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## Redescription and taxonomic status of *Paguristes praedator* Glassell, 1937 and *P. oxyphthalmus* Holthuis, 1959 (Anomura: Paguroidea: Diogenidae), with an emendation to the diagnosis of the genus *Areopaguristes* Rahayu & McLaughlin, 2010

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### Abstract

The taxonomic status of *Paguristes praedator* Glassell, 1937, and *Paguristes oxyphthalmus* Holthuis, 1959, is reevaluated, and the two species redescribed and illustrated in detail. Both species are transferred to the genus *Areopaguristes* Rahayu & McLaughlin, 2010, a genus previously defined to accommodate species of *Paguristes* sensu lato with 12 pairs of gills instead of 13. Two important characters in both species were found to differ or have not been mentioned in the current definition of *Areopaguristes*, i.e., the first maxilliped lacking epipod, and dactyls of second and third pereopods unarmed on the ventral margins. The presence of other diagnostically significant characters (e.g., lack of first pleopods in females) previously noted in other species of *Areopaguristes*, requires the generic emendation of this genus presented herein. With the transfer of *A. praedator* nov. comb. and *A. oxyphthalmus* nov. comb. to *Areopaguristes*, this genus now contains 27 species, of which nine occur in the Americas (four in the eastern tropical Pacific, and five in the western Atlantic).

**Key words:** Crustacea, Diogenidae, hermit crabs, *Areopaguristes*, new combination, eastern Pacific, western Atlantic

### Introduction

With a total of 118 currently assigned species, *Paguristes* sensu stricto is the most speciose genus in the Diogenidae, and second only in number of species to *Pagurus*, of the Paguridae (McLaughlin *et al.* 2010). Despite various revisions and descriptions of new species published since first *Stratiotes* Thomson, 1899 and then *Areopaguristes* Rahayu & McLaughlin, 2010 (a replacement name for the preoccupied *Stratiotes* Thomson, 1899) were proposed for species previously in *Paguristes* sensu lato with 12 pairs of gills instead of 13, this group of diogenids (i.e., *Paguristes* sensu stricto, *Areopaguristes*) has remained one of the most taxonomically and morphologically problematic in the Paguroidea (e.g., Hendrickx & Harvey 1999; Rahayu 2005; Ayón-Parente & Hendrickx 2006, 2012; Komai 2009, 2010; McLaughlin 2008; Lemaitre & Felder 2012). In the eastern tropical Pacific, several new species of *Areopaguristes*, and a morphologically similar genus, *Tetralobistes* Ayón-Parente & Hendrickx, 2010, have been described, and taxonomic problems in various taxa resolved (Ayón-Parente & Hendrickx 2006, 2007, 2009, 2010b, 2012). In the western Atlantic, Lemaitre & Felder (2012) described a new species and provided a list of species from that region of *Paguristes* sensu stricto and *Areopaguristes*, although they inadvertently omitted *P. meloi* Nucci & Hebling, 2004 from the species of *Paguristes* sensu stricto.

During the revision of species of the family Diogenidae from the Mexican Pacific by Ayón-Parente (2009), the type material of *Paguristes praedator* Glassell, 1937 was studied, and numerous specimens of this species

recognized from recent collections from the Pacific coast of Mexico and holdings in various museums. Similarly, specimens of *Paguristes oxyphthalmus* Holthuis, 1959 from the western Atlantic were studied. Glassell's (1937) original description of *P. praedator*, although adequate given the year published, did not include illustrations. Holthuis (1959) provided a lengthy description of *P. oxyphthalmus*, with some illustrations, but did not mention details of what are now considered important diagnostic characters of mouthparts, fourth pereopods, first pair of female pleopods, and telson. Both species are morphologically similar and share such characters as: short blunt rostrum; slender, long ocular peduncles; ocular acicles terminating in simple spine; antennal flagella with numerous long setae ventrally; and second and third pereopods (ambulatory legs) long and slender, with dactyls lacking spines ventrally. Specimens of both species have 12 pairs of gills, the primary character used to define species of *Areopaguristes* by Rahayu (2005, as *Stratiotes*).

In this study, we present redescrptions and illustrations of *P. praedator* and *P. oxyphthalmus*, and transfer both to *Areopaguristes*. In order to accommodate new morphological findings discovered in these two species and other recently documented species of *Areopaguristes*, an emendation to the diagnosis of this genus is also provided.

## Material and methods

The material used during this study was collected from localities in the eastern tropical Pacific and western Atlantic, and remain deposited in: American Museum of Natural History, New York, U.S.A. (AMNH); Centro de Ecología de la Costa (CEC), University of Guadalajara, Melaque, Jalisco, Mexico; Regional Collection of Marine Invertebrates, Instituto de Ciencias del Mar y Limnología, UNAM, Mazatlán, Mexico (EMU); Natural History Museum of Los Angeles County (LACM), Marine Biodiversity Processing Center (MBPC); Naturalis Biodiversity Center, Leiden, the Netherlands (RMNH.CRUS), formerly Rijksmuseum van Natuurlijke Historie; Scripps Institution of Oceanography, La Jolla, USA (SIO-C); Texas Cooperative Wildlife Collection, Texas A & M University, College Station, U.S.A. (TCWC); and National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A. (USNM). Specimen size is indicated by shield length (SL) in mm, measured from the tip of the rostrum to the midpoint of the posterior margin of the shield. The length of the ocular peduncles has been determined by measuring the left ultimate peduncular segment, including the cornea, along its lateral surface; corneal diameter is the maximum width of the cornea measured on the dorsal surface. Terminology used in the descriptions generally follows that of McLaughlin (1974, 2003, 2004). Localities are given in Spanish or English, following the spelling used on labels found in the jars. Other abbreviations used: coll., collector; juv, juvenile(s); NS, not sexed; NM, not measured; ot, otter trawl; ovig, ovigerous; sta, station; months are indicated using first three letters.

## Systematics

### Family Diogenidae Ortmann, 1892

### Genus *Areopaguristes* Rahayu & McLaughlin, 2010

*Stratiotes* Thomson, 1899: 185 (junior homonym of *Stratiotes* Putzeys, 1846, Coleoptera).—Rahayu, 2005: 4.—De Grave *et al.*, 2009: 25.

*Areopaguristes* Rahayu & McLaughlin, 2010: 67 (replacement name for preoccupied *Stratiotes* Thomson, 1899).—McLaughlin *et al.*, 2010: 18.

**Emended diagnosis.** Twelve pairs of bi- or quadriserial gills [no pleurobranch on fifth or eighth thoracic somites]. Shield with rostrum well developed or reduced. Ocular acicles simple, bi- or multidenticulate. Antennal peduncle with supernumerary segmentation. Maxillule with external lobe of endopod well developed, distinctly recurved. First maxilliped with epipod well developed or absent. Third maxilliped with coxal segments approximate or somewhat separated; crista dentata usually well developed, no accessory tooth; merus usually with 1 or more spines; carpus, propodus and dactyl usually unarmed.

Chelipeds equal, subequal or unequal, often with left considerably larger, similar or dissimilar in armament;

claws corneous, fingers opening in horizontal or oblique plane. Fourth pereopods subchelate or weakly semichelate, with or without preungual process developed at base of claw.

Males with paired gonopores; first and second pleomeres each with pair of pleopods modified as gonopods; unpaired, unequally biramous left pleopods on pleomeres 3–4, pleopod 5 with external ramus well developed, internal ramus rudimentary. Females usually with paired gonopores; first pleomere with or without pair of modified pleopods (gonopods); pleomeres 2–4 with unequally biramous left pleopods; pleopod 5 as in male; brood pouch usually well developed, occasionally absent.

Uropods asymmetrical. Telson with lateral indentations; posterior portion divided by median cleft into 2 subequal to markedly unequal lobes.

**Type species.** *Pagurus setosus* Filhol, 1885.

**Remarks.** With the addition of the two species discussed in this study, *Aeropaguristes* now contains 27 species worldwide (Tab. 1). Of these, nine occur in the Americas, with four in the eastern tropical Pacific: *A. lemaitrei* Ayón-Parente & Hendrickx, 2012, *A. mclaughlinae* (Ayón-Parente & Hendrickx, 2006), *A. praedator* (Glassell, 1937) nov. comb., and *A. waldoschmitti* Ayón-Parente & Hendrickx, 2012; and five in the western Atlantic: *A. hewatti* (Wass, 1963), *A. hummi* (Wass, 1955), *A. iris* (Forest & de Saint Laurent, 1968), *A. oxyophthalmus* (Holthuis, 1959) nov. comb., and *A. tudgei* (Lemaitre & Felder, 2012). The remaining species occur in the Indo-west Pacific.

**TABLE 1.** List of known species of *Areopaguristes* Rahayu & McLaughlin, 2010 and their geographical ranges.

Species	Geographical range
<i>Areopaguristes abbreviatus</i> (Dechancé, 1963)	Madagascar
<i>Areopaguristes breviantennatus</i> (Rahayu, 2005)	Indonesia
<i>Areopaguristes cyanops</i> (Forest, 1978)	Nigeria, Cameroon
<i>Areopaguristes difficilis</i> (Forest, 1952)	Senegal
<i>Areopaguristes engyops</i> (Barnard, 1947)	South Africa
<i>Areopaguristes hewatti</i> (Wass, 1963)	Texas, USA
<i>Areopaguristes hispidus</i> (A. Milne-Edwards & Bouvier, 1892)	Liberia, Congo
<i>Areopaguristes hummi</i> (Wass, 1955)	North Carolina to Louisiana, Caribbean coast of Colombia
<i>Areopaguristes iris</i> (Forest & de Saint Laurent, 1968)	Brazil
<i>Areopaguristes japonicus</i> (Miyake, 1961)	Japan, Korea, China
<i>Areopaguristes lemaitrei</i> Ayón-Parente & Hendrickx, 2012	Mexican Pacific
<i>Areopaguristes mclaughlinae</i> (Ayón-Parente & Hendrickx, 2006)	Mexican Pacific
<i>Areopaguristes micheleae</i> (Rahayu, 2005)	Indonesia
<i>Areopaguristes ngochoae</i> (Rahayu, 2005)	Indonesia
<i>Areopaguristes nigroapiculus</i> (Komai, 2009)	Japan, Far east Russia
<i>Areopaguristes orbis</i> (Komai, 2009)	Izu Islands, Japan
<i>Areopaguristes oxyophthalmus</i> (Holthuis, 1959) nov. comb.	Gulf of Mexico, Caribbean in Puerto Rico and Colombia, Suriname, Brazil
<i>Areopaguristes perspicax</i> (Nobili, 1906)	Red Sea, Persian Gulf
<i>Areopaguristes pilosus</i> (H. Milne Edwards, 1836)	New Zealand
<i>Areopaguristes praedator</i> (Glassell, 1937) nov. comb.	Mexican Pacific to Costa Rica
<i>Areopaguristes rubrodiscus</i> (Forest, 1952)	Senegal
<i>Areopaguristes setosus</i> (H. Milne Edwards, 1848)	New Zealand
<i>Areopaguristes taenia</i> (Komai, 1999)	Ogosawara Islands, Ohsumi Islands
<i>Areopaguristes tuberculatus</i> (Whitelegge, 1900)	New South Wales, Western Australia, Indonesia
<i>Areopaguristes tudgei</i> Lemaitre & Felder, 2012	Belize
<i>Areopaguristes virilis</i> (Forest, 1952)	Guinea, Congo, Angola
<i>Areopaguristes waldoschmitti</i> Ayón-Parente & Hendrickx, 2012	Mexican Pacific

***Areopaguristes praedator* (Glassell, 1937) nov. comb.**

(Figs. 1–3)

*Paguristes praedator* Glassell, 1937: 243, 245.—Haig *et al.*, 1970: 18, 27.—Moran & Dittel, 1993: 601.—García-Madrigal, 1999: 924.—Hendrickx & Harvey, 1999: 370.—Boschi, 2000: 104.—Vargas & Cortés, 2006: 480.—McLaughlin *et al.*, 2010: 23.

*Paguristes preadator*.—Rodríguez de la Cruz, 1987: 86 (misspelling).

*Stratiotes praedator*.—Ayón-Parente, 2009: 232, Figs. 117–119.—Ayón-Parente & Hendrickx, 2010a: 4.

**Type material.** Holotype: male (SL 3.5 mm), 5.4 km NW from Cabo Pulmo, Baja California, Gulf of California, Mexico, 23°28'N, 109°24'W, 1 May 1936, Zaca sta 136 D-27, sandy bottom with rocks, 91 m, coll. W. Beebe, AMNH-12232 ex. 36782. Paratypes: 1 male (SL 1.2 mm), Bahía Santa Inés, Baja California, Mexico, 26°59'38"N, 111°59'W, 10 Apr 1936, Zaca sta 141 D-4, 6 m, coll. W. Beebe, AMNH-12521; 1 male (SL 3.4 mm), Banco Gordo, 23°50'N, 109° 28'W, 21 Apr 1936, Zaca sta 150 D-3, 104 m, coll. W. Beebe, AMNH-12522; 11 males (SL 2.8–3.7 mm), Arena Bank, Baja California, Gulf of California, Mexico, 19 Apr 1936, Templeton Crocker Expedition, sta 136, coll. W. Beebe, 146 m, USNM 1076126.

**Type locality.** 5.4 km NE of Cabo Pulmo, Baja California, Gulf of California, Mexico.

**Additional material.** EMU holdings: 11 males, 13 females, 1 juv, 3 NS, off Teacapán, Sinaloa, Mexico, 22°17'36"N, 106°10'54"W, 23 Apr 1981, SIPCO I, sta A2, ot, 61 m, EMU-6970; 41 males (SL 1.5–2.8 mm), 23 females (SL 0.9–2.6 mm), off Teacapán, Sinaloa, Mexico, 22°17'36"N, 106°10'54"W, Apr 1981, SIPCO I, sta A2, ot, 61 m, EMU-10055; 2 males (NM), 1 female (NM), 2 NS, off Teacapán, Sinaloa, Mexico, 22°24'18"N, 105°54'24"W, 23 Apr 1981, SIPCO I, sta A1, oyster dredge, 35 m, EMU-6964; 1 male (SL 2.8 mm), 1 female (SL 2.7 mm), off Mazatlán, Sinaloa, Mexico, 23°08'7"N, 106°32'8"W, 24 Aug 1981, SIPCO II, sta B2, ot, 78 m, EMU-6959; 2 males (SL 2.4 mm), off Teacapán, Sinaloa, Mexico, 15 Jan 1982, SIPCO III, ot, EMU-6963; 3 males (SL 1.6–2.9 mm), 1 female (SL 2.5 mm), off Punta Piaxla, Sinaloa, Mexico, 23°37'12"N, 106°55'54"W, 16 Jan 1982, SIPCO III, sta C1, ot, 45 m, EMU-6968A; 2 males (SL 2.12–2.65 mm), same data, EMU-6968B; 11 males (SL 1.4–2.9 mm), 12 females (SL 1.7–2.0 mm), 17 NS (NM), Isla Carmen, 25°58'N, 111°07'5"W, 4 May 1982, CORTES 1, sta 10, oyster dredge, 35–65 m, EMU-10038; 1 ovig female (SL 2.9 mm), off Cabo San Miguel, Baja California, Mexico, 28°7'48"N, 112°45'06"W, 6 May 1982, CORTES 1, sta 20, ot, 68 m, EMU-6965; 2 females (SL 3.1–3.7 mm), same data, EMU-9598; 1 female (SL 2.5 mm), Rocas Consag, Gulf of California, 31°8'8"N, 114°13'1"W, 16 Mar 1985, CORTES 1, sta 38, ot, 60 m, EMU-6999; 1 NS (NM), off Río Fuerte, Sinaloa, 25°45'30"N, 109°34'18"W, 12 May 1982, CORTES 1, sta 50, ot, 91 m, EMU-6847; 2 males (SL 2.3–2.9 mm), off Banco Gordo, Baja California Sur, Mexico, 23°5'48"N, 109°31'54"W, 13 May 1982, CORTES 1, sta 57, ot, 56 m, EMU-6997; 1 male (SL 2.5 mm), off Bahía Santa María, Sinaloa, 24°56'42"N, 108°44'6"W, 10 Mar 1985, CORTES 2, sta. 4, ot, 64 m, EMU-3701A; 1 male (SL 3.2 mm), off Rocas Consag, Gulf of California, 31°9'18"N, 114°15'30"W, 16 Mar 1985, CORTES 2, sta. 38bis, ot, 65 m, EMU-3701B; 1 NS (NM), off Río Fuerte, Sinaloa, 25°46'12"N, 109°35'06"W, 20 Mar 1985, CORTES 2, sta 50, ot, 97 m, EMU-6848; 11 males (SL 1.3–1.7 mm), 12 females (1.2–2.0 mm), 2 ovig females (SL 1.4 mm), 11 NS (NM), Rocas Consag, 31°09' N, 114°15'3" W, 09 May 1982, CORTES 1, sta 38, ot, 60 m, EMU-10058; 3 males (SL 1.7–1.9 mm), 2 females (SL 1.8–2.0 mm), off Punta de Mita, Nayarit, Mexico, 20°52'N, 105°32'7"W, 14 May 1982, CORTES 1, sta 60, ot, 55–60 m, EMU-10056; 1 male, Cabo San Miguel, Baja California, Gulf of California, 28°08'30"N, 112°42'36" W, 6 May 1982, CORTES 1, sta 21, ot, 106 m, EMU-6962; 3 males (SL 2.3–3.7 mm), off Bahía Santa María, Sinaloa, Mexico 24°56'42"N, 108°44'06"W, 10 Mar 1985, CORTES 2, sta 4, ot, 64 m, EMU-6966; 1 female (SL 2.8 mm), off Bahía Santa María, Sinaloa, Mexico, 24°56'12"N, 108°44'30"W, 10 Mar 1985, CORTES 2, sta 5, ot, 110 m, EMU-6957; 1 male (NM), off Rocas Consag, Gulf of California, Mexico, 31°15'12"N, 114°22'06"W, 16 Mar 1985, CORTES 2, sta 37, ot, 32 m, EMU-6960; 18 males (NM), 17 females (NM), 1 NS, off Punta de Mita, Nayarit, Mexico, 20°53'54" N, 105°27'18" W, 23 Mar 1985, CORTES 2, sta 61, ot, 48 m, EMU-6971; 4 NS (NW), off Punta Arboleda, 26°46'8" N, 110°06'9" W, CORTES 2, sta 14, ot, 92 m, EMU-4190; 1 male (SL 3.1 mm), same data, EMU-10059; 3 NS (NM), Cabo San Miguel, Gulf of California, 28°10' N, 112°47'7" W, 13 Mar 1985, CORTES 2, sta 19-A, ot, 29 m, EMU-4189; 1 female (SL 5.3 mm), same data, EMU-10060; 1 female (SL 2.5 mm), 2 juv, 2 NS (NM), off Estero Tastiota, Sonora, Gulf of California, 28°17'8" N, 111°37'3" W, 18 Mar 1985, CORTES 2, sta 47, dredge, 34–37 m, EMU-10061; 6 males (2.0–3.6 mm), 5 females (SL 2.0–3.3 mm), 2 NS, CORTES 2, sta 49-A, ot, EMU-10062; 18 males (SL 1.1–2.4 mm), 16 females (SL 1.2–2.0 mm), 7 NS (NM), off Punta Mita, Nayarit, Mexico, 20°53'54"N,

105°27'18"W, 23 Mar 1985, CORTES 2, sta 61, ot, 48 m, EMU-10057; 1 NS (NM), off Punta de Mita, Nayarit, Mexico, 20°51'54"N, 105°33'12"W, 28 Jul 1985, CORTES 3, sta 60, ot, 70 m, EMU-6958; 5 males (SL 4.1–5.0 mm), 2 females (SL 3.4–4.1 mm), 2 ovig females (SL 3.2–3.8 mm), 1 NS (NM), N of Isla Tiburón, Gulf of California, 29°11'48"N, 112°31'06"W, 2 Aug 1985, CORTES 3, sta 25, ot, 80 m, EMU-6967A; 1 female (SL 3.1 mm), same data, EMU-6967B; 1 male (SL 2.5 mm), 1 NS (NM), off Estero Tastiota, Sonora, Mexico, 28°19'54"N, 111°41'16"W, 7 Aug 1985, CORTES 3, sta 47, Van Veen grab, 28 m, EMU-6961; 1 female (SL 2.0 mm), NE of Isla Ángel de la Guarda, Gulf of California, 29°30'N, 113°24'W, 17 Feb 1987, GUAYTEC I, ot, 105 m, EMU-7448; 1 male (SL 3.9 mm), Gulf of California, Mexico, 26°47' N, 110°06' W, GUAYTEC II, sta 4, ot, 85 m, EMU-10064; 1 male (SL 3.6 mm), Gulf of California, Mexico, 27°00'N, 111°50'W, 2 Aug 1987, GUAYTEC II, sta 10, ot, 85–89 m, EMU-10065; 7 males (SL 2.0–3.8 mm), 6 females (SL 1.7–3.1 mm), 8 ovig females (SL 1.5–2.7), Gulf of California, Mexico, 29°29'N, 113°23'W, 11 Aug 1987, GUAYTEC II, sta 69, 83–88 m, ot, EMU-10066; 3 males (SL 1.9–2.8 mm), 1 female (SL 3.6 mm), off Piaxtla River, Sinaloa, Mexico, 23°31'54"N, 106°52'36"W, 14 Mar 1992, BIOCAPESS V, sta 6, ot, 62 m, EMU-10063; 1 male (SL 3.1 mm), Cuenca Wagner-Consag, Gulf of California, Mexico, 30°49'57"N, 114°09'48"W, 31 Jul 2010, sta 13C, 162 m, EMU-10067.

CEC holdings: 10 males (SL 1.6–3.0 mm), 1 female (SL 1.9 mm), 4 juv, 10 NS (NM), Navidad, 1 Jun 1995, DEM I-3, ot, 27 m; 2 males (SL 2.5–2.7 mm), off Cuitzmala, Jalisco, Mexico, 19°21.74'N, 105°01.25'W, 13 Jun 1995, DEM I BIP V, sta 1, ot, 73 m; 1 male (SL 1.2 mm), 1 female (SL 1.2 mm), 1 ovig female (SL 1.5 mm), off Navidad Bay, Jalisco, Mexico, 19°10.09'N, 104°42.06'W, 20 Jun 1996, DEM IV-3, ot, 73 m; 1 female (SL 2.2 mm), off Tenacatita, 25 May 1995, DEM I BIP V, sta 2, ot, 18 m; 1 male (SL 1.5 mm), off Manzanillo, Colima, Mexico, 19°03.06'N, 104°22.09'W, 6 Dec 1995, DEM II, ot, 73 m.

LACM CR holdings: 1 male (SL 2.5 mm), Tenacatita Bay, Mexico, 18 Feb 1938, 45–72 m, MBPC14304; 1 male (SL 1.8 mm), ca 16 km SE off Puerto Peñasco, Sonora, Gulf of California, Mexico, 2 Jul 1966, 14–18 m, MBPC14306; 2 males (SL 3.5–3.8 mm), 5 females (SL 2.2–2.9 mm), Puerto Refugio, Angel de la Guarda Island, Gulf of California, Mexico, 21 Mar 1937, sta 708–39, 108 m, MBPC14302; 7 males (SL 2.0–2.8 mm), Tenacatita Bay, Mexico, 18 Feb 1938, coll. S.A. Glassell, 45–72 m, MBPC14306; 1 male (SL 2.8 mm), W of Puerto Libertad, Sonora, Gulf of California, Mexico, 30 Mar 1960, sta P-211–60, 108 m, MBPC14303; 14 males (SL 1.8–2.9 mm), 1 female (SL 2.1 mm), 28 juv (NM), off Teacapan, Sinaloa, Gulf of California, Mexico, sta P-159-60, 45–56 m, MBPC14293; 1 male (SL 3.1 mm), SE of Isabel Island, Gulf of California, 8–9 Mar 1960, sta P-157–60, 13–22 m, MBPC14299; 1 male (SL 1.5 mm), off Punta Bahía Kino, Sonora, 27 Mar 1960, sta P-196–60, 23 m, MBPC14292; 4 males (SL 2.5–2.8 mm), 1 female (SL 2.3 mm), NW of Isabel Island, Gulf of California, 10–11 Mar 1960, sta P-158–60, 52–59 m, MBPC14294; 1 male (SL 2.7 mm), off Punta Lesma, Sonora, Gulf of California, 22 Mar 1960, sta P-170-60, 59 m, MBPC14297; 1 male (SL 2.8 mm), San Gabriel Bay, Espiritu Santo Island, Gulf of California, 20 Feb 1936, shoal, MBPC14296; 1 male (SL 2.3 mm), E of Cabeza Ballena, Gulf of California, 3 Mar 1937, sta 620–37, MBPC14295; 1 female (SL 1.8 mm), Agua Verde Bay, Gulf of California, 10 Mar 1937, sta 656–37, 45 m, MBPC14298; 3 males (SL 2.2–2.8 mm), 4 females (SL 1.8–2.3 mm), 9 juv (NM), 4.5 km SW of SE point of Cleopha Island, Tres Mariás Islands, Mexico, 8 Feb 1954, sta 2602–54, 36–74 m, MBPC14300; 1 male (SL 3.3 mm), 2 females (2.8–3.0 mm), 1 juv (NM), N of Ángel de la Guarda Island, Gulf of California, 5 Mar 1936, sta 546–36, 72–126 m, MBPC14301.

USNM holdings: 1 female (SL 1.6 mm), Gulf of California, 20°28'N, 113°06'30"W, 24 Mar 1889, Albatross R/V, sta 3019, 26 m, USNM 265362; 39 males (SL 1.7–2.8 mm), 27 females (SL 1.4–2.8 mm), 21 NS, in shell, Bahía Banderas, Jalisco, Mexico, 20°38'N, 105°23'W, 13 Feb 1938, coll. S. A. Glassell, 46–73 m, USNM 1076129; 52 males (SL 1.4–3.0 mm), 22 females (SL 1.1–2.5 mm), 9 ovig females (SL 1.8–2.2 mm), Bahía Chamela, Jalisco, Mexico, 16 Feb 1938, coll. S. A. Glassell, 46–55 m, USNM 1076337; 1 ovig female (SL 2.2 mm), 2 juv (SL 1.19 mm), Bahía Chamela, Jalisco, Mexico, 16 Feb 1938, 46–55 m, id. S. A. Glassell, USNM 1107138; 5 males (SL 1.2–1.8 mm), 2 females (SL 1.0–1.3 mm), 1 juv (SL 0.9 mm), Secas Island, SW group, Gulf of Chiriqui, Panama, 22 Feb 1934, sta 251–34, coll. W.L. Schmitt, 27 m, USNM 1253253; 4 males (SL 1.0–1.9 mm), 12 females (SL 1.2–2.4 mm), 1 ovig female (SL 1.5 mm), Parker Bay, Costa Rica, 9 Feb 1935, R/V Velero III, sta 468–35, 9 m, USNM 1253254; 2 males (SL 1.3–1.6 mm), Salinas Bay, Costa Rica, 11 Feb 1935, R/V Velero III, sta 481–35, 11 m, USNM 1253255.

SCRIPPS holdings: 24 NS, in shell, Bahía Banderas, Mexico, 20°41'N, 105°23.5'W, 21 Aug 1961, sta 610813–52, coll. F.H. Berry, 63–65 m, SIO C-2441; 1 male (SL 2.0 mm), Golfo de Fonseca, El Salvador, 13°01.1'N, 88°01.7'W, 4 Apr 1978, B/O "A. Helix", sta TEPE 78–9, coll. J. Lance, ot, 42 m, SIO C-4085.

**Diagnosis.** Shield about as long as broad; rostrum broadly subtriangular, blunt, not reaching tip level of lateral

projections or basis of ocular acicles. Ocular peduncles long, slender, straight, cornea weakly dilated. Antennal flagellum with numerous long setae directed ventrally. First maxilliped without epipod. Third maxillipeds with endopod-exopod joint moderately separated. Carpus and palm of chelipeds each with 5 strong spines on dorsomesial margin. Propodus of second pereopods with row of 5–7 spines on dorsal margin.

**Redescription.** Shield (Fig. 1A) about as long as broad, dorsal surface with few small spines anteriorly, short transverse rows of small spines mostly near anterolateral margins, and scattered tufts of short setae; rostrum blunt, broadly subtriangular, not reaching tip level of lateral projections or basis of ocular acicles, upper surface somewhat concave; lateral projections obtuse, exceeding rostrum in distal extension, ending in marginal spine. Posterior margin rounded. Anterolateral angles each with 1 moderately strong spine. Branchiostegites each with row of spinules on dorsomesial and distal margins, concealed partially by tufts of long setae.

Ocular peduncles (Fig. 1A) long, slender, slightly compressed medially, about 0.90 length of shield. Ocular acicles subtriangular, terminating in strong spine, separated by approximately 0.33 basal width of 1 acicle.

Antennular peduncles (Fig. 1A) long, distal segment overreaching ocular peduncles by 0.50 length of ultimate segment. Ultimate and penultimate segments unarmed, with some tufts of setae on ventral and dorsal margins. Basal segment with 1 small spine on distal ventromesial margin, 1 small spine on laterodistal margin, and 1 moderately strong subdistal spine on lateral margin.

Antennal peduncles (Fig. 1A) with supernumerary segments, overreaching distal margin of corneas by about 0.33 of fifth segment. Fifth segment unarmed, with few short setae on ventrolateral margin and dorsal surface. Fourth segment with small dorsodistal spine. Third segment with 1 strong or moderately strong spine on ventromesiodistal angle and tufts of long setae. Second segment with dorsolateral distal angle moderately to strongly produced, ending in single spine; lateral margin unarmed; dorsomesial distal angle ending in strong spine, mesial margin with tufts of setae. First segment with ventrodistal margin produced, with 1 moderately strong laterodistal spine. Antennal acicle nearly straight, approximately 0.25 length of antennal peduncle, mesial margin armed with 2–4 spines, lateral margin with 2 small spines or spinules subdistally, ending in bifid spine. Antennal flagella long, approximately 1.50 length of shield, consisting of about 21 articles and reaching to tip of cheliped fingers when totally extended, ventrally with rows of long setae 3–6 flagellar articles in length.

Mandible without distinguishing characters. Maxillule (Fig. 2A) with proximal endite subquadrate, distal endite subrectangular, enlarged distally; endopod with 1 proximal seta, 3–5 stout setae or bristles on weakly produced internal lobe, external lobe well developed, recurved, approximately 0.75 length of endopod, external angle with 7 long setae. Maxilla (Fig. 2B) with endopod moderately long, extending to distal margin of scaphognathite, somewhat inflated basally. First maxilliped (Fig. 2C) with endopod elongate, approximately 0.70 length of basal segment of exopod, strongly twisted; flagellum short, unsegmented, with long, marginal plumose setae distally; epipod absent. Second maxilliped (Fig. 2D) with basis-ischium fusion incomplete. Third maxilliped (Fig. 2E) with joint of endopod and exopod moderately separated; basis-ischium fusion incomplete; coxa with 3 or 4 small spines distally concealed partially by long setae; basis usually with 2 or 3 small spines; ischium with crista dentata well developed, with 10–12 teeth, without accessory tooth, usually with 1 small spine on dorsodistal margin; merus with 1 or 2 spines on ventrolateral margin, dorsodistal margin with 1 small spine; carpus, propodus and dactyl unarmed.

Chelipeds subequal, right slightly longer than left, similar in armature (Fig. 3A, B). Dactyls each about 1.75 times longer than palms; dorsomesial margin with row of strong, corneous-tipped spines decreasing in size distally and accompanied with tufts of long setae; dorsal surface with 2 irregular longitudinal rows of corneous-tipped spines accompanied by tufts of long setae; mesial surface with 2 irregular longitudinal rows of spines, upper largest; ventral surface with scattered tufts of long setae; cutting edge with small calcareous denticles interspaced with small corneous spines; terminating in an acute corneous claw overlapped by fixed finger. Palms each about 0.80 length of carpi; dorsomesial margin armed with 5 prominent, corneous-tipped conical spines accompanied with tufts of long setae; dorsolateral margin armed with small, corneous-tipped spines or tubercles, more numerous on fixed finger; dorsal surface with 4 or 5 irregular longitudinal rows of corneous-tipped spines smaller than on dorsomesial margin, each accompanied by tufts of long setae; mesial surface nearly straight, with scattered granules or tubercles, larger near dorsal margin and accompanied by long setae; lateral surface slightly convex, with few small spines accompanied by tufts of long setae; ventral surface with few spines or tubercles extending on fixed finger. Fixed finger ending in small corneous claw; dorsal surface with 2 or 3 irregular longitudinal rows of corneous-tipped spines accompanied by tufts of long setae. Carpi short, each about 0.80 length of meri, subquadrate in cross-section; dorsomesial margin with 5 or 6 strong, corneous-tipped spines increasing in size

distally; dorsolateral margin with 4 or 5 small spines; dorsal surface flat, with few tufts of long setae; mesial and lateral surfaces with few flattened granules or tubercles accompanied by tufts of long setae; ventrolateral distal angle with 1 or 2 moderately strong spines. Meri triangular in cross-section; dorsal surface with small granules partially concealed by tufts of long setae; distal and subdistal margins each armed with 1 large corneous-tipped spine; ventromesial and ventrolateral margins spinose, with larger spines on mesial margin; mesial surface smooth; external surface with few small granules and tufts of long setae. Ischia each with row of small spines on ventromesial margin; ventrolateral distal angle with 1 moderately strong spine.

Second (Fig. 3C) and third (Fig. 3D) pereopods slender, similar right from left except slightly in armature, exceeding to chelipeds by approximately 0.50 of dactyls length when totally extended. Dactyls each 1.30–1.40 times length of propodi; dorsal surface with double row of tufts of long setae; mesial and lateral surfaces each with median longitudinal row of setae, longer on mesial surface; ventromesial and ventrolateral margins and ventral surface each with row of tufts of long setae. Propodi 1.28–1.30 times length of carpi; dorsal surface with row of 5–7 moderately strong spines (second, spines weakly developed and less in number in specimens  $SL \leq 2.0$  mm), or 1 anterior and 1 posterior (third) and tufts of long setae; mesial surface usually with 2 longitudinal rows of long setae; lateral surface with shallow longitudinal sulcus and usually 2 rows of long setae; ventral surface with 1 irregular (second) or 2 rows (third) of small, spiniform granules accompanied by tufts of short setae. Carpi each 0.77–0.88 times length of meri; dorsal surface with 1 row of spines (second), or 1 or 2 small spines (third), 1 distal and 1 posterior, and tufts of long setae; mesial, lateral and ventral surfaces with tufts of long setae. Meri compressed laterally; dorsal surface of each usually with 1 or 2 small spines concealed partially by tufts of long setae; ventral surface with row of spinules on ventromesial margin (second), or with 1 or 2 denticles (third); mesial and lateral surfaces with few tufts of short setae. Ischia each with few small spines on ventromesial margin concealed partially by tufts of long setae; dorsodistal margin with 1 spine (longer on second pereopods). Coxa of second pereopods each with 1 small ventrodistal spine, third pereopods unarmed.

Sternite XII (between third pereopods; Fig. 1B) with anterior lobe subdivided in 2, with tufts of long setae. Fourth pereopods (Fig. 1C) subchelate; dactyl 0.80 times length of propodus, ventrolateral margin unarmed, preungual process long, slender; propodi each with 3 rows of ovate scales on propodal rasp, and 1 spine on dorsolateral proximal margin. Carpi and meri unarmed.

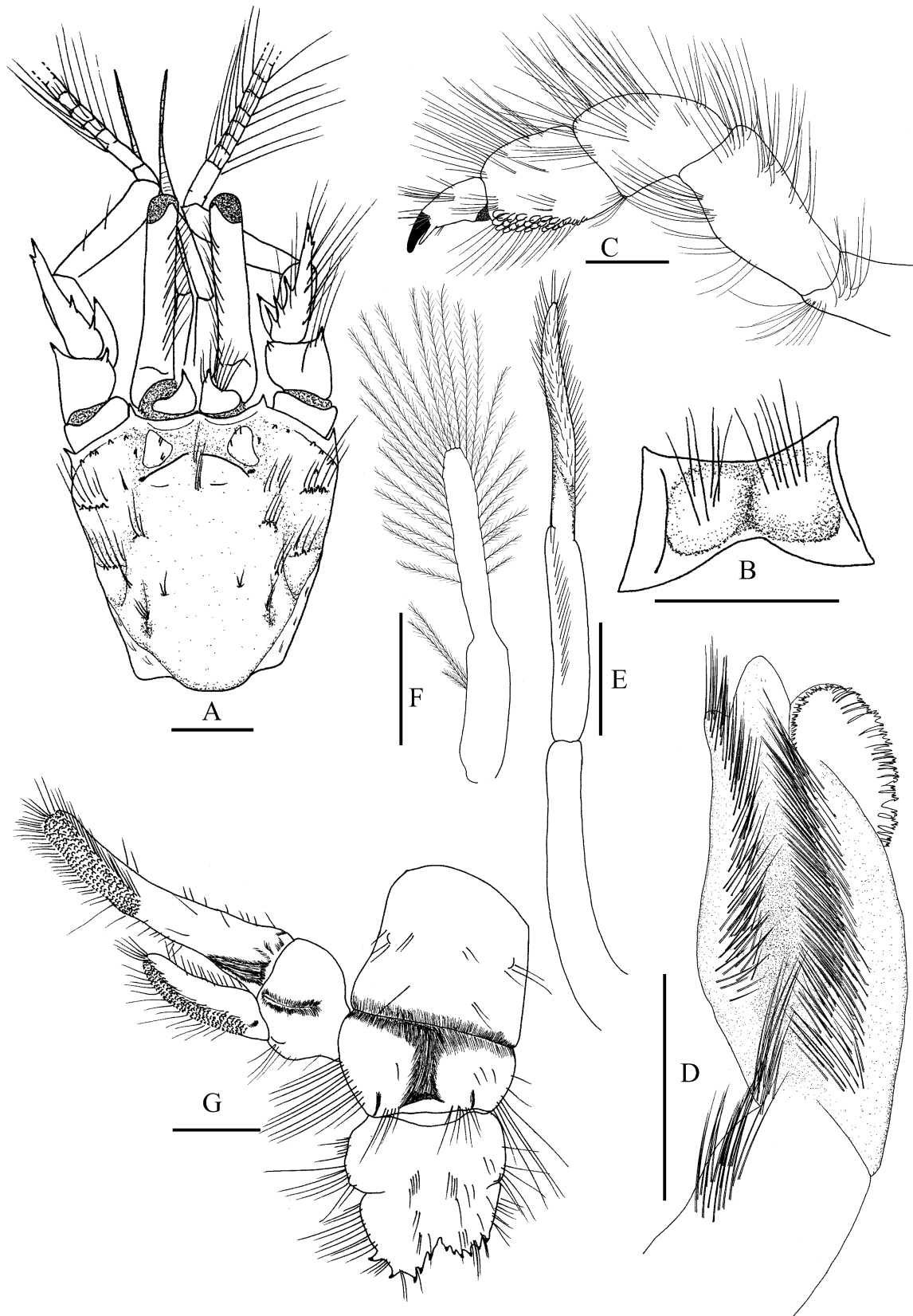
Fifth pereopods chelate; dactyls each with 2 or 3 rows of small corneous spines; propodi each with well developed propodal rasp bearing several rows of small corneous spines.

Male first and second pleopods modified as gonopods. First gonopod (Fig. 1D) with tuft of long setae on mesial margin of basal lobe and superior mesial angle, lateral margin of basal lobe naked; inferior lamella with several rows of long setae on lateral margin, distal margin with row of simple, bifid or trifid, curved corneous spines extending on mesial face; external lobe subtriangular, exceeding inferior lamella in distal extension, naked; inner lobe subtriangular, with setae on mesial margin and inner margin. Second gonopod (Fig. 1E) with distal segment longer than basal segment, slightly twisted, with long simple setae on laterobasal margin and distally on lateral and mesial margins; basal segment naked. Pleopods 3–5 unpaired, exopod well developed, endopod vestigial or absent.

Female first pleopods (gonopods, Fig. 1F) with submedian constriction incompletely dividing basal and distal segments; distal segment with long plumose setae on lateral and distal margins; basal segment naked or with some setae. Pleopods 2–5 lacking brood pouch, with dense long setae.

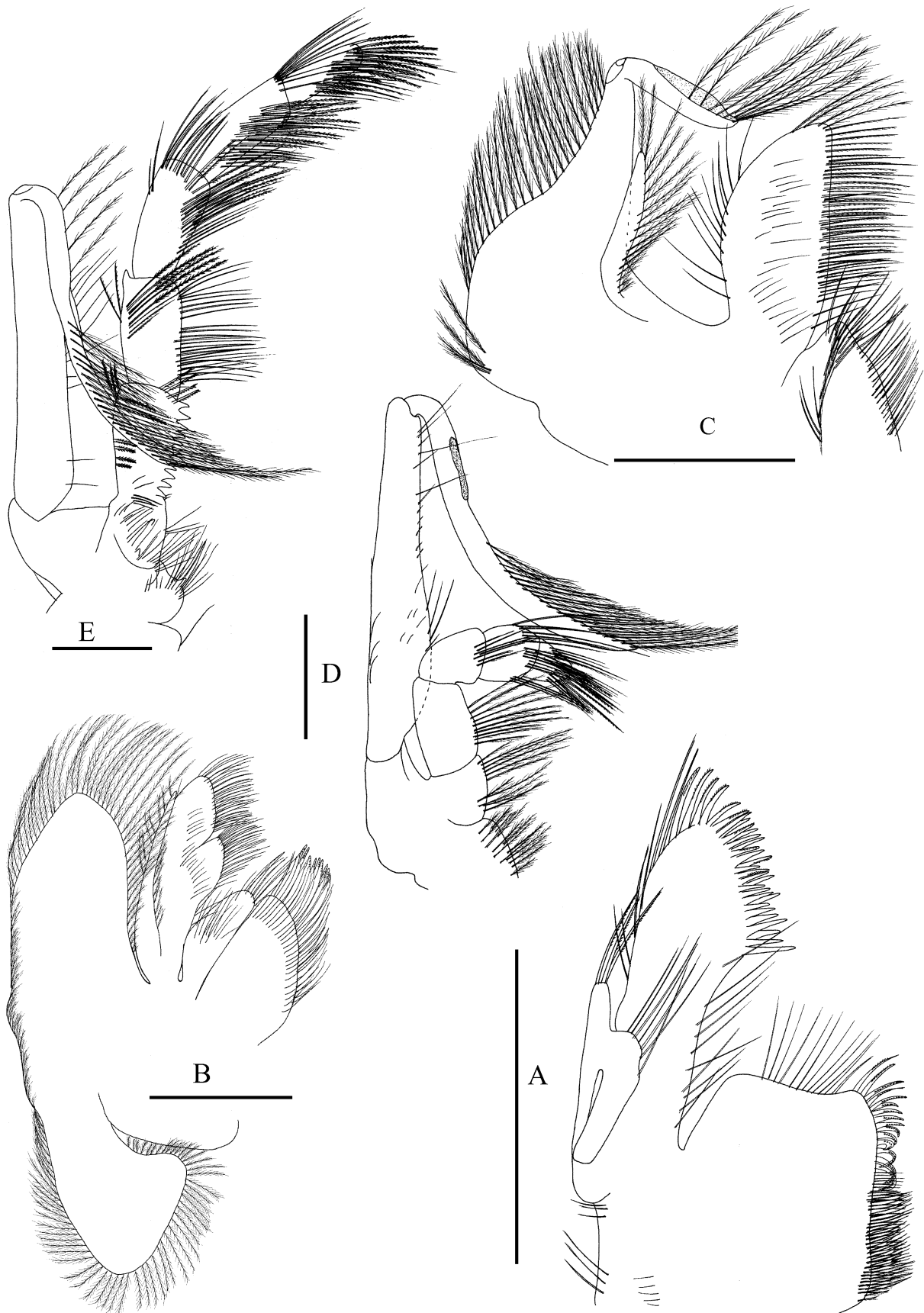
Uropods and telson (Fig. 1G) asymmetrical; protopod with pair of granules or denticles distally. Telson with distinct, deep lateral incisions dividing anterior and posterior portions; posterior portion separated in 2 unequal lobes by moderately deep median cleft, terminal margins of lobes each armed with 5 or 6 corneous-tipped spines, 2 of which on left lobe are largest and on lateral margin of lobe; anterior portions unarmed except for tufts of long setae laterally.

**Color.** According to Glassell (1937: 246), specimens fixed in ethanol: "the ground color is an iridescent cream with dashes and splotches of crimson, this extends to the chelipeds and legs, the former are more highly colored on the inside, while the latter appear to be banded. The setae are a straw colored yellow".

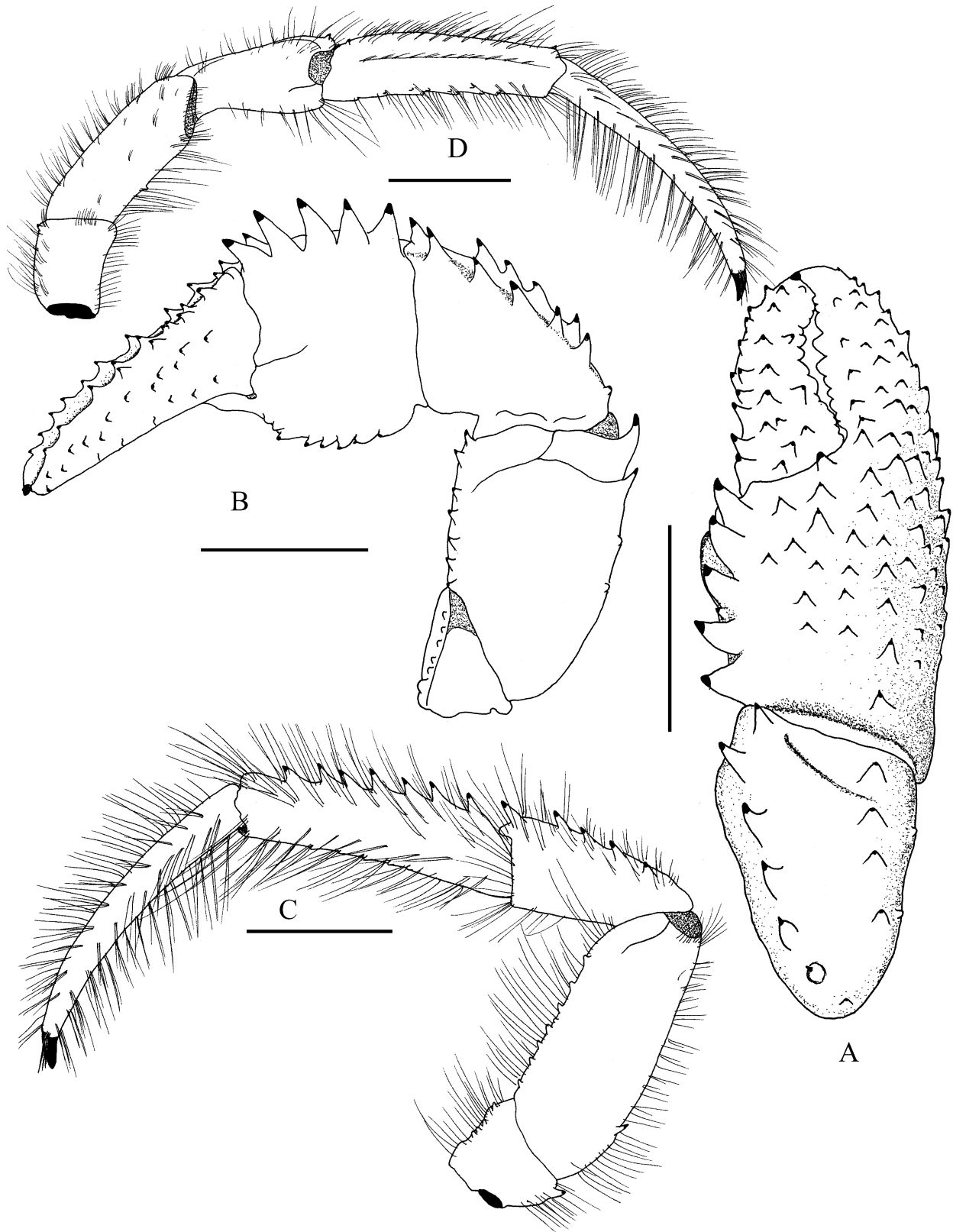


**FIGURE 1.** *Areopaguristes praedator* nov. comb. (Glassell, 1937). A, male holotype (SL 3.5 mm), AMNH-12232; B–E, G, male (SL 3.2 mm), EMU-3701B; F, female (SL 3.1 mm), EMU-6967B. A, shield and cephalic appendages, dorsal view; B, sternite XII (third pereopods), ventral view; C, left fourth pereopod, lateral view; D, first pleopod, internolateral view; E, left second pleopod, inner view; F, left first pleopod, inner view; G, sixth abdominal tergite, left uropod and telson, dorsal view. Scale bars: A = 1 mm, B–G = 0.5 mm.





**FIGURE 2.** *Areopaguristes praedator* nov. comb. (Glassell, 1937). Male (SL 3.2 mm), EMU-3701B. Left mouthparts, inner view. A, maxillule; B, maxilla; C, first maxilliped; D, second maxilliped; E, third maxilliped. Scale bars = 0.5 mm.



**FIGURE 3.** *Areopaguristes praedator* nov. comb. (Glassell, 1937). Male (SL, 3.2 mm), EMU-3701B. A, chela and carpus of right cheliped, dorsal view (setae omitted); B, right cheliped, mesial view (setae omitted); C, second right pereopod, mesial view; D, third right pereopod, lateral view. Scale bars = 2 mm.

**Habitat and ecology.** This is an abundant species which occurs rarely in less than 40 m, and frequently in 60 m or deeper (Haig *et al.* 1970, Ayón-Parente & Hendrickx 2010a). The material collected by Glassell (1937) was found on sandy substrate with rocks, between 55–155 m. Material collected during the SIPCO and CORTES cruises was obtained in 20–110 m. The organisms were found on mixed substrate, including sandy substrate mixed with varying proportions of clay and silt, and sand substrates mixed with silt and clay. Epibenthic temperature ranged from 14.5–29.4°C and oxygen concentration from 1.47 to 4.00 ml/l. Occasionally *Areopaguristes praedator* nov. comb. can tolerate a range of slight to severe hypoxia (0.39 to <1.00 ml/l). Specimens were mostly found in shells of *Phos veraguensis* Hinds, 1843, *P. articulatus* Hinds, 1844, *Fusinus panamensis* Dall, 1908, *Conus* sp., *Bursa sonorana* Berry, 1960, *Terebra* sp., *Hindsiclava militaris* Reeve, 1843, *Turritella nodulosa* King & Broderip, 1832, and *Trajana perideris* (Dall, 1910). Oviparous females were observed during the months of February, May, June and August. One female (SL 2.80 mm) was carrying 315 eggs with a diameter range of 0.55–0.60 mm.

**Distribution.** Eastern Pacific: from west coast of Baja California and the Gulf of California, to Costa Rica (Hendrickx & Harvey 1999, this study). Depth: 6–155 m.

**Remarks.** The study of the extensive material (including holotype and paratypes) of this species previously still assigned to *Paguristes*, revealed that it possesses 12 pairs of gills and therefore, by the current definition of *Areopaguristes*, should be assigned to that genus. Although incomplete and lacking illustrations, the original description by Glassell (1937) is sufficiently accurate. The only discrepancy in Glassell's description with the type material is in the armature of the telson. Glassell described the distal margin of the telson as unarmed, but in the types the distal margin is distinctly armed with corneous-tipped spines.

When *Areopaguristes praedator* nov. comb. is compared with congeners from the eastern Pacific, it shows most resemblance with *A. lemaitrei*. Both species have a truncated rostrum, not extending to the distal level of the lateral projections or bases of ocular acicles. *Areopaguristes praedator* nov. comb. can be easily differentiated from *A. lemaitrei* by the shape of the eyestalks, which are proportionately longer and thinner than in the latter. In *A. praedator* nov. comb., the ocular acicles are distinctly separated and end in a strong, simple or rarely bifid spine directed anterolaterally, the antennal acicle has two or three spines on the mesial margin, whereas in *A. lemaitrei* the acicles are nearly contiguous, the ocular acicles end in a multidentate spine directed anteriorly, and the antennal acicles has four to six spines on the mesial margin. The dactyls of the second and third pereopods are unarmed in *A. praedator* nov. comb., whereas in *A. lemaitrei* the dactyls bear small spines on dorsal and ventral margins. The other major difference between these two species is the absence of an epipod on the first maxilliped of *A. praedator* nov. comb., whereas an epipod is present in *A. lemaitrei*.

### ***Areopaguristes oxyophthalmus* (Holthuis, 1959) nov. comb.**

(Figs. 4–6)

*Paguristes oxyophthalmus* Holthuis, 1959: figs. 22b, 23.—Baker *et al.*, 1981: 93.—Abele & Kim, 1986: 30 (checklist).—Campos & Sánchez, 1995: 570, fig. 6 a-c.—Calado, 1996: 155.—Perry & Larsen, 2004: unnumbered, fig. unnumbered.—McLaughlin *et al.*, 2005: 244 (listed), 2010: 22.—Wicksten, 2005: 32.—Coelho *et al.* 2007: 10, tbl 4.—Felder *et al.*, 2009: 1069 (listed).—Merchán-Cepeda *et al.*, 2009: 126.—Lemaitre & Felder, 2012: 69.

*Paguristes oxyophthalmus*.—Rodríguez-Almaraz & Zavala-Flores, 2005: 290, Fig. 17 (misspelling).

**Type material.** Holotype (not examined): female (carapace length 6 mm), Coquette, first voyage, about 20 miles NNW of mouth of Coppename River, Suriname, 31 m, 1–5 Apr 1957, RMNH.CRUS D 12586. Paratypes: 1 male (SL 1.3 mm), 1 ovig female (damaged), off Suriname, 06°48'N, 54°54'W, 12 May 1957, R/V Coquette, sta 28, 46 m, USNM 103272; 1 male (SL 2.2 mm), off Suriname, 06°41'N, 55°27'W, 25 Jun 1957, R/V Coquette, sta 274, 42 m, USNM 103273.

**Type locality.** About 20 miles NNW of the mouth of the Coppename River, 31 m, 1–5 Apr 1957.

**Additional material.** USNM holdings: 1 male (SL 2.7 mm), West Delta Lease Area, 500 m N of Platform, Louisiana, United States, 28°44'04"N, 89°44'07"W, 31 Aug 1978, coll. Southwest research Institute for BLM/MMS, sta 09S, 85 m, USNM 187044; 1 male (SL 1.6 mm), near Morro Castle light and Punta Salinas, Puerto Rico, 18°29'40"N, 66°08'30"W, 3 Feb 1933, Johnson-Smithsonian Deep Sea Expedition, R/V Caroline, sta 16, coll. P. Bartsch, 69–174 m, USNM 267532; 1 male (SL 4.2 mm), Texas, United States, [no date], R/V Oregon II, Cruise 232, sta 21, 73 m, USNM 310863; 1 male (SL 3.8 mm), Gulf of Mexico, United States, 23 May 2000, DGOMB,

Gyre R/V, RW-1, 175–200 m, USNM 310879; 1 male (SL 2.4 mm), Puerto Rico, Caribbean Sea, year 1899, R/V Fish Hawk, USNM 103422; 1 male (SL 4.5 mm), Florida Keys, Dry Tortugas, Florida, United States, year 1934, coll. H. Darby, 82 m, USNM 103430; 1 male (SL 3.1 mm), Texas, Gulf of Mexico, United States, 27°52'N, 92°55'W, 20 Jul 1971, sta 71A7-34, 192 m, USNM 1089226; 1 female (SL 3.6 mm), Gulf of Mexico, United States, 29°40'30"N, 87°16'W, 11 Mar 1988, NAMES B2, R/V Tommy Munro, sta D4, 200 m, USNM 1095935; 1 male (SL 3.6 mm), off Mississippi River Delta, Gulf of Mexico, United States, 29°04'56"N, 88°45'31"W, Mar 1988, NAMES B2, R/V Tommy Munro, sta C3, 150 m, USNM 1095960; 11 males (SL 1.9–5.0 mm), 5 females (SL 1.9–3.9 mm), 7 ovig females (SL 2.1–3.9 mm), NW of Trinidad, Lesser Antilles, Caribbean Sea, R/V Pillsbury, sta P-849, 11°14.5'N, 61°46.2'W, 137–139 m, ot, USNM 1253257.

TCWC holdings: 1 female (SL 3.3 mm), SW Gulf of Mexico, 19°25'N, 95°57'W, 20 Aug 1969, sta 69A11-60, 201 m, skimmer, TCWC 2-5574; 1 female (SL 3.3 mm), SW Gulf of Mexico, 21°16'N, 96°57'W, 23 Aug 1969, sta 69A11-76, 183 m, skimmer, TCWC 2-5575; 1 male (SL 3.0 mm), SW Gulf of Mexico, 21°30'N, 96°55'W, 23 Aug 1969, sta 69A11-78, 677–732 m, skimmer, TCWC 2-6536.

**Diagnosis.** Shield about as long as broad; rostrum broadly subtriangular, blunt, not reaching tip level of lateral projections or basis of ocular acicles. Ocular peduncles long, slender, straight, cornea narrow, tapering anteriorly. Antennal flagellum with long setae ventrally 3–5 articles in length. Third maxillipeds with endopod-exopod joint moderately separated. Carpus and palm of chelipeds each with five strong spines on dorsomesial margin. Dorsal margin of propodus of second pereopods with 4 spines on proximal half.

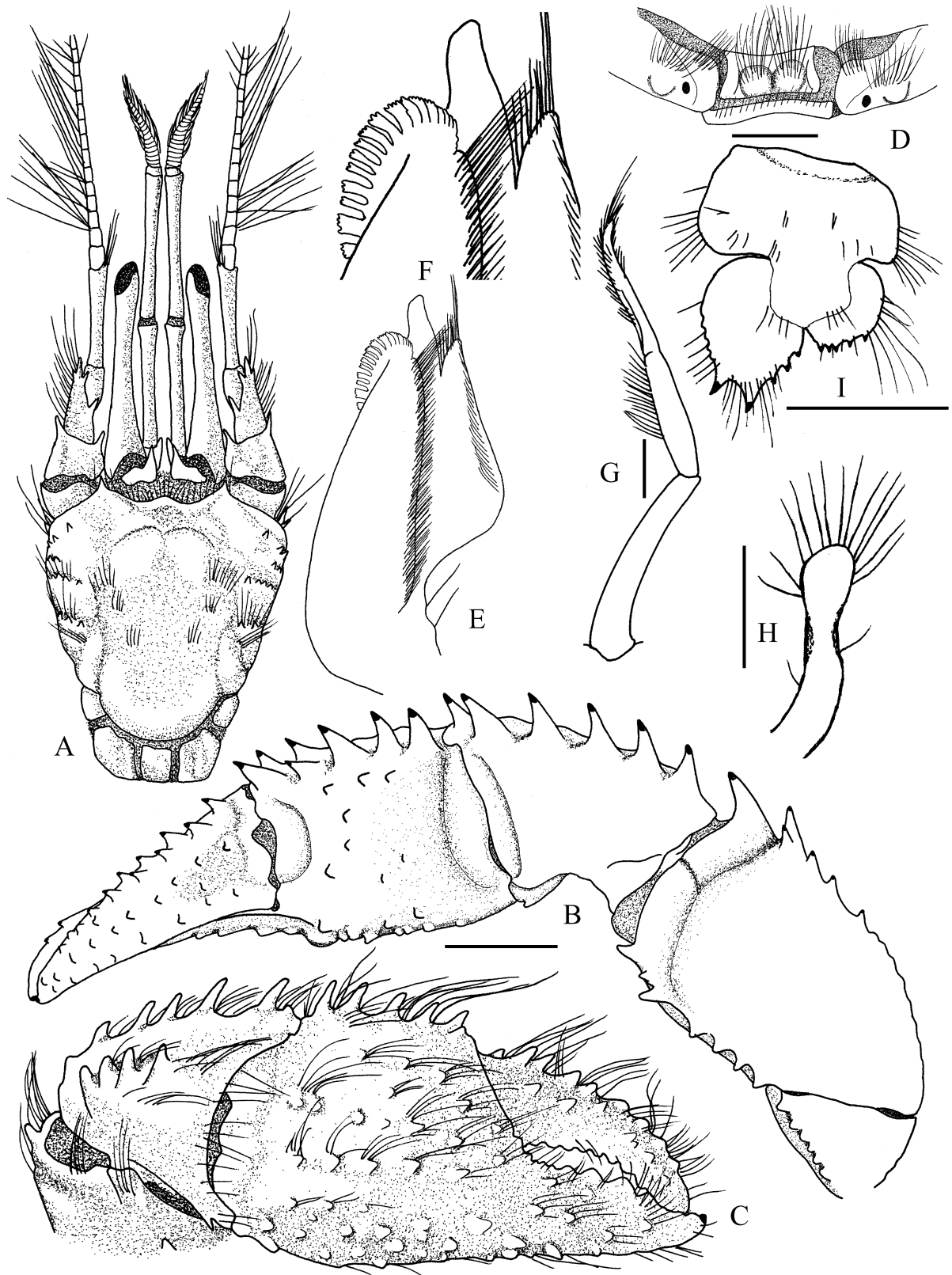
**Redescription.** Gills biserial. Shield about as long as broad (Fig. 4A), dorsal surface with scattered tufts of setae, and short, transverse rows of spinules on anterior dorsolateral margins. Anterolateral margins sloping. Anterior margins between rostrum and lateral projections concave. Rostrum broadly subtriangular, blunt, shorter than lateral projections; lateral projections each ending in spine. Posterior margin rounded. Anterolateral angles usually with 1 small spine. Branchiostegites each with row of spinules on dorsomesial and distal margins, concealed partially by tufts of long setae.

Ocular peduncles (Fig. 4A) slender, slightly compressed medially, about 0.90 length of shield. Cornea weakly dilated, about as long as broad, tapering anteriorly to blunt point; inner dorsal portion with narrowly triangular extension of terminal segment of ocular peduncle. Ocular acicles subtriangular, terminating in strong, narrow spine (occasionally bifid or with small spine basally on lateral margin), separated by approximately 0.40 basal width of 1 acicle.

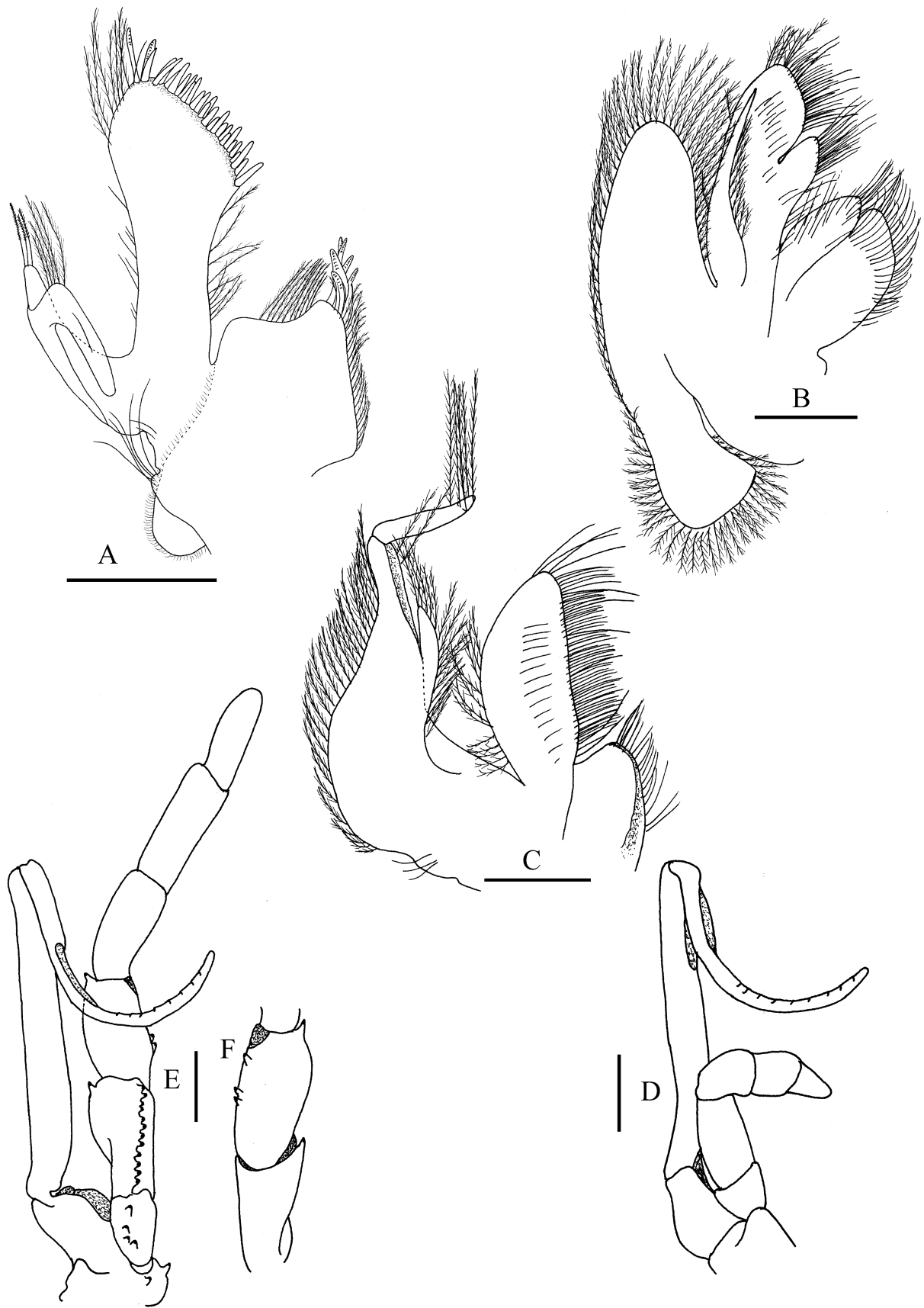
Antennular peduncles (Fig. 4A) exceeding ocular peduncles by 0.50 length of ultimate antennular segment; ultimate and penultimate segments unarmed, with few tufts of long setae; basal segment with small spine on ventrodorsal margin, lateral face with moderately strong spine on middorsal margin, distal margin with small spine concealed by long setae.

Antennal peduncles (Fig. 4A) with supernumerary segment, long, reaching only slightly beyond distal margin of corneas; fifth segment with scattered tufts of setae on dorsal and ventral surfaces; fourth segment with small dorsodistal spine; third segment with ventrodorsal margin produced into strong spine; second segment with laterodistal angle produced and terminating in large corneous-tipped spine, remainder of lateral margin unarmed; mesiodistal angle with strong spine, mesial margin setose; first segment unarmed. Antennal acicles triangular, slightly exceeding distal margin of fourth antennal segment, terminating in single or bifid spine, mesial margin with 2 or 3 spines. Antennal flagella short, slightly longer than shield, consisting of about 18 articles, reaching to tip of chelipeds, each article with long, paired setae ventrally about 3–5 flagellar articles in length.

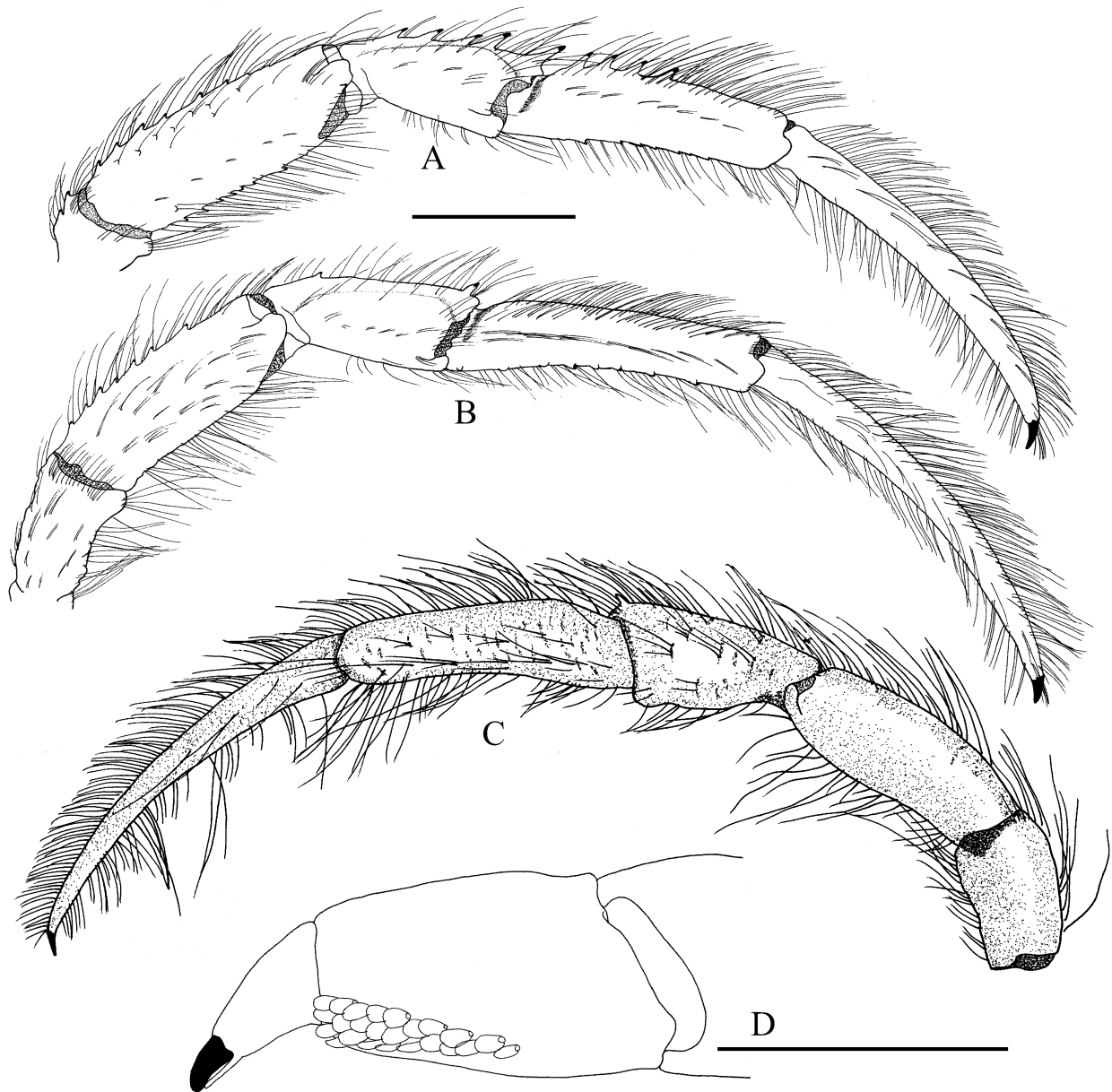
Mandible without distinguishing characters. Maxillule (Fig. 5A) with proximal endite subquadrate, distal endite subrectangular, enlarged distally; endopod with 3 apical bristles on weakly produced internal lobe, external lobe well developed, recurved, about 0.75 length of endopod, externobasal angle with 5 long setae. Maxilla (Fig. 5B) with endopod moderately long, exceeding scaphognathite by approximately 0.25 of its length, somewhat inflated basally. First maxilliped (Fig. 5C) with endopod elongate, approximately 0.75 length of basal segment of exopod, strongly twisted; flagellum short, 1-segmented, with long marginal plumose setae distally; epipod absent. Second maxilliped (Fig. 5D) with basis-ischium fusion incomplete. Third maxilliped (Fig. 5E, F) with joints of endopod and exopod moderately separated; basis-ischium fusion incomplete; coxa with 2 small spines distally, partially concealed by long setae; basis usually with 4 small spines; ischium with crista dentata well developed, with 12 teeth, without accessory tooth, and usually 1 small spine on dorsodistal margin; merus with 2 or 3 spines on ventrolateral margin, dorsodistal margin with 1 small spine; carpus, propodus and dactyl unarmed.



**FIGURE 4.** *Areopaguristes oxyophthalmus* nov. comb. (Holthuis, 1959). A, C, presumably female holotype (carapace length 6 mm, *vide* Holthuis 1959), RMNH.CRUS D 12586; E, F, presumably male paratype (SL 2.2 mm), USNM 103273; G, male (SL 4.2 mm), USNM 310863; B, D, H, I, female (SL 3.3 mm), TCWC 2-5574. A, shield and cephalic appendages, dorsal view; B, right cheliped, mesial view; C, same, outer view; D, sternite XII (third pereopods), ventral view; E, first pleopod, internolateral view; F, same magnified; G, first pleopod, internolateral view; H, first pleopod; I, telson, dorsal view. Scale bars B, D, H = 1 mm, G = 0.5 mm. (A, C, E, F, redrawn from Holthuis 1959).



**FIGURE 5.** *Areopaguristes oxyophthalmus* nov. comb. (Holthuis, 1959). Female (SL 3.3 mm), TCWC 2-5574. Left mouthparts, inner view. A, maxillule; B, maxilla; C, first maxilliped; D, second maxilliped (setae omitted); E, third maxilliped (setae omitted); F, ischium and merus of third maxilliped, outer view (setae omitted). Scale bars = 0.5 mm.



**FIGURE 6.** *Areopaguristes oxyophthalmus* nov. comb. (Holthuis, 1959). A, B, D, female (SL 3.3 mm) (TCWC 2-5574); C, presumably female holotype (carapace length 6 mm, *vide* Holthuis 1959), RMNH.CRUS D 12586. A, second right pereopod, lateral view; B, third right pereopod, lateral view; C, third left pereopod, lateral view; D, dactyl and propodus of fourth left pereopod, lateral view (setae omitted). Scale bars: A, B = 2 mm, D = 1 mm. (C, redrawn from Holthuis 1959).

Chelipeds (Fig. 4B, C) subequal, thickly covered by long hairs. Dactyls each moderately long, 1.50 times as long as palms, terminating in moderately large or large corneous-tipped claw overlapped by fixed finger; cutting edge with row of about 10 unequal teeth; dorsomesial margin with row of strong spines decreasing in size distally; dorsal surface with irregular longitudinal row of spines decreasing in size distally; mesial surface with 2 rows of corneous-tipped spines. Palms each with row of 5 strong spines on dorsomesial margin accompanied by tufts of long setae, dorsolateral margin not well delimited, dorsal surface with 3 or 4 rows of spines accompanied by tufts of long setae, of which 2 extend on fixed finger, ventrolateral surface with several irregular rows of spine-like tubercles; mesial and ventral surfaces convex with some small spine-like tubercles. Carpi each with row of 5 prominent corneous-tipped spines on dorsomesial margin; dorsolateral margin with 4 or 5 smaller spines; ventrolaterodistal angle with 1 small spine. Meri long, about 1.75 times as long as carpi, subtriangular in cross-section; dorsal margins with row of tubercles proximally, becoming corneous-tipped spines distally and accompanied with tufts of long plumose setae; ventrolateral and ventromesial margins each with row of spines,

smaller on ventromesial margins; ventral faces with plumose setae. Ischia each with row of small spines and tufts of long setae on ventromesial margins.

Second and third pereopods (Fig. 6A–C) slender, similar right from left except slightly in armature, exceeding chelipeds by approximately 0.50 length of dactyls when totally extended. Dactyls long, 1.50–1.60 times length of propodi; dorsal surface with rows of tufts of long setae; mesial and lateral surfaces each with median longitudinal row of setae, longer on mesial surface; ventromesial and ventrolateral margins and ventral surface each with row of tufts of long setae. Propodi 1.20–1.40 times length of carpi; dorsal surface with row of 4 moderately strong spines on proximal half (second) or with only tufts of long setae (third); mesial surface usually with 2 longitudinal rows of long setae; lateral surface with shallow longitudinal sulcus and usually 2 rows of long setae; ventral surface with 1 irregular row of small spiniform granules accompanied by tufts of long setae. Carpi 0.70–0.80 length of meri; dorsal surface with 1 row of spines (second) or 1 or 2 small spines, one distal and other posterior (third), and tufts of long setae; mesial, lateral and ventral surfaces with tufts of long setae. Meri compressed laterally; dorsal surface with row of small spines or spinules concealed partially by tufts of long setae; ventral surface with row of spinules on ventromesial margin (second) or only tufts of long plumose setae (third); mesial and lateral surfaces with few tufts of short setae. Ischia of second pereopods with 1 or 2 small spines dorsally, third pereopods with pair of granules on ventrolateral margin and tufts of long setae. Coxa of second pereopods with 1 small spine ventrodiscal. Third pereopods unarmed.

Sternite XII (between third pereopods; Fig. 4D) with anterior lobe subdivided in 2, each lobe with tufts of long stiff setae. Fourth pereopods (Fig. 6D) subchelate; dactyls each 0.60 length of propodus, ventrolateral margin unarmed, with long, slender preungual process; propodal rasp with 2–4 rows of scales at least distally. Carpi and meri unarmed. Fifth pereopods chelate; dactyls each with 2 or 3 rows of small corneous spines; propodi each with well developed propodal rasp bearing several rows of small corneous spines.

Male first and second pleopods modified as gonopods. First gonopod (Fig. 4E, F) with tuft of long setae on mesial margin of basal lobe and superior mesial angle, lateral margin of basal lobe naked; inferior lamella with row of long setae on lateral margin, distal margin with row of simple, bifid or multifid curved corneous spines extending on mesial face; external lobe subtriangular, exceeding inferior lamella in distal extension, naked; inner lobe subtriangular, almost as long as inferior lamella, with setae on mesial margin. Second gonopod (Fig. 4G) with distal segment longer than basal segment, slightly twisted, with long simple setae on laterobasal margin and distally on lateral and mesial margins; basal segment naked. Left pleopods 3–5 unpaired, each with exopod well developed, endopod vestigial or absent.

Female with paired gonopods, paired first pleopods (Fig. 4H), and unpaired left pleopods 2–5; first pleopod usually with 2 setae on basal segment, distal segment with long plumose setae on lateral and distal margins. Pleopods 2–5 lacking brood pouch, with dense long setae.

Uropod and telson strongly asymmetrical. Telson (Fig. 4I) with distinct, deep lateral incisions dividing anterior and posterior portions; posterior portion separated in 2 unequal lobes by moderately deep median cleft, terminal margins of lobes each armed with about 5 small corneous-tipped spines, 2 of which on left lobe near lateral margin distinctly larger; anterior and posterior portions with lateral margins sparsely setose.

**Color.** According to Holthuis (1959: 137), based on preserved material: "a few faint reddish spots are visible on the carapace, while a very small red spot is present in the basal part of the eyestalks. On the chelipeds there is a red band basally on the palm; a red band extends along the external and posterior margin of the upper surface of the carpus and continues on the basal part of the inner surface; a red spot is visible in the antero-internal part of the dorsal surface of the carpus; the merus has a red distal band and shows a red colour in the upper basal part. The ambulatory legs show a red band in the basal and in the distal part of the propodus, carpus and merus, and furthermore in the basal part of the dactylus".

**Habitat.** Muddy and muddy-sand bottoms, among shells, mud and shells, and shell and coral debris. Depth: 27–732 m, most frequently found between 20–40 m (Holthuis 1959; Campos & Sánchez 1995; this study).

**Distribution.** Western Atlantic: from the Gulf of Mexico and Caribbean Sea, to Pará, Brazil (Campos & Sánchez 1995; this study).

**Remarks.** When Holthuis (1959) described *Paguristes oxyphthalmus* it appears that he was not aware of Glassell's (1937) description of *P. praedator*, as he did not include a comparison of the similarities between these two taxa. In both species the second and third pereopods are similarly long and slender, and the dactyls lack spines dorsally and ventrally. However, in *A. oxyphthalmus* the dactyls are proportionally longer relative to the propodi



than in *A. praedator*. Also, in *A. oxyophthalmus*, there are four spines on the posterior half of the propodus of the second pereopod, whereas there are usually six or seven (or rarely five) spines in at least larger specimens (SL >2.5 mm) of *A. praedator*.

*Areopaguristes oxyophthalmus* can be distinguished from the four other current western Atlantic congeners primarily by the short, blunt rostrum which does not exceed the lateral projections of the shield. One western Atlantic congener, *A. hummi*, does have a similarly short rostrum; however, in *A. hummi* the mesial margins of the ocular acicles are adjacent and each acicle has a multidentate anterolateral margin, whereas in *A. oxyophthalmus* the acicles are distinctly separated and the anterolateral margin of each acicle is entire.

## Discussion

With the transfer of *Paguristes praedator* and *P. oxyophthalmus* to *Areopaguristes*, 27 species are now recognized in this genus, of which nine were originally described in *Areopaguristes* and 18 reassigned from *Paguristes sensu lato*. Although the nine species originally described in *Areopaguristes* have been documented in detail, several of the species reassigned from *Paguristes sensu lato* have remained poorly diagnosed or insufficiently illustrated (see Rahayu 2005).

Given the morphological similarity and parallel tropical distributions in the eastern Pacific and western Atlantic, *Areopaguristes praedator* nov. comb. and *A. oxyophthalmus* nov. comb. can be considered geminate species. Both share characters such as: rostrum short and not reaching distal level of lateral projections, ocular acicles ending in simple spine; antennal flagella with long setae ventrally; first maxilliped without epipod; dactyls of pereopods with ventral margin unarmed; first male pleopod with distal margin armed with simple and multifid teeth; and females lacking brood pouches.

Both *Areopaguristes praedator* nov. comb. and *A. oxyophthalmus* nov. comb. exhibit several significant characters (e.g., absence of epipod on first maxilliped, and lack of spines on ventral margins of dactyls of second and third pereopods) that were not considered in the original diagnosis of the genus *Areopaguristes* or mentioned in descriptions of these two species. Furthermore, Ayón-Parente & Hendrickx (2006, 2012) previously found that three eastern Pacific species (*A. mclaughlinae*, *A. lemaitrei*, and *A. waldoschmitti*) differ in important characters such as lack of first pleopods in females, from other congeners known from the Indo-West Pacific and western Atlantic (Rahayu 2005, McLaughlin 2008, Komai 2009, 2010, Lemaitre & Felder 2012). Thus, the need fulfilled in this study to emend the diagnosis of *Areopaguristes*.

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## References

- Abele, L.G. & Kim, W. (1986) An illustrated guide to the marine decapod crustaceans of Florida. *State of Florida. Department of Environmental Regulation, Technical Series*, 8 (1), Parts 1 & 2, 1–760.
- Ayón-Parente, M. (2009) *Taxonomía, zoogeografía y aspectos ecológicos de los cangrejos ermitaños de la familia Diogenidae (Crustacea: Decapoda: Anomura) del Pacífico mexicano*. Tesis de doctorado, Posgrado en Ciencias del Mar y Limnología, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, 465 pp.
- Ayón-Parente, M. & Hendrickx, M.E. (2006) A new species of *Stratiotes* Thomson, 1899 (Anomura, Paguroidea, Diogenidae)

- from the eastern tropical Pacific. *Zoosystema*, 28 (2), 487–497.
- Ayón-Parente, M. & Hendrickx, M.E. (2007) A new species of *Paguristes* Dana, 1851 (Anomura, Paguroidea, Diogenidae) from the Mexican Pacific. *Zootaxa*, 1470, 59–68.
- Ayón-Parente, M. & Hendrickx, M.E. (2009) A review of the *Dardanus sinistripes* (Stimpson, 1859) (Decapoda, Anomura, Diogenidae) species complex with the description of five new species from the Mexican Pacific. *Zootaxa Monograph*, 2323, 1–71.
- Ayón-Parente, M. & Hendrickx, M.E. (2010a) Species richness and distribution of hermit crabs of the family Diogenidae (Crustacea: Decapoda: Anomura) in the eastern Pacific. *Nauplius*, 18 (1), 1–12.
- Ayón-Parente, M. & Hendrickx, M.E. (2010b) A new genus and new species of hermit crab (Crustacea: Anomura: Paguroidea: Diogenidae) from the eastern tropical Pacific. *Zootaxa*, 2677, 49–59.
- Ayón-Parente, M. & Hendrickx, M.E. (2012) Two new species of hermit crabs of the genus *Areopaguristes* Rahayu & McLaughlin, 2010 (Crustacea: Anomura: Paguroidea: Diogenidae) from the eastern tropical Pacific. *Zootaxa*, 3407, 22–36.
- Baker, J.H., Jobe, W.D., Howard, C.L., Kimball, K.T., Janousek, J. & Case, P.R. (1981) Benthic biology. In: Bedinger, C.A. Jr. (Ed.), *Ecological Investigations of Petroleum Production Platforms in the Central Gulf of Mexico*. *Southwest Research Institute*, 1 (6), 1–391. [Houston]
- Berry, S.S. (1960) Notes of new eastern Pacific Mollusca – IV. *Leaflets in Malacology*, 1 (23), 139–146.
- Boschi, E.E. (2000) Species of decapod crustaceans and their distribution in the American marine zoogeographic provinces. *Revista de Investigación y Desarrollo Pesquero*, 13, 7–136.
- Calado, T.C.S. (1996) Crustacea Decapoda Anomura e Stomatopoda da Comissão “Pavasas I” na costa Norte e Nordeste do Brasil. *Boletim de Estudos de Ciências do Mar*, 9, 149–174.
- Campos, N.H.C. & Sánchez, M.E. (1995) Los cangrejos ermitaños del género *Paguristes* Dana (Anomura: Diogenidae) de la costa norte colombiana, con la descripción de dos nuevas especies. *Caldasia*, 17 (82–85), 569–586.
- Coelho, P.A., Oliveira de Almeida, A., Arruda Bezerra, L.E. & de Souza-Filho, J.F. (2007) An updated checklist of decapod crustaceans (infraorders Astacidea, Thalassinidea, Polychelida, Palinura, and Anomura) from the northern and northeastern Brazilian coast. *Zootaxa*, 1519, 1–16.
- Dall, W.H. (1908) Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission steamer "Albatross" during 1891, ... XXXVIII. Reports on the scientific results of the expedition to the eastern tropical Pacific in charge of Alexander Agassiz, by the U.S. Fish Commission steamer "Albatross", from October, 1904, to March, 1905. .. XIV [concerning : Kabat (1996)]. Harvard College [University]. *Bulletin of the Museum of Comparative Zoology*, 43 (6), 205–487.
- Dall, W.H. (1910) Description of a new genus and species of bivalve from the Coronado Islands, Lower California. *Proceedings of the Biological Society of Washington*, 23, 171–172.
- Felder, D.L., Álvarez, F., Goy, J.W. & Lemaitre, R. (2009) Decapoda (Crustacea) of the Gulf of Mexico, with comments on the Amphionidacea. In: Felder, D.L. & Camp, D.K. (Eds.), *Gulf of Mexico origin, waters, and biota. Vol. 1. Biodiversity*. College Station, Texas A & M University Press, pp. 1019–1104.
- García-Madrigal, M.S. (1999) Anomuros (Anomura) del arrecife de Cabo Pulmo-Los Frailes y alrededores, Golfo de California. *Revista de Biología Tropical*, 47 (4), 923–928.
- Glassell, S.A. (1937) The Templeton Crocker Expedition. XI. Hermit crabs from the Gulf of California and the west coast of Lower California. *Zoologica*, 22, 241–263.
- Haig, J., Hopkins, T.S. & Scanland, T.B. (1970) The shallow water anomuran crab fauna of southwestern Baja California, Mexico. *Transactions of the San Diego Society of Natural History*, 16 (2), 13–32.
- Hendrickx, M.E. & Harvey, A.W. (1999) Checklist of anomuran crabs (Crustacea: Decapoda) from the eastern tropical Pacific. *Belgian Journal of Zoology*, 129, 363–389.
- Hinds, R.B. (1843) Descriptions of new shells, from the collection of Captain Sir Edward Belcher, R.N., C.B. & C. *Proceedings of the Zoological Society of London*, part 11, 36–46.  
<http://dx.doi.org/10.1080/03745484309445298>
- Hinds, R.B. (1844) *The Zoology of the voyage of H.M.S. Sulphur, under the command of Captain Sir Edward Belcher, R.N., C.B., F.R.G.S., etc. during the years 1836–1842. Vol. II*. Smith, Elder and Co., London, 72 pp., 21 pls.
- Holthuis, L.B. (1959) The Crustacea Decapoda of Suriname (Dutch Guiana). *Zoologische Verhandelingen*, 44, 1–296.
- King, P.P. & Broderip, W.J. (1832) Description of the Cirripedia, Conchifera and Mollusca in a collection formed by the officers of HMS Adventure and Beagle employed between the years 1826 and 1830 in surveying the southern coasts of South America, including the strait of Magallanes and the coast of Tierra del Fuego. *Zoological Journal*, 5, 332–349.
- Komai, T. (2009) A review of the northwestern Pacific species of the genus *Paguristes* (Decapoda: Anomura: Diogenidae). II. Species transferred to the genus *Stratiotes*, with descriptions of two new species. *Natural History Research*, 10 (2), 59–92.
- Komai, T. (2010) A review of the northwestern Pacific species of the genus *Paguristes* (Decapoda: Anomura: Diogenidae). III. Clarification of the identity of a species heretofore referred to *Paguristes balanophilus* Alcock and descriptions of two new species from Japan. *Natural History Research*, 11 (1), 9–33.
- Lemaitre, R. & Felder, D.L. (2012) A new species of the hermit crab genus *Areopaguristes* Rahayu & McLaughlin, 2010 (Crustacea: Decapoda: Anomura: Diogenidae) discovered in the Mesoamerican Barrier Reef of Belize, Caribbean Sea.

- Zootaxa*, 3480, 67–79.
- McLaughlin, P.A. (1974) The hermit crabs (Crustacea, Decapoda, Paguridea) of northwestern North America. *Zoologische Verhandelingen*, 130, 1–396.
- McLaughlin, P.A. (2003) Illustrated keys to families and genera of the superfamily Paguroidea (Crustacea: Decapoda: Anomura), with diagnosis of genera of Paguridae. *Memoirs of Museum Victoria*, 60 (1), 111–144.
- McLaughlin, P.A. (2004) *Paguristes puniceus* Henderson, 1896 (Decapoda: Anomura: Paguroidea: Diogenidae): a study in intraspecific variability. *Zootaxa*, 742, 1–28.
- McLaughlin, P.A. (2008) Australian hermit crabs of the genera *Paguristes* Dana, *Stratiotes* Thomson, and *Pseudopaguristes* McLaughlin (Crustacea: Anomura: Paguroidea: Diogenidae). In: Jones, D.S. (Ed.), Crustaceans collected by the Western Australian Museum/Woodside Energy Ltd. Partnership to explore the marine biodiversity of the Dampier Archipelago, Western Australia, 1998–2002. *Records of the Western Australian Museum*, 73 (Supplement), 185–273.
- McLaughlin, P.A., Komai, T., Lemaitre, R. & Rahayu, D.L. (2010) Annotated checklist of anomuran decapod crustaceans of the world (exclusive of the Kiwaoidea and families Chirostylidae and Galatheidae of the Galatheoidea) part I – Lithodoidea, Lomisoidea and Paguroidea. *Raffles Bulletin of Zoology*, 23 (Supplement), 5–107.
- McLaughlin, P.A., Camp, D.K., Angel, M.V., Bousfield, E.L., Brunel, P., Brusca, R.C., Cadien, D., Cohen, A.C., Conlan, K., Eldredge, L.G., Felder, D.L., Goy, J.W., Haney, T., Hann, B., Heard, R.W., Hendrycks, E.A., Hobbs III, H.H., Holsinger, R.J., Kensley, B., Laubitz, D.R., LeCroy, S.E., Lemaitre, R., Maddocks, R.F., Martin, J.W., Mikkelsen, P., Nelson, E., Newman, W.A., Overstreet, R.M., Poly, W.J., Price, W.W., Reid, J.W., Robertson, A., Rogers, D.C., Ross, A., Schotte, M., Schram, F.R., Shih, C.-T., Watling, L., Wilson, G.D.F. & Turgeon, D.D. (2005) Common and Scientific Names of Aquatic Invertebrates from the United States and Canada. Crustaceans. *American Fisheries Society*, 31 (Special Publication), 1–545. [Bethesda, Maryland]
- Merchán-Cepeda, A., Campos, N.H., Franco, A. & Bermúdez, A. (2009) Distribución y datos biológicos de los cangrejos ermitaños (Decapoda: Anomura) del Mar Caribe colombiano colectados por la expedición INVEMAR-MACROFAUNA II. *Boletín de Investigaciones Marinas y Costeras*, 38 (1), 121–142.
- Moran, D.A. & Dittel, A.I. (1993) Anomuran and brachyuran crabs of Costa Rica: annotated list of species. *Revista de Biología Tropical*, 41, 599–617.
- Perry, H. & Larsen, K. (2004) A Picture Guide to Shelf Invertebrates from the Northern Gulf of Mexico. Available from: [http://www.gsmfc.org/seamap/picture\\_guide/main.htm](http://www.gsmfc.org/seamap/picture_guide/main.htm) (accessed 10 February 2014)
- Rahayu, D.L. (2005) Additions to the Indonesian fauna of the hermit crab genus *Pseudopaguristes* McLaughlin and a further division of the genus *Paguristes* Dana (Crustacea: Decapoda: Paguroidea: Diogenidae). *Zootaxa*, 831, 1–42.
- Rahayu, D.L. & McLaughlin, P.A. (2010) *Areopaguristes*, a generic replacement name for *Stratiotes* Thomson, 1899 (Crustacea: Decapoda: Paguroidea: Diogenidae). *Zootaxa*, 2509, 67–68.
- Reeve, L.A. (1843) *Conchologica Iconica, or, Illustrations of the Shells of Molluscos Animals. Vol. I. Containing Monographs of the Genera... Pleurotoma...* London, King William Street, Strand. [Real printing dates various months in 1845 and 1846].
- Rodríguez de la Cruz, M.C. (1987) *Crustáceos decápodos del Golfo de California*. Secretaría de Pesca (Ed.), México, D.F., 306 pp.
- Rodríguez-Almaraz, G.A. & Zavala-Flores, J.C. (2005) Cangrejos ermitaños. In: Hernández-Aguilera, J.L., Ruiz-Nuno, J.A., Toral-Almazán, R.E. & Arenas-Fuentes, V. (Eds.), *Camarones, Langostas y Cangrejos de la Costa Este de México. Vol. I*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (Conabio), México, D.F., pp. 263–335.
- Vargas, R. & Cortés, J. (2006) Biodiversidad Marina de Costa Rica: Crustacea: Infraorden Anomura. *Revista de Biología Tropical*, 54 (2), 461–488.  
<http://dx.doi.org/10.15517/rbt.v54i2.13894>
- Wicksten, M.K. (2005) Decapod crustaceans of the Flower Garden Banks National Marine Sanctuary. Gulf of Mexico. *Science*, 23, 30–37.