

# CONTRIBUTION TO THE ROTIFER FAUNA OF THE PITYUSIC ISLANDS (Ibiza and Formentera, Balearic Archipelago)

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Key Words: Rotifera, Balearic archipelago, Zoogeography.

## ABSTRACT

Thirty-four species of rotifers were identified from samples of fresh and brackish inland waters from Ibiza (21 spp) and Formentera (25 spp). A type community related to rotifer communities of Marina de Lluçmajor (Majorca) was found in ephemeral waterbodies from the islands, while in the brackish ponds from the littoral strip predominated a community also similar to that found in littoral strips of other Balearic islands. Under a zoogeographical point of view, the most relevant contribution was the presence of *Keratella procurva* (Thorpe, 1912), previously found in Majorca and Minorca, considered a pantropical species. Its occurrence in Ibiza and Formentera corroborates that it has colonized freshwater environments throughout the Balearic archipelago. *Lecane punctata* (Murray, 1913), other pantropical species, was also collected in Ibiza.

## RESUMEN

### CONTRIBUCIÓN A LA FAUNA DE ROTÍFEROS DE LAS ISLAS PITYUSAS (IBIZA Y FORMENTERA, ARCHIPIÉLAGO BALEAR)

Treinta y cuatro especies de rotíferos fueron identificadas en las aguas de lagunas costeras, temporales, artificiales de las islas de Ibiza (21 especies) y Formentera (25 especies). Las comunidades de rotíferos encontradas en las aguas temporales de las islas fueron semejantes a las encontradas en Marina de Lluçmajor (Mallorca), mientras que en los medios acuáticos de la franja litoral predominó un tipo de comunidad similar al encontrado en otras islas del archipiélago. Desde el punto de vista zoogeográfico, la contribución más relevante fue el hallazgo de la especie pantropical *Keratella procurva* (Thorpe, 1912) en ambas islas, lo cual confirma que esta especie ha colonizado ampliamente las aguas dulces del archipiélago. *Lecane punctata* (Murray, 1913), otra especie pantropical, fue también encontrada en Ibiza.

## INTRODUCTION

Islands are interesting sites to investigate biogeography, but zoogeographical significance of rotifers can be discussed because of their great potential passive dispersal which leads to cosmopolitanism for many species (DE RIDDER, 1981; DUMONT, 1983). However, a certain degree of endemism has been found in rotifers from some isolated and unexplored areas of the world (SHIEL *et al.*, 1989; SEGERS *et al.*, 1993; among others). One probable endemic species has been also found in Majorca (DE MANUEL, in press), supporting the zoogeographical relevance of the limnofauna of the Balearic archipelago.

Since the work on hydrobiology of Ibiza by MARGALEF (1951) no study on rotifers in this island had been carried out

until the present, and rotifer fauna of Formentera was never studied before.

This paper is a contribution to the series of works related with the rotifer fauna of different islands of the Balearic archipelago (DE MANUEL, 1989, 1990) and complements the information given in DE MANUEL *et al.* (1992). It investigates the occurrence and distribution of the species from different limnetic environments of Ibiza and Formentera, and discusses some morphological, ecological and biogeographical particularities of the species found.

## STUDY SITE AND METHODS

Ibiza and Formentera (Pityusic islands) are small islands located in the Southwestern Balearic archipelago (Fig. 1). They

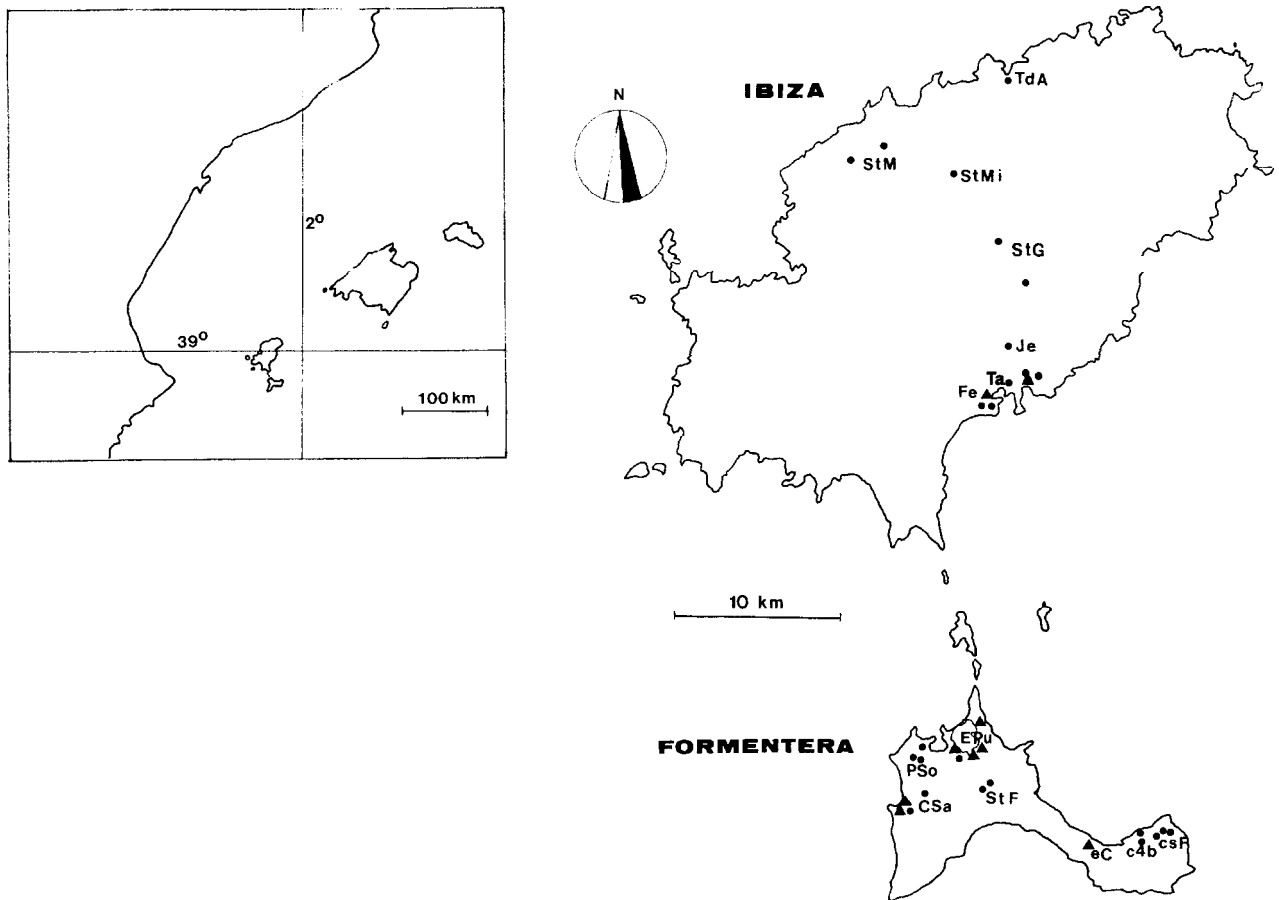


FIGURA 1. Sampling sites of the islands Ibiza and Formentera.

A brackish waterbodies

● ephemeral ponds

Ibiza: StG, Santa Gertrudis; StMi, Sant Miquel (Puig d'en Bassora) TdA Torrent d'Azut; StM, basses de Sant Ilateu; Je, Nostra Senyora de Jesus (Plà de Vila); Ta, Talamanca (basses de prat de ses Monges); Fe, Les Feixes.

Formentera: Epu, Estany Pudent; PSo, basses de Porto Soler; StF, basses de Sant Francesc; CSa, Cala Sahona; eC, pou d'Es Calo; c4b, cocons de Ses 4 Boques; csF, cocons de Ses Fontanelles.

are closer to the Iberian peninsula than the other Balearic islands (approximately 100 kms). The geological substrata of Ibiza (572 km<sup>2</sup>) are mainly calcareous. The inland waters of the island are constituted by temporal streams, brackish ponds (mainly located in the littoral strip), irrigation and farm ponds and ephemeral waterbodies. Formentera (77 km<sup>2</sup>), has also some brackish waters near the coastal strip, some little man-made waterbodies and ephemeral ponds. The mediterranean climate of the Pityusic islands is characterized by low rainfall and irregular annual precipitations. Geological features and climate characteristics are obtainable in POMAR (1982) and JANSÁ (1985).

Twenty samples from 16 localities of Ibiza, and 31 samples from 17 localities of Formentera were taken between April

1986 and May 1990. Most of sites were visited in autumn 1987 and in winter and spring 1986, 1988 and 1990. Some localities were sampled twice, but with no regular seasonality. Samples were collected with a 40 µm mesh plankton net, from littoral and pelagic environments. They were preserved in 4% formaldehyde solution. Some specimens were treated with sodium hypochlorite to identify the features of the *trophy* under HP microscope. All drawings were made with a *camera lucida* and scanning preparations were done with a method similar to that proposed by ANSELLEM & CLEMENT (1981). Observations were carried out under a SEM Cambridge S 120.

Identifications followed HARRING & MYERS (1924, 1926) for Notommatidae and Lecanidae respectively, and the taxonomic work of KOSTE (1978), for the rest of the families.

## RESULTS AND DISCUSSION

### Species and community types

The species identified, and the islands and localities where they were collected, are listed in Table 1. Thirty-four species, pertaining to 8 families, were identified, 21 in Ibiza and 25 in

Formentera. Considering the intensity of sampling, this number is surely undervaluing the truly rotifer fauna of Pityusic islands, in spite of the fact that Ibiza and Formentera are sites with scanty limnetic environments.

The community composition in some ephemeral waterbodies located inland of Formentera and Ibiza resembled the communities found in the ponds of Marina de Lluçmajor in

TABLE 1. Rotifera collected from Ibiza and Formentera.

Numbers indicate number of samples where each species have been found. Acronyms of localities where each species have been collected are indicated following the legend shown in figure 1.

SPECIES	IBIZA	FORMENTERA
<i>F. Brachionidae</i>		
<i>Anuraeopsis fissa</i> Gosse, 1851	1 Je	
<i>Brachionus angularis</i> Gosse, 1851		3 StF
<i>B. plicatilis</i> Müller, 1786.		1 CSa
<i>B. quadridentatus</i> Hermann, 1873		8 Epu, PSo, CSa, StF
<i>B. urceolaris</i> (Müller, 1773)	2 StG	13 Epu, PSo, eC, c4b, csF
<i>Notholca squamula</i> (Müller, 1786)		2 Epu, StF
<i>Keratella procurva</i> (Thorpe, 1912)	6 StG, StM	1 csF
<i>F. Colurellidae</i>		
<i>Colurella adriatica</i> Ehrenberg, 1831		1 Epu
<i>C. colurus</i> (Ehrenberg, 1830)	1 Ta	
<i>Lepadella patella</i> (Müller, 1786)	1 StG	3 Epu, CSa
<i>L. rhomboides</i> (Gosse, 1886)		2 StF
<i>L. triptera</i> (Ehrenberg, 1830)	1 StG	4 StF, c4b
<i>F. Lecanidae</i>		
<i>Lecane bulla</i> (Gosse, 1886)	4 StG, Je	
<i>L. closteroerca</i> Schmarida, 1859	4 StG, StM, Je	7 StF, csF
<i>L. hamata</i> Stokes, 1896	1 StG	
<i>L. inopinata</i> (Harring & Myers, 1926)	1 StG	
<i>L. lamellata</i> (Daday, 1893)		1 Epu
<i>L. luna</i> (Miiller, 1776)	3 StG, Ta	
<i>L. lunaris</i> (Ehrenberg, 1832)	1 StG	
<i>L. nana</i> (Murray, 1913)	1 StG	2 Epu, StF
<i>L. punctata</i> (Murray, 1913)	2 StG	
<i>F. Notommatidae</i>		
<i>Cephalodella catellina</i> (Müller, 1776)		3 Epu, CSa
<i>C. gibba</i> (Ehrenberg, 1838)		3 StF
<i>C. gracilis</i> (Ehrenberg 1831)	1 StM	1 StF
<i>C. innesi</i> Myers 1924		1 Epu
<i>F. Trichocercidae</i>		
<i>Trichocerca rattus f. carinata</i> (Ehrb. 1830)		6 PSo, StF, c4b, csF
<i>T. pusilla</i> (Lauterborn, 1898)	1 StG	
<i>T. weberi</i> Jennings, 1903		3 StF
<i>F. Synchaetidae</i>		
<i>Polyarthra vulgaris</i> Carlin, 1943		2 c4b, csF
<i>Synchaeta oblonga</i> Ehrenberg, 1831	2 Fe, Je	1 Epu
<i>F. Testudinellidae</i>		
<i>Testudinella clypeata</i> (Müller, 1786)	1 Fe	
<i>T. patina</i> (Hermann, 1783)	5 StM, Je, Ta	15 Epu, CSa, StF, c4b, csF
<i>F. Hexarthridae</i>		
<i>Hexarthra femica</i> Levander, 1892	1 StG	15 Epu, PSo, CSa, StF, csF
<i>H. mira</i> (Hudson, 1871)		1 StF
<i>Bdelloidea</i>		
	7 StG, StM, Fe, Je	10 Epu, CSa, StF, eC, PSo

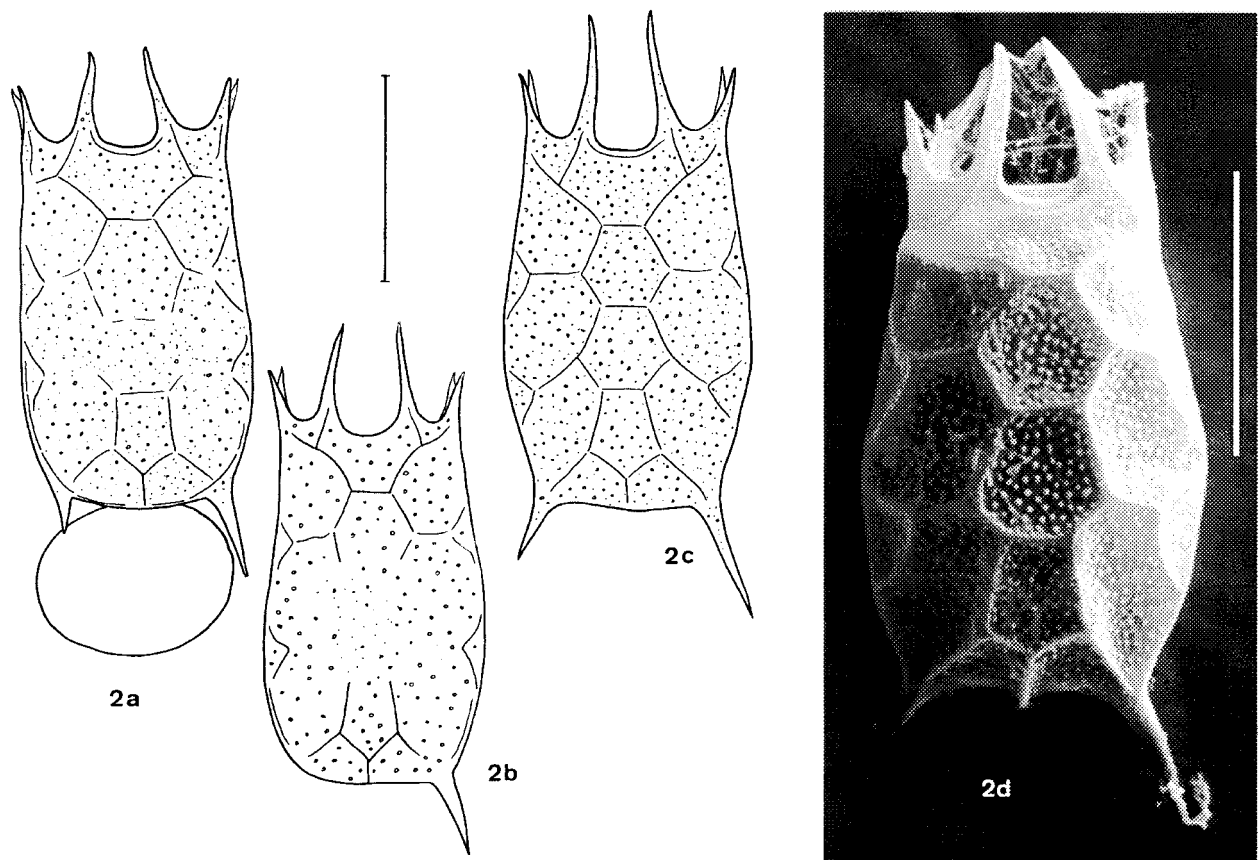


FIGURA 2. *Keratella procurva* (Thorpe, 1912). a, d, from Sta. Gertrudis (Ibiza); b, from Ses Fontanelles (Formentera); c, from St. Mateu (Ibiza). Bar scale 50  $\mu$ m.

Majorca (DE MANUEL, 1989/1990). This similarity was also observed by PRETUS (1990) with the crustacean communities from this area. Frequent assemblages in those collections were: *Lepadella patella*, *L. triptera*, *T. weberi*, and *Testudinella patina*/*B. quadridentatus*. A second typical community was found in the brackish waters of the littoral strip from both islands, according with the cluster analysis designed in DE MANUEL *et al.* (1992). Some occasional species from this habitat were: *Brachionus plicatilis*, *Cephalodella catellina*, *Lecane lamellata* and *Testudinella clypeata*. The uncommon *L. lamellata* was collected in winter in the brackish waters (14,140  $\mu$ mS) of the Estany Pudent in Formentera. Other rare species, *T. clypeata*, that was found before in the archipelago by DE RIDDER (1967), MARGALEF (1953) and PRETUS *et al.* (1992), was recorded in a brackish waterbody from Ibiza (Les Feixes). Species more euryhaline than those, were common in brackish and mineralized waterbodies of the islands: *Brachionus quadridentatus*, *B. angularis*, *B. urceolaris*, *Notholca squamula*, *Synchaeta oblonga*, *Testudinella patina* (which was the most common rotifer of the islands) and *Hexarthra fennica*.

*Cephalodella gracilis* (Fig. 5) in Formentera and Ibiza, and *C. innesi* (Fig. 6) in brackish waterbodies of Formentera, were species exclusively recorded in the Pityusic islands.

A remarkable variability in the length of the left caudal spine was observed in *Keratella procurva* (Fig. 2), as has been reported in other congeneric species (e. g. *Keratella tropica*, by GREEN, 1980).

The species *Lecane punctata* (Fig. 3), previously recorded in Minorca (DE MANUEL, 1990), was collected in Ibiza, in an ephemeral man-made waterbody.

### Zoogeographical remarks

*Keratella procurva* is considered a pantropical or pansubtropical species (KOSTE, 1978). Until now it has only been recorded in two localities of the North-East of the Iberian peninsula (in an artificial pond of Arbdcies by CATALAN, 1986; and also in a man-made pond from Tordera by DE MANUEL, unpublished data). It has been recorded widespread in other islands of the Balearic archipelago (DE MANUEL, 1989/1990,

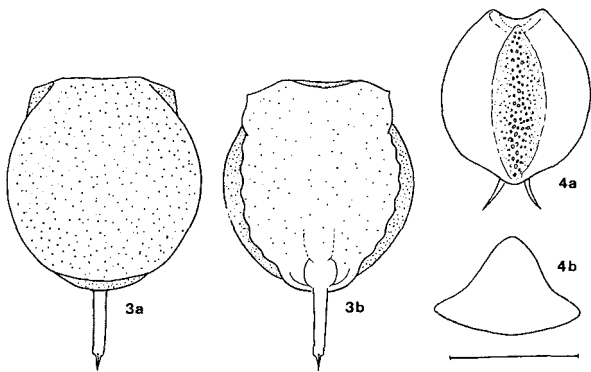


FIGURA 3 y FIGURA 4  
 3. *Lecane punctata* (Murray, 1913), from Sta. Gertrudis (Ibiza). a, dorsal view; b, ventral view.  
 4. *Lepadella triptera* (Erhenberg, 1830), from bassa de Can Ferrando (Formentera). a, dorsal; b, cross-section of the lorica.  
 Bar scale 50  $\mu$ m.

1990). COUSSEMENT & DUMONT (1980) found *K. procurva* in the Atlas Mountains and the species probably has colonized the Balearic islands from Africa. It may be an example of a southern species occupying suitable habitats, and there are some hypothesis, supported on the passive dispersal of rotifers,

to explain that colonization. One is based on the mud rains coming from North Africa, which are frequent in the Balearic archipelago as was reported by COLOM (1948) and JANSÁ (1948); the other is that these islands are in the migration pathway of birds (ARAUJO et al., 1977). Resting eggs of rotifers can be transported with the wind long distances and can remain in the digestive tract or attached to the plumage of birds. Similar cases of dispersion were discussed by JAUME (1989) and PRETUS (1990) for some crustaceans recorded in the archipelago, typical from North Africa in Majorca and Minorca (e.g. *Metadiaptomus chevreuxi*, *Leptostheria mayeti*, *Cyzicus bucheti*, *Branchinecta ferox*). But the mud rain and also the migrant birds reach the Iberian peninsula, why then is the species so rarely found there? Perhaps an important consideration to be done is that in the Balearic archipelago there are few permanent waterbodies with enough volume to ensure the development of euplanktonic rotifer communities. This fact may be responsible of the scarcity of planktonic Brachionidae there. Only 2 species of the genus *Keratella* have been reported until now in the islands (*K. procurva* and *K. quadrata*, and the latter was not found in Ibiza and Formentera). Maybe *K. procurva* is excluded in mainland by competition, as other planktonic rotifers

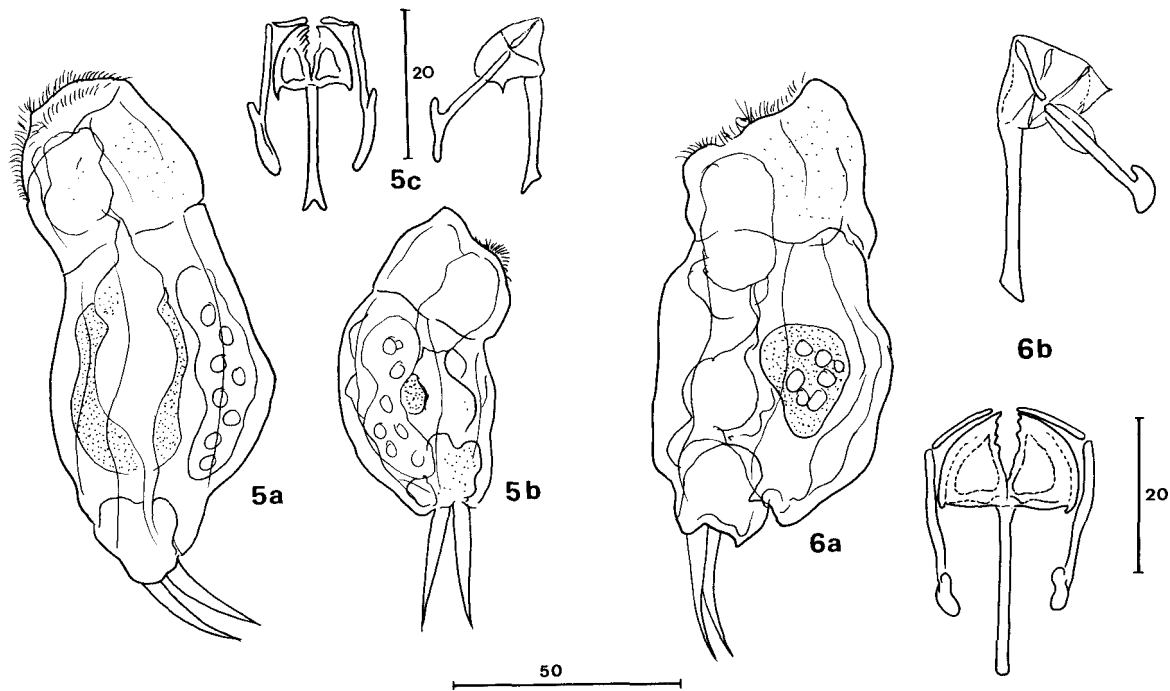


FIGURA 5 y FIGURA 6  
 5. *Cephalodella gracilis* (Erhenberg, 1831). a, contracted specimen from St. Mateu (Ibiza); b, contracted specimen from bassa de Can Ferrando (Formentera); c, trophi (lateral and frontal view) of the latter specimen.  
 6. *Cephalodella innesi* Myers 1924. a, contracted specimen from Estany Pudent (Formentera); b, trophi (lateral and frontal view).  
 Scale in  $\mu$ m.

fers of the same genus (*K. quadrata*, *K. cochlearis*, *K. tropica*) have more opportunities for colonizing small waterbodies which are easier colonized by *K. procurva* in the islands. The absence or the scarcity of these species in the Balearic archipelago may facilitate its occurrence.

*Lecane punctata* is not confined to the Neotropical region, as was firstly discussed by DE RIDDER (1981). The species is cosmopolite in tropical and subtropical regions. Some arguments on the taxonomic differences between *L. punctata* Murray 1913 and *Lecane harringi*, described by AHLSTROM (1934), have been accounted by JOSE DE PAGGI (1989) and TURNER (1990), but both names are synonyms (DE RIDDER and SEGERS, per. com.), as was earlier proposed by KOSTE (1978).

### Acknowledgements

I want to express my gratitude to Damià Jaume and Joan Lluís Pretus, who, as in others occasions, have entrusted their samples to me. I'm also indebted to Rafael Morales for his constructive comments on a first manuscript and to Sue J. Ansell who corrected the language. Figure Id was done in the Servei de Microscopia Electrònica de la Universitat de Barcelona.

### REFERENCES

- AHLSTROM, E.H. 1934. Rotatoria of Florida *Trans. Amer. Micro. Soc.*, 53: 251-266.
- AMSELLEM, J. & CLEMENT, P., 1980. A simplified method for the preparation of rotifers for transmission and scanning electron microscopy. *Hydrobiologia* 73: 119-122.
- ARAUJO, J., MUÑOZ-COBO, L., & F.J. PURROY, 1977. Las rapaces y aves marinas del archipiélago de Cabrera. *Nat. Hisp.* 12, 94 pp.
- CATALAN, J., 1986. Aproximación a la composición y organización del Neuston. *Oecologia Aquatica* 8: 25-38.
- COLOM, G., 1948. Las lluvias de barro en las Baleares, bajo el punto de vista geológico. *Rev. Geofís.* (año VII). 26: 194-210.
- COUSSEMENT, M. & H.J. DUMONT, 1980. Some peculiar elements in the rotifer fauna of the Atlantic Sahara and of the Atlas Mountains. *Hydrobiologia*. 73: 249-254.
- DE MANUEL, J., 1990. Contribution to the knowledge of rotifer fauna (Rotifera: Monogononta) from Minorcan inland waters (Balearic Isles: Spain). *Limnética*. 6: 119-130.
- DE MANUEL, J., 1989-1990. Some rotifers (Rotifera: Monogononta) from inland waters of Majorca (Balearic archipelago: Spain). *Boll. Soc. Hist. Nar. Balears*, 33: 189-199.
- DE MANUEL, J., PRETUS, J. LL. & D. JAUME., 1992. Rotifers of the Balearic archipelago. *Hydrobiologia* 239: 33-41.
- DE MANUEL, J. (in press). Aportad a la fauna de rotifers de les aigües de S'Albufera d'Alcúdia. In *S'Albufera de Mallorca* (MARTÍNEZ, A. & J. MAYOL, Ed.). *Monografies de la Societat d'Historia Natural de les Balears. Publ. Parc Natural de S'Albufera n. 1*.
- DE MANUEL, J., (in press). Taxonomic and zoogeographic considerations on Lecanidae (Rotifera: Monogononta) of the Balearic archipelago, with description of a new species, *Lecane margalefi* n.sp. *Hydrobiologia*.
- DE RIDDER, M., 1967. Quelques rotiferes de Majorque. *Bull Nat. Belg.* 48, 8: 409-418.
- DE RIDDER, M., 1981. Some considerations on the global distribution of rotifers. *Hydrobiologia* 85: 209-225.
- DUMONT, H.J., 1983. Biogeography of Rotifers. *Hydrobiologia*. 104: 19-30.
- JANSA, A., 1948. Lluvias de barro registradas en las Baleares durante la primavera de 1947. *Rev. Geofís.* 26: 182-193.
- JANSA, A., 1985. Condiciones climáticas. In: *Baleares, Macromaynitudes del sector agrario*. El Campo. Boletín de información agraria, 100. Banco de Bilbao.
- JAUME, D., 1989. *Metadiaptomus chevreuxi* (Copepoda: Calanoida: Diaptomidae) and *Leptestheria mayeti* (Branchiopoda: Conchostraca: Leptestheriidae), two African freshwater crustaceans recorded in Majorca. *Limnética*, 5: 101-109.
- JOSE DE PAGGI, S., 1989. Rotíferos de algunas provincias del Noroeste argentino. *Rev. Hydrobiol. trop.* 22 (3): 223-238.
- HARRING, H.G. & F.J. MYERS, 1924. The rotifer fauna of Wisconsin II. A revision of the notommatid, exclusive of the Dicranophoridae. *Trans. Wisc. Acad. Arts. Sci. Lett.* 21: 415-549.
- HARRING, H.K. & F.J. MYERS, 1926. The Rotifer fauna of Wisconsin. III. A revision of the genera *Lecane* and *Monostyla*. *Trans. Wisc. Acad. Sci. Arts Lett.* 22: 315-423.
- KOSTE, W., 1978. *Rotatoria. Die Radertiere Mitteleuropas. Bestimmungswerk begründet von Max Voigt.* 2 vols. (Bomtraeger: Stuttgart).
- MARGALEF, R., 1951. Materiales para la hidrobiología de la isla de Ibiza. P *Inst. Biol. Apl.* 8: 9-70.
- MARGALEF, R., 1953. Materiales para la hidrobiología de la isla de Mallorca. P *Inst. Biol. Apl.* 15: 5-111.
- POMAR, L., 1982. La evolución tectosedimentaria de las Baleares: Análisis crítico. *Acta Geol. Hisp.* 14: 293-310.
- PRETUS, J.LL., 1990. A commented check-list of the Balearic branchipoda (Crustacea). *Limnética*, 6: 157-164.

PRETUS, J.LL, DE MANUEL, J. & LL. CARDONA., 1992. Temporal heterogeneity, zooplankton composition and fish food supply in the Albufera of Minorca, a highly fluctuant environment. *Bulletin de l'Institut océanographique! Monaco*. n° spécial 11: 179-188.

SEGRS, H., 1993. Rotifera of some lakes in the floodplain of the River Niger (Imo State, Nigeria). I. New species and

other taxonomic considerations. *Hydrobiologia*, 250: 39-61.

SHIEL, R.J., KOSTE, W. & L.W. TAN, 1989. Tasmania revisited: rotifer communities and habitat heterogeneity. *Hydrobiologia* 1861187: 239-245.

TURNER, P.N., 1990. Some rotifers from coastal lakes of Brazil, with description of a new rotifer, *Lepadella* (*Xenolepadella*) *curvicaudata*. *Hydrobiologia*, 208: 141-152.