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SOME ROTIFERS (ROTIFERA:MONOGONONTA) FROM INLAND WATERS OF MAJORCA (BALEARIC ARCHIPELAGO, SPAIN)

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KEY WORDS: Rotifera, new records, Balearic Islands, biogeography.

ABSTRACT. Thirty three species of rotifers were identified from samples of fresh and brackish waters from Majorca. Permanent ponds, ephemeral waterbodies, and artificial waters were sampled. Most of the species were new records for the island and 10 were found for the first time in the Balearic archipelago. The pools of the Marina de Llucmajor yielded most of the taxa, and showed a uniform community composition. *Keratella procurva* (Thorpe, 1912), which is considered a pantropical species, was collected in the north of the island. The community structure for each environment is described, and zoogeographical aspects are discussed. Original drawings of species that are new records for the Balearic islands are presented.

RESUM. ALGUNS ROTIFERS (ROTIFERA: MONOGODONTA) DE LES AIGÜES EPICONTINENTALS DE MALLORCA (ILLES BALEARS). Han estat trobades trenta-i-tres espècies de rotífers a l'estudiar mostres procedents d'aigües dolces i salobroses de l'Illa de Mallorca. S'han investigat aigües permanents, temporals i artificials. La major part de les espècies constitueixen noves troballes per a l'Illa, i 10 d'elles són noves cites per a les Balears. A les basses de la Marina de Llucmajor, on s'ha trobat la majoria dels taxa, s'hi desenvolupaven comunitats amb una composició uniforme. *Keratella procurva* (Thorpe, 1912), considerada com una espècie pantropical, s'ha trobat al nord de Mallorca. Es fa una descripció de l'estructura de les comunitats dels diferents ambients estudiats, i es comenten els aspectes zoogeogràfics. Es presenten dibuixos originals de les noves aportacions per a la fauna Baleàrica.

INTRODUCTION

The only records on rotifer fauna from the island of Majorca are due to the investigations on freshwater biology carried out by MARGALEF (1953) and

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DE RIDDER (1967), the latter on brackish waters from Pollença and S'Albufera d'Alcúdia in the northeast of the island. There are some other contributions on rotifers from the Balearic archipelago (MARGALEF, 1951, 1952; DE MANUEL, 1990).

Production of resting eggs is an efficient strategy for freshwater colonization. This passive dispersal facilitates the foundation of new populations if ecological conditions are suitable. For this reason, rotifers are considered to be cosmopolitan organisms. However, a certain degree of endemicity has been observed in rotifer faunas found in isolated areas from several latitudes of the world (DUMONT, 1983). It suggests that the rotifers present some zoogeographical significance.

This work adds new records to the knowledge of the rotifer fauna of Majorca. It investigates the occurrence of the species in the different habitats sampled, and discusses some biogeographical particularities.

MATERIAL AND METHODS

All the samples were collected with a 40 µm mesh planton net, and preserved in 4% formaldehyde.

Preparations of subsamples were made for observation under microscope. Some were treated with sodium hypochlorite for *trophi* analyses. Drawings were done with camera lucida.

STUDY AREA

Majorca is an island the Balearic archipelago, 170 Km of the Iberian Peninsula, in the Mediterranean Sea. Its extension is of 3,640.16 Km^2.

Most of the island is constituted by calcareous rocks, and karstic phenomena are frequent (POMAR, 1982).

Fifty samples, from forty sampling stations (figure 1) corresponding to temporary pools, streams, and man-made waterbodies, were studied. Most of them were collected in spring (March) and summer (September) of 1987.

Several environments can be differenciated:

1) Marina de Llucmajor, in the south. It is a platform 90 m.a.s.l. located in the semi-arid part of the island. Close to the sea, pools are established because of impermeable soil profiles. This is a windy area, with scanty precipitation, 350-400 mm/year of mean rainfall (COLOM, 1958). Twenty five samples from nineteen permanent and ephemeral pools were studied.

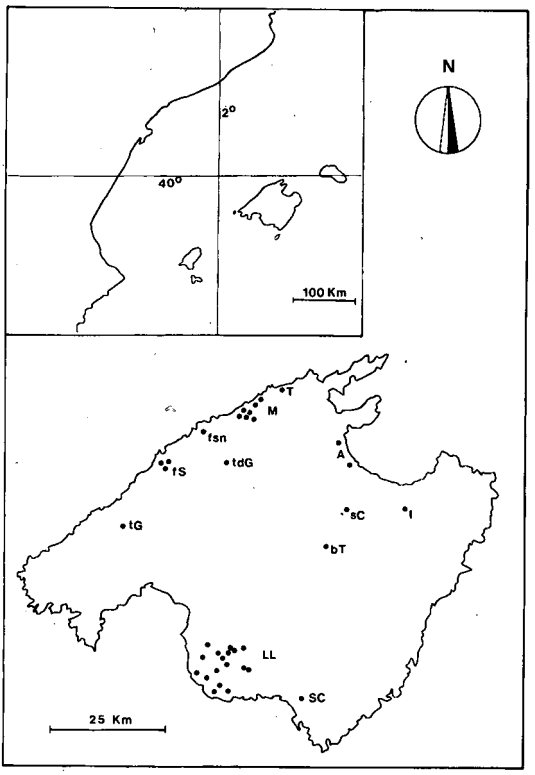

Fig. 1.- Sampling sites in the island of Majorca: **LL**. pools of Marina de Llucmajor; **M**. pools and reservoir at Mortitx (Escorca); **SC**. Son Cortana; **I**. Infern; **T**. "bassa dels Tamarells", **T**. Ternelles; **tdG**. "torrent des Guix"; **fsn**. "font de sa Casa Nova"; **fs**. "fonts de Sóller"; **tG**. "torrent de sa Granja".

2) Brackish waters from the littoral strip. This is the case of Salobrar de Campos in the south and S'Albufera d'Alcúdia in the northeastern part of the island. Only six samples were investigated.

3) Some ponds and a reservoir at Mortitx in the north of the island (Escorca). These environments are all on calcareous soils, and are surrounded by karstic formations.

The rest of the samples were collected from different parts of the island, mainly artificial waterbodies (pools, troughs) and ephemeral pools.

RESULTS AND DISCUSSION

The species found and their habitats are listed in table 1. Thirty three species were identified, twenty one were new records for the island, and ten for the Balearic archipelago.

Table 1. Rotifera collected from Majorca.
• new record for the island.
* new record for the Balearic archipelago.
Localities where each species was collected are indicated in figure 1. The number of samples in which each species occurs is indicated in brackets.

SPECIES	LOCALITIES
Anuraeopsis fissa Gosse, 1851 •	M (3), tdG, sC
Brachionus plicatilis Müller, 1786.	A (4)
B. quadridentatus Hermann, 1873	LL (4)
Cephalodella auriculata (Müller, 1773) *	fsn
C. forficula (Ehrenberg, 1838) *	LL (2), M
C. megalocephala (Glascott, 1893) *	LL (3)
C. stenroosi (Wulfert, 1937) *	M
Dicranophorus epicharis (Harring & Myers,1928) *	LL
Euchlanis dilatata (Ehrenberg, 1832)•	LL (9), I
Hexarthra fennica Levander, 1892	M (2)
H. mira (Hudson, 1871)•	M
Keratella procurva (Thorpe, 1912)•	M (2)
Lecane (M.) bulla (Gosse, 1886)	M (2)
L.(M.) closterocerca Schmarda, 1859	LL (14), I
L.(M.) bifurca (Bryce, 1892)•	LL (5)
L.(M.) hamata Stokes, 1896•	M
L.(L.) hastata (Murray, 1913) *	LL, M
L.(L.) luna (Müller, 1776)	M (2)
Lepadella patella (Müller, 1786)	LL (19), M (2)
L. ovalis (Müller, 1786)	M (2)
L. rhomboides (Gosse, 1886) *	LL (10)
L. triptera (Ehrenberg, 1830)•	LL (3)
Lophocharis salpina Ehrenberg, 1834•	LL
Notholca squamula (Müller, 1786)	A, SC
Polyarthra vulgaris Carlin, 1943•	M (3)
Synchaeta pectinata Ehrenberg, 1832 *	M
Synchaeta oblonga Ehrenberg, 1831 *	M (1)
Testudinella patina (Hermann, 1783)	LL (4), M (1)
T. rattus f. carinata (Ehrenberg, 1830)•	LL (5)
T. pusilla (Lauterborn, 1898)	M (1)
T. weberi Jennings, 1903 *	LL (11), M(1)
Trichotria pocillum (Müller, 1776)•	M (1)
T. tetractis Ehrenberg, 1830	M (1)

FAUNISTIC ASPECTS

Rotifers were recorded from the following families:

Fam. *BRACHIONIDAE* (5 spp)

The genus *Brachionus* was represented only by two species: *B. plicatilis* Müller 1786, found in the saline waters of S'Albufera d'Alcúdia. It reached high density in the channels among the coastal lagoons; and *Brachionus qua-*

dridentatus Hermann 1873, a very common littoral rotifer from temperate climates. It was found in four collections from pools in the Marina de Llucmajor.

The subtropical species *Keratella procurva* (Thorpe, 1912) (figure 2), with a distinct pentagonal posteromedian plaque (figure 2, p), was collected in the north of the island (Mortitx) from two neighbouring karstic ponds.

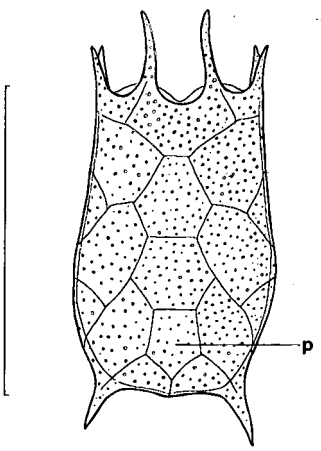

Fig. 2.- *Keratella procurva* (Thorpe, 1992) (from Mortitx), lorica, dorsal. **p**. posteromedian plaque. Scale line 100 µm.

Anuraeopsis fissa (Gosse, 1851) was found widespread in Majorca. It occurred in small alkaline waterbodies.

A few specimens of *Notholca squamula* (Müller, 1786) occurred in the brackish waters from S'Albufera d'Alcúdia and Salobrar de Campos. Some individuals showed relatively longer, submedian spines resembling those of *Notholca salina* (Focke, 1961).

Fam. *EUCHLANIDAE* (1 sp)

The cosmopolitan species *Euchlanis dilatata* (Ehrenberg, 1832) was collected in ten localities, frequently among macrophytes, but also in plankton samples.

Fam. *MYTILINIDAE* (1 sp)

A population of large specimens (length of lorica: 175-190 µm) of *Lophocharis salpina* (Ehrenberg, 1834) occurred in the pond of Cas Frares in Marina de Llucmajor.

Fam. *TRICHOTRIIDAE* (2 spp)

Trichotria pocillum (Müller, 1776) was found in the plankton from the small reservoir in Mortitx. It is a plankton migrant from benthic and litoral areas.

Trichotria tetractis (Ehrenberg, 1830) was collected in a calcareous pond, living among macrophytes. Both species can be easily distinguishable by the presence of a minute spine between the toe bases in *T. pocillum* which is absent in *T. tetractis*.

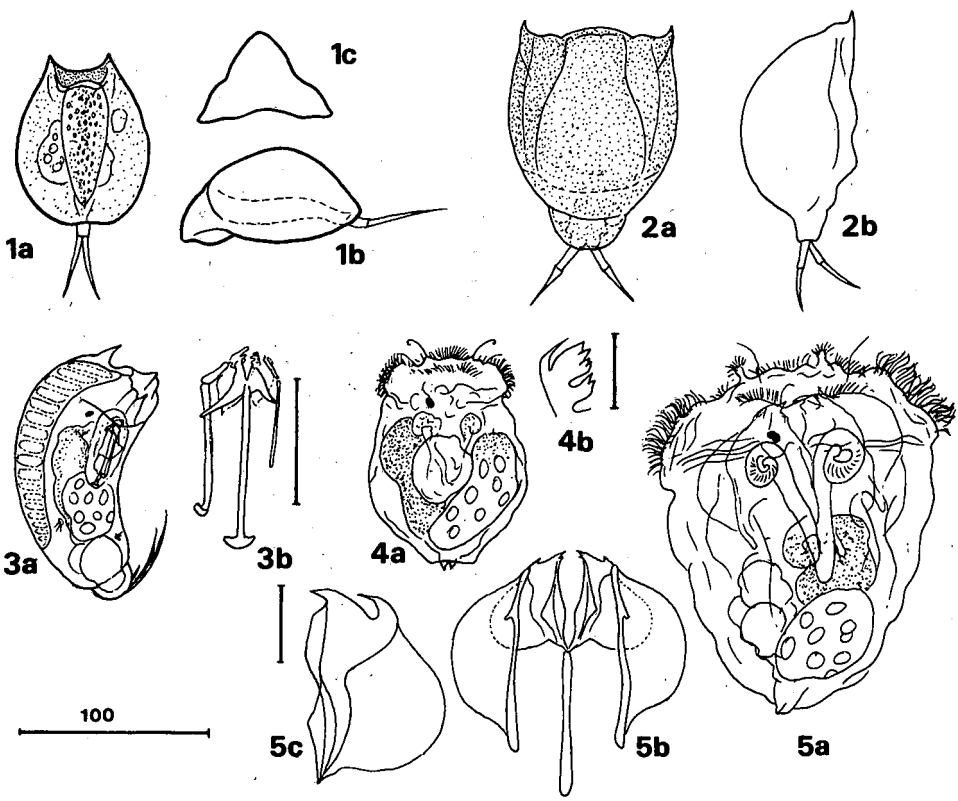

Fig. 3.- Some rotifers new for Majorca: **1 a-c**. *Lepadella rhomboides* (from Ses Pedreres noves), **a**. dorsal, **b**. section, **c**. lateral; **2 a-b**. *Lecane hastata* (from Llucmajor), **a**. dorsal, **b**. lateral; **3 a-b** *Trichocerca weberi* (from Cap Blanc. Llucmajor), **a**. lateral, **b**, *trophi*; **4 a-b**. *Synchaeta oblonga* (from Mortitx), **a**. ventral (specimen contracted), **b**; *unci* **5 a-c**. *Synchaeta pectinata* (from Mortitx), **a**. ventral (specimen contracted), **b**, *trophi*, **c**. *unci* of the same.
Scale bars in µm. Vertical bars 20 µm.

Fam. *COLURELLIDAE* (4 spp)

The littoral cosmopolitan *Lepadella ovalis* (Müller, 1776) and *L. patella* (Müller, 1776), were found. The latter was the most common rotifer of the island.

The small *Lepadella triptera* Ehrenberg 1830, with a distinct dorsal keel and a finely striped lorica, was found by MARGALEF (1952) in Minorca, and our specimens from the pools in the Marina de Llucmajor were first records for Majorca.

Lepadella rhomboides (Gosse, 1886) (figure 3. 1 a,b,c) is a new record for the Balearic archipelago. It presents a low and wide dorsal keel, and a granulated collar.

Fam. *LECANIDAE* (6 spp)

Most of the species in this family are cosmopolitan and very common in freshwater habitats. All *Lecanidae* are littoral and benthic.

L.(M.) closterocerca (Schmarda, 1859) was one of the most frequent rotifer of the island. It was collected in fifteen localities.

L. luna (Müller, 1776), widespreead in Minorca (DE MANUEL, 1990), was collected only in the plankton samples from the reservoir at Mortitx.

Lecane (M.) bifurca (Bryce, 1892) and *Lecane (M.) hamata* Stokes 1896 are new records for Majorca; the first was found in five pools from the Marina de Llucmajor.

Lecane (M.) bulla (Gosse, 1886) was found in the reservoir at Mortitx and in a pond near the reservoir.

Lecane hastata (Murray, 1913) (figure 3.2) is a new record for the rotifer fauna of the Balearic islands. It was collected in a pool near a road in theMarina de Llucmajor and in the Gorg des Bec de s'Oca at Mortitx. This species has finely stippled dorsal and ventral plates. The two small spines at the external angles and the toes terminating in long acute claws, are diagnostic features.

Fam. *NOTOMMATIDAE* (4 spp)

The genus *Cephalodella* yielded four species which are new for the Balearic islands. They are benthic rotifers, occasionally migrants in the plankton.

Cephalodella megalocephala (Glascott, 1893) (figure 4.2) was found in three localities from the Marina de Llucmajor. *Cephalodella stenroosi* (Wulfert, 1937) (figure 4.3) was collected in a pond over calcareous rocks at Mortitx. *Cephalodella forficula* (Ehrenberg, 1838) (figure 4.4), which has distinct

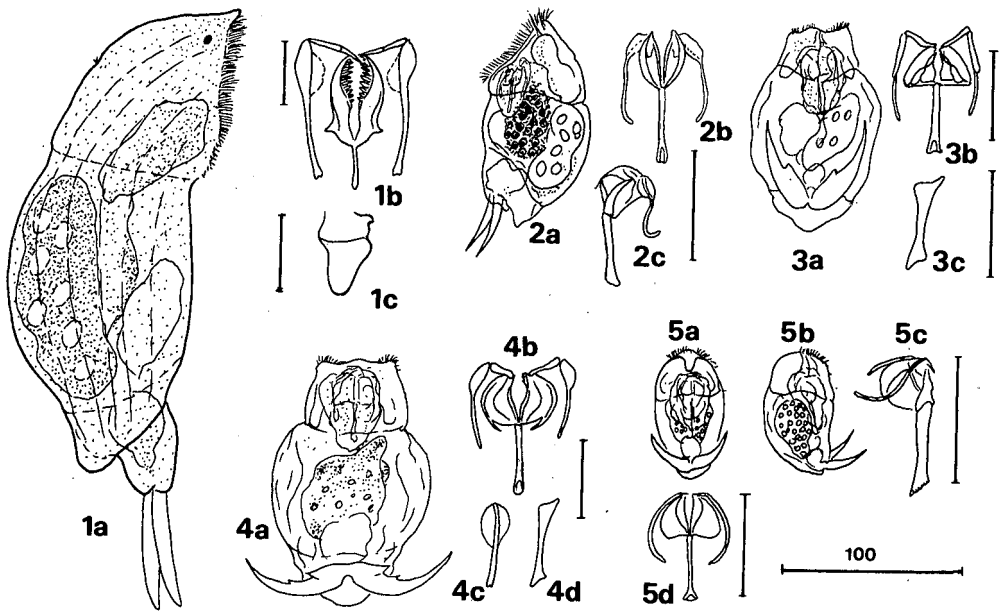

Fig. 4.- Some rotifers new for Majorca: **1 a-c**. *Dicranophorus epicharis* (from Cas Guarda. Llucmajor), **b**. *trophi*, **c**. *fulcrum;* **2 a-c**. *Cephalodella megalocephala* (from S'Aguila. Llucmajor), **b**. *trophi* (frontal), **c**. *trophi* (lateral); **3 a-c**., *Cephalodella stenroosi* (from Mortitx), **a**. ventral (contrated specimen), **b**. *trophi* and **c**. *fulcrum;* **4 a-d**. *Cephalodella forficula* (from Llucmajor) **a**. Ventral (specimen contracted), **b**. *trophi,* **c**. *manubrium,* **d**. *fulcrum;* **5 a-d**. *Cephalodella auriculata* (from Font de Sa Casa Nova), **a**. ventral (specimen contracted) **b**. lateral, **c**. *trophi* (lateral), **d** *trophi* (frontal). Scale bars in µm. Vertical bars 20 µm.

spines in the inner margin of the toes, occurred in pools from Mortitx. And the little *Cephalodella auriculata* (Müller, 1773) (figure 4.5) was found in a pond near Escorca, in the north of Majorca.

Fam. *TRICHOCERCIDAE* (4 spp)

Trichocerca rattus f. *carinata* (Ehrenberg, 1830), which has a dorsal crest, is a first record for the island, and it was found in five samples from the Marina de Llucmajor. Margalef recorded this species in Minorca in 1952 as *T.* cf. *carinata*.

Trichocerca pusilla (Lauterborn, 1898), a very common rotifer, ocurred in samples from Mortitx.

Trichocerca weberi Jennings 1903 (figure 3.3) a new rotifer for the Balearic archipelago, was frequent in pools from the south of the island, but one specimen was also found in the north, in a pond at Mortitx.

Fam. *SYNCHAETIDAE* (2 spp)

The planktonic *Polyarthra vulgaris* Carlin 1943 was found in the reservoir at Mortitx.

Synchaeta oblonga Ehrenberg 1831 (figure 3.4) and *Synchaeta pectinata* Ehrenberg 1832 (figure 3.5), common and cosmopolitan planktonic species, were recorded for first time in the archipelago.

Fam. *DICRANOPHORIDAE* (1 sp)

A specimen of the benthic species *Dicranophorus epicharis* (Harring & Myers, 1928) (figure 4.1) was found in the pool of Cas Guarda in Llucmajor. The *trophi* (figure 4.1 b,c) is larger than in any other species of the *forcipatus* group.

Fam. *TESTUDINELLIDAE* (1 sp)

Testudinella patina (Herman, 1783) occurred in the phytobenthic zone and among macrophytes.

Fam. *HEXARTHRIDAE* (2 spp).

Hexarthra fennica Levander 1892 and *H. mira* (Hudson, 1871), both seasonal species, were collected in summer samples from the north of the island. *H. mira* was found for first time in Majorca, co-existing in a pond with the congeneric *H. fennica*.

Contracted *Bdelloidea (Digononta)* were observed in most of the samples but could not be identified from preserved material.

COMMUNITY COMPOSITION

From 0-10 species occurred in each locality (mean: 3.06).

The more diverse rotifer communities were observed in the Marina de Llucmajor, where the mean number of species was 4.6. The communities were rather uniform and composed of littoral species: *Trichocerca weberi* was very common and frequent in the same pond with species of *Lepadella rhomboides,*

L. tripera and *L. patella*. The assemblage was completed with the presence of common species such as *Euchlanis dilatata* and *Lecane closterocerca*.

In the coastal lagoons studied, high salinity restricted the rotifer community to one or two species (*Brachionus plicatilis* and *Notholca squamula*), although sometimes populations reached high densities (i.e. *B. plicatilis*). De Ridder (1967), who investigated some littoral brackish ponds in Alcúdia and Pollença, found many more species: in Pollença *Epiphanes macrourus, Brachionus plicatilis, Notholca squamula, Notholca striata* and *Colurella halophila* were abundant; in S'Albufera d'Alcúdia *Colurella adriatica* and *Cephalodella catellina* were numerous.

The ponds and the reservoir on the north of the island showed a community structure of planktonic rotifers with frequent assemblages of *Anuraeopsis fissa* / *Polyarthra vulgaris* and *Hexarthra fennica* / *Keratella procurva*.

ZOOGEOGRAPHY

Synchaeta oblonga and *S. pectinata* are cosmopolitan, and very common on the Iberian peninsula, but they were recorded for the first time in the Balearic islands. The reason is probably that all the investigations from Balearic freshwater habitats have been done on small waterbodies.

Keratella procurva is considered as pantropical and pansubtropical (KOSTE, 1978). It has been found in different localities of Minorca (DE MANUEL, 1990). Its presence in Majorca suggests that it is a frequent inhabitant of the Balearic archipelago. CATALAN (1986) found *K. procurva* in an artificial pool in Catalonia (N.E. Spain) and it is the only record from the Iberian peninsula. This species may have colonized the islands coming from Africa. COUSSEMENT & DUMONT (1980) have found it in the Atlas Mountains. It may be an example of a southern species occupying suitable habitats. Passive dispersal of rotifers facilitates colonization, resting eggs can stay for a long time in the digestive tract or attached to the plumage of migrating birds. The mud rains from the Atlas valleys are frequent in the Balearic archipelago (COLOM, 1948), and we must take into account that *K. procurva* occurs in the more rainy parts of Majorca. A similar case is discussed by JAUME (1989) who recorded some African crustaceans (*Calanoida* and *Conchostraca*) in Majorca.

Trichocerca weberi, was frequent in the south of Majorca and some specimens were collected in the north. It is rare on the Iberian peninsula.

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