

F A U N A N O R R L A N D I C A

Vol. 5

1981

OCCURRENCE AND FLIGHT MOVEMENTS OF MAYFLIES (Ins. Ephemeroptera) IN THE MOUTH OF A COASTAL STREAM IN THE NORTHERN BOTHNIAN SEA

E. Engblom & P.E. Lingdell  
Skärmarbrinksvägen 5  
S-122 31 ENSKEDE/Sweden

K. Müller  
Department of Ecological Zoology  
University of Umeå  
S-901 87 UMEÅ/Sweden

University of Umeå  
Department of Ecological Zoology

Editor: Karl Müller, Ph.D.  
Scientific editors: Per Douwes, Ph.D.  
Lars Huggert, Ph.D.

This volume of "Fauna Norrlandica" has received financial support from the Seth M. Kempes Minnesfond. The editors are greatly indebted for this generous assistance.

OCCURRENCE AND FLIGHT MOVEMENTS OF MAYFLIES (Ins. Ephemeroptera) IN THE MOUTH OF A COASTAL STREAM IN THE NORTHERN BOTHNIAN SEA

E. Engblom., P.E. Lingdell & K. Müller

1. INTRODUCTION

The occurrence of mayflies in the coastal stream Ångerån and its estuary has been described in several papers (Lingdell & Müller 1979a, 1979b and 1981), (Harmanen 1980). In a previous investigation (Lingdell & Müller 1979c) by means of window-trap placed out on the water surface of the lower part of the Ångerån, 30 to 50 m upstream the mouth, we could demonstrate that mayfly imagos fly upstream which results in them laying their eggs in freshwater. These movements have been checked in the years 1979 and 1980 by means of bilateral Malaise traps. This paper and the results are presented here.

2. INVESTIGATION AREA AND METHODS

The study area and its physical characteristics and chemical properties have been described elsewhere (Müller & Müller-Haeckel 1978, Müller & Müller-Haeckel 1981, Müller-Haeckel & Sjöberg 1981).

In 1979/80 we placed out a Malaise-trap (M1) across the Ångerån about 40 m above the mouth, which enabled determination of the "upstream" and "downstream" flight direction (Fig. 6). Another Malaise-trap (M3) was placed on a small island about 150 m outside the river mouth. This trap made it possible to estimate the number from the seaside or the landside. The investigation started 1979 on June, 13 and in 1980 on April, 24.

The taxonomical work has been carried out by E. Engblom and P.E. Lingdell. The material is deposited in the collection Lingdell (Stockholm/Enskede).

### 3. RESULTS

3.1 The mayfly fauna of the river Ångerån and its estuary. Mayflies (Ephemeroptera) can be regarded as one of the most typical insect groups in freshwater biotopes. From European lakes, rivers and streams 217 species have been described (Puthz 1978). Only a few investigations mention the occurrence of mayflies in brackish water (Stammer 1928, Saaristo 1966, Lingdell & Müller 1979c).

Due to the low pH-values (Harmanen 1980), few mayflies occur in the coastal river Ångerån and therefore is even the number of species in the estuary reduced. Based on extensive investigations in 1977-1980 in the river Ångerån and its estuary we observed the following species (Tab. 1).

Tab. 1 Survey of mayfly species occurring in the Ångerån mouth and the estuary arranged in order of the seasonal flight period.

SPECIES	Flight period
<i>Leptophlebia marginata</i> L.	May, June
<i>Leptophlebia vespertina</i> L.	June
<i>Heptagenia fuscogrisea</i> Retz.	June, July
<i>Baetis rhodani</i> Pict.	June, July
<i>Baetis subalpinus</i> Bgtss.	June, July      Sept. Oct.
<i>Siphonurus alternatus</i> Say	July
<i>Siphonurus lacustris</i> Etn.	July
<i>Cloeon simile</i> Etn.	August, September
<i>Baetis fuscatus</i> L.	August, September
<i>Caenis horaria</i> L.	August

Two of the species *Baetis fuscatus* and *Caenis horaria* have only been observed in the brackish water areas.

3.2 The seasonal flight periods of mayflies in the Ångerån area. Figs. 1 and 2 show the flight periods determined from the Malaise-trap (Ml) data in the years 1979 and 1980, respectively. The values from 1979 are based on samples in two-day intervals from June, 13 and in 1980 on samples in ten-day intervals from April 24th. In both investigations, *Baetis subalpinus* is the dominating species in the Malaise-trap, although few drifting nymphs of the species were found (Lingdell & Müller 1979c). From this investigation it can be seen that nymphs of both *Leptophlebia* species were dominant (up to 98%).

### 3.3 INVESTIGATIONS ON FLIGHT DIRECTION OF MAYFLY ADULTS

#### 3.2.1 The occurrence in Malaise-trap Ml.

This trap across the lower reaches of the Ångerån gave the largest numbers. In this evaluation we shall only discuss the results for *Baetis subalpinus*. Figs. 3 and 4 show the upstream and downstream flight movements of *B. subalpinus* in 1979 and 1980 plotted out in 10-day intervals over the whole flight period. As we described earlier (Lingdell & Müller 1980), this Baetidae has two generations in the course of summer, one in June-July and another one in August-September.

The catches have been very much higher in 1980 compared with 1979. But the mayflies behaved in the same way. In both years 96% of all captured imagos of *B. subalpinus* showed an upstream flight direction. The difference in the number of *B. subalpinus* in both years and also the differences in the number of animals

in the first and the second generation can be explained by the weather conditions in both years. There were higher monthly mean air temperatures in 1980 than in 1979 and a continuous high pressure weather condition in the main spring fly period of *B. subalpinus*

### 3.2.2 The occurrence of mayflies in M3.

In earlier investigations (Lingdell & Müller 1979c and Danielsson & Müller 1981) we have described the drift of mayfly nymphs from Ångerån into the estuary. An estimation of the filtered nymphs in the drift sieves in relation to the total water discharge showed that about 3.6 million mayflies drift into the estuary per year. In the estuary we can observe a clear zonation of the nymphs (Fig. 5). The nymphs of *Leptophlebia marginata* and *L. vespertina* occupy the estuary up to the island Skepparhällan. *B. subalpinus*, *C. simile*, *H. fuscogrisea*, *S. alternatus* and *S. lacustris* stay in the rich vegetation belt which is found in the outflow of the river Ångerån. *B. fuscatus* prefers the stony region around the peninsula Getholmen and *Caenis horaria* was found on the outside of the estuary where the salinity vary between 3 and 5‰. Our hypothesis is that the nymphs which drift from the Ångerån to the estuary fly back up the stream. The adults should also be captured in higher numbers flying from the seaside in M3 and in even higher numbers than in M1. Fig. 6 shows the location of both the traps and the numbers of captured mayflies. In all cases we found more mayflies in the seaside part of M3 and in the downstream directed part of M1.

#### 4. DISCUSSION

In the Ångerån and its estuary the mayflies are only represented by ten species. The dominating species, based on drift samples over a whole annual period, are *Leptophlebia marginata* and *L. vespertina*. The adults are dominated by *B. subalpinus*.

Of the downstream drifting species, both *Leptophlebia* species show the highest adaption to brackish water. In the vegetation belt in the outflow region, *B. subalpinus*, *C. simile*, *S. alternatus* and *S. lacustris* rise to the highest abundances. *H. fuscogrisea*, *B. subalpinus* and *C. simile* were also found in the Ångerån. Only a few individuals of *B. rhodani* were observed.

All adult mayflies which have been captured in the Malaise-traps show a flying direction from the seaside or directed upstream in the trap which was built across the lower part of the Ångerån. A comparison between the number of drifting nymphs and flying adults shows that several species are clearly underrepresented as adults. On the other hand, we found that *B. subalpinus* in the drift was represented by only a few individuals. These differences must be looked for in the flying behaviour of various species in relation to the capture method used. In studies of flying behaviour of insects in the field it is necessary to adapt methods which utilize the individual migratory or swarming behaviour. From direct observations in the mouth part of the Ångerån and its estuary we could observe that, especially *B. subalpinus* due to the habit of swarming immediately above the water surface, is highly catchable by Malaise-traps which are placed across the river. The other species observed, such as *L. vespertina*, *L. marginata* or *H. fuscogrisea*, were found

in the vegetation on both sides of the river bed and in sunny weather flying over the tops of trees close to the stream. To analyze this flying behaviour we must in the future develop other methods. Our investigations are in agreement with other non-quantitative observations reported by several authors. Stadler observed (1915) mayflies flying up to 150 m over the river bed of the river Main in Central Europe in an upstream flight direction. Russev (1972) reported a similar observation from the Bulgarian part of the river Danube.

Our measurements and the cited observations suggest the hypothesis that running waters can be seen as pathways for insects, in order to compensate the downstream drift movements in running waters (Müller 1954). Also, this study shows that the mature females transport the eggs from the brackish water areas to suitable localities in the limnic biotopes of the Ångerån.

What is the ecological or physiological reason for this behaviour? We have earlier postulated for the mayflies and stoneflies (Lingdell & Müller 1979c and Müller & Mendl 1979, Mendl & Müller 1981) that this behaviour can be considered as a "colonization cycle" (Müller 1954) between the coastal stream and its estuary. The nymphs mainly develop and grow in the estuary. For oviposition the adults search after limnic biotopes in the stream. These biotopes are rich in oxygen and in the early summer warmer than the estuary. The nymphal stages later drift to the estuary which offers a rich food supply, in autumn and winter.

## Literature

- Danielsson, P. & Müller, K. 1981. Faunistic zonation of the Ångerån estuary. - Mon.Biol. (Ed. K.Müller) (in press).
- Harmanen, M. 1980. Der Einfluss saurer Gewässer auf den Bestand der Ephemeriden- und Plecopterfauna. - Gewässer und Abwässer 66/67:130-136.
- Lingdell, P.E. & Müller, K. 1979a. Eintagsfliegen (Ephemeroptera) im Küstengebiet des Bottnischen Meerbusens. - Ent. Zeitschr. 89:41-47.
- Lingdell, P.E. & Müller, K. 1979b. Dagsländor i brackvatten. Ent. Tidskr. 100:13.
- Lingdell, P.E. & Müller, K. 1979c. Migrations of *Leptophlebia vespertina* L and *L. marginata* L. (Ins.: Ephemeroptera) in the estuary of a coastal stream. - Aquatic Insects L.137-142.
- Lingdell, P.E. & Müller, K. 1980. Unterschiedliche Entwicklungszyklen von *Baetis subalpinus* in zwei nordschwedischen Fließgewässern. - Ent. Zeitschr. 90:179-184.
- Lingdell, P.E. & Müller, K. 1981. Mayflies (Ins. Ephemeroptera) in coastal areas of the Gulf of Bothnia. Mon.Biol. (Ed. by K.Müller) (in press).
- Müller, K. 1954. Investigations on the organic drift in north Swedish streams. - Rep. Inst. Freshwater Res. Drottningholm 35:133-148.
- Müller, K. & Müller-Haeckel, A. 1978. Faunistic research in the river Ångerån and in adjacent areas of the Bothnian Sea. - Fauna Norrl. 3:1-17.
- Müller, K. & Müller-Haeckel, A. 1981. The Physiography of the river Ångerån. - Mon.Biol. (Ed. K.Müller) (in press).



- Müller-Haeckel, A. & Sjöberg, A. 1981. Annual variations in chemical and hydrographical factors in the river Ängerån and in brackish water of the adjacent coastal area of the Bothnian Sea. Mon. Biol. (Ed. K.Müller) (in press).
- Puhtz, V. 1978. Ephemeroptera, in Limnofauna Europaea (Ed. J. Illies) 256-263).
- Russev, B. 1972. Über die Migration der Rheobionten in Fließgewässern. - Verh. Int. Verein. Limnol. 18:730-734.
- Stadler, F. 1915. In Ulmer(1929). Eintagsfliegen (Ephemeroptera) Agnatha). Die Tierwelt Mitteleuropas 4:1-43.

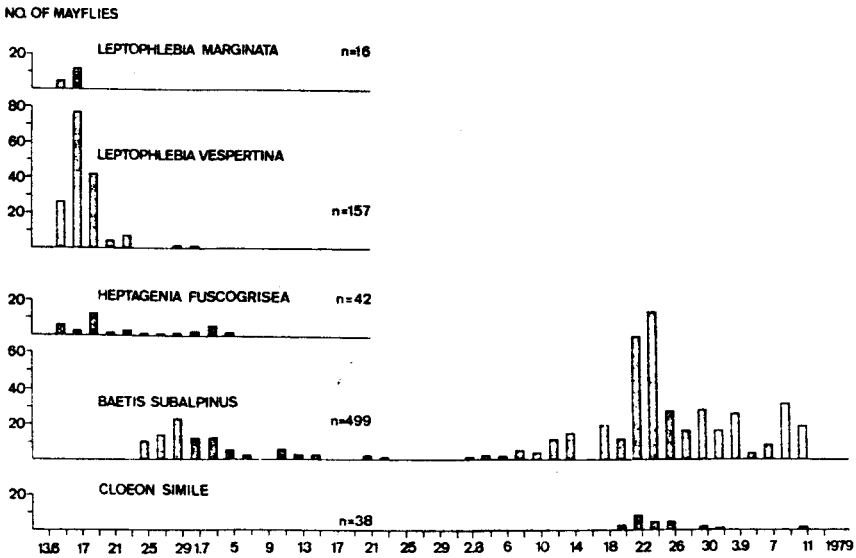


Fig. 1.

Flight periodicity of the dominating mayflies in the mouth-part of the river Ångerån, 1979.

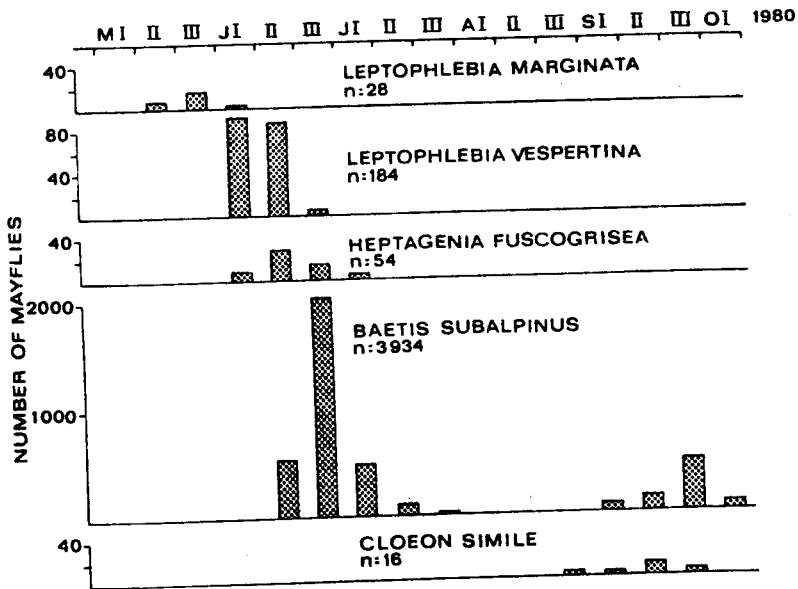


Fig. 2

Flight periodicity of the dominating mayflies in the mouth part of the river Ångerån, 1980.

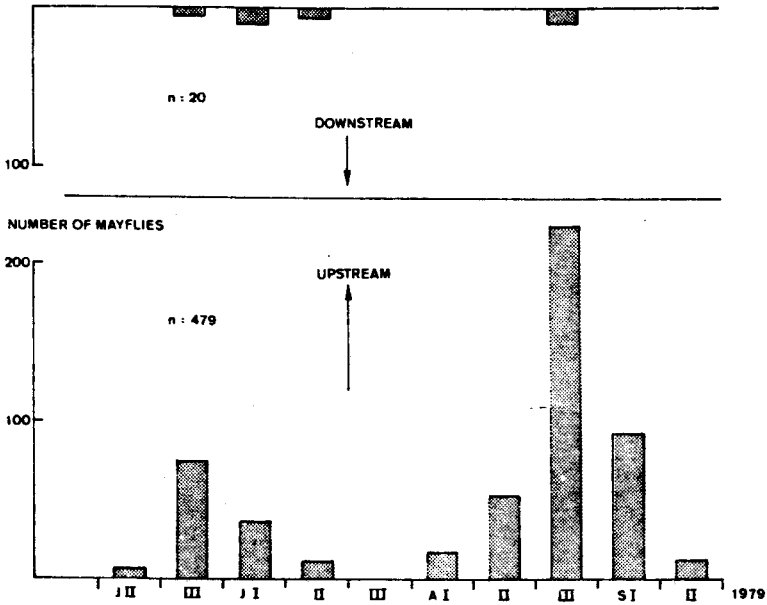


Fig. 3.

The upstream and downstream flight movements of *Baetis subalpinus* controlled by a Malaise-trap in the mouth of the river Ångerån 1979.

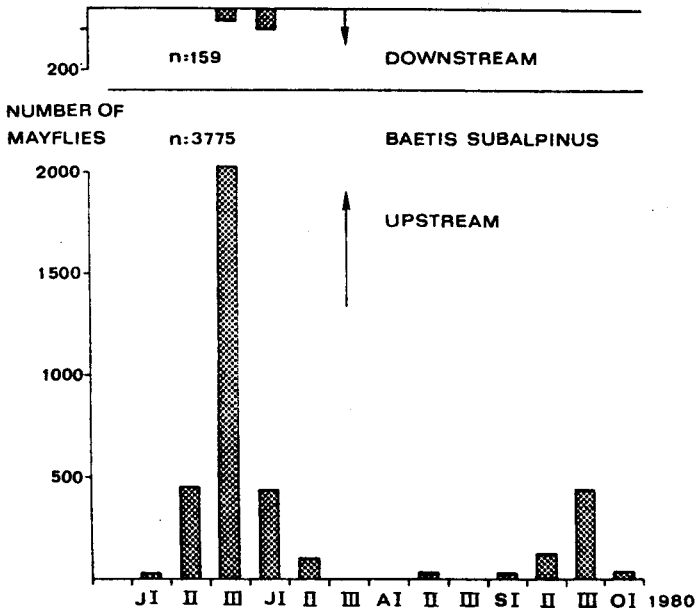


Fig. 4

The upstream and downstream flight movements of *Baetis subalpinus* controlled by a Malaise-trap in the mouth of the river Ångerån, 1980.

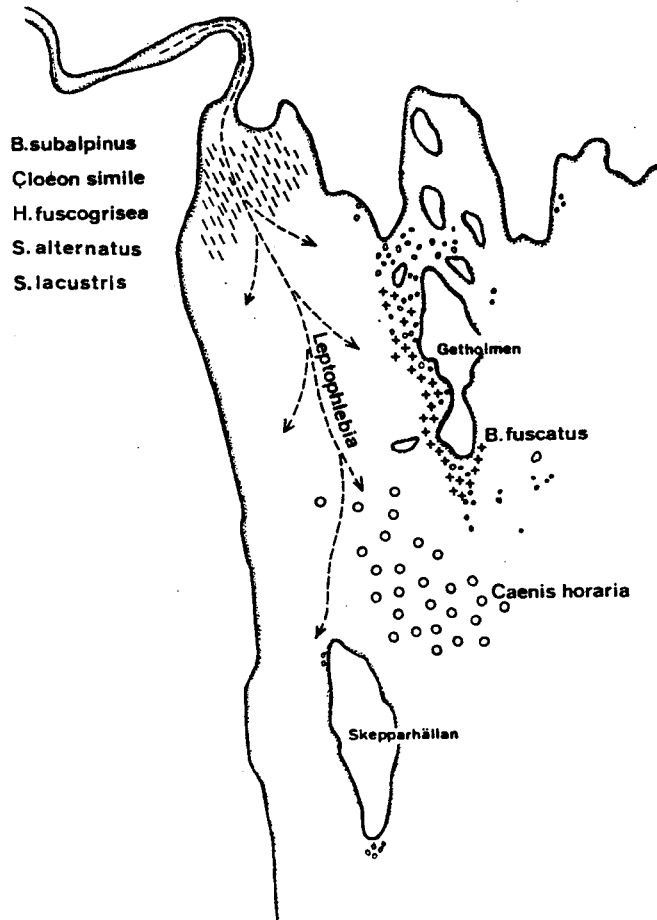


Fig. 5

Distribution of mayfly nymphs in the estuary of the river Ängerån.

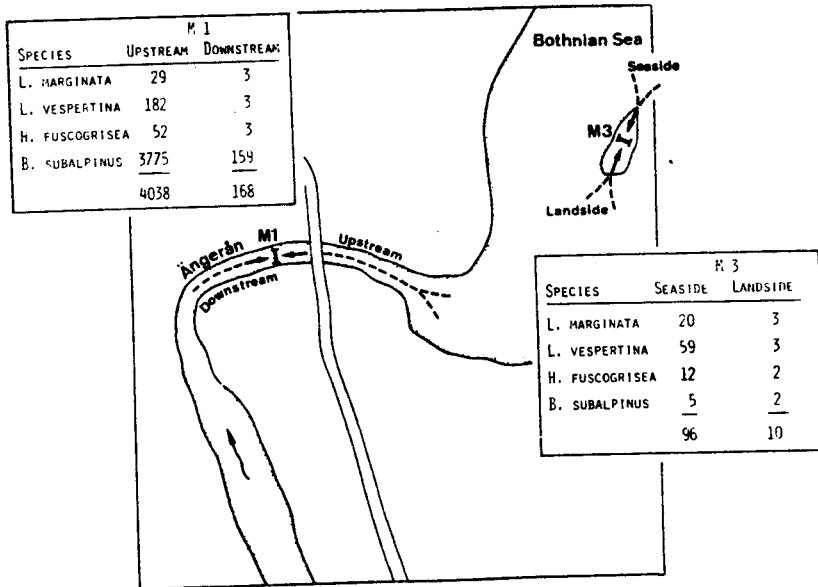


Fig. 6.

Flight movements in the Malaise-traps M 1 and M 3 in the year 1980.