

Mayflies inhabiting the sandy bottom in the rivers Bug and Narew (North East Poland)

Adam Głazaczow

Department of Systematic Zoology, Adam Mickiewicz University, Fredry 10, 61-701 Poznań, Poland

Abstract

Most of the bottom of the rivers Bug and Narew consists of shifting sand, packed sand and packed sand covered with silt. In this type of environment, specialized psammophilous mayflies are important. In the river Bug, six species, *Ametropus fragilis*, *Oligoneurisca borysthenica*, *Procloeon nana*, *Pseudocentropatiloides shadini*, *Baetopus wartensis* and *Cercobrachys minutus* were found. Only two of these species, *P. nanum* and *P. shadini* occurred in the river Narew. *O. borysthenica* and *B. wartensis* are quite scarce in the overall area of investigation, while the others are frequent inhabitants of the sandy substrata.

Mayfly distribution across a profile of the river bottom was investigated. *C. minutus* was numerous in the whole river-bed, *A. fragilis* was distributed in the centre of the channel on shifting and compact sand while the other species occupied the area close to the banks with sand covered by silt. Population changes were also studied. The greatest density of nymphs was observed on the sandy-silty substratum, where the most numerous were *C. minutus* (255 m⁻²) and *P. nanum* (110 m⁻²). Most of these mayflies are 'summer species' and only *A. fragilis* has a one year life cycle. Examples of the age structure of population of the most numerous species are also presented.

Introduction

In most lowland Polish rivers sandy substrata are the main components of the river bottom. Mayflies are not particularly abundant there, but some are specialized for living on this substratum only. Their adaptations concern the possibility of remaining on the substratum – certain species possess very long claws on the tarsus, and in some cases there are adaptations of feeding behaviour, where some species are deposit feeders on the bottom (most common) while others are filter feeders. Among the psammophilous mayflies found in bigger European rivers are: *Ametropus fragilis* Albarda, 1878, *Procloeon nana* (Boguescu, 1951), *Pseudocentropatiloides shadini* (Kazlauskas, 1964), *Baetopus wartensis* Keffermüller, 1960, *Oligoneurisca borysthenica* Tshernova, 1937, *Cercobrachys minutus* (Tshernova, 1952) and *Behningia ulmeri* Lestage, 1930 (if the latter is still extant). Like McCafferty (1991) I do not consider burrowing mayflies, which can be found in sand, as psammophilous, although *B. ulmeri*

digs in the sand. All these species, except perhaps *A. fragilis*, are quite rare and have still not been recorded from many localities in the Middle and East Europe (Kazlauskas, 1963; Keffermüller, 1960; Soldán, 1981). With the exception of *B. ulmeri*, all these species have been found on the sandy bottom of the river Bug (sites between Barcice and Mierzvice), and two of them (*P. nana* and *P. shadini*) also occur in the river Narew (Laskowiec locality).

Site description

The lower reaches of both rivers were examined. The river Bug has a high current speed over a wide river-bed, which makes it impossible for macrophytes to establish themselves on the bottom, except in a few pools with sluggish water. In some parts, water flows round the rushes growing along the banks. Therefore, the most abundant substratum, suitable for benthic macrofauna was

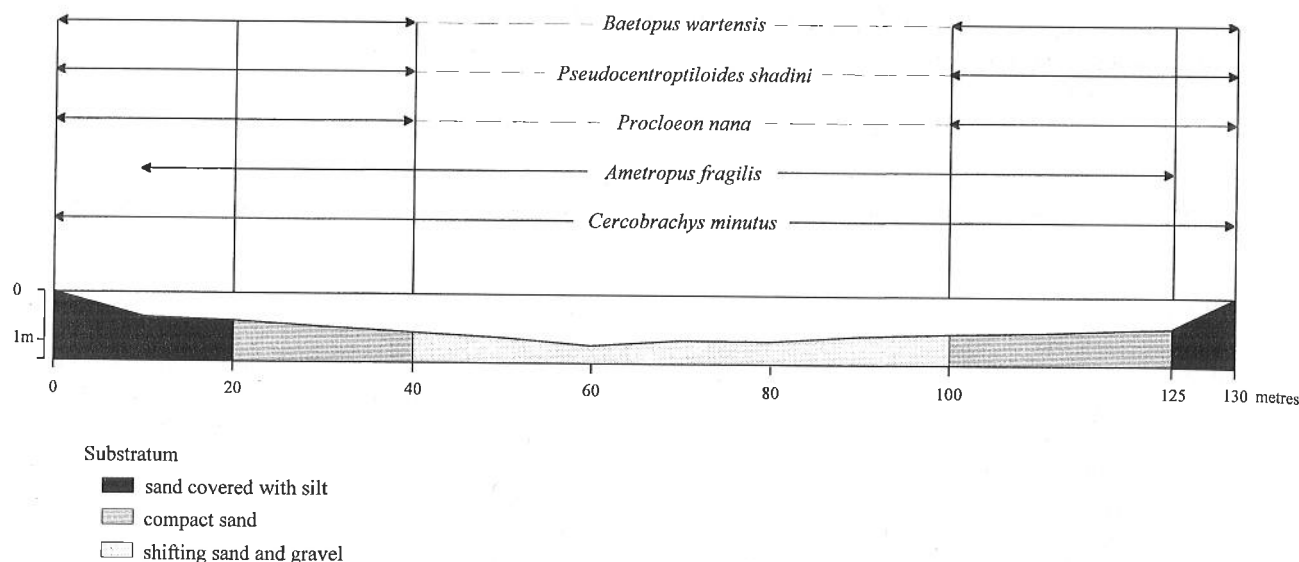


Fig. 1. Cross-section of the river Bug; on the scheme are shown distributions of psammophilous mayfly nymphs in the river-bed.

sand. There is a good deal of shifting sand, in some places mixed with gravel and small stones. This movement builds sandy bars which additionally diversify the river bed and divide the channel into smaller branches. Near the banks, where the water current become slower, a few metres wide strip of compact sand forms, covered in some places by a thin layer of silt. These types of substrata are inhabited to different degrees by a different mayfly species.

As evident from this short description of the river Bug, its bottom is mainly suitable for psammophilous species.

There are also sandy bars in the lower course of the river Narew, but they consist of finer sand than in the river Bug; gravel and small stones substrata can be found too. However, the marginal strip of aquatic vegetation (*Potamogetonetea* class) is richer, the mayfly fauna is more differentiated and psammophilous species are not so abundant.

Methods

Mayflies were collected monthly between April and September in the years 1989-95. Nymphs were caught both by a scooper with a fine wire mesh base (a qualitative method) as well as with a bottom scraper (a quantitative method) and by

means of a drift net. A scooper (20 cm in diameter) was most often used for gathering nymphs which were washed out from the substratum by a kicking technique. Substratum from about 30 m sections was moved and nymphs swimming with the current were caught in this net. A bottom scraper for quantitative samples had sides of 22.5 cm and substratum from about 5 dm² was swept into it. The organic matter was washed out, preserved in alcohol and nymphs were selected under the microscope. Because of the low abundance of nymphs, 20 such samples were at least taken, which corresponds with 1 m² of the bottom surface. The drift-net (1 m × 20 cm) was fixed in the evening, usually in shallow places, and emptied next morning.

Results

Distribution across the river

Among all the psammophilous mayfly species which were found in the river Bug, only four were numerous: *Cercobrachys minutus*, *Procloeon nana*, *Pseudocentropiloides shadini* and *Ametropus fragilis*. Others, like *Baetopus wartensis* and *Oligoneuriscia borysthena* were rare, the latter being found as nymph of exuviae only.

Most of the middle of the river is covered by

shifting sand (Fig. 1). This habitat is the poorest in mayfly fauna and only two species, *A. fragilis* and *C. minutus* occurred there. Their abundance was very low there ($\leq 1 \text{ m}^{-2}$) and they are probably restricted to depressions with more compact sand which are surrounded by 'hills' of loose and shifting substratum. Because of the great water turbidity, however they were very difficult to observe.

Towards the banks a strip of compact sand forms. This part of the river-bed was the richest in mayflies and all psammophilous species were recorded here. *C. minutus* was the most abundant species, which nymphs inhabited sandy substrata over the whole river-bed. On the compact sand its density reached 130 nymphs 1 m^{-2} . *P. shadini* was most numerous on compact sand without small silty particles. Its maximum density occurred in the river Narew and amounted to 30 m^{-2} . *A. fragilis* was the next common species, which was less abundant. In this section were especially found nymphs in the last stages, collected in the spring. Its density reached 9 m^{-2} . *P. nana* nymphs also occurred on compact sand, but its density was low ($\leq 2 \text{ m}^{-2}$).

Near the banks the water current is slower, which is why the sand is covered by a thin layer ($\leq 2 \text{ cm}$) of very fine silt. Except *A. fragilis* the other psammophilous species enter this area, but *C. minutus* and *P. nana* are most numerous. *C. minutus* the greatest number was noted on the sandy-silty substratum and density reached to 255 m^{-2} in July. *P. nana* was the next most numerous species which occurrence was restricted mainly to the sandy-silty substratum where it reached maximum density of 110 m^{-2} . The distribution of *P. shadini* was different. Nymphs of this species were more numerous on compact sand and on sandy-silty substrata its density dropped and was not more than 2 m^{-2} . Although these species appeared on the sandy-silty substratum I did not find them in places with still water and more silty substratum.

In the river Narew, the sandy bars occur mainly along the banks of the river. As in the river Bug, the sandy parts near the banks are covered by a fine silt. Further from the banks the bottom is changes to being compact and next to shifting sand. Both of the two species, found in the Narew were mainly found near the banks in the sandy-silty and sandy substrata.

Life cycles

Almost all of the psammophilous mayflies occurring in the study area are summer species, nymphs occurring mainly in July and August. The only species in which nymphs could be found all year round is *A. fragilis*. Therefore, from late autumn until emergence, which takes place in May, nymphs of this species were the only psammophilous mayflies. The other species appeared in June and during summer two of them, *C. minutus* and *P. nana*, predominated and were the most important species in this assemblage. In some years, the situation changed and the domination of *C. minutus* in summer was not always so evident, although it lasted from July to the end of August. From mid June, young nymphs of *P. shadini* and *P. nana* usually also appeared, although sometimes they were delayed until early July. From the beginning of July, young nymphs of *A. fragilis* were found on the bottom in the first stages of development. Only from the end of August did it again become dominant. In July and August, nymphs of all species could be found in the river. From the end of August, *A. fragilis* again became dominant whereas the others declined and then disappeared. They were still present in September but by early autumn there remained only a few specimens, and overwintered in the egg stadium.

The most evident is *A. fragilis* univoltine life cycle (Jażdżwska, 1973; Keffermüller, 1959). The present study essentially agrees with previous descriptions, but confirms very rapid egg development compared to other univoltine species. Mid-May is the main emergence period with very young nymphs appearing at the end of June.

O. borysthena is also probably univoltine, but with a long period of egg development; in this case, young nymphs appeared in June.

The other species have multivoltine life cycles with two summer generations per year. I assume that nymphs of *P. shadini* occur first but sometimes, at the beginning of June, only young nymphs of *C. minutus* were observed without other baetids. Then appeared nymphs of *P. nana*, and in great numbers, nymphs of *C. minutus*, a dominant species all summer. The second generation developed in August and lasted until the end of September. This generation was less numerous and the various species occurred in the same sequence. Nymphs of *C. minutus* stayed longest in

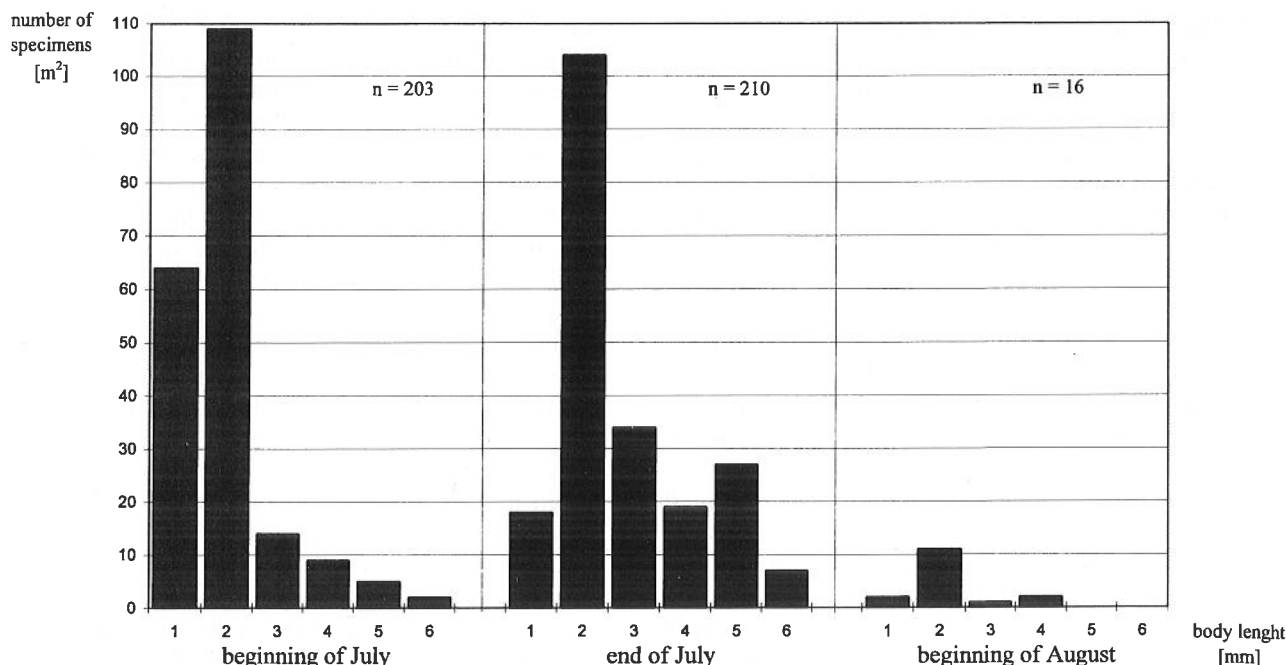


Fig. 2. Changes of the age structure of *C. minutus* in the summer.

the river and probably some could overwintered, but in general it winters in the egg stage. In the same group of multivoltine species I also include *B. wartensis*, but have too little data, to discuss it further

✱

Age structure

I present age structure of *C. minutus* only (Fig. 2). In all samples groups of young nymphs (1-2 mm long) were very numerous, but as early as beginning of July appeared a group of larger ones, in the last stages. At the end of this month, this group of larger specimens is yet bigger. In August, the pattern was similar, although abundance was very low and probably signals the end of development. A very high abundance of young individuals may cause difficulties with analysing these patterns, but it confirms the very high mortality of mayfly nymphs.

Sandy habitats, which accounted for most of the river's bottom, were poorest in benthic macrofauna. Psammophilous mayflies occurred in the bigger lowland rivers only and, after *Chironomidae*, *Sphaeriidae* and some *Oligochaeta* are very

important elements of the fauna, in spite of their generally low abundance. These mayflies are very poorly known and may be threatened by water pollution. They are a rarity in many European rivers and their disappearance would cause a significant impoverishment of this very specific habitat.

References

- Jazdzewska, T. 1973. 'Notes on the biology and ecology of the mayfly *Ametropus eatoni* Brodskij (Ephemeroptera)'. *Pol. Pismo Entomol.* 43, 469-477.
- Kazlauskas, R. S. 1964. 'Entomofauna, (Ephemeroptera, Plecoptera, Trichoptera) rek Litowskoj SSR i ee znaceniye w pitanii foreli'. Wilnjus. p. 15.
- Keffermüller, M. 1959. 'Nowe dane dotyczące jętek (Ephemeroptera) z rodzaju *Ametropus* Alb. i *Behningia* Lest.'. *Prace Kom. Biol. Pozn. TPN*, 5, 1-32.
- Keffermüller, M. 1960. 'Badania nad fauną jętek (Ephemeroptera) Wielkopolski'. *Prace Kom. Biol. Pozn. TPN*, 8, 1-57.
- McCafferty, W. P. 1991. 'Comparison of Old and New World *Acanthametropus* (Ephemeroptera: Acanthametropodidae) and other psammophilous mayflies'. *Entomol. News*, 102, 205-214.
- Soldán, T. 1981. 'The mayflies (Ephemeroptera) of the river Latorica in Eastern Slovakia'. *Biología*, 36, 1043-1048