

The life-history of *Ameletus inopinatus* (Siphonuridae, Ephemeroptera)

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INTRODUCTION

Ameletus inopinatus EATON, 1887 is the only arctic-alpine species of the order Ephemeroptera recorded from the British Isles. It occurs in the Vosges mountains (EATON 1883—88, SCHOENEMUND 1930a); in the mountains of the Black Forest (EATON 1883—88, SCHOENEMUND 1930a, EIDEL 1933); in Czechoslovakia in the High Tatra to the east (SCHOENEMUND 1930a), in Moravia in the centre (ZELINKA 1951) and in the Böhmerwald mountains to the west (WINKLER 1956). SCHOENEMUND (1930b) and TIENSUU (1937) record it from Norway. In Britain it is usually found in streams at high altitudes (BROWN 1937, HARRIS 1952, KIMMINS 1954 and MACAN 1959) but has been recorded from several lochs not far above sea level in the extreme north-west of Scotland (MACAN 1959). In the Lake District it has not been found in streams below 1000 ft (300 m) (MACAN 1951).

THE STREAM

Whelpside Ghyll rises at about 2,820 ft (859 m) on the western slopes of Helvellyn in the English Lake District. At 2,170 ft (661 m) it is joined by a tributary which has its source at about 2,350 ft (716 m). Just below the confluence the stream falls steeply, with a gradient of 1 in 2.9, for about 1,000 ft (304 m), afterwards resuming a less precipitous course, 1 in 4, into Thirlmere at 600 ft (182 m) near the village of Wythburn. The observations were carried out in the tributary above the confluence, where it consists mainly of small pools and stretches of shallow, fast-flowing water connected by small waterfalls. The average gradient in this stretch, from its source to

just below the confluence, is 1 in 4.7. It is about 1 m wide with depths varying from a few to about 50 cm in the deeper pools. The bed varies from gravel to quite large stones, a few big enough to require two hands to lift them. *Fontinalis* sp. was present on the larger stones. Two stations were chosen, St. II being about 45 m upstream from St. I.

METHOD

Collections were made with a net having 20 threads to the inch and in 1958 a fine net with 180 threads to the inch was also used. These are the two standard pond nets produced by the Freshwater Biological Association. Dr MACAN has asked me to point out that he was using similar nets and his figure of 160 is an error (MACAN 1957). I used the collecting technique described by MACAN (1958), turning stones as I moved upstream and catching the animals thus disturbed. I also swept under the banks where undercutting had occurred and, in the deeper pools, held the net against the bottom and disturbed the area in front. Collecting lasted for five minutes at each station and the collections were sorted in the laboratory. The specimens of *A. inopinatus* were measured, usually with the naked eye, from the front of the head to the base of the caudal filaments. Collections were made during 1957, 1958 and early 1959, generally once a month except in the winter. In April 1958 a „pyramid” emergence trap (MUNDIE 1956, fig. 3) was placed in the lower pool of St. II and in May another trap was put in position about 10 m upstream. The second trap was square in plan and had a catching area of 1472 sq. cm. It was of the floating box-trap type (MUNDIE, 1956 p. 9) being supported by corks placed round the perimeter. The sides were of Tygan Screencloth, a plastic fine-meshed gauze and the roof was of transparent celluloid.

THE COLLECTIONS

Fig. 1 shows the numbers of *Ameletus inopinatus* caught each collection at St. I arranged in mm size groups and also the numbers of adults caught by the traps during the emergence period. Because the traps were not in use during 1957 and, as the course of events during that year was similar to that of 1958, detailed information about the 1957 collections has been omitted. October 1957 was chosen as the starting point because that was the month when small nymphs first appeared. As can be seen from the figure, the species has a rather long emergence period, from late May to late August, growth starts

in the winter and the cycle is completed in a year. Events are not, however, quite as straightforward as they at first seem. Presumably the first specimens to hatch in the autumn of 1957 had been missed, the collections in September having been made with a coarse net. Fine-net collections in August and September 1958 showed this

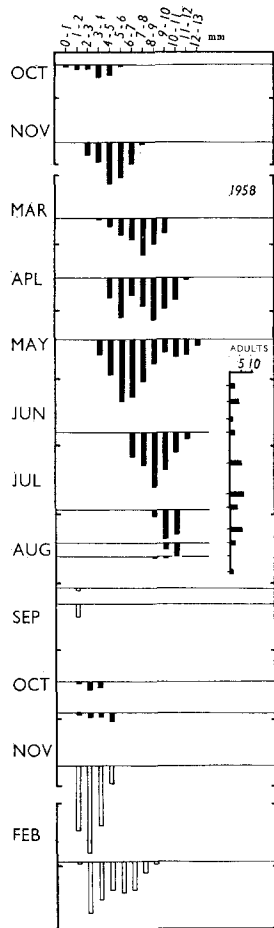


Fig. 1.
The numbers of *Ameletus inopinatus* caught each collection at St. I arranged in mm size groups and the numbers of adults caught by the traps during the emergence period. The unshaded histograms refer to collections made with a fine net.

assumption to be correct, the first small ones being found on 2 September. Growth continued throughout the winter of 1957—58 but in April another peak appeared besides the one at 8—9 mm and in the May collection this lower peak was more accentuated. In February the following year the fine net collection shows a similar pattern and gives every indication that two peaks will develop as in the April and May collections of 1958. What causes the two peaks? One possibility is that only some of the nymphs have been growing as happens with the damsel-fly *Pyrrhosoma nymphula* (MACAN,

unpublished records). Another is that there is a peak of hatching in the autumn and another early the next year, with little or no hatching in mid-winter.

TABLE I

Body lengths in mm of adult *Ameletus inopinatus* (from front of head to base of caudal filaments).

i = imago. s = subimago.

	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5 mm
10 June							♂ i ♀ i		♂ s	♀ s
18 June								♀ s		
24 June							♂ s		♂ s	
8 July			♀ s			♀ s				
29 July		♀ s	♂ s		♂ s					
7 August	♂ s		♂ s		♂ s ♀ s		♂ s			
13 August			♂ s ♂ s							
26 August		♀ s								

A study of the adults supports the second possibility. Table I shows that the early ones are large and the later smaller. If the larger adults are from nymphs that have grown throughout the winter, and the smaller ones from eggs that hatched later, there must have been bursts of hatching at two different times. In May the largest nymphs were 12–13 mm long, emergence could be expected to commence but no adults were taken in the traps until 3 June although cast skins and a male subimago were found on the surface of the lower pool of St. I on 27 May. Emergence continued until late August although numbers caught at any one time by both traps never exceeded 6 specimens. The emergence period then is short compared with the egg-hatching period. EIDEL (1933) gives July and August as the emergence period and June and early July are given by HARRIS (1952) and KIMMINS (1954). BROWN (1937) has taken subimagines as early as 15 May.

Mating and oviposition were not observed by the writer and the only adult seen, apart from those trapped, was the subimago of 27 May. BROWN (1937) mentions this elusiveness of the adults.

SUMMARY

Ameletus inopinatus has an emergence period lasting from late May until late August. That the hatching of eggs goes on from September to February is deduced from the capture of tiny nymphs in these months. Judging from the numbers in the different size groups, there is a peak of egg hatching in the autumn and another early the following year with a period in between with little or none. Nymphs growing throughout the winter produce the larger adults in May and early June, and it is thought that all the smaller adults emerging later originated from eggs that hatched later. The life cycle is completed in a year.

ZUSAMMENFASSUNG

Die Flugperiode von *Ameletus inopinatus* dauert von Ende Mai bis Ende August. Dass das Schlüpfen aus dem Ei von September bis Februar stattfindet, wird aus dem Fang von winzigen Nymphen während dieser Monate geschlossen. Die Beurteilung der Zahlen der verschiedenen Grossengruppen zeigt ein Maximum des Schlüpfens aus dem Ei im Herbst und ein zweites früh im folgenden Jahr. In der Periode zwischen diesen beiden Maxima schlüpfen wenig oder keine Tiere. Nymphen, die während des ganzen Winters wachsen, liefern die grösseren Imagines im Mai und Anfang Juni. Es wird angenommen, dass alle kleineren Imagines, die später schlüpfen, aus Eiern stammen, die später geschlüpft sind. Der Lebenszyklus in einem Jahr vollendet.

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