

Notes on the biology and ecology of the mayfly  
*Ametropus eatoni* BRODSKIJ (*Ephemeroptera*)Uwagi o biologii i ekologii jętki *Ametropus eatoni* BRODSKIJ  
(*Ephemeroptera*)

BY

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European mayflies of the genus *Ametropus* ALB. are classed in two species: *A. fragilis* ALB. and *A. eatoni* BROD. The description of *A. fragilis* ALB. was based on winged forms collected in the Netherlands. The nymph of this mayfly is at present unknown. Data on the occurrence of *A. fragilis* ALB. are given by EATON (1883-1888), HABERMAN (1953), BOGOESCU (1958), PAPESCU and PRUNESCU-ARION (1960), ENACEANU and BREZEANU (1964), DUDICH (1967), ILLIES (1967) and RUSSEV (1968). This last author, however, has determined the nymphs collected by himself as *Ametropus* sp., and the name *A. fragilis* ALB. he mentions only when he is citing other authors. In south-east Siberia BRODSKIJ (1930) collected winged specimens which, according to the original description, were distinct from *A. fragilis* ALB. to such an extent that he created a new species — *A. eatoni* BROD. This same species is mentioned in the Amur and Pečora drainage systems, in the Ob mouth, in the rivers of the northern part of the Ural Mounts, and in the rivers of Lithuania, by ČERNOVA (1941, 1952, 1958) and KAZLAUSKAS (1962, 1968).

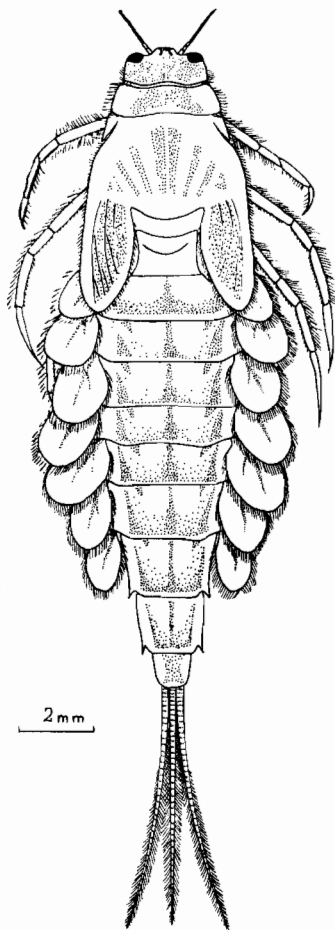
The first note on the occurrence in Poland of *A. eatoni* BROD. imago ♂ was given by MIKULSKI (1936). KEFFERMÜLLER (1957, 1959) has found this species in the river Warta in the Konin district. She was able to complete [the data concerning the colour and morphology of winged forms and to describe the nymph of this species, basing] the description

on the last moult skin. Her investigations confirm DEMOULIN's (1955) suggestion that the drawings and description of the unnamed nymph given in the paper by BEHNING (1932) concern in fact *A. eatoni* BROD. In the larger rivers of Poland (Vistula, Warta, and San) some nymphs and their cast skins or a few subimagines were found by MIKULSKI and TARWID (1951), POPRAWSKA (1960), WÓJCIK (1963) and SOWA (1964).

LANDA (1969) is of the opinion that the differences between *A. fragilis* ALB. and *A. eatoni* BROD. are very slight and that there is only one species in question which, according to the law of priority, should be called *A. fragilis* ALB. To solve this problem a comparison of types or topotypes should be made.

I have frequently collected the nymphs of *Ametropus* ALB. in the rivers Widawka and Warta (Odra basin) and in Pilica (Vistula basin). From a dozen or so of these nymphs I have reared the winged forms which I have determined as *A. eatoni* BROD. agreeing, however, with the reservations of KEFFERMÜLLER (1959) who also found some differences in size and colour pattern between the mayflies in her material and specimens from south-east Siberia (BRODSKIJ, 1930). The colour pattern of my imagines was consistent with that of KEFFERMÜLLER's material and their size was also larger than the size of the specimens of BRODSKIJ. In the table (p. 474) the dimensions of the winged forms in my collection are given. Only one subimago specimen was caught in the field, all others were reared from nymphs in the laboratory.

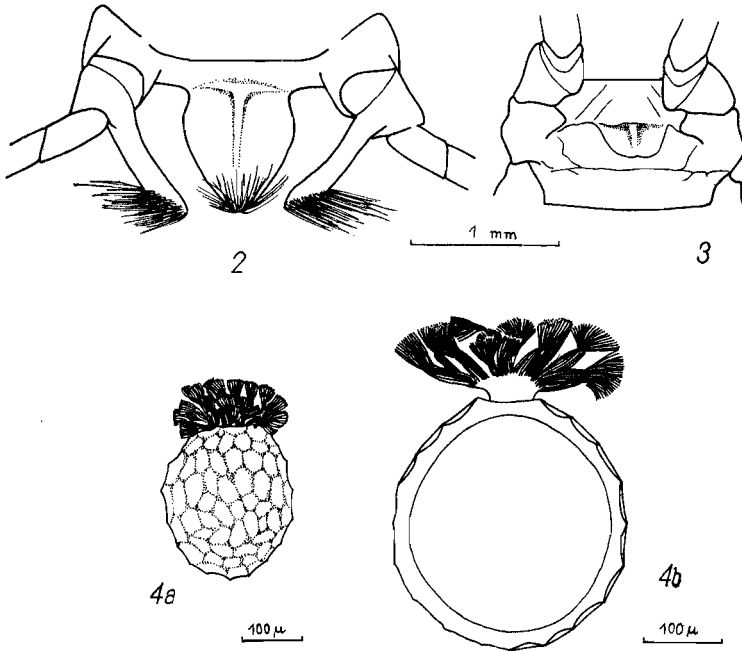
The morphology of the nymphs also agreed with the figures and description in the paper by KEFFERMÜLLER (1959). In my material there were nymphs of various lengths, measuring from 5 to 18 mm from the anterior head margin to the base



1. The nymph ♀ of *Ametropus eatoni* BROD. after the penultimate moult; dorsal aspect

Larwa ♀ *Ametropus eatoni* BROD. po przedostatniej wylince larwalnej; strona grzbietowa

of the tails. As the drawing in the paper by KEFFERMÜLLER (1959) is based on the cast skin only I am giving here the figure of the older nymph seen from the dorsal aspect (fig. 1). It is worthy noting the presence on the wing-buds of a greyish brown spot which becomes darker after each moult. In other mayfly species wing buds usually grow darker only before the last moult.



2. Prothorax of the nymph of *Ametropus eatoni* BROD. Only the setation of the coxal processes and of the triangular plate is taken into account

Przedpiersie larwy *Ametropus eatoni* BROD. Zaznaczone jest tylko oszczecinienie wyrostków biodrowych odnóży oraz trójkątnej płytki

3. Prothorax of the imago of *Ametropus eatoni* BROD.

Przedpiersie imago *Ametropus eatoni* BROD.

4. Eggs of *Ametropus eatoni* BROD. a — egg kept in water for three hours, b — outline of the egg kept in water for 48 hours

Jaja *Ametropus eatoni* BROD. a — jajo przetrzymywane w wodzie przez trzy godziny, b — kontur jaja przetrzymwanego w wodzie przez 48 godzin

In the nymphs there is a triangular lamella (plate) between the coxae of the first pair of legs, on the prothorax; the apical part of this plate is armed with a tuft of anteriorly directed hairs (fig. 2). Such a plate

was to be observed even in the smallest nymph of 5 mm. Similar morphological details were observed by NEEDHAM, TRAYER and HSU (1935) in the nymphs of the American mayfly *Ametropus albrighti* TRAYER. A somewhat shorter plate is also present in winged forms (fig. 3).

By applying slight pressure to the abdomen of a female imago of *A. eatoni* BROD. I was fortunately able to obtain some eggs. The eggs appeared singly on the ventral side of the abdomen; they were very pale green becoming whitish after some days in the water. When placed in the water the eggs did not adhere together but lay loosely on the bottom. The egg of *A. eatoni* is elliptical (fig. 4); on the surface of the chorion there are numerous small, polygonal, cup-like depressions. The fastening arrangement consists of the bunch of filaments made up from the smaller tufts bunching on one pole of the egg. Such an arrangement resembles that of the eggs of *Ephoron virgo* (OLIV.) (DEGRANGE, 1960). In the water the tufts of filaments are spread in the crown with which the egg is fastened to the ground. The egg in fig. 4b looks somewhat more rounded as, when drawn, it was placed slightly obliquely. The dimensions of nine eggs stored in the water for 3 hours fell within the following range: longer axis: 237–256  $\mu$ , shorter axis: 199–228  $\mu$ . The diameter of the fastening crown and its height were variable. Usually the crown diameter was approximate to the length of the shorter egg axis and the crown height varied from 57 to 95  $\mu$ . When deposited in the water the eggs swell; one egg kept in water for two days had its axes of following lengths: 313  $\mu$  and 294  $\mu$ ; the crown was also higher — 105  $\mu$ .

I have collected the nymphs of *A. eatoni* BROD. in the river Warta between the localities Działoszyn and Burzenin (from 204 to 275 km of the river length), in the river Widawka near the village of Podgórze (10 km upstream from where the river Widawka joins the Warta) and in the river Pilica between the localities Przedbórz and Tomaszów Mazowiecki (from 123 to 203 km of the river length). Altogether I have gathered 116 nymphs from the river Warta, 25 from the river Widawka and 65 nymphs and 1 subimago from the river Pilica. From some nymphs I have reared 11 winged specimens.

In collecting the mayflies the following persons have helped me: Prof. Dr. L. K. PAWŁOWSKI, B. PAWŁOWSKA, Dr. S. KRAJEWSKI, Dr. K. JAŹDZEWSKI and Mgr. W. KITTEL. I should like to express to them my deepest thanks.

The occurrence of the nymphs of *A. eatoni* BROD. in the rivers is strictly connected with the season. KEFFERMÜLLER (1959) has collected very young nymphs in August, while in May and early June she has

observed cast skins of the oldest nymphs flowing down the river; she has caught also some winged specimens. In the area investigated I have found the nymphs of *A. eatoni* BROD. from September till May. They were never numerous in one haul of the hand net. In addition to the hand net, sometimes a triangular dredge was also used. The nymphs occurred near the river banks in samples taken from the bottom of sand with an admixture of a small amount of detritus, of sand and clay or of sand and gravel and also from the bottom where muddy sand was covered with a thick layer of alder twigs, leaves and cones. Accompanying species were usually the nymphs of *Ephemera* L., of *Gomphus* LEACH (*Odonata*) and the waterbug *Aphelocheirus aestivalis* FABR.

In the laboratory the nymphs were kept in dishes in a temperature about the same as that out-of-doors. This allowed me to perform some observations and to rear winged forms from the older nymphs. In the literature there is a short note on the behaviour of the nymphs of *A. eatoni* BROD. by KAZLAUSKAS (1962). As observed by him, my nymphs were usually buried in sand with the head, the first pair of legs and the tails uncovered. If not moving and in such a position they were difficult to find owing to their yellowish brown colour pattern. The nymphs crawled on the bottom or swam rather heavily when irritated, with legs stretched backwards along their body sides, bending the body vertically. The sand in the rearing dishes was usually furrowed, indicating the wanderings of the nymphs, undertaken presumably at night, for during the day they were inactive. KAZLAUSKAS (1962) has observed that the nymphs of *A. eatoni* BROD. ate detritus; in my cultures I have tried to feed the nymphs with filamentous algae. Some nymphs devoured them, pulling the food nearer with their fore legs. When crawling on the bottom the nymph, whilst eating the algae, supported its body on the mid and hind legs and on the ends of the tails.

Moult took place in sand or on its surface, but also in a dish without sand. Before flying the oldest nymphs left the sand, swimming from the bottom to the surface, bending their bodies strongly. In my cultures this last moult was a very critical one — many nymphs died during this period. In the laboratory the metamorphosis into the subimago stage took place several times in the afternoon, once between 10,30 and 11,30 a. m. The subimago stage lasted over 24 hours, imagines lived 2–3 days.

I have observed that the nymphs with wing-buds reaching to about the hind margin of the second abdominal tergite were before the last moult leading to the subimago stage. The length of these nymphs varied be-

tween 16 and 18 mm. The first sign of approaching metamorphosis was the appearance of the segmentation of the next stage inside the chitinous cover of the still onesegmented tarsus of the fore legs. These initially light segments gradually became brownish red and the segmentation was already well visible. The tibiae and distal parts of the femora also became darker. Then, similarly as in other *Ephemeroptera*, the wing-buds became black and the segmentation of tarsi of the other legs was manifested; these legs, however, remained less pigmented. Inside the dark wing-buds it was possible to observe the folded wings. Nymphs of the length of 11–14 mm with wing-buds reaching the hind margin of the first abdominal tergite were before the penultimate moult. Soon after this moult the length of the nymphs increased and their wing-buds reached the hind margin of the second abdominal tergite.

Measurements of winged forms of *Ametropus eatoni* BROD.

Pomiary osobników uskrzydlnych *Ametropus eatoni* BROD.

Developmental stage — sex Stadium rozwojowe — płeć	Length in mm — Długość w mm			
	body ciała	setae szczecin	wing I skrzydła I	wing II skrzydła II
i ♂*	14.5	11.5	12.7	11.3
i ♂	14.0	9.5	11.0	10.8
i ♂	16.5	—	13.0	11.0
i ♂	13.0	—	12.5	9.0
i ♀	16.5	11.0	14.5	5.6
subi ♂	17.0	9.0	13.5	6.1
subi ♂	13.3	8.0	12.5	4.5
subi ♂	16.5	8.0	12.0	5.5
subi ♂	13.5	9.7	13.0	6.4
subi ♂	16.1	9.2	12.8	6.0
subi ♀	16.0	9.0	13.6	4.0

\* i — imago, subi — subimago.

Comparing laboratory and field observation I was able to show that by November (1969 and 1970) there were many nymphs in the stage preceding the penultimate moult to be found in the rivers. At the same time I captured also smaller, younger nymphs (the smallest 6.5 mm in length) with short wing-buds reaching only to the end of the thorax or slightly beyond. In the samples in December (1968 and 1969) there were already single nymphs with wing-buds reaching the hind margin of the second abdominal tergite. I have collected many more of such nymphs in Feb-

ruary, 1971; I have noted a similar sample composition in March and April of 1968, 1970 and 1971. In my cultures in 1971 I observed the first signs of preparation of one older nymph for the last moult in early March. On the 11th of this month the wing-buds were already dark and all the tarsi were seen to be well segmented inside; the abortive attempt of flying out was undertaken when the weather that spring got considerably warmer for the first time on March 17th. The weather then became markedly colder; only in the first half of April did the older nymphs kept in rearing dishes begin to prepare for metamorphosis. During sunny days between April 17th and 20th and in early May they tried to fly out; unfortunately only few moults were successful. I suppose that at the same time there were flights in the field but I did not observe them. However, the nymphs became rare in the rivers. In other years I have obtained single subimaginal specimens in the first half of May.

Thus the characteristic feature of the development of *A. eatoni* BROD. is the advanced growth till the end of autumn and the slow development to maturity in winter. Some specimens caught in December and January were so advanced that they became winged forms after one or two moults; however, the intervals between these moults were rather long. Moreover, in laboratory cultures it was observed that the period from the very beginning of preparation for the last moult till the flight itself also lasted fairly long. Such a development of *A. eatoni* BROD. shows that this mayfly belongs to the group of winter species which produce only one generation per year. By autumn these species already attain the older nymph stage; they grow slowly in winter and fly out in the spring of the following year.

#### STRESZCZENIE

W pracy podano nowe stanowiska w Polsce larw jętki *A. eatoni* BROD. W laboratorium część zebranych larw umieszczono w hodowli. Umożliwiło to przeprowadzenie obserwacji zachowania się larw, ich sposobu żywienia się oraz przeobrażania w osobniki uskrzydłone. Ponieważ współcześnie znajdowane osobniki *A. eatoni* BROD. odbiegają nieco od wymiarów tego gatunku podanych przez BRODSKIEGO (1930), przytoczono w pracy ważniejsze wyniki pomiarów ciała wyhodowanych osobników uskrzydłonych. Zamieszczono także rysunek dorosłej larwy zebranej w terenie badań. Ponadto podano również krótki opis i rysunki jaj *A. eatoni* BROD.

Porównanie obserwacji hodowlanych z obserwacjami dokonanymi w terenie dostarczyło informacji na temat przebiegu rozwoju starszych larw omawianego gatunku oraz sposobu ich przygotowania do przeobrażenia w postać uskrzydloną.

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