Littoral caprellids (Crustacea: Amphipoda) from the Mexican Central Pacific coast, with the description of four new species

J.E. Sánchez-Moyano*, I. García-Asencio and J.M. Guerra-García

Laboratorio de Biología Marina, Departamento de Zoología, Facultad de Biología, Universidad de Sevilla, Sevilla, Spain

(Received 24 July 2013; accepted 30 May 2014; first published online 13 August 2014)

The caprellids of shallow-water localities from the Mexican Central Pacific coast are investigated. The Mexican Pacific coast is poorly known, unlike more northern sites such as the California coast where c. 40 species have been reported. Hence, this is the first study dealing with the caprellidean fauna of this area. Seven species in three genera were found (four of which are new to science): Aciconula acanthosoma Chess, 1989; Caprella equilibra Say, 1818; Caprella mendax Mayer, 1903; Caprella pitu sp. nov.; Liropus isabelensis sp. nov.; Paracaprella carballot sp. nov.; and Paracaprella isabelae sp. nov. All the species are fully illustrated.

http://zoobank.org/urn:lsid:zoobank.org:pub:B04D3837-E7E1-4DA5-A8ED-28CA7BF1E1AF

Keywords: Crustacea; Amphipoda; Caprellidae; new species; México

Introduction

Caprellids (Crustacea: Amphipoda) are small marine crustaceans that inhabit algae, hydroids, ascidians, anthozoans, bryozoans, sponges, sea grasses and sediments (McCain 1968; Guerra-García 2001). They feed mainly on detritus (Guerra-García and Tierno de Figueroa 2009) although some caprellid species can prey on other organisms (such as copepods or other amphipods) or graze on epibiota fauna and flora. Many fish feed on caprellids (Caine 1991) and, therefore, caprellids are being considered as a potential resource in aquaculture (Woods 2009). Furthermore, caprellids are useful as bioindicators of marine pollution and environmental stress (e.g. Takeuchi et al. 2004). In spite of interest in them, knowledge of caprellids in some geographical areas, especially in central and South America, is still scarce (McCain and Steinberg 1970).

In contrast to the North American Pacific coast, the caprellidean amphipods of the Eastern Tropical Pacific have been poorly studied (García-Madrigal 2007). In this area, only six species have been cited of which two are deep species (Abyssicaprella galatheae McCain, 1966 and Caprella unguilina Mayer, 1903 from Costa Rica and Peru and the Galapagos Archipelago) and four are littoral species (Caprella californica Stimpson, 1857, from British Columbia to Coquimbo, Chile; Caprella equilibra Say, 1818 and Caprella scaura Templeton, 1836, cosmopolitan species; Paracaprella barnardi McCain, 1967, from the west coast of Panama). However, c. 40 species have been found from California to Alaska (Dougherty and Steinberg 1953; Laubitz 1970; Laubitz and Lewbel 1974; Martin 1977; Chess 1989; Watling and Carlton 2007; Guerra-García and Hendrycks 2013).

*Corresponding author. Email: smoyano@us.es

© 2014 Taylor & Francis
Undoubtedly, the collection effort and number of studies dealing with the caprellid fauna of the North American Pacific coasts have been superior to those for the southern area (see references in Watling and Carlton 2007 and García-Madrigal 2007), although, as with other marine invertebrates, the North Pacific fauna is presumably more diverse than the South Pacific one (Ekman 1953). Guerra-García and Thiel (2001) reported only seven species in a study from the Central North coast of Chile. In spite of this, it is expected that many new records and species can be reported from the southern Pacific coast in the future. With the present study, we contribute to the knowledge of the biodiversity of the Mexican Central Pacific coast, to properly address future biogeographical and ecological studies.

**Material and methods**

Samples were taken in three localities from the Mexican Central Pacific coast: Mazatlán (five stations), National Park of Isla Isabel (three stations) and Bahía Banderas (two stations) (Figure 1). The study area is located in the subtropical region and its climate is warm and subhumid with wet summers. Mazatlán is a touristic city located in an embayment with long sandy beaches and small rocky islands near to the coastline; its bottoms are shallow and the visibility is poor because of the proximity of the mouth of several estuaries. Isla Isabel is an uninhabited small volcanic island of c. 82 hectares with clean waters and bottoms up to 35 m deep and with the presence of degraded coral reefs due to El Niño events. Bahía Banderas is a touristic bay with a coastline 100 km long and important protected environmental areas such as Islas Marietas (a group of small uninhabited volcanic islands) and Los Arcos (a breeding zone for many seabirds and a popular snorkelling destination).

All samples were collected during January–February 2008, except those from Bahía Banderas stations (April 2002). Except for intertidal sites, the remaining stations were sampled by SCUBA diving. In each station we sampled all potentially suitable substrates such as seaweeds, hydroids, gorgonians and sediments. Coordinates, depth, substrates, number of samples and caprellid species are summarized in Table 1.

Samples were fixed in 70% ethanol, and the specimens were sorted using a stereomicroscope. The type material of new species, holotype male, allotype females and paratypes have been deposited in the Museo Nacional de Ciencias Naturales de Madrid (Spain).

We have followed the classification proposed by Myers and Lowry (2003) and Lowry and Myers (2013), in such a way that the infraorder Corophiida Leach 1814 (Myers and Lowry 2003) is divided into two parvorders: Corophiidiida and Caprellidida. The superfamily Caprelloidea contains five families, although in the present work we have only focused on members of the family Caprellidae.

**Systematic account**

Family **CAPRELLIDAE** Leach, 1814
Subfamily **CAPRELLINAE** Leach, 1814

*Aciconula acanthosoma* Chess, 1989,
(Figure 2)
Figure 1. Map of study area showing the sampling stations. St5 not shown.
Table 1. Characteristics of the stations sampled for the present study.

| Key | Station             | Locality      | Coordinates                        | Depth | Substrates                                                                 | Caprellids species                                                                 | No. samples |
|-----|---------------------|---------------|------------------------------------|-------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------|
| St1 | Isla de los Pájaros | Mazatlán      | 23°15′05.88″N 106°28′26.34″W        | 3–6   | Algae (Zonaria cf. farlowii), epiphytic hydroids, gorgonians (Leptogorgia rigida, L. peruviana) | Aciconula acanthosoma, Paracaprella isabelae sp. nov., Caprella pitu sp. nov., Caprella mendax, Liropus isabelensis sp. nov. | 3           |
| St2 | Isla Venado         | Mazatlán      | 23°13′53.97″N 106°27′44.14″W        | 2     | Sediments, gorgonians (Muricea sp., Pacifigorgia sp.)                     | Aciconula acanthosoma, Caprella pitu sp. nov., Caprella mendax                      | 3           |
| St3 | Faro                | Mazatlán      | 23°10′36.19″N 106°25′29.14″W        | Intertidal | Algae                                                                       | Not found                                                                         | 4           |
| St4 | Estero de Urías     | Mazatlán      | 23°11′05.09″N 106°25′18.15″W        | 3     | Algae (Codium cf. fragile, Zonaria cf. farlowii, red algae), gorgonians (Leptogorgia cf. alba), bryozoan (Bugula sp.) | Caprella mendax                                                                  | 5           |
| St5 | Las Labradas        | Mazatlán      | 23°36′54.34″N 106°45′56.62″W        | Intertidal | Barnacles                                                                    | Not found                                                                         | 1           |
| St6 | Bahía Tiburón       | Isla Isabel   | 21°50′34.24″N 105°53′03.28″W        | 1–3   | Sediments, thecata and athecata hydroids, red algae                        | Aciconula acanthosoma, Paracaprella carballo sp. nov., Caprella equilibra, Liropus isabelensis sp. nov. | 5           |
| St7 | Las Monas           | Isla Isabel   | 21°51′00.22″N 105°52′48.67″W        | 6     | Thecata hydroids, gorgonians (Leptogorgia cf. rigida, L. peruviana, Pacifigorgia cf agassizii), bryozoan (Bugula sp.) | Aciconula acanthosoma, Paracaprella carballo sp. nov., Caprella pitu sp. nov., Caprella equilibra | 5           |

(Continued)
| Station | Location | Coordinates | Number | Taxa Description | Specimen Count |
|---------|----------|--------------|--------|-----------------|----------------|
| St8     | Cerro Pelón, Isla Isabel | 21°51′15.58″N 105°53′34.65″W | 25 | Hydroids (Thecata and Athecata), gorgonians (Leptogorgia peruviana, L. rigida, Leptogorgia sp., Muricea cf. californica, Pacifigorgia cf. agassizii, Pacifigorgia sp.), bryozoan (Bugula sp.) | 7 |
| St9     | Islas Marietas, Bahía Banderas | 20°42′01.75″N 105°33′50.03″W | 10 | Gorgonians | Caprella pitu sp. nov. | 1 |
| St10    | Los Arcos, Bahía Banderas | 20°33′02.35″N 105°17′35.82″W | 12 | Gorgonians | Caprella pitu sp. nov. | 1 |
Figure 2. *Aciconula acanthosoma* Chess 1989. Lateral view. Scale bar: 1 mm.
Material examined
St1: 41 males, 23 females, 5 juveniles; St2: 2 males; St6: 3 males, 6 females, 5 juveniles; St7: 11 males, 7 females; St8: 30 males, 22 females, 21 juveniles.

Remarks
The specimens are in agreement with the original description by Chess (1989) with material from Santa Catalina island (California). Typical features of the species are present such as all pereonites dorsally spinose or basis of gnathopod 2 with acute distolateral projection. However, the studied specimens have some intraspecific variation in the head projection pattern compared with the four prominent curved projections from the material type: two anterior prominent and two posterior reduced ones (about one-third of the length of anterior ones). In some specimens from Mazatlán (St1 and St2), one or two posterior projections can be absent or very reduced. The length is slightly smaller in Mexican \textit{A. acanthosoma} (male to 5.5 mm, female to 4.5 mm) than in the type material (male and female to 7.3 mm and 6.3 mm, respectively). Additionally, pereonites 3 and 4 have fewer lateral spinose projections. Other generic characters are present such as the six-articulate pereopod 5, elongate, with long setae (although slightly less setose than in the original description) and the distal article reduced to a small cone, instead of the typical dactylus.

Habitat
\textit{Aciconula acanthosoma} was found attached to different species of Thecata and Athecata hydroids, gorgonians (\textit{Leptogorgia rigida}, \textit{Leptogorgia peruviana}, \textit{Pacifigorgia} sp., \textit{Pacifigorgia} cf. \textit{agassizii}, \textit{Muricea} sp., \textit{Muricea} cf. \textit{californica}), a bryozoan \textit{Bugula} sp., and the seaweed \textit{Zonaria} cf. \textit{farlowii} with epiphytic hydroids. Chess (1989) collected specimens from different substrata but they were more abundant on seaweeds (e.g. \textit{Cystoseira neglecta}, \textit{Sargassum palmeri} or \textit{Zonaria} \textit{farlowii}). In the present study, however, they were more abundant on sessile animals, being absent in most of the sampled seaweeds. Although in temperate ecosystems the highest densities of caprellids can be found in seaweeds (Guerra-García 2001), in the tropical region caprellids are mainly associated with hydroids and secondarily with gorgonians and other corals (Guerra-García 2006; Scinto et al. 2008). The unique available seaweed as substrate, \textit{Zonaria} \textit{cf. farlowii}, had a high coverage of hydroids which could indicate a strong relationship between \textit{A. acanthosoma} and cnidarians.

According to Chess (1989), \textit{A. acanthosoma} feeds on sponges and ascidians. Recently in a study on feeding habits of Pacific Mexican caprellids, Alarcón-Ortega et al. (2012) reported that this species feeds mainly on detritus (75\% of the gut content), crustaceans (17.5\%) and hydroids (6.7\%). In agreement with Guerra-García and Tierno de Figueroa (2009), the caprellid species with molars in mandibles (such as genus \textit{Aciconula}) are characterized by a diet mainly based on detritus, although in general caprellids are rather opportunistic because they can change their feeding habits depending on the substrates to which they cling.
**Distribution**

Type locality. Santa Catalina island, California (USA) (Chess 1989). Other records: Mazatlán and Isla Isabel, Pacific coast of México (Alarcón-Ortega et al. 2012).

**Caprella equilibra** Say, 1818

(Figure 3–5)

*Caprella equilibra* Say 1818: 391–392; McCain 1968: 25, figs 12–13; McCain and Steinberg 1970: 19; Cavedini 1982: 500; Krapp-Schickel 1993: 782–783, fig. 533. *Caprella aequilibra* Mayer 1882: 45, pl. 1, fig. 7; pl. 2, figs 1–11; pl. 4, figs 20–25; pl. 5, figs 16–18; Chevreaux and Fage 1925: 455, fig. 433.

**Material examined**

St6: 300 males, 250 females, 500 juveniles; St7: 19 males, 6 females, 21 juveniles; St8: 50 males, 35 females, 100 juveniles.

**Remarks**

The morphology of the specimens observed is in agreement with the description and figures included in Krapp-Schickel (1993) for Mediterranean specimens. This cosmopolitan species has a distinctive ventral projection between gnathopods 2, head with rectangular rostrum, gnathopod 2 basis robust and short with high and denticulate anterior carina. The largest male length found during the present study was 10 mm in length. Taking into account that Krapp-Schickel (1993) found specimens up to 20 mm, presumably our specimens are subadults. However, this variation could also be attributed to environmental variation between different geographical regions.

Three species with similar characteristics have been described from the North American Pacific coast: *Caprella equilibra, Caprella mendax* Mayer, 1903 and *Caprella pilidigita* Laubitz, 1970. All of them show the ventral projection between gnathopods 2. According to Laubitz (1970), *C. pilidigita* is clearly different from the others, especially based on the structure of gnathopod 2 (dactylus with hairs along inner margin, propodus three times as long as broad, basis one-third of total appendage) and the setation of antenna 1. *Caprella mendax* was described by Mayer (1903) but its distinction from *C. equilibra* is very tenuous (some authors such as Dougherty and Steinberg (1953) and Stoddart and Lowry (2003) consider *C. mendax* to be a synonym of *C. equilibra*). In fact, our specimens showed characteristics of both species as summarized in Table 2.

Widespread species such as *C. equilibra* can show natural morphological variation in their range or may encompass cryptic species. Disentangling species boundaries and/or cryptic species is a common issue for a great number of marine groups and especially for crustaceans (Cabezas et al. 2013, and references therein). In this sense, Cabezas et al. (2013) provided the first evidence for cryptic species in Caprellidae with a study of the cosmopolitan species *Caprella penantis* Leach, 1814, and supporting evidence that this species is a complex of at least four species. However, another study on the exotic *Paracaprella pusilla* Mayer, 1890 has demonstrated that this species exhibits great genetic uniformity throughout its distribution range (Ros et al. 2013). In the case of *C. equilibra*, further studies are necessary to clarify this issue. Due to this
Figure 3. *Caprella equilibra* Say, 1818. Lateral view. Scale bar: 1 mm.
and the presumable absence of superadult males, the material examined has been assigned to \textit{C. equilibra} despite a certain similarity with \textit{C. mendax}, such as the length of pereonite 5 larger than pereonite 4 or antenna 1 length.

Figure 4. \textit{Caprella equilibra} Say, 1818. Male mouthparts. Scale bar x (Mx1, Mx2, LMd, Mxp) and y (UL, LL): 0.1 mm.
Figure 5. *Caprella equilibra* Say, 1818. Male gnathopod 1 and 2, pereopods 5–7, abdomen. Female abdomen. Scale bar: x (Gn2): 1 mm; y (Gn1): 0.3 mm; z (P5-7): 1 mm; w (Ad): 0.1 mm.
Table 2. Comparison of selected characters between *Caprella equilibra* and *Caprella mendax*.

| Character                              | *C. equilibra* (according to Krapp-Schickel 1993) | *C. mendax* (according to Laubitz 1970) | *C. equilibra* (present study) | *C. mendax* (present study) |
|----------------------------------------|--------------------------------------------------|----------------------------------------|--------------------------------|-----------------------------|
| Gnathopod 2 propodus                   | 3 × as long as broad = pereonites 1 + 2          | 2 × as long as broad > pereonites 1 + 2 + 3 | 3 × as long as broad > pereonites 1 + 2 + 3 | 2 × as long as broad > pereonites 1 + 2 + 3 |
| Antenna 1 length                       | Present                                          | Present                                | Present                        | Absent                      |
| Ventral projection between gnathopods 2| 1/4 total antenna                                | > 1/3 total antenna                    | 1/4 total antenna              | > 1/3 total antenna         |
| Antenna 1 flagellum length             | 12–16                                            | 19                                     | 12–13                          | 15–16                       |
| Antenna 1 articles flagellum           | 1/4 of total appendage                           | 1/3 of total appendage                 | 1/4 of total appendage         | ¼ of total appendage        |
| Gnathopod 2 basis                      | ≤ pereonite 4                                    | > pereonite 4                          | > pereonite 4                  | > pereonite 4               |
| Pereonite 5 length                     |                                                  |                                        |                                |                             |
Habitat

*Caprella equilibra* has been found on a great variety of substrates such as seaweeds, hydroids, bryozoans, sponges or ascidians from the intertidal to 3000 m deep (Krapp-Schickel 1993). In the present study, *C. equilibra* was more abundant on hydroids and bryozoans, scarce on gorgonians (*Pacifigorgia cf. agassizii*) and absent on seaweeds. Despite its worldwide distribution and ubiquity of substrates, it has been only found in Isla Isabel within our study area. Guerra-García and Tierno de Figueroa (2009) included *C. equilibra* as detritivorous predators based on a high percentage of detritus in the gut content (> 80%) besides hydroids (> 7%) and copepods (> 6%). More recently, Alarcón-Ortega et al. (2012) showed with material from the present study that the gut content of *C. equilibra* was approximately 40% of both detritus and hydroids, so that the substrate is not only used as habitat but can also be a source of food.

Distribution

*Type locality.* South Carolina. Other records: cosmopolitan species (McCain 1968; Krapp-Schickel 1993; Guerra-García 2004).

*Caprella mendax* Mayer, 1903

(Figures 6–8)

*Caprella mendax* Mayer 1903; Laubitz 1970.

*Caprella equilibra*: Dougherty and Steinberg 1953.

Material examined

St1: 67 males, 56 females, 54 juveniles; St2: 11 males, 5 females, 6 juveniles; St4: 6 males.

Remarks

Typical features of the species are present such as body smooth, a small projection at the base of each gnathopod 2 or length of pereonite 5 larger than pereonite 4. Mouthparts typical of genus. Antenna 1 longer than pereonites 1, 2 and 3 with 16 articles in flagellum. Gnathopod 2 inserted posteriorly on pereonite 2; basis shorter than half pereonite 2 and one-quarter of total appendage length, with an anterior denticulate carina; propodus twice as long as broad, palm with one proximal grasping spine, and poison tooth and triangular projection distally. Pereopods 5, 6 and 7 increasing in length, with propodus with proximal grasping spines and concave palm. Abdomen typical of genus.

However, our specimens showed characteristics of both *Caprella mendax* and *C. equilibra* (Table 2), although, according to Mayer (1903) and Laubitz (1970), because the main differences are based on the structure of the second gnathopod and the length of pereonite 5 being greater than pereonite 4 in the first species, we have tentatively assigned them to *C. mendax*.

Laubitz (1970) found specimens up to 16.4 and 11.2 mm in length for males and females, respectively, but the largest male and female lengths in our study were 9.3 and 7 mm.
One of the more distinctive features in both *C. mendax* and *C. equilibra* is the presence of a ventral acute projection between gnathopods 2, which is absent in the material studied. McCain (1968) reported a variant of *C. equilibra*, associated with the gorgonian *Leptogorgia*, along the coast of Virginia, North Carolina and South Carolina in which the spine was reduced or absent and the body not quite as stout.

Figure 6. *Caprella mendax* Mayer, 1903. Lateral view. Scale bar: 1 mm.
Figure 7. *Caprella mendax* Mayer, 1903. Male mouthparts. Scale bar x (Mx1, Mx2, LMd, RMd, Mxp) and y (UL, LL): 0.1 mm.
Figure 8. *Caprella mendax* Mayer, 1903. Male gnathopod 1 and 2, pereopods 5–7, abdomen. Female abdomen. Scale bar: x (Gn1, Gn2): 0.3 mm; y (P5-7): 0.3 mm; z (Ad): 0.1 mm.
as in the typical form. Our material was also found on gorgonians (\textit{Leptogorgia rigida, Leptogorgia peruviana, Muricea} sp. and \textit{Pacifigorgia} sp.). In agreement with McCain (1968), this substrate may have some relation to the reduction of the spine and stoutness of the body. Further studies would be necessary to clarify this question and to elucidate the potential synonymy between \textit{C. equilibra} and \textit{C. mendax}.

\textbf{Habitat}

\textit{Caprella mendax} occurs predominately in the intertidal zone and shallow waters (Watling and Carlton 2007), although it has also been found up to 80 m deep (Martin 1977). It lives on a great variety of substrates such as seaweeds (Hammer and Zimmerman 1979) or hydroids (Dougherty and Steinberg 1953). In our study, \textit{C. mendax} was more abundant in shallow waters (up to 5 m) on seaweeds (\textit{Zonaria} cf. \textit{farlowii}) with epiphytic hydroids and on gorgonians (\textit{Leptogorgia rigida, Leptogorgia peruviana, Muricea} sp. and \textit{Pacifigorgia} sp.).

\textbf{Distribution}

\textit{Type locality.} California. Other records: Dillon Beach, Moss Beach and Pacific Grove-Monterey Bay, California (Dougherty and Steinberg 1953); Vancouver Island and Hecate Strait (British Columbia), San Juan Islands (Washington) (Laubitz 1970); off Humboldt Bay (Martin 1977); Mazatlán is the most southerly record of \textit{C. mendax} if validity of species is confirmed.

\textbf{Caprella pitu} sp. nov.  
(Figures 9–14)

\textbf{Type material}

Holotype male (MNCN 20.04/9211), Allotype female (MNCN 20.04/9212), Paratypes: 7 males (MNCN 20.04/9213-19), 4 females (MNCN 20.04/9220-23).

\textbf{Additional material examined}

Five males (MNCN 20.04/9224), 5 females (MNCN 20.04/9225), collected from Cerro Pelón (Isla Isabel), México, 25 m, on gorgonians (\textit{Pacifigorgia} cf. \textit{agassizii}); St1: 108 males, 110 females, 96 juveniles; St2: 4 males, 1 juveniles; St7: 212 males, 245 females, 326 juveniles; St8: 272 males, 356 females, 446 juveniles; St9: 17 males, 18 females; St10: 7 males, 19 females.

\textbf{Type locality}

Isla de Los Pájaros (Mazatlán), México, 3–6 m, on gorgonians (\textit{Leptogorgia rigida} and \textit{Leptogorgia peruviana}).
Figure 9. Caprella *pitu* sp. nov. Lateral and dorsal view, holotype male and allotype female. Scale bar x and y: 1 mm.
Figure 10. *Caprella pitu* sp. nov. Holotype male mouthparts. Scale bar x (Mx1, Mx2, LMd, RMd) y (Mxp) and z (UL, LL): 0.1 mm.
Figure 11. *Caprella pitu* sp. nov. Holotype male antennae, gnathopod 1 and 2. Allotype female gnathopod 2. Scale bar: x (A1, A2): 0.3 mm; y (Gn1-2): 1 mm.
Figure 12. *Caprella pitu* sp. nov. Holotype male pereopods 5–7 and abdomen. Allotype female abdomen. Scale bar: x (P5-7): 1 mm; y (Ad): 0.1 mm.
Figure 13. *Caprella pitu* sp. nov. Lateral and dorsal view variety ‘long-legs’ from Isla Isabel. Scale bar: 1 mm.
Figure 14. *Caprella pitu* sp. nov. Male pereopods 5–7 variety ‘long-legs’ from Isla Isabel. Scale bar: 1 mm.
Etymology
The species is dedicated to Emilio Sánchez ‘Pitu’, son of the first and second authors; used as a noun in apposition.

Diagnosis
Head with rostrum short and triangular. Body stout and wide with tiny tubercles. Peduncle of antenna 1 scarcely setose. Gnathopod 2 basis short with an anterior carina; palm of propodus with a acute projection medially and a rounded distal one. Pereopod 5–7 with carpus elongated and palm of propodus without grasping spines.

Description
Male holotype. Body length: 8.7 mm.

Lateral and dorsal view (Figure 9): Head rostrum short and triangular. Body stout and slightly flattened, with numerous tiny tubercles. Pereonites 2–7 decreasing in length respectively. In dorsal view, body wide, with lateral and flat expansions especially in pereonites 3 and 4 (about as wide as long). Strong pleural development.

Gills (Figure 9): Present on pereonites 3–4, rounded.

Mouthparts (Figure 10): Upper lip symmetrically bilobed with small setulae apically. Mandibles without palp, mandibular molar process strong, incisor and lacinia mobilis five-toothed, left and right mandible with three and two pectinated setae, respectively. Lower lip with inner lobes well-demarcated, inner and outer lobes setose apically. Maxilla 1 outer lobe with seven robust setae, distal article of the palp with six apical robust setae and 12 lateral setae. Maxilla 2 inner lobe oval and outer lobe rectangular, about 1.5 times as long as the inner lobe. Maxilliped inner plate oval with two robust and short setae and eight plumose setae; outer plate with four robust setae and eight long setae; palp four-articulate, with numerous long setae,article 4 with row of setulae on its grasping margin.

Antennae (Figure 9 and 11): Antenna 1 about half of body length; peduncle scarcely setose; article 1 and 2 enlarged; flagellum nine-articulate. Antenna 2 flagellum two-articulate and setose, carrying robust setae in the distal article; swimming setae present.

Gnathopods (Figure 11): Gnathopod 1 basis as long as ischium, merus and carpus combined, with an anterior denticulate carina and tiny tubercles; propodus palm with two proximal grasping spines and setae along the palm; dactylus elongate with rows of setulae. Gnathopod 2 inserted in the middle of pereonite 2 and with numerous tiny tubercles along all surface; basis short, about one-sixth as long as total length of gnathopod, with an anterior carina; propodus oval, length about 1.5 times width, palm of propodus without grasping spines, with an acute projection medially and a rounded distal one; dactylus short and wide with tiny tubercles.

Pereopods (Figure 12): Pereopods 3 and 4 absent. Pereopod 5–7 robust and increasing in length; basis, merus and carpus with a posterior carina with rows of setae; carpus elongated; palm of propodus without grasping spines; dactylus short and robust.

Penes (Figure 12): Situated medially, rounded.
Abdomen (Figure 12): With a pair of two-articulated appendages, a pair of lateral lobes and a single dorsal lobe.

Allotype female. Body length: 5.2 mm. Similar to male (Figures 9 and 11). Body wide, especially in pereonites 3 and 4 (width about twice length). Oostegites present, being slightly setose on pereonite 3. Antenna 1 peduncle not enlarged. Gnathopod 2 similar to male but propodus palm with a minor excavation between medial and distal projections. Abdomen with a pair of lateral lobes and a single dorsal lobe (Figure 12).

**Intraspecific variation**

Most of the morphological characters from *C. pitu* were rather constant. However, there are slight differences between populations from the type locality and other sites based especially on body length and the morphology of the pereopods 5–7 (Figures 9 and 13). In the type locality (Mazatlán), the individuals were more robust and longer than in other localities further south such as Isla Isabel and Bahía Banderas (length varied from 8.7 to 7.8 mm in males, and 5.2 to 4.3 mm in females). The length of the pereopods was apparently larger in specimens from Isla Isabel and these specimens were referred to as a ‘long-leg’ form. These differences are based mainly on the ratio between width and length of the merus and propodus (independently for males or females), which gives a relative appearance of greater length. For example, the propodus of pereopod 7 was one-third as wide as long in Mazatlán versus one-quarter in Isla Isabel; and the carpus was one-half and one-third, respectively (Figures 12 and 14).

**Remarks**

The new species is close to *Caprella penantis* Leach, 1814 in the general shape of the body. *Caprella penantis* is considered a cosmopolitan species with remarkable intraspecific morphological variation (Mayer 1903; McCain 1968; Laubitz 1972; Cabezas et al. 2010) and the taxonomic status of the different forms has been controversial for years (Cabezas et al. 2013).

Although *C. penantis* has been cited through the Pacific Ocean, the nearest record to the Mexican Pacific coast was cited by Laubitz (1972) from Monterey Bay but without location, date of collection or drawings. According to Watling and Carlton (2007), *C. penantis* could be an introduction to the California coast. Laubitz (1972) wrote that specimens of *C. penantis* from California were less setose and smaller than specimens from the Atlantic, but they showed the typical stout body and strong pleural development. In fact, our specimens are clearly smaller than *C. penantis* (8.7 mm as opposed to 14 mm). Recently, a genetic and morphological study on the *C. penantis* group has refuted the cosmopolitan distribution of this species and has highlighted the existence of at least four species (Cabezas et al. 2013). Our specimens were included in this study as ‘*C. penantis* from Mexico’ and the results demonstrated that it represents a different species from the *C. penantis* group. Additionally, Cabezas et al. (2013) pointed out the reciprocal monophyly of the two forms of *C. pitu* and suggested that the absence of gene flow between populations from Mazatlán and Isla Isabel could be an indication of the existence of two distinct species. However, we
have considered these as a single species due to the scarcity of morphological
differences between both forms and until more detailed studies can be carried out.

*Caprella pitu* and *C. penantis* can be distinguished mainly on the basis of the
following characteristics: male gnathopod 2 propodus less setose and with medial
projection in *C. pitu* and with proximal projection in *C. penantis* (or without projection
in some varieties); female gnathopod 2 propodus similar to male in *C. pitu*, with
medial projection, small excavation and distal rounded projection, while in *C. penantis*
female gnathopod 2 propodus is different to male with palm slightly convex with a
pair of proximal grasping spines; propodus pereiopod 5–7 without proximal grasping
spines in *C. pitu*, versus with grasping spines in *C. penantis*; carpus of pereiopod 5–7
elongate in *C. pitu* (half as wide as long in pereiopod 7) and subquadrate in *C. penantis*.

McCain (1968) reported the absence or reduction of grasping spines on the propodus
of pereiopods 5–7 in specimens of *C. penantis* taken on the gorgonian *Leptogorgia* from
Florida. *Caprella pitu* has been found exclusively on gorgonians and, in agreement with
Aoki and Kikuchi (1995) for *Caprella andreeae*, the adaptation to an ecologically isolated
habitat such as gorgonians could have led to its speciation. Potentially, the material of
McCain (1968) lacking grasping spines could also belong to a different species.

Another morphologically similar species from the California coast is *Caprella natalensis* Mayer, 1903 (= *C. angusta* in Dougherty and Steinberg 1953, and Laubitz 1970). It is considered to be the Pacific coast equivalent of *C. penantis* (Laubitz 1972) and it is very abundant along the California coast (Dougherty and Steinberg 1953; Martin 1977; Watling and Carlton 2007). The main differences between *C. pitu* and *C. natalensis* are basically similar to the differences with *C. penantis*. Additionally, the three species can be differentiated because pereonite 5 is usually longer than pereonites 6 and 7 in *C. natalensis* whereas in *C. pitu* and *C. penantis* it is shorter (three pereonites are subequal). Pleural development is not present in adults of *C. natalensis*.

**Habitat**

*Caprella pitu* has been found exclusively clinging to several species of gorgonians
(*Leptogorgia* sp., *Leptogorgia rigida*, *Leptogorgia peruviana*, *Pacificigorgia* sp and
*Pacificigorgia* cf. agassizii) from 2 to 25 m deep. It was more abundant on *L. rigida*
and *P. cf. agassizii* (some samples with more than 500 individuals). In some samples
from Mazatlán, it shared the substrates with other species such as *Aciconula acantho-
soma* and *Caprella mendax*; however it was the only species in the samples from Isla
Isabel and Bahía Banderas.

**Distribution**

The typical form has been collected from Mazatlán (St1, Isla de los Pájaros; St2, Isla
Venado), whereas the ‘long-leg’ form is known from Isla Isabel (St7, Las Monas;
St8- Cerro Pelón) and Bahía Banderas (St9- Islas Marietas; St10, Los Arcos).

*Liropus isabelensis* sp. nov.
(Figures 15–18)
Figure 15. *Liopus isabelensis* sp. nov. Holotype male lateral and dorsal view. Allotype female lateral view. Scale bar x: 0.5 mm; y: 1 mm.
Type material
Holotype male plus 1 slide (MNCN 20.04/9226), Allotype female plus 1 slide (MNCN 20.04/9227). Paratypes: 2 males (MNCN 20.04/9228-29), 1 female (MNCN 20.04/9230).

Additional material examined
St1: 1 male; St6: 3 males, 3 females; St8: 3 males, 1 female, 1 juvenile.

Type locality
Cerro Pelón (Isla Isabel), México, 25 m, on hydroids and bryozoans.

Etymology
Named *isabelensis* alluding to the National Park of Isla Isabel (Nayarit), México.

Diagnosis
Eyes present. Body dorsally smooth. Anterolateral acute and downward-directed projections on pereonite 2 and mediolateral on pereonite 3 in males and absent in females. Flagellum of antenna 1 five-articulate. Gnathopod 2 basis slightly longer than pereonite 2; ischium and propodus elongated. Pereopods 3, 4 and 5 one-articulate. Abdomen without appendages in males.
Figure 17. *Liopus isabelensis* sp. nov. Holotype male antennae, gnathopod 1 and 2. Allotype female gnathopod 2. Scale bar x (A1, A2) and y (Gn1-2): 0.1 mm.
Figure 18. *Liropus isabelensis* sp. nov. Holotype male pereopods 3–7 and abdomen. Allotype female abdomen. Scale bar x (P3-7) and y (Ad): 0.1 mm.
Description

Male holotype. Body length: 3.25 mm.

Lateral and dorsal view (Figure 15): Body dorsally smooth. Head rounded, eyes present. Pereonite 1 fused with head, suture present. Pereonite 2 with a pair of anterolateral acute and directed downwards projections. Pereonite 3 with a pair of mediolateral projections. Pereonite 5 the longest. Pereonite 7 the shortest.

Gills (Figure 15): Present on pereonites 3–4, oval. Gills on pereonite 3 about 2.5 times longer than those on pereonite 4.

Mouthparts (Figure 16): Upper lip symmetrically bilobed with small setulae apically. Mandibles with molar process and three-articulate palp; distal article of palp the longest, with one seta apically (lost in the dissection); second article of palp with one distal plumose seta; incisor and lacinia mobilis five-toothed; left and right mandibles with three and two pectinated setae respectively. Lower lip with inner lobes well-demarcated, inner and outer lobes setose apically. Maxilla 1 outer lobe carrying five robust setae; distal article of the palp with five apical setae. Maxilla 2 inner lobe oval, carrying five distal setae, and outer lobe rectangular, with six apical setae. Maxilliped inner plate rectangular carrying from inner to outer margin a nodular seta, two plumose setae and one seta; outer plate with four setae and one plumose seta apically; palp four-articulate, scarcely setose, third article provided with a projection.

Antennae (Figures 15 and 17): Antenna 1 about one-third of body length; peduncle scarcely setose; flagellum five-articulate. Antenna 2 about two-thirds of antenna 1; proximal peduncular article with a developed acute projection distally; swimming setae absent; flagellum two-articulate.

Gnathopods (Figure 17): Gnathopod 1 basis longer than ischium, merus and carpus combined (length about 1.5 times); propodus palm with proximal grasping spine and setae along the palm present. Gnathopod 2 inserted on the anterior half of pereonite 2; basis slightly longer than pereonite 2, with tiny tubercles on the proximal half; ischium elongated, half as long as basis; merus rounded; carpus short and triangular; propodus elongated, longer than basis, and four times as long as wide; palm with proximal projection with one grasping spine, followed by another proximal acute projection, margin setose; dactylus with setulae and widened medially.

Pereopods (Figure 18): Pereopod 3 and 4 small, one-articulate, with three or four setae apically, respectively. Pereopod 5 one-articulate, with five setae and one plumose seta apically. Pereopod 6–7 increasing in length, six-articulate and attached to the posterior end of the pereonite; propodus palm carrying a row of robust setae.

Penes (Figure 18): Situated medially, rounded.

Abdomen (Figure 18): A pair of lateral lobes, and a single dorsal lobe.

Allotype female. Body length: 2.6 mm. Similar to male except for the following characteristics (Figures 15 and 17): oostegites present, being slightly setose on pereonite 3 and 4; pereonite 2 and 3 lacking anterolateral and lateral projections, respectively; gnathopod 2 ischium less elongated than in male (one-quarter as long as basis), propodus oval, as long as basis, with only one proximal projection, dactylus not setose. Abdomen with a pair of lateral lobes and single dorsal lobe (Figure 18).
Remarks

Liropus isabelensis represents the 10th species from the genus Liropus Mayer, 1890. The other species included in the genus are as follows: L. africanus Mayer, 1920, L. azorensis Guerra-García, 2004, L. cachuchoensis Guerra-García, 2008, L. elongatus Mayer, 1890, L. gracilis Chevreux, 1927, L. japonicus Mori, 1995, L. minimus Mayer, 1890, L. minusculus Guerra-García and Hendrycks, 2013 and L. nelsonae Guerra-García, 2003. Most of the species have an Atlantic or Mediterranean distribution except L. japonicus, from Japanese waters, and L. minusculus, from California, USA. Therefore, the new species is the second record of the genus Liropus from the East Pacific coast.

A morphological comparison among Liropus species is given in Table 3. Liropus isabelensis can be distinguished from all other species mainly by the following characteristics: anterolateral acute and downwards-directed projections on pereonite 2, presence of mediolateral projections on pereonites 3 and gnathopod 2 ischium elongated. Liropus minusculus is the geographically nearer species and shares some characteristics with L. isabelensis such as pereopod 5 one-articulate and the anterolateral projections in pereonite 2 although this is more acute and downwards directed in the latter. Both species have the smallest size, although L. africanus and L. japonicus are also characterized by a very small size.

Habitat

This species was found attached to species of Thecata and Athecata hydroids, gorgonian (Muricea cf. californica), a bryozoan (Bugula sp.), the seaweed Zonaria cf. farlowii with epiphytic hydroids and several red seaweeds. They occur from 3 to 25 m deep, although always in low densities. Other caprellids, such as Paracaprella spp. and Aciconula acanthosoma, live on these substrates together with L. isabelensis.

Distribution

Liropus isabelensis has been found from the type locality, Isla Isabel, México (St6, Bahía Tiburón; St8, Cerro Pelón), and Mazatlán (St1, Isla de los Pájaros).

Paracaprella carballoi sp. nov.
(Figures 19–22)

Type material

Holotype male plus 5 slides (MNCN 20.04/9231), Allotype female (MNCN 20.04/9232). Paratypes: 2 males (MNCN 20.04/9233-34), 4 females (MNCN 20.04/9235-38).

Additional material examined

St1: 20 males, 19 females, 15 juveniles.
Table 3. Comparison of selected characters among the species of *Liropus*. Modified from Guerra-García et al. (2008) and Guerra-García and Hendrycks (2003).

| Character                        | L. africanus | L. azorensis | L. cachuchoensis | L. elongatus | L. gracilis | L. isabelensis | L. japonicus | L. minimus | L. minusculus | L. nelsonae |
|---------------------------------|--------------|--------------|------------------|--------------|-------------|---------------|--------------|-------------|---------------|-------------|
| **Body length (mm)**            | Male 3.5     | Female 6.7   | 5.3              | 5.3          | 5.0         | 12            | 3.25         | 3.8         | 4.5           | 3.3         | 7.9         |
| **Head projections**            | One pair, anterolateral | Absent | One pair, anterolateral | Absent | One, anterior projection (=rostrum) | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| **Eyes**                        | Present | Without distinguishable ommatidia | Absent | Present | Present | Present | Small thickened anteriorly | Present | Present | Present |
| **Dorsal projections**          | Absent | Absent | On pereonites 3,4,5 in males, on 3 and 5 in females | Absent | On pereonite 3 in males, absent in females | Absent | Absent | Absent | Absent | Absent |
| **Pereonite 2 anterolateral projections in males** | Present, small and rounded | Absent | Present, small, acute and forwards directed | Absent | Present, acute and downwards directed | Absent | Absent | Absent | Present, acute and forwards directed | Absent | Absent |
| **Pereonites 3-4 anterolateral projections in males** | Absent | Absent | Absent | Absent | Absent | Present, acute and forwards directed | Absent | Absent | Absent | Absent | Absent |
| **Pereonites 3 mediolateral projections in males** | Absent | Absent | Absent | Absent | Absent | Present | Absent | Absent | Absent | Absent | Absent |
| **Antenna 1 flagellum, no. of articles** | %6 | 8–9 | 4–5 | 5–6 | 10 | 5 | 2 | 5 | 5 | 5 | 5 |
| **Gnathopod 2 ischium**         | Rectangular | Rectangular | Rectangular | Rounded | Rectangular | Elongated | Rectangular | Rectangular | Rectangular | Rectangular | Rectangular |
| **Pereopods 3 and 4, no. of articles** | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Pereopod 5, no. of articles** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 3 |
| **Male abdominal appendages**   | 1-articulate | 2-articulate | Vestigial | 1-articulate | 1-articulate | Absent | Vestigial | 1-articulate | 2 pairs, 1-articulate | Vestigial |
| **Female abdominal appendages** | 2-articulate | 2-articulate | Vestigial | 2-articulate | 1-articulate | Absent | Vestigial | 1-articulate | 2 pairs, 1-articulate | Vestigial |
Figure 19. *Paracaprella carballoi* sp. nov. Lateral view, holotype male and allotype female. Scale bar: 1 mm.
Figure 20. *Paracaprella carballoi* sp. nov. Holotype male mouthparts. Scale bar: 0.05 mm.
Figure 21. *Paracarella carballoi* sp. nov. Holotype male antennae, gnathopod 1 and 2. Allotype female gnathopod 2. Scale bar: x (Gn1-2): 0.4 mm; y (A1, A2): 0.2 mm.
Figure 22. *Paracaprella carballoi* sp. nov. Holotype male pereopods 3–7 and abdomen. Allotype female abdomen. Scale bar: x (P3-4): 0.05 mm; y (Ad): 0.05; z (P5-7): 0.1 mm.
Type locality
Isla de los Pájaros (Mazatlán), México, 3–6 m, on the seaweed *Zonaria cf. farlowii* with epiphytic hydroids.

Etymology
The species is dedicated to Dr José Luis Carballo for his important contribution to the knowledge of the benthic fauna from the Pacific coast of México.

Diagnosis
Head rounded. Pereonite 2 with a rounded and narrow anteroventral projection in adult males, absent in females. Mandibles with molar process and palp reduced to a long seta. Flagellum of antenna 1 nine-articulate. Propodus of gnathopod 2 palm with rectangular projection proximally, carrying two proximal grasping spines and a distal robust tooth. Pereopod 3 and 4 two-articulate. Pereopod 5–7 without grasping spines. Abdomen with a pair of setose uni-articulate appendages.

Description
Male holotype. Body length: 5 mm.

Lateral view (Figure 19): Head rounded. Pereonite 1 fused with head, suture present. Body dorsally smooth, except anterodorsal blunt protuberance on pereonite 2 (absent in immature males). Pereonite 2 with a rounded and narrow anteroventral projection. Pereonite 3 the longest. Pereonite 7 the shortest.

Gills (Figure 19): Present on pereonites 3–4, oval. Gills on pereonite 3 about twice as long as those on pereonite 4.

Mouthparts (Figure 20): Mandibles with molar process and palp reduced to a long seta; incisor and lacinia mobilis five-toothed; left and right mandibles with three and two pectinated setae, respectively. Maxilla 1 outer lobe carrying six robust-stout setae; distal article of the palp with three robust-stout setae and three marginal setae. Maxilla 2 inner lobe oval, carrying four distal setae, and outer lobe elongated, with five apical setae. Maxilliped inner plate rectangular carrying three setae apically; outer plate with six submarginal and two apical setae; palp four-articulate, setose; third article provided with a large distal process and setose apically; terminal article with a row of setulae on grasping margin, and one seta subdistally. Upper and lower lip lost in dissection.

Antennae (Figures 19 and 21): Antenna 1 shorter than the combined lengths of head and pereonite 2–3. Peduncle scarcely setose; flagellum nine-articulate. Antenna 2 a little shorter than peduncle of antenna 1; proximal peduncular article with a small acute projection distally; swimming setae absent; flagellum two-articulate, proximal article c. 2.5 times the length of the distal one.

Gnathopods (Figure 21): Gnathopod 1 basis as long as ischium, merus and carpus combined; propodus palm with a single proximal grasping spine; grasping margin of propodus serrated with setae; distal ventral margin of dactylus with one tooth. Gnathopod 2 inserted on the anterior half of pereonite 2; basis elongated slightly shorter than pereonite 2, with two distal short processes on lateral margin; propodus length about twice width; propodus palm with rectangular projection proximally,
carrying two proximal grasping spines and a distal robust tooth; grasping margin setose; dactylus thickened medially and setose.

Pereopods (Figures 19 and 22): Pereopod 3 and 4 two-articulate, both with four setae apically on distal article and two setae subdistally on basal article. Pereopod 5–7 increasing in length, six-articulate and attached to the posterior end of the pereonite, with several plumose setae. Palm of propodus of pereopod 5 with a proximal short knob bearing a small spine; palm of pereopod 6–7 with several proximal short knobs, each bearing a small spine. Grasping spines absent.

Penes (Figure 22): Penes short, situated laterally.

Abdomen (Figure 22): A pair of setose uni-articulate appendages, a pair of lateral lobes, and a single dorsal lobe.

Allotype female. Body length: 4.4 mm. Similar to male except for the following morphological characteristics (Figures 19 and 21): oostegites present, being slightly setose on pereonite 3 and 4; anterolateral projection on pereonite 2 absent; flagellum of antenna 1 eight-articulate; propodus of gnathopod 2 oval, with a proximal knob bearing a grasping spine, dactylus not setose. Abdomen with a pair of lateral lobes and single dorsal lobe carrying two setae (Figure 22).

Habitat
Paracaprella carballoi was mainly found attached to the seaweed Zonaria cf. farlowii with abundant small hydroids on underside of thallus, between 3–6 m depth. On these substrates it was relatively abundant. Also it has been found on the gorgonian Leptogorgia rigida, although in low densities. Other caprellids on these substrates were Aciconula acanthosoma, Caprella mendax, C. pitu and Liropus isabelensis.

Distribution
Paracaprella carballoi has been found so far from the type locality, Isla de los Pájaros (Mazatlán), México.

Paracaprella isabelae sp. nov.
(Figures 23–26)

Type material
Holotype male (MNCN 20.04/9239), Allotype female (MNCN 20.04/9240). Paratypes: 4 males (MNCN 20.04/9241-44), 4 females (MNCN 20.04/9245-48).

Additional material examined
St6: 12 males, 14 females, 34 juveniles; St7: 65 males, 56 females, 32 juveniles; St8: 12 males, 5 females, 3 juveniles.

Type locality
Las Monas (Isla Isabel), México, 6 m, on hydroids and bryozoans.
Figure 23. *Paracaprella isabelae* sp. nov. Holotype male lateral, ventral and dorsal view. Allotype female lateral view. Scale bar: 1 mm.
Etymology
The species is dedicated to Isabel Sánchez, daughter of the first and second authors. She was born just after the sample survey of this study.

Figure 24. *Paracaprella isabelae* sp. nov. Holotype male mouthparts. Scale bar x (Mx1, Mx2, LMd, RMd, LL, UL) and y (Mxp): 0.05 mm.

*Etymology*

The species is dedicated to Isabel Sánchez, daughter of the first and second authors. She was born just after the sample survey of this study.
Figure 25. *Paracaprella isabelae* sp. nov. Holotype male antennae, gnathopod 1 and 2. Allotype female gnathopod 2. Scale bar x (A1, A2) and y (Gn1-2): 0.2 mm.
Figure 26. *Paracaprella isabelae* sp. nov. Holotype male pereopods 3–7 and abdomen. Allotype female abdomen. Scale bar: x (P5-7): 0.3 mm; y (Ad): 0.1; z (P3-4): 0.05 mm.
**Diagnosis**

Head rounded and dorsally humped. Large bifid sharp-pointed anterolateral projection on anterior margin of pereonite 2 in males, simple and rounded in females. Pereonite 3 with a rounded anterolateral projection in males. Short ventral forward-directed projection with ‘raspberry’-like surface between the gnathopods 2. Mandibles with molar process and without palp. Flagellum of antenna 1 10-articulate. Coxa of gnathopod 2 with a tubercle with ‘raspberry’-like surface in males. Propodus palm of gnathopod 2 with rectangular projection proximally, bearing one proximal grasping spine and a distal long robust tooth in males. Pereopod 3 and 4 two-articulate. Pereopod 5–7 without grasping spines. Abdomen with a pair of setose uni-articulate appendages in males.

**Description**

Male holotype. Body length: 5.4 mm.

Lateral and dorsal view (Figure 23): Head rounded and dorsally humped, eyes present. Pereonite 1 fused with head, suture present. Body dorsally smooth, except blunt dorsal protuberance in the middle of pereonites 2–3. Large adult with other blunt dorsal posterior protuberance on pereonite 2. Large bifid sharp-pointed anterolateral projection on anterior margin of pereonite 2. It has a short ventral forward-directed projection with ‘raspberry’-like surface between gnathopods 2. Pereonite 3 with a rounded anterolateral projection. Pereonite 3 the longest. Pereonite 7 the shortest.

Gills (Figure 23): Present on pereonites 3–4, oval. Gills on pereonite 3 about twice as long as those on pereonite 4.

Mouthparts (Figure 24): Upper lip symmetrically bilobed without setulae apically. Mandibles with molar process and without palp; incisor and lacinia mobilis five-toothed; left and right mandibles with three and two pectinated setae, respectively. Lower lip with inner lobes well-marked and with a medial suture, outer lobes setose apically. Maxilla 1 outer lobe carrying six robust-stout setae; distal article of the palp with three robust and two long apical setae. Maxilla 2 inner lobe oval, carrying four distal setae, and outer lobe elongated, with five apical setae. Maxilliped inner plate rectangular carrying three setae apically; outer plate with six submarginal setae; palp four-articulate, scarcely setose; third article provided with a large distal process and setose apically; terminal article with a row of setulae on grasping margin, and two setae subdistally.

Antennae (Figures 23 and 25): Antenna 1 shorter than the combined lengths of head and pereonite 2–3. Peduncle setose; flagellum 10-articulate. Antenna 2 a little shorter than peduncle of antenna 1; proximal peduncular article with a short acute projection distally; swimming setae absent; flagellum two-articulate, proximal article 2 times the length of the distal one.

Gnathopods (Figure 25): Gnathopod 1 basis as long as ischium, merus and carpus combined; propodus palm with a single proximal grasping spine; grasping margin of propodus with setae; ventral margin of dactylus with several teeth. Gnathopod 2 inserted on the anterior half of pereonite 2; coxa bearing anteriorly a tubercle with ‘raspberry’-like surface; basis elongated slightly shorter than pereonite 2, without proximal serrated knob on ventral margin; propodus length about twice width;
propodus palm with rectangular projection proximally, carrying one proximal grasping spine and a distal long robust tooth; grasping margin setose; dactylus thickened medially and setose.

Pereopods (Figures 23 and 26): Pereopod 3 and 4 two-articulate, with five and four setae apically, respectively, and one seta distally on basal article. Pereopod 5–7 increasing in length, six-articulate and attached to the posterior end of the pereonite, with several plumose setae. Palm of propodus of pereopod 5 with a proximal knob bearing a small spine; palm of pereopod 6–7 with several proximal knobs, each bearing a small spine. Grasping spines absent.

Penes (Figure 26): Penes short, situated laterally.

Abdomen (Figure 26): A pair of setose uni-articulate appendages, a pair of lateral lobes, and a single dorsal lobe.

Allotype female. Body length: 4.2 mm. Similar to male except for the following characteristics (Figures 23 and 25): oostegites present, being slightly setose on pereonite 3; small and rounded anterolateral projection on pereonite 2, lacking anterolateral projection on pereonite 3; flagellum of antenna 1 six-articulate; propodus of gnathopod 2 oval, with a proximal knob bearing a grasping spine and a plumose seta, dactylus not setose. Abdomen with a pair of lateral lobes and single dorsal lobe carrying two plumose setae (Figure 26).

Habitat

This species has been found on several substrates along the coast of Isla Isabel from 1 to 25 m depth. It was more abundant on hydroids and Bryozoan (Bugula sp.) at 6 m depth, although it was also recorded on gorgonians (Pacifigorgia cf. agassizi), and several red seaweeds. Other caprellids such as Aciconula acanthosoma, Caprella pitu, C. equilibra or Liropus isabelensis live on these substrates together with P. isabelae.

Distribution

Paracaprella isabelae has been found from the type locality, Isla Isabel, México (St6, Bahía Tiburón; St7, Las Monas; St8, Cerro Pelón).

Remarks on Paracaprella spp.

So far, the genus Paracaprella Mayer, 1890 is represented by eight species: P. alata Mayer, 1903; P. barnardi McCain, 1967; P. crassa Mayer, 1903; P. digitimanus Quitete, 1971; P. guerragarciai Winfield and Ortiz, 2013; P. insolita Arimoto, 1980; P. pusilla Mayer, 1890; and P. tenuis Mayer, 1903. The main differences between Paracaprella spp. and the two new species, P. carballoi and P. isabelae, are summarized in Table 4. Paracaprella insolita has been excluded because only females have been described and it is the only Paracaprella with a characteristic projection dorsally on the head (Arimoto 1980).

Paracaprella carballoi is morphologically close to P. barnardi and P. pusilla, but can be distinguished by the following characters: both P. carballoi and P. pusilla have a smooth body dorsally with an anterodorsal blunt protuberance on pereonite 2, whereas P. barnardi has a large tubercle in this position; the anterolateral projection of pereonite 2 is rounded and narrow as opposed to the sharp-pointed projection in the others; pereonite 4 and 5 are subequal in length whereas pereonite 3 is the longest;
Table 4. Comparison of selected characters in males among the species of *Paracaprella* based on data from Mayer (1903), McCain (1967, 1968), Quitete (1971), Laubitz (1972), Arimoto (1976), Sivaprakasam (1977), Diaz et al. (2005), Guerra-García et al. (2006) and Winfield and Ortiz (2013). *P. insolita* excluded.

|                         | P. adata | P. barnardi | P. carballoi | P. crassa | P. digitimanus | P. guerragarciai | P. isabelae | P. pusilla | P. tenuis |
|-------------------------|----------|-------------|--------------|-----------|----------------|------------------|-------------|------------|-----------|
| **Body length (mm)**    | 7        | 5.5         | 5            | 4.6       | 4.4            | 3.6              | 5.4         | 3.5        | 7         |
| **Head**                | Rounded  | Rounded     | Rounded      | Rounded   | Smooth         | Smooth and setae | Rounded     | Smooth     | Smooth    |
| **Dorsal margin**       | Smooth   | Smooth, except anterodorsal blunt protuberance on pereonite 2 | Smooth, except blunt posterior protuberance on pereonite 2 | Smooth, except blunt protuberance in the middle of the pereonites 2-3, and blunt posterior protuberance on pereonite 2 | Smooth, except blunt protuberance on pereonite 2 | Smooth, except anterodorsal tubercle on pereonite 2 | Smooth, except blunt posterior protuberance on pereonite 2 | Smooth, except blunt anterior tubercle on pereonite 2 | Smooth, except blunt protuberance on pereonite 2 |
| **Pereonite 2 anterolateral projections** | Triangular and sharp-pointed | Sharp-pointed | Rounded and narrow | Sharp-pointed and upwards | Triangular | Large and subrectangular | Large, bifid and sharp-pointed | Large and sharp-pointed | Small and rounded |
| **Pereonites 3 and 4 anterolateral projections** | Triangular on pereonite 3 and small and rounded on pereonite 4 | Absent | Absent | Absent | Triangular on pereonite 3 | Absent | Rounded on pereonite 3 | Absent | Absent |
| **Pereonites 3 and 4 mediolateral projections** | Absent | Absent | Absent | Three blunt projections | Absent | Absent | Absent | Absent | Absent |
| **Pereonites 3, 4 and 5 length** | Subequal | Pereonite 3 and 4 subequal, pereonite 5 the shortest | Pereonite 3 and 4 subequal, pereonite 5 the shortest | Subequal | Subequal | Pereonite 4 and 5 subequal, pereonite 3 the longest | Pereonite 3 and 4 subequal, pereonite 5 the shortest | Subequal |
| **Antenna 1 flagellum, no. of articles** | 9 | 10 | 9 | 11 | 7 | 9 | 10 | 9 | 7–10 |
| **Antenna 2 flagellum, length proximal in relation to distal article** | c. 2 times longer | c. 2 times longer | c. 2.5 times longer | c. 2 times longer | Subequal | c. 2 times longer | Subequal | c. 2.5 times longer | Subequal |
| **Gnathopod 2 basis**   | Elongated | Elongated | Elongated, two distal short processes on lateral margin | Elongated | Elongated | Elongated, proximal serrated knob | Elongated | Elongated | Elongated |

(Continued)
|                      | Gnathopod 2 propodus palm, proximal projection | Rectangular, one grasping spine and short-robust tooth | Rectangular, two grasping spines and robust tooth | Rectangular, three teeth | Quadrato, one grasping spine, short-robust tooth and a digitiform projection | Rectangular, one grasping spine and long-robust tooth | Rectangular, one grasping spine and robust tooth | Rectangular and large, one small grasping spine and short-robust tooth |
|----------------------|-----------------------------------------------|------------------------------------------------------|-------------------------------------------------|--------------------------|--------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------|--------------------------------------------------|
|                      | Gnathopod 1 propodus palm, no. of grasping spine | 1                                                    | 1                                               | 1                        | ?                                                                             | 2                                               | 1                                               | 1                                                 |
| Mandibular palp      | Absent                                        | A simple seta                                        | A simple seta                                  | Absent                   | A simple seta                                                                  | Absent                                         | A simple seta                                   | Variable, a simple seta to three-articulated     |
basis of gnathopod 2 elongated without proximal serrated knob but with two distal short processes on lateral margin; gnathopod 2 propodus palm with rectangular proximal projection bearing two grasping spines, but only one in all other species of the genus (except *P. crassa*, without grasping spines and carrying three teeth); and mandibular palp as a simple seta (similar to *P. barnardi*, *P. pusilla* and *P. guerragarcia*).

*Paracaprella isabelae* can be distinguished from all other species mainly by the following characteristics: head rounded and dorsally humped (similar to *P. crassa*, with which it also shares a blunt posterior protuberance on pereonite 2); large and bifid sharp-pointed anterolateral projection on pereonite 2 (in other species can be sharp-pointed but always single); rounded anterolateral projections on pereonite 3 (similar to *P. alata* although triangular on pereonite 3 and small and rounded on pereonite 4 in this case; triangular in *P. digitimanus*; and absent in the other species of the genus); short ventral forward directed projection with ‘raspberry’-like surface between gnathopods 2; pereonite 4 and 5 subequal in length and pereonite 3 the longest, similar to *P. carballoi*; and mandibular palp absent as is the case of *P. alata* and *P. digitimanus*.

According to Winfield and Ortiz (2013), the genus *Paracaprella* has a geographic distribution encompassing temperate, subtropical and tropical seas. However, only *P. barnardi* and *P. pusilla* have been recorded so far from the American Pacific coast. While *P. barnardi* has a more local distribution (it has only been recorded from the type locality in Culebra Island, Panama), *P. pusilla* is the species of the genus with a more worldwide distribution and it is the only species found in European waters, presumably introduced by ship fouling (Ros and Guerra-García 2012; Ros et al. 2013), even though it has only been cited from the American coast in Chile (Guerra-García and Thiel 2001). Hence, both *P. carballoi* and *P. isabelae* represent the northernmost records of the genus on the East Pacific coast.

Acknowledgements

The authors are very grateful to the Laboratorio de Ecología del Bentos from Instituto de Ciencias del Mar y Limnología de la Universidad Autónoma de México in Mazatlán, for the facilities provided during sampling. Special thanks to Dr José Luis Carballo for his friendship, hospitality and assistance during the stay in México. Thanks are also due to the crew members of the CONANP’s ship for assistance and hospitality during sampling in the National Park of Isla Isabel (Nayarit), and to Consejería de Innovación, Ciencia y Empresa de la Junta de Andalucía, Spain for financial support.

References

Alarcón-Ortega LC, Guerra-García JM, Sánchez-Moyano JE, Cupul-Magaña FG. 2012. Feeding habits of caprellids (Crustacea: Amphipoda) from the west coast of Mexico. Do they feed on their hosting substrates? Zool baetica. 23:11–20.
Aoki M, Kikuchi T. 1995. Notes on *Caprella andreae* Mayer, 1890 (Crustacea, Amphipoda) from the carapace of loggerhead sea turtles in the East China Sea and in Kyushu, Japan. Proc Jpn Soc Syst Zool. 53:54–61.
Arimoto I. 1976. Taxonomic studies of caprellids (Crustacea, Amphipoda, Caprellidae) found in the Japanese and adjacent waters. Seto Mar Biol Lab, Spec Publ. 3:1–229.
Arimoto I. 1980. Supplements to the Japanese caprellid fauna. I. Caprellids from the Korean Straits and adjacent waters. Publ Seto Mar Biol Lab. 25:95–113.

Cabezas MP, Cabezas M, Machordom A, Guerra-García JM. 2013. Hidden diversity and cryptic speciation refute cosmopolitan distribution in Caprella penantis (Crustacea: Amphipoda: Caprellidae). J Zool Syst Evol Res. 51:85–99. doi:10.1111/jzs.12010

Cabezas MP, Guerra-García JM, Baeza-Rojano E, Redondo-Gómez M, Figueroa E, Luque T, García-Gómez JC. 2010. Exploring molecular variation in the cosmopolitan Caprella penantis (Crustacea: Amphipoda); results from RAPD analysis. J Mar Biol Assoc U K. 90:617–622. doi:10.1017/S00253154099990828

Caine EA. 1991. Caprellid amphipods: fast food for the reproductively active. J Exp Mar Biol Ecol. 148:27–33. doi:10.1016/0022-0981(91)90144-L

Cavedini P. 1982. Contributo alla conoscenza dei Caprellidi del Mediterraneo (Crustacea, Amphipoda). Boll Mus Civ St Nat Verona. 8:493–531.

Chess JR. 1989. Aciconula acanthosoma, new species, a caprellid amphipod from Southern California, with notes on its ecology. J Crust Biol. 9:662–665. doi:10.2307/1548595

Chevreaux E. 1927. Crustacés Amphipodes. Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882, 1883. Malacostracés. 3:1–229.

Chevreaux E, Fage L. 1925. Amphipodes. Faune de France. 9:1–488.

Diaz YJ, Guerra-García JM, Martín A. 2005. Caprellids (Crustacea: Amphipoda: Caprellidae) from shallow waters of the Caribbean coast of Venezuela. Org Divers Evol. 5:249–251. doi:10.1016/j.ode.2004.11.010

Dougherty EC, Steinberg EE. 1953. Notes on the skeleton shrimps (Crustacea: Caprellidae) of California. Proceed Biol Soc Wash. 66:39–50.

Ekman S. 1953. Zoogeography of the Sea. London: Sidgwick and Jackson Ltd.

Guerra-García JM. 2001. Habitat use of the Caprellidea (Crustacea: Amphipoda) from Ceuta, North Africa. Ophelia. 55:27–38. doi:10.1080/00785236.2001.10409471

Guerra-García JM. 2003. Two new species of deep-water caprellids (Crustacea: Amphipoda) from northeastern Brazil. Cah Biol Mar. 44:171–184.

Guerra-García JM. 2004. The Caprellidea (Crustacea, Amphipoda) from Western Australia and Northern Territory, Australia. Hydrobiologia. 522:1–74. doi:10.1023/B:HYDR.0000029929.07691.a7

Guerra-García JM, Hendrycks EA. 2013. A new species of Liropus (Crustacea, Amphipoda, Caprellidae) from California, USA, with an illustrated key of the genus. Zootaxa. 3718:467–476. doi:10.11646/zootaxa.3718.5.3

Guerra-García JM, Krapp-Schickel T, Müller HG. 2006. Caprellids from the caribbean coast of Colombia, South America, with description of three new species and a key for species identification. Bol INVEMAR. 35:149–194.

Guerra-García JM, Sorbe JC, Frutos I. 2008. A new species of Liropus (Crustacea, Amphipoda, Caprellidae) from Le Danois bank (southern Bay of Biscay). Org Divers Evol. 7:253e1–253e12.

Guerra-García JM, Thiel M. 2001. La fauna de caprélidos (Crustacea: Amphipoda: Caprellidae) de la costa de Coquimbo, centro-norte de Chile, con una clave taxonómica para la identificación de las especies. Rev Chil Hist Nat. 74:873–883. doi:10.4067/S0716-078X2001000400014

Guerra-García JM, Tierno de Figueroa JM. 2009. What do caprellids (Crustacea: Amphipoda) feed on? Mar Biol. 156:1881–1890. doi:10.1007/s00227-009-1220-3
Hammer RM, Zimmerman RC. 1979. Species of demersal zooplankton inhabiting a kelp forest ecosystem off Santa Catalina Island, California. Bull South Calif Acad Sci. 78:199–206.

Krapp-Schickel T. 1993. Suborder Caprellidea. In: Ruffo S, editor. The Amphipoda of the Mediterranean. Mem Inst Oceanogr Monaco. 13:773–809.

Laubitz DR. 1970. Studies on the Caprellidae (Crustacea: Amphipoda) of the American North Pacific. Natl Mus Nat Sci, Ottawa, Publ Biol Oceanogr. 1:1–89.

Laubitz DR. 1972. The Caprellidae (Crustacea, Amphipoda) of Atlantic and Arctic Canada. Natl Mus Nat Sci, Ottawa, Publ Biol Oceanogr. 4:1–82.

Laubitz DR, Lewbel GS. 1974. A new species of caprellid (Crustacea: Amphipoda) associated with gorgonian octocorals. Can J Zool. 52:549–551. doi:10.1139/z74-070

Leach WE. 1814. Crustaceology. Edinb Encyclopaedia. 7:383–434.

Lowry JK, Myers AA. 2013. A Phylogeny and Classification of the Senticaudata subord. nov. Crustacea: Amphipoda). Zootaxa. 3610:1–80. doi:10.11646/zootaxa.3610.1.1

Martin DM. 1977. A survey of the family Caprellidae (Crustacea: Amphipoda) from selected sites along the northern California coast. Bull South Calif Acad Sci. 76:146–167.

Mayer P. 1882. Caprelliden. Fauna und flora des golfes von Neapel und der angrenzenden Meeres-Abschnitte. 61:1–201.

Mayer P. 1890. Die Caprelliden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Fauna Flora Golf Neapel. 17:1–55.

Mayer P. 1903. Die Caprellidae der Siboga-Expedition. Siboga-Expeditione. 34:1–160.

Mayer P. 1920. Crustacea V: Laemodipoda. In: Michaelsen W, editor. Beiträge zur Kenntnis der Meeresfauna Westafrikas 3:13–15.

McCain JC. 1966. Abyssicaprella galatheae, a new genus and species of abyssal caprellid (Amphipoda: Caprellidae). Galathea Re. 8:91–95.

McCain JC. 1967. Paracaprella barnardi, a new species of caprellid (Crustacea: Amphipoda) from the West Coast of Panama. Proc Biol Soc Wash. 80:219–222.

McCain JC. 1968. The Caprellidae (Crustacea: Amphipoda) of the Western North Atlantic. US Natl Mus Bull. 278:1–147. doi:10.5479/si.03629236.278

McCain JC, Steinberg JE. 1970. Amphipoda-I, Caprellidea-I. Crustaceorum Catalogus. 2:1–78.

Mori A. 1995. A new species of Liopus (Crustacea: Amphipoda: Caprellidea) from off Minabe, Kii Peninsula, Central Japan. Publ Seto Mar Biol Lab. 36:329–337.

Myers AA, Lowry JK. 2003. A phylogeny and a new classification of the Corophiidea Leach, 1814 (Amphipoda). J Crust Biol. 23:443–485. doi:10.1163/20021975-99990353

Quitete JMPA. 1971. Paracaprella digitimanus, nova espécie de Caprellidae da costa brasileira (Crustacea: Amphipoda). Atas Soc Biol Rio do Janeiro. 14:161–164.

Ros M, Guerra-García JM. 2012. On the occurrence of the tropical caprellid Paracaprella pusilla Mayer, 1890 (Crustacea: Amphipoda) in Europe. Mediterr Mar Sci. 13:134–139.

Ros M, Vázquez-Luis M, Guerra-García JM. 2013. The tropical caprellid amphipod Paracaprella pusilla: a new alien crustacean in the Mediterranean Sea. Helgol Mar Res. doi:10.1007/s10152-013-0353-4

Say T. 1818. An account of the Crustacea of the United States. J Acad Nat Sci Philadelphia. 1:374–401.

Scinto A, Bavestrello G, Boyer M, Previati M, Cerrano C. 2008. Gorgonian mortality related to a massive attack by caprellids in the Bunaken Marine Park (North Sulawesi, Indonesia). J Mar Biol Assoc UK. 88:723–727. doi:10.1017/S002531540800129X

Sivaprakasam TE. 1977. The skeleton shrimps (Amphipoda: Caprellidea) of the Tamil Nadu and Kerala coasts. J Mar Biol Assoc India. 19:78–96.

Stimpson W. 1857. The Crustacea and Echinodermata of the Pacific shores of North America. Boston J Nat Hist. 6:444–532.
Stoddart HE, Lowry JK. 2003. Zoological catalogue of Australia. Crustacea: Malacostraca: Peracarida: Amphipoda, Cumacea, Mysidacea. Volume 19.2B. Victoria, Australia: CSIRO Publishing.

Takeuchi I, Takahashi S, Tanabe S, Miyazaki N. 2004. Butyltin concentrations along the Japanese coast from 1997 to 1999 monitored by Caprella spp. (Crustacea: Amphipoda). Mar Environ Res. 57:397–414. doi:10.1016/j.marenvres.2003.11.005

Templeton R. 1836. Descriptions of some undescribed exotic Crustacea. T Entomol Soc London. 1:185–198.

Watling L, Carlton JT. 2007. Caprellidae. In: Carlton JT, editor. The light and smith manual of the intertidal invertebrates from central California to Oregon. Berkeley and Los Angeles, California: University of California Press; p. 618–628.

Winfield I, Ortiz M. 2013. The Caprellidea (Crustacea: Peracarida: Amphipoda) from the Gulf of Mexico with a description of a new species of Paracaprella. Sci Mar. 77:161–168. doi:10.3989/scimar.03753.26C

Woods CMC. 2009. Caprellid amphipods: an overlooked marine finfish aquaculture resource? Aquaculture. 289:199–211. doi:10.1016/j.aquaculture.2009.01.018