

The Ephemeroptera, Plecoptera and Trichoptera caught by emergence traps in two streams during 1958

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With 2 figures and 1 table in the text

INTRODUCTION

In an investigation of the life-history of *Ameletus inopinatus* EATON in Whelpside Ghyll (GLEDHILL 1959), two emergence traps were used to find the emergence period. It seemed worthwhile to record the other Ephemeroptera and the Plecoptera and Trichoptera caught so that comparison might be made with the results from similar traps in a stream at lower altitude. Differences in the composition of the populations of the two stations and differences in the emergence period of species fairly abundant in both are discussed, and the data also throw some light on the question of temporal isolation of closely related species that emerge one after the other.

THE STREAMS AND TRAPS

Both streams are small and stony and have been described, the lower one, Ford Wood Beck, by MACAN (1957) and the higher, Whelpside Ghyll, by GLEDHILL (1959). MACAN (1958) found that the highest reading on a maximum and minimum thermometer hidden in Whelpside Ghyll at 2,000 ft (609 m) in 1952 was 15°C. Outgate Beck, a tributary of Ford Wood Beck, reached a maximum of 19°C during the same year. In 1951 and 1953 the maximum in Whelpside Ghyll was 13.9°C, 2.8°C below that of Outgate Beck in 1951. A maximum and minimum thermometer near the mouth of Ford Wood Beck, where the traps were, showed that the maximum temperature always exceeded that at Outgate, the greatest difference

being 2.9°C. The difference between the maxima at the trapping stations in Whelpside Ghyll and Ford Wood Beck is, then, about 5°C.

Two traps were used in each stream, a "pyramid" emergence trap (MUNDIE 1956, fig. 3) and a trap of the floating box type, (MUNDIE 1956, p. 9). The traps in Ford Wood Beck were 146 ft (44.5 m) above sea level and those in Whelpside Ghyll were 2,050 ft (624 m) higher. The "pyramid" traps were identical but the box types had different catching areas, the one in Whelpside Ghyll being smaller (1472 sq. cm) than that in Ford Wood Beck (3,333 sq.cm). The "pyramids" retained their captures, whereas the box-traps did not, a distinct disadvantage, especially when the trap in Whelpside Ghyll could not be visited sometimes for over a fortnight. In Ford Wood Beck the "pyramid" was in operation from 23 March and the box-trap from 12 May, in Whelpside Ghyll the "pyramid" from 22 April and the box-trap from 30 May. The traps in both streams were kept in operation for some time after the capture of the last specimen.

The suitability of emergence traps comes into question when a species list is the objective. During 1958 the traps in Ford Wood Beck yielded 6 of the 11 species of Ephemeroptera, 8 of the 17 species of Plecoptera and 7 of the 19 species of Trichoptera that have been recorded from the same station during seven years trapping. Some species may not be caught because they are scarce, but certain species, numerous as larvae or nymphs, are scarce in, or absent from, the traps, presumably because of their emergence habits. For example, MACKERETH (1957, fig. 1) shows *Nemoura cambrica* as being common, yet in the trapping season of 1953 only one specimen was taken. *Perla bipunctata (carlukiana)*, another common species, has only been taken three times during seven years. Trapping of adults and larval and nymphal collections have been carried out in Ford Wood Beck for seven years whereas, in Whelpside Ghyll, traps have only been used for one year and larval and nymphal collections have been few; consequently species present in Whelpside Ghyll and absent from Ford Wood Beck can be listed with some confidence whereas the reverse is not so.

RESULTS

Fig. 1 and fig. 2 show the number of each species caught by both traps during 1958 in Whelpside Ghyll and Ford Wood Beck respectively. The total number of species caught in the two streams was:

	Ephemeroptera	Plecoptera	Trichoptera
Whelpside Ghyll	4	12	7
Ford Wood Beck	6	8	7

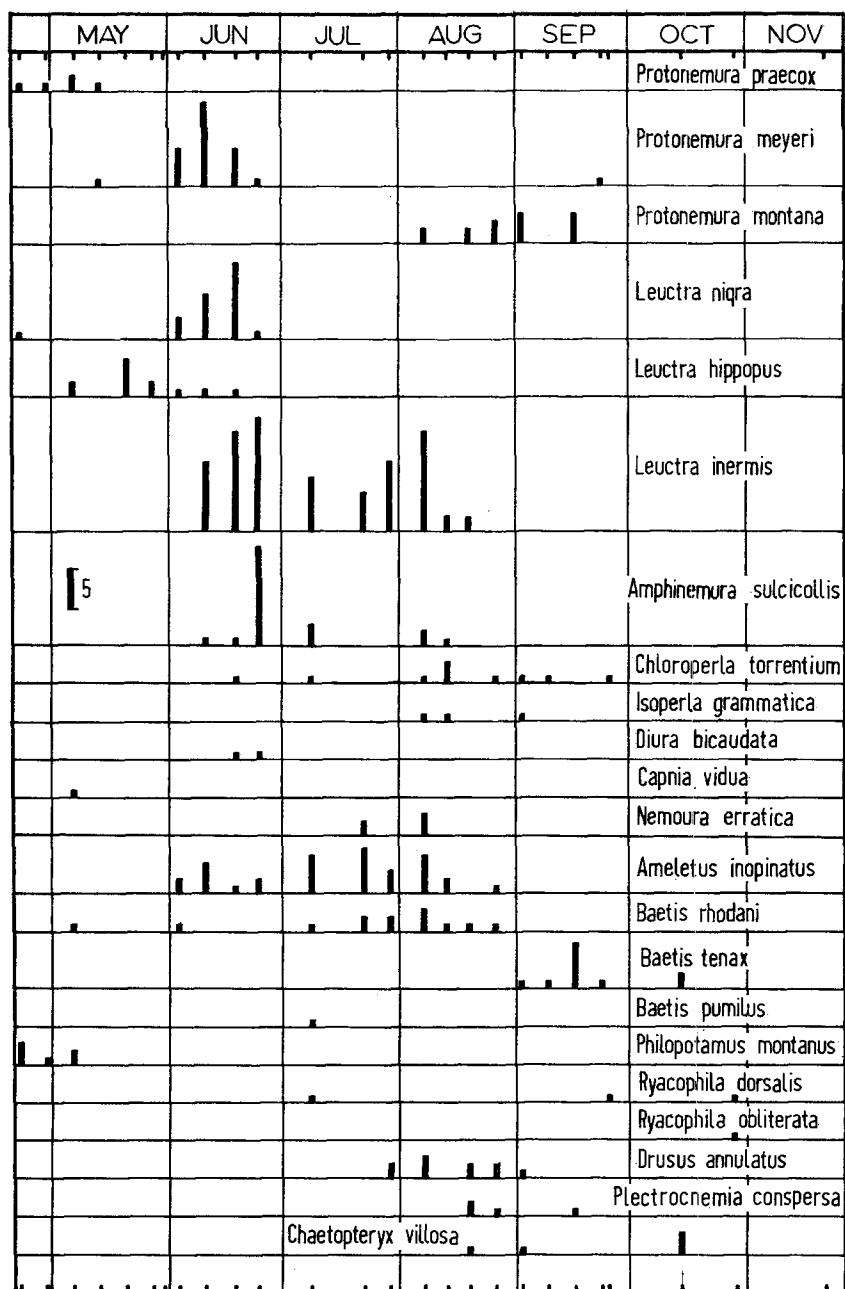


Fig. 1.
The number of each species caught by both traps during 1958 in Whelpside Ghyll.

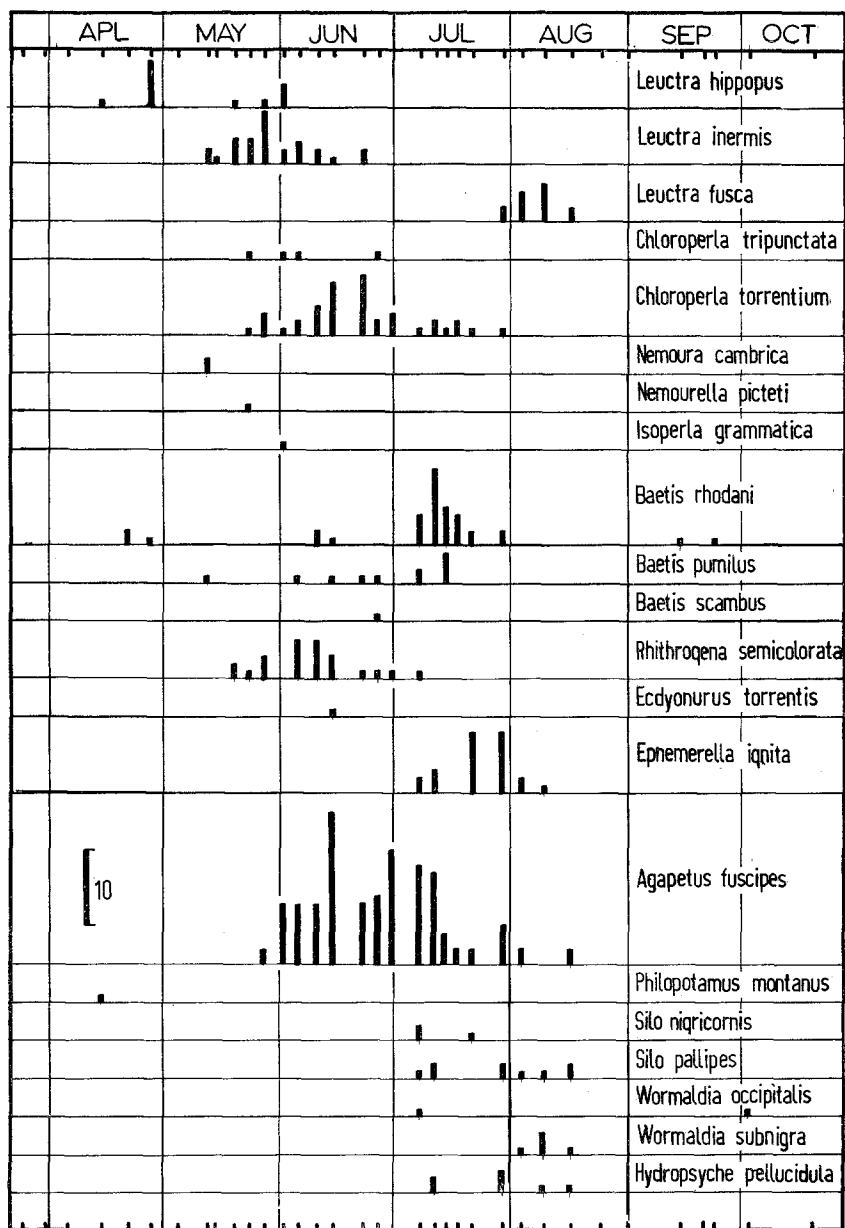


Fig. 2.
The number of each species caught by both traps during 1958 in Ford Wood Beck.

One species of Trichoptera, *Potamophylax latipennis*, caught by the traps in Whelpside Ghyll from 22 July to 9 September, is not shown on fig. 1 because it was not identified until after the figure was completed. Chironomids and other Diptera, although collected, have been ignored in this paper.

Leuctra hippopus, *L. inermis*, *Chloroperla torrentium*, *Isoperla grammatica*, *Baetis rhodani*, *B. pumilus* and *Philopotamus montanus* were caught from both streams. Other species captured by the traps in Whelpside Ghyll and absent from Ford Wood Beck captures during 1958 have been taken in previous years. The only species never found in Ford Wood Beck are:

Ameletus inopinatus which, except for some records from lochs in the extreme northwest of Scotland, is confined to streams at high altitudes (GLEDHILL 1959).

Baetis tenax. MACAN (1957), who doubts whether *B. tenax* and *B. vernus* are distinct, does not record either from stony streams or stony rivers and finds them most plentiful in slow rivers with rooted vegetation. It occurs at high altitudes, for KIMMINS (1954) states that it may be found up to at least 1,700 ft (518 m) in the Lake District and WINKLER (1956) records it from brooks at an altitude of 1,000—1,100 m in Czechoslovakia. The distribution of the species is probably like that of *Diura bicaudata* described below.

Protonemura montana has so far been recorded only from Britain and only in small stony streams at high altitudes (HYNES 1958).

Diura bicaudata is an inhabitant of stony streams at altitudes above 1,000 ft (304 m) and of stony lake shores (HYNES 1958). It has not been recorded from lowland streams except on the Isle of Man, where *Perlodes microcephala* (*P. mortoni*) is absent. HYNES (1953) suggests that the inability of *D. bicaudata* to compete with *P. microcephala* in running water at low altitudes may account for its distribution on the mainland. *P. microcephala* is present in Ford Wood Beck and, although absent from collections made above 2,000 ft (609 m) in Whelpside Ghyll, where *D. bicaudata* is common, has been recorded at 1,500 ft (457 m). BRINKHURST (1957) found both species present in the "middle reaches" of a stream in the Spey Valley, Inverness-shire, but only *D. bicaudata* in the "upper reaches", above about 2,250 ft (685 m).

Capnia vidua occurs in small stony streams and is rare, often scarce (HYNES 1958).

Species present in Ford Wood Beck and absent from Whelpside

Ghyll, as explained previously, cannot be listed with confidence. *Paraleptophlebia submarginata*, *Habrophlebia fusca* and *Bäetis scam-bus* have not been taken anywhere in Whelpside Ghyll. *Rhithrogena semicolorata*, *Ephemerella ignita* and *Heptagenia lateralis* are very scarce above 2,000 ft (609 m), and *Ecdyonurus* species have only been taken lower down the stream. *Perlodes microcephala*, *Leuctra fusca* and *Chloroperla tripunctata* have been absent from collections made above 2,000 ft (609 m) by the writer but *P. microcephala* is recorded from lower down the stream (MACAN and MACKERETH, unpublished records). It might be that Whelpside Ghyll is too cold for *L. fusca*, a species which grows during the summer months.

Agapetus fuscipes and *Silo pallipes*, common in Ford Wood Beck, appear to be absent, at least above 2,000 ft (609 m).

The proportion of *Bäetidae* to *Ecdyonuridae* and *Ephemerellidae* is much higher in the Whelpside Ghyll station than in streams at lower altitudes and VERRIER (1953) has noted a similar change.

Worthy of note is the absence, except for *Philopotamus montanus* and *Agapetus fuscipes*, of Trichoptera from the traps in Ford Wood Beck until July and August.

The succession of the *Protonemura* species is shown well in Whelpside Ghyll although the appearance of the single specimen of *P. meyeri* in September, three months after the main emergence, is puzzling. HYNES (1958) states that they may occur as late as September. ILLIES (1952) found a succession of Plecoptera emerging throughout the year although with some overlap. Collecting adults along the banks, he found that at the beginning of an emergence period come males, at the peak both sexes are about equal in number and that at the end there are only spent or ovigerous females, which means that there is therefore complete reproductive isolation. In Ford Wood Beck and Whelpside Ghyll there was a similar succession of *Protonemura* and *Leuctra* species but no such distribution of the sexes (table I), and the species of *Leuctra* except *L. fusca* were not isolated in time.

The emergence period in the two streams of *Leuctra hippopus*, *L. inermis* and *Chloroperla torrentium* is considerably different. *L. inermis* in Ford Wood Beck has a compact emergence period and starts almost a month earlier than in Whelpside Ghyll. In the latter it is more spread out with a suggestion of two peaks. Emergence is beginning in Whelpside Ghyll as it is drawing to a close in Ford Wood Beck. Again, the emergence period of *C. torrentium* in Whelpside Ghyll is longer and begins later than in Ford Wood Beck. Peak emergence is in August in the former and in June in the latter.

What causes this difference? BRINCK (1949) found that hiemal

TABLE I.

Distribution of the sexes during the emergence period of 6 species of Plecoptera caught in emergence traps during 1958.

<i>Protonemura praecox</i>																			
Whelpside Ghyll	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
<i>Protonemura meyeri</i>																			
Whelpside Ghyll	1	4	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
	-	1	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
<i>Protonemura montana</i>																			
Whelpside Ghyll	-	1	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
	2	1	-	4	1	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
<i>Leuctra hippopus</i>																			
Whelpside Ghyll	1	4	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
	1	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
Ford Wood Beck	1	5	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
<i>Leuctra inermis</i>																			
Whelpside Ghyll	3	5	10	3	2	6	6	1	1	-	-	-	-	-	-	-	-	♂♂	♀♀
	6	8	5	4	3	3	7	1	1	-	-	-	-	-	-	-	-	♂♂	♀♀
Ford Wood Beck	2	-	3	3	3	1	1	1	-	1	-	-	-	-	-	-	-	♂♂	♀♀
	-	1	1	1	4	1	2	1	1	1	-	-	-	-	-	-	-	♂♂	♀♀
<i>Chloroperla torrentium</i>																			
Whelpside Ghyll	1	-	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-	♂♂	♀♀
	-	1	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-	♂♂	♀♀
Ford Wood Beck	1	2	1	1	4	3	4	1	2	-	1	1	1	1	1	1	1	♂♂	♀♀
	-	1	-	1	-	4	6	1	1	1	1	1	-	1	-	-	-	♂♂	♀♀

species, those growing during autumn, winter and spring, with a late emergence period are distinctly affected by climatic conditions. He found that *Brachyptera risi* emerged mainly in May in South Sweden but in the high mountains not until July with the peak in August.

Difference in temperature seems the most likely explanation of the differences in emergence times, but undoubtedly the relationship is not a wholly straightforward one. If it were, there should have been a greater difference in emergence times than has been observed between successive years in Ford Wood Beck. *Leuctra inermis* has emerged from Ford Wood Beck for the past six years during May and June with only about 14 days difference between first emergers during that time and *Chloroperla torrentium*, emerging during May, June and July, has had only about 19 days difference between first emergers. Moreover the latest emergences of these species did not

always occur in the coldest seasons, nor the earliest in the warmest. MACAN (1958, p. 99) contrasting the warm winter of 1956/57 with the cold winter of 1954/55 in Ford Wood Beck, found that by May the warmer season was between 3 and 4 weeks ahead of the colder. Records, however, show that *Leuctra inermis* emerged about 10 days later in 1957 than in 1955. *Chloroperla torrentium* on the other hand did emerge earlier, about 8 days, in 1957. *Leuctra fusca* emerged at almost the same time in the two contrasted years. Although temperature may considerably influence emergence, it is suggested that, if species emerge at, or roughly at, the same time each year, some other factor is controlling emergence.

SUMMARY

1. The captures from emergence traps in a high mountain stream, Whelpside Ghyll, are compared with those from similar traps in a warmer lower stream, Ford Wood Beck.
2. The number of species caught by the Ford Wood Beck traps and the number of species known to inhabit the stream are discussed.
3. In Whelpside Ghyll the traps yielded 4 species of Ephemeroptera, 12 of Plecoptera and 7 of Trichoptera, in Ford Wood Beck, 6 species of Ephemeroptera, 8 of Plecoptera and 7 of Trichoptera.
4. *Leuctra hippopus*, *L. inermis*, *Chloroperla torrentium*, *Isoperla grammatica*, *Bäetis rhodani*, *B. pumilus* and *Philopotamus montanus* were caught from both streams.
5. Species found in Whelpside Ghyll and not in Ford Wood Beck are *Ameletus inopinatus*, *Bäetis tenax*, *Protonemura montana*, *Diura bicaudata* and *Capnia vidua*, of which two are known high-altitude species and one, possibly two, is known also from stony lake shores being kept out of other habitats presumably by competition.
6. The proportion of Bätids to Ecdyonurids and Ephemerellids is higher in the Whelpside Ghyll station than in streams at lower altitudes.
7. There was, in both streams, a succession of *Protonemura* and *Leuctra* species but the *Leuctra* species, except *L. fusca*, were not isolated in time.
8. The distribution of the sexes during the emergence period of 6 species of Plecoptera is shown.
9. There was a considerable difference in the emergence period from the two streams of *Leuctra hippopus*, *L. inermis* and *Chloroperla torrentium*, the emergence period in Ford Wood Beck being earlier and shorter than in Whelpside Ghyll.
10. *Leuctra inermis* has emerged from Ford Wood Beck during six

successive years in May and June with only about 14 days difference between first emergers, and *Chloroperla torrentium*, emerging during May, June and July, has had only about 19 days difference between first emergers during that time.

ZUSAMMENFASSUNG

Schlüpfende Imagines wurden in einem etwa 600 m über dem Meeresspiegel liegenden Bach und in einem zweiten, niedrigeren Bach gefangen. Der Maximum-Temperaturwert war um 5° C höher in dem niedrigeren Bach. Nur in dem höheren Bach kamen *Ameletus inopinatus*, *Baetis tenax*, *Diura bicaudata* und *Capnia vidua* vor. Die Arten, die lediglich in dem niedrigeren Bach gefunden wurden, sind ebenfalls erörtert. Im niedrigeren Bach fand der erstmalige Imagines-Auftritt früher statt und die Flugzeit war kürzer. In den Gattungen *Protonemura* und *Leuctra* folgte eine Reihe von Arten nacheinander, aber die späteste der einen und die früheste der nächsten erschienen zusammen.

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