Vertical distribution of caprellids (Crustacea: Amphipoda) associated to hydroids, with the first record of *Pseudoprotella inermis* for Morocco

Distribución vertical de los caprélidos (Crustacea: Amphipoda) asociados a hidrozoos, con la primera cita de *Pseudoprotella inermis* para Marruecos

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Palabras clave: Caprélidos, hidrozoos, distribución vertical, ecología, *Pseudoprotella inermis*, ampliación del rango

ABSTRACT

The vertical distribution of caprellids associated to hydroids was studied from 5 to 30 m deep in Agadir, Morocco. The highest caprellid densities were measured between 5 and 10 m. *Phtisica marina* Slabber, 1769 and *Pseudoprotella phasma* Montagu, 1804 were the most abundant species distributed along the whole depth gradient. *Caprella liparotensis* Haller, 1879 and *Caprella acanthifera* Leach, 1814 were restricted to shallow waters, while *Pseudoprotella inermis* Chevreux, 1927 was found only from 15 to 30 m, being the dominant species in deeper areas. *P. inermis* had been previously collected only in Cádiz and Ceuta (Spain) and this study represents the first record of this species for Morocco, enlarging its distribution range ca. 1000 km to the south.

RESUMEN

Se estudió la distribución de los caprélidos asociados a hidrozoos desde los 5 a los 30 metros de profundidad en Agadir, Marruecos. Las densidades mayo-

res de caprélidos se registraron entre los 5 y los 10 metros. *Phtisica marina* Slabber, 1769 y *Pseudoprotella phasma* Montagu, 1804 fueron las especies más abundantes, distribuidas en todas las profundidades. *Caprella liparotensis* Haller, 1879 y *Caprella acanthifera* Leach, 1814 estuvieron restringidas a aguas más superficiales, mientras que *Pseudoprotella inermis* Chevreux, 1927 se registró sólo en el intervalo de 15 a 30 metros, siendo la especie dominante en las áreas más profundas. *P. inermis* había sido citada previamente en Cádiz y Ceuta. Este estudio representa la primera cita en Marruecos e incrementa el rango de distribución de la especie unos 1000 km hacia el sur.

INTRODUCTION

Caprellids are small peracarid crustaceans which constitute an important trophic link between primary producers and higher trophic levels in marine ecosystems (Woods, 2009). They are considered useful marine bioindicators (Guerra-García & García-Gómez, 2001; Takeuchi *et al*., 2001; Ohji *et al*., 2002; Guerra-García *et al.*, 2009a) and a potential resource in aquaculture (Woods, 2009). They live on algae, hydrozoans, bryozoans, sponges, seagrasses, sediment and other marine invertebrates (Guerra-García, 2001), and feed mainly on detritus and secondarily on microalgae, dinoflagellates, hydroids, sponges, polychaetes and crustaceans (Guerra-García & Tierno de Figueroa, 2009).

Caprellids can reach very high densities on hydroids (Guerra-García, 2001). In fact, these hydroids can be the preferred substrate by caprellids, especially in tropical areas (Guerra-García, 2006). Several authors have demonstrated interesting relationships between caprellids and hydroids. Some species feed mainly on hydroid tissue (Alarcón-Ortega *et al.*, 2012). Other species do not feed directly on hydroid polyps but the food collected by these polyps (e.g. copepods) can be exploited by caprellids in a cleptocommensalistic relationship (Bavestrello *et al*., 1996; Di Camillo *et al.*, 2008a). Even cases of caprellid-hydroid mutualism have been described: Caine (1998) showed that *Paracaprella tenuis* Mayer, 1903 aggressively displaces *Tenellia pallida* (Alder & Hancock, 1845), a nudibranch predator of the hydroid. The caprellid receives a substrate to cling on and access to food items such as detritus, diatoms, nematodes and copepods from the epibiotic community, but it does not feed directly on hydroid polyps. This caprellid aggressively defends its location on the hydroid, causing the nudibranch to move away. A similar relationship has also been proposed for *Paracaprella pusilla* and the hydroid *Eudendrium racemosum* in Southern Spain (Ros & Guerra-García, 2012). In spite of the interesting aspects of hydroid-caprellid associations, there is a lack of studies describing the associated fauna of caprellids on hydroids. Most

studies have focused on the caprellid assemblages of macroalgae, especially in intertidal areas and very shallow waters (Guerra-García *et al.*, 2010).

The amphipod fauna of the North African coast has still been scarcely explored. After the classical works conducted up to the beginning of the twentieth century (Lucas, 1849; Chevreux, 1888, 1910, 1911; Schellenberg, 1928, 1936) and Mayer's monographs (Mayer, 1890, 1903), a long interval ensued until the recent work of Bakalen & Dauvin (1995) carried out on the Argelian coasts, the contributions of Guerra-García & Takeuchi (2000, 2002) about caprellids from Ceuta, the study of caprellids from Tunisian coast (Zakhama-Sraieb *et al*., 2008) and a biogeographical study of the intertidal peracarids from the Strait of Gibraltar, including the coast of North Africa (Guerra-García *et al.*, 2009b). In Morocco, we can point out the detailed work conducted by Menioui (1988) dealing with the macrofaunal assemblages of hard bottoms. But this work is focused exclusively on fauna associated to macroalgae and no information about caprellids on hydroids is included.

For all the above reasons, the main objective of the present study is to contribute to the knowledge of caprellids associated with hydroids in the coast of Morocco, and to explore the vertical distribution of species in a gradient of depth from 5 to 30 meters.

MATERIAL AND METHODS

Samples were collected by SCUBA diving from Agadir Bay, Morocco during October 2007 (Fig. 1), as a part of a more general sampling programme on hydroid assemblages from Southern Spain and Northern Africa (Iazza *et al*., 2013). Two transects were located on rocky cliffs, one in Anchor Point (30.535910N, 9.744290W) and other one in Killer Point (30.546070N, 9.747050W). In each transect, the following depth ranges were considered: 5-10 m, 10-15 m, 15-20 m and 20-30 m. Hydroids were collected using a visual collection technique (Boero & Fresi, 1986; Di Camillo *et al.*, 2008b; Puce *et al*., 2009). To homogenise the sampling effort among the two zones and depths, all samples were collected by the same previously trained operators. The operator moved at a constant speed along each transect collecting samples of all hydroid colonies detected in a band 1 m wide. This visual technique probably has a lower quantitative precision than scratching off the complete surface of the sampling unit, but it allows the use of a large sampling unit which more efficiently represents the hydroid and caprellid diversity in shallow coastal habitats (Puce *et al*., 2009). Samples of hydroids taken at each depth interval were preserved in ethanol 90%. Caprellids from the samples were sorted in the laboratory and

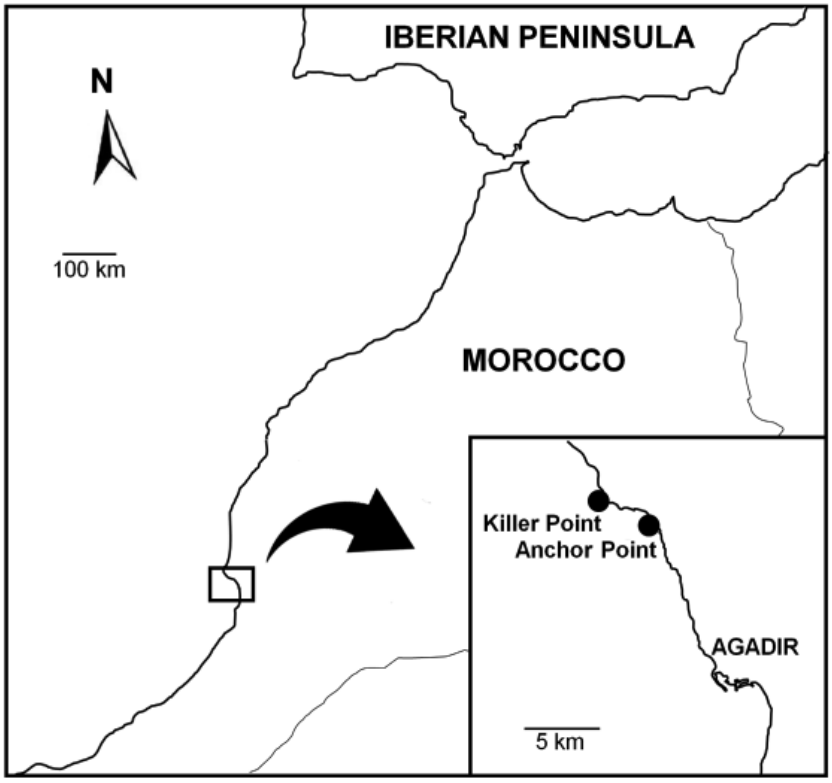

Fig. 1.—Study area map showing sampling locations in Agadir, Morocco.
Fig. 1.—Mapa del área de estudio mostrando las localidades de muestreo en Agadir, Marruecos.

identified to species level. All the hydroids of the same depth were kept together in the same sample so caprellid species could not be assigned to the particular hydroid species where they were clinging to.

RESULTS AND DISCUSSION

Five caprellids were found associated to hydroids (Fig. 2): *Phtisica marina* Slabber, 1769, *Pseudoprotella phasma* Montagu, 1804, *Caprella liparotensis* Haller, 1879, *Caprella acanthifera* Leach, 1814 and *Pseudoprotella inermis* Chevreux, 1927. The species *P. marina* and *P. phasma* were found from 5-30 m, with the highest abundances for these species recorded at 5-10 m. *Caprella liparotensis* was abundant from 5-10 meters but was not present in the samples from 10 to 30 m. *Caprella acanthifera* also preferred shallower

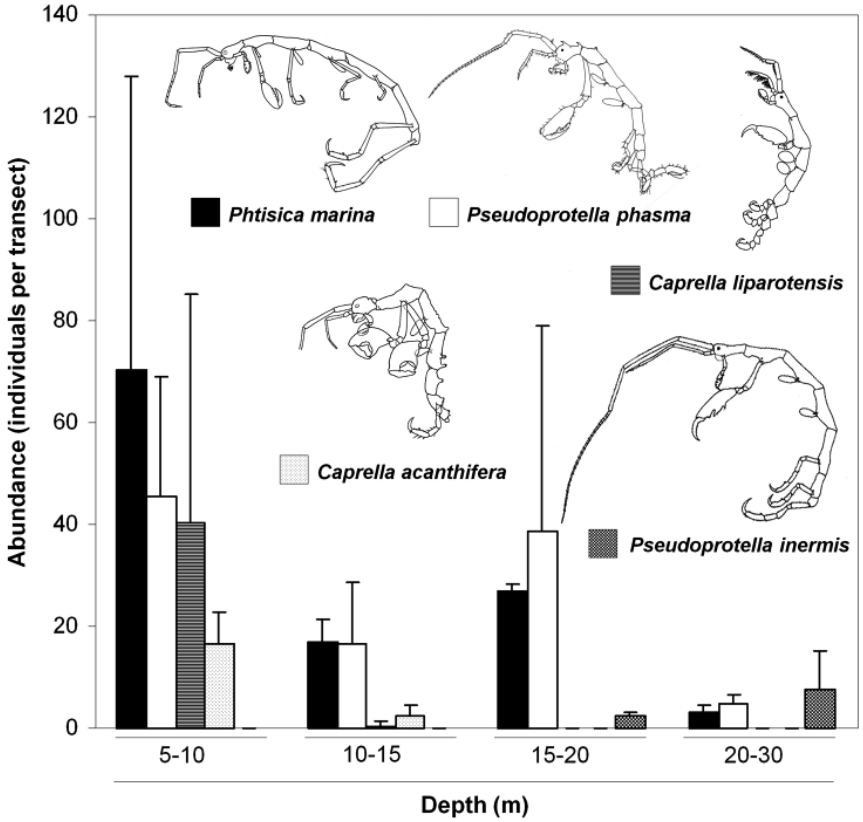

Fig. 2.—Caprellid abundance in each depth range considered, measured as the number of specimens per transect. Values are mean ± standard deviation of the two transects conducted.
Fig. 2.—Abundancia de caprélidos en cada intervalo de profundidad considerado, medido con el número de ejemplares por transecto. Los valores son datos medios ± desviaciones estándar de los dos transectos realizados.

waters, being found from 5 to 15 m. The most common hydroids collected in shallow waters (5-15 m) were *Halecium tenellum* Hincks, 1861, *Aglaophenia tubiformis* Marktanner-Turneretscher, 1890 and *Sertularella ellisii* (Deshayes & Milne Edwards, 1836).

In deeper areas, *C. acanthifera* and *C. liparotensis* were replaced by *Pseudoprotella inermis* which was restricted to the range 20-30 m where it is the most abundant species, even exceeding *P. marina* and *P. phasma* in abundance. From 15 to 30 m deep, the most common hydroids were *Obelia dichotoma* (Linnaeus, 1758), *Sertularia distans* (Lamouroux, 1816) and *Sertularella ellisii* (Deshayes & Milne Edwards, 1836).

The study conducted along the littoral of Ceuta (from 0-40 m) by Guerra-García (2001) also showed that *P. marina* and *P. phasma* were the most common species on hydroids. *Caprella erethizon* Mayer, 1901 and *C. santosrosai* Sánchez-Moyano, Jiménez-Martín & García-Gómez, 1995 were also found in very high densities during this study in Ceuta, while these species were not collected during the present study in Agadir. This indicates that probably the southernmost distribution range of these species is limited to the northern area of African coast with cooler waters and they are not able to reach Southern areas in the coast of Morocco.

Phtisica marina, *P. phasma*, *C. liparotensis* and *C. acanthifera* are common species, often reported in caprellid literature along Mediterranean and Atlantic waters. However, *P. inermis* (Fig. 3) had only been recorded from Cádiz and Ceuta, and the present study represents the first record for

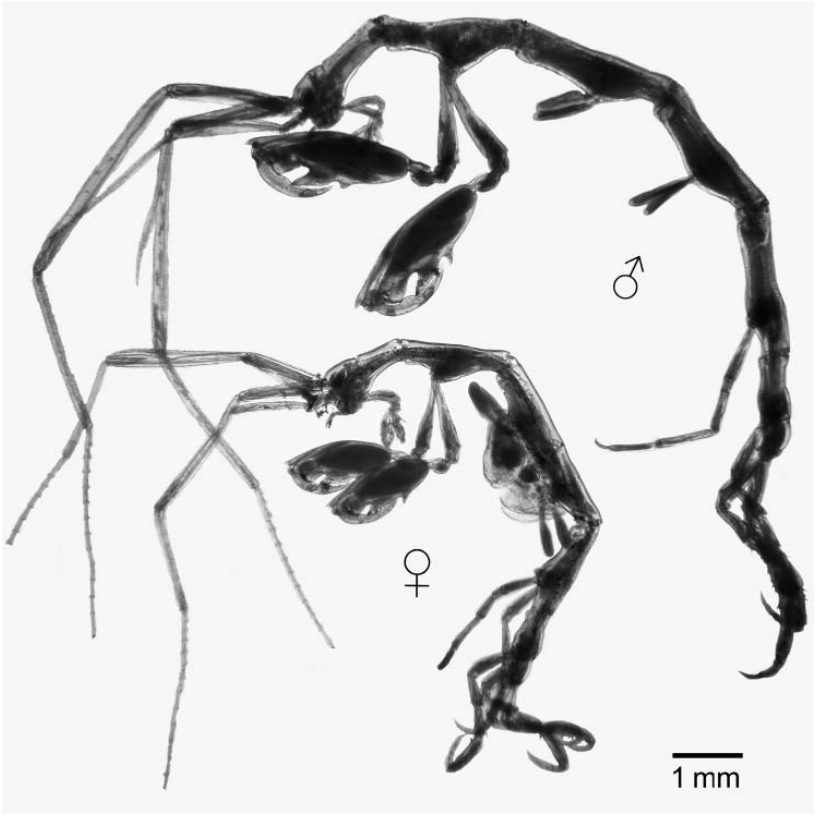

Fig. 3.—Lateral view of *Pseudoprotella inermis*, collected from Killer Point, Agadir (Morocco).
Fig. 3.—Vista lateral de *Pseudoprotella inermis*, recolectada en Killer Point, Agadir (Marruecos).

Morocco. This species was initially described by Chevreux (1927) based on a single specimen collected from a depth of 99 m in the Gulf of Cádiz. After this, Guerra-García & Takeuchi (2000) redescribed the species in detail based on material collected from Ceuta (Spain) between 30 and 40 meters. In Ceuta, the species were found clinging to the hydroid *Sertularella gayi* Lamouroux, 1821 and also on the alga *Dilophus spiralis* (Montagne) G.Hamel, 1939. During the present study, some specimens of *P. inermis* remained attached to the hydroid *Pseudoplumularia marocana* (Billard, 1930) after fixation. The material examined (Fig. 3) morphologically coincides with the original description and the description of specimens from Ceuta, with a clear diagnosis based on the absence of dorsal projections and the antenna 1 being longer than the body.

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