

OBSERVATIONS ON THE PSAMMOPHILOUS MAYFLY SPECIES *PROCLOEON NANUM* IN THE NORTH EAST OF POLAND

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Procloeon nanum is one of the more numerous psammophilous mayfly species living in the lower part of the River Bug. It inhabits the sandy substratum which is covered with a thin layer of silt, in the places where the speed of the current does not exceed 0.25 m/sec. The maximum number was recorded in the latter part of July and totalled 110 individuals/m². In this period, very young nymphs dominate. It is a summer species, young nymphs appearing towards the end of June and the beginning of July, reaching maximum numbers in July and August. The last were observed at the end of September. Emergence of subimagines took place from the afternoon hours to the late dusk. Swarms, formed by individuals which emerged one or more days earlier, appeared two hours later, 2-3 meters above the surface of the water or river bank.

INTRODUCTION

Psammophilous mayflies are rarely found in collections. This is, at least in part, a result of difficulties in gathering them caused by their low numbers and grouping dispersion even when the population is more numerous locally. These highly specialised mayflies, whose occurrence is limited to some kinds of sandy habitats, are the most threatened (McCafferty, 1991). McCafferty has often drawn attention to the preservation of these riverine habitats, which are the first to be altered by water pollution.

Therefore, I consider, that even small amounts of data concerning psammophilous mayflies are worthy of presentation.

Such sandy substrata inhabited by specialized benthic macroinvertebrate communities are formed in big lowland rivers. The River Bug is a typical lowland river flowing in a wide, shallow river-bed and building numerous sandy bars. We investigated the lower section. The greater part of the river-bed substratum is composed of shifting sand. At some places, compact sand is formed, partly covered with silt, or coarser substrates built from gravel and small stones. The river is polluted. According to the physicochemical and bacteriological parameters its water is located outside the classes of purity. The river is relatively poor in macrophytes and only in the backwaters do the patches of vegetation from the *Potamogetonetea* class develop. At some places, water flows round the manna rushes and reed grasses growing along the banks.

A somewhat different character is shown by the lower part of the River Narew. Sandy bars

occur on the river-bed here also, but the strip of marginal vegetation is richer. This river is not so polluted as the River Bug, but contains a lot of humus compounds which limit the development of plankton.

Because of very poor marginal vegetation in the River Bug, psammophilous mayflies compose the dominant part of the mayflies fauna (in spite of its organic pollution). In its sandy substrata (shifting sand, compact sand and compact sand covered with silt) such species as: *Ametropus fragilis*, *Cercobrachys minutus*, *Procloeon nanum*, *Pseudocentropilum shadini*, *Baetopus wartensis*, *Oligoneursica borysthenica* occur. Only a small percentage of them are typical of the different habitats which appear here incidentally: *Procloeon ornatum*, *P. pulchrum*, *Labiobaetis tricolor*, *Caenis pseudorivulorum*, *C. macrura*, *Ephoron virgo*. In the River Narew, in which marginal vegetation is richer, young nymphs of other species such as *Baetis fuscatus* appear in great numbers.

One of the more numerous psammophilous species in the area under investigation is *Procloeon nanum*. Our knowledge of this species is relatively poor. In the survey of Central European species of the genera *Centropilum* (KEFFERMÜLLER & SOWA, 1984) you can find only a note: «species rare and not numerous, therefore biology almost unknown». It was described on the basis of findings made in Romania (BOGOESCU, 1951) and seems to have a Central-East European range, because all its localities are known from Bohemia (SOLDAN, 1981), central and south Poland (KEFFERMÜLLER & SOWA, 1984), Lithuania and Russia (KAZLAUSKAS, 1964). In none of these stations was it collected in any numbers. According to

KAZLAUSKAS (1963) it is a species which lives on sandy bottoms in the bigger Lithuanian rivers, consequently it should be expected in the similar habitats in North-Eastern Poland, too.

METHODS

Mayflies were collected between April and September in the years 1989-94; the stations are shown on Fig. 1. The most effective method on sandy and sandy-silty substratum where mayfly nymphs are quite scarce, appeared to be the kicking technique. For comparison, substratum from about 30 m sections was moved and the nymphs swimming with the current were caught in a hand net. A bottom scraper was used for quantitative samples. The length of their sides was 22.5 cm and the substratum from about 5 dm² was swept into it. Then, the organic matter was washed out and selected under the microscope. Because of the low abundance of nymphs, 20 such samples at least were taken, which corresponds with 1 m² of the bottom surface. Drift-samples were taken with a net 1 m x 20 cm, which collected the top of the surface drift. However, in shallower places, it nearly reached the substratum. This net was fixed in the evening and emptied next morning. Emergence traps proved to be ineffective because of the very low abundance

of mature nymphs. A twenty-four hour observation of winged stages was possible by bivouacking near the river edges. Current speed was measured with a hydrometric current meter. Data concerning water quality were obtained from The State Inspectorate For Environmental Protection.

RESULTS AND DISCUSSION

Distribution

Procloeon nanum was discovered in the River Bug on all sites under examination (Fig.1). In the lower section (Barcice [1], Brok [2]) this species was not numerous, which refers to the other mayflies living on the different types of sandy substratum (the average 4-6 specimens in the sample). Gradually (from the station in Nur [3]) its numbers increase, being the most numerous in stations at Drohiczyn [4] and Mierzvice [6]. Here, the mean number of specimens in one sample was several times higher and nymphs of *P. nanum* composed 35% of mayfly fauna inhabiting different kinds of sandy bottom.

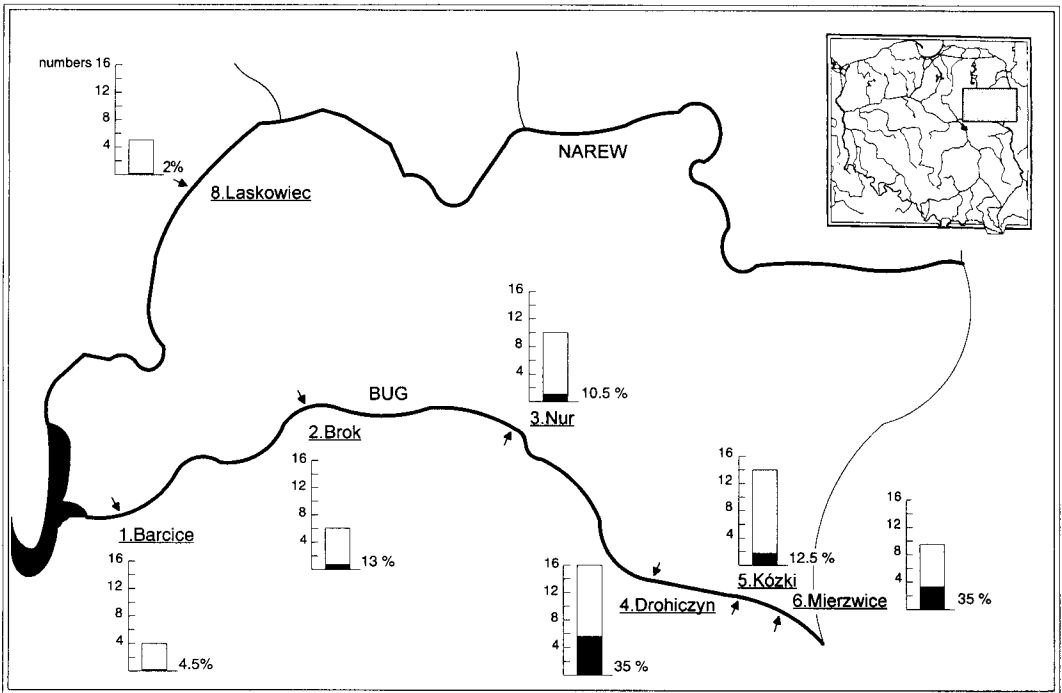


Fig. 1. Distribution of *Procloeon nanum* in the rivers Bug and Narew. Columns present the mean numbers of psammophilous species in one sample, their black parts show percentage of *Procloeon nanum*.

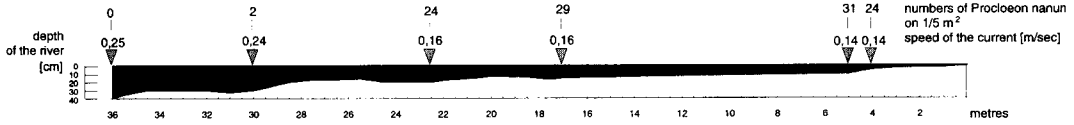


Fig. 2. Distribution of *Procloeon nanum* nymphs along the bank of the River Bug (Drohiczyn [4]) at the end of July.

Psammophilous mayflies, and among them *P. nanum*, were also recorded in the River Narew, but only in the one station located in its lower part (Laskowiec [8]). Here this species was not abundant.

Microhabitats

Procloeon nanum inhabits compacted parts of the sandy substratum which are covered with thin layers of silt (0.5-2 cm). Presumably, adaptation to this microhabitat explains the very long, needle-like claws that may serve to anchor them in sand (McCAFFERTY, 1991), similarly to *Pseudocentropiloides shadini*.

This type of habitat, suitable for *Procloeon nanum*, is formed in the places where the speed of the current is slow, but not slower than 0.14 m/sec and not exceeding 0.25 m/sec. Such places are found along the banks of the river (Fig. 2) as well as in the middle of the river-bed, along the sandy bars. In the places unaffected by the current, this species was not recorded. The occurrence of *P. nanum* did not depend on the depth of water because it was met both at a depth of a few centimetres near the banks and also at a depth of 60 cm. Single, fully grown nymphs, probably just before emergence, were collected from the vegetation growing near the banks and also from branches lying in the shifting sand. The ecologically-related species, *Pseudocentropiloides shadini*, concentrated itself in the places near the main current (water flow about 0.2 m/sec). It is often a border made up of fine parts of silt sedimentation. Neither species crossed the border of compacted sand. For the shifting sand, *Ametropus fragilis* was typical. Bottoms made from gravel and small stones were densely inhabited by the burrowing species - *Ephoron virgo*. But the most abundant species on the whole cross-section of the river was *Cercobrachys minutus*.

However, the irregular, patchy distribution of *Procloeon nanum* showed that this species was still not numerous to the same degree at the places which seemed to be suitable for its habitat.

Abundance

The greatest abundance of *Procloeon nanum*, 110 nymphs per 1 m² of sandy-silty substratum was recorded in the Drohiczyn locality [4] in late July. It composes 34% of all mayfly nymphs occurring here and after *Cercobrachys minutus* the nymphs of which constituted more than half of the mayfly population (57%), it is the second most abundant summer species. In this season very young nymphs dominate, the body length of which does not exceed 3 mm (Fig. 3). At this time they make up 91% of *P. nanum* population. In the same period, overgrown nymphs, ready or almost ready to emerge, composed only 7% of this species population. It is difficult to find out at the present moment if so small a number of overgrown nymphs is a result of high mortality or

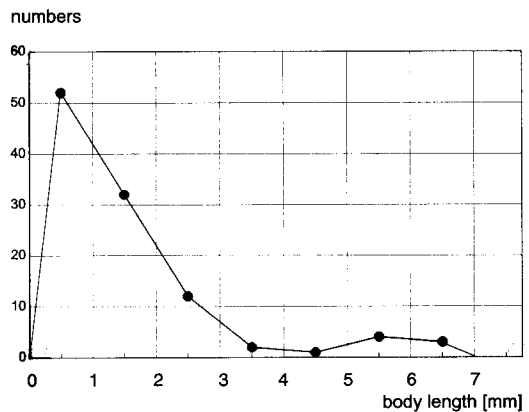


Fig. 3. Body length of *Procloeon nanum* nymphs collected from 1 m² in the River Bug (Drohiczyn [4]) at the end of July.

the effect of the life cycle - the beginnings of the next generation.

An additional difficulty in the study on numbers of this species is their tendency to change their localities, caused by fluctuations of the water level. It has been observed twice (in different years) that after a water level rise of about 10 cm, which did not particularly influence a change in the substratum, nymphs of *P. nanum* became scarce. After a change in water level the number of nymphs dropped drastically from a maximum to only 20 per m². Nymphs of this species often appear in the drift-samples. A drift net fastened in shallow places caught many exuviae as well as drifting nymphs. Among them *P. nanum* nymphs predominated (49%). For its tendency to shift with the current can explain its frequent occurrence in these samples. This frequency is composed of 90% *P. nanum*, whereas other psammophilous species were reduced by half. This could explain then the sudden change in *P. nanum* habitats.

Life cycle

Procloeon nanum life cycles can only be investigated approximately. Sufficiently frequent observations which would allow a thorough study of this species development were not carried out. The first young nymphs appear at the end of June (Dr. Keffermüller material). They are, however, very scarce and still at the beginning of July there is a lack of nymphs of this species, and they have no important significance in the mayfly assemblages in this period. They appear more numerous in mid-July, and from the end of this month this species becomes one of the more abundant which inhabit the sandy-silty substratum of the River Bug. During this period, numerous subimaginal specimens appear as well as the first adult forms. The distribution of the nymphs' body length shows that the population is in its predominant part, composed of very young specimens, mature nymphs composing only 7%. This corresponds with our general knowledge about very high mortality among mayfly nymphs.

It is, however, possible that so big a percentage of young nymphs, which predominate at the

end of July, make a second generation of this species, whose adult specimens appear in the latter part of August and at the beginning of September. In the latter part of August not so many nymphs were observed and the last few mature nymphs were collected at the end of September.

Winged forms became active in the afternoon and evening. Emergence of subimagines were observed, beginning from 5 p.m. to the late dusk, taking off from the water surface. This stadium lasted to the next day. Male swarms appeared somewhat later, depending on the prevailing conditions, beginning from 6³⁰ p.m. These swarms, numbering about a dozen specimens, were most often observed in the area between water and land, and they rose to 2-3 meters. At the same time, there appeared fairly numerous swarms of *Procloeon ornatum*. In worse conditions, in strong wind for instance, these swarms appeared later, often during sunset at about 8 p.m. During strong, gusty winds they flew considerably lower, up to 1 meter, still protected by the river bank. After sunset, the male activity decreased, while the females remained still active.

Procloeon nanum, this rare psammophilous mayfly species, needs further study. The subject of this observation should be not only incompletely known life cycles, but also the other aspects of its biology. Observations concerning their habitat seem to be especially important. Like other psammophilous species, they are considered particularly sensitive to water pollution. The River Bug is very polluted, but in spite of that, some psammophilous mayfly species are numerous represented. In the last ten years we have observed a decrease in the numbers of *Oligoneurisca borysthena*, which is now very rare. Only some exuviae drifting with the current were recorded. Other mayflies have also become scarce. For example *Oligoneuriella pallida* and *Ephemerella ignita*. *Heptagenia coerulans* and *Isonychia ignota* have not been found in this river recently.

I expect these changes will also have affected *Procloeon nanum*, but I have no comparative data, so that this question still needs to be studied.

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