

Distribution and ecology of the stoneflies (Plecoptera) in Catalanian rivers (NE-Spain)

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Since 1978 a sampling program is being conducted on various basins of Catalonia (NE-Spain), covering the whole of the basins of the rivers Tordera, Llobregat, Besòs, Ter, Foix and Segre (Andorran rivers included).

A total of 51 species of Plecoptera has been collected in a range of altitudes from 100 m to 2 250 m. Among them, there are stenothermal species of high altitude and a group of species that live in temporary water courses. Some species of Leuctridae, Capniidae and Chloroperlidae are members of the interstitial fauna in some instars of their life.

Distribution et écologie des Plécoptères dans des rivières catalanes (Nord-Est de l'Espagne).

Nous avons commencé en 1978 un programme extensif pour connaître les macro-invertébrés des bassins de Catalogne (Nord-Est de l'Espagne). Cette étude porte sur les bassins des rivières Tordera, Llobregat, Besòs, Ter, Foix et Segre (y compris les rivières d'Andorre).

Nous avons récolté 51 espèces de Plécoptères entre 100 et 2 250 m d'altitude. Certaines de ces espèces sont des sténothermes de haute altitude, d'autres habitent des ruisseaux temporaires des Pyrénées ou du littoral méditerranéen. Quelques espèces de Leuctridae, Capniidae et Chloroperlidae vivent en milieu interstitiel à certains stades de leur cycle.

1. — Introduction

The Ecology Department of the University of Barcelona has a research program centered on river ecosystems. As a part of this general work, it was necessary to study extensively the macrobenthic fauna and the physico-chemical characteristics of the Catalanian river basins. In this work, the results of prospections in the rivers Llobregat, Besòs, Foix, Tordera, Ter and Segre (Andorran basins included) are presented. The data concerning the river Ter are only of a preliminary nature, as this work is still incomplete. 225 stations have been studied and Plecoptera have been found in 118 (Fig. 1).

2. — The environment

Two of the rivers studied arise in the Pyrenees (Ter and Segre), one in the Pre-Pyrenees (Llobregat)

and three in the Pre-Littoral mountains (Besos, Tordera and Foix). Morphometric and physico-chemical data and localisation of the sampling stations are given in Prat et al. (1979, 1982 and 1983). Extreme pollution of stretches of our rivers excludes Plecoptera from rivers of an order higher than three (on 1 : 250 000 maps).

3. — Species distribution according to different parameters

3.1. — Altitude

Fifty one species have been captured between 105 and 2 249 m. Table I shows that the altitudinal ranges of each species are not the same in the different basins. Conditions in the river Tordera are similar to those in the Pyrenean and Pre-Pyrenean upper reaches and catchment areas of the rivers Segre, Llobregat and Ter.

The altitudinal substitution among different species inside each of the larger groups, as observed

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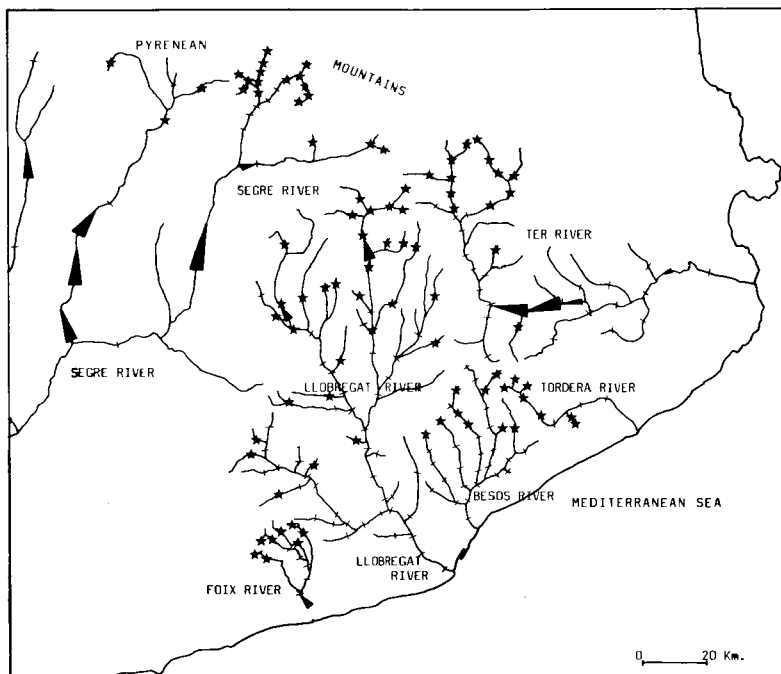


Fig. 1. Distribution of sampling stations in Catalonia. All the sampling stations in Andorra (50) are not shown. Stoneflies have been found in all the stations marked with an asterisk (*).

by Berthélemy (1966), has been confirmed. *Perlodes microcephalus*, *Leuctra major* and *L. fusca* reach 2 000 m. *Euleuctra geniculata* has been found between 250 and 1 000 m, and *Leuctra despaxi* was found in lower altitudes than those from which it was recorded by Berthélemy (1966).

3.2. — Substrates

In the river Ter, *Capnia vidua*, *Leuctra major* and *L. leptogaster* and the early instars of *Taeniopteryx schoenemundi* and *Siphonoperla torrentium* have

been found as components of the interstitial fauna. In river Tordera, early instar of *Capnioneura mitis*, *Brachyptera risi* and *B. braueri* live in similar habitats. *B. risi* and *B. braueri*, in their last instars, are normally inhabitants of dead leaves and vegetal detritus retained on the stream bed; so is *Taeniopteryx hubaulti*. The last instars of *Euleuctra geniculata* appear preferently associated with *Cladophora*. *Nemoura pictetii* has been found only amongst mosses. *Nemoura cinerea cinerea* occurs amongst mosses and filamentous algae, and in its last instars, before the emergence, it gathers sometimes on the Characeae.

Table I. Altitudinal distribution of the stoneflies in the Catalanian basins.

SPECIES	Segre	Ter	Llobregat	Tordera	Besos	Foix
<i>Taeniopteryx hubaulti</i> Aubert, 1946	1500					
<i>T. schoenemundi</i> (Mertens, 1923)		470				
<i>Brachyptera braueri</i> (Klapálek, 1900)				105		
<i>B. risi</i> (Morton, 1896)		1100	745-980	105		
<i>B. seticornis</i> (Klapálek, 1902)		1100				
<i>Protonemura beatensis</i> Despax, 1929	900-2080	860-1000	650-1360	390	1000	
<i>P. intricata intricata</i> (Pictet, 1842)	900-1960			680	340	
<i>P. meyeri</i> (Pictet, 1894)		470-950		680-700	1000	
<i>P. praecox</i> (Morton, 1894)				680	1000	
<i>P. pyrenaica pyrenaica</i> Mosely, 1930	1407	915-1300		680		
<i>P. pyrenaica asturica</i> Aubert, 1954						250-625
<i>P. risi spinulosa</i> (Navás, 1921)	960-1780	2100	1360	680		
<i>P. vandeli</i> Berthélemy, 1963	1140-2080	1100-2100	1000	680		
<i>Amphinemura sulcicollis sulcicollis</i> (Stephens, 1835)	1360-1680	915-1300	720-980	390-720	420-1000	
<i>A. triangularis</i> Ris, 1902				680		
<i>Nemoura cinerea cinerea</i> Retzius, 1783			180-740	105	560-570	310-525
<i>N. erratica</i> Claassen, 1936	1680-2040					
<i>N. lacustris</i> Pictet, 1865						625
<i>N. linguata</i> Navás, 1918	1140		392-420			
<i>N. cf. mortoni</i> Ris, 1902		470-1000			1000	
<i>N. uncinata</i> Despax, 1934	2020	740-1300		720		
<i>Nemurella pictetii</i> Klapálek, 1909	1900-2080				320-340	
<i>Euleuctra geniculata</i> Stephens, 1835		950	350-800		250-340	
<i>Leuctra alosi</i> Navás, 1919	1140					
<i>L. aurita</i> Navás, 1919	960-2040	1300	640	680		
<i>L. despaxi</i> Mosely, 1930		1300		240		
<i>L. fusca</i> (Linné, 1758)	1900		480			
<i>L. hippos</i> Kempny, 1899			425-980		340	
<i>L. inermis</i> Kempny, 1899	1060-1800	1100-1300	285-1360		1000	
<i>L. leptogaster</i> Aubert, 1949		950	480-550			
<i>L. major</i> Brinck, 1949	1140-2000			680		
<i>Pachyleuctra benlocchi</i> (Navás, 1917)	1780	2100				
<i>P. bertrandi</i> Aubert, 1952		1100				
<i>Capnia bifrons</i> (Newman, 1838)				105		
<i>C. vidua</i> Klapálek, 1904			326-740			
<i>Capnionemura brachyptera</i> Despax, 1932	1660-2020					
<i>C. mitis</i> Despax, 1932			326	105-240	560	505
<i>Arcynopteryx compacta</i> (MacLachlan, 1872)	2249	2100				
<i>Perlodes intricatus</i> (Pictet, 1842)	2040					
<i>P. microcephalus</i> (Pictet, 1842)	1800-2040				340	
<i>Isoperla acicularis acicularis</i> (Despax, 1936)	1180-1800			680		
<i>Isoperla d.</i>	1260-1760	740-1300	1360			
<i>I. grammatica</i> sp. IV			380-800	105-240	320-660	
<i>I. moselyi</i> (Despax, 1936)	2000					
<i>I. cf. viridinervis</i> (Ed. Pictet, 1865)	1340					
<i>Dinocras cephalotes</i> (Curtis, 1827)	780-1360	780-1300	480-800			
<i>Perla grandis</i> Rambur	1160-1740	1300				
<i>P. marginata marginata</i> (Panzer, 1799)	780-1360	990-1000	540-980	240-700	340-420	
<i>Chloroperla tripunctata</i> (Scopoli, 1763)	1800-1960					
<i>Xantoperla apicalis</i> (Newman, 1837)	1140					
<i>Siphonoperla torrentium</i> (Pictet, 1842)	1140-1800	1300		105-680	1000	

3.3. — Physico-chemical characteristics

Euleuctra geniculata has been found only in calcareous areas. *Nemoura lacustris* and *Protonemura pyrenaica asturica* live in streams that dry up in summer. *Capnioneura mitis* and *Nemoura c. cinerea* have been found also in the same streams but also in others which dry up less frequently. In the latter also occur *Brachyptera braueri*, *B. risi*, *B. seticornis* and *Capnia bifrons*.

The Plecoptera are not tolerant, in general, to organic and industrial pollutions. The less sensitive species are those living in interstitial water (*Capnia vidua* and *Capnioneura mitis*) and in temporary streams (*Nemoura c. cinerea* and *Capnioneura mitis*). *Isoperla grammatica* sp. IV, *Dinocras cephalotes* and *Perla marginata marginata* are also quite tolerant.

Most of the 51 species have been found in water at temperatures lower than 15°C. Five species have been captured in summer at water temperatures between 22 and 27°C; these are *Perla marginata marginata*, *Dinocras cephalotes*, *Leuctra inermis*, *Leuctra hippopus* and *Euleuctra geniculata*.

4. — Discussion

We have divided our 51 species, into five groups according to their biogeographic distribution (based on Berthélemy's (1966) broad criteria). Twenty eight species are widely distributed in Spain and Europe. Six are Pyrenean endemics (*Pachyleuctra benlocchi*, *Pachyleuctra bertrandi*, *Isoperla moseleyi*, *Isoperla viridineris* and *Isoperla d.*). Five inhabit both the Pyrenees and the Iberian peninsula (*Protonemura beatensis beatensis*, *P. risi spinulosa*, *Leuctra despaxi*, *L. alosi* and *Isoperla grammatica* sp. IV). Ten species have not been recorded south of the river Ebro (*Protonemura praecox*, *P. pyrenaica pyrenaica*, *P. vandeli*, *Nemoura linguata*, *N. uncinata*, *Leuctra digitata*, *Capnia vidua vidua*, *Taeniopteryx hubaulti*, *Perlodes intricatus* and *Isoperla acicularis acicularis*). One species is an endemic from the Iberian peninsula (*Protonemura pyrenaica asturica*). According to our findings, *Protonemura vandeli*, *P. pyrenaica pyrenaica* and *Nemoura linguata* cannot be considered any more as endemics from the Pyrenees. *Taeniopteryx hubaulti* is recorded for the first time from the Spanish Pyrenees.

Table II. Distribution of the stoneflies along the Ter and Valira del Nort rivers.

Altitude (m)	Valira del Nort	Altitude (m)	Ter
2 249	<i>Arcynopteryx compacta</i>	2 100	<i>Arcynopteryx compacta</i>
2 020	<i>Protonemura vandeli</i>		<i>Protonemura vandeli</i>
	<i>Capnioneura brachyptera</i>		<i>Protonemura risi spinulosa</i>
	<i>Perlodes microcephalus</i>		<i>Pachyleuctra benlocchi</i>
1 480	<i>Protonemura vandeli</i>	1 300	<i>Leuctra inermis</i>
	<i>Protonemura beatensis</i>		<i>Isoperla d.</i>
	<i>Isoperla a. acicularis</i>	990	<i>Dinocras cephalotes</i>
	<i>Perla grandis</i>		<i>Nemoura uncinata</i>
1 360	<i>Amphinemura s. sulcicollis</i>		<i>Amphinemura s. sulcicollis</i>
1 320	<i>Leuctra aurita</i>		<i>Isoperla d.</i>
1 280	<i>Protonemura vandeli</i>		<i>Perla marginata marginata</i>
	<i>Protonemura beatensis</i>	915	<i>Protonemura meyeri</i>
	<i>Isoperla d.</i>		<i>Protonemura p. pyrenaica</i>
1 260	<i>Perla grandis</i>		<i>A. s. sulcicollis</i>
1 160	<i>Protonemura beatensis</i>		<i>Nemoura cf. mortoni</i>
	<i>Leuctra aurita</i>		<i>Isoperla d.</i>
	<i>Perla grandis</i>	780	<i>Dinocras cephalotes</i>
1 080	740

The Plecoptera distribution in the different rivers does not show clear communities. As Berthélemy (1966) noticed, there is a greater similarity among the sampling stations of the same river, than in the similar stations of different rivers (Table II). Each station presents a characteristic community, except in cases of organic pollution, where the population is reduced to one or two species. This is the case of *Dinocras cephalotes* in Llobregat, Ter and Valira stations and *Protonemura beatensis* and *Leuctra major* in Valira d'Orient (Andorra). In the temporary streams, different combinations of the four species *Nemoura cinerea cinerea*, *N. lacustris*, *Capnioneura mitis* and *Protonemura pyrenaica asturica* are present.

The plecopteran fauna of Catalonia is not yet completely known. The research on other basins, on lakes population and on interstitial waters have scarcely begun.

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