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# Brachyuran crabs (Crustacea: Decapoda) from the Canary Islands (eastern Atlantic): checklist, zoogeographic considerations and conservation

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**Summary**: Just 20 years have passed since González (1995) finished one of his seminal works on decapod crustaceans of the Canary Islands, thanks to the help of the reputed carcinologists L.B. Holthuis and C.H.J.M. Fransen. This publication allowed d'Udekem d'Acoz (1999) to include the Canarian decapods in his inventory of the NE Atlantic. No checklists of decapod fauna specifically covering this area have been published since then, and an update is needed. The current list of Canarian brachyuran crabs comprises 132 species. Additional species have been recorded thanks to intensified research into deep water, natural range expansions from nearby areas, introduction by anthropogenic activities and description of new taxa; several of these changes are detailed in this review. Although the description of new brachyuran species is not expected to occur at a significant rate, an increase in the number of species from the Canaries is expected to result from trawling and dredging sampling, as well as from introduction of non-native species. For the first time, some zoogeographic comments on the Canarian brachyuran carcinofauna are made. Finally, crab species of commercial interest are listed, their current threats are identified and some updated conservation measures are proposed.

**Keywords**: checklist; zoogeography; conservation; Brachyura; Decapoda; Crustacea; Canary Islands; eastern Atlantic.

**Cangrejos braquiuros (Crustacea: Decapoda) de las Islas Canarias (Atlántico oriental): lista comentada, consideraciones zoogeográficas y conservación**

**Resumen**: Se cumplen 20 años desde que González (1995) publicó uno de sus trabajos seminales sobre crustáceos decápodos de Canarias, gracias a la ayuda de los reputados carcinólogos L.B. Holthuis y C.H.J.M. Fransen. Dicha publicación permitió a d'Udekem d'Acoz (1999) incluir los decápodos canarios en su inventario del Atlántico NE. Desde entonces no ha sido publicada ninguna lista completa de decápodos que cubra específicamente esta área y es necesaria una actualización. La lista actual de braquiuros canarios consta de 132 especies. Otras especies han sido citadas debido a la intensificación de las investigaciones dirigidas a aguas profundas, expansiones naturales de su rango de distribución desde áreas cercanas, introducciones causadas por actividades antropogénicas y a descripción de nuevas especies; algunos de estos cambios se detallan en esta revisión. Aunque no se espera que la descripción de nuevos braquiuros se produzca a un ritmo significativo, es esperable un incremento en el número de especies en Canarias como resultado de muestreos con arrastre bentónico y dragas y de la introducción de especies exóticas. Por primera vez, se realizan consideraciones zoogeográficas sobre la carcinofauna de braquiuros de Canarias. Por último, las especies de interés comercial son listadas, sus amenazas actuales identificadas y se proponen algunas medidas de conservación.

**Palabras clave**: lista; zoogeografía; conservación; Brachyura; Decapoda; Crustacea; Canarias; Atlántico oriental.

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## INTRODUCTION

Just 20 years have passed since González (1995) finished one of his seminal works on decapod crustaceans of the Canary Islands, thanks to the invaluable help of the reputed carcinologists L.B. Holthuis (see Holthuis 1995) and C.H.J.M. Fransen. This publication allowed d'Udekem d'Acoz (1999) to include the

Canarian decapods in his inventory and distribution of decapods in northeastern Atlantic north of 25°N.

The Canary archipelago is an overseas Spanish territory and an outermost European Region placed in the eastern-central Atlantic. This archipelago is situated in front of the northwestern coast of Africa, fairly close to the continents of Europe and Africa (104 km from Cape Juby, Morocco) but separated from them by great depths (Fig. 1). The age of the islands varies from east to west between 19 my (Lanzarote) and 0.7 my (El Hierro). The volcanic characteristics of the Canary Islands are shown by the absence of wide insular shelves, with a bottom depth of 180-200 m near the coast. The archipelago has nearly 1300 km of coastline and is washed by the oligotrophic ocean (Braun and Molina 1984). The Canaries are under the influence of the subtropical gyre of the eastern-central Atlantic, which facilitates the transport of planktonic larvae and rafting organisms to the archipelago from the American, European and Northwest African coast. The average seawater temperature around the Canary Islands is 18.5°C in February, rising abruptly to 24°C in August–September (e.g. Barton et al. 1998). A mesoscale distribution of larval communities has recently been described in filaments of the upwelling system from the African coast reaching the southeast of the archipelago (e.g. Landeira et al. 2009, 2010). Also, the Canaries are geographically located on a very important maritime route, and both ships and oil platforms have been recognized as major vectors for the introduction of non-native species (e.g. González et al. 2012a, Triay-Portella et al. 2015).

Geomorphological, geographical and oceanographic particularities of the Canaries could explain the great diversity in the biogeographic patterns of the biota inhabiting this area. These physical and biodiversity characteristics, together with the climatic condition of the Canary Islands—a temperate-subtropical area—compared with the surrounding region highlight the uniqueness of the Canary Islands and their oceanographic connectivity to the adjacent waters (e.g. González et al. 2012a).

The sustainable use of marine resources and their conservation measures is a major goal on national and international policy agendas (e.g. Spalding et al. 2007). According to the comprehensive biogeographic system for classifying the oceans (for both coastal and shelf areas) proposed by Spalding et al. (2007), the Canary Islands are included in the Azores-Madeira-Canaries ecoregion (i.e. the Macaronesian archipelagos), within the Lusitanian province of the Temperate Northern Atlantic realm.

After the work of González (1995) and the compilation by d'Udekem d'Acoz (1999), Fransen and Wirtz (1997) published on Canarian decapod crustaceans, and González et al. (1996, 2000) and Quiles et al. (2002) listed crab families in the Canary Islands. Moro et al. (2014) published a list of decapods from the Canary Islands based on both material examined and in situ sightings, illustrated with colour photographs. Moreover, several authors have published updated lists of brachyuran decapod fauna at different geographical scales (e.g. Türkay 2001, Ng et al. 2008, Marco-Herrero et al. 2015). However, none of these has specifically covered the diversity found around the Canary Islands; and an update is needed for this area.

The systematic research landscape on decapod crustaceans has changed drastically in the last few decades. A great number of changes concerning the brachyuran crustacean species found around the Canary Islands have also taken place. These changes are due to systematic modifications, non-confirmed presence or newly recorded species for the area. Today's most widely used classifications have all appeared after the work of Zariquiey Álvarez (1968), and there is a concerted effort by carcinologists worldwide to check the validity of taxa using multiple tools such as ecology, larvae and genetics (Marco-Herrero et al. 2015).

The present work summarizes all changes in Canarian brachyuran carcinofauna since González (1995), provides scientists with an updated classification list, and makes for the first time a zoogeographic analysis of this important component of the marine biota of the Canary Islands. Moreover, crab species of commercial interest are listed, their current threats are identified, and some updated conservation measures are proposed.

## MATERIALS AND METHODS

For the compilation of this list, all publications since 1995 about the distribution of brachyuran crabs were checked, including previous lists for the Canary Islands region (González 1995, González and Quiles 2003), data from Internet databases such as WoRMS (http://www.marinespecies.org/) and GBIF (http://www.gbif.org/species), systematic data, new records, and unpublished or in-preparation data. Several contributions need to be highlighted here, particularly the impressive studies on European decapods (d'Udekem d'Acoz 1999, Türkay 2001), Iberian decapods (gathering many records from the Canaries, Zariquiey Álvarez 1968), and West African brachyuran crabs (Manning and Holthuis 1981), but also several specific works on brachyurans (Neumann 1996, Fransen and Wirtz 1997, Moro et al. 2014), particularly the accounts on Canarian species of several crab families (González et al. 1996, 2000, Quiles et al. 2002). Several studies on feeding habits of fishes in waters of the Canaries (Fanlo et al. 1993, 1996, Tuset et al. 1996, Dürr and González 2001, Moreno-López et al. 2002) have also been used as a source of brachyurans occurring in the area.

Some projects (DGXIV/C/1 94/034, CAMARON, PESCPROF 1-3, REDECA, AQUACRU, MARPROF) have provided us with deep-water crabs from the Canaries, collected with a panoply of fishing gear. Finally, many vouchers from the 'Museo de Ciencias Naturales de Tenerife (TFMC)', 'Museu d'Historia Natural do Funchal (MMF)', and the study collection of the 'Instituto Canario de Ciencias Marinas' (ICCM, now transferred to the 'Universidad de Las Palmas de Gran Canaria') were checked.

This checklist covers all marine brachyuran species present in the Canary Islands from the intertidal to deep water. As in previous regional studies on decapod crus-

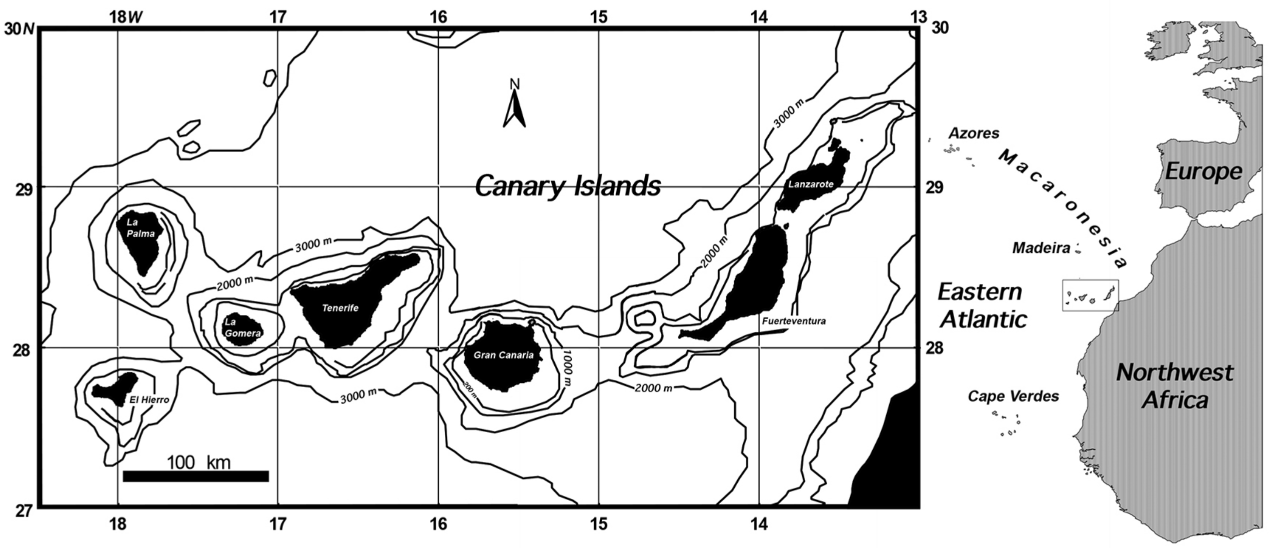


Fig. 1. – Map of the Canary Islands (northeastern Atlantic) showing their geographic situation and bathymetric characteristics.

taceans (González 1995) or fishes (Brito et al. 2002), the study area is bounded by the 30°N and 27°N parallels, the 19°W meridian and, in the Canaries-Africa channel, the 13°W meridian. The depth is generally less than 1500 m. This area occupies a band of about 600 km from east to west and about 330 km from north to south. In the north and west the depth is greater than 4000 m and on the southern edge it is greater than 3500 m (Fig. 1).

This updated systematic classification follows Ng et al. (2008), but also takes into account the latest changes in particular taxa (e.g. Marco-Herrero et al. (2013) for Majoidea; Schubart and Reuschel (2009) and Spiridonov et al. (2014) for Cancroidea and Portunoidea). Superfamilies are listed by systematic order following the Sections and Subsections as currently accepted, and by alphabetical order within them. Families, subfamilies, genera, species and subspecies are also listed by alphabetical order within their respective superfamilies.

All changes with respect to the catalogue by González (1995) and the subsequent checklist by González and Quiles (2003) are explained, including systematic modifications, misidentifications, synonyms, species that reach Canarian waters by increasing their distribution range, invasive and introduced species in the Canary Islands, and new records from the Canaries.

Each crab species was classified as pelagic or benthic according to the main spatial distribution of their adults. Moreover, according to depth boundaries found around the Canary Islands (closely linked to regional oceanographic conditions determined by the water masses present) (Pajuelo et al. 2015), each benthic species was then assigned to a depth boundary where the species mainly occur in waters of the Canary Islands: shelf and transition area between shelf and slope (ST, 0-300 m), upper slope (US, 301-800 m), middle slope (MS, 801-2000 m) and lower slope (LS, >2000 m).

Each crab species was also assigned to a biogeographic pattern category adapted from Brito et al. (2002) and subsequent studies (e.g. Espino et al. 2014). Recent biogeographic studies that clearly separate the coastal and shelf biota occurring in the Macaronesian ecoregion (i.e. the Azores, Madeira and the Canaries) from that occurring in the Cape Verde Islands (officially Cabo Verde) (Brito et al. 2007, Spalding et al. 2007, Brito 2010, Wirtz et al. 2013) were also taken into account. Canarian brachyuran crabs were classified into the following 11 groups according to their distribution range and the above-mentioned considerations: 1, cosmopolitan or worldwide species (COSM); 2, pantropical or circumtropical species (PANT); 3, amphi-Atlantic species of wide distribution (AAWD); 4, amphi-Atlantic species of warm affinity (AAWA); 5, eastern Atlantic species of wide distribution (EAWD); 6, eastern Atlantic cold-temperate species (EACT); 7, eastern Atlantic warm-temperate species (EAWT); 8, Atlanto-Mediterranean species (ATLM); 9, Guinean species (restricted to tropical and subtropical eastern Atlantic) (TSEA); 10, eastern-central Atlantic island species (from the Azores to Cape Verde Islands, and southwards even to St. Helena) (ECAI); and 11, Macaronesian species (around the Azores, Madeira, Savage, and/or the Canary Islands) (MAC). Two different zoogeographic approaches (consisting in describing the different components of the brachyuran fauna) were performed. A first description included all brachyuran species. For the second approach, both pelagic and deep-water benthic species (those living deeper than the transition area between shelf and slope, >300 m depth) were excluded from the analysis. It is widely accepted that the set of littoral and upper-bathyal species (in the Canaries, those living shallower than the upper slope, 0-300 m) better characterize the brachyuran carcinofauna of the Canary Islands and their zoogeographic affinities.

The species' occurrence around the neighbouring archipelago of Madeira (to the north) and the Cape Verde Islands (to the south) has also been recorded. Apart from publications containing well-documented first records, the main references used to check the occurrence of the brachyuran species were Manning and Holthuis (1981), Türkay (1982), Fransen (1991), d'Udekem d'Acoz (1999), Wirtz and d'Udekem d'Acoz (2001), Araújo and Calado (2003), González et al. (2004), and Araújo et al. (2009, 2014) among others.

## RESULTS

A total of 132 marine crab species are reported herein around the Canary Islands (including three species of doubtful presence and another three of probable occurrence). Their spatial distribution, depth boundary, bathymetric range and biogeographic pattern are presented in Table 1. This represents a number of species close to the 140 brachyuran species reported around the Iberian Peninsula (Marco-Herrero et al. 2015), and nearly half of the 284 brachyuran species known in European waters (including the Azores, Madeira and the Canaries), with 40 freshwater crab species (d'Udekem d'Acoz 1999). When compared with the recent brachyuran catalogue from the Iberian Peninsula (Marco-Herrero et al. 2015), it is also noteworthy that both the Iberian and the Canarian lists comprise 20 currently accepted brachyuran superfamilies (Ng et al. 2008, Spiridonov et al. 2014). The Iberian superfamilies Cyclodorippoidea, Homolodromoidea and Corystoidea do not currently occur around the Canary archipelago. The superfamily Ocypodoidea has been reported from the Canaries based on two single findings of one species. The Macaronesian superfamily Pseudozioidea, as well as the African subtropical-tropical superfamilies Trapezioidea and Cryptochiroidea are represented in Canary Island waters, but not around the Iberian Peninsula to date (Marco-Herrero et al. 2015). No freshwater crab species occur in the Canaries.

## REMARKS

### Systematic and nominal changes since 1995

Systematic changes have affected the taxonomical arrangement of Brachyura by Zariquiey Álvarez (1968) and Manning and Holthuis (1981), which were followed in the Canarian catalogue by González (1995). The main changes in the systematics of brachyuran crabs after those impressive catalogues were recently explained by Marco-Herrero et al. (2015).

So, instead of the 20 crab families and 67 genera considered in González (1995), a total of 39 brachyuran families and 77 genera are presented here. Several currently accepted families were included within other families in González (1995), as follows: Ethusidae within the Dorippidae; Eriphiidae, Oziidae, Pilumnidae, Pseudoziidae, Domeciidae, and Panopeidae within the Xanthidae; Euryplacidae within the Goneplacidae; Progeryonidae within the Geryonidae; Epialtidae and Inachidae within the Majidae; Carcinidae and Polybiidae within the Portunidae; Percnidae, Plagusiidae, and Varunidae as subfamilies within the Grapsidae. The family Cryptochiridae was reported as Hapalocarcinidae in González (1995). Ocypodidae (Castro 2012) and Varunidae (Moro et al. 2014) were reported based on very few findings of few individuals. The western Atlantic family Mathildellidae (Fransen and González in prep.) and the Thiidae (Monterroso and González in prep.) are newly reported from the Canaries here.

The current account of brachyuran crabs of the Canary Islands adds another 22 to the 108 valid species in González (1995). According to d'Udekem d'Acoz (1999), *Homologenus rostratus* (A. Milne-Edwards, 1880) (Bouvier 1922) is a misidentification with *Homologenus boucheti* Guinot and Richer de Forges, 1995. *Maja crispata* Risso, 1827 (Herrera et al. 1993, as *M. crisperata*) should not be considered here because it is a misidentification with *Pisa tetraodon*. *Macropodia aegyptia* (H. Milne-Edwards, 1834) should be considered a synonym of *Macropodia deflexa* Forest, 1978. *Portunus* sp. in González (1995) should be assigned to *Laleonectes vocans* (A. Milne-Edwards, 1878). According to Reuschel and Schubart (2006), *Xantho incisus* Leach, 1814 is considered here a synonym of *X. hydrophilus* (Herbst, 1790), and the erroneous citation of the Indo-Pacific crab *Lophozozymus incisus* (H. Milne-Edwards, 1834) by Moro et al. (2014) is based on a secondary homonym of *Xantho incisus*, the true record. According to Neumann (1996), records for *Maja squinado* (Herbst, 1788) from the Canaries, the type locality, should be reassigned to *Maja brachydactyla* Balss, 1922. *Pinnotheres pinnotheres* (Linnaeus, 1758) is now considered as a new combination, *Nepinnotheres pinnotheres* (Linnaeus, 1758), made by Manning (1993) when he described a new genus (*Nepinnotheres*) with several previously *Pinnotheres* species.

After González (1995), *Chaceon inglei* Manning and Holthuis, 1989 was reported from the Canaries by Araújo et al. (2009) as a result of deep sea surveys with selective crab traps. *Ebalia tuberculata* Miers, 1881 was reported from both littoral (Quiles et al. 2002) and bathyal bottoms (Moro et al. 2014). *Ebalia tumefacta* (Montagu, 1808) was first recorded from the Canaries by Quiles et al. (2002). Some littoral crab species have recently been found by expert scuba divers and reported by Moro et al. (2014): *Xaiva mcleayi* (Barnard, 1947), *Liocarcinus pusillus* (Leach, 1816), and *Pinnotheres pisum* (Linnaeus, 1767). Other littoral species were reported based on dredging sampling: *Macropodia linaresi* Forest and Zariquiey Álvarez, 1964, *Liocarcinus navigator* (Herbst, 1794), and *Thia scutellata* (Fabricius, 1793) (Monterroso and González in prep.).

Some additional species are now present in Canarian waters, probably due to natural range expansions from nearby eastern Atlantic or Mediterranean areas: *Calappa galloides* Stimpson, 1859 (González et al. 2000), *Ebalia tuberculata* Miers, 1881 (Quiles et al. 2002), *Merocryptus boletifer* A. Milne-Edwards and Bouvier, 1894, and *Macropipus tuberculatus* (Roux, 1830) (Moro et al. 2014). However, the finding of one specimen of *Neopilumnoplax* sp. in Canarian waters (Fransen and González in prep.) may represent a recent colonization from the subtropical western Atlantic, or reflect that the deep-water crabs *Neopilumnoplax americana* (Rathbun, 1898) or *Neopilumnoplax gervaini* Tavares and Guinot, 1996 are amphi-Atlantic species. Regarding the specimens of *Brachynotus*

Table 1. – List of the brachyuran species occurring in waters of the Canary Islands. Spatial distribution, benthic habitat, bathymetric range (depth interval in m known at the Canaries and elsewhere), and biogeographic pattern are provided for each species. Their occurrence (X) or absence (-) around Madeira and/or the Cape Verde Islands is also provided. Species: * doubtful presence, ** probable occurrence. Depth boundaries: ST shelf and transition area between shelf and slope (0-300 m), US upper slope (301-800 m), MS middle slope (801-2000 m), LS lower slope (>2000 m). Species' biogeographic pattern codes: COSM cosmopolitan or worldwide, PANT pantropical or circumtropical, AAWD amphi-Atlantic of wide distribution, AAWA amphi-Atlantic of warm affinity, EAWD eastern Atlantic of wide distribution, EACT eastern Atlantic cold-temperate, EAWT eastern Atlantic warm-temperate, ATLM Atlanto-Mediterranean, TSEA tropical and subtropical eastern Atlantic, ECAI eastern-central Atlantic island (from Azores to Cape Verde Is., and even to St. Helena, MAC Macaronesian (Azores, Madeira, Savage, and/or the Canaries).

| Taxa / Species | Spatial distribution | Depth boundary | Bathymetric range | | Biogeographic pattern | Canarian species also in | |
|---|---|---|---|---|---|---|---|
| | | | Canaries | Elsewhere | | Madeira | Cape Verde |
| BRACHYURA Linnaeus, 1758 | | | | | | | |
| PODOTREMATA Guinot, 1977 | | | | | | | |
| DROMIOIDEA de Haan, 1833 | | | | | | | |
| Dromiidae de Haan, 1833 | | | | | | | |
| *Dromia marmorea* Forest, 1974 | Benthic | ST | 0-96 | 0-76 | TSEA | X | X |
| *Dromia personata* (Linnaeus, 1758) | Benthic | ST | 2-201 | 0-100 | EACT | likely | likely |
| HOMOLOIDEA de Haan, 1839 | | | | | | | |
| Homolidae de Haan, 1839 | | | | | | | |
| *Homola barbata* (Fabricius, 1793) | Benthic | ST | 40-324 | 2-637 | AAWD | X | X |
| *Homologenus boucheti* Guinot and Richer de Forges, 1995 | Benthic | MS | 733-1575 | 738-2195 | EACT | X | - |
| *Paromola cuvieri* (Risso, 1816) | Benthic | US | 120-860 | 10-1212 | EAWD | X | X |
| Latreilliidae Stimpson, 1858 | | | | | | | |
| *Latreillia elegans* Roux, 1830 | Benthic | ST | 180-330 | 35-475 | ATLM | likely | X |
| EUBRACHYURA de Saint Laurent, 1980 | | | | | | | |
| HETEROTREMATA Guinot, 1977 | | | | | | | |
| CALAPPOIDEA de Haan, 1833 | | | | | | | |
| Calappidae de Haan, 1833 | | | | | | | |
| *Calappa galloides* Stimpson, 1859 | Benthic | ST | 15-80 | 15-218 | AAWA | - | X |
| *Calappa granulata* (Linnaeus, 1758) | Benthic | ST | 15-300 | 10-400 | ATLM | X | X |
| *Cryptosoma cristatum* Brullé, 1837 | Benthic | ST | 2-89 | 2-75 | ECAI | X | X |
| CANCROIDEA Latreille, 1802 | | | | | | | |
| Atelecyclidae Ortmann, 1893 | | | | | | | |
| *Atelecyclus rotundatus* (Olivi, 1792) | Benthic | ST | 65-278 | 0-795 | EAWD | - | X |
| *Atelecyclus undecimdentatus* (Herbst, 1783) | Benthic | ST | 0-51 | 0-51 | ATLM | likely | likely |
| Cancridae Latreille, 1802 | | | | | | | |
| *Cancer bellianus* Johnson, 1861 | Benthic | US | 120-871 | 37-700 | EACT | X | - |
| *Cancer pagurus* Linnaeus, 1758 | Benthic | ST | 150-400 | 0-520 | EACT | - | - |
| DORIPPOIDEA MacLeay, 1838 | | | | | | | |
| Dorippidae MacLeay, 1838 | | | | | | | |
| *Medorippe lanata* (Linnaeus, 1767) | Benthic | ST | 10-100 | 9-952 | EAWT | - | - |
| Ethusidae Guinot, 1977 | | | | | | | |
| *Ethusa mascarone* (Herbst, 1785) | Benthic | ST | 3-80 | 5-100 | ATLM | - | - |
| *Ethusa rosacea* A. Milne-Edwards and Bouvier, 1897 | Benthic | ST | 125-132 | 100-1013 | TSEA | - | X |
| ** *Ethusina alba* Filhol, 1884 | Benthic | LS | ? | 2800-4265 | EACT | likely | X |
| *Ethusina talismani* A. Milne-Edwards and Bouvier, 1897 | Benthic | LS | 2050-2083 | 1892-2400 | EACT | likely | - |
| ERIPHIOIDEA MacLeay, 1838 | | | | | | | |
| Eriphiidae MacLeay, 1838 | | | | | | | |
| *Eriphia verrucosa* (Forskål, 1775) | Benthic | ST | 0-6 | 0-6 | ATLM | X | - |
| Oziidae Dana, 1851 | | | | | | | |
| *Eupilumnus africanus* (A. Milne-Edwards, 1867) | Benthic | ST | 0-20 | 0-35 | TSEA | X | X |
| GONEPLACOIDEA MacLeay, 1838 | | | | | | | |
| Euryplacidae Stimpson, 1871 | | | | | | | |
| * *Machaerus atlanticus* (Miers, 1881) | Benthic | ST | ? | 10-90 | TSEA | - | - |
| Goneplacidae MacLeay, 1838 | | | | | | | |
| *Goneplax barnardi* (Capart, 1951) | Benthic | US | 500-570 | 200-590 | TSEA | - | X |
| *Goneplax rhomboides* (Linnaeus, 1758) | Benthic | ST | 15-570 | 0-580 | EAWT | X | X |
| Mathildellidae Karasawa and Kato, 2003 | | | | | | | |
| *Neopilumnoplax* sp. | Benthic | ST | 279-279 | - | AAWA | - | - |
| Progeryonidae Števčić, 2005 | | | | | | | |
| *Paragalene longicrura* (Nardo, 1869) | Benthic | ST | 130-160 | 20-30 | ATLM | X | - |
| LEUCOSIOIDEA Samouelle, 1819 | | | | | | | |
| Leucosiidae Samouelle, 1819 | | | | | | | |
| ** *Ebalia affinis* Miers, 1881 | Benthic | ST | ? | 4-140 | TSEA | X | X |
| *Ebalia deshayesi* Lucas, 1846 | Benthic | ST | 2-80 | 5-100 | ATLM | X | - |
| *Ebalia edwardsii* Costa, 1838 | Benthic | ST | 0-190 | 0-100 | ATLM | X | - |
| *Ebalia fragifera* Miers, 1881 | Benthic | ST | ? | ? | MAC | X | - |
| *Ebalia nux* A. Milne-Edwards, 1883 | Benthic | US | 540-2983 | 80-2983 | EACT | likely | X |
| *Ebalia tuberculata* Miers, 1881 | Benthic | ST | 40-300 | 12-110 | TSEA | - | - |
| *Ebalia tuberosa* (Pennant, 1777) | Benthic | ST | 30-180 | 0-199 | EACT | X | - |
| *Ebalia tumefacta* (Montagu, 1808) | Benthic | ST | 150-200 | 0-199 | EACT | - | - |
| *Ilia nucleus* (Linnaeus, 1758) | Benthic | ST | 162-162 | 0.5-80 | ATLM | - | - |
| *Ilia spinosa* Miers, 1881 | Benthic | ST | 0-107 | 5-132 | TSEA | - | - |
| *Merocryptus boletifer* A. Milne-Edwards and Bouvier, 1894 | Benthic | ST | 100-150 | 40-629 | ATLM | X | - |
| MAJOIDEA Samouelle, 1819 | | | | | | | |
| Epialtidae MacLeay, 1838 | | | | | | | |
| Epialtinae MacLeay, 1838 | | | | | | | |
| *Acanthonyx brevifrons* A. Milne-Edwards, 1869 | Benthic | ST | 0-7 | 0-110 | ECAI | X | X |
| *Acanthonyx lunulatus* (Risso, 1816) | Benthic | ST | 0-15 | 0-90 | EAWT | X | X |

| Taxa / Species | Spatial distribution | Depth boundary | Bathymetric range | | Biogeographic pattern | Canarian species also in | |
|---|---|---|---|---|---|---|---|
| | | | Canaries | Elsewhere | | Madeira | Cape Verde |
| Pisinae Dana, 1851 | | | | | | | |
| *Anamathia rissoana* (Roux, 1828) | Benthic | US | 100-500 | 100-730 | ATLM | X | - |
| *Herbstia condyliata* (Fabricius, 1787) | Benthic | ST | 0-54 | 0-80 | ATLM | X | - |
| *Herbstia rubra* A. Milne-Edwards, 1869 | Benthic | ST | 0-20 | 0-75 | TSEA | - | X |
| *Micropisa ovata* Stimpson, 1858 | Benthic | ST | 0-3 | 0-110 | TSEA | - | X |
| *Pisa armata* (Latreille, 1803) | Benthic | ST | 41-82 | 18-162 | EAWT | likely | X |
| *Pisa carinimana* Miers, 1879 | Benthic | ST | 4-120 | 4-100 | EAWT | X | - |
| *Pisa nodipes* (Leach, 1815) | Benthic | ST | 3-70 | 0-100 | ATLM | X | X |
| *Pisa tetraodon* (Pennant, 1777) | Benthic | ST | 2-50 | 0-50 | ATLM | - | - |
| *Rochinia carpenteri* (Thomson, 1873) | Benthic | MS | 500-1059 | 400-1340 | EACT | X | - |
| Inachidae MacLeay, 1838 | | | | | | | |
| *Achaeus cranchii* Leach, 1817 | Benthic | ST | 0 - >20 | 0-70 | ATLM | X | - |
| *Dorhynchus thomsoni* Thomson, 1873 | Benthic | MS | 570-1163 | 106-2080 | COSM | likely | X |
| *Inachus aguiarii* de Brito Capello, 1876 | Benthic | ST | 55-110 | 20-100 | ATLM | X | - |
| *Inachus dorsettensis* (Pennant, 1777) | Benthic | US | 540-540 | 0-749 | EAWD | - | - |
| *Inachus grallator* Manning and Holthuis, 1981 | Benthic | ST | 60-125 | 36-325 | TSEA | - | - |
| *Inachus nanus* Manning and Holthuis, 1981 | Benthic | ST | 45-80 | 29-118 | TSEA | - | - |
| *Inachus phalangium* (Fabricius, 1775) | Benthic | ST | 0.5-35 | 0.5-160 | EACT | X | - |
| *Inachus thoracicus* Roux, 1830 | Benthic | ST | 30-90 | 10-200 | ATLM | - | - |
| *Macropodia deflexa* Forest, 1978 | Benthic | ST | 23-23 | 0-90 | EACT | - | - |
| *Macropodia linaresi* Forest and Zariquiey Álvarez, 1964 | Benthic | ST | 5-50 | 3.5-140 | ATLM | - | - |
| *Macropodia* aff. *hesperiae* Manning and Holthuis, 1981 | Benthic | MS | 821-821 | - | MAC | - | - |
| *Macropodia longirostris* (Fabricius, 1775) | Benthic | ST | 30-60 | 4-130 | ATLM | - | - |
| *Macropodia* aff. *longirostris* (Fabricius, 1775) | Benthic | ST | 50-60 | - | MAC | - | - |
| *Macropodia* aff. *parva* van Noort and Adema, 1985 | Benthic | ST | 25-82 | 20-90 | TSEA | - | - |
| *Macropodia rostrata* (Linnaeus, 1761) | Benthic | ST | 0-100 | 0-193 | EAWD | likely | - |
| *Macropodia* spec. 2 Fransen, 1991 | Benthic | ST | 86-200 | 140-170 | MAC | - | - |
| *Stenorhynchus lanceolatus* (Brullé, 1837) | Benthic | ST | 2-273 | 5-96 | TSEA | X | X |
| Majidae Samouelle, 1819 | | | | | | | |
| *Eurynome aspera* (Pennant, 1777) | Benthic | ST | 10-200 | 10-1216 | EAWD | X | X |
| *Maja brachydactyla* Balss, 1922 | Benthic | ST | 0-72 | 0-91 | EAWT | X | - |
| *Maja goltziana* d'Oliveira, 1888 | Benthic | ST | 50-287 | 27-250 | ATLM | - | - |
| Oregoniidae Garth, 1958 | | | | | | | |
| *Ergasticus clouei* A. Milne-Edwards, 1882 | Benthic | US | 420-570 | 70-1000 | ATLM | X | X |
| PALICOIDEA Bouvier, 1898 | | | | | | | |
| Palicidae Bouvier, 1898 | | | | | | | |
| *Palicus caronii* (Roux, 1828) | Benthic | ST | 20-220 | 18-220 | ATLM | X | X |
| PARTHENOPOIDEA MacLeay, 1838 | | | | | | | |
| Parthenopidae MacLeay, 1838 | | | | | | | |
| *Distolambrus maltzami* (Miers, 1881) | Benthic | ST | 45-125 | 22-550 | EAWT | likely | X |
| *Parthenopoides massena* (Roux, 1830) | Benthic | ST | 25-90 | 3-141 | ATLM | X | X |
| *Spinolambrus macrochelos* (Herbst, 1790) | Benthic | ST | 100-475 | 5-1478 | ATLM | likely | X |
| *Velolambrus expansus* (Miers, 1879) | Benthic | ST | 2-125 | 30-170 | ATLM | X | X |
| PILUMNOIDEA Samouelle, 1819 | | | | | | | |
| Pilumnidae Samouelle, 1819 | | | | | | | |
| *Pilumnus hirtellus* (Linnaeus, 1761) | Benthic | ST | 0-25 | 0-90 | EACT | X | X |
| *Pilumnus inermis* A. Milne-Edwards and Bouvier, 1894 | Benthic | ST | 200-250 | 5-400 | ATLM | X | X |
| *Pilumnus spinifer* H. Milne-Edwards, 1834 | Benthic | ST | 0-20 | 1-179 | ATLM | X | X |
| *Pilumnus villosissimus* (Rafinesque, 1814) | Benthic | ST | 0-20 | 0-20 | ATLM | X | - |
| PORTUNOIDEA Rafinesque, 1815 | | | | | | | |
| Carcinidae MacLeay, 1838 | | | | | | | |
| * *Carcinus aestuarii* Nardo, 1847 | Benthic | ST | 10-10 | 1-26 | COSM | - | - |
| * *Carcinus maenas* (Linnaeus, 1758) | Benthic | ST | ? | 0-60 | EACT | - | - |
| *Portumnus latipes* (Pennant, 1777) | Benthic | ST | 0-3 | 0-30 | ATLM | likely | - |
| *Xaiva mcleayi* (Barnard, 1947) | Benthic | ST | 4-4 | 8-73 | TSEA | - | - |
| Geryonidae Colosi, 1923 | | | | | | | |
| *Chaceon affinis* (A. Milne-Edwards and Bouvier, 1894) | Benthic | US | 411-1350 | 130-2047 | EACT | X | X |
| *Chaceon inglei* Manning and Holthuis, 1989 | Benthic | LS | 2156-2156 | 1640-2500 | EACT | X | - |
| *Chaceon maritae* (Manning and Holthuis, 1981) | Benthic | US | ? | 100-1000 | TSEA | - | X |
| *Geryon trispinosus* (Herbst, 1803) | Benthic | US | 639-833 | 32-2220 | EACT | - | - |
| Pirimelidae Alcock, 1899 | | | | | | | |
| *Pirimela denticulata* (Montagu, 1808) | Benthic | ST | 0-15 | 0-250 | EACT | X | X |
| Polybiidae Ortmann, 1893 | | | | | | | |
| *Bathynectes longipes* (Risso, 1816) | Benthic | ST | 30-100 | 15-226 | ATLM | X | - |
| *Bathynectes maravigna* (Prestandrea, 1839) | Benthic | US | 366-846 | 60-1410 | EACT | - | - |
| *Liocarcinus corrugatus* (Pennant, 1777) | Benthic | ST | 1-225 | 1-147 | EAWT | X | X |
| *Liocarcinus depurator* (Linnaeus, 1758) | Benthic | ST | 45-90 | 1-871 | EACT | - | - |
| *Liocarcinus holsatus* (Fabricius, 1798) | Benthic | ST | <100 | 1-400 | EACT | likely | - |
| *Liocarcinus navigator* (Herbst, 1794) | Benthic | ST | 5-50 | 0-108 | EACT | - | - |
| *Liocarcinus pusillus* (Leach, 1816) | Benthic | ST | 20-30 | 0-455 | EACT | likely | - |
| *Liocarcinus vernalis* (Risso, 1816) | Benthic | ST | 35-100 | 0-150 | ATLM | - | - |
| *Liocarcinus zariquieyi* Gordon, 1968 | Benthic | ST | 23-80 | 5-80 | ATLM | - | - |
| *Macropipus tuberculatus* (Roux, 1830) | Benthic | ST | 100-150 | 48-748 | EACT | likely | - |
| *Polybius henslowii* Leach, 1820 | Pelagic | - | 0-5 | 2-1245 | EACT | likely | - |
| Portunidae Rafinesque, 1815 | | | | | | | |
| Portuninae Rafinesque, 1815 | | | | | | | |
| *Laleonectes vocans* (A. Milne-Edwards, 1878) | Benthic | ST | 5-10 | 6-37 | AAWA | X | - |

| Taxa / Species | Spatial distribution | Depth boundary | Bathymetric range Canaries | Bathymetric range Elsewhere | Biogeographic pattern | Canarian species also in Madeira | Canarian species also in Cape Verde |
|---|---|---|---|---|---|---|---|
| *Portunus* (*Portunus*) *hastatus* (Linnaeus, 1767) | Benthic | ST | 2-60 | 2-40 | TSEA | X | X |
| *Portunus* (*Portunus*) *inaequalis* (Miers, 1881) | Benthic | ST | ? | 4-73 | TSEA | X | X |
| Thalamitinae Paul'son, 1875 | | | | | | | |
| *Thalamita poissonii* (Audouin, 1826) | Benthic | ST | 0.5-120 | 0.5-20 | PANT | - | X |
| Thiidae Dana, 1852 | | | | | | | |
| *Thia scutellata* (Fabricius, 1793) | Benthic | ST | 5-50 | 0-110 | EACT | - | - |
| PSEUDOZIOIDEA MacLeay, 1838 | | | | | | | |
| Pseudoziidae MacLeay, 1838 | | | | | | | |
| *Euryozius bouvieri* (A. Milne-Edwards, 1869) | Benthic | ST | 0-23 | 6-30 | ECAI | X | X |
| TRAPEZIOIDEA Miers, 1886 | | | | | | | |
| Domeciidae Ortmann, 1893 | | | | | | | |
| *Domecia acanthophora africana* Guinot, 1964 | Benthic | ST | 0-0 | 0-35 | ECAI | - | X |
| XANTHOIDEA MacLeay, 1838 | | | | | | | |
| Panopeidae Ortmann, 1893 | | | | | | | |
| *Panopeus africanus* A. Milne-Edwards, 1867 | Benthic | ST | 0-8 | 0-140 | TSEA | - | X |
| Xanthidae MacLeay, 1838 | | | | | | | |
| Actaeinae Alcock, 1898 | | | | | | | |
| *Paractaea monodi* Guinot, 1969 | Benthic | ST | 5-82 | 0-200 | ATLM | X | X |
| *Paractaea rufopunctata* (H. Milne-Edwards, 1834) | Benthic | ST | 0-45 | 0-91 | PANT | - | - |
| Euxanthinae Alcock, 1898 | | | | | | | |
| *Glyptoxanthus cavernosus* (A. Milne-Edwards, 1878) | Benthic | ST | 0-0 | 0-17 | ECAI | - | X |
| *Monodaeus couchii* (Couch, 1851) | Benthic | ST | 20-500 | 0-1415 | EAWT | likely | X |
| ** *Monodaeus rouxi* (Capart, 1951) | Benthic | ST | ? | 11-510 | TSEA | X | - |
| Xanthinae MacLeay, 1838 | | | | | | | |
| *Coralliope parvula* (A. Milne-Edwards, 1869) | Benthic | ST | 0-33 | 0-355 | TSEA | - | X |
| *Microcassiope minor* (Dana, 1852) | Benthic | ST | 0-20 | 0-220 | AAWA | X | X |
| *Nanocassiope melanodactyla* (A. Milne-Edwards, 1867) | Benthic | ST | 5-110 | 5-225 | TSEA | X | X |
| *Xantho hydrophilus* (Herbst, 1790) | Benthic | ST | 0-25 | 0-37 | ATLM | X | X |
| *Xantho pilipes* A. Milne-Edwards, 1867 | Benthic | ST | 0-36 | 0-133 | EAWD | X | - |
| *Xantho poressa* (Olivi, 1792) | Benthic | ST | 0-15 | 0-20 | ATLM | - | - |
| *Xantho sexdentatus* (Miers, 1881) | Benthic | ST | 0-15 | 0-35 | TSEA | likely | X |
| *Xantho* sp. Fransen, 1991 | Benthic | ST | 0-7 | 0-15 | TSEA | X | X |
| Zosiminae Alcock, 1898 | | | | | | | |
| *Platypodiella picta* (A. Milne-Edwards, 1869) | Benthic | ST | 0-30 | 0-30 | TSEA | X | - |
| THORACOTREMATA Guinot, 1977 | | | | | | | |
| CRYPTOCHIROIDEA Paul'son, 1875 | | | | | | | |
| Cryptochiridae Paul'son, 1875 | | | | | | | |
| *Detocarcinus balssi* (Monod, 1956) | Benthic | ST | 20-25 | 3-62 | TSEA | - | - |
| GRAPSOIDEA MacLeay, 1838 | | | | | | | |
| Grapsidae MacLeay, 1838 | | | | | | | |
| *Grapsus adscensionis* (Osbeck, 1765) | Benthic | ST | 0-7 | 0-4 | TSEA | X | X |
| *Pachygrapsus marmoratus* (Fabricius, 1787) | Benthic | ST | 0-6 | 0-20 | ATLM | X | - |
| *Pachygrapsus maurus* (Lucas, 1846) | Benthic | ST | 0-6 | 0-6 | ATLM | X | X |
| *Pachygrapsus transversus* (Gibbes, 1850) | Benthic | ST | 0-7 | 0-7 | PANT | X | X |
| *Planes minutus* (Linnaeus, 1758) | Pelagic | - | 0-31 | 0-31 | PANT | X | X |
| Percnidae Števčić, 2005 | | | | | | | |
| *Percnon gibbesi* (H. Milne Edwards, 1853) | Benthic | ST | 0-29 | 5-29 | PANT | X | X |
| Plagusiidae Dana, 1851 | | | | | | | |
| *Euchirograpsus liguricus* H. Milne-Edwards, 1853 | Benthic | ST | 150-250 | 10-359 | EAWT | X | X |
| *Plagusia depressa* (Fabricius, 1775) | Benthic | ST | 0-5 | 0-5 | AAWA | X | X |
| Varunidae H. Milne-Edwards, 1853 | | | | | | | |
| *Brachynotus sexdentatus* (Risso, 1827) | Benthic | ST | 1.5-1.5 | 0-2 | ATLM | - | - |
| OCYPODOIDEA Rafinesque, 1815 | | | | | | | |
| Ocypodidae Rafinesque, 1815 | | | | | | | |
| *Uca* (*Afruca*) *tangeri* (Eydoux, 1835) | Benthic | ST | 0-2 | 0-2 | TSEA | - | X |
| PINNOTHEROIDEA de Haan, 1833 | | | | | | | |
| Pinnotheridae de Haan, 1833 | | | | | | | |
| *Nepinnotheres pinnotheres* (Linnaeus, 1758) | Benthic | ST | 2-25 | 6-250 | ATLM | - | - |
| *Pinnotheres pisum* (Linnaeus, 1767) | Benthic | ST | 38-38 | 0-150 | EACT | - | - |

*sexdentatus* (Risso, 1827) found in a brackish littoral pond with mobile sandy substrate (Charca de Maspalomas, S of Gran Canaria), under stones at 1.5 m of depth (Moro et al. 2014), given that this species has been introduced in other zones (for instance, the U.K.) and that even the habitat observed is not the more appropriate for this species, the most plausible reason for that finding is a human-mediated activity (through ballast water, fouling or oil platform, or a release from aquarium or pet trade).

The finding in 2011 of one single male of *Uca* (*Afruca*) *tangeri* (Eydoux, 1835) on a sandstone platform on a crowded urban beach (Las Canteras, Gran Canaria) could be a consequence of larvae drifting transport between the African coast and the Canary archipelago, and the subsequent process of settlement and growing of an isolated individual (Castro 2012). Another plausible explanation is a human-mediated introduction (release from aquarium or pet trade).

*Acanthonyx brevifrons* A. Milne-Edwards, 1869 is first recorded from the Canary Islands herein, based on one male (ICCM408, 3.8 mm carapace length) collected by hand at the Bay of Melenara, Gran Canaria, 27°59'N 15°12'W, Dec. 1997, on red algae *Gelidium*, 0-7 m. An eastern Atlantic species, appearing to be endemic from the NE Atlantic archipelagos of Azores

(Milne-Edwards and Bouvier 1894), Madeira (Chapman and Santler 1955, as *A. lunulatus* var. *brevifrons*) and the Cape Verde Islands (Milne-Edwards 1869, type locality), associated with *Cystoseira* meadows or rocks with algae, from the intertidal to up more than 110 m of depth (d'Udekem d'Acoz 1999).

Although Forest and Zariquiey Álvarez (1964) reviewed the Mediterranean species of *Macropodia* Leach, 1814 and their nomenclature, specific identification of the eastern-central Atlantic *Macropodia* has remained particularly difficult (Manning and Holthuis 1981, d'Udekem d'Acoz 1999). Eight *Macropodia* species not fully identified at specific level from the Canary-Cape Verde region were included in the Fransen (1991) account. Of them, four species were compiled in the d'Udekem d'Acoz (1999) inventory, with three of them (*M.* aff. *hesperiae*, *M.* aff. *longirostris*, and *Macropodia* spec. 2) potentially representing endemic forms from the Macaronesia.

**Species of doubtful presence in the Canary Islands**

*Machaerus atlanticus* (Miers, 1881) has only been recorded from the Canary Islands by Barquín-Diez and Carrillo (1988) (as *Pilumnoplax atlantica*, with no collecting data). In the Eastern Atlantic, it is known from Senegal to Congo-Brazzaville, on mixed bottoms dominated by mud, 10-90 m (d'Udekem d'Acoz 1999).

From the time when Santaella (1973) conducted his research, confusion has long existed over the validity of records for the species of *Carcinus* from the Canaries. Unfortunately, neither González (1995) nor this work have shed too much light on this issue. *Carcinus maenas* (Linnaeus, 1758) was first recorded from the Canaries by Heller (1863) (with no location), and then compiled by García Cabrera (1971) ("Canaries"). Santaella (1973) did not give validity to these citations based on the absence of a well-documented finding, and also the fact that the European species of *Carcinus* had not yet been separated in the 19th century. Although live specimens of this species were recorded as commercialized bait (Núñez et al. 2011), they were imported. The species' supposed natural range of distribution covered the eastern Atlantic, from SE Iceland to Atlantic Morocco, the Western Sahara and Mauritania, and it is also known from the western Mediterranean. However, it has been introduced in the NE Pacific, South Africa, S of Australia, and perhaps in the NW Atlantic and has been accidentally observed in many locations around the world (d'Udekem d'Acoz 1999). It is found in intertidal and shallow subtidal zones, 0-60 m, mainly at 0-6 m, rarely to 200 m (?), under rocks and algae, tide pools, marshes and seagrass beds, and in low to full salinity areas (d'Udekem d'Acoz 1999, Fransen 2015a in WoRMS). *Carcinus aestuarii* Nardo, 1847 was probably first recorded from the Canaries by Heller (1863) (as *C. maenas*) and Almaça (1960), and then compiled by Zariquiey Álvarez (1968) (as *C. mediterraneus*), García Cabrera (1971) (as *C. maenas*), and Manning and Holthuis (1981) among others. The presence of this species in waters of the Canaries was corroborated by Barquín-Diez et al. (1982-1983) (one spec., Tenerife, muddy sand, 10 m), and collected again on polluted bottoms of the Port of Santa Cruz de Tenerife (González 1995, based on a pers. comm.). Were both specimens well identified? If correctly identified, were both specimens introduced? It has been recorded in scattered localities worldwide: the West Pacific (Japan, introduced, d'Udekem d'Acoz 1999), the Indo-West Pacific, the Indian Ocean (Suez Canal, ?Red Sea), the western Atlantic (USA). It has been found in the eastern Atlantic, the Mediterranean and Black Seas, in Morocco, Mauritania, and South Africa (Fransen 2015b in WoRMS), on muddy sand, under rocks, and seagrass meadows, at 1-26 m (Abelló et al. 1988, d'Udekem d'Acoz 1999). If *C. aestuarii* is the right identification for the species occurring in the Canaries, it should be considered as introduced. If *C. maenas* occurs in the Canaries, this would represents a range extension of this west-African species.

**Species probably occurring in the Canary Islands**

*Ethusina alba* Filhol, 1884: an eastern Atlantic species, found between France and the Azores, off Azores and off Cape Verde Islands, on mud bottoms often with pumice stone, 2800-4265 m (Manning and Holthuis 1981, Fransen 1991). *Ebalia affinis* Miers, 1881: an eastern Atlantic species, known from Seine Bank, N of Madeira (Doflein 1904), the Cape Verde Islands (Monod 1956) and from Senegal to Angola, including São Tomé and Principe Islands (Manning and Holthuis, 1981), on calcareous algae and mud with shells, 4-140 m (d'Udekem d'Acoz 1999). *Portunus* (*Portunus*) *inaequalis* (Miers, 1881): an eastern Atlantic species, known from Madeira (Türkay 1976), the Cape Verde Islands and Guinea-Bissau southward to Angola, including the islands of the Gulf of Guinea, on various bottom types, 4-73 m, mainly at 4-40 m (Manning and Holthuis 1981, d'Udekem d'Acoz 1999). To date no records for these three crab species exist from the Canaries. However, as they have been recorded from northern and southern adjacent areas, their presence in the Canary Islands is very probable. Very recently, photographic evidence was provided to me proving the occurrence of large specimens of *P.* (*P.*) *inaequalis* in waters of both Tenerife and Gran Canaria islands.

*Monodaeus rouxi* (Capart, 1951): an eastern Atlantic species, found in Madeira (Fransen 1991), Senegal, Gambia and southward to Angola (d'Udekem d'Acoz 1999), mainly on mud, also on sand and clay (Forest and Guinot 1966, Fransen 1991), from 11 m (Manning and Holthuis 1981) to 510 m depth (Fransen 1991). No record exists for this species from the Canaries. However, it has been recorded from Madeira and the neighbouring African coast, so its presence in the Canary Islands is very probable.

*Cancer pagurus* Linnaeus, 1758: an eastern Atlantic species, known from Norway (70°N) to S Portugal, including the Mediterranean (very rare), rocks and sand, from the intertidal to 520 m of depth, rarely down to 100 m (d'Udekem d'Acoz 1999). Some doubtful findings from Canada, USA and the Pacific Ocean have been reported in global databases. Macaronesia: Azores (Borges et al. 2010). Up to three fishermen have reported to us on sporadic catches of ox crab (= 'buey liso' in Canarian Spanish), few individuals per trap, off Fuerteventura. Some of these catches were sold in local supermarkets, and a dried carapace used as an ornamental object was examined by us. So the northeastern sector of the Canaries seems to be the southern distribution limit for the species, coinciding with the coldest waters around the archipelago.

### Spatial and vertical distribution

Of the 132 brachyuran species occurring around the Canary Islands, 130 are benthic forms (Table 1). *Polybius henslowii* has been reported as epi- to bathypelagic, with benthic stages (e.g. González-Gurriarán 1987). *Planes minutus* is epipelagic, living on loggerhead sea turtles and inanimate flotsam (e.g. Dellinger et al. 1997), but also has benthic stages when flotsam reaches the beaches. *Dorhynchus thomsoni* is known to be benthic with a pelagic initial stage (e.g. Hartnoll et al. 1987). *Portunus* (*Portunus*) *hastatus* has juveniles with pelagic stages, but adults are clearly benthic (Table 1).

Of the 130 brachyuran benthic species occurring in the Canaries, 112 are forms of the shelf and transition area between shelf and slope (ST, 86.2%, mainly inhabiting at a depth interval of 0-300 m), 11 are upper slope species (US, 8.5%, mainly at a depth interval of 301-800 m), 4 are middle-slope species (MS, 3.1%, mainly at a depth interval of 801-2000 m), and 3 are lower slope species (LS, 2.3%, mainly at a depth greater than 2000 m) (Table 1).

Seven brachyuran benthic species seem to occur in waters of the Canary Islands at the shallowest depth ever recorded elsewhere: *Homologenus boucheti, Ilia spinosa, Velolambrus expansus, Xaiva mcleayi, Laleonectes vocans, Euryozius bouvieri*, and *Percnon gibbesi*. Seventeen brachyuran benthic species seem to occur in waters of the Canary Islands at the greatest depth ever recorded elsewhere: *Dromia marmorea, D. personata, Cryptosoma cristatum, Cancer bellianus, Paragalene longicrura, Ebalia edwardsii, E. tuberculata, E. tumefacta, Ilia nucleus, Pisa carinimana, Inachus aguiarii, Stenorhynchus lanceolatus, Maja goltziana, Liocarcinus corrugatus, L. zariquieyi, Portunus* (*Portunus*) *hastatus* and *Thalamita poissonii*.

### Zoogeographic considerations

To describe for the first time the different components of the brachyuran fauna, all the Canarian brachyuran crabs listed herein (132 species) are grouped by biogeographic pattern in Table 2. A first preliminary description showed three main groups: 39 ATLM species (29.5%), 28 TSEA species (21.2%), and 27 EACT species (20.5%). The remaining eight biogeographic groups varied from six EAWD species (4.5%) to one AAWD species (0.8%) (Table 2).

The presence of one MAC endemic species, *Macropodia* aff. *hesperiae* Manning and Holthuis, 1981, is noteworthy. The only record for this middle-slope species from the Canary Islands was by González (1995), based on one specimen caught off Playa de Santiago, S of La Gomera, 821 m, which was identified by C.H.J.M. Fransen, and then validated by d'Udekem d'Acoz (1999). Since all *Macropodia* species known to date were discarded during the identification, the Canarian specimen may represent a new species, even being an endemism from the Canary Islands or the Macaronesia. The true *Macropodia hesperiae* Manning and Holthuis, 1981 inhabits littoral waters at depths between 46 and 97 m from Senegal to Nigeria (Manning and Holthuis 1981).

The Canarian brachyuran crabs inhabiting the shelf and transition area between shelf and slope (123 species), i.e. those living shallower than the upper slope, at 0-300 m, are grouped by biogeographic pattern in Table 2. This description of the benthic littoral and/or upper-bathyal species showed the same three main groups: 39 ATLM species (31.7%), 28 TSEA species (22.8%), and 21 EACT species (17.1%). The remaining eight biogeographic groups varied from ten EAWT species (8.1%) to one AAWD species (0.8%) (Table 2).

The presence of four ECAI species is noteworthy. 1. *Cryptosoma cristatum* Brullé, 1837: known from the Azores (Wirtz and Martins 1993), Porto Santo, Madeira, Desertas Islands (Türkay 1976, as *Crytosoma cristatum*, erroneous spelling), the Canaries (Brullé 1837-1839, as *C. cristata*, type locality), the Cape Verde Islands (Monod 1956), and St. Helena Island; as an introduced species, found in the southwestern Mediterranean, with one record from the Alboran Sea (García-Raso 1993). 2. *Acanthonyx brevifrons* A. Milne-Edwards, 1869: from the Azores (Milne-Edwards and Bouvier 1894), Madeira (Chapman and Santler 1955, as *A. lunulatus* var.

Table 2. – Zoogeographic composition of the Canarian brachyuran fauna showing the number of species (N) grouped by biogeographic pattern.

| Species' biogeographic pattern | All Canarian brachyuran (132 species, depth 0 - >2000 m) | | Littoral and upper bathyal benthic (123 species, depth 0-300 m) | |
|---|---|---|---|---|
| | N | % | N | % |
| Atlanto-Mediterranean (ATLM) | 39 | 29.5 | 39 | 31.7 |
| Tropical and subtropical Eastern Atlantic (TSEA) | 28 | 21.2 | 28 | 22.8 |
| Eastern Atlantic cold-temperate (EACT) | 27 | 20.5 | 21 | 17.1 |
| Eastern Atlantic warm-temperate (EAWT) | 10 | 7.6 | 10 | 8.1 |
| Eastern Atlantic of wide distribution (EAWD) | 6 | 4.5 | 6 | 4.9 |
| Amphi-Atlantic of warm affinity (AAWA) | 5 | 3.8 | 5 | 4.1 |
| Eastern-central Atlantic island (ECAI) | 5 | 3.8 | 5 | 4.1 |
| Pantropical or circumtropical (PANT) | 5 | 3.8 | 4 | 3.3 |
| Macaronesian (MAC) | 4 | 3.0 | 3 | 2.4 |
| Cosmopolitan or worldwide (COSM) | 2 | 1.5 | 1 | 0.8 |
| Amphi-Atlantic of wide distribution (AAWD) | 1 | 0.8 | 1 | 0.8 |

*brevifrons*), the Canaries (present work) and the Cape Verde Islands (Milne-Edwards 1869, type locality). 3. *Euryozius bouvieri* (Milne-Edwards, 1869): from the Azores (Barrois 1888, as *Ozius Edwardsi*), Madeira (Türkay 1976), the Canaries (Santaella 1973) and the Cape Verde Islands (Milne-Edwards and Bouvier 1900). 4. *Glyptoxanthus cavernosus* (Milne-Edwards, 1878): from the Canaries (Fransen 1991) and the Cape Verde Islands (Bouvier 1922).

The occurrence of three MAC endemics is also noteworthy. 1. *Ebalia fragifera* Miers, 1881: from Madeira and the Canaries (Miers 1881, type locality). To date it is only known from the type material and, according to Monod (1956), its status needs to be reviewed. 2. *Macropodia* aff. *longirostris* (Fabricius, 1775): from the British Isles, Belgian North Sea, France, and the Mediterranean and Black Seas (d'Udekem d'Acoz 1999), detrital bottoms, sand, rocks covered by algae, and seagrass meadows, 4-130 m, mainly at 18-36 m (d'Udekem d'Acoz 1999). First recorded from the Canaries by Milne-Edwards and Bouvier (1900) (as *Stenorhynchus aegyptius*) based on "Talisman 1883" material (one spec., 28°49'N 13°53'W, sand and rocks, 30 m). This record was compiled by Bouvier (1940) but the collection was placed at a depth of 40 m. Forest (1964) reassigned this specimen to the genus *Macropodia*. Forest (1978) demonstrated that H. Milne-Edwards had based the species' description on material of *M. longirostris* (Fabricius, 1775). 3. *Macropodia* spec. 2 Fransen, 1991: only known from the Savage Islands (Fransen 1991, one spec., Selvagem Pequena, 30°01'N 16°00'W, 140-170 m) and the Canary Islands (Fransen 1991, La Palma, one spec., 28°38'N 17°59'W, 200 m; one spec., 28°38'N 17°58'W, mud with oysters, 86-110 m). This material may represent a new species, even being an endemism from the Canary-Savage Islands or more extended in Macaronesia.

Twenty-seven brachyuran benthic species occurring in the Canary Islands currently have their southern limit of distribution in this archipelago: *Cancer bellianus, Cancer pagurus, Ethusa mascarone, Paragalene longicrura, Ebalia edwardsii, Ebalia fragifera, Ebalia tuberosa* (with certainty in the Canaries and the Western Sahara, Manning and Holthuis 1981), *Ebalia tumefacta, Merocryptus boletifer, Anamathia rissoana*, *Inachus thoracicus* (probably), *Macropodia deflexa, Macropodia linaresi, Macropodia longirostris, Macropodia* sp., *Pilumnus villosissimus, Portumnus latipes, Chaceon inglei, Geryon trispinosus, Bathynectes longipes, Liocarcinus navigator, Liocarcinus holsatus, Liocarcinus zariquieyi, Macropipus tuberculatus, Xantho poressa, Pachygrapsus marmoratus* and *Brachynotus sexdentatus*. This southern group of 27 species represents 20.8% of the 130 benthic crabs listed herein.

Another 23 brachyuran benthic species occurring in the Canary Islands currently have their northern limit of distribution in this archipelago: *Calappa galloides, Ethusa rosacea, Machaerus atlanticus, Goneplax barnardi, Ebalia tuberculata, Ilia spinosa, Herbstia rubra, Micropisa ovata, Inachus grallator, Inachus nanus, Macropodia* aff. *parva*, *Stenorhynchus lanceolatus, Palicus caronii, Velolambrus expansus, Chaceon maritae, Thalamita poissonii, Domecia acanthophora africana, Glyptoxanthus cavernosus, Coralliope parvula, Microcassiope minor, Nanocassiope melanodactyla, Xantho sexdentatus* (one single record from the Gulf of Cadiz, Marco-Herrero et al. 2015) and *Detocarcinus balssi*. This northern group of 23 species represents 17.7% of the 130 benthic crabs listed herein.

Seventy-eight brachyuran benthic species occur in both the Canary and Madeira archipelagos (including 16 species very probably present at Madeira) (Table 1); this represents 60.0% of species shared with Madeira. Sixty-three brachyuran benthic species occur in both the Canary and Cape Verde archipelagos (including two species very probably present at the Cape Verde Islands) (Table 1); this represents 48.5% of species shared with the Cape Verde Islands. Like the Canaries, Madeira belongs to the Macaronesian ecoregion within the Lusitanian province of the Temperate Northern Atlantic realm, whereas the Cape Verde Islands belongs to its own ecoregion within the West African Transition province of the Tropical Atlantic realm (Spalding et al. 2007). The above-mentioned information could be relevant in the context of faunal movements derived from the eastern Atlantic warming.

## The Canarian carcinofauna: future changes

The ongoing phylogenetic studies together with the use of larval morphology are expected to bring further changes in the systematics of brachyuran decapods; these will have an impact at several taxonomic levels, from species to superfamilies. The main changes will affect new synonymizations, the split of some taxa into new species, and the erection of new genera (e.g. Marco-Herrero et al. 2015). Therefore, significant changes in the Canarian carcinofauna are expected to come in the near future.

Some taxa occurring in waters of the Canary Islands need an in-depth revision. As mentioned, confusion exists over the status of the *Carcinus* records. The Leucosiidae Samouelle, 1819, in particular the genus *Ebalia* Leach, 1817, with the necessity to review the status of *Ebalia fragifera* Miers, 1881, only known from the type material, needs to be revised. The Epialtidae MacLeay, 1838, in particular the genus *Pisa* Leach, 1814, shows much confusion among species. The Inachidae MacLeay, 1838, in particular the genera *Inachus* Weber, 1795 and *Macropodia* Leach, 1814, need to be revised. Within the *Inachus* species, some geographic distribution remains uncertain due to the morphological similarity and confusion among males of these species and their respective close relatives. The *Macropodia* species have been traditionally assigned and reassigned to different species, but there remain some doubtful synonyms and several species *affinis*, i.e. with specimens apparently related to, or resembling, a known species. The Parthenopidae MacLeay, 1838 is a taxonomically problematic group. Fransen (1991) reported on intermediate forms between *Parthenope miersii* (A. Milne-Edwards and Bouvier, 1898) (a synonym of *Spinolambrus macrochelos* (Herbst, 1790)) and *Parthenope notialis* Manning and Holthuis, 1981 from Mauritania and the Cape Verde Islands. In the Geryonidae Colosi, 1923, morphological differences between the Atlantic *Geryon trispinosus* (Herbst, 1803) and the Mediterranean *Geryon longipes* A. Milne-Edwards, 1882 are not clear (d'Udekem d'Acoz 1999). The Polybiidae Ortmann, 1893, in particular the genus *Liocarcinus* Stimpson, 1871, is probably one of the most taxonomically complicate. Within the Domeciidae Ortmann, 1893, the status of *Domecia acanthophora africana* Guinot, 1964 and its parent *Domecia acanthophora* (Desbonne, in Desbonne and Schramm, 1867) needs to be clarified, as well as the geographic range of each taxon.

Finally, within the Xanthidae MacLeay, 1838, morphology differences and distribution of the species of genus *Paractaea* Guinot, 1969 should be better explained. In this regard, records from the Canaries were Brullé (1837-1839) (as *Xantho rufo-punctatus*), Milne-Edwards and Bouvier (1900) (as *Actaea rufopunctata*) and Holthuis and Gottlieb (1958) for *P. rufopunctata* (H. Milne-Edwards, 1834); and Guinot (1969), Santaella (1974), Fransen (1991) and González (1995) for *P. monodi* Guinot, 1969.

Although description of new brachyuran species is not expected to occur at a significant rate, an increase in the number of species from the Canary Islands is expected to result from trawling and dredging samplings, as well as from human-mediated introduction of non-native species, mainly via the following main vectors: through ballast waters, fouling, oil platforms, and release of aquarium or pet trade. Triay-Portella et al. (2015) pointed out that a process driving massive introduction to the Canaries of non-indigenous tropical and subtropical fish species has been taking place in the last five years through oil platforms. Concerning the natural expansion of species from adjacent areas, northwestern African and Cape-Verdean warm crab species are likely candidates to expand the Canarian checklist. A tropicalization process of fish assemblages in temperate biogeographic transition zones, including the Macaronesian region and some parts of the Mediterranean Sea, has been postulated by many authors (Brito et al. 2005, Wirtz et al. 2008, Afonso et al. 2013, Horta Costa et al. 2014). This process is associated with global warming in many cases (Brito et al. 2005, Perry et al. 2005, Occhipinti-Ambrogi 2007). In temperate marine ecosystems, climate-driven change in biotic interactions can profoundly alter ecological communities, particularly when they impact foundation species (Vergés et al. 2014). In particular, the tropicalization process associated with global warming may mainly affect the presence of the 33 brachyuran benthic species occurring in the Canaries which currently have their southern limit of distribution in this archipelago. These anthropogenic vectors of introduction of warm-affinity exotic species are synergic with the natural range extensions (Triay-Portella et al. 2015), and therefore all causes together are significantly reinforcing the tropical and subtropical component of their littoral and upper-bathyal brachyuran assemblages. The ecological impact of these non-indigenous crabs on the native community remains unknown.

## Species of commercial interest and conservation measures

The Brachyura may be claimed to contain the highest degree of diversity among decapod crustaceans and include both crab species with an important role in trophic webs and others of commercial interest (Marco-Herrero et al. 2015).

Several deep-water crab species, such as *Cancer bellianus, C. pagurus, Maja goltziana, Chaceon affinis* and *Paromola cuvieri*, are targeted by local small-scale fisheries operating with non-selective bottom traps at some island localities, but their catches are moderate (e.g Santaella 1973, González 1995, Triay-Portella et al. 2014, Biscoito et al. 2015). *Maja brachydactyla* is seasonally fished with traps and sometimes with gillnets at a few localities (e.g Santaella 1973, González 1995). A dozen intertidal crab species, such as *Plagusia depressa, Eriphia verrucosa, Xantho* spp., *Grapsus adscensionis, Pachygrapsus* spp. and *Percnon gibbesi*, are being intensively harvested, mainly by hand by both recreational and professional fishermen, to be used for human consumption and/or as bait in the small-scale fisheries. *P. gibbesi* and *Platypodiella picta* are also collected by hand and used for both aquarium and pet trade.

The Canarian population of *P. picta* has been considered as potentially menaced by habitat losses and uncontrolled harvesting (aquarium, dry specimens), and its collecting is currently forbidden by the regional government. Similar situations have been observed by the author regarding *P. depressa, E. verrucosa, Xantho* spp., *G. adscensionis, Pachygrapsus* spp. and *P. gibbesi*, with different degrees of harvesting pressure dependent mainly on human demography and resource accessibility at each island and insular sector. On some islands the population status of some of these threatened shallow-water species is critical, even close to local extinction. Basic biological parameters of these crabs should be determined, their island populations evaluated, and some conservation measures urgently implemented in order for them to be recovered in the near future.

A panel of experts in marine organism reproduction proposed the implementation of a minimum landing size (MLS, in cm carapace length) for the following harvested or fished crab species: *P. depressa* and *G. adscensionis* (6 cm), *C. affinis* (13 cm) and *C. bellianus* (19 cm) (González et al. 2012b). Considering the newness of some of these local fisheries, the absence of reliable landing statistics, and a lack of knowledge pertaining to population biomasses, initial precautionary MLS have been recently proposed for *P. cuvieri* (9.2 cm) (Triay-Portella et al. 2014) and *C. affinis* (12.5-13.0 cm) (Biscoito et al. 2015), together with specific additional management measures. However, no conservation measures have been implemented to date by national or regional regulatory bodies for the sustainable use of these 18 exploited species, except an MLS for *P. depressa* (5 cm) and *G. adscensionis* (6 cm).

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