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Metreletus balcanicus (ULMER, 1920) (Ephemeroptera) in Poland with notes on its ecology and biology

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ABSTRACT. *Metreletus balcanicus* (ULMER, 1920) was found for the first time in Poland, in two small, periodically drying-up streams, affluents of the Rawka River, Vistula drainage system. Life cycle of this species is compatible with peculiar environmental conditions. Adults emerged in spring before drying-up of the stream bed and in autumn first nymphs of next generation appeared.

KEY WORDS: Ephemeroptera, *Metreletus*, distribution, Poland.

INTRODUCTION

Metreletus balcanicus is an interesting mayfly inhabiting a special habitat which influences its biology. Because of the rather peculiar morphological features of nymphs and winged forms, the relationship of *M. balcanicus* to other mayflies was for a long time difficult to recognize. The species was described by ULMER (1920) as *Metretopus balcanicus*. Further studies on its morphology (FIZAINE 1931, DEMOULIN 1951, UJHELYI 1960, PUTHZ 1977, STUDEMANN et al. 1988, 1992) have finally clarified a rather intricate synonymy. DEMOULIN (1951) transferred the species to the new genus - *Metreletus*. JACOB (1984) was of the opinion that *Metreletus* DEMOULIN is a junior synonym of *Ameletus* EATON. However other morphological and biochemical studies by STUDEMANN & TOMKA (1991) and STUDEMANN et al. (1994) proved the distinctiveness of *Metreletus*.

M. balcanicus was classified into families: Ecdyonuridae (now Heptageniidae) by ULMER (1920a), Ametropodidae by ULMER (1920b, 1933), Metropodidae by LESTAGE

(1938) and DEMOULIN (1951), Siphlonuridae by DEMOULIN (1952), Rallidentidae by TOMKA & ELPERS (1991). At present the species in question is most often placed in the Siphlonuridae (PUTHZ 1978, STUDEMANN et al. 1988, STUDEMAN & TOMKA 1991, FIEDLER & BOHLE 1994, FAASCH 1994, HAYBACH & FISCHER 1994). STUDEMANN et al. (1994) include *Metreletus* in the family Ameletidae, expecting at the same time new rearrangements of the siphlonurid systematics because the revision is underway.

In Poland *M. balcanicus* was hitherto not recorded. It was first found in 1994 during studies on the Ephemeroptera of the Rawka River drainage system.

STUDY AREA AND METHODS

Rawka river is the largest right tributary of the Bzura river (Vistula system) being 90 km in length. The approximate geographical position of this area is 52°01'20" N and 20°13'10" E. *M. balcanicus* was found in two neighbouring right side affluents of the Rawka river - streams called Rokita and Grabinka. They are short, approximately 10 km, water courses that begin as drainage ditches. Downstream they are natural, periodically drying-up streams, flowing through the Bolimowska Primaeval Forest. Both streams cut through sandy substrate, creating picturesque valleys overgrown by wet Tilio-Carpinetum composed mainly of oaks, hornbeams and alders. Rokita empties into the Rawka at the Budy Grabskie village, and Grabinka at the village of Grabie. In each stream four sections were chosen as sampling stations. These sections differed in their bottom quality, weed overgrowth, and shading by trees and bushes.

Samples were collected using a hand-net. Each sample consisted of bottom surface sediments and water vegetation of about 1 dm^3 volume. The material was examined under low binocular magnification; mayfly nymphs were picked out and preserved in 70% ethanol. Winged forms were collected using a hand entomological net.

RESULTS

The distribution and abundance of *M. balcanicus* in the Rokita and Grabinka streams were diversified. In Grabinka the species occurred in all sampling stations, whereas in Rokita none were recorded in the lowermost station. The richest samples (over 80 per sample) came from those sections that flow through forest glades, where their water is largely exposed to the sun. The bottom here was sandy, with detritus, twigs and decaying leaves. Stream banks and the bottoms at the banks were overgrown by *Carex* sp., *Mentha* sp., *Sium latifolium* and water moss. In the more shadowed and less overgrown sections nymphs of *M. balcanicus* were distinctly less abundant.

		1993	1994				1995									1996					
		06 December	26 April-03 May	06 June	23 July-03 August	14-18 November	21-28 February	22 March	11 April	09 May	31 May	11 June	04 July	31 October	05 December	07 February	12 March	12 April	15 May	11-15 June	18 June
Rokita	water temp.°C	0.3	12.1	13.5		4.4	3.8	4.8	5.2	12.8	19.2	18.4	15.6	7.5	0.3	0.1	0.3	2.5	18.5	19.2	-
	water flow				S								–							–	– –
	nymphs	b	++	+++		+	+++	++++	++++	++++	++++	+	b	++++	++++	++++	-	++++	++++	++	+
	winged forms	n	n	↑↑	n	n	n	n	n	↑↑	↑↑↑	n	n	n	n	n	n	n	↑	↑↑	↑
Grabinka	water temp.°C		11.2	13.0			1.8	4.5	3.5	12.1	17.4			2.5	0.3			1.9	17.8		-
	water flow	S			S	S					– –	S	S							S	-
	nymphs		++	++			+++	++++	++++	++++	++++			b	+	b	b	b	+++		-
	winged forms	n	n	n	n	n	n	n	n	n	n	↑	↑↑↑	n	n	n	n	n	n	n	-

Abundance

Hydrological regime

——— continuous water flow
– – – water flow interrupted, separate pools
S stream channel dry
////// ice on the surface
|||||| stream frozen to the bottom

Nymphs

++++ > 80 ind./sample
+++ 36 - 80 ind./sample
++ 6 - 35 ind./sample
+ ⩽ 5 ind./sample
b no nymphs

Winged forms

↑↑↑ > 20 ind./sample
↑↑ 10 - 20 ind./sample
↑ ⩽ 10 ind./sample
n no winged forms

- lack of data

Table. Occurrence of *M. balcanicus* in the Rokita and Grabinka streams in correlation with their hydrological regime. Data for four stations in each stream are cumulated.

The occurrence of *M. balcanicus* in Rokita and Grabinka in relation to some features of their hydrological regime is presented in Table. In May and June the water level of these streams dropped and the water course fractured into small, isolated basins; later the streams dried up. Before drying up the nymphs matured and winged forms emerged. Nymphs of the next generation appeared in these streams in autumn (October, November). The 1994/95 winter season was milder than that of 1995/96 when the streams were frozen (Table). Under thin ice-cover nymphs were noted, but in one station of Grabinka where the ice-cover reached the bottom, it was impossible to find any nymph despite a thorough search in April 1996. On the other hand a month later in the same station a rich sample of *M. balcanicus* nymphs was collected; the majority of them were 5.5 - 7 mm in length. It can be supposed that they hatched after the stream thawed. In June 1996, in the same station the stream channel was dry and we do not know whether the nymphs concluded their metamorphosis in time.

Measurements of the nymphs collected demonstrated that the length of those ready to emerge (with folded wings in wing-pads) ranged from 7.5 to 10.5 mm; a few specimens were smaller (6.5 mm) or larger (11.5 mm). Mature nymphs were collected in May and

early June, together with winged forms. The length of the largest imago was 11 mm. No differences were noted between the average size of nymphs from the Rokita or Grabinka streams. However, during a sampling in Grabinka on 28 Feb. 1995, the size range of nymphs collected in different stations differed sharply: 2-4 mm versus 4-9 mm.

Out of 49 female winged forms of *M. balcanicus* in our study one caught at the Rokita stream exhibited the asymmetry of the IXth abdominal sternite. Similar asymmetry, evidence of slight gonosomal aberration, was observed in one female nymph out of 29 collected in Rokita and in two female nymphs (out of 134) caught in Grabinka. These aberrations could possibly be recognized as gynandromorphy.

The sex ratio (♂/♀) in winged forms collected at Rokita stream in 1996 was 41/35, and in those collected at Grabinka stream - 60/9. Among mature nymphs caught in 1995 in Rokita the sex ratio was 46/28, whereas in Grabinka in 1994 it amounted to 6/9 and in 1995 - 154/121. Most of this data evidencing the predominance of males in the population is typical of Ephemeroptera.

Along with *M. balcanicus* other mayfly species were found in both streams. Some of them - like *Baetis rhodani* (PICTET), *B. vernus* CURTIS, *Heptagenia fuscogrisea* (RETZ.) and *Habrophlebia fusca* (CURTIS) were noted sporadically and in low numbers, whereas *Siphlonurus armatus* ETN. and *Paraleptophlebia werneri* ULMER were recorded regularly and were rather abundant. Their cycle was also concluded before the streams dried out.

DISCUSSION

The first information that the *M. balcanicus* nymphs inhabit streams which run dry in the summer was given from France by FIZAINE (1931). Similar observations were noted in Belgium (DEMOULIN 1951) and in Germany (BOHLE & POTABGY 1992, FIEDLER & BOHLE 1994, HAYBACH & FISCHER 1994). SOLDAN (1978) has observed that eggs of this species overwintered in wet mud of the Dobris stream in the Czech Republic. Many authors have stressed the preference of *M. balcanicus* for habitats strongly overgrown with water plants (DEMOULIN 1951, UJHELYI 1960, SOLDAN 1978). UJHELYI (1960) indicated the abundance of *Carex* in the station where he collected this species. The streams where *M. balcanicus* occurred were most often woodland water courses, although the nymphs usually inhabited those sections flowing through glades or at least clear fragments of the forest (DEMOULIN 1951, UJHELYI 1960). Similar habitats were preferred by the Polish populations presently studied in the Rawka river basin; nymphs of *M. balcanicus* were also present here in shaded parts of the streams, although they were distinctly less numerous there. On the other hand in Germany nymphs of *M. balcanicus* occurred in strongly shaded woodland streams poor in water vegetation (BOHLE & POTABGY 1992, FIEDLER & BOHLE 1994, HAYBACH & FISCHER 1994).

According to Czech authors (SOLDAN 1978, LANDA & SOLDAN 1989) *M. balcanicus* completes one generation in one year. After egg-laying in summer the diapause lasts till the end of the year. In the Rokita and Grabinka streams also one generation developed

during a year, but the hatching started earlier, evidenced by the fact that in autumn numerous young nymphs were encountered. It is possible that in autumn only a part of the eggs hatched; the above-mentioned wide length range of the nymphs observed in spring and the presence of nymphs after winter congelation of the stream channel would indicate a prolonged hatching period.

Literature on the subject indicates the considerable variability in the length of full-grown nymphs and adults of *M. balcanicus*. Differences occurred not only between distant populations but also between neighbouring ones, or even populations occurring in different years in the same place (PUTHZ 1977, FIEDLER & BOHLE 1994). The length of *M. balcanicus* individuals found in Poland places them among the European populations of smaller nymphs and imagines.

FIZAINE (1931) was the first who observed male features in females of *M. balcanicus* in France. Such a gynandromorphy in females was accompanied by a strong deviation in sex ratio: one male fell to 99 females (PUTHZ 1977, after the manuscript of Fizaine). HAYBACH & FISCHER (1994) in the streams in Germany, in Pfalz, did not observe any anomalies in their only two adult females found and sex ratio among full-grown nymphs was balanced. In 1991/92, in other German streams (in Hessen) FIEDLER & BOHLE (1994) obtained different results. In one of the streams studied (Josklein) they collected only gynandromorphic females, probably reproducing parthenogenetically. In other, not very distant stream, male individuals were present, although in a minority (sex ratio less than 1:3) and morphological aberration was found only in one female among 200 studied.

In our populations, judging from their composition in the period studied, *M. balcanicus* reproduced normally. The presence of individual morphological anomalies, even those concerning one side only, confirms its tendency toward gonosomal aberrations.

M. balcanicus is a mayfly rather widely distributed in Europe. It was first collected in the Balkans at a nonspecified site, then repeatedly in the Balkans in the Pirin Mts. (Bulgaria), as well as in Hungary, Belgium, France, Germany, the Czech Republic and Slovakia (Fig.). These findings are scattered over regions differing in their altitude and climatic conditions. According to LANDA & SOLDAN (1987) *M. balcanicus* was found in the Czech Republic and in Slovakia up to 500 m a.s.l. Previous data on *M. balcanicus* appeared rarely, but recently new findings are quite numerous, probably due to the increasing interest in periodically drying streams. Other mayfly species accompanying *M. balcanicus* in Hessian streams were mainly *Siphlonurus armatus* ETN. (PUTHZ 1973, BOHLE & POTABGY 1992) as well as *Habrophlebia fusca* CURTIS (FIEDLER & BOHLE 1994); in the streams of Pfalz - *Siphlonurus aestivalis* ETN. and, sporadically, *Baetis vernus* (CURTIS), *B. rhodani* (PICTET) and *Centroptilum luteolum* MÜLLER (HAYBACH & FISCHER 1994). Therefore it is worth mentioning that in the Polish streams presently studied *M. balcanicus* was regularly accompanied also by *Siphlonurus armatus* ETN. and by *Paraleptophlebia werneri* ULMER. In Europe this latter species is quite rare (LANDA & SOLDAN 1989).

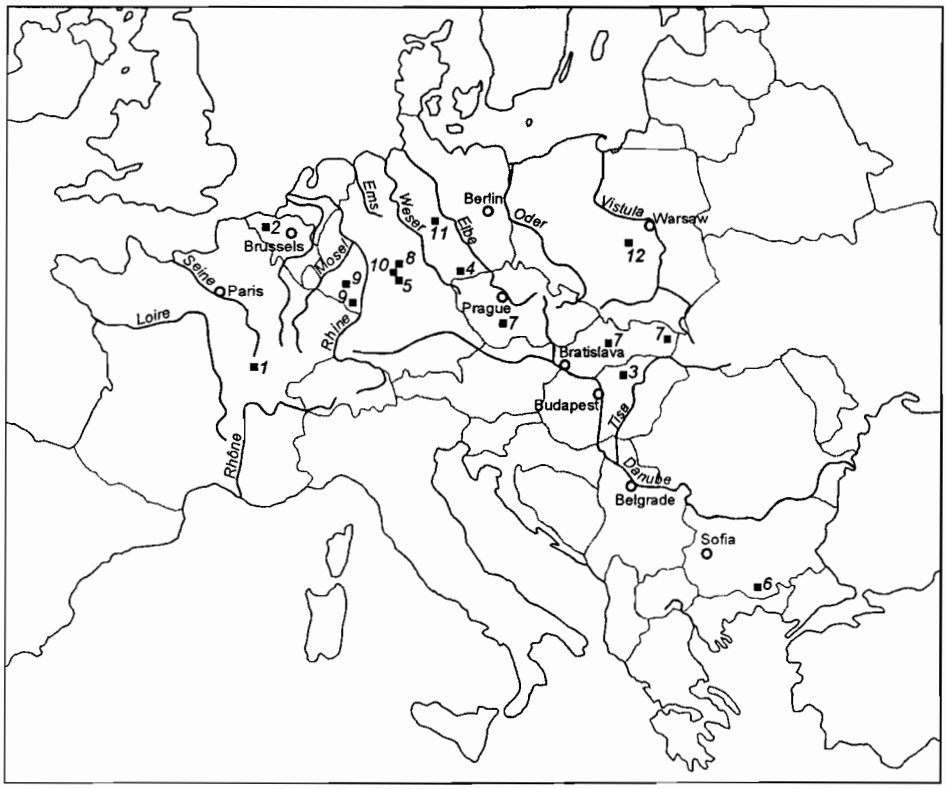

Fig. Distribution of *M. balcanicus* in Europe.
1 - FIZAINE (1931), 2 - DEMOULIN (1951), 3 - UJHELYI (1960), 4 - MÜLLER-LIEBENAU (1973), 5 - PUTHZ (1973), 6 - PUTHZ (1977), 7 - SOLDAN (1978), LANDA & SOLDAN (1989), 8 - BOHLE & POTABGY (1992), 9 - HAYBACH & FISCHER (1994), 10 - FIEDLER & BOHLE (1994), 11 - FAASCH (1994), 12 - new data from Poland.

In Poland *P. werneri* was abundant in the ditch-like uppermost section of a small, lowland Grabia river (Warta river system); this section in some years ran dry in the summer. Observations on *P. werneri* carried out in 1964/65 demonstrated that the nymphs of this species grew quickly and matured in late spring and winged forms emerged in May and early June (JAŻDŻEWSKA 1967).

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