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# New records of freshwater Ostracoda (Crustacea) from La Gomera, El Hierro, Fuerteventura and Tenerife (Canary Islands)

by

Gabriele BEYER [1]), Claude MEISCH [2]) & Karel WOUTERS [3])

**Abstract:** The occurrence of 20 species of freshwater Ostracoda on four of the Canary Islands (La Gomera, El Hierro, Fuerteventura and Tenerife) is reported. Six of these species, *Ilyocyris bradyi* Sars, 1890, Candoninae sp., *Cypria ophtalmica* (Jurine, 1820), *Strandesia vinciguerrae* (Masi, 1905), *Potamocypris producta* (Sars, 1924) and *Potamocypris pallida* Alm, 1914, were encountered for the first time in the archipelago. Apart from the latter, they also represent new records for the entire Macaronesian region. Other species are new for one or more of the Canary Islands. The total number of Ostracoda known from the archipelago now stands at 27, and they are given in an updated checklist. A first attempt is made to characterise the seasonal appearance of the species found, as well as dealing briefly with their ecology. Scanning electron micrographs of the carapace and valves of *Strandesia vinciguerrae* (Masi, 1905) and *Potamocypris arcuata* (Sars, 1903) are presented. A new species belonging to the Candoninae was discovered. A description of this species will follow in a separate publication.

**Keywords:** Crustacea, freshwater Ostracoda, Macaronesia, Canary Islands, ecology, zoogeography.

## Introduction

The Canary Islands are of volcanic origin and situated in the Atlantic Ocean off the Moroccan coast. Their precise age is unclear. The prevailing view is that they emerged above sea-level some time during the Miocene or even later (Rothe 1986). However, new records of Gammaridae (Crustacea) from La Gomera (Beyer & Stock 1994) have led Stock (1995) to suggest that the islands may be considerably older. The Canaries harbour a broad range of freshwater, brackish and saline aquatic habitats. In recent years, publications by Meisch & Broodbakker (1990, 1993), Baltanás & García-Avilés (1993), Meisch et al. (1995) and Beyer & Meisch (1996) have broadened our knowledge on the occurrence and distribution of Ostracoda on

[1]) Institut für Angewandte Zoologie, Rheinische Friedrich-Wilhelms-Universität Bonn, An der Immenburg 1, D-53121 Bonn (email: gabybey@aol.com).

[2]) Musée national d'histoire naturelle de Luxembourg, Marché-aux-Poissons, L-2345 Luxembourg (email: claude.meisch@ci.educ.lu).

[3]) Koninklijk Belgisch Instituut voor Natuurwetenschappen, Vautierstraat 29, B-1000 Brussels (email: kwouters@kbinirsnb.be).

these islands, bringing the total number of species known to 21. Baltanás et al. (1996) summarised these results in their list of non-marine Ostracoda occurring on the Iberian Peninsula, Balearics and Canary Islands. However, the picture is probably by no means complete. For instance, only 3 species (*Cypridopsis vidua* (O.F. Mueller, 1776), *Plesiocypridopsis newtoni* (Brady & Robertson, 1870) and *Sarscypridopsis lanzarotensis* (Mallwitz, 1984) have been recorded from El Hierro up to now. Investigations from La Palma and Lanzarote are by and large lacking. New data will soon become available from Gran Canaria (Malmqvist et al., in press).

Limnological studies carried out by the first author over the past few years (1993-1997) on La Gomera, El Hierro, Fuerteventura and Tenerife have yielded a number of new and interesting records of freshwater Ostracoda, and provided a wealth of new data on the distribution of species already known to occur there. The object of this study therefore, is to present an update of the species and their distribution on the four islands, and on the Canaries in general. Furthermore, ecological features of some of the species are discussed on the basis of available information. In this context, particular attention was paid to the seasonal appearance of the individual species, as the paucity of published data had previously prevented an examination of this aspect. Finally, the data available now allow a comparison to be carried out between the occurrence of ostracods on the moister western islands and the more arid eastern ones.

## Material and methods

Between December 1993 and February 1997, a number of field trips to the islands La Gomera, El Hierro, Fuerteventura and Tenerife were undertaken by the first author, during which a variety of different aquatic habitats (natural and artificial) such as streams, springs, remnant pools in dried-out stream beds, irrigation channels, reservoirs, water-tanks, hygropetric habitats, water-butts and troughs were investigated. Some islands (La Gomera and El Hierro) were subject to more detailed examination than others (Fuerteventura and Tenerife).

Animal samples were obtained using a sieve or a finely-meshed hand-net, as well as directly with forceps or a pipette. In addition, a microscopic analysis of the substrate was carried out. The specimens were preserved in ethanol (70 %).

For orientation in the field, the military maps of Spain (1:25000) were used as well as a Magellan GPS 2000. The altitude was determined using a Casio Alti-Depth Meter.

The specimens are at present in the working collection of the first author (G. B.). Voucher specimens and dissections have been deposited in the collection of the second author (C. M.). The 'Index and Bibliography of nonmarine Ostracoda' published by Kempf (1980, 1991) were extensively used when working on the taxonomic part of the present paper.

## Results

**Species collected for the present study from 1993 to 1997 on La Gomera, El Hierro, Fuerteventura and Tenerife**

Phylum or Subphylum: CRUSTACEA Pennant, 1977
Class: OSTRACODA Latreille, 1806
Subclass: PODOCOPA Müller, 1894
Order: PODOCOPIDA Sars, 1866
Infraorder: CYPRIDOCOPINA Jones, 1901
Superfamily: Cypridoidea Baird, 1845
Family: Candonidae Kaufmann, 1900
- Subfamily: Candoninae Kaufmann, 1900
  - *Pseudocandona albicans* (Brady, 1864)
  - Candoninae sp.
- Subfamily Cyclocypridinae Kaufmann, 1900
  - *Cypria ophtalmica* (Jurine, 1820)

Family: Ilyocyprididae Kaufmann, 1900
- Subfamily: Ilyocypridinae Kaufmann, 1900
  - *Ilyocyris bradyi* Sars, 1890

Family: Cyprididae Baird, 1845
- Subfamily: Cyprinotinae Bronstein, 1947
  - *Heterocypris incongruens* (Ramdohr, 1808)
  - *Heterocypris salina* (Brady, 1868)
- Subfamily: Cypricercinae McKenzie, 1971
  - *Strandesia vinciguerrae* (Masi, 1905)
- Subfamily: Herpetocypridinae Kaufmann, 1900
  - *Herpetocypris brevicaudata* Kaufmann, 1900
  - *Herpetocypris chevreuxi* (Sars, 1896)
  - *Herpetocypris helenae* Müller, 1908
- Subfamily: Cypridopsinae Kaufmann, 1900
  - *Cypridopsis lusatica* Schäfer, 1943
  - *Cypridopsis obesa* (Brady & Robertson, 1869)
  - *Cypridopsis vidua* (O.F. Müller, 1776)
  - *Plesiocypridopsis newtoni* (Brady & Robertson, 1870)
  - *Potamocypris arcuata* (Sars, 1903)
  - *Potamocypris pallida* Alm, 1914
  - *Potamocypris producta* (Sars, 1924)
  - *Potamocypris villosa* (Jurine, 1820)
  - *Sarscypridopsis aculeata* (Costa, 1847)
  - *Sarscypridopsis lanzarotensis* (Mallwitz, 1984)

**Species and localities**

The following abbreviations are used in the text and figures:

f. = female; m. = male; ad. = adult; subad. = subadult; juv. = juvenile; la. = larvae; spm = specimen; e. cp. = empty carapace; diss. = dissection; v. = valve; RV = right valve; LV = left valve; L = length of carapace; SEM = scanning electron microscope. Altitude is given in metres above sea-level (m a.s.l.).

## *Pseudocandona albicans* (Brady, 1864)

La Gomera:
Bco. de Las Lagunetas, small temporary stream (UTM 28RBS 75/12, 940 m a.s.l.), 08.VI.1996: 1 subad. f.
Agua Jerba Huerto, spring-pool (UTM: 28RBS 78/12, 1230 m a.s.l.), 13. and 18.IV.1995: 3 ad. and 1 subad. f.
Erque, open irrigation channel (UTM: 28RBS 77/10, 850 m a.s.l.), 01.IV.1995: 1 spm.
Meriga, pool of permanent stream (UTM: 28RBS 80/16, 840 m a.s.l.), 31.III.1995: 34 ad. and subad. f.
Meriga, permanent stream (UTM: 28RBS 80/16, 830 m a.s.l.), 31.XII.1996: 21 ad., subad. and juv. f.; 04.I.1997: 29 ad., subad. and juv. f.

El Hierro:
Fuente Rodriguez, the upper one, spring-pool (UTM: 28RAR 88/69, ca 860 m a.s.l.), 01.VIII.1996: 3 ad. f. (Size: L = 0.78-0.84 mm, 3 animals were measured).

Only females were found. The males of this species are very rare. They are so far only known from Germany (one single male reported), Norway, Macedonia (former Yugoslavia), and Turkey.

The habitats mentioned above are very characteristic for this species. *P. albicans* is indeed known to occur in permanent and seasonal, stagnant and slow flowing waters, with a preference for small water bodies with a muddy bottom. The species also colonises underground waters (wells, caves, interstitial habitat).

General distribution: Canary Islands, Europe, Asia and North America. The species has so far not been recorded from the African continent, where its occurrence is, however, expected.

*P. albicans* is new to the fauna of El Hierro.

## **Candoninae** sp.

La Gomera:
Erque, open irrigation channel (UTM: 28RBS 77/10, 850 m a.s.l.), 01.IV.1995: 6 f. (Size: L = 0.70 mm).

Examination of these animals revealed that they belong to a species which has not been described in the literature. Furthermore, the generic assignment appears problematic. Full description and discussion of the taxonomy of this species will be given in a separate publication (Meisch, in preparation).

## *Cypria ophtalmica* (Jurine, 1820)

El Hierro:
Fuente Rodriguez, two spring-pools (UTM: 28RAR 96/69, ca 850 m a.s.l.), 01.VIII.1996: 14 ad. f.
Fuente del Lomo, cemented spring (UTM: 28RBR 05/71, 1300 m a.s.l.), 02.VIII.1996: 313 ad., subad. and juv. f., (1 diss.).

Both sexes were found. *C. ophtalmica* is known to reproduce always bisexually. It appears tolerant of a very wide range of environmental conditions. It has been found in almost all types of non-marine habitats.

General distribution: cosmopolitan. C. ophtalmica is recorded for the first time from El Hierro, the Canary Islands and Macaronesia in general.

Taxonomy: *C. ophtalmica* comprises two extreme morphological forms without taxonomic status, designated as f. *ophtalmica* and f. *lacustris*. The two forms were considered separate species (Sars 1925, Petkovski 1964b, 1977), until the occurrence of animals with transitional characters was reported (review in Meisch 1987, Wagenleitner 1990). All animals recorded here belong to the forma *ophtalmica*.

## *Ilyocypris bradyi* Sars, 1890

La Gomera:
Macayo, Presa Nueva, reservoir (UTM: 28RBS 76/17, 350m a.s.l.), 07.VII.1996: 5 ad. f. (1 diss.).
Arguamul, Chorros de La Fuente, pool fed by water-pipe (UTM: 28RBS 74/21, 280 m a.s.l.), 30.VI.1996: 7 f., 1 e. cp., 3 v. (1 diss.).

Fuerteventura:
Jandia, north side, Agua de Camellos, small water course below entrance to a gallery (UTM: 29RES 62/08, 200 m a.s.l.), 02.I.1994: ca 100 ad., subad. and juv. f. and v. (Size: L = 0.77-0.84 mm; 2 diss.).

Only females were found. The males of this species are unknown. *I. bradyi* clearly prefers springs and waters connected with springs. It is, however, also found in (eutrophic) ponds, slow rivers and, more rarely, the littoral zone of lakes.

General distribution: Canary Islands, Europe, North Africa, Middle East, Asia, and North America (Holarctic). These are the first records from the Canary Islands and the entire Macaronesia in general.

## *Heterocypris incongruens* (Ramdohr, 1808)

La Gomera:
La Laja, pool at base of wet rockface (UTM: 28RBS 85/11, 420 m a.s.l.), 07.IV.1995: 5 e. cp.
Presa above El Cercado, reservoir (UTM: 28RBS 77/12, 1120m a.s.l.), 12.IV.1995: 7 ad. and subad. f.
San Sebastian de La Gomera, Casa de Ileana Chinea, fountain (UTM: 28RBS 92/08, 25 m a.s.l.), 19.VIII.1996: more than 100 ad., subad. and juv. f.

Bco. de Las Lagunetas, pool of temporary stream (UTM: 28RBS 75/12, 940 m a.s.l.), 08.VI.1996: 2 f.
Imada, Bco. de Guarimiar, pool of temporary stream (UTM: 28RBS 80/08, 780 m a.s.l.), 18.VI.1996: 14 ad. subad. and juv f.
Igualero, spring in man-made basin below the village, (UTM: 28RBS 78/09, ca 1250 m a.s.l.), 07.VIII.1996: ca 100 ad., subad. and juv. f.
Bco. del Agua, pool of temporary stream (UTM: 28RBS 75/12, 940 m a.s.l.), 08.VI.1996: ca 160 ad., subad. and juv. f.
Puddle by roadside to Gerian (UTM: 28RBS 74/10, 980 m a.s.l.), 04.I.1997: 50 ad., subad. and juv. f.

El Hierro:
Charcas del Arbol Santo, man made tuff-basins (UTM: 28RBR 10/78, ca 1000 m a.s.l.), 27.VII.1996: 24 ad., subad. and juv. f., 1 v.
Cattle-trough, fed by water-pipe coming from closed reservoir (UTM: 28RAR 91/70, 590 m a.s.l.), 29.VII.1996: 1 f.
Cattle-trough near Montaña Hocha (UTM: 28RBR 06/75, 1160 m a.s.l.), 27.VII.1996: 1 ad. f., 1 juv. and 2 v. (Size: L = 1.44 mm).

Fuerteventura:
Presa de Las Peñitas, rockpool above the reservoir, filled with rain-water (UTM: 28RES 88/40, 220 m a.s.l.), 30.XII.1993: 19 ad., subad. and juv f., 3 e. cps., 11 v.
Puddle in Malpais Huriamen by roadside Villaverde to Corralejo (UTM: 28RFS 08/70, ca 140 m a.s.l.) 31.XII.1993: 27 ad. f., 2 subad. f. (Size: L = 1.48-1.66 mm, 2 animals were measured).
Jandia, north side, Agua de Camellos, small water course below entrance to a gallery (UTM: 28RES 62/08, 200 m a.s.l.), 02.I.1994: more than 100 subad. and juv. f., some ad. f. (Size: L = 1.11 mm).

Tenerife:
Parque Nacional Las Cañadas, Bco. Riachuelo, stream-pool (UTM: 28RCS 40/21, ca 2150 m a.s.l.), 22.VI.1996: ca 100 ad., subad. and juv. f., (Size: L = 1.24-1.48 mm, 4 animals were measured).

Only females were found. Bisexual populations are known from eastern Europe (eastern Germany, eastern Austria, the Czech Republic, Hungary, Romania), and the circum-Mediterranean areas (Portugal, Spain, southern France, Turkey, and North Africa). This common species clearly prefers shallow temporary waters.

General distribution: cosmopolitan. *H. incongruens* is reported for the first time from the island of El Hierro.

## ***Heterocypris salina*** (Brady, 1868)

La Gomera:
Arguamul, Chorros de La Fuente, pool fed by water-pipe (UTM: 28RBS 74/21, 280 m a.s.l.), 30.VI.1996: 41 ad., subad. and juv. f., e. cp. and v.
Vallehermoso, pool of permanent stream, (UTM: 28RBS 79/21, 5 m a.s.l.), 12.VII.1996: 11 ad., subad. and juv. f.
Bco. de Los Guanches, pool of temporary stream (UTM: 28RBS 77/20, 200 m a.s.l.), 14.VII.1996: 1 f.
Alojera, small spring-pool by roadside to Tazo (UTM: 28RBS 71/17, 150m a.s.l.), 04.VIII.1996: 9 ad. and subad. f.

Fuerteventura:
Presa de Las Peñitas, stream-pool below the reservoir with vigorous plant growth (UTM: 28RES 88/40, 190 m a.s.l.), 18.XII.1993: 2 juv. f., 1 la.

Only females were found. The males remain unknown. *H. salina* occurs in both pure freshwater and slightly salty coastal and inland waters with a salinity range of 1-20 ‰ (review in Meisch & Broodbakker 1993). From their altitude, which exceeds 140 m (except for one site) and their inland situation, it may be inferred that the sites investigated have freshwater conditions.

General distribution: The Azores, Canary Islands, Europe, Asia, and Africa.

## ***Strandesia vinciguerrae*** (Masi, 1905) (Fig. 1)

La Gomera:
La Laja, pool at base of wet rockface (UTM: 28RBS 85/11, 420 m a.s.l.), 07.IV.1995: 24 ad. f. (Size: L = 0.83-0.85 mm).

This species was first collected and described from the gut of a fish (*Atherina rissoi*) bought at a market in Rome, Italy; the fish came from Lago di Fondi (Lazio, Italy). *S. vinciguerrae* has been reported from lakes and rice-fields.

General distribution: southern Europe and Africa, where it is widely distributed. *S. vinciguerrae* is new to the Canary Islands and Macaronesia in general.

## ***Herpetocypris brevicaudata*** Kaufmann, 1900

La Gomera:
Agua Jerba Huerto, pool of spring-stream (UTM: 28RBS 78/12, 1230 m a.s.l.), 13.IV.1995: 1 ad. and 1 juv. f.
Tazo, stream coming from Epina (UTM: 28RBS 74/18, 350-400 m a.s.l.), 03.VII.1996: 7 ad. and subad. f.
Igualero, spring in man-made basin below the village, (UTM: 28RBS 78/09, ca 1250 m a.s.l.), 07.VIII.1996: 1 subad. and 1 juv. f.
El Cedro, spring-stream (UTM: 28RBS 82/12, 960-980 m a.s.l.), 12.VI.1996: 18 ad. and subad. f.
Agua Los Llanos, spring-stream (UTM: 28RBS 79/14, 1070 m a.s.l.), 22.VII.1996: 27 f. (Size: L = 1.72-1.92 mm, 7 animals measured; 1 diss.).
Erque, open irrigation channel (UTM: 28RBS 77/10, 850 m a.s.l.), 01.IV.1995: 2 f.
Erquito, open water-tank (UTM: 28RBS 77/09, 650-700 m a.s.l.), 19.IV.1995: 1 f.
Macayo, Presa Nueva, stream feeding reservoir (UTM: 28RBS 76/17, 350-360 m a.s.l.), 07.VII.1996: 10 subad. and juv. (3 diss.).

Fuerteventura:
Bco. de Trimijov, pool of a temporary small spring-stream (UTM: 28RES 87-88/38, 300-320 m a.s.l.), 21.XII.1993: 3 ad. and 2 subad. f.

Only females were found. The males have so far only been recorded from Portugal and North Africa. This species is known to occur in springs and waters connected with springs, in ditches, and the littoral zone of lakes. For a taxonomic review, see Gonzalez Mozo et al. (1996).

General distribution: Canary Islands, Europe, and Africa. *H. brevicaudata* is recorded for the first time from Fuerteventura.

***Herpetocypris chevreuxi*** (Sars, 1896) and ***Herpetocypris helenae*** Müller, 1908

La Gomera:
Erque, open irrigation channel (muddy) and an open water-tank below (UTM: 28RBS 77/10, 800 m a.s.l.), 01.IV.1995: *H. chevreuxi / helenae*, 17 subad. and juv. f. (1 diss.).
Presa above El Cercado, reservoir (UTM: 28RBS 77/12, 1120 m a.s.l.), 12.IV.1995: *H. chevreuxi*, 7 ad. f. (1 diss.).
Open water-tank by roadside to Meriga (UTM: 28RBS 81/16, 800 m a.s.l.), 04.IV.1995: *H. chevreuxi*, 8 ad. f. (1 diss.).
Arguamul, Chorros de La Fuente, pool fed by water-pipe (UTM: 28RBS 74/21, 280 m a.s.l.), 30.VI.1996: *H. helenae*, 13 f. (2 diss.).
Macayo, Presa Nueva, reservoir (UTM: 28RBS 76/17, 350 m a.s.l.), 07.VII.1996: *H. chevreuxi / helenae*, 18 ad. and juv. f. (1 diss.).
Imada, Bco. de Guarimiar, remnant pool of temporary stream (UTM: 28RBS 80/08, 780 m a.s.l.), 18.VI.1996: *H. chevreuxi*, 43 f. (2 diss.).
Bco. del Agua, pool of temporary stream (UTM: 28RBS 75/12, 940 m a.s.l.), 08.VI.1996: *H. chevreuxi*, 2 f. (1 diss.).
Meriga, permanent stream (UTM: 28RBS 80/16, 830 m a.s.l.), 31.XII.1996: *H. chevreuxi / helenae*, 1 ad. and 1 subad. f.; 4.I.1997: *H. chevreuxi / helenae*, 1 ad. and 2 subad.f. (1 diss.).

Fuerteventura:
Bco. de Trimijov, small temporary spring-pool (UTM: 28RES 88/38, 340 m a.s.l.), 26.XII.1993: *H. helenae*, 7 f. (2 diss.).

Tenerife:
Bco. de Los Nunez, Fte. de La Mina, small stream 28RCS 73/56, 850 m a.s.l.) 19.03.1995: *H. chevreuxi / helenae*, 9 subad. und 1 juv. f. (1 diss.).
Bco. de Masca, stream-pool (UTM: 28RCS 20/31, 570 m a.s.l.) 16.03.1995: *H. chevreuxi / helenae*, 12 subad. and juv. f. (3 diss.).

Only females were found. The males of both species remain unknown. *H. chevreuxi* inhabits ponds, the littoral zone of lakes, and slowly flowing streams. It occurs in both fresh and slightly saline waters It tolerates and apparently even prefers strong eutrophic conditions. The species is reported from both permanent and seasonal waters. *H. helenae* has probably a similar ecology.

General distribution of *H. chevreuxi*: Azores, Canary Islands, Europe. *H. helenae*: probably Europe (but so far not expressively recorded from there), Canary Islands, North Africa (Levant included), and South Africa.

Taxonomy: *H. helenae* was generally considered synonymous with *H. chevreuxi* (Sars 1924, Meisch & Broodbakker 1993). Baltanás & García-Avilés (1993) reported *H.* cf. *helenae* from La Gomera and Fuerteventura. More recently Gonzalez Mozo et al. (1996) revised the taxonomy of the European species of the genus *Herpetocypris*, providing detailed redescriptions of both *H. chevreuxi* and *H. helenae*, which those authors consider separate species. According to Gonzalez Mozo et al. (op. cit.), *H. chevreuxi* and *H. helenae* differ in the carapace shape and three characters of the appendages (relative length of the natatory setae of the antennula; relative lengths of the terminal setae of the maxillar palp; shape and

length of the denticles on the posterior margin of the furcal rami). It should be noticed that the second 'soft' character (terminal setae of the Mx2 palp) was shown by the authors of the revision to have an overlapping variability.

One of us (C. M.) carefully examined the *H. chevreuxi/helenae* specimens of our material. 16 dissections in total and at least one from each sample were made. From this examination, some of the specimens could unambiguously be assigned to either *H. chevreuxi* or *H. helenae* (see above). However, a number of specimens appeared to have appendages with intermediate characters and therefore could not clearly be lodged within either of the two forms; these samples are designated as *H. chevreuxi / helenae* in the list above. Future investigators should pay close attention to the variability of the taxonomic characters of these two species.

### *Cypridopsis lusatica* Schäfer, 1943

Synonyms: *Cypridopsis lauta* Margalef, 1948; *Cypridopsis brincki* Petkovski, 1963; *Cypridopsis bamberi* Henderson, 1986.

La Gomera:
La Laja, pool at base of wet rockface (UTM: 28RBS 85/11, 420 m a.s.l.), 07.IV.1995: 5 ad. f.
Erque, open irrigation channel (UTM: 28RBS 77/10, 850 m a.s.l.), 01.IV.1995: 1 ad. f.
Erquito, open water-tank (UTM: 28RBS 77/09, 650-700 m a.s.l.), 19.IV.1995: 3 ad. and 1 subad. f.

Tenerife:
Parque Nacional Las Cañadas, Bco. Riachuelo, stream-pool (UTM: 28RCS 40/21, ca 2150 m a.s.l.), 22.VI.1996: ca 100 ad., subad. und juv. f., (1 diss.).

Only females were found. The males of this species remain unknown. *C. lusatica* prefers springs located in the open field and waters connected with those springs. For a detailed redescription of the species, a review of the taxonomy, ecology and distribution, see Petkovski et al. (1993).

General distribution: Azores, Canary Islands, Madeira, and Europe. In Europe, the species is wide-spread in the circum-Mediterranean area, rare in the north. It is so far unknown in North Africa, where it, however, probably also occurs..

### *Cypridopsis obesa* (Brady & Robertson, 1869)

La Gomera:
Meriga, pool of permanent stream (UTM: 28RBS 80/16, 840 m a.s.l.), 31.III.1995: 5 ad. f. (Size: L = 0.72 mm).

Only females were found. The males of this species remain unknown.The ecology is poorly known but is probably similar to that of the closely related and common *C. vidua*. For a recent differential diagnosis of this species see Beyer & Meisch (1996). In a previous paper (Beyer & Meisch 1996) *Cypridopsis obesa* was erroneously stated to be new for the Macaronesian region, where it had already been recorded on the Azores by Petkovski (1963).

General distribution: Azores, Canary Islands, Europe, and ?North America.

## *Cypridopsis vidua* (O. F. Müller, 1776)

La Gomera:
Macayo, Presa Nueva, reservoir (UTM: 28RBS 76/17, 350 m a.s.l.), 07.VII.1996: 2 ad. f.
Arguamul, Chorros de La Fuente, pool fed by water-pipe (UTM: 28RBS 74/21, 280 m a.s.l.), 30.VI.1996: 1 ad. f.
Bco. de Tazo, open water-tank (UTM: 28RBS 72/18, 110 m a.s.l.), 04.VIII.1996: 10 ad. and subad. f. (Size: L = 0.60 mm).
La Laja, pool at base of wet rockface (UTM: 28RBS 85/11, 420 m a.s.l.), 07.IV.1995: 10 ad. f. (Size: L = 0.62 mm).
Gerian, privat ground from Maria Arteaga, rain-water container (UTM: 28RBS 72/09, 690 m a.s.l.), 06.VIII.1995: 8 ad. f.

El Hierro:
Los Llanitos, open water-tank below the village (UTM: 28RBR 01/73, 200 m a.s.l.), 26.VII.1996: 1ad., 2 subad. 1 juv. f.

Only females were found. The males of this species remain unknown. *C. vidua* occurs in a wide range of aquatic habitats, usually with dense vegetation, such as ponds, the littoral zone of lakes, man-made basins, etc. General distribution: cosmopolitan.

## *Plesiocypridopsis newtoni* (Brady & Robertson, 1870)

El Hierro:
Cattle-trough near Montaña Hocha (UTM: 28RBR 06/75, 1160 m a.s.l.), 27.VII.1996: ca 250 m. and f.
Los Llanitos, open water-tank below the village (UTM: 28RBR 01/73, 210 m a.s.l.), 26.VII.1996: 86 m. and f.
Los Llanitos, open water-tank below the village (UTM: 28RBR 01/73, 200 m a.s.l.), 26.VII.1996: 55 f., some v.
Llano de Tejeguate, open water-tank in plantation (UTM: 28RBR 01/74, 120 m a.s.l.), 27.VII.1996: 3 ad. m., 2 juv., 1 v. (Size: L = 0.63-0.68 mm, 2 animals were measured; 1 diss.).
Fuente Rodriguez, two spring-pools (UTM: 28RAR 96/69, ca 850 m a.s.l.), 01.VIII.1996: 188 ad. m. and f., some subad. and juv. (Size: L = 0.80-0.93 mm, 5 animals were measured).
Open water-tank (UTM: 28RBR 07/77, 940 m a.s.l.), 27.VII.1996: ca 200 ad., subad. and juv. m. and f.

Fuerteventura:
Presa de Las Peñitas, rockpool above the reservoir, filled with rain-water (UTM: 28RES 88/40, 220 m a.s.l.), 30.XII.1993: 68 m., ad., subad. and juv f.

Six populations of seven comprise both males and females. The sample from one site (El Hierro, Los Llanitos; 55 females) consists of females only. However, as in the six other sites, males are distinctly outnumbered by females, it may be assumed that they probably also occur in the latter site. *P. newtoni* reproduces bisexually in the tropics and the Mediterranean zone; in the north, only parthenogentic females occur.

*P. newtoni* prefers small permanent water bodies and the littoral zone of lakes. However, at least some of the sites investigated presumably dry up occasionally (for instance the rockpool on Fuerteventura). General distribution: Canary Islands, Africa, Europe, Asia, North America.

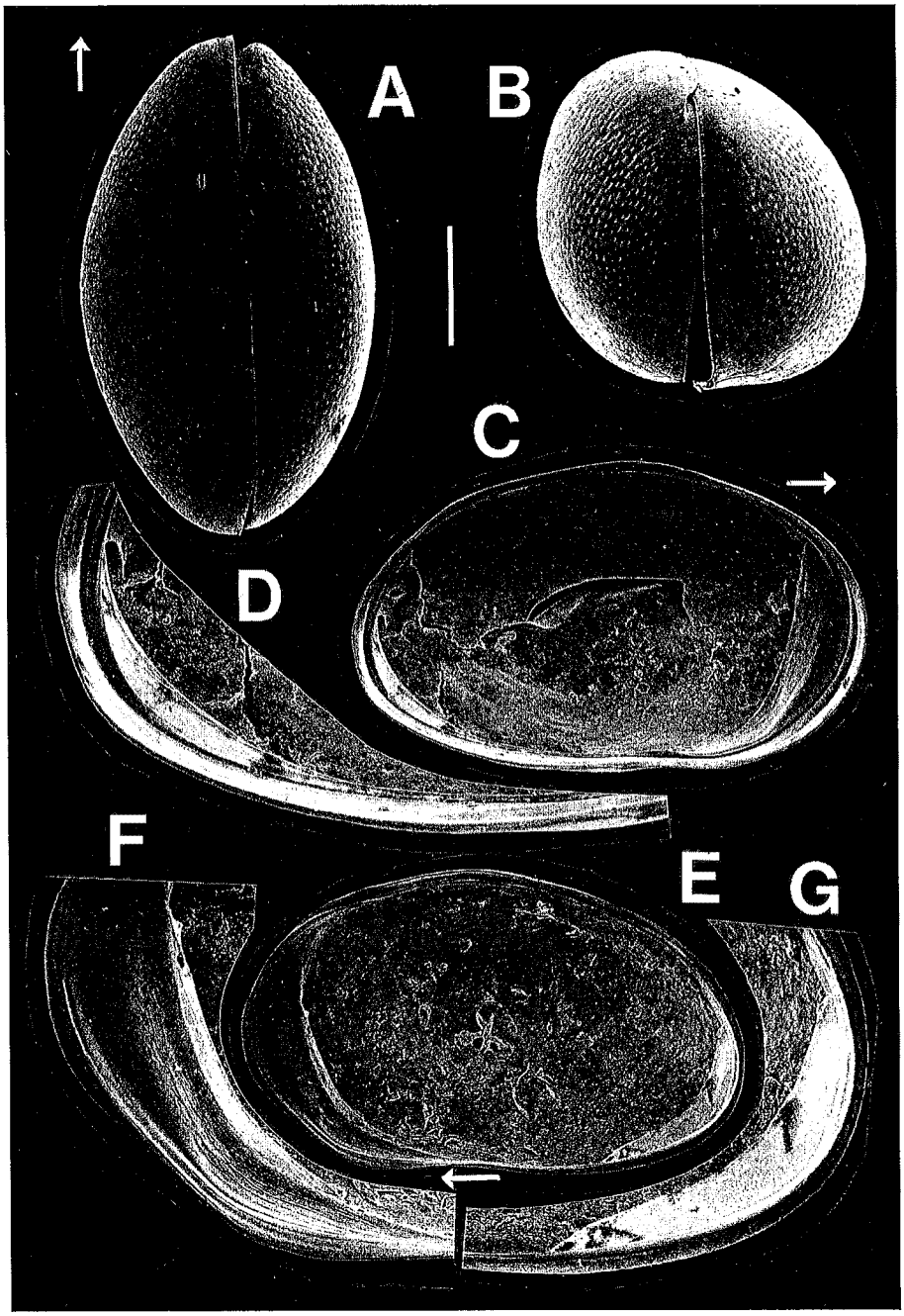



Fig. 1. - *Strandesia vinciguerrae* (Masi). La Gomera. Female. A, carapace in dorsal view; B, carapace in frontal view (see the dorsal RV/LV overlap); C, LV, internal; D, LV, posterior inner marginal zone; E, RV, internal; F, RV, anterior inner marginal zone; G, RV, posterior inner marginal zone. Scale bar 0.20 mm for A, C and E.

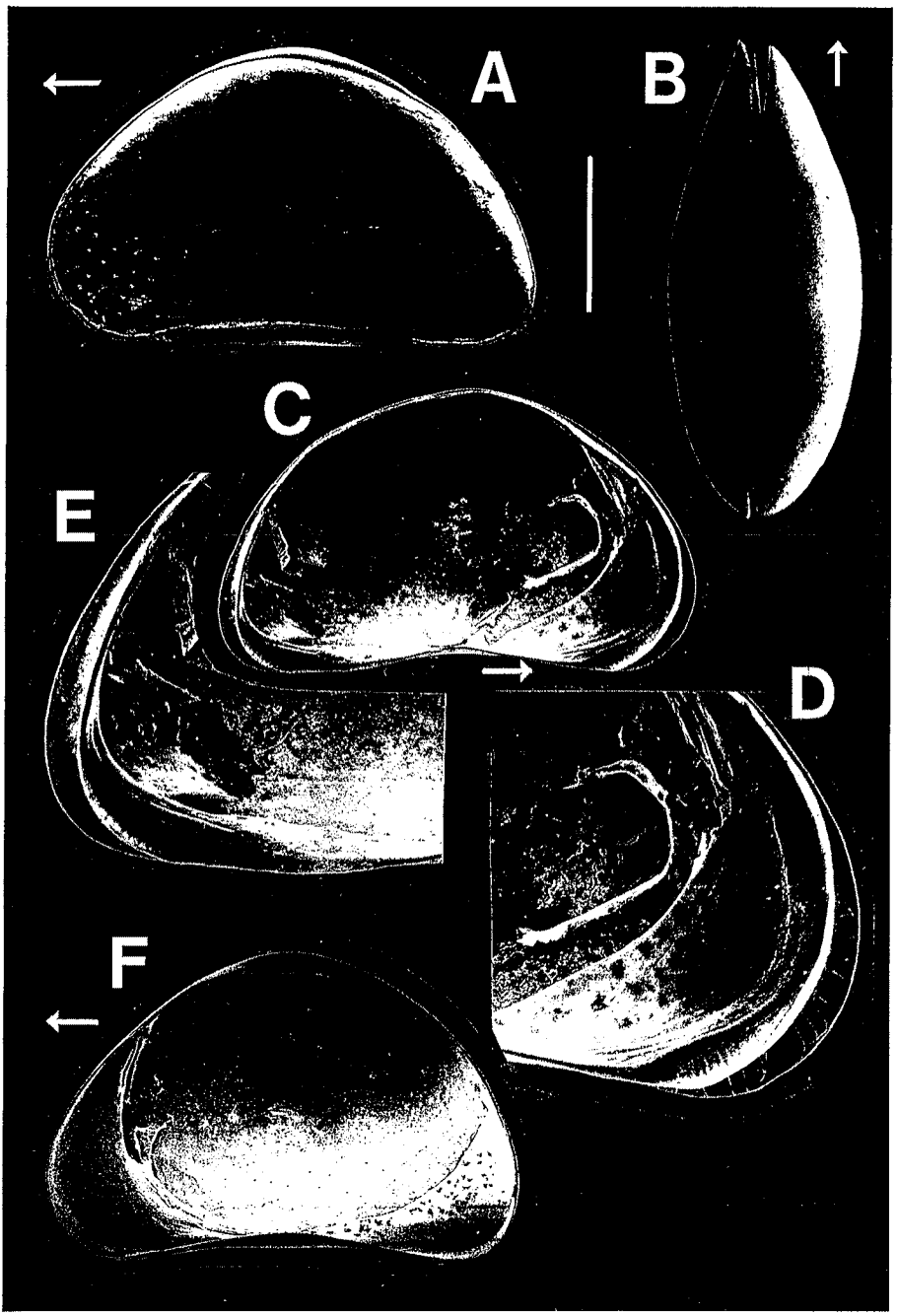



Fig. 2. - *Potamocypris arcuata* (Sars). El Hierro. Female. A, carapace in lateral view; B, carapace in dorsal view; C, LV, internal; D, LV, anterior inner marginal zone; E, LV, posterior inner marginal zone; F, RV, internal. Scale bar 0.20 mm for A, B, C and F.

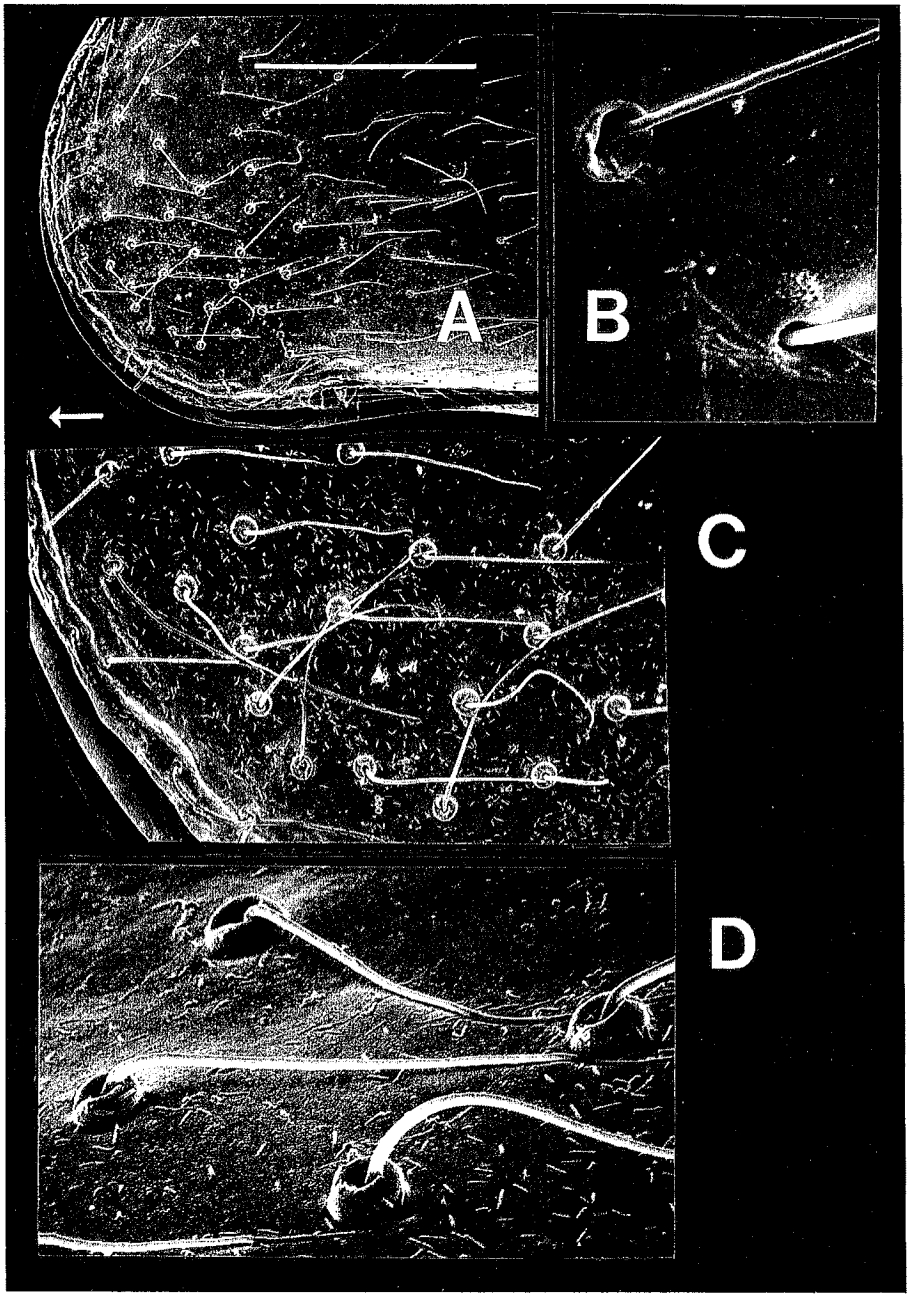



Fig. 3. - *Potamocypris arcuata* (Sars). El Hierro. Female. A, LV, anteroventral valve area; B, posterior valve area: see two normal pores, one with a non-swollen lip (left) and another without a lip (right); C, LV, detail of A: see the transformed pore canals (normal pores with swollen lips); D, detail of C: oblique view of pores with swollen lips. See text for explanation. Scale bar 0.10 mm for A.

***Potamocypris arcuata*** (Sars, 1903) (Figs 2 and 3)

Synonyms: *Potamocypris maculata* Alm, 1914. *Potamocypris almasyi caspica* Hartmann, 1964. For a full list of synonyms see Meisch (1985) and Martens et al. (1992).

El Hierro:
Llano de Tejeguate, open water-tank in plantation (UTM: 28RBR 01/74, 120 m a.s.l.), 27.VII.1996: 2 ad. f.
Cattle-trough, fed by water-pipe coming from closed reservoir (UTM: 28RAR 91/70, 590 m a.s.l), 29.VII.1996: 1 ad. f., 1 e. cp.
Fuente Rodriguez, the lower one, spring-pool (UTM: 28RAR 96/69, ca 850 m a.s.l.), 01.VIII.1996: 50 ad. f.
Open water-tank (UTM: 28RBR 07/77, 940 m a.s.l.), 27.VII.1996: ca 300 ad. and subad. f. (Size: L = 0.63 mm; 1 diss.).
Cattle-trough near Montaña Hocha (UTM: 28RBR 06/75, 1160 m a.s.l.), 27.VII.1996: ca 200 ad. and subad. f.

Only females were found. Males are so far only known from North Africa. *P. arcuata* prefers both permanent and temporary small water bodies. It is widely distributed in the circum-Mediterranean area. General distribution: Azores, Canary Islands, North Africa, Europe, and Asia (Palaearctic). *P. arcuata* is recorded for the first time from El Hierro.

Taxonomy: Our specimens from El Hierro are remarkable on account of their smooth valves, and, above all, the presence of transformed normal pore canals. The latter character is new to the literature.

*P. arcuata* is known to be extremely variable in carapace shape and valve ornamentation. On the other hand, the structure of both the inner marginal valve zones and the appendages appears remarkably uniform (Meisch 1985). The valves are usually covered with shallow round pits (see SEM illustrations in Meisch 1985, Martens et al. 1992). However, the occurrence of animals with almost smooth valves has repeatedly been reported (Löffler 1960, Sywula 1968: forma *oligogranulata*).

The valves of our specimens appear completely smooth in the stereomicroscope, even at high magnifying power (x 60-80). In the SEM, very shallow and inconspicuous pits can be seen in the central valve area. The SEM reveals another remarkable character not seen in the stereomicroscope, i.e. the presence of transformed surface pore canals in the anteroventral valve area (figs 2A, 3A, C, D). In the remaining valve areas, the pore openings are either totally smooth or bear a faint lip (fig. 3B).

The latter, untransformed pores, are commonly designated as « type A': normal pores without a lip » and « type A'': normal pores with a lip » (see Puri & Dickau 1969, Puri 1974, Keyser 1980).

In the transformed pores of the anteroventral valve area the lip is markedly swollen and thus protrudes conspicuously (at least in the SEM) from the valve surface (fig. 3A, C,D). Similar but slightly differently-shaped pore lips have recently been described and illustrated for *Heterocypris incongruens* (Ramdohr, 1808) and *Trajancypris clavata* (Baird, 1838) (see Meisch et al. 1995). These variously modified setae bearing pores have most probably an enhanced sensitive function.

It is here suggested that the pore canals with 'swollen' lips be ranked as « type A'' ». Alternatively, they could be designated as « type A''': normal pores with a swollen lip ».

### *Potamocypris pallida* Alm, 1914

La Gomera:
Bco. Cuadernas, spring-stream (UTM: 28RBS 73/16, 935-965 m a.s.l.), 01.I.1997: 4 f. (1 diss.).

Only females were found. The males of this species remain unknown. *P. pallida* occurs mainly in springs, waters connected with springs, and the interstitial habitat.

General distribution: Canary Islands, Madeira (Stauder & Meisch 1991), and Europe. *P. pallida* is new to the fauna of La Gomera and the Canary Islands in general.

### *Potamocypris producta* (Sars, 1924)

La Gomera:
La Dama, two open water-tanks (UTM: 28RBS 73/05, 230 m a.s.l.), 02.VII.1996: 67 ad. f.

El Hierro:
Los Llanitos, open water-tank below the village (UTM: 28RBR 01/73, 180 m a.s.l.), 26.VII.1996: 36 ad. and subad. f. (Size: L = 0.58-0.60 mm, 5 animals were measured).

Only females were found. The males, which are so far only known from South Africa (Sars 1924), remain undescribed. *P. producta* is reported from swamps, streams, lakes, rice-fields, and fishponds.

This species is new to the fauna of the Canary Islands and Macaronesia in general. It is widely distributed throughout the African continent. General distribution: Canary Islands, southern Europe (Macedonia, Petkovski 1964a; possibly also Spain, see Baltanás et al. 1996), Africa, the Middle East, and Asia (Japan included).

### *Potamocypris villosa* (Jurine, 1820)

La Gomera:
Erquito, open water-tank (UTM: 28RBS 77/09, 650-700 m a.s.l.), 19.IV.1995: 1 ad. f. and 2 v.
Bco. del Agua, 3 open water-tanks, (UTM: 28RBS 76/12, 980-1000 m a.s.l.), 03.IV.1995: 18 ad. and subad. f.

Tenerife:
Parque Nacional Las Cañadas, Bco. Riachuelo, stream-pool (UTM: 28RCS 40/21, ca 2150 m a.s.l.), 22.VI.1996: 7 ad. f.

Only females were found. The males are so far only known from Italy (Margalef 1954) and northwestern Spain (Martens & Meisch 1985). *P. villosa* occurs in springs, waters connected with springs, ponds, ditches, fountains, and the littoral zone of lakes.

The species is new to the fauna of Tenerife. General distribution: cosmopolitan, except Australia.

### *Sarscypridopsis aculeata* (Costa, 1847)

El Hierro:
Cattle-trough, fed by water-pipe coming from closed reservoir (UTM: 28RAR 91/70, 590 m a.s.l.), 29.VII.1996: 7 ad. f. (Size: L = 0.62-0.64 mm; 1 diss.).

Only females were found. The males of this species are unknown. *S. aculeata* prefers the slightly salty coastal and inland waters of both permanent and temporary small water bodies. It is more rarely found in pure freshwater habitats. The valves of our specimens are densely covered with stiff setae, but lack any spines.

The species is recorded for the first time from El Hierro. General distribution: cosmopolitan.

## *Sarscypridopsis lanzarotensis* (Mallwitz, 1984)

La Gomera:

Macayo, Presa Nueva, reservoir (UTM: 28RBS 76/17, 350 m a.s.l.), 07.VII.1996: 67 ad. f.

Macayo, Presa Nueva, stream feeding reservoir (UTM: 28RBS 76/17, 350-360m a.s.l.), 07.VII.1996: 3 ad. f (Size: L = 0.66-0.70 mm; 1 diss.).

Vallehermoso, permanent stream (UTM: 28RBS 79/21, 5m a.s.l.), 12.VII.1996: 67 ad., subad. and juv. f.

Wet rockface and run-off water at its base by roadside Arure to Valle Gran Rey (UTM: 28RBS 73/12, 500 m a.s.l.), 30.XII.1996: 1 ad. and 3 subad. f.

Wet rockface by roadside La Palmita to Meriga (UTM: 28RBS 82/17, 750 m a.s.l.), 31.XII.1996: 30 ad. and subad. f., 2 e. cp.

El Hierro:

Cattle-trough, fed by water-pipe coming from closed reservoir (UTM: 28RAR 91/70, 590 m a.s.l), 29.VII.1996: more than 1000 ad. and subad. f.

Fuente Rodriguez, the lower one, spring-pool (UTM: 28RAR 96/69, ca 850 m a.s.l.), 01.VIII.1996: 20 ad. f. (Size: L = 0.61-0.62 mm).

Charcas del Arbol Santo, man made tuff-basins (UTM: 28RBR 10/78, ca 1000 m a.s.l.), 27.VII.1996: 54 ad. f.

Cattle-trough near Montaña Hocha (UTM: 28RBR 06/75, 1160 m a.s.l.), 27.VII.1996: 65 ad. and subad. f.

Fuente Isora, spring-pool in rock (UTM: 28RBR 10/72, ca 700 m a.s.l.), 30.VII.1996: 37 ad. and subad. f.

Fuerteventura:

Presa de Las Peñitas, stream-pool below the reservoir with vigorous plant growth (UTM: 28RES 88/40, 190 m a.s.l.), 18.XII.1993: 134 ad., subad. and juv. f.

Jandia, north side, Agua de Camellos, small water course below entrance to a gallery (UTM: 28RES 62/08, 200 m a.s.l.), 02.I.1994: more than 100 ad., subad. and juv. f.

Bco. de Trimijov, temporary small spring-stream, 2 pools and wet rocks with algal growth (UTM: 28RES 87-88/38, 300 -320 m a.s.l.), 21.XII.1993: 1 ad. f. and 1 la.

Only females were found. The males are unknown.

*S. lanzarotensis* is common and widely distributed on the Canary Islands. It is reported from springs and waters connected with springs, ponds, streams, stream pools, reservoirs, cattle troughs, and cave waters.

*S. lanzarotensis* was unknown outside the Canary Islands until recently, although its occurrence at least on the African continent was assumed (Meisch & Broodbakker 1990, 1993). Recently one of us (CM; unpublished) has examined specimens of this species collected in eastern Spain (leg. F. Mezquita) and Italy (leg. Dr G. Benassi). The species is probably distributed throughout the circum-Mediterranean area, where it has been overlooked previously.

## Discussion

After evaluating all the published records of freshwater Ostracoda from the Canary Islands and on the basis of the results of the present study, the archipelago can be considered home to 27 species. Most of these are widely distributed or are indeed cosmopolitan. A few are restricted in their occurrence to southern Europe and Africa. In contrast to other aquatic animal groups (Amphipoda, Trichoptera), no ostracod species can be regarded as being endemic to the Canary Islands, particularly after recent discoveries of *Sarscypridopsis lanzarotensis* on the Iberian Peninsula and also in Italy (see above). This also applies to the so far undescribed species discovered on La Gomera from the subfamily Candoninae, which, on account of the particular dispersal strategy of ostracods by birds, can be expected to be found on other islands in the future.

The updated checklist (Table 1) shows the current distribution of all freshwater ostracod species recorded to date on the individual islands of the archipelago. It is, however, clear from this table which islands have been the focus of more detailed studies. La Gomera, one of the smaller islands but with numerous freshwater habitats, has so far been the most intensively examined, which is reflected in the 18 species recorded from there, followed by Fuerteventura and Tenerife.

A comparison of the moister western islands (Tenerife, Gran Canaria, La Palma, La Gomera and El Hierro) with the more arid eastern ones (Fuerteventura and Lanzarote) reveals that many of the species are found in suitable habitats in both of these contrasting areas. Three species have so far only been found on the eastern islands, 13 only on the western ones. As many of these records represent individual finds, a more detailed analysis of subtle differences in the geographical distribution of certain species remains hardly possible.

*Sarscypridopsis lanzarotensis* has now been recorded from all the islands of the archipelago, with the exception of Gran Canaria, where, however, it can be expected to occur. On La Gomera, this species is by far the most common ostracod, occurring in a wide range of habitats from more-or-less sea level (5 m a.s.l.) to the highest examined spring (1230 m a.s.l.).

Table 2 gives a first overview of the seasonal appearance of the individual species. Some (e. g. *Sarscypridopsis lanzarotensis* and *Herpetocypris chevreuxi*) appear to be present throughout the year. This can probably be attributed to the mild climate typical of the Canaries. *Pseudocandona albicans* and some other species for example reveal a number of gaps in its seasonal appearance which might well be closed during further studies. It is not possible to comment on the seasonal appearance of certain species (*Strandesia vinciguerrae*, *Cypridopsis obesa* and some others) due to the limited number of records currently available. Most were found during the wet winter / spring period. Further studies are required to obtain a more complete picture.

The large number of new records registered during the present investigation (for instance 6 species alone for El Hierro and 5 for La Gomera) indicates that more exhaustive studies will reveal further ones, thus increasing the number of freshwater ostracod species currently known to occur on the Canary Islands.

Table 1. Updated checklist of freshwater Ostracoda of the Canary Islands (*Cyprideis torosa* included). Apart from those of the present study, data were evaluated from the following publications: Mallwitz (1984), Meisch & Broodbakker (1990 and 1993), Baltanás & García-Avilés (1993), Meisch et al. (1995), Beyer & Meisch (1996).

C = Gran Canaria T = Tenerife
F = Fuerteventura L = Lanzarote
P = La Palma G = La Gomera
H = El Hierro A = Alegranza

● = previous records and records of the present study
⊙ = new record for the island
○ = new to the Canary archipelago and the entire Macaronesian region

| SPECIES | C | T | F | L | P | G | H | A |
|---|---|---|---|---|---|---|---|---|
| *Ilyocyris bradyi* Sars | | | ○ | | | ○ | | |
| *Ilyocypris gibba* (Ramdohr) only empty carapaces! | | | ● | | | | | |
| *Pseudocandona albicans* (Brady) | | ● | | | | ● | ⊙ | |
| Candoninae sp. | | | | | | ○ | | |
| *Cypria ophtalmica* (Jurine) | | | | | | | ○ | |
| *Cypris pubera* O. F. Müller | | ● | | | | | | |
| *Heterocypris incongruens* (Ramdohr) | | ● | ● | | | ● | ⊙ | |
| *Heterocypris salina* (Brady) | ● | ● | ● | | | ● | | |
| *Trajancypris clavata* (Baird) | | ● | | | | | | |
| *Bradleycypris obliqua* (Brady) | | ● | | | | | | |
| *Strandesia vinciguerrae* (Masi) | | | | | | ○ | | |
| *Herpetocypris brevicaudata* Kaufmann | | | ⊙ | | | ● | | |
| *Herpetocypris* cf. *helenae* G.W. Müller | | | ● | | | ● | | |
| *Herpetocypris chevreuxi* (Sars) | | ● | ⊙ | | | ● | | |
| *Cypretta seurati* Gauthier | | | | | | ● | | |
| *Cypridopsis lusatica* Schäfer | | ● | | | | ● | | |
| *Cypridopsis obesa* (Brady & Robertson) | | | | | | ● | | |
| *Cypridopsis vidua* (O. F. Müller) | | | ● | | ● | ● | ● | |
| *Plesiocypridopsis newtoni* (Brady & Robertson) | | ● | ● | ● | ● | | ● | ● |
| *Potamocypris arcuata* (Sars) | | | ● | | | | ⊙ | |
| *Potamocypris pallida* Alm | | | | | | ⊙ | | |
| *Potamocypris producta* (Sars) | | | | | | ○ | ○ | |
| *Potamocypris villosa* (Jurine) | | ⊙ | | | | ● | | |
| *Sarscypridopsis aculeata* (Costa) | | | ● | | | ● | ⊙ | |
| *Sarscypridopsis lanzarotensis* (Mallwitz) | | ● | ⊙ | ● | ● | ● | ● | |
| *Limnocythere inopinata* (Baird) | | | ● | | | | | |
| *Cyprideis torosa* (Jones) | | | ● | | | | | |
| Σ | 1 | 11 | 14 | 2 | 3 | 18 | 9 | 1 |

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Table 2. Seasonal appearance of freshwater Ostracoda from the Canary Islands (*Cyprideis torosa* included). Apart from those of the present study, data concerning all Canary Islands, as well as Alegranza were evaluated from the following publications: Mallwitz (1984), Meisch & Broodbakker (1990 and 1993), Baltanás & García-Avilés (1993), Meisch et al. (1995), Beyer & Meisch (1996). Empty carapaces were not taken into consideration!

| SPECIES ⇓ MONTH ⇒ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ilyocyris bradyi* Sars | ♦ | | | | | ♦ | ♦ | | | | | |
| *Pseudocandona albicans* (Brady) | ♦ | | ♦ | ♦ | | ♦ | ♦ | ♦ | ♦ | | ♦ | ♦ |
| Candoninae sp. | | | | ♦ | | | | | | | | |
| *Cypria ophtalmica* (Jurine) | | | | | | | | ♦ | | | | |
| *Cypris pubera* O. F. Müller | | | ♦ | | | | | | | | | |
| *Trajancypris clavata* (Baird) | | | ♦ | | | | | | | | | |
| *Heterocypris incongruens* (Ramdohr) | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | | | | ♦ |
| *Heterocypris salina* (Brady) | | ♦ | ♦ | ♦ | | ♦ | ♦ | ♦ | | | ♦ | ♦ |
| *Bradleycypris obliqua* (Brady) | | | ♦ | | | | | | | | | |
| *Strandesia vinciguerrae* (Masi) | | | | ♦ | | | | | | | | |
| *Herpetocypris brevicaudata* Kaufmann | | | | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | | ♦ |
| *Herpetocypris* cf. *helenae* Müller | | | | | | | ♦ | | | | | ♦ |
| *Herpetocypris chevreuxi* (Sars) | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ |
| *Cypretta seurati* Gauthier | | | | | | | | | | | ♦ | |
| *Cypridopsis lusatica* Schäfer | | | | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | | |
| *Cypridopsis obesa* (Brady & Robertson) | | | ♦ | | | | | ♦ | | | | |
| *Cypridopsis vidua* (O. F. Müller) | | | | ♦ | ♦ | ♦ | ♦ | ♦ | | | ♦ | |
| *Plesiocypridopsis newtoni* (Brady & Roberts.) | ♦ | | | ♦ | ♦ | | ♦ | ♦ | | | ♦ | ♦ |
| *Potamocypris arcuata* (Sars) | | | | | | | ♦ | ♦ | | | | ♦ |
| *Potamocypris pallida* Alm | ♦ | | | | | | | | | | | |
| *Potamocypris producta* (Sars) | | | | | | | ♦ | | | | | |
| *Potamocypris villosa* (Jurine) | | | | ♦ | | ♦ | | ♦ | | ♦ | | |
| *Sarscypridopsis aculeata* (Costa) | | | | | ♦ | | ♦ | | | | | ♦ |
| *Sarscypridopsis lanzarotensis* (Mallwitz) | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ | ♦ |
| *Limnocythere inopinata* (Baird) | | | | | | | | | | | | ♦ |
| *Cyprideis torosa* (Jones) | | | | | | | | | | | | ♦ |

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