BENTHIC AND HYPORHEIC FAUNAS OF MAYFLIES AND STONEFLIES IN THE TER RIVER BASIN (NE-SPAIN)

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ABSTRACT

In the Riera major, north-eastern Spain, hyporheic stoneflies and mayflies were far less abundant than those in the benthos. Three species, *Baetis scambus, Caenis macrura* and *Leuctra fusca*, spent a major part of their life cycle in the hyporheos.

INTRODUCTION

The role of the hyporheic zone in fluvial ecosystems has been widely discussed (Williams 1984), although its importance for the river invertebrates is still not completely known. Although Berthelemy (1966) mentions it as a principle habitat for some species of stoneflies, the European stonefly and mayfly fauna of the hyporheos is poorly known (Botosaneanu 1986).

In this paper the results obtained from the sampling of the benthos and the hyporheic zone in the Riera Major (R. Ter basin, NE-Spain) (Fig. 1) over a yearly cycle are presented.

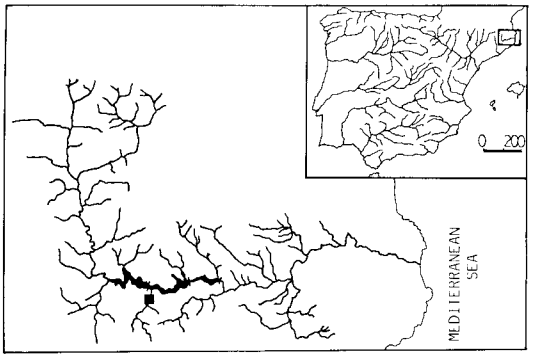

Fig. 1. Location of the study area in the Ter River basin.

STUDY AREA AND METHODS

The stretch of the Riera Major sampled is an order 3 water-course in a siliceous area. The substratum consists of principally stones and sand and the river flows between wooded banks so that the summer temperatures do not rise above 21 °C.

Monthly sampling was conducted from January 1983 to January 1984. A handpump of the type described by Bou & Rouch (1967) was used to capture the hyporheic fauna. 50 l of water was extracted from a depth of 5 to 15 cm. in the stream bed in the central area of the watercourse, and filtered, the benthos corresponding to the same area was also sampled. Surface and hyporheic water samples were collected for analysis. The hyporheic water had a higher conductivity (120 μs) than the benthic (60 μs) and was slightly more acidic (pH 7.35 cf. 7.43). These differences are maintained throughout the year. The concentrations of iron (2.134 cf 0.068 μg-at l^{-1}) and orthophosphate (6.06 cf 1.04 μg-at l^{-1}) were higher in the hyporheic and nitrate (17.35 cf 35.57 μg-at l^{-1}) was lower, results similar to those of Williams (1984).

I.C. Campbell (ed.) Mayflies and Stoneflies, 255–258.

Table 1. Distribution of species in the benthic and hyporheic zones

Species	Benthos	Hyporheos
EPHEMEROPTERA		
Cloeon dipterum (Linneo, 1761)	+	
Baetis maurus Kimmins, 1958	+	
Baetis muticus Linneo, 1758	+	+
Baetis rhodani Pictet, 1843–45	+	+
Baetis scambus Eaton, 1870	+	+
Centroptilum pennulatum Eaton, 1870		+
Epeorus torrentium Eaton, 1881	+	
Ecdyonurus insignis (Eaton, 1870)	+	
Ecdyonurus lateralis (Curtis, 1834)	+	+
Rhithrogena diaphana Navas, 1917	+	
Rhithrogena iridana Kolenati	+	
Rhithrogena semicolorata (Curtis, 1884)	+	
Habroleptoides modesta (Hagen, 1864)	+	+
Torleya major Klapalek, 1905		+
Ephemerella ignita (Poda, 1761)	+	
Caenis macrura Stephens, 1835	+	+
Ephemera lineata Eaton, 1870	+	+
PLECOPTERA		
Taeniopteryx schoenemundi (Mertens, 1923)	+	
Brachyptera risi (Morton, 1896)	+	
Protonemura beatensis Despax, 1929	+	
Protonemura meyeri (Pictet, 1842)	+	
Nemoura cf. mortoni Ris, 1902	+	+
Capnioneura mitis Despax, 1952	+	
Leuctra fusca (Linneo, 1758)	+	+
Chloroperla sp.		+
Isoperla grammatica (Poda, 1761)	+	

Table 2. Temporal distribution of the mayflies and stoneflies for the study period (+ benthos, − hyporheos)

Species	Month											
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
B. scambus	−	−	−	+	−	−	±	+		−	−	
B. muticus		−						+		−		
B. rhodani	+		+		+	+	+			−		−
C. pennulatum	−											
E. lateralis			+	+	−	−						
H. modesta	±	−	−		−	−	−			−	−	−
T. major		−	−		−					−		
C. macrura	+	−	−		±	−	−			−	−	−
E. lineata							+				−	
N. mortoni	−	+						+				
L. fusca		−	−			±	±	+			−	−
Chloroperla sp.	−									−		

RESULTS AND DISCUSSION

A total of 24 species, 17 of mayflies and 9 of stoneflies, were captured in the study stretch (Table 1). The majority of the species are present in the benthos (23 species in total), while only 12 have been collected as components of the hyporheic fauna. Three species from the hyporheic have not been captured in the benthos, probably indicating that they are very scarce and have escaped our sampling. 80% of the population of the benthos consists of two species (*Baetis maurus* and *Epeorus torrentium*) which have not been captured in any instar in the hyporheic fauna.

The abundance of the hyporheic populations is very variable, the maximum being found in November (80 individuals/50 l) coinciding with the maximum precipitation and flow registered during the study. *Caenis macrura* contributes 60% of the animals collected followed in importance by *Baetis scambus* and *Leuctra fusca*. In the months of May, September and October no mayflies or stoneflies were captured; for September and October the fauna was dominated by Chironomidae.

Specimens of *Leuctra fusca* have only been captured in the benthos in the months of July to September; they are always large specimens and in September all the individuals were final nymphal instar. Adults of *Leuctra fusca* have been captured in September and October and it is missing from the hyporheic fauna in September and October (Table 2); there is no obvious explanation for the absence of captures in May.

The frequency of the different instars in the hyporheos and benthos and the presence of flying adults of the major hyporheic species, *Baetis scambus* and *Caenis macrura*, are contrasted in Fig. 2. *Baetis scambus* shows a cycle that is made up of two generations per year. The first generation has a nymphal phase from February to May with the emergence of the adults between June and July. The second shorter generation lasts from June to August, with the emergence of the adults in September (Fig. 2). There is a clear separation in depth of the distinct instars, in that the first five primarily inhabit the hyporheic zone, while instars 6 and 7 are exclusive to the benthos.

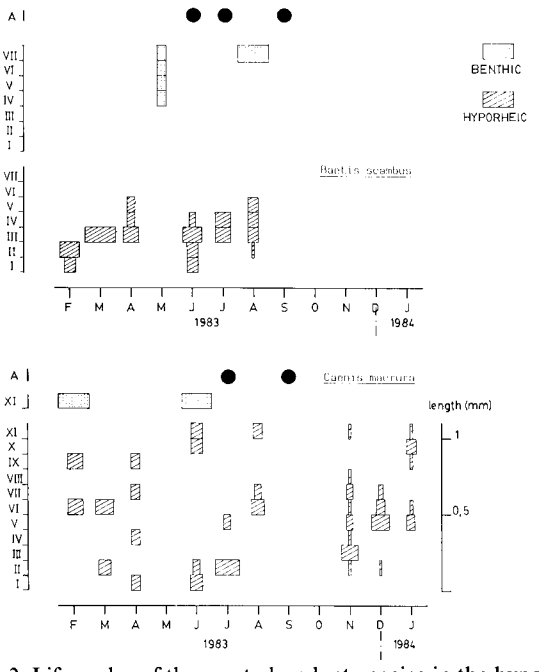

Fig. 2. Life cycles of the most abundant species in the hyporeic zone. A. *Baetis maurus*; *B. Caenis macrura*. Benthic and hyporheic frequencies are indicated.

These two instars are not missing from the hyporheos as a result of a size selection by the sampling technique because specimens of *Baetis rhodani* of much larger size have been caught in this zone.

The life cycle of *Caenis macrura* is not as clear as the former species. If one considers the capture of mature nymphs (last instar) in the benthos in February and June, together with the presence of adults in July and September, it is possible to separate two generations, a shorter summer one and one that would extend throughout the autumn and winter. Nymphs have been sorted using measurements that seem to group themselves clearly into 11 instars. The morphological measurements that fit best are the length of the branchial plate of the second pair of gills and the length of the mesonotum. Although the use of size presents problems (McDonald & Pitcher 1979, Fink 1984), in the case of these species it seems to be sufficiently valid as a method to separate instars. In *Caenis macrura* one must emphasize that the similarity of size between males and females makes the use of sizes easier, a system which would be difficult to use for other species of the same genus (*C. luctuosa*, for example).

The data obtained from the population of *C. macrura* show this species to be a characteristic inhabitant of the hyporheic zone, the area where it spends all its nymphal phase.

CONCLUSIONS

The hyporheic fauna is much less abundant than the benthic fauna in the Riera Major. Although the hyporheic zone is a habitat of the first instars of some species (*T. major, E. lateralis, N. cf. mortoni*), these are a minority of the mayflies and stoneflies of the benthos. Only three species spend a major part of the nymphal cycle in the hyporheos (*Baetis scambus, C. macrura* and *L. fusca*), and of these *Caenis macrura* is the most strictly confined to the hyporheos.

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