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Abstract

A new species of *Leptalpheus* is described from Estero Pérula, Jalisco, on the Pacific coast of Mexico. *Leptalpheus corderoae* sp. nov. is most similar to *Leptalpheus azuero* Anker, 2011 from Panama and *Leptalpheus axianassae* Dworschak & Coelho, 1999 from Brazil, differing from both of them by a combination of morphological characters, especially the presence of tubercles on the ventral surface of the major chela palm and pollex. The most common host of *L. corderoae* sp. nov. at the type locality is the callianassid ghost shrimp *Lepidophthalmus bocourti* (A. Milne Edwards, 1870). Additional specimens of *Leptalpheus mexicanus* Ríos & Carvacho, 1983, from Estero de Urías, Sinaloa, are reported and compared to the type material from Río Mulegé, as well as to *Leptalpheus bicristatus* Anker, 2011 from Panama. Finally, *Leptalpheus hendrickxi* Anker, 2011 is reported from Mexico for the first time, representing a significant northward range extension of the species. In Estero Pérula, *L. hendrickxi* lives in burrows of *Lepidophthalmus bocourti*, sometimes together with *L. corderoae* sp. nov.

Key words: *Leptalpheus*, Mexico, infaunal shrimp, burrows, Callianassidae, East Pacific

Introduction

The alpheid shrimps of the genus *Leptalpheus* Williams, 1965 are generally associated with larger burrowing decapods of the families Callianassidae, Axianassidae and Upogebiidae. The 14 currently known species occur in marine shallow waters of the Indo-West Pacific, eastern Pacific, and western Atlantic (Williams 1965; Ríos & Carvacho 1983; Anker et al. 2006; Anker & Marin 2009; Anker 2011). Several additional species are known but are as yet undescribed, partly because the specimens collected so far are either incomplete or represent juvenile stages (Anker 2011). Five species have so far been reported from the eastern Pacific: *Leptalpheus mexicanus* Ríos & Carvacho, 1983 (Mexico to Colombia), *Leptalpheus azuero* Anker, 2011, *Leptalpheus bicristatus* Anker, 2011, *Leptalpheus hendrickxi* Anker, 2011, and *Leptalpheus penicillatus* Anker, 2011 (Panama) (Anker 2011).

Recent samplings in coastal lagoons along the Pacific coast of Mexico resulted in the collection of a relatively large series of specimens of *Leptalpheus* representing two of the previously described species (*L. hendrickxi* and *L. mexicanus*) and a species new to science. This material is reported herein.

Material and methods

In December 2010, two specimens of *Leptalpheus* were collected during a routine survey in the Estero de Urías, part of the "Urías" coastal lagoon system, Sinaloa, in the southeastern Gulf of California. In March and June 2013 several additional specimens of *Leptalpheus* were collected in the Estero Pérula, in Bahía Chamela, Jalisco, as part
of a project developed by the Departamento de Ecología, Centro Universitario de Ciencias Biológicas y Agropecuarias (CUCBA), Universidad de Guadalajara. Both collecting sites (Fig. 1) are characterized by a muddy bottom with numerous low mounds marking burrow openings of the mud shrimps *Upogebia dawsoni* Williams, 1986, *Neotrypaea tabogensis* (Sakai, 2005) (see Ayón-Parente et al. 2013), and *Lepidophthalmus bocourti* (A. Milne Edwards, 1870). All shrimps were captured using a yabby pump operated in very shallow water (0–30 cm depth). The material is deposited in the Regional Collection of Marine Invertebrates, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México (UNAM), in Mazatlán, Mexico (EMU); in the National Crustacean Collection, Instituto de Biología, UNAM, Mexico, D.F., Mexico (CNCR); and in the Reference Collection of the Laboratorio de Ecosistemas Marinos y Acuicultura, CUCBA, in Zapopan, Jalisco, Mexico (LEMACR). Carapace length (CL, in mm) was measured from the end of the rostral projection to the posterior margin of the carapace.

**FIGURE 1.** Sampling localities on the Pacific coast of Mexico. a. Estero de Urías. b. Estero Pérula.

**Taxonomy**

**Alpheidae Rafinesque, 1815**

*Leptalpheus corderoae* sp. nov.

Figs. 2–5

**Material examined.** Holotype: 1 male (CL 7.6 mm), Estero Pérula, Chamela, Jalisco, Mexico, 19°35′22″ N, 105°08′07″ W, mudflat, near mangroves, yabby pump, 0.1–0.3 m, low tide, 7 March 2013 (EMU-10050). Paratypes: 4 males (CL 3.1–9.1 mm) and 4 females (CL 5.4–6.4 mm), same locality, 7 March 2013 (EMU-10051); 1 male (CL 5.8 mm) and 1 female (CL 7.4 mm), same locality 26 June 2013 (CNCR-28959); 2 males (CL 5.0–7.2 mm), 3 females (CL 4.8–5.2 mm), same locality and date, 26 June 2013 (EMU-10052).

**Description.** Frontal margin of carapace triangular, without rostral projection, carapace smooth, without orbital crests (Fig. 2A). Eyestalks with anteromesial margin rounded. Antennular peduncles (Fig. 2A, B) moderately stout, flattened dorsoventrally; second article longer than wide; stylocerite appressed, not reaching distal margin of first article; ventromesial carina terminating in slender, upwards curving tooth and obtuse triangular process (Fig. 2C); lateral flagellum with short secondary ramus. Antenna (Fig. 2A, D) with stout basicerite bearing strong distoventral tooth; scaphocerite ovate, with small distolateral tooth reaching beyond
anterior margin of moderately broad blade; carpocerite longer than scaphocerite and antennular peduncle. Mouthparts typical for genus, as illustrated (Figs. 3A–E). Third maxilliped (Fig. 3E) with lateral plate on coxa subacutely produced; ultimate article with brush-like rows of thick setae increasing in length distally.

Major cheliped (Fig. 4A–C) with ischium unarmed; merus relatively slender, with concave depression along ventral margin, ventrolateral margin somewhat rugose; carpus very short, cup-shaped, dorsally convex, smooth; chela robust, longer than merus, with palm depressed ventromesially; irregular rows of tubercles extending from proximal half of palm to pollex, tubercles increasing in size distally; dorsal margin smooth; adhesive discs conspicuous; fingers about 0.6 palm length, not strongly twisted or curved, not gaping when closed; cutting edge of pollex with subtriangular, blunt, proximal tooth protruding on mesial side, and much stronger subdistal tooth protruding almost perpendicularly to main axis of pollex, together with much shorter apex; dactylus dorsally convex, longer than pollex, fitting into broad hiatus of pollex; cutting edge with broad low tooth, tip strongly but gradually curving; lateral surface of pollex and dactylus slightly rugose.

Minor cheliped (Fig. 4D, E) with merus as long as chela, smooth; carpus short; chela smooth, fingers slender, as long as palm, proximal two third of cutting edges armed with small, regularly spaced teeth and one larger tooth at about 0.6–0.7 finger length; tips crossing distally.

Second pereiopod (Fig. 5A) slender; ischium about 0.8 as long as merus; merus shorter than carpus; carpus five-articulated, article ratio approximately equal to 5:1:1:1:2; distal portion of chela with long setae.

Third and fourth pereiopods (Figs. 5B, C) similar, with endopodal articles strongly compressed. Third pereiopod (Fig. 5B) slightly longer and stouter than fourth; merus slightly longer than combined length of carpus and propodus; carpus with distoventral spiniform seta; propodus with two spiniform setae and several long setae along ventral margin, and two ventrodistal spiniform setae; dactylus slender, conical, gently curved, about half as long as propodus, with distodorsal setae. Fifth pereiopod (Fig. 5D) slender, less compressed than third and fourth; ventral margin of propodus with seven distal rows of setae, latter increasing in number and length distally; dactylus strongly curved.

Male second pleopod (Fig. 2E) with appendix masculina slender, with two subterminal and five terminal setae; appendix interna about 0.6 length of appendix masculina (Fig. 2F). Uropod (Fig. 2G) with lateral lobe of protopod ending in two small subacute teeth; exopod with distal margin truncate; diaeresis deeply incised, with large tooth near mesial margin; distotateral spiniform seta stout, not reaching distal margin of exopod.

Telson (Fig. 2H) widest in proximal third, slightly tapering distally; dorsal surface with two pairs of strong spines inserted in deep pits close to lateral margin; posterior margin rounded, with two pairs of spiniform setae at posterolateral angles, lateral shorter than mesial, and with 14 plumose setae between mesial spiniform setae.

**Ecology.** *Leptalpheus corderoae sp. nov.* lives commensally in burrows of the callianassid ghost shrimp *Lepidophthalmus bocourti*, sometimes together with *Leptalpheus hendrickxi* (see below). Both species were also found in burrows situated closer to the mangrove trees and adjacent to the burrows of the mud shrimp *Upogebia dawsoni*. However, a possible association between *L. corderoae sp. nov.* and *U. dawsoni* remains to be confirmed.

**Etymology.** The species is named in honor of Mercedes Cordero-Ruiz, in recognition of her enormous support and numerous and significant contribution to the Laboratorio de Invertebrados Bentónicos, ICML, UNAM, in the last two decades.

**Remarks.** *Leptalpheus corderoae sp. nov.* is morphologically closest to *L. azuero* from the Pacific coast of Panama, and *L. axianassae* Dworschak & Coelho, 1999 from Brazil. The three species are very similar in the general shape of the major chela, the presence of large adhesive discs, the fingers not gaping when closed, the cutting edge of pollex armed with two large blunt teeth and with a short tip curved upward (similar to that of *L. axianassae* from Brazil), and the dactylus dorsally convex and ventrally thickened. The new species differs from *L. azuero* and *L. axianassae* by the presence of conspicuous tubercles on the ventral surface of the major chela (absent in *L. azuero* and *L. axianassae*); specifically from *L. azuero* by the more obtuse rostrum (sharply triangular in *L. azuero*), shorter stylocerite (not reaching distal margin of the first antennular article vs. overreaching this margin in *L. azuero*), longer and more slender dactylus and propodus of third pereiopod, more slender scaphocerite, and the presence of 14 setae on the posterior margin of the telson (vs. eight in *L. azuero*). The new species differs clearly from *L. axianassae* by having a slender antennular peduncle with stylocerite not reaching the anterior margin of the first article (overreaching it in *L. axianassae*) and the lateral antennular flagellum possessing a short secondary ramus vs. a well developed secondary ramus in *L. axianassae*. 

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FIGURE 2. *Leptalpheus corderoeae* sp. nov., male holotype (EMU-10050). A, anterior part of carapace and appendages, dorsal view; B, antennula, lateral view; C, ventromesial carina of antennular peduncle, lateral view; D, scaphocerite, dorsal view; E, second pleopod, ventral view; F, detail of appendices masculina and interna; G, left uropod, dorsal view; H, telson, dorsal view. Scale bars all = 1 mm, except F = 0.2 mm.
FIGURE 3. *Leptalpheus corderoae* sp. nov. male holotype (EMU-10050). A, maxillule; B, maxilla; C, first maxilliped; D, second maxilliped; E, third maxilliped. Scale bar =1 mm.
Leptalpheus corderoae sp. nov. also has affinities to the *L. pacificus* Banner & Banner, 1974 group (Anker et al. 2006; Anker & Marin 2009), which is characterized mainly by the shape of the peculiar dentition of the major chela, slender antennular peduncles and tightly appressed stylocerite. However, the new species can be easily distinguished from the three species currently assigned to this group (Anker & Marin 2009) by the major chela, e.g., by a different dentition on the fingers and the presence of tubercles on the ventral surface of the major chela palm and pollex.

**FIGURE 4.** *Leptalpheus corderoae* sp. nov. male holotype (EMU-10050). A, major cheliped, mesial view; B, same, tip, lateral view; C, same, fingers, mesial view; D, minor cheliped, lateral view; E, minor chela, lateral view. Scale bars = 1 mm.
FIGURE 5. Leptalpheus corderoe sp. nov. male holotype (EMU-10050). A, second pereiopod, lateral view; B, third pereiopod, lateral view; C, fourth pereiopod, lateral view; D, fifth pereiopod, lateral view. Scale bars = 1 mm.
**Leptalpheus mexicanus** Ríos & Carvacho, 1983

Figs. 6A–F


**Material examined.** 2 females (CL 5.1–6.3 mm), Estero de Urías, Mazatlán, Sinaloa, Mexico, 23°12'28.6" N, 106°24'05" W, mudflat, yabby pump, 1 December 2010 (EMU-8784).

**Distribution.** Estero Mulegé, Baja California Sur (type locality), and Manzanillo, Colima, Mexico, to Bahía Málaga, Colombia (Ríos & Carvacho 1983; Ramos 1995; Lazarus-Agudelo & Cantera-Kintz 2007).

**Ecology.** The specimens were collected on a mudflat, in burrows of unknown hosts.

**FIGURE 6.** *Leptalpheus mexicanus* Ríos & Carvacho, 1983, female (A–D, EMU-8784). A, anterior part of carapace and appendages, dorsal view; B, anterior part of carapace, lateral view; C, major cheliped, lateral view; D, right uropod and telson. *Leptalpheus mexicanus* Ríos & Carvacho, 1983 (E–F, CNCR-2506); E, female holotype, anterior part of carapace, lateral view; F, male allotype, anterior part of carapace, lateral view. Scale bars = 1 mm.

**Remarks.** According to Anker (2011), *Leptalpheus mexicanus* and *L. bicristatus* are very similar, the later being distinguished from the former mainly by the presence of a small crest on the carapace above each eye, and the shape of the lateral lobe of the uropodal protopod. Although of small size, these crests are very conspicuous in *L. bicristatus*, particularly in lateral view (see Anker 2011: Fig. 15A, B). A toptotypical specimen of *L. mexicanus* deposited in the Muséum National d'Histoire Naturelle, Paris, France (MNHN Na13624), examined by Anker (2011: 22) apparently did not have these crests. The holotype (female) and the allotype (male) of *L. mexicanus* were originally deposited at the Colección Nacional de Crustáceos (CNCR), in Mexico D.F., but are currently on loan to Darryl L. Felder of the University of Louisiana. On our request, D. L. Felder revised the two type specimens and provided illustrations of the lateral view of the frontal area of the carapace (Fig. 6E, F). These figures show that both type specimens of *L. mexicanus* possess a very low crest above each eye, a character which was not mentioned nor illustrated by Ríos & Carvacho (1983) in their original description of the species. Ramos (1995) reported *L. mexicanus* from Colombia, not illustrating these crests in his material (see Ramos 1995: fig. 1);
however, his drawings are rather diagrammatic and may not be accurate. Nevertheless, the presence or absence of the carapacial crests above the eyes can no longer be used as a distinctive character between *L. mexicanus* and *L. bicristatus*. Unfortunately, the other two paratypes of *L. mexicanus*, deposited at the CICESE, Ensenada, Mexico, are no longer available. The other important characters in distinguishing *L. mexicanus* from *L. bicristatus* are the size and shape of the marginal tooth of the uropodal protopod. The material of *L. mexicanus* from Estero de Urías (EMU-8784) features two short teeth separated by a shallow concavity (Fig. 6D), much similar to what is illustrated by Anker (2011) for *L. bicristatus*. Consequently, both characters cited hereabove should no longer be considered valid for separating one species from the other.

Anker (2011) mentioned other morphological differences between *L. bicristatus* and *L. mexicanus* based on a comparison between his single specimen, a male of 4.6 mm CL from Chame Bay, Panama, and the illustrations provided by Ríos and Carvacho (1983). He noted that the major cheliped of *L. bicristatus* is stouter than in *L. mexicanus*, the anterior margin of the antennal scaphocerite of *L. bicristatus* is less convex than in *L. mexicanus*, the first carpal article of the second pereiopod is relatively longer in *L. bicristatus*, and that the two species also differ in the shape of the lateral tooth of the protopod (cf. Ríos & Carvacho 1983: fig. 1e and Anker 2011: fig. 15I). We consider, however, that these characters are very relative and might reflect an intraspecific variation. We are reluctant to include *L. bicristatus* in the synonymy of *L. mexicanus* and, as pointed out by Anker (2011), additional material of both nominal species should be collected from the type localities and within their distribution range, and carefully examined. Additionally, a molecular comparison would be highly desirable.

### Leptalpheus hendrickxi Anker, 2011
Figs. 7A–E

**Material examined.** 1 male (CL 9.5 mm) and 1 female (CL 8.2 mm), Estero Pérula, Chamela, Jalisco, Mexico, 19°35'22" N, 105°08'07" W, sand-mud flat, near mangroves, yabby pump, 0.1–0.3 m at low tide, 7 March 2013 (EMU-10053); 1 male (CL 7.5 mm) and 1 female (CL 9.9 mm), same locality, 17 June 2013 (LEMA CR 57); 2 males (CL 5.4 and 8.7 mm) and 1 female (CL 5.3 mm), same locality and date, 17 June 2013 (EMU-10054).

**Ecology.** Most specimens were collected together with *Leptalpheus corderoae* sp. nov., from burrows of *Lepidophthalmus bocourti*, as well as from an unidentified host burrowing near mangroves close to burrows of *Upogebia dawsoni*.

**Remarks.** Specimens collected in Estero Pérula fit well to the description and illustrations of *L. hendrickxi* provided by Anker (2011) and a few small differences observed in our specimens may be related to size. In large specimens from Estero Pérula, the stylocerite may slightly exceeds the anterior margin of the first antennular article (Figs. 7A, B), whilst in specimens of Panama it does not. The propodus of the fifth pereiopod (Fig. 7E) bears seven rows of ventrodiscal setae (instead of five illustrated in the Panama material), but this might be a normal variation for this species which is not well known. In large specimens, the armature of the merus and propodus of the major cheliped is more pronounced, with an additional row of granules extending from the mesial surface of the propodus to the ventral surface of the pollex (Fig. 7C). The collection of *L. hendrickxi* in Jalisco, Mexico, represents a significant extension of the species’ distribution range by ca. 3000 km (= 11° of latitude) to the north.

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FIGURE 7. *Leptalpheus hendrickxi* Anker, 2011 (A, C, D, E, EMU-10054; B, LEMA-CR 57). A, B, anterior part of carapace and appendages, dorsal view; C, major cheliped, lateral view; D, minor cheliped, lateral view. Scale bars = 1 mm.

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