A COMMENTED CHECK-LIST OF THE BALEARIC BRANCHIOPODA (CRUSTACEA)

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ABSTRACT

43 species of branchiopoda have so far been recorded from the Balearic islands, including species mentioned here for the first time. Chorologic grouping hows an important stock of species associated with semiarid regions of continental inland basins, both from fresh and atalassohaline waters. Their biogeographic significance and age is discussed in relation to the neotectonics of the islands and the possible existence of barren conditions in part of the insular landscape in the past.

INTRODUCTION

The Iberian region is noted for its interesting freshwater entomostracan zoogeography, the study of which was originated at the end of the past century, but with its exponential development cooccuring with that of the regional limnosociology in the forties and fifties. The Balearic Islands were not an exception to this rule, and they were one of the areas studied by MARGALEF (1951b, 1952, 1953a,b), who started the taxonomy and biogeography of the freshwater crustacea of the islands (MARGALEF, 1948, 1958). Recently work on the subject was recommenced, mainly due to separate situations which have arisen: One, the appearance of botanists and zoologists interested in and centred on the aquatic systems of the Balearic region, which has led to a greater geographic exploration and recognition of aquatic habitats unknown so far; this situation has allowed different authors to collect and study a varied spectrum of crustacean samples (JAUME, 1989; PRETUS, 1985, 1987, 1989). Two, the existence of faunistic synthesis on different groups of branchiopoda, from severa1 Mediterranean countries (GAUTHIER, 1928; NEGREA, 1983; ALONSO, 1985a, b; MARGARITORA, 1985; RAMDANI, 1986; THIÉRY, 1987) resulting in an easier and more detailed comparison of new zoologic data. And three, the progressive consolidation of the vicariant evolutionary model for several genera of Chydoridae (FREY, 1982; ALONSO, 1987). This model is revolutionising the classic approach which consists of a supposed generalized cosmopolitanism. This change has affected the Balearic area (ALONSO & PRETUS, 1989). The result of these combined features is to change our view of the Balearic branchiopod biota, to a point at which a first check-list recording the new materials is now possible.

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MATERIAL AND METHODS

The study area concerns the four main islands of the Balearic archipelago. The Check-list includes the existing bibliographic data and unpublished data collected by the author. Samples were taken in Majorca during May and June 1987, dunng January and February 1988 and in March 1989. Ibiza is poorly endowed with freshwater environments. Samples were also taken in both Ibiza and

Formentera in February 1988. Minorca has been studied since 1984, with the largest effort made in fieldwork taking place between March and May 1984, July 1986, from December to April 1987, and in January 1988.

General characteristics of the Balearic regional limnology are compiled in previous works, mainly Margalef's papers on the hydrobiology of the islands. It is also interesting to comment here that these islands, especially Majorca and Minorca, are furnished in some degree with wetlands, mainly near the coastal areas, connected with rather irregular rushing streams. Temporary muddy and transparent freshwater pools are well developed in the south of Mallorca (SASTRE, 1987), and we refer to this as the Lluchmajor area. Ecologically similar aquatic systems, although not so frequent, but nonetheless still of importance, are also present in the west part of Minorca, namely in the Ciutadella area, and at severa1 points near the coast in the same island. Finally, they are also present in Formentera island. Springs are numerous in the mountainous area of Mallorca. Temporary pools and phreatic permanent ponds are developed in the north part of Minorca, where a complex and varied superposition of permeable and impermeable, limestone, dolomitic and silicic sandstone materials, make it a rich area of aquatic diversification. The hyporheic is poor, but well developed locally in Mallorca. No true atalassohaline lagoons are present.

RESULTS

A commented Check-list follows (see also table 1). Concise descriptive notes are presented for each island separately, because of the distinct sampling timespan spent by different authors on each one. Species cited by previous authors are also incorporated in separate form. Species not followed by references are first records for their corresponding island. First records for overall Balearic islands are shown in comments. Data on localities recorded are accompanied by a reference to date and the observed conductivity rank; accidental extreme high values of conductivity are indicated separately, as placed outside a more or less continuous rank. Marine cladocera are not treated here. The systematic groups at the level of orders are structured following FRYER (1987).

Order ANOSTRACA Sars

Family Branchinectidae Daday

Branchinecta ferox (Milne-Edwards, 1840)

Minorca: Temporary muddy pool in Ciutadella (11/01/88); 316 µS/cm (PRETUS, 1989).

Family Chirocephalidae Daday

Chirocephalus diaphanus Prévost, 1803

Minorca: Small humic temporary pool in Fornells (13103184); very rare (PRETUS, 1985).

Family Artemiidae Grochowski

Artemia salina (L., 1758)

Majorca: Salt marsh in Campos (25105187); 265 mS/cm (DE BUEN, 1916; MARGALEF, 1953a, b). Ibiza: (DE BUEN, 1916; MARGALEF, 1951b, 1953a). Formentera: Estany Pudent and Salines (13/02/88); 136 mS/cm (DE BUEN, 1916; MARGALEF, 1953a).

Family Branchipodidae Daday

Branchipus schaefferi Fischer, 1834

Majorca: Temporary pools, common in Lluchmajor; January and February; 18 localities; 161 to 528 µS/cm (MARGALEF, 1953b, 1958; JAUME, 1989). Minorca: Common in temporary freshwater pools over all the island; December to March, and up to July occasionally; 21 localities; 216 to 1157 µS/cm, and up to 2770 µS/cm (PRETUS, 1985, 1987). Ibiza: (MARGALEF, 1951b, 1953a). Formentera: Temporary pools in Ses Fontanelles and Porto Saler; February; 450 and 490 µS/cm.

Order SPINICAUDATA Linder

Family Cycizidae Barnard

Cyzicus bucheti (Daday, 1914)

Minorca: Muddy pool at north of Ciutadella; May and June; 540 µS/cm (PRETUS, 1989).

Family Leptestheriidae (Stebbing)

Leptestheria mayeti Simon, 1885

Majorca: Temporary pools in Lluchmajor; January and February; 5 localities; 199 to 451 µS/cm (MAYOL, 1977; ALONSO, 1985a, 1986; JAUME, 1989). Minorca: Temporary muddy pool in Mola de Fornells (14103187); 1157 µS/cm (PRETUS, 1989).

Order ANOMOPODA Sars

Family Daphniidae (Straus)

Daphnia (Ctenodaphnia) magna Straus, 1820

Majorca: Brackish waters near Albufera de Alcudia (5102188); Temporary hipereutrophic pools in Lluchmajor (25101188); 3 localities; 264 µS/cm to 17.3 mS/cm (MARGALEF, 1953a, b; JAUME, 1989). Minorca: Common in the northeast of the island, rare elsewhere; strongly mineralized waters, although absent in brackish waters in contact with the sea; November to July; 15 localities; 266 µS/cm to 18.1 mS/cm (MARGALEF, 1952, 1953a; PRETUS, 1985, 1987).

Daphnia (Ctenodaphnia) mediterranea Alonso, 1985

Majorca: Brackish waters near Alcudia (05/02/88), salt marshes of Can Picafort (26103189); without forming dense populations; 17.4 and 160 mS/cm; 2 localities. First record for Balearic Islands.

Daphnia (Ctenodaphnia) atkinsoni Baird, 1859

Majorca: Muddy pools in Lluchmajor (28101188); 256 µS/cm; 2 localities. Minorca: Muddy pools in Ciutadella; December to April; 4 localities; 204-318 µS/cm, and up to 3640 µS/cm. First record for Balearic Islands.

Daphnia (Ctenodaphnia) bolivari Richard, 1888

Majorca: Temporary muddy pool in Lluchmajor (25101188); 199 µS/cm (ALONSO, 1986; JAUME, 1989). Minorca: Doubtful form with intermediate nape morphology, in a muddy pool in Ciutadella (11101188).

Daphnia (Daphnia) obtusa Kurz, 1874

Majorca: Muddy pools in Lluchmajor (January), and basin in a spring in Banyalbufar (05106187); 4 localities; 200 to 789 µS/cm (JAUME, 1989).

Daphnia (Daphnia) pulex Leydig, 1860

Majorca: (MARGALEF, 1953a, b). Formentera: Artificial covered pond (13102188); 368 µS/cm.

Daphnia (Daphnia) curvirostris Eylmann, 1887

Minorca: Permanent waters in S'Albufera (Mercadal) and temporary dystrophic pools of the island; January to April; 8 localities; 1700 to 4400 µS/cm (PRETUS, 1985).

Daphnia (Daphnia) longispina O.F. Müller, 1785

Majorca: Pool with vegetation in Lluchmajor (06102188); reservoirs of Gorg Blau and Cuber

Table 1.- Distnbution of the species of Branchiopoda on the Baleanc islands (M, Majorca; m, Minorca; I, Ibiza; F, Formentera); +, doubtfull morphology.
Distribución de las especies de branquiópodos en las distintas islas Baleares (M, Mallorca; m, Menorca; I, Eivissa; F, Formentera); +, asignación dudosa.

Species	*M*	*m*	*I*	*F*
Order ANOSTRACA Sars. 1867				
Branchinecta ferox (Milne-Edwards, 1840)	.	+	.	.
Chirocephalus ***diaphanus*** Prévost, 1803	.	+	.	.
Artemia salina (L., 1758)	+	.	+	+
Branchipus schaefferi Fischer, 1834	+	+	+	+
Order SPINICAUDATA Linder, 1945				
Cyzicus bucheti (Daday, 1914)	.	+	.	.
Leptestheria ***mayeti*** Simon, 1885	+	+	.	.
Order ANOMOPODA Sars, 1865				
Daphnia magna Straus, 1820	+	+	.	.
D. mediterranea Alonso, 1985	+	.	.	.
D. atkimoni Baird. 1859	+	+	.	.
D. bolivari Richard, 1888	+	(+)	.	.
D. obtusa Kurz, 1874	+	.	.	.
D. pulex Leydig, 1860	+	.	.	+
D. curvirostris Eylmann, 1887	.	+	.	.
D. longispina O.F. Müller, 1785	+	+	.	.
Simocephalus vetulus (O.F. Müller, 1776)	+	+	+	.
S. exspinosus (Koch, 1841)	.	+	.	.
Ceriodaphnia reticulata (Jurine, 1820)	+	+	+	.
C. quadrangula (O.F. Müller, 1785)	+	+	+	.
C. dubia Richard, 1894	+	+	.	.
C. laticaudata P.E. Müller, 1867	+	+	+	+
Scapholeberis ramneri Dumont & Pensaert, 1983	.	+	.	.
Moina brachiata (Jurine, 1820)	.	+	.	.
M. micrura Kurz, 1874	.	+	.	.
M. salina Daday, 1888	+	.	.	.
Macrothrix hirsuticornis Norman & Brady. 1867	+	+	.	.
M. laticornis (Jurine, 1820)	+	.	.	.
Bosmina longirostris (O.F. Müller, 1785)	+	.	.	.
Pleuroxus ***letourneuxi*** (Richard, 1888)	+	+	.	+
P. aduncus (Jurine, 1820)	+	+	+	.
Alonella ***excisa*** (Fischer, 1854)	+	.	.	.
Dunhevedia crassa King, 1853	+	+	.	.
Chydorus sphaericus (O.F. Müller, 1776)	+	+	+	.
Ephemeroporus phintonicus (Margaritora, 1969)	+	+	.	.
Alona guttata Sars, 1862	+	+	+	.
A. rectangula Sars, 1862	+	+	.	.
A. elegans Kurz, 1875	+	+	.	+
A. iberica Alonso & Pretus, 1989	.	+	.	.
A. azorica Frenzel & Alonso, 1988	.	+	.	.
A. affinis (Leydig, 1860)	.	+	.	.
Leydigia acanthocercoides (Fischer, 1854)	+	+	.	.
Tretocephala ambigua (Lilljeborg, ***1900)***	+	+	+	.
Oxyurella ***tenuicaudis*** (Sars, 1862)	.	+	+	.
Order NOTOSTRACA Sars, 1867				
Triops cancriformis Bosc., 1801	+	+		

(June, 347 µS/cm); phreatic freshwater pools in Sa Calobra (May); 4 localities. Minorca: Common in the north of the island, in mineralized permanent or semitemporal waters, with vegetation, some strongly rich in humic substances; November to May, accidentally in August; 16 localities; 497 to 3710 µS/cm, and up to 13.1 mS/cm (PRETUS, 1985; ALONSO & PRETUS, 1989).

Simocephalus vetulus (O.F. Müller, 1776)

Majorca: (MARGALEF, 1953a, b). Minorca: Very common in mineralized waters of all the island; all the year; 64 localities; 709 to 8620 µS/cm (MARGALEF, 1952, 1953a; PRETUS, 1985, 1987; ALONSO & PRETUS, 1989). Ibiza: Artificial imgation ponds (08102188); 3 localities; 693 to 704 µS/cm (MARGALEF, 1951b, 1953a).

Simocephalus exspinosus (Koch, 1841)

Minorca: Localized in the northeast of the island, in mineralized semitemporary waters; 10 localities; 1651 to 9800 µS/cm (PRETUS, 1985).

Ceriodaphnia reticulata (Jurine, 1820)

Majorca: Phreatic pools in Sa Calobra, Torrent Sollerich, Torrent Fondo (February, June); 470 to 3460 µS/cm (MARGALEF, 1953a, b). Minorca: Very common in statgnate and slightly running waters, all over the island; November to July; 36 localities; 706 to 5390 µS/cm, up to 9800 µS/cm (MARGALEF, 1952, 1953a; PRETUS, 1984; ALONSO & PRETUS, 1989). Ibiza: Artificial irrigation pond (09102188); 704 µS cm (MARGALEF, 1951b, 1953a).

Ceriodaphnia quadrangula (O.F. Müller, 1785)

Majorca: Pools in Lluchmajor (January); 4 localities; 223 to 356 µS/cm. Minorca: Common, even in small waterbodies in stone; November to August; 16 localities; 204 to 3010 µS/cm, and up to 8700 µS/cm. (MARGALEF, 1952, 1953a; PRETUS, 1985, 1987). Ibiza: (MARGALEF, 1951b, 1953a).

Ceriodaphnia dubia Richard, 1894

Majorca: Artificial ponds in Puigpunyent and Massanella (01102188 and 02/02/88); 514 and 675 µS/cm. Minorca: Transparent pool with vegetation (15105184); 709 µS/cm (ALONSO & PRETUS, 1989).

Ceriodaphnia laticaudata P.E. Müller, 1867

Majorca: Common in temporary pools in Lluchmajor (January to February); 7 localities; 346 to 650 µS/cm (JAUME, 1989). Minorca: Mineralized waters in summer (21107186 and 27107186); 2 localities; 1670 to 6830 µS/cm. Ibiza: Transparent pools (February); 3 localities; 733 to 1335 µS/cm. Formentera: Common in small temporary pools (February); 5 localities; 280 to 1132 µS/cm.

Scapholeberis rammneri Dumont & Pensaert, 1983

Minorca: Rich in vegetation wetlands, transparent pools; November to July; 11 localities; 709 to 3230 µS/cm, and up to 5390 µS/cm (MARGALEF, 1952, 1953a; PRETUS, 1985; ALONSO & PRETUS, 1989).

Family Moinidae Goulden

Moina brachiata (Jurine, 1820)

Minorca: Semitemporary muddy pools in Ciutadella; February and April-May; 3 localities: 200 to 427 µS/cm. First record for Baleares.

Moina micrura Kurz, 1874

Minorca: Watering place in the centre of the island (22107186). First record for Balearic Islands.

Moina salina Daday, 1888

Majorca: Salt marsh in Campos (25105187 and 29/01/88); 255 and 80 mS/cm respectively. First record for Balearic Islands.

Family Macrothricidae Norman & Brady

Macrothrix hirsuticornis Norman & Brady, 1867

Majorca: Hipereutrophic temporary pool in Lluchmajor (25101188); 264 µS/cm. Minorca: Temporary muddy pools; January to May; 6 localities; 228 to 776 µS/cm. First record for Balearic Islands.

Macrothrix laticornis (Jurine, 1820)

Majorca: Reservoir of Gorg Blau (06106187); 347 µS/cm. First record for Balearic Islands.

Family Bosminidae (Baird, 1845)

Bosmina longirostris (O.F. Müller, 1785)

Majorca: Reservoirs of Cuber and Gorg Blau, planktonic (06106187); 250 and 347 µS/cm. First record for Balearic Islands.

Family Chydoridae Stebbing

Pleuroxus letourneuxi (Richard, 1888)

Majorca: Very common in temporary pools in Lluchmajor (January and February); 13 localities; 150 to 890 µS/cm (JAUME, 1989). Minorca: Temporary pools in the east, northeast, and west of the island; December to March; 10 localities; 259 to 1701 µS/cm. Formentera: Temporary pools (February); 5 localities; 417 to 1132 µS/cm.

Pleuroxus aduncus (Jurine, 1820)

Majorca: Running waters, springs and artificial irrigation ponds (January, February, but mainly in June); 11 localities; 356 to 1230 µS/cm (MARGALEF, 1953b; JAUME, 1989). Minorca: Running waters, springs and artificial irrigation ponds all over the island; April to July, scarce in winter; 555 to 3710 µS/cm, and up to 5200 µS/cm; 36 localities; (MARGALEF, 1952, 1953a; PRETUS, 1985). Ibiza: Irrigation ponds, phreatic waters (February); 5 localities; 300 to 2800 µS/cm (MARGALEF, 1951b, 1953a).

Alonella excisa (Fischer, 1854)

Majorca: (MARGALEF, 1953b).

Dunhevedia crassa King, 1853

Majorca: Pools in Lluchmajor (January and February); 158 to 346 µS/cm (in Albufera of Alcudia up to 15 mS/cm); 6 localities; (MARGALEF, 1953b; JAUME, 1989). Minorca: Transparent or muddy pools with vegetation; November, March to June; 9 localities; 312 to 2270 µS/cm, up to 7700 µS/cm (PRETUS, 1985; ALONSO & PRETUS, 1989).

Chydorus sphaericus (O.F. Müller, 1776)

Majorca: Indistinctly stagnant and running waters (January, February and June); 15 localities; 158 to 1009 µS/cm (MARGALEF, 1953a, b). Minorca: Indistinctly stagnant and running waters; November to February, abundant from March to June; 123 localities; 216 to 9800 µS/cm (MARGALEF, 1952, 1953a; PRETUS, 1985). Ibiza: Spring of Atzaró (12102188); 792 µS/cm (MARGALEF, 1951b).

Ephemeroporus phintonicus (Margaritora, 1969)

Majorca: (JAUME, 1989). Minorca: Muddy pool in Sa Mesquida (14111186); 776 µS/cm.

Alona guttata Sars, 1862

Majorca: Torrent Sant Miquel, running waters (10106187); 710 µS/cm (MARGALEF, 1953b). Minorca: Torrent Son Fideu, running waters (05103187). Ibiza: (MARGALEF, 1951b, 1953a).

Alona rectangula Sars, 1862

Majorca: Reservoir of Gorg Blau (06.06.87); 347 µS/cm; pool near Alcudia (05/02/88) (MARGALEF, 1953b). Minorca: Frequent in mineralized pools in the north and northeast of the island, rare in the rest; November to June; 20 localities; 709 to 6510 µS cm, and up to 18.1 mS/cm (MARGALEF, 1952, 1953a; PRETUS, 1985; ALONSO & PRETUS, 1989).

Alona elegans Kurz, 1875

Majorca: Common in temporary pools in Lluchmajor (January and February); 7 localities; 170 to 1200 µS/cm (JAUME, 1989). Minorca: Temporary muddy pools; January to April, July; 204 to 670 µS/cm, up to 5390 µS/cm; 8 localities. Formentera: Temporary pools; February; 3 localities; 417 and 1132 µS/cm.

Alona iberica Alonso & Pretus, 1989

Minorca: Transparent pools over silicic rocky substrates, rich in vegetation and coloured water by humic substances. April and May; 2 localities; 312 and 1500 µS/cm (PRETUS, 1985; ALONSO, 1986, 1987; ALONSO & PRETUS, 1889).

Alona azorica Frenzel & Alonso, 1988

Minorca: Temporary pools with vegetation, mineralized; November to April; 3 localities; 776 to 1500 µS/cm, up to 4510 µS/cm; the populations are morphologically very close to a taxon described as *Alona esteparica* Alonso, 1985 (ALONSO & PRETUS, 1989).

Alona affinis (Leydig, 1860)

Minorca: clean waters at the north of the island; January and April; 6 localities; 1048 to 3350 µS/cm. First record for Balearic Islands.

Leydigia acanthocercoides (Fischer, 1854)

Majorca: Common in pools in Lluchmajor; January and February; 8 localities; 266 to 451 µS/cm (JAUME, 1989). Minorca: Common in both, temporary muddy waters or clean with vegetation; December to May; 13 localities; 311 to 2660 µS/cm, up to 4500 µS/cm (PRETUS, 1985; ALONSO & PRETUS, 1989).

Tretocephala ambigua (Lilljeborg, 1900)

Majorca: Pools in Lluchmajor (06102188) and Banyalbufar (05106187); 715 µS/cm (JAUME, 1989). Minorca: Common at the north of the island, in clean semitemporary waters with vegetation; November, January, April to July; 8 localities; 365 to 2660 µS/cm (ALONSO & PRETUS, 1989). Ibiza: Phreatic waters in Cala Xerraca and Font Torres; February; 1335 and 1690 µS/cm.

Oxyurella tenuicaudis (Sars, 1862)

Minorca: Permanent waters in S'Albufera (Mercadal), and a clean mineralized pool in Sa Mesquida; November, January, June, July; 2 localities; 1350 to 5390 µS/cm. Ibiza: (MARGALEF, 1951b, 1953a).

Order NOTOSTRACA (Sars)

Family Triopsidae Keilhack

Triops *cancriformis* (Bosc, 1801)

Majorca: Temporary muddy pools in Lluchmajor; January and February, up to May; 4 localities; 199 to 528 µS/cm (MARGALEF, 1953b; MAYOL, 1977; JAUME, 1989). Minorca: Temporary muddy pools in Ciutadella; May and June; 2 localities; 1858 µS/cm (MARGALEF, 1948, 1951a, 1952, 1953a; PRETUS, 1985; ALONSO, 1985a; PRETUS, 1989).

DISCUSSION

43 species of Branchiopoda have been recorded in Balearic Islands: 4 Anostraca, 2 Spinicaudata, 36 Anomopoda and 1 Notostraca. One part of the species belongs to a group of generalized forms in the Mediterranean-European area: *Simocephalus, Scapholeberis*, several Ceriodaphnia, Daphnia subgenus Daphnia, Alonella excisa, Alona affinis, A. guttata, or A. rectangula. Nevertheless, an important sector is a part of a chorologic grouping inhabiting steppic areas in inland zones: *Branchinecta ferox*, Cyzicus *bucheti,* Leptestheria mayeti, Daphnia *atkinsoni,* D. bolivari, or chydorids as Alona cf esteparica, Alona iberica, or *Ephemeroporus phintonicus*. On the other hand, at least two species from continental atalassohaline waters occur in the hiperhaline coastal marshes of Majorca: Daphnia mediterranea and Moina salina. New environments such as the reservoirs in Majorca, have been colonized by some species such as *Bosmina longirostris*, Macrothrix *laticornis* and *Daphnia longispina*, which are common in the Iberian reservoirs (ARMENGOL, 1978).

The most remarkable data concerns the appearance of steppic species in the islands, where no extreme continental climate is supposed to exist. They frequently inhabit temporary muddy pools, distributed in some areas of the south of Majorca, and also in the west part, and the littoral of Minorca, in accordance with the distribution of the semiarid zones in the islands. The presence of steppic species amongst the Iberian fauna may be due to the persistence since the Tertiary of appropriate conditions, despite the Quaternary climatic oscillations. On the other hand, more recent colonizations could have occured as the result of passive migrations from dispersal areas situated in North Africa. The value of either hypothesis is difficult to measure precisely (MARGALEF, 1947, 1983; ALONSO, 1985a; JAUME, 1989). In the case of the Balearic islands, the persisting Quaternary argument is hardly defensible in a preliminary consideration, mainly due to the inherent ecologic instability of small areas, such as limited areas inside the islands. This instability is derived Pom changes in the local hydrography due to the neotectonics, and is favoured by the climatic oscillations. The known biota could have arrived at the islands by means of the present active dispersal mechanisms thought to exist, as discussed by JAUME (1989) for Leptestheria mayeti in Majorca, and this can be extended to the minorcan population of this species, known from a tectonically emerging area in the north littoral.

Minorcan pools where the rarest species occur (the Ciutadella area), are placed on a stable western platform weakly affected by the neotectonics since the late Miocene (BOURROUILH, 1983). Here appears Branchinecta ferox, an extended but not frequent steppic species in the Western Palaeartic region, and Cyzicus *bucheti*, one locality in Sardinia and common in Morocco (THIÉRY, 1987), where it is found in the «dayas», mainly in the flatlands of the Atlantic region. Alona iberica, a recently described chydorid from Minorca and SW of Iberia, is also found in this area.

The hypothesis of ancient biota cannot be rejected a priori, since arguments concerning Balearic ecological aspects are also favourable. The arguments emerge from sedirnentologicand paleontologic data. A synthesis on the Quaternary of the islands (CUERDA, 1975) shows that glacial periods, owing to the effect of glacioeustatic regressions, are registered along most of the coast by eolic dunes, sometimes intercalated with red soils. Although the age of these soils is yet uncertain, their formation requires the existence of a dry season, which is necessary to explain the reddening due to iron hydroxide that furnishes characteristic terra rossa soils. These eolic formations are known from probably the ancient Plioquaternary to the greater part of the Pleistocene. The geographic extension involved is not only that which is close to the littoral, but also includes far off inland areas. With respect to Minorca, this latter situation precisely

defines the stable Ciutadella region, mentioned here because of its outstanding steppic freshwater communities. This area had probably more «continental)) characteristics before a great part of lands at the north disappeared in recent subsidence (BOURROUILH, 1983). Moreover, the disharmonic mammal composition of Majorca and Minorca during the Pliopleistocene, dominated by the Balearic dwarf goral (Myotragus sspp.), expanding and evolving in the absence of mammal predators, must have aided the development of a particular landscape. Part of the hypothetic impact should concern local barren conditions and the consolidation of temporary pools, in some instances because of the effect of winds, which are considerable as shown by the presence of inland dunes. Similarly, connections between the appearance of the Balearic endemic flora and the evolution of the specific functional anatomy of the *Myotragus* have previously been pointed out by severa1 authors (see ALCOVER et al., 1981). The fact that Myotragus ossiferous deposits are ubiquitous in Majorca and Minorca, and are not only located in mountainous areas, shows the possible extension involved. The progressive evolution of the Balearic dwarf goral over 6 million years is assumed by paleontologists to be in cause-effect relationship with the denudation of the vegetation due to successive demographic explosions, which at the same time created specific insular selection pressures to the isolated artiodactyles (op. cit.). If the phenomenon is admitted, its repercussion on the landscape, and particularly on the persistence of temporary ponds, must have been only a question of degree. According to all the arguments expressed here all the present steppic fauna is not necessarily a postglacial (holocenic) introduction. In other words, the point made is that recent colonizations are still not necessarily the only explanation to a part of the biotic composition of the isles. Some species, once more widely distributed, may have persisted under a local geologic stability due to weak neotectonics, and under assumed barren conditions originated by climatic events and the disharmonic vertebrate biota.

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RESUMEN

LISTA COMENTADA DE LOS BRANQUIÓPODOS BALEÁRICOS (CRUSTACEA)

Se presenta un catálogo de los branquiópodos encontrados hasta el presente en las Baleares con aportaciones inéditas. Se conocen en total 43 especies, de las cuales 9 son nuevas para el archipiélago: ***Daphnia mediterranea,*** D. ***atkinsoni, Moina brachiata, M. micrura, M. salina, Macrothrix hirsuticornis, M. laticornis, Bosmina longirostris*** y ***Alona affinis***. El total de especies por islas es: 31 en Mallorca, 35 en Menorca, 11 en Eivissa y 6 Formentera. El significado corológico del poblamiento balear ha cambiado notablemente, por la existencia de un grupo de especies propio de territorios con clima marcadamente continental, árido o semiárido que aparece en el sur de Mallorca, y el oeste y litoral de Menorca. A grandes rasgos, este grupo de especies refleja con fidelidad la repartición de las áreas de mayor índice de aridez de las islas más extensas y heterogéneas. En las aguas salobres y salinas litorales de Mallorca aparecen especies descritas en las lagunas atalasohalinas continentales. Por otra parte, los embalses de Mallorca han sido colonizados por especies que son comunes en los embalses españoles.

Se discute el sentido biogeográfico de la riqueza insular en especies típicamente esteparias. La sugerencia de que puede haber persistido parte de la fauna de branquiópodos desde períodos preglaciales se sustenta por: 1) La presencia de especies raras, con disyunciones en sentido este-oeste, difícilmente explicadas por efecto de la ornitocoria, como el quidórido ***Alona iberica;*** o bien del concostráceo ***Cyzicus bucheti***, presente en Cerdeña, pero más característico de los llanos. 2) La estabilidad neotectónica descrita sobre un área más o menos coincidente con las

localidades donde se registran las nuevas citas de eufilópodos y quidóridos cuyas distribuciones mundiales son más restringidas o disyuntas. 3) Las características sedimentarias del Cuaternario en parte del área insular, con arenas eólicas intercaladas con suelos rojos, indicadores de aridez. 4) La trascendencia que el supuesto efecto devastador sobre la vegetación por parte de los rumiantes endémicos del Pliopleistoceno de las Baleares, exentos de depredadores importantes, pudo tener en el mantenimiento de los enclaves esteparios.

BIBLIOGRAPHY

ALCOVER, J.A., S. MOYA-SOLA & J. PONS-MOYA, 1981. *Les quimeres del passat. Els vertebrats fòssils del Plio-Quaternari de les Balears i Pitiüses*. Col. Monografies Científiques, 1. Ed. Moll. Palma de Mallorca. 260 pp.

ALONSO, M., 1985a. A survey of the Spanish Euphyllopoda. *Misc. Zool.* 9: 179-208.

ALONSO, M., 1985b. *Las lagunas de la España peninsular: Taxonomía, ecología y distribución de los cladóceros.* Tesis Dpt. Ecologia, Univ. Barcelona. 795 pp.

ALONSO, M., 1986. Els branquibpodes. In: J. Armengol (Ed.), *Historia Natural dels Països Catalans*, vol. 9 (Artrbpodes I): 231-248. Enciclopedia Catalana S.A., Barcelona.

ALONSO, M., 1987. Aportaciones a la idea del localismo de los cladóceros: algunas especies españolas como paradigma. J. Toja (Ed.), *Act. N Congr. Esp. Limnología:* 369-378. Departamento de Ecología, Universidad de Sevilla.

ALONSO, M. & J. Ll. PRETUS, 1989. *Alona iberica* n. sp.: first evidence of non-conspecificity within *A. karua* complex (Cladocera, Chydoridae). *J. Crust. Biol.* 9 (3): 459-476.

ARMENGOL, J., 1978. Los crustáceos del plancton de los embalses españoles. *Oecologia aquatica* 3: 3-96.

BOURROUILH, R., 1983. *Estratigrafía, sedimentología y tectónica de la isla de Menorca y del noreste de Mallorca (Baleares). I. Texto.* Instituto Geológico y Minero de España. Madrid. 672 pp.

CUERDA, J., 1975. *Los tiempos cuaternarios en las Baleares.* Diputación Provincial de Baleares. Palma de Mallorca. 304 pp.

DE BUEN, O., 1916. Los Crustáceos de las Baleares. *Bol. Real. Soc. Esp. Hist. Nat.* 16: 355-367.

FREY, D.G., 1982. Questions concerning cosmopolitanism in Cladocera. *Arch. Hydrobiol.* 93 (4): 484-502.

FRYER, G., 1987. A new classification of the branchiopod Crustacea. *Zool. J. Linn. Soc.* 91: 357-383.

GAUTHIER, H., 1928. *Recherches sur la faune des eaux continentales de l'Algérie et de la Tunisie*. Imp. Minerva, Alger. 419 pp.

JAUME, D., 1989. *Metadiaptomus chevreuxi* (Copepoda: Calanoida: Diaptomidae) and *Leptestheria mayeti* (Branchiopoda: Conchostraca: Leptestheriidae), two African freshwater crustaceans recorded in Majorca. *Limnetica* 5: 101-109.

MARGALEF, R., 1947. Estudios sobre la vida en las aguas continentales de la región endorreica manchega. *P. Ins. Biol. Apl. 4:* 5-51.

MARGALEF, R., 1948. Miscelánea de zoología dulceacuícola, II. *P. Ins. Biol. Apl.* 5: 69-76.

MARGALEF, R., 1951a. Observaciones sobre *Triops (=Apus) cancriformis* de una localidad catalana. *P. Ins. Biol. Apl.* 9: 247-254.

MARGALEF, R., 1951b. Materiales para la hidrobiología de la Isla de Ibiza. *P. Ins. Biol. Apl.* 8: 5-70.

MARGALEF, R., 1952. Materiales para la hidrobiología de la isla de Menorca. *P. Ins. Biol. Apl.* 11: 5-112.

MARGALEF, R., 1953a. *Los crustáceos de las aguas continentales ibéricas.* Biología de las aguas continentales, X. Minist. Agricultura, Ins. Forest. Inv. Exp. Madrid. 243 pp.

MARGALEF, R., 1953b. Materiales para la hidrobiología de la isla de Mallorca. *P. Ins. Biol. Apl.* 15: 5-111.

MARGALEF, R., 1958. Algunos crustáceos de las aguas continentales de España y norte de Africa. *Misc. Zool.* 1 (1): 51-60.

MARGALEF, R., 1983. *Limnología.* Ed. Omega. 1010 pp. Barcelona.

MARGARITORA, F., 1985. *Cladocera.* Fauna d'Italia. Ed. Calderini Bologna. 399 pp.

MAYOL, J., 1977. Hallazgo de *Triops cancriformis* (Bosc., 1801) y *Leptestheria dahalacensis* (Rüppel, 1837) en la isla de Mallorca. *Graellsia* 31: 231-233.

NEGREA, S., 1983. *Cladocera.* In Fauna Republicii Socialiste Romania, Bucuresti, 4, Fasc. 12, 399 pp.

PRETUS, J. Ll., 1985. Els Crustacis. In: *Enciclopedia de Menorca,* Ed. Obra Cultural de Menorca. pp: 201-274. Maó.

PRETUS, J. Ll., 1987. Los branquiópodos y copépodos de las aguas epicontinentales de Menorca, en función de las características físicas y químicas de sus aguas. In: J. Toja (Ed.), *Com. N Congr. Esp. Limnologia*. Departamento de Ecología, Universidad de Sevilla.

PRETUS, J. Ll., 1989. Presencia d'elements estepàrics a les aigües dolces de Menorca: Crustacis eufil·lòpodes. Nota Preliminar. *Boll. Soc. Hist. Nat. Balears* 31: 153-154.

RAMDANI, M., 1986. *Écologie des crustacés (Copepodes, Cladoceres et Ostracodes) des Dayas Marocaines.* Thèse. Université de Provence. Aix-Marselle. 226 pp.

SASTRE, B., 1987. Distribució i tipus de basses a sa Marina de Lluchmajor. *Com. les. Jor. del Medi Ambient de Balears.* Ed. Univ. Illes Balears. Ciutat de Mallorca, 2-3 juliol 1987.

THIÉRY, A., 1987. *Les crustacés branchiopodes Anostraca Notostraca & Conchostraca des milieux limniques temporaires (Dayas) au Maroc. Taxonomie, Biogeographie, Écologie*. Thèse Univ. Aix-Marseille. 406 pp.