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New data on freshwater ostracod assemblages (Crustacea, Ostracoda) from Cuenca (Central Spain)

by

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Abstract: We discuss the freshwater ostracod fauna of the Cuenca Mountains using data collected from both lakes and rivers between 1992 and 1994. Previous to this, data on the ostracod fauna of this area were very scarce. From the data presently available, thirteen species from to ten genera have been identified, including *Paralimnocythere psammophila* (Flössner 1965) and *Pseudocandona rostrata* (Brady & Norman 1889) which were previously unknown from the Iberian Peninsula. Water flow velocity appears to be a critical factor governing the presence or absence of various of these species in lotic (e. g. riverine) or lenitic (e. g. lacustrine) habitats. Taxonomic and ecological comments are given for selected species.

Key words: Ostracoda, *Paralimnocythere*, *Pseudocandona*, freshwater, Cuenca, Spain.

Introduction

Ostracods are a group of small crustaceans that inhabit a wide variety of aquatic habitats, including both marine and fresh waters. They are known to be good ecological indicators as different species inhabit different kind of environment (Carbonel et al. 1988).

Although the ostracod community of the Castilla-La Mancha region (in which Cuenca province lies) has been studied for many years (see Margalef 1947, Armengol et al. 1975, Baltanás et al. 1990), most of this research effort has focused on saline lakes and the unusual crustacean fauna that they support. On the other hand, there are very few data on the ostracod fauna of systems such as mountain rivers and karstic lakes. In order to attain a better knowledge on the distribution and ecology of Ostracoda in this region, samples were taken from water bodies in the Cuenca Mountains. Because of the kind of water bodies sampled, the most relevant comparative data available are those presented by Roca & Baltanás (1993) from Pyrenean springs.

Material and methods

The study area lies located around 40° N and 2° W, in the Iberian Peninsula and at altitudes of between 800 and 1400 m a. s. l. (see fig. 1 and table 1 for further explanations).

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Most samples were obtained from surface waters using a benthic D-frame hand net (100 µm mesh size) and fixed "in situ" in 30% ethanol following Ghetti & Mckenzie (1981) and Athersuch et al. (1989). In the laboratory, specimens were hand-picked under a dissecting stereomicroscope and stored in 70% ethanol with glycerine. The dissection protocol follows Danielopol (1983). Some sites were sampled several times to attain some impressions of the pattern of seasonal variability within the fauna.

Specimens were identified following Sywula (1974) and Bronstein (1988), but also used Meisch (1984, 1985) for *Potamocypris*, Meisch (1988) for *Ilyocypris* and Martens (1992) for *Paralimnocythere*.

In some localities, current velocity, water temperature, conductivity, pH and dissolved oxygen concentration were measured in situ with portable instruments.

Results

Thirteen species of freshwater ostracodes are identified from 20 sampling localities during the present survey. Out of these, two are new to the Spanish fauna: *Paralimnocythere psammophila* (Flössner 1965) and *Pseudocandona rostrata* (Brady & Norman, 1889). Four species appeared in more than 20 % of the samples (table 3): *Candona candida* (O. F. Müller, 1776), *Cyclocypris ovum* (Jurine, 1820), *Herpetocypris brevicaudata* Brady & Norman, 1889, and *Potamocypris zschokkei* (Kaufmann, 1900).

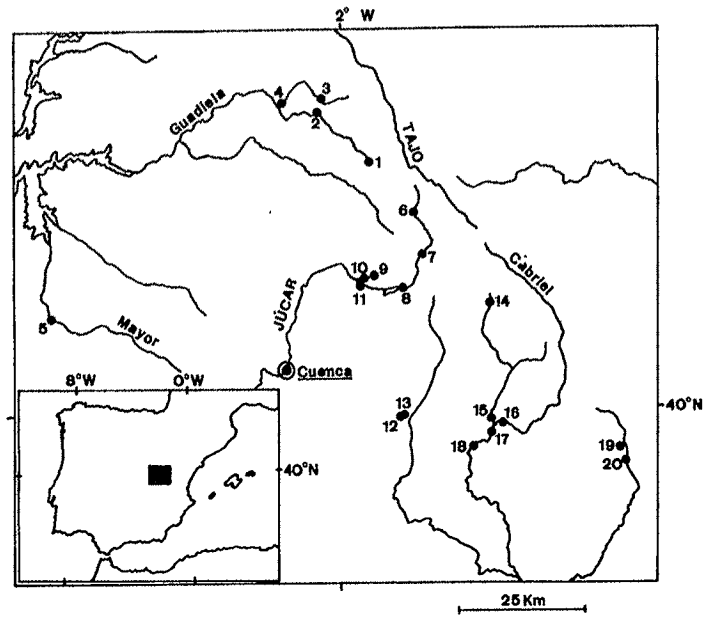


Fig. 1: Collecting localities in Cuenca Mountains (see table 1).

Table 1: Sampling sites and environmental data. The code for each locality is the same as in Fig. 1. Lat = deg., min., and sec. of latitude N. Long = deg., min., and sec. of longitude W: Alt = altitude (m a. s. l.); Cond = electrical conductivity (µS/cm); $\%O_2$ = saturation percent of oxygen; O_2 = dissolved oxygen content (mg/l); wT = temperature of water (C°); vel. = velocity of water (cm/seg); in. sub. = type of the most abundant inorganic substrate; or. sub. = type of the most abundant organic substrate (CPOM: coarse particulate organic matter, FPOM: fine particulate organic matter); veg = submerged vegetation (relative abundance scale from 0 to 5).

Sampling site	Code	Date	Lat	Long	Alt	Cond	$\%O_2$	O_2	pH	wT	vel.	in.sub.	or.sub.	veg
River Cuervo (source)	1	May-94	402554	15316	1400	-	-	-	-	-	-	sand	CPOM	1
R. Cuervo (source)	1	Aug-94	402554	15316	1400	356.0	92	8.7	7.99	10.1	15	sand	CPOM	1
Res. La Tosca (brook)	2	May-94	403058	20315	1150	-	-	-	-	-	-	sand	FPOM	3
LakeTobar (surgence)	3	May-94	403244	20248	1150	523.0	102	9.4	-	13.0	0	gravel	CPOM	4
LakeTobar (surgence)	3	Aug-94	403244	20248	1150	630.8	77	7.3	7.33	11.3	0	gravel	CPOM	4
LakeTobar (surgence)	3	Sep-94	403244	20248	1150	614.0	102	8.7	-	17.0	0	gravel	CPOM	4
L. Tobar (Cerebro basin)	3	May-94	403244	20248	1150	508.0	110	9.6	-	15	0	sand	FPOM	2
L. Tobar (Cerebro basin)	3	Aug-94	403244	20248	1150	-	-	-	-	-	0	sand	FPOM	2
L. Tobar (Cerebro basin)	3	Sep-94	403244	20248	1150	614.0	82	7.1	-	17	0	sand	FPOM	2
L.Tobar (in *Myriophyllum*)	3	Sep-94	403244	20248	1150	608.0	107	9.1	-	18	0	-	-	4
R. Guadiela (Vadillos)	4	Aug-94	403200	20855	1000	542.8	94	7.9	8.44	18.4	25	gravel	absent	2
R. Mayor (Huete)	5	Apr-93	401015	24105	800	-	-	-	-	-	-	-	-	-
R. Júcar (Tragacete)	6	Oct-92	402110	15057	1280	-	-	-	-	-	-	-	-	-
R. Júcar (Huélamo)	7	Feb-92	401711	14807	1250	-	-	-	-	-	-	-	-	-
Reservoir La Toba (tail)	8	Nov-92	401237	15232	1150	-	-	-	-	-	-	-	-	-
Fish farm Uña (source)	9	May-94	401348	15747	1140	-	-	-	-	-	0	mud	FPOM	2
Fish farm Uña (source)	9	Aug-94	401348	15747	1140	436.5	90	8.2	7.54	11.4	0	mud	FPOM	3
Fish farm Uña (exit)	10	Aug-94	401341	15802	1140	-	-	-	-	-	47	gravel	absent	0
R.Júcar (Uña)	11	Jul-92	401320	15819	1100	-	-	-	-	-	-	-	-	-
L. La Llana (Cañada)	12	May-94	395920	15233	1020	424.0	112	11	8.80	17	0	-	-	-
Lake La Cruz (Cañada)	13	May-94	395920	15225	1020	502.0	114	11	8.70	16	0	rock	FPOM	1
Lake La Cruz (Cañada)	13	Aug-94	395920	15225	1020	458.4	160	11.8	8.66	25.7	0	rock	FPOM	1
L. Marquesado (in *Chara*)	14	May-94	401113	13936	1340	418.0	120	11	-	11	0	mud	FPOM	3
L. Marquesado (in *Chara*)	14	Aug-94	401113	13936	1340	332.1	111	8.3	8.07	21.9	0	mud	FPOM	3
R.M.Molinillo (Boniches)	15	Aug-94	395836	14000	1000	749.8	94	8.0	8.55	18.0	62	rock	absent	1
R.Cabriel (Boniches)	16	Aug-94	395857	13701	1000	1031.7	78	6.5	8.20	17.8	25	gravel	CPOM	4
R.Cabriel + Mayor	17	Aug-94	395823	13948	950	747.0	93	7.5	8.32	20.5	-	mud	FPOM	3
R.Cabriel (El Cañizal)	18	May-94	395658	14142	950	-	-	-	-	-	-	-	-	-
Spr. Ojos de Moya (Moya)	19	Aug-94	395557	12330	1000	485.1	70	6.6	7.38	12.8	36	gravel	CPOM	3
R.Algarra (Landete)	20	Aug-94	395512	12149	1000	864.0	78	7.2	7.88	13.4	32	gravel	absent	2

A list of the species found in this survey is presented hereafter. Moreover, the ostracode assemblages for each sampling site, as well as the physical and chemical data recorded are shown in table 1 and 3. Ostracod specimens not identified until the specific level are not presented in the list below. Anyway, they can be seen on table 3.

List of species

Paralimnocythere psammophila (Flössner, 1965)
Darwinula stevensoni (Brady & Robertson, 1879)
Ilyocypris bradyi Sars, 1890
Ilyocypris inermis Kaufmann, 1900
Candona candida (O. F. Müller, 1776)
Pseudocandona albicans (Brady, 1864)
Pseudocandona rostrata (Brady & Norman, 1889)

Cyclocypris ovum (Jurine, 1820)
Isocypris beauchampi (Paris, 1920)
Herpetocypris brevicaudata Brady & Norman, 1889
Cypridopsis vidua (O. F. Müller, 1776)
Potamocypris villosa (Jurine, 1820)
Potamocypris zschokkei (Kaufmann, 1900)

Discussion

Taxonomic and faunistic comments on selected species

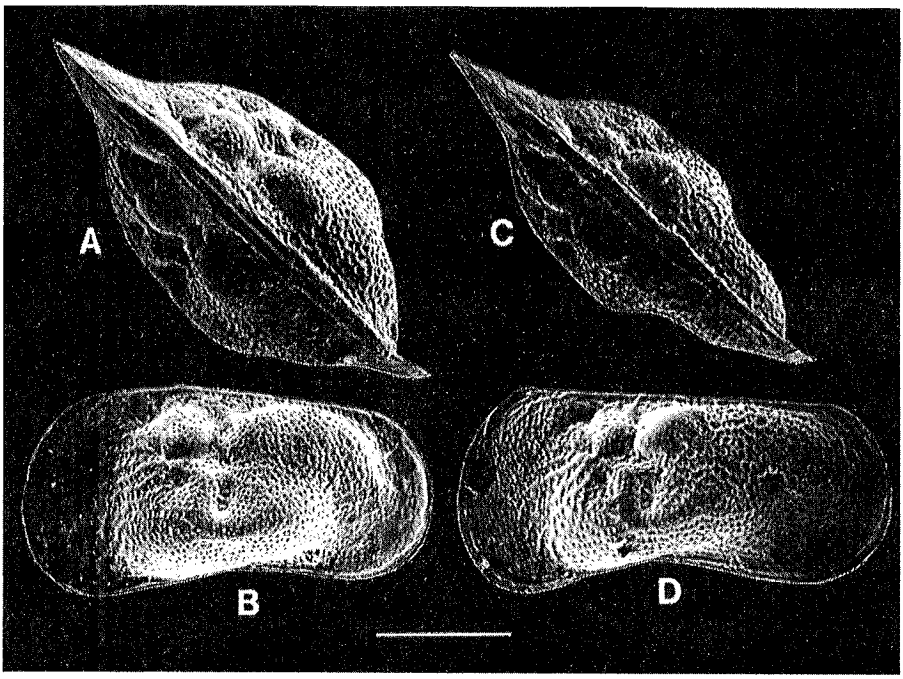
Paralimnocythere psammophila: (fig. 2) This is the first record of the species in the Iberian Peninsula. Margalef (1955) had previously reported *Paralimnocythere relicta* (Lilljeborg 1863) in the area but, prior to the revision of the genus by Martens (1992) there was considerable confusion over the identity of its constituent species. From reviewing the information provided by Margalef (op. cit.) we conclude that the male copulatory organ figured by him (Margalef 1955: fig.13) belonged to *P. psammophila* and not to *P. relicta*. As Margalef (loc. cit.) knew *P. "relicta"* from three different sites this suggests that, provided all his material was conspecific, *P. psammophila* is actually know from four different Iberian localities.

That our specimens clearly belong to *Paralimnocythere psammophila*, can be shown both from Martens (1992), and by comparison with ilustrations of the male copulatory organ in the original description (Flössner 1965). Nevertheless, some differences in carapace size can be seen between our material and that discussed by Martens (1992) and Flössner (1965). Our specimens of *P. psammophila* (both male and female) are narrower, and have most elongated carapaces (see table 2).

Herpetocypris sp.: The species *H. brevicaudata* has been identified in several samples (table 3), but with it we have found another, unidentifiable form of *Herpetocypris*, which can be differentiated from *H. brevicaudata* by the distinct pattern of the swimming setae on the second antennae. While the second swimming setae is the longest in *H. brevicaudata* (Sywula 1974, Baltanás 1992), our *Herpetocypris* sp. has swimming setae all of similar length, although the second appears to be shorter than the first and the third setae. Those characters are reminiscent of specimens of *Herpetocypris* found by Roca (1990) in Pyrenean springs. Nevertheless, the length of those setae itself is not thought to be a definitive-enough character to allow the separation of these forms, as it can be highly variable even within the same population (Mezquita, pers. obs.).

Table 2: Absolute (in mm) and relative carapace sizes of *P. psammophila* as given by two previous authors and compared with our measurements.

		LENGTH	HEIGHT	WIDTH	L/H	L/W
MALES	Flössner (1965)	0.56	0.25	0.27	2.24	2.07
	Martens (1992)	0.645	0.271	0.288	2.22	2.24
	Mezquita et al.	0.65	0.28	0.23	2.32	2.83
FEMALES	Flössner (1965)	0.61	0.31	0.36	1.96	1.69
	Martens (1992)	0.687	0.365	0.339	1.97	2.02
	Mezquita et al.	0.64	0.29	0.29	2.21	2.21



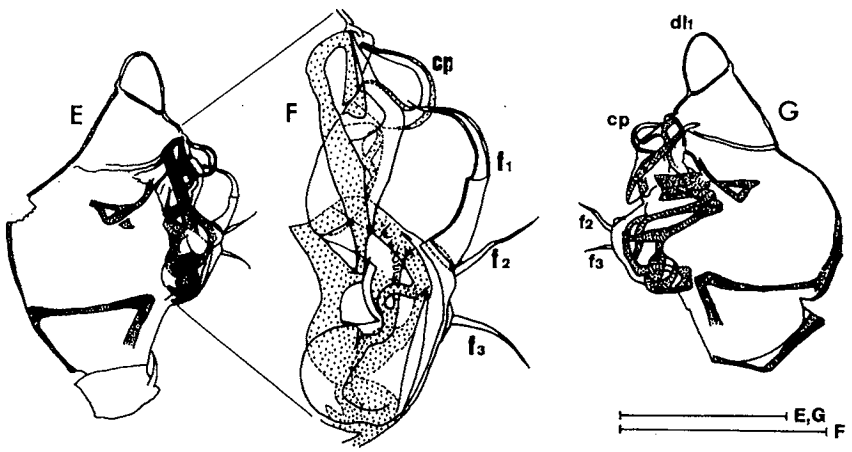


Fig. 2: *Paralimnocythere psammophila*. A: Female carapace in dorsal view. B: Female, left valve, external view. C: Male carapace in dorsal view. D: Male, left valve, external view. Scale bar: 176 µm (A,C), 200 µm (B,D). E: Right hemipenis. F: Detail of E. G: Left hemipenis. Scales: 100 µm (E,G), 50 µm (F). Abbreviations as in Martens (1992).

Table 3: Sampling sites and ostracode species. Site codes as in table 1. Pp = *Paralimnocythere psammophila*; Ds = *Darwinula stevensoni*; Ib = *Ilyocypris bradyi*; Ii = *I.inermis*; Ca = *Candona* sp. sl. indet.; Cc = *Candona candida*; Pa = *Pseudocandona albicans*; Pr = *P. rostrata*; Co = *Cyclocypris ovum*; Is = *Isocypris beauchampi*; H = *Herpetocypris* sp.; Hb = *H. brevicaudata*; Cv = *Cypridopsis vidua*; Cy = *Cypridopsis* sp. indet.; Pv = *Potamocypris villosa*; Pz = *P. zschokkei*.

	Sampling site	Code	Date	Pp	Co	Pv	Ca	Cv	Pr	Ib	Cc	Ii	Pa	Pz	H	Hb	Ds	Cy	Is
	Lake Tobar ("Cerebro" basin)	3	5/94	X															
	Lake Tobar ("Cerebro" basin)	3	8/94	X															
	Lake Tobar ("Cerebro" basin)	3	9/94	X															
L	LakeTobar (surgence)	3	8/94	X															
A	LakeTobar (surgence)	3	5/94	X			X												
K	LakeTobar (surgence)	3	9/94	X		X	X			X									
E	LakeTobar (in *Myriophyllum*)	3	9/94		X		X	X											
S	Lake La Llana (Cañada)	12	5/94		X														
	Lake La Cruz (Cañada)	13	5/94		X				X										
	Lake La Cruz (Cañada)	13	8/94		X				X										
	Lake Marquesado (in *Chara*)	14	5/94		X														
	Lake Marquesado (in *Chara*)	14	8/94		X														
	Fish farm Uña (1st pool)	9	5/94		X	X	X												
SPRINGS	Fish farm Uña (1st pool)	9	8/94		X						X								
	Spring Ojos de Moya (Moya)	19	8/94									X							
	R. Guadiela (Vadillos)	4	8/94		X								X						
	Fish farm Uña (water exit)	10	8/94											X					
	R. Cuervo (source)	1	8/94				X							X	X				
	R. Cuervo (source)	1	5/94											X	X				
R	Lateral brook (Reserv. La Tosca)	2	5/94											X					
I	Tail of Reserv. La Toba	8	11/92								X								
V	R. Mayor (Huete)	5	4/93													X			
E	R. Júcar (Tragacete)	6	10/92													X			
R	R. Júcar (Huélamo)	7	2/92								X					X			
S	R.Júcar (Uña)	11	7/92								X				X		X	X	
	R.Algarra (Landete)	20	8/94							X				X		X			
	R.Cabriel (El Cañizal)	18	5/94							X									
	R.Mayor del Molinillo (Boniches)	15	8/94									X							
	R.Cabriel (Boniches)	16	8/94															X	
	R.Cabriel + Mayor	17	8/94													X			X

Further investigations on the taxonomic position of this form of *Herpetocypris* sp. are needed to allow the clarification of its actual taxonomic status.

Ecology and distribution

One of the most important morphological features that permits different ostracod species to be assigned to one habitat type or another (i. e. flowing or still water), is the length of the swimming setae on the second antennae. Thus, species with long natatory setae tend to live in stagnant waters, often swimming between the macrophytes (i. e. are phytophylous). On the other hand, ostracode species with short

swimming setae are crawling species that can withstand high water velocity rates, but are not able to swim for a long time across the water column (Margalef 1953, Marmonier et al. 1994). According to this *C. ovum*, the commonest ostracode in this survey, can be considered as a phytophylous species, and has been frequently found in lakes and stagnant waters, often over macrophytes such as *Myriophyllum* sp., *Chara major*, or other Characeae. The other commonest ostracods in this survey are the larger, heavier-bodied species such as *Herpetocypris* sp., *H. brevicaudata* and *C. candida* as well as another poorly-swimming ostracod, *P. zschokkei*. These all appear in rivers and brooks. Neither *Herpetocypris* species nor *P. zschokkei* have been found together with *C.ovum*, whereas other forms with long swimming setae, even phytophylous, may co-occur with it (e. g. *Cypridopsis vidua*, *Potamocypris villosa* (see table 3).

Most of these species have also been found in Pyrenean springs: e. g. *C. ovum*, *P. villosa*, *P. zschokkei*, *Herpetocypris* sp. (the same species?) and *H. brevicaudata* (see Roca & Baltanás 1993). Even thought the authors of this paper talk about the flow discharge (volume) but not the flow velocity, we can still recognise some trends related to this factor, by looking at species co-ocurrences. In this way, we observe several similarities between the two sets of results: *C. ovum* co-occurs twice with *P. villosa*, but never with *P. zschokkei*, *Herpetocypris* sp. or *H. brevicaudata*. Moreover, *P. zschokkei* and *Herpetocypris* sp. co-occur in five springs from 16 that include *Herpetocypris* sp.

Nevertheless, not only the physical (current) but he chemical properties of the water, and its solute composition in particular, have been demonstrated to be important factors that affect the distribution of different ostracod species. That is true, for example, for several species of *Limnocythere* from the lakes of North America (Forester 1986). *Paralimnocythere* is closely related to (and was formerly congeneric with) *Limnocythere*, but the basic ecological requirements of the species belonging to that genus have not been established yet.

Lake Tobar, where *P. psammophila* has been found, is an unusual karstic lake with crenogenic meromixis (Miracle et al. 1992). Its mixolimnion major ionic composition is as follows (all measurements in meq/l): $Ca^{+2} = 3$; $Mg^{+2} = 2$; $Na^{+} = 0.8$; $K^{+} = 0.04$; Alkalinity = 4; $SO4^{-2} = 0.7$; $Cl^{-} = 1$, and 0.6 - 0.7 mS/cm (Vicente et al. 1993). This information alone is not enough to determine the ecology of *P. psammophila*, but it does provide hints for future studies.

It is remarkable that *Ilyocypris inermis* occurs at two sampling points, but always without any accompanying ostracod species. One of these sites was a spring, which is in agreement with the crenobiont character of this species (Roca & Baltanás 1993), but the other was a small river. Following Roca & Baltanás (op. cit.) these are the second and third records for the species in Spain, respectively. On the other hand, *I. bradyi*, a well-known, widespread and rather eurioic species (Meisch 1988, Roca & Baltanás 1993), appears together with five different species (it was found in one lake and in two different rivers: table 3).

In conclusion, the ostracode species inhabiting the freshwaters of Cuenca Range are distributed mainly along a pattern related to current velocity, and with some species preferring lotic habitats or lenitic environments. However, despite the generally wet, cold climate of the area, differences in the chemical properties of the water, that relate to geological features, seem to be another important factor affecting the local biogeography of freshwater ostracoda, as can be presumed by the presence of

different species in different water types. Nevertheless, this must be formally resolved by further field and laboratory studies.

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