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Description of two new associated infaunal decapod crustaceans (Axianassidae and Alpheidae) from the tropical eastern Pacific

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ABSTRACT

Two new species of infaunal decapod crustaceans are described based on material collected in Bahía Málaga, Pacific coast of Colombia, in 2009. The mud-shrimp Axianassa darrylfelderi *sp. nov. (Axianassidae) appears to be most closely related to* A. australis *Rodrigues & Shimizu, 1992,* A. canalis *Kensley & Heard, 1990, and* A. jamaicensis *Kensley & Heard, 1990. The new species may be distinguished from each of them by a combination of morphological features, mainly on the uropodal exopod, antennal acicle, third maxilliped and first pleonite. The shrimp* Leptalpheus canterakintzi *sp. nov. (Alpheidae), associated with burrows of* A. darrylfelderi *sp. nov., undoubtedly represents the eastern Pacific sister species of the western Atlantic* L. axianassae *Dworschak & Coelho, 1999, which lives exclusively in burrows of* A. australis. *The two species are reliably distinguishable only by the proportions of the merus and propodus of the third pereiopod.* Leptalpheus azuero *Anker, 2011, previously known only from the Pacific coast of Panama, is reported for the first time from Bahía Málaga, Colombia.*

Key-Words: Decapoda; Shrimp; Mud-shrimp; Infauna; Symbiosis; Axianassidae; Alpheidae; *Axianassa; Leptalpheus;* Transisthmian species; East Pacific; New species; New record.

INTRODUCTION

The mud-shrimp genus *Axianassa* Schmitt, 1924 in the monogeneric family Axianassidae currently includes 10 species, four in the western Atlantic (Schmitt, 1924; Kensley & Heard, 1990; Rodrigues & Shimizu, 1992), two in the eastern Pacific (Kensley & Heard, 1990), and four in the Indo-West Pacific (Anker, 2010, 2011a; Liu & Liu, 2010; Komai, 2014). All species of *Axianassa* inhabit coastal waters, burrowing in silt-sand or mud substrates in various intertidal and subtidal habitats, down to about 42 m. However, most species have been collected on intertidal mud and sand flats, often close to mangrove stands, or in siltier parts of backreef lagoons.

The alpheid shrimp genus *Leptalpheus* Williams, 1965 currently contains the highest number of infaunal symbiotic species in the family (14), the majority of them (11) distributed in very shallow tropical and subtropical parts of the western Atlantic and eastern Pacific (Williams, 1965; Ríos & Carvacho, 1983; Dworschak & Coelho, 1999; Anker *et al.,* 2006a, 2008, 2011b; Salgado-Barragán *et al.,* 2014), the remaining found in the tropical Indo-West Pacific

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(Banner & Banner, 1974; Anker & Marin, 2009). All members of this genus appear to be associated with burrowing ghost and mud shrimps (Callianassidae, Upogebiidae, Axianassidae), although for several species the actual hosts remain unknown. One species, *Leptalpheus axianassae* Dworschak & Coelho, 1999, appears to be associated exclusively with burrows of *Axianassa australis* Rodrigues & Shimuzu, 1992, in the western Atlantic from Florida to Brazil (Dworschak & Coelho, 1999; Felder *et al.,* 2003).

Sampling of infaunal decapods in Bahía Málaga, on the Pacific coast of Colombia in April 2009 yielded two male and one female specimens of an undescribed species of *Axianassa.* In addition, a single male specimen of *Leptalpheus* sp., which at first glance appeared to be identical to the western Atlantic *L. axianassae,* was collected at the same locality. However, a direct comparison of the Colombian specimen with four Brazilian specimens of *L. axianassae* revealed some morphological characters separating the eastern Pacific species from its presumed western Atlantic sister species. In the present study, a new species of *Axianassa* and a new species of *Leptalpheus,* its burrow associate, are described and illustrated. Material is deposited in the collections of the Museo de Historia Natural Marina de Colombia – MHNMC-INVEMAR, Santa Marta, Colombia (INV CRU), and Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZUSP). Carapace length (cl, in mm) was measured along the dorsal midline from the tip of the rostrum (or rostral projection) to the posterior margin of the carapace.

Comparative material of *Axianassa* and *Leptalpheus* examined in this study is as follows:

Axianassa australis Rodrigues & Shimizu, 1992: 1 male (cl 8.3 mm), MZUSP 33013, USA, Florida, Fort Pierce Inlet, North Causeway Island, Little Jim Bridge, near Stan Blum Memorial Boat Launch, mudflat, 0.1-0.3 m at low tide, in burrows, leg. A. Anker, 24.vii.2009; 1 male (cl 7.8 mm), MZUSP 33004, Brazil, unknown locality, leg. S.A. Rodrigues, 24.vi.1984; 1 male (cl 10.0 mm), MZUSP 16683, Brazil, Pernambuco, Vila Velha, leg. S.A. Rodrigues & R.M. Shimizu, 13.v.1995; 3 females (cl 12.2, 12.3, 14.5 mm), MZUSP 16317, Brazil, Rio de Janeiro, Ilha da Marambaia, Praia Suja, leg. A.S. Gomes, vii.2004.

Leptalpheus axianassae Dworschak & Coelho, 1999: 1 male, paratype (cl 8.6 mm), 1 female, paratype (cl 8.7 mm), MZUSP 13010, Brazil, São Paulo, São Sebastião, Praia do Araçá, tidal flat, in burrow of *Axianassa australis,* coll. V.R. Coelho & S.A. Rodrigues, 09.viii.1998; 1 female (cl 4.9 mm), MZUSP 24807, Brazil, Alagoas, Barra de Camaragibe, Rio Camaragibe estuary, 09°18'47.7"S, 35°25'17.0"W, leg. M. Tavares & J.B. Mendonça, 23.x.2011; 1 male (cl 5.2 mm, chelipeds missing), MZUSP 28013, Brazil, Bahia, Boipeba, Castelhanos, sta. 3, 13°39.134'S, 38°53.491'W, mangrove on fossil coral platform, mud, leg. M. Tavares *et al.,* 17.ix.2012.

Leptalpheus azuero Anker, 2011: 1 male (cl 2.4 mm, carapace damaged), INV CRU8364, Colombia, Bahía Málaga, La Plata, 04°02'N, 77°13'W, mudflat, in burrow of unknown host, leg. A. Anker, 25.iv.2009 [COL-00100].

Taxonomic account

Family Axianassidae Schmitt, 1924
Genus *Axianassa* Schmitt, 1924
Axianassa darrylfelderi sp. nov.
(Figs. 1-4)

Type material: Holotype: 1 male (cl 11.5 mm, dissected), INV CRU8361, Colombia, Bahía Málaga, Curichichi, 03°59'37.8"N, 77°19'03.9"W, intertidal mudflat, low tide, in burrow, leg. A. Anker, 26.iv.2009 [COL-00192]; 1 ov. female (cl 9.0 mm, dissected), INV CRU8362, same collection data as for holotype [COL-00202]; 1 male (cl 9.7 mm), MZUSP 33014, same collection data as for holotype [COL-00200].

Description: Carapace with rostrum broad at base, apically rounded, not toothed, reaching well beyond anterior margin of eyestalks, fringed with setae; linea thalassinica straight, running entire length of carapace; cervical groove deep, crescent-shaped in dorsal view; branchiostegial margin slightly elevated; pterygostomial region rounded, not conspicuously protruding, fringed with setae; dorsal surface of carapace with few scattered setae, especially on frontodorsal and posterodorsal areas (Fig. 1A-C).

Pleon thinly sclerotised, smooth; dorsal surface of tergites with scatteted setae of various length; ventral margin of second to sixth pleonites with dense rows of plumose setae; first pleonite ventrally produced into acute or subacute process, stronger in males (Fig. 1D). Telson broad, convex proximally, smoothly tapering posteriorly, posterior margin broadly rounded, neither lateral nor posterior margin with armature; dorsal surface with very shallow median groove (Fig. 1E).

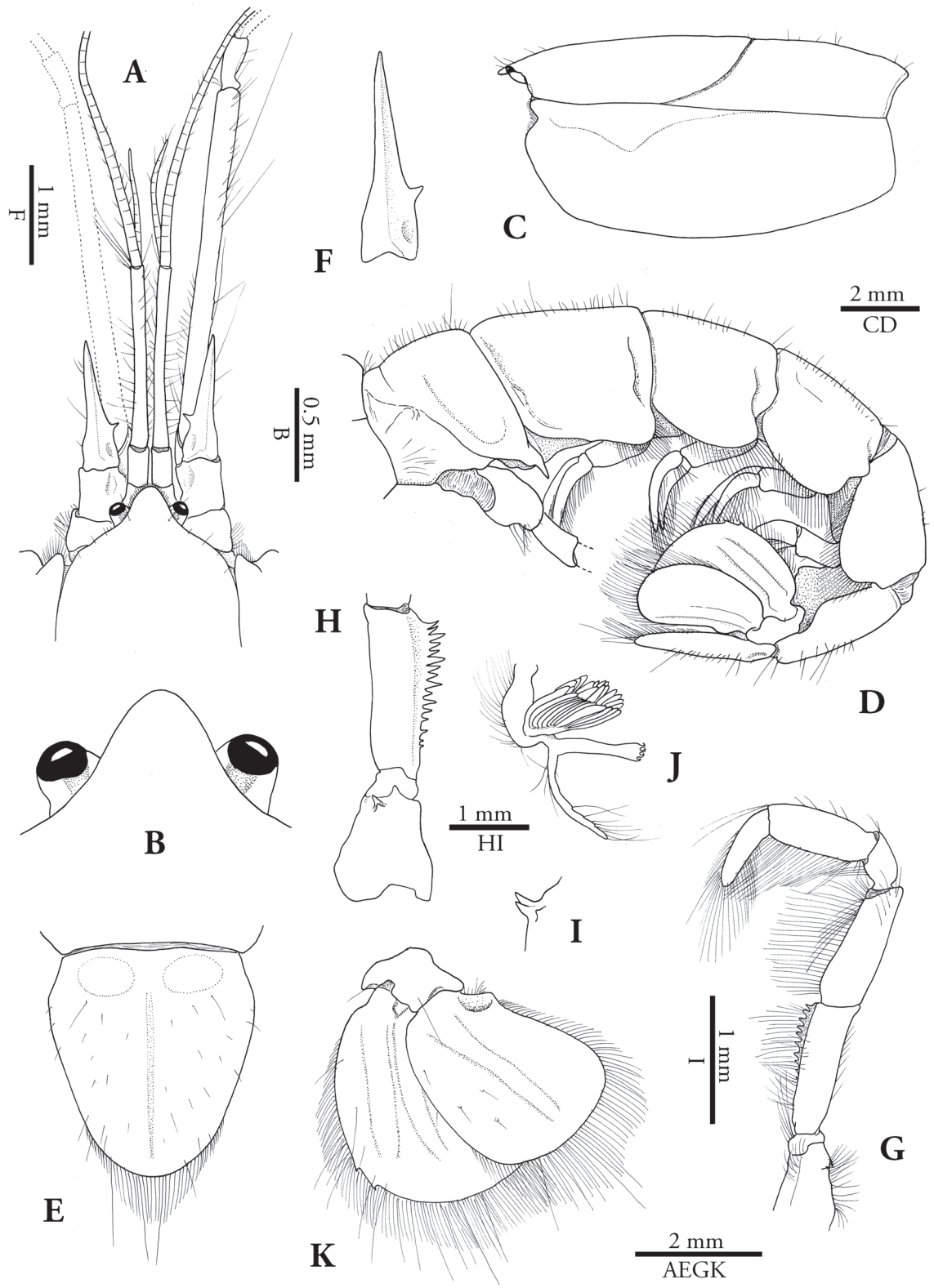

FIGURE 1: *Axianassa darrylfelderi* sp. nov., holotype, male (cl 11.5 mm), INV CRU8361, from Bahía Málaga, Colombia: **A:** frontal region, dorsal; **B:** rostrum and eyestalks (setae omitted), dorsal; **C:** carapace, lateral; **D:** pleon with pleopods and tail-fan, lateral; **E:** telson, dorsal; **F:** antennal acicle, dorsal; **G:** third maxilliped (epipodial complex detached), lateral; **H:** same, coxa and ischium, mesial; **I:** same, detail of mesial teeth on coxa, mesial; **J:** same, bilobed epipod with podobranch, lateral; **K:** uropod, dorsal.

Eyestalks rounded distally; cornea moderately developed compared to eyestalk, in subterminal position, well-pigmented (Fig. 1B).

Antennular peduncle with third article elongate, subcylindrical, slender, not reaching half-length of fourth article of antenna; ventral flagellum slender, less than half-length of dorsal flagellum (Fig. 1A). Antennal acicle dagger-like, relatively broad at base, tapering distally, with strong mesial tooth at about proximal third of acicle length, tip reaching to about

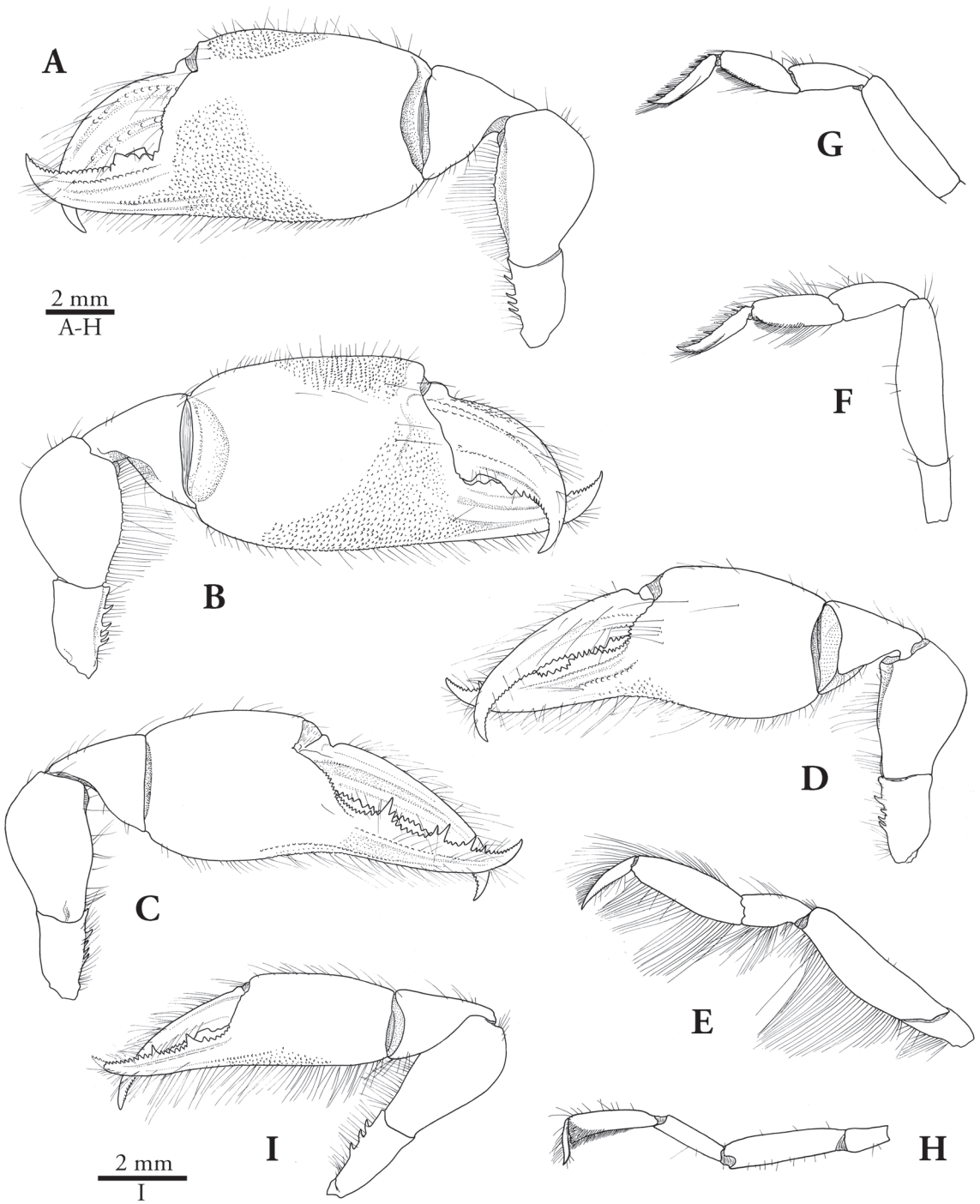

FIGURE 2: *Axianassa darrylfelderi* sp. nov., holotype, male (cl 11.5 mm), INV CRU8361 (A-H), and paratype, ovigerous female (cl 9.0 mm), INV CRU8362 (I), from Bahía Málaga, Colombia: **A:** major cheliped, lateral; **B:** same, mesial; **C:** minor cheliped, lateral; **D:** same, mesial; **E:** second pereiopod, lateral; **F:** third pereiopod, lateral; **G:** fourth pereiopod, lateral; **H:** fifth pereiopod, lateral; **I:** minor cheliped, mesial.

0.35 length of fourth antennal article, overreaching mid-length of third article of antennular peduncle; fourth antennal article subcylindrical, elongate, robust, about twice as long as third article of antennular peduncle, with numerous long setae on lateral and ventrolateral surface (Fig. 1A, F).

Mouthparts typical for genus (cf. Kensley & Heard, 1990: fig. 2d-i; Rodrigues & Shimizu, 1992: figs. 4-8; Anker, 2011a: fig. 2a-e; Komai, 2014: fig. 3a-e). Mandible with incisor process bearing eight large and two small triangular teeth distally; molar process with three large blunt processes distally; palp with three articles, distal article furnished with mostly short setae dorsally. Maxillule with ventral endite very large, with dense row of long setae distally, dorsal endite with spiniform setae; palp composed of two articles, distal recurrent, lacking setae. Maxilla with ventral endite entire, dorsal endite divided by deep cleft; endopod (palp) not subdivided, distally curved mesially, hook-like; scaphognathite with eight long setae ventrally. First maxilliped with ventral endite weakly protruding, moderately setose distally; dorsal endite large, with dense row of long setae distally; endopod (palp) two-articulated, with slender proximal article and very broad, lobe-like distal article; exopod composed of long, posteriorly greatly expanded proximal article, followed by and forming almost 90° angle with short subdistal article, latter carrying relatively short setose flagellum. Second maxilliped with coxa bearing posteriorly elongated epipod, latter with well-developed podobranch; three distal articles of endopod (dactylus, propodus and carpus) articulated perpendicularly to long proximal article, propodus enlarged, forming short "head"; exopod composed of long, posteriorly slightly widened proximal article, followed by and forming almost 90° angle with short subdistal article carrying moderately long setose flagellum.

FIGURE 3: *Axianassa darrylfelderi* sp. nov., holotype, male (cl 11.5 mm), INV CRU8361 (A) and paratype, ovigerous female (cl 9.0 mm), INV CRU8362 (B), from Bahía Málaga, Colombia: **A:** habitus in life, lateral view; **B:** habitus in life, lateral view. Photographs: A. Anker.

Third maxilliped pediform; coxa with bifid epipod bearing well-developed podobranch, and with three relatively small subacute teeth (two stronger and one weak) on dorsomesial surface; ischium about as long as merus, with well-developed crista dentata bearing about 16 teeth, two most proximal teeth weakest; carpus vase-shaped, propodus as long as merus, dactylus about 0.7 length of propodus, ventral margin of ischium to dactylus with long fine setae (Fig. 1G-J).

First pereiopods (chelipeds) stout, asymmetrical in shape, slightly unequal in size (Figs. 2A-D, 3A, 4), smaller in females (Fig. 3B). Major cheliped robust; ischium with four or three strong sharp teeth on ventrolateral margin, and small tubercles irregularly scattered on ventral surface; merus inflated, with strongly convex dorsal margin and slightly convex ventromesial and ventrolateral margins; ventrolateral margin smooth, ventromesial margin with row of small, widely spaced tubercles, most concentrated in distal two thirds of merus length and near articulation with ischium; carpus large, cup-shaped, unarmed; chela ovate, somewhat compressed laterally; palm about 1.5 times as long as high (in adult males), with large fields of granules near base of pollex and near distodorsal margin, on both mesial and lateral surface, ventral granules usually larger; fingers about 0.6 length of palm, stout, with strongly crossing tips; lateral surface of pollex with low longitudinal ridge with small tubercles originating near distoventral margin of palm and more dorsally situated longitudinal ridge with tubercles, near cutting edge; mesial surface of pollex with smooth longitudinal ridge near cutting edge; cutting edges of pollex and dactylus armed with irregular blunt teeth, including two larger teeth separated by hiatus on proximal half of dactylus and one very stout tooth at about proximal third of pollex (Fig. 2A, B). Minor cheliped slightly smaller and less robust than major cheliped; ischium with two to four strong teeth

FIGURE 4: *Axianassa darrylfelderi* sp. nov., paratype, male (cl 9.7 mm), MZUSP 33014, from Bahía Málaga, Colombia: **A:** habitus in life, dorsal view; **B:** habitus in life, lateral view. Photographs: A. Anker.

on ventrolateral margin, and some minute tubercles on ventral surface, ventromesial margin slightly rugose; merus similar to that of major cheliped in proportions, ventromesial margin smooth, without tubercles; carpus similar to that of major cheliped; chela distinctly more slender, ovate; palm with small area of granules near pollex, more developed on mesial than on lateral surface; fingers slightly longer than palm, with fully crossing tips; lateral surface of pollex with ventral longitudinal ridge with small tubercles originating near distoventral margin of palm and more dorsally situated, faint longitudinal ridge with small tubercles, near cutting edge; mesial surface of pollex with row of tubercles proximally and longitudinal ridge with small tubercles along cutting edge; cutting edge of pollex armed with strong subtriangular teeth, including three or two conspicuously larger teeth (double teeth in males); cutting edge of dactylus with fairly strong teeth of about same size (Fig. 2C, D, I).

Second pereiopod moderately stout; merus, carpus and propodus with long setae along ventral margin; dactylus about half as long as propodus, simple, with crenulated ventral margin and numerous setae (Fig. 2E). Third pereiopod relatively robust, ischium, merus and carpus smooth, with few setae; propodus with distoventral brush of stiff setae; dactylus slightly shorter than propodus, dorsal margin with several corneous spines (easily broken off), distoventral margin slightly expanded, with comb-like row of minute spiniform setae (Fig. 2F). Fourth pereiopod similar to third, somewhat more slender (Fig. 2G). Fifth pereiopod much more slender than third and fourth; propodus subchelate, ending in short fixed tooth, latter typically concealed by dense setae; most of distal and ventral surface of propodus occupied by broad band of short stiff grooming setae; dactylus subspatulate, somewhat twisted and excavated mesially, with row of minute setae on edge (Fig. 2H).

First pleopod absent in males; first pleopod in females consisting of short base and longer distal article, latter fringed with setae along margins. Second to fifth pleopods similar, biramous; protopods unarmed. Uropod with broadly ovoid exopod and endopod, latter slightly truncate distally; both exopod and endopod unarmed dorsally, except for few minute tubercles marking insertion of setae; exopod without diaeresis, lateral margin with two or three small, rather widely spaced teeth (Fig. 1K).

Gill/exopod formula typical for genus (cf. Kensley & Heard, 1990: p. 559).

Colouration: Semitransparent with large areas of pink colour, latter being more intense on dorsal surface of carapace and pleon, antennal peduncles, chelipeds (especially merus, carpus and palm), near articulations on second to fourth pereiopods, and tail fan; eggs dark orange-red (Figs. 3, 4).

Etymology: The new species is named after our colleague, Dr. Darryl L. Felder (University of Louisiana, Lafayette, USA), for his important contributions to the taxonomy, biology and phylogeny of the American ghost- and mud-shrimps (Axiidea and Gebiidea).

Type locality: Bahía Málaga, Pacific coast of Colombia.

Distribution: Tropical eastern Pacific: presently known only from Colombia.

Ecology: Intertidal mudflat with abundance of large and small rocks, and some wood debris (Fig. 9), in burrows in muddy sand, mostly in lower, rock-free part of the mudflat.

Remarks: The most important taxonomic features of *Axianassa darrylfelderi* sp. nov. are the uropodal exopod lacking a diaeresis, the antennal acicle dagger-shaped and with a strong mesial tooth, the first pleonal somite ventrally with a stout sharp process, and the second to fifth pleura ventrally rounded. This combination of features is present in only two other species of the genus, viz. the western Atlantic *A. australis* Rodrigues & Shimizu, 1992, and the eastern Pacific *A. canalis* Kensley & Heard, 1990.

Axianassa darrylfelderi sp. nov. can be separated from *A. australis* by the presence of two or three small teeth on the lateral margin of the uropodal exopod (absent in *A. australis*); the longer antennal acicle (reaching to about 0.35 length of the fourth antennal article in *A. darrylfelderi* sp. nov. vs. less than 0.25 length of the fourth antennal article in *A. australis*); and the male minor cheliped armed with three strong double teeth, in addition to numerous smaller teeth, on the cutting edge of the pollex (vs. with one proximal double or triple tooth and two simple, more distal teeth in *A. australis*) (cf. Figs. 1A, F, K, 2C and Rodrigues & Shimuzu, 1992: figs. 3, 13, 20).

Axianassa canalis Kensley & Heard, 1990 is presently known only from a single incomplete specimen (missing both chelipeds) from the Pacific coast of Panama. The new species differs from *A. canalis* by the absence of a dense row of fusiform setae on the ventral surface of the third maxilliped ischium (present in *A. canalis*); the dorsomesial surface of the third maxilliped coxa with three relatively small teeth (vs. with one large tooth in *A. canalis*); the lateral margin

of the uropodal exopod with two or three small teeth (vs. with one tooth in *A. canalis*); the protopods of the second to fourth pleopods posteroventrally unarmed (vs. with spinules in *A. canalis*); the longer antennal acicle (reaching to about 0.35 length of the fourth antennal article in *A. darrylfelderi* sp. nov. vs. less than 0.20 length of the fourth antennal article in *A. canalis*) (cf. Figs. 1A, F, H, K and Kensley & Heard, 1990: fig. 7; see also Rodrigues & Shimuzu, 1992 and Komai, 2014).

Axianassa darrylfelderi sp. nov. also appears to have some affinities with the western Atlantic *A. jamaicensis* Kensley & Heard, 1990, in which, however, the first pleonite is not ventrally produced into a stout spiniform process, as in the new species (cf. Fig. 1D and Kensley & Heard, 1990: fig. 6A). In addition, in *A. darrylfelderi* sp. nov., the ventromesial margin of the cheliped merus only bears small spaced tubercles, whilst in *A. jamaicensis,* it bears a fairly conspicuous sharp tooth, slightly posterior to the merus mid-length (cf. Fig. 2A, B and Kensley & Heard, 1990: fig. 6A).

Axianassa darrylfelderi sp. nov. can be more easily distinguished from the remaining American species of the genus, for instance, from the western Atlantic *A. arenaria* Kensley & Heard, 1990 by the antennal acicle bearing a mesial tooth (lacking in *A. arenaria*), a much wider telson, the second to fifth pleura ventrally unarmed (vs. each with a sharp tooth in *A. arenaria*), and the ventromesial margin of the major cheliped merus with small spaced tubercles (vs. with tubercles in proximal half and a strong sharp tooth at merus mid-length in *A. arenaria*); from the western Atlantic *A. intermedia* Schmitt, 1924 by the first pleonite ventrally produced into a spiniform process (ventrally unarmed in *A. intermedia*), the ventrolateral margin of the cheliped ischium armed with several strong teeth (vs. finely denticulate in *A. intermedia*), and the ventromesial margin of the cheliped merus with small spaced tubercles (major) or smooth (minor) (vs. both strongly serrated distally in *A. intermedia*); and from the eastern Pacific *A. mineri* Boone, 1931 by the shape of the frontal margin of the carapace (not forming a distinct rostral projection in *A. mineri*), the long, dagger-shaped antennal acicle (short and bidentate in *A. mineri*), and several conspicuous differences in the armature of the cheliped and uropod (cf. Figs. 1, 2 and Kensley & Heard 1990: figs. 1-5). The new eastern Pacific species presents even a greater amount of differences with the four Indo-West Pacific species (cf. Figs. 1, 2 and figures in Anker, 2010, 2011a, Liu & Liu, 2010; Komai, 2014).

Felder *et al.* (2003) reported *Axianassa* cf. *canalis* from the Pacific coast of Nicaragua, a taxon closely related to *A. australis* based on its position in the molecular tree in fig. 8. Whether the Nicaraguan material corresponds to *A. darrylfelderi* sp. nov., *A. canalis* or yet another species remains unknown.

Family Alpheidae Rafinesque, 1815
Genus *Leptalpheus* Williams, 1965
Leptalpheus canterakintzi sp. nov.
(Figs. 5-7)

Type material: Holotype: 1 male (cl 6.0 mm, dissected), INV CRU8363, Colombia, Bahía Málaga, Curichichi, 03°59'37.8"N, 77°19'03.9"W, intertidal mudflat, low tide, in burrow of *Axianassa darrylfelderi* sp. nov., leg. A. Anker, 26.iv.2009 [COL-00177].

Description: Carapace with frontal margin rounded-subtriangular, with minute median rostral projection; pterygostomial angle angular-rounded, not anteriorly produced; branchiostegial margin with pronounced lip (Fig. 5A, B); posterior margin with deep cardiac notch.

Pleon with all pleomeres rounded; sixth pleomere with well-demarked subtriangular articulated plate. Telson widest at about proximal third, smoothly tapering distally; dorsal surface with two pairs of strong spiniform setae inserted in deep pits at some distance from lateral margin; posterior margin rounded, with two pairs of spiniform setae at each posterolateral angle, lateral spiniform setae minute, much shorter than mesial; margin between mesial spiniform setae with at least 18 long plumose setae (Fig. 5C).

Eyestalks with anteromesial margin rounded, slightly protruding; anterior surface furnished with setae; dorsal surface with small tubercle; process lateral to eyestalks and adjacent to antennular base very strong (Fig. 5A, B, D).

Antennular peduncles stout, flattened dorsoventrally; stylocerite slightly convex laterally, with subacute point slightly overreaching distal margin of first article; ventromesial carina of first article with complex tooth comprising small sharp point ventrally and larger subacute lobe, reaching far beyond sharp point, dorsally; second article about 1.2 times as long as wide; lateral flagellum with long secondary ramus furnished with at least three tufts of aesthetascs (Fig. 5A, B, E). Antenna with stout basicerite ending in stout sharp distoventral tooth; scaphocerite oval, with small subacute distolateral tooth, not reaching beyond anterior margin of very broad blade; carpocerite stout, reaching far beyond scaphocerite and end of antennular peduncle; flagellum robust (Fig. 5A, B).

Mouthparts (mandible, maxillule, maxilla, first and second maxillipeds) not dissected, typical for genus in external view (cf. Dworschak & Coelho, 1999: figs. 8-13). Third maxilliped with lateral plate on coxa projecting towards but not reaching beyond arthrobranch, distally subacute; ultimate article about as long as antepenultimate, with dense bands of thick setae, tip without spiniform setae (Fig. 5F).

Chelipeds highly asymmetrical in shape and unequal in size, both folded when not in use (Figs. 6, 7). Major cheliped slender proximally, but with robust chela; ischium relatively short, unarmed; merus slender, slightly curved, depressed ventrally, with smooth surfaces; carpus very short, cup-shaped; chela somewhat elongate, stout, with palm depressed ventrally, smooth; fingers about 0.6 palm length, slightly twisted,

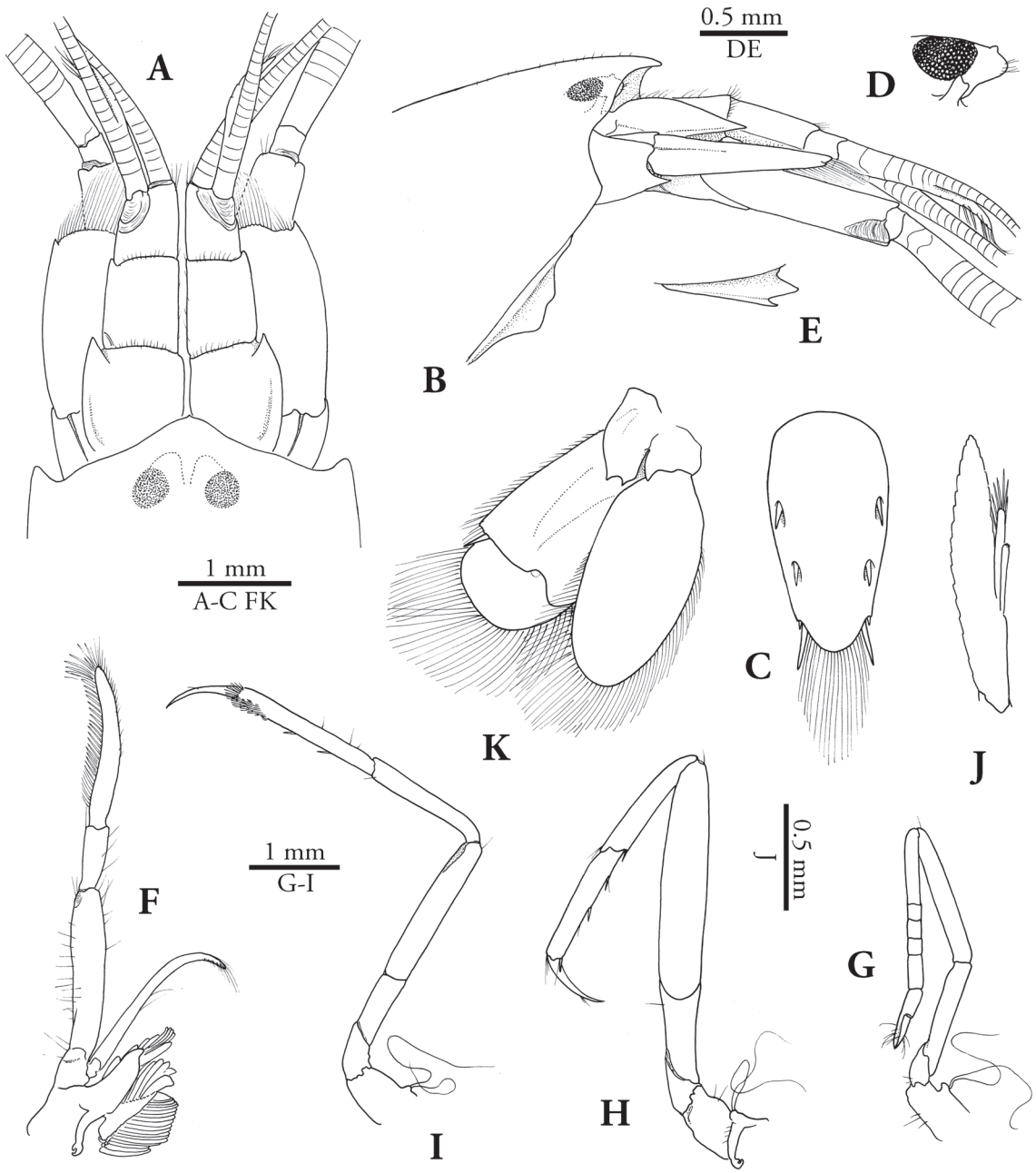

FIGURE 5: *Leptalpheus canterakintzi* sp. nov., holotype, male (cl 6.0 mm), INV CRU8363, from Bahía Málaga, Colombia: **A:** frontal region, dorsal; **B:** same, lateral; **C:** telson, dorsal; **D:** eyestalk and lateral process (drawn by transparency through anterolateral wall of carapace), lateral; **E:** tooth on ventromesial carina of first article of antennular peduncle, lateral; **F:** third maxilliped, lateral; **G:** second pereiopod, lateral; **H:** third pereiopod, lateral; **I:** fifth pereiopod, lateral; **J:** endopod of second pleopod, mesial; **K:** uropod, dorsal.

nearly non-gaping when closed (except for very small subdistal gap); with stout, broadly subtriangular tooth proximally, and stout molar-shaped tooth, nearly perpendicular to main axis of pollex, distally, both teeth bypassing dactylus on lateral side of pollex; tip of pollex blunt; dactylus with large bulge bypassing pollex on mesial side; adhesive disks well developed (Fig. 6A-C). Minor cheliped much smaller than major cheliped; ischium smooth; merus slender, ventrally depressed, with smooth surfaces; carpus very short, cup-shaped; chela moderately slender, simple, with fingers somewhat shorter than palm, with crossing tips; cutting edge of dactylus with four small spaced teeth, most proximal tooth situated at about mid-length, most distal tooth largest, situated at about 0.7 length of dactylus; cutting edge of pollex with numerous (about 12) small teeth on proximal 0.7 length, becoming slightly larger and more spaced distally, in addition to larger tooth at 0.7 length of pollex, opposed (slightly proximal) to similarly sized tooth on dactylus (Fig. 6D, E).

Second pereiopod with merus slightly longer than ischium but much shorter than carpus; carpus five-articulated, with article ratio approximately equal to 4.5 : 1.0 : 1.3 : 1.0 : 2.0 (Fig. 5G). Third pereiopod moderately slender, compressed; ischium lacking spiniform seta on ventrolateral surface; merus about 5.3 times as long as wide; carpus about 0.4 length of merus, with distoventral spiniform seta; propodus with three slender spiniform setae along ventral margin, including one adjacent to dactylus; dactylus about half length of propodus, conical, slender, slightly curved, acute distally (Fig. 5H). Fourth pereiopod similar to third, slightly smaller and more slender. Fifth pereiopod much more slender than third and fourth, not compressed; carpus about 0.7 length of merus; propodus with well-developed grooming brush distolaterally, consisting of at least four rows of short setae, ventromesial margin with two slender spiniform setae; dactylus nearly half as long as propodus, conical, slender, curved, acute distally (Fig. 5I).

Male second pleopod with slender appendix masculina significantly exceeding appendix interna, with at least seven stiff setae, mostly on or near apex (Fig. 5J). Uropod with lateral lobe of protopod end-

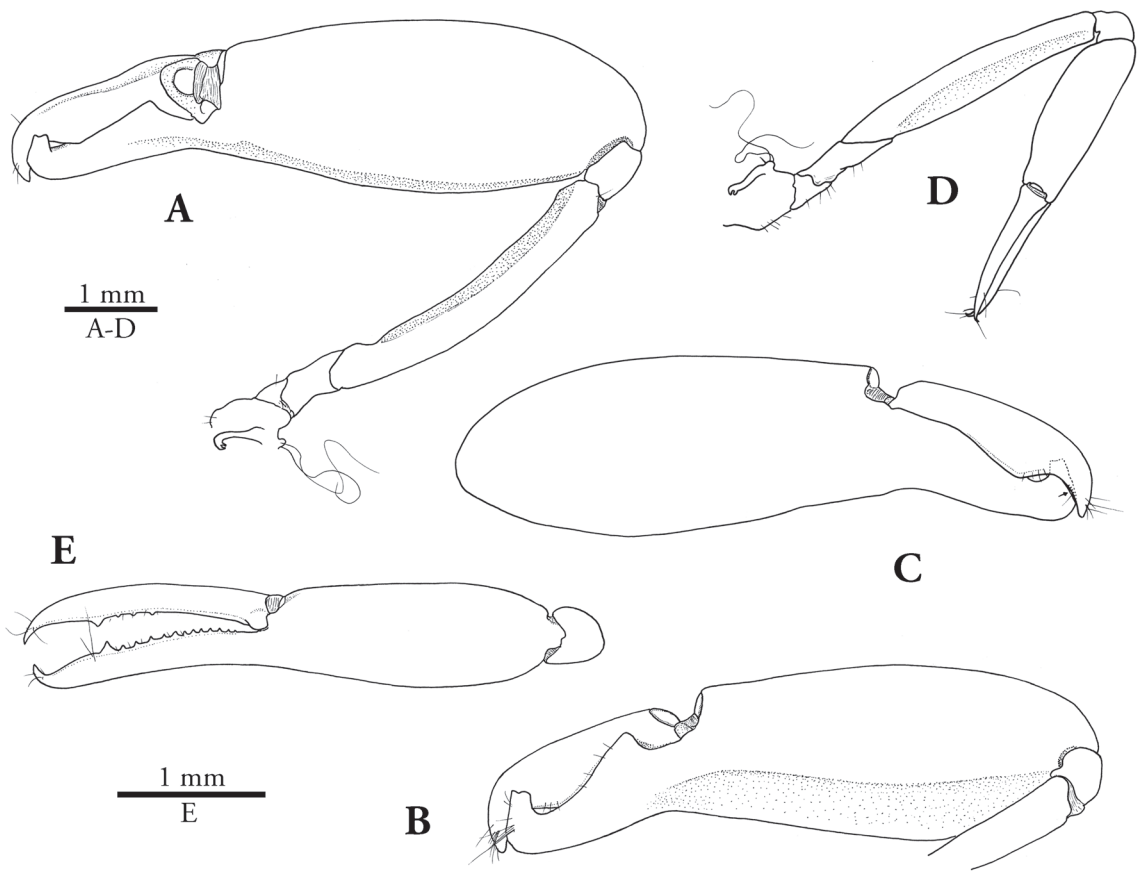

FIGURE 6: *Leptalpheus canterakintzi* sp. nov., holotype, male (cl 6.0 mm), INV CRU8363, from Bahía Málaga, Colombia: **A:** major cheliped, lateral; **B:** same, distal merus, carpus and chela, lateral; **C:** same, chela, mesial; **D:** minor cheliped, lateral; **E:** same, carpus and chela, mesial.

ing in two small, sharp, somewhat spaced teeth; exopod with distal margin broadly rounded; diaeresis with straight lateral portion, rather shallow mesial incision flanked by broad rounded tooth near mesial margin (Fig. 5K).

Gill-exopod formula typical for genus (cf. Anker, 2011b: p. 3).

Colouration: Semitransparent with reddish chromatophores forming large pale red-pink patches, especially on antennules, antennae, tail fan, and diffuse reddish transverse bands on pleon; chelae distally hyaline white; pereiopods mostly colourless (Fig. 7).

Etymology: The new species is named after Dr. Jaime R. Cantera-Kintz (Universidad del Valle, Cali, Colombia), for his engagement in the progress of marine biology in Colombia and unconditional support to JFL in his academic career. Additionally, Dr. Cantera-Kintz arranged and organised several surveys of the marine invertebrates of Bahía Málaga, and enabled AA to participate in one of them, in April 2009.

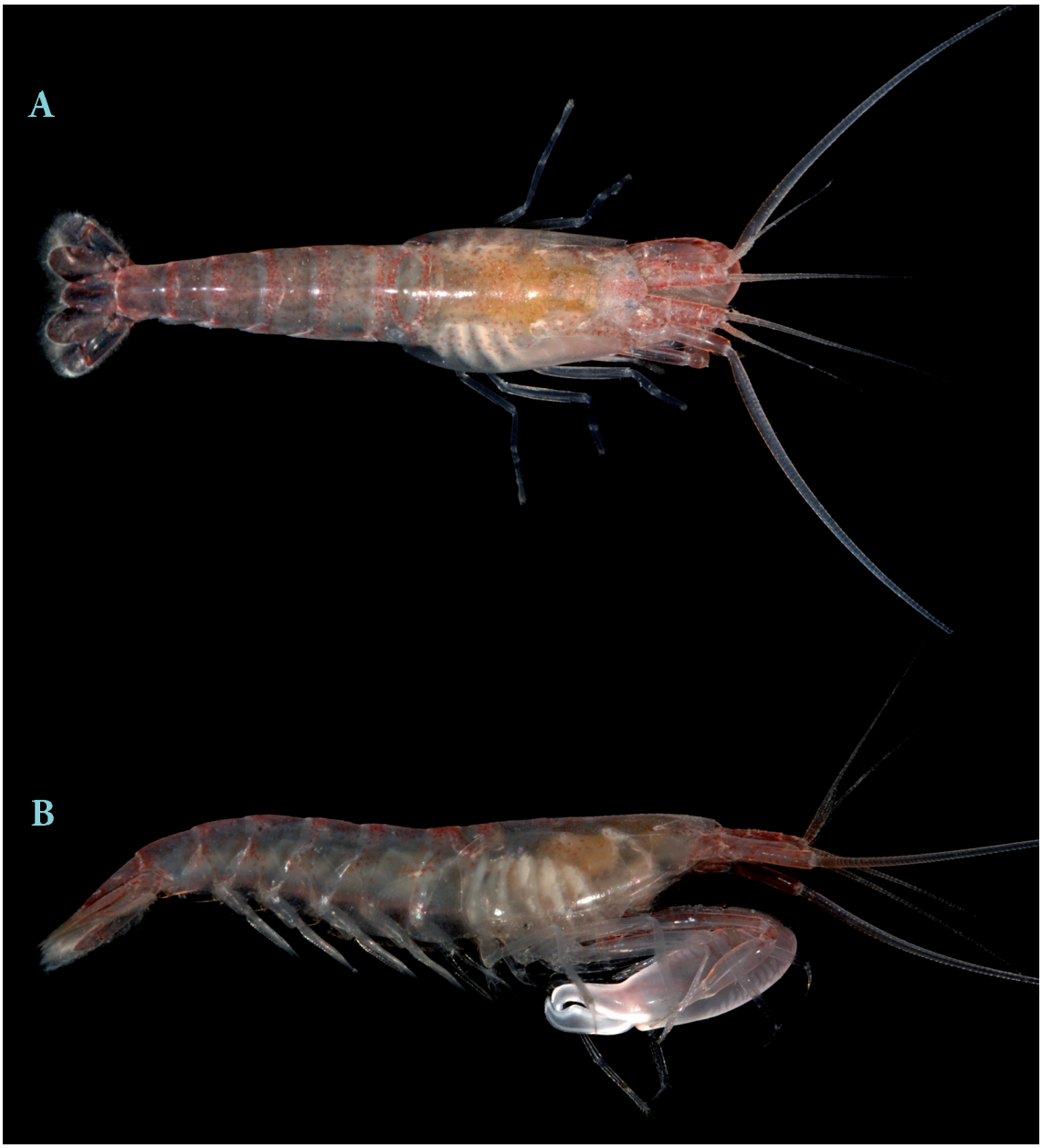

FIGURE 7: *Leptalpheus canterakintzi* sp. nov.: holotype, male (cl 6.0 mm), INV CRU8363, from Bahía Málaga, Colombia: **A:** habitus in life, dorsal view; **B:** habitus in life, lateral view. Photographs: A. Anker.

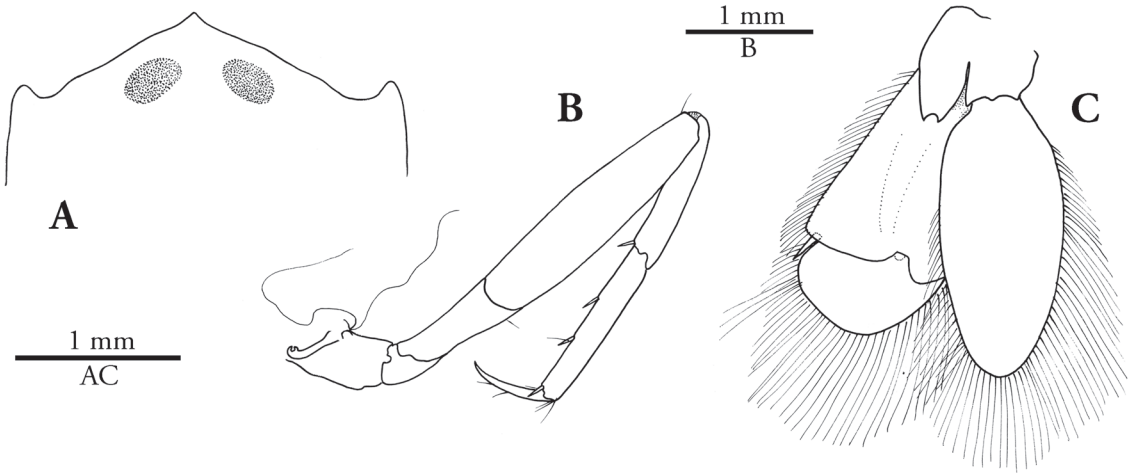

FIGURE 8: *Leptalpheus axianassae* Dworschak & Coelho, 1999: female (cl 4.9 mm), MZUSP 24807, from Rio Camaragibe estuary, Alagoas, Brazil (A), and male (cl 5.2 mm), MZUSP 28013, from Boipeba, Bahia, Brazil (B, C): **A:** frontal margin of carapace, dorsal; **B:** third pereiopod, lateral; **C:** uropod, dorsal.

Type locality: Bahía Málaga, Pacific coast of Colombia.

Distribution: Tropical eastern Pacific: presently known only from Colombia.

Ecology: Intertidal mudflat with abundance of large and small rocks, and some wood debris (Fig. 9), in burrows of *Axianassa darrylfelderi* sp. nov., mostly in lower, rock-free part of the mudflat.

Remarks: Leptalpheus canterakintzi sp. nov. represents, beyond any doubt, the eastern Pacific sister species of the morphologically almost identical western Atlantic *L. axianassae.* The two transisthmian sister species can be reliably distinguished only by the proportions of the third pereiopod, viz. by the somewhat shorter propodus (about half-length of merus in *L. canterakintzi* sp. nov. vs. > 0.6 length in *L. axianassae*) and the more slender merus (~5.3 times as long as wide in *L. canterakintzi* sp. nov. vs. 4.3 to 4.5 times as long as wide in *L. axianassae*) (cf. Figs. 5H and 8B). The difference in the propodus length may be best appreciated when the leg is completely folded, with the dactylus tip pointing to the distal quarter of the ischium in *L. canterakintzi* sp. nov. vs. to the mid-length of the ischium or its proximal third in *L. axianassae.* In all examined specimens of *L. axianassae,* the merus of the third pereiopod is slightly stouter compared to that of *L. canterakintzi* sp. nov., and also stouter than the merus of the fourth pereiopod. For instance, in both paratypes of *L. axianassae* (MZUSP 13010), the merus of the third pereiopod is about 4.5

FIGURE 9: Curichichi, Bahía Málaga, Pacific coast of Colombia, type locality of *Axianassa darrylfelderi* sp. nov. and *Leptalpheus canterakintzi* sp. nov., two different views of the same mudflat partly exposed at low tide, with rocks and debris in the upper part, mostly mud and sand in the lower part. Photographs: J.F. Lazarus.

times as long as wide, which corroborates the proportions shown in Dworschak & Coelho's (1999) fig. 1, but not the proportions in their fig. 24, in which the merus is noticeably more slender, being nearly identical to that of the fourth pereiopod. This discrepancy may be due either to a slight inaccuracy of Dworschak & Coelho's (1999) fig. 24 or to the somewhat abnormal proportions of the third pereiopod (*e.g.,* after an early regeneration of the appendage).

Other differences initially scored between *L. canterakintzi* sp. nov. and *L. axianassae* appear to be inconsistent. The shape of the frontal margin of the carapace appears to be more broadly rounded in the eastern Pacific species, compared to the more triangularly shaped in the western Atlantic species (cf. Figs. 5A and 8A; see also Dworschak & Coelho, 1999: fig. 2). However, in *L. canterakintzi* sp. nov., it bears a minute rostral point (visible only at higher magnification), whereas in the female paratype of *L. axianassae* (MZUSP 13010), the frontal margin is untypically rounded and has two shallow lateral bumps, thus indicating some variation of this feature at least in the western Atlantic species. Dworschak & Coelho's (1999: fig. 30) illustration of the tail fan shows the diaeresis of the uropodal exopod of *L. axianassae* bearing a deep median incision, flanked by a large, bluntly triangular tooth. However, in all specimens of *L. axianassae* examined in the present study, including the paratypes, the incision is rather shallow and is flanked by a more rounded median tooth, a configuration nearly identical to that of *L. canterakintzi* sp. nov. (cf. Figs. 5K and 8C). Therefore, the frontal margin of the carapace and the diaeresis of the uropodal exopod cannot be used to distinguish the new species from *L. axianassae.*

Leptalpheus canterakintzi sp. nov. and *L. axianassae* share a number of characters with the eastern Pacific *L. corderoae* Salgado-Barragán, Ayon-Parente & Hendrickx, 2014 and *L. azuero* Anker, 2011, including the frontal margin of the carapace lacking dorsal crests, the general shape and proportions of the major cheliped, the more or less stout antennular peduncles, and the ventromesial carina of the first article of the antennular peduncle with a uniquely shaped tooth, bearing a small sharp point ventrally and a large subacute lobe dorsally, the latter reaching to or beyond the former (cf. Fig. 5E and Dworschak & Coelho, 1999: fig. 6; Anker, 2011b: fig. 5D; Salgado-Barragán *et al.,* 2014: fig. 2C). However, *L. canterakintzi* sp. nov. can be easily separated from *L. corderoae* by the smooth ventral surface of the major chela palm and pollex (vs. with large tubercles or pustules in *L. corderoae*), the much stouter antennular peduncles, with a much less appressed stylocerite, the ventromesial carina of the first article of the antennular peduncle with the dorsal lobe reaching far beyond the ventral sharp point (vs. equal in *L. corderoae*), and the uropodal exopod with a much shallower incision flanked by a rounded tooth mesially (vs. much deeper and flanked by a acutely triangular tooth in *L. corderoae*) (cf. Figs. 5A, E, 6A-C and Salgado-Barragán *et al.,* 2014: figs. 2A, C, G, 4A-C).

Leptalpheus canterakintzi sp. nov. also differs from *L. azuero,* previously known only from Panama and here recorded for the first time from Colombia, based on a single damaged specimen from Bahía Málaga (see under Comparative material). The two most important features separating the new species from *L. azuero* are the absence of a stout spiniform seta on the ischium of the third and fourth pereiopods in *L. canterakintzi* sp. nov. (present in *L. azuero*) and the pollex of the major chela terminating in a single tooth perpendicular to the pollex axis in *L. canterakintzi* sp. nov. (vs. with a strongly bidentate tip, i.e. with an additional tooth slightly oblique to the pollex axis, in *L. azuero*) (cf. Figs. 5H, 6A, B and Anker, 2011b: fig. 5H, 6D).

The general shape and armature of the major cheliped, the shape of the frontal margin of the carapace, the stout antennular peduncle, and the peculiar shape of the tooth on the ventromesial carina of the first article of the antennular peduncle are all features in support of a small species complex, most likely forming a monophyletic clade, that includes *L. canterakintzi* sp. nov., *L. axianassae* (sister taxa), *L. corderoae* and *L. azuero.* This clade differs substantially from all other American species of *Leptalpheus* (cf. Williams, 1965; Ríos & Carvacho, 1983; Anker *et al.,* 2006a; Anker, 2008, 2011b) and shows some affinities with the three Indo-West Pacific species of the *L. pacificus* Banner & Banner, 1974 complex, especially in the general shape of the major cheliped (cf. Banner & Banner, 1974; Anker & Marin, 2009). An exhaustive cladistic analysis of morphological characters of all species of *Leptalpheus* and related genera (cf. Felder & Manning, 1986; Anker *et al.,* 2006b; Anker & Jeng, 2006; Anker, 2011b; Marin *et al.,* 2014), optimally combined with analyses of DNA sequences, is needed to answer the question whether *Leptalpheus* in its current definition represents a monophyletic group or, alternatively, needs a taxonomic rearrangement.

The material reported by Felder *et al.* (2003) as *Leptalpheus* sp. from the Pacific coast of Nicaragua has not been taxonomically studied until the present day; whether it represents *L. canterakintzi* sp. nov., *L. corderoae, L. azuero* or yet another undescribed species remains unknown.

Leptalpheus is now represented by five species in Colombia, three on the Pacific coast (all in Bahía Málaga), viz. *L. canterakintzi* sp. nov., *L. azuero* (present study) and *L. mexicanus* Ríos & Carvacho, 1983 (Ramos, 1995; Lazarus-Agudelo & Cantera-Kintz, 2007) and two on the Caribbean coast, viz. *L. felderi* Anker, Vera Caripe & Lira, 2006 and *L. marginalis* Anker, 2011 (Anker *et al.,* 2006a; Anker, 2011b).

RESUMO

O presente estudo descreve duas novas espécies de crustáceos decápodos da infauna baseado em material coletado na Bahía Málaga, costa pacífica da Colombia, em 2009. A primeira delas, o corrupto Axianassa darrylfelderi *sp. nov. (Axianassidae), aparenta estar mais relacionada morfologicamente a* A. australis *Rodrigues & Shimizu, 1992,* A. canalis *Kensley & Heard, 1990, e* A. jamaicensis *Kensley & Heard, 1990. Contudo, a nova espécie difere em uma combinação de caracteres morfológicos, principalmente no exópodo uropodial, acículo (escama) antenal, terceiro maxilípede e primeiro pleonito. A segunda espécie nova, o camarão* Leptalpheus canterakintzi *sp. nov. (Alpheidae), associado às galerias de* A. darrylfelderi *sp. nov., incontestavelmente representa a espécie-irmã no Pacífico Oriental da espécie* L. axianassae *Dworschak & Coelho, 1999 do Atlântico Ocidental, a qual vive exclusivamente em galerias de* A. australis. *As duas espécies são distinguíveis apenas pelas proporções do mero e propodo do terceiro par de pereiópodos. Além disso,* Leptalpheus azuero *Anker, 2011, previamente conhecido somente para o Panamá, é registrado pela primeira vez para a Colômbia.*

Palavras-Chave: Decapoda; Camarão; Corrupto; Infauna; Simbiose; Axianassidae; Alpheidae; *Axianassa; Leptalpheus;* Espécie trans-istmiana; Pacífico Oriental; Espécie nova; Novo registro.

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