull.)		225	3,0		15	0,3	1
Pseudocentroptilium nemorale (Etn.) and P. pennulatum (Etn.)		42	0,6				
Pseudocentroptilium pulchrum (Etn.)		1	0,01				
Pseudocentroptilium pulchrum (Etn.) and P. parapulchrum (Keff. et Sowa)		11	0,2				
Proclleon bifidum (Bngtss.)		2	0,02	14			
Proclleon ornatum		9	0,1	1			
Proclleon bifidum (Bngtss.) and P. ornatum Tsher.		112	1,5		2	0,04	
• Cloeon dipterum (L.)		6	0,1		26	0,5	
Cloeon dipterum (L.) group		199	2,7	1	111	2,2	
Rhithrogena sp.		1	0,01				

Table 1. (continued)

Species	Region Stage N of samples	Świętokrzyskie Mountains			Roztocze Upland		
		Nymphs		W	Nymphs		W
		309		49	201		12
		N	D%	N <sub>w</sub>	N	D%	N <sub>w</sub>
<i>Ecdyonurus dispar</i> (Curt.)		127	1,7				
<i>Ecdyonurus macani</i> Thomas et Sowa		33	0,4	75			
<i>Ecdyonurus submontanus</i> Landa					109	2,2	
<i>Ecdyonurus venosus</i> (Fabr.) group		16	0,2				
<i>Ecdyonurus</i> sp.		220	3,0	3	5	0,1	
* <i>Electrogena affinis</i> (Etn.)					45	0,9	
# <i>Electrogena cf. samalorum</i> (Landa)		5	0,1				
<i>Electrogena</i> sp.		30	0,4		2	0,04	
* <i>Heptagenia flava</i> Rost.		95	1,3	3	1	0,02	
* <i>Heptagenia fuscogrisea</i> (Retz.)		108	1,5	9	38	0,7	5
* <i>Heptagenia longicauda</i> (Steph.)		1	0,01	1			
# <i>Heptagenia sulphurea</i> (O. F. Mull.)		17	0,2		12	0,2	
# <i>Paraleptophlebia cincta</i> (Retz.)		4	0,05		1	0,02	
# <i>Paraleptophlebia submarginata</i> (Steph.)		180	2,4	26	38	0,7	4
<i>Paraleptophlebia wernerii</i> Ulm.		1	0,01				
* <i>Leptophlebia marginata</i> (L.)		540	7,3	10	70	1,4	2
* <i>Leptophlebia vespertina</i> (L.)		30	0,4	55	14	0,3	
<i>Habroleptoides confusa</i> Sart. et Jacob		3	0,04	26			
* <i>Habrophlebia fusca</i> (Curt.)		90	1,2	5	3	0,06	
# <i>Habrophlebia lauta</i> Etn.		308	4,1	110	3	0,06	
* <i>Ephemera danica</i> O. F. Mull.		216	2,9	16	139	2,8	2
# <i>Ephemera lineata</i> Etn.		1	0,01				
* <i>Ephemera vulgata</i> L.		54	0,7	23			
# <i>Ephemerella ignita</i> (Poda)		806	10,9	1	227	4,5	
* <i>Ephemerella notata</i> Etn.		8	0,1	4	41	0,8	
<i>Eurylophella karelica</i> Tiensuu		12	0,2				
* <i>Caenis horaria</i> (L.)		9	0,1		9	0,2	
* <i>Caenis luctuosa</i> (Burm.)		47	0,6				
# <i>Caenis macrura</i> Steph.		14	0,2				
# <i>Caenis pseudonivulorum</i> Keff.		32	0,4		2	0,04	
# <i>Caenis rivulorum</i> Etn.		1	0,01				
* <i>Caenis robusta</i> Etn.					1	0,02	
* <i>Brachycerus harrisellus</i> Curt.		36	0,5		2	0,04	
Ephemeroptera n. det.		621	8,4	3	19	0,4	
<b>Total</b>		<b>7401</b>	<b>100</b>	<b>530</b>	<b>4987</b>	<b>100</b>	<b>24</b>

The four species that dominated in each of the two regions are outlined within thick frames in Table 1.

In the streams of Swietokrzyskie Mountains, *Baetis* Leach nymphs were the most abundant taxon, constituting 40 per cent of all collected specimens. The dominant *Baetis* species was *B. rhodani* (Pict.), which was probably an absolute dominant as well. Because of the preservation method used for some early samples from the Swietokrzyskie Mountains (entire benthos samples preserved in formalin in the field, materials sorted in the laboratory), an important portion of *Baetis* nymphs (25 per cent of all material) could not be identified to species because they were damaged. However, one can assume that the proportion of *Baetis* species in the rest of the completely determined samples reflects more or less the true situation. *Ephemerella ignita* (Poda) also made up a large proportion of the nymphs. *Habrophlebia lauta* Etn., *Centroptilum luteolum* (O.F. Müller) and *Ephemera danica* O.F. Müller were also relatively abundant. *Ecdyonurus dispar* (Curt.) and *E. macani* (Thomas et Sowa) were common and abundant in sectors with stony rapids.

The mayfly fauna of specific streams depended upon the length and slope. Ephemeroptera were totally absent from spring-fed sectors of streams, especially those flowing through forests. *Baetis* nymphs were the first mayflies to appear below treeline. The next species to appear was most often *Habrophlebia* Etn. or *Ecdyonurus* Etn. The larger the stream became, the more diverse the mayfly fauna became. Sectors of minimal slope that were well overgrown with vegetation were often abundantly inhabited by *Cloeon dipterum* (L.)(s.l.) and *Ephemera vulgata* L.

*Baetis* were even more dominant in the running waters of the Roztocze Upland (80 per cent of all specimens). Here, *B. rhodani* was also a generally dominant species, to even a greater degree than in the Swietokrzyskie Mountains. *B. vernus* Curt. and *B. liebenauae* Keff. were next in abundance in Roztocze Upland streams. The latter species was completely absent in the Swietokrzyskie Mountains. In the Roztocze Upland, some small streams were inhabited only by *Baetis* nymphs. *Ephemerella ignita* and *Ephemera danica* were also comparatively abundant, and in lotic habitats, abundant populations of *Ecdyonurus submontanus* Landa were encountered.

In general, the ephemeropteran fauna of both regions were dominated by mayflies of the genus *Baetis*, with *B. rhodani* as a leading species. The proportion of *Ephemerella ignita* was considerable, and in lentic sectors, *Cloeon dipterum* was equally important. However, differences between the two regions are obvious. The mayfly fauna of the Swietokrzyskie Mountains is more diverse and the dominance of *Baetis* over the other species is not as clearly marked as in Roztocze Upland. The ephemeropteran fauna of the Roztocze Upland is clearly less rich, and *Baetis* species are both more predominant and more diverse, especially with respect to *B.*

*liebenauae*. A striking feature of the mayfly fauna of the Roztocze Upland was the clear poverty in baetid nymphs other than *Baetis* or *Cloeon* species. A marked difference was also observed in the composition of ecdyonurids — at least three species occurred in the Swietokrzyskie Mountains versus only one, *Ecdyonurus submontanus*, in the Roztocze Upland. However, *E. submontanus* was absent in the Swietokrzyskie Mountains. *Electrogena affinis* also occurred only in streams of the Roztocze Upland.

## Discussion

Szczesny (1990), who studied the macrofauna of acidified streams of the Swietokrzyski National Park reported ten species of Ephemeroptera. One of them, *Potamanthus luteus* (L.) was not found in the present study.

According to recent data, 120 mayfly species are known from Poland (Sowa 1990). Thus, the 51 taxa reported in this study, together with *P. luteus* found by Szczesny (1990) make up over 42 per cent of the ephemeropteran fauna of the country (34 per cent in Swietokrzyskie Mountains; 25 per cent in Roztocze Upland). The faunas of Swietokrzyskie Mountains and Roztocze Upland are clearly less rich than, for instance, the mayfly fauna of the Carpathians and their submontane areas (90 species). The difference in richness, of course, is due to the large size and greater environmental diversity of the Carpathians associated with the wide range of altitude (200-2500 m).

No species were found that were unique to Roztocze Upland or the Swietokrzyskie Mountains. *Eurylophella karelica* Tiensuu, which is very rare in Poland, was found in the Swietokrzyskie Mountains. However, the last record of its occurrence was in 1978. *Paraleptophlebia wernerii* Ulm. is also rare in Poland (Jazdzewska 1967, Keffermüller 1967, Ratajczak 1976). Only a single specimen from the Swietokrzyskie Mountains was found.

*Electrogena samalorum* (Landa) was described in 1982 from Czechoslovakia and is known from many localities in that country (Landa and Soldán 1989). Szczesny (1990) provided the first and hitherto only record of this species in Poland. The few specimens of *Electrogena* found in the Swietokrzyskie Mountains in the present study were juvenile and somewhat damaged, and are tentatively defined as *E. cf. samalorum*.

The remaining species listed in Table 1 are not especially rare in Poland. Nineteen species (marked with asterisks) are widely distributed in lowland areas (*viz.* Keffermüller 1960, Jazdzewska 1971, Fall 1976, Glazaczow 1986). All of these species, excepting *Caenis horaria* (L.), *Baetis liebenauae* and *B. pentaplebedes* Ujh. were also found in submontane Carpathian regions, at elevations not exceeding 300 m (Sowa 1975). *Caenis horaria* is known from many regions of

Poland, whereas *Baetis liebenauae* and *B. pentaplebedes* were hitherto recorded from northwestern parts of the country (Keffermüller 1972, 1974). *Baetis liebenauae* appeared to be one of the dominant species in the Drawa River (Glazaczow 1986).

Seventeen species (indicated by a # symbol in Table 1) and *Potamanthus luteus* are forms that inhabit lowlands (Keffermüller 1960, Machel 1969, Jazdzewska 1971, Fall 1976, Glazaczow 1986) but also occur at altitudes exceeding 300 m (Sowa 1975). Many of these taxa, when found in the lowlands, clearly preferred lotic habitats. *Caenis rivulorum* Etn. is included in this group, although in lowland regions only single specimens of this species have been found (Glazaczow 1986).

Lastly, the fauna of Swietokrzyskie Mountains and Roztocze Upland includes species that are otherwise found only in the mountainous areas of southern Poland. To this group belong *Ecdyonurus* species (*E. dispar* (Curt.), *E. macani* Thomas et Sowa, *E. submontanus* Landa, *E. venosus* (Fabr.) group) as well as *Baetis beskidensis* Sowa, *B. lutheri* Müll.-Lieb. and *Habroleptoides confusa* Sart. and Jacob (Mikulski 1937, Sowa 1961b, 1965, 1975, Kamler 1962, Glowacinski 1968, Kownacki and Kownacka 1965, Dratnal 1976). According to Sowa (1975), *Ecdyonurus dispar* and *E. submontanus* occur in the Carpathians as high as 700-800 m, and *E. macani* reaches an altitude of over 500 m, whereas *Baetis beskidensis* was found as high as 1000 m and *B. lutheri* attained elevations of 850 m. All of these species, however, were recorded in submontane, lower sectors of the rivers at an altitude of less than 200 m. Moreover, numerous *B. lutheri* were found by Dratnal (1976) in the swift stream Pradnik, which flows through the Cracow-Wielun Upland at altitudes of 200 to 400 m. *Habroleptoides confusa* is the most common and abundant species of this group, occurring in the vast span of altitudes ranging from 200 to 1100 m. Outside of the Carpathians it was also recorded in the vicinity of Cracow (Sowa 1959, Glowacinski 1968, Dratnal 1976). In the neighbouring areas of the Czechoslovakian Carpathians, many of the above mentioned species were found at even higher altitudes (Landa and Soldan 1989).

The composition of the mayfly faunas of the Swietokrzyskie Mountains and Roztocze Upland attests to their significant affinities to the fauna of the vast Polish lowlands. On the other hand, a considerable number of species characteristic of lotic habitats and species occurring mainly or exclusively in montane and submontane areas are evidence of the distinctness of these faunas.

Higher diversity of the mayfly fauna of the Swietokrzyskie Mountains, different dominance structure and different taxa of full fidelity for one particular region create the uniqueness of mayfly taxocens in both areas. The reasons for this distinctness are probably both ecological and zoogeographical. It seems that the wide Vistula River valley has had a major isolating influence upon the formation of the mayfly faunas of the investigated regions.



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