



A new species of symbiotic palaemonid shrimp of the genus *Pseudocoutierea* Holthuis, 1951 (Decapoda: Caridea: Palaemonidae) from the eastern Gulf of Mexico, with an updated key for the identification of species of the genus

GABRIEL E. RAMOS-TAFUR^{1,2} & RAFAEL LEMAITRE³

¹University of Florida, Florida Museum of Natural History, Ichthyology Department, Dickinson Hall, Newell Dr. and Museum Rd., PO Box 117800, Gainesville, FL 32611, U. S. A.

²Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave. SE, St. Petersburg, FL 33701, U. S. A. E-mail: Gabriel.Ramos@myFWC.com

³Department of Invertebrate Zoology, Smithsonian Institution, National Museum of Natural History, 4210 Silver Hill Road, Suitland, MD 20746 U. S. A. E-mail: lemaitrr@si.edu

Abstract

A new species of symbiotic palaemonid shrimp of the genus *Pseudocoutierea* Holthuis, 1951, is described based on a specimen collected in the eastern Gulf of Mexico, off the southwest coast of Florida. *Pseudocoutierea stephanieae* sp. nov., is the seventh known in this genus, and morphologically most similar to *P. antillensis* Chace, 1972, and *P. conchae* Criales, 1981, from the western Atlantic, and *P. elegans* Holthuis, 1952, from the eastern Pacific, all sharing an expanded rostral base or eaves that terminate supra-distally in an acute tooth. This new species can be separated by: the presence of an epigastric knob or tubercle on the anterior mid-dorsal third of the carapace, which is absent in all other congeneric species; the shape of the pterygostomial sinus, which is shallow in this new species, whereas it is deep and well defined in all other congeneric species. An updated dichotomous key to species of *Pseudocoutierea* is presented.

Key words: Gulf of Mexico, *Pseudocoutierea stephanieae*, new species, Decapoda, Caridea, Palaemonidae

Resumen

Una nueva especie de camarón palaemónido simbiote del género *Pseudocoutierea* Holthuis, 1951, es descrita, basándose en un espécimen colectado en el este del Golfo de México, al suroeste de la costa de Florida. *Pseudocoutierea stephanieae* n. sp., es la séptima especie descrita de este género y morfológicamente es muy similar a *P. antillensis* Chace, 1972, y *P. conchae* Criales, 1981, del Atlántico oeste, y *P. elegans* Holthuis, 1952, del Pacífico este, compartiendo con esas especies la presencia de un alerón o expansión rostral basal, el cual termina en un diente agudo supero distal. La nueva especie se diferencia de las restantes descritas en el género por la presencia de un tubérculo epigástrico o proyección obtusa, situado en el tercio anterior medio dorsal del caparazón, el cual está ausente en sus congéneres; y por la forma de la depresión pterigostomiana, la cual es somera en la nueva especie, mientras que es profunda y bien definida en las otras especies del género. Una clave dicotómica actualizada es presentada para identificar las especies del género *Pseudocoutierea*.

Palabras clave: Gulf of Mexico, *Pseudocoutierea stephanieae*, new species, Decapoda, Caridea, Palaemonidae

Introduction

The west coast of Florida has been the subject of intense marine bottom trawling and fish monitoring surveys conducted since 2008 by the Florida Independent Monitoring (FIM) program of the Florida Wildlife Research Institute (FWRI) and the Southeast Area Monitoring and Assessment Program (SEAMAP). These broad surveys have sampled the eastern part of the Gulf of Mexico on a biannual basis to gather independent data on fisheries resources for State and Federal management agencies (see Switzer *et al.* 2015a, 2015b). As a result, numerous specimens of invertebrates from this biodiverse region have been obtained.

A recent study of a portion of the caridean shrimps obtained during the summer SEAMAP cruise of 2014 off the west coast of Florida, revealed an unusual specimen of *Pseudocoutierea* Holthuis, 1951, which did not match any of the descriptions of the six species known to date of this genus (Holthuis 1952; Chace 1972; Criales 1981; d'Udekem d'Acoz 2001; De Grave 2007). Criales (1981: 167) did indicate 35 years ago that two species from the eastern Gulf of Mexico were being described at the time by R.W. Heard, but to date no such descriptions have been published.

Although the single specimen of the new species described herein was slightly damaged during capture, the most significant morphological structures remained sufficiently intact in order to determine that it represents a new species, herein fully described and illustrated. We follow De Grave *et al.* (2015) in not recognizing the validity of the subfamily Pontoninae Kingsley, 1879, where the genus *Pseudocoutierea* had formally been placed.

The single specimen and holotype collected was fixed in 10% formalin, and subsequently transferred to 70% ethanol. The holotype was stained with a solution of 95% ethanol and Rose Bengal salt. Drawings were prepared with the aid of drawing tubes attached to a Stereoscope Olympus SZX16 or a Leitz GM-Lux compound microscope. Stacked pictures of small structures were taken with a Canon T6i camera attached to a photo port of Zeiss Axio vert, A1 inverted compound microscope, and using a copy stand built by one of us (GERT), moved or controlled by Stackshot of Cognisys, Inc.©, following Brecko *et al.* (2014). The stacked images were combined using the software Zerene Stacker (<http://zerenesystems.com/cms/home>), and pictures and pencil drawings then inked digitally with aid of a Wacom Intuos tablet and pen in Adobe Illustrator CS5, following Coleman (2003; 2006). The holotype has been deposited in the National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM).

Measurements (in mm) for the holotype are provided for carapace length (CL), measured from tip of rostrum to posterior margin of carapace; total length (TL), from tip of rostrum to tip of telson; and postorbital carapace length (POCL), from postorbital margin to posterior margin of carapace. The abbreviation SMP refers to SEAMAP, as used in the labels for the samples obtained from that program.

Systematics

Family Palaemonidae Rafinesque, 1815

Genus *Pseudocoutierea* Holthuis, 1951

Pseudocoutierea stephanieae sp. nov.

(Figs 1–3)

Holotype. Ovigerous female, CL 3.7 mm, POCL 2.1 mm, TL 9.1 mm, R/V *Tommy Munro*, SMP 171402056, 26°29'12"N, 83°48'36"W, eastern Gulf of Mexico, ~175 km offshore of midpoint between Naples and Sanibel Island, W coast of Florida, 14 June 2014, 83–92 m, bottom trawl, bottom temperature ~20°C, salinity 32.34 ppt, dissolved oxygen 5.4 mg/l, USMN 1292255.

Description of holotype. Carapace glabrous, suboval in cross-section, not dorsoventrally depressed; anterolateral margin with antennal tooth acute (Fig. 1A, D), well developed, situated near pterygostomial angle and with acute projection ventrally giving bifid appearance. Pterygostomial sinus shallow almost inconspicuous, partially visible when tilting carapace or in supra-lateral view (Fig. 1D). Hepatic area smooth, without protuberances. Mid-dorsal line of carapace with conspicuous epigastric protuberance or knob (Fig. 1A, B, D) on anterior third and pointing anteriorly. Branchiostegal groove sinuous, extending posteriorly from near anterolateral angle to posterodistal margin of carapace. Submarginal groove well defined, subparallel to ventral margin of carapace, and together with marginal groove giving double-grooved appearance along border of carapace.

Rostrum long, smooth, dorsally convex; without teeth or spines on ventral or dorsal margins, in lateral view straight and slightly directed downward; slightly overreaching distal margin of third antennular segment. Rostral base wide, expanded laterally forming supraorbital wing-like expansions or eaves (Fig. 1A, C, D) partially covering basal part of ocular peduncles, each eave terminating anterolaterally in strong, acute supra-orbital tooth; margin between supra-orbital tooth and base of rostrum concave, supra-orbital tooth separated from rostrum by

deep depression enhancing rostral carina. In lateral view, wing-like expansions each with external margin raised up and forming concavity to allow movement of ocular peduncle and cornea. Rostral carina not reaching posteriorly to epigastric knob.

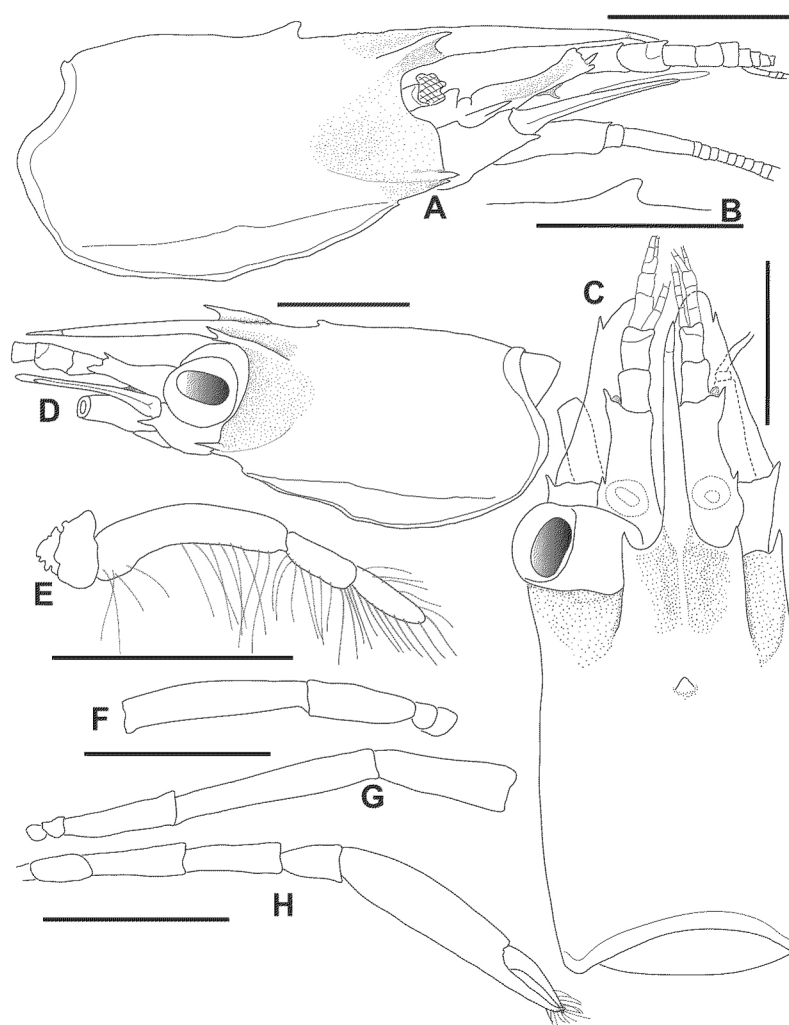


FIGURE 1. *Pseudocoutierea stephanieae* sp. nov., holotype ovigerous female, CL 3.7 mm, eastern Gulf of Mexico (USNM 1292255): A, carapace and cephalic appendages, right side, lateral view; B, detail of dorsal protuberance of carapace; C, carapace and cephalic appendages, dorsal view; D, left side of same in supra-lateral view; E, right third maxilliped, lateral view; F, merus and ischium of left first pereopod, lateral view; G, carpus, merus and ischium of right first pereopod, lateral view; H, right second pereopod, lateral view. Scales equal 1 mm (A, C–F), and 0.5 mm (B).

Antennular peduncle (Fig. 1A, C, D) with basal segment about 2.3 times as long as wide, longer than second and third segments combined, with acute distolateral tooth accompanied by small, rounded lateroventral projection; ventral margin with acute, curved tooth (Fig. 1A) directed anteriorly. Stylocerite small, with acute tip reaching the supra-distal margin of basicerite. Second and third segments subequal in size and shape, unarmed.

Scaphocerite (Fig. 1C) well developed, 2.5 times as long as wide, overreaching antennular peduncle; outer margin sinuous, slightly concave; lateral tooth short, not reaching distal margin of blade. Basicerite robust, with rounded dorsal projection and ventral tooth. Carpocerite reaching to midsection of second antennular segment.

Third maxilliped (Fig. 1E) reaching slightly beyond distal margin of basicerite, without exopod; lateral plate irregular; with tiny, bilobed arthrobranch; ultimate and penultimate segments subequal in length; antepenultimate segment 2.2 times as long as combined length of ultimate and penultimate segments. Remaining mouthparts not dissected, similar to those of previously described species of genus.

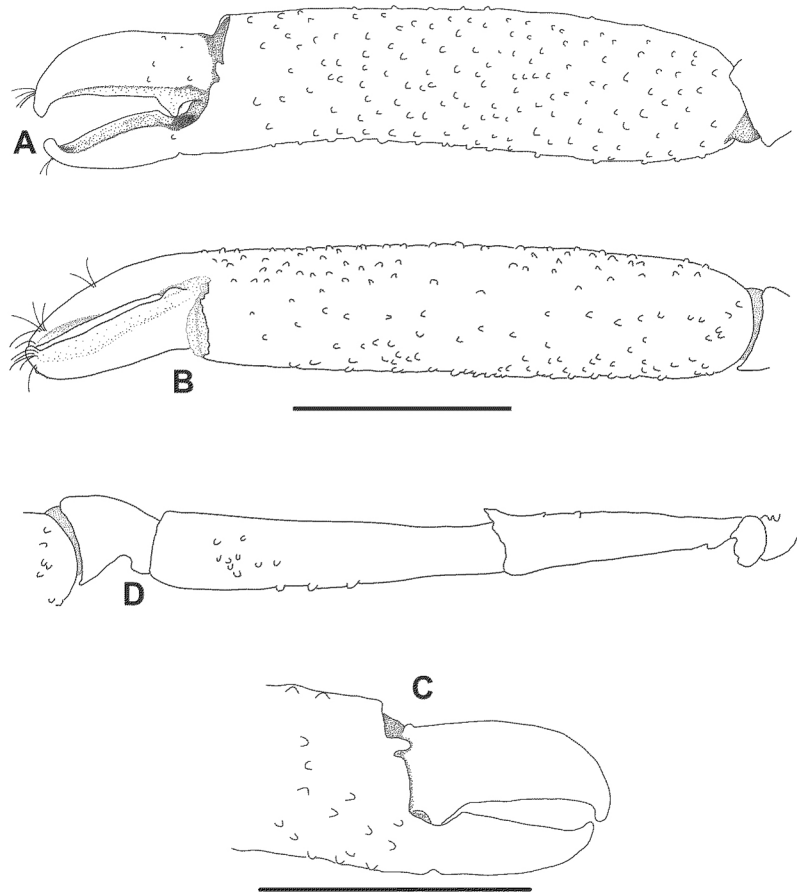


FIGURE 2. *Pseudocoutierea stephanieae* sp. nov., holotype ovigerous female, CL 3.7 mm, eastern Gulf of Mexico (USNM 1292255): Left second pereopod: A, chela, lateral view; B, same, superior view; C, fingers, mesial view; D, ischium, merus and carpus, lateral view. Scale equals 1mm.

First right pereopod (Fig. 1G) missing chela; without granules on ischium, merus and carpus; carpus overreaching distal margin of scaphocerite, elongated; merus about 6 times as long as broad; ischium about 0.6 length of merus, and 0.9 as long as carpus.

First left pereopod missing all segments except carpus and ischium (Fig. 1F); merus reaching distal margin of carpus; merus about 4.8 times as long as broad; ischium about 0.6 as long as carpus.

Right second pereopod (Fig. 1H) with carpus overreaching distal margin of scaphocerite; merus and ischium subequal in length, merus about 3.3 times as long as broad; carpus about 0.5 times as long as merus. Chela enlarged, about 3.9 times as wide as long; fingers occupying distal third of chela, with brush-like setae distally.

Left second pereopod or larger cheliped, enlarged (Fig. 2A–D); merus overreaching distal margin of scaphocerite. Ischium with tiny granules on dorsal margin, about 0.7 times as long as merus, supra-distal margin projected as acute tooth. Merus about 7.0 times as long as broad; with patches of tiny granules on dorsal, ventral and external margins. Carpus smooth, cup shaped, lacking granules, about 0.2 as long as merus. Chela elongated, about 5 times as long as broad; palm surfaces covered with small granules; fingers occupying distal 0.25 of chela, with few granules on proximal half, fixed finger with V-shaped notch on inferior margin close to dactylar articulation. Cutting edge of dactylus with large subtriangular tooth proximally; fixed finger with deep socket to accommodate opposing cutting edge and tooth of dactylus; tip of dactylus and fixed finger terminating in rounded tip.

Third to fifth pereopod morphologically similar, diminishing slightly in size posteriorly.

Third pereopod elongated (Fig. 3A–C), dactylus overreaching distal part of third antennular segment when fully extended; merus about 3.5 times as broad as long, dorsal margin slightly arched; with subtriangular swelling on distal end of flexor margin, and small orifice facing ventral margin of carpus when retracted (Fig. 3C). Carpus 0.3 times as long as merus; ventral margin smooth in front of merus pore. Propodus 1.2 times as long as merus;

dorsal margin arched; flexor margin unarmed except for sparse setae, distal end with small rounded aperture to allow movement of conspicuous hinge, proximal margin of aperture fringed with 2 sensory setae and 2 simple flexible setae. Dactylus 0.3 times as long as propodus, curved, terminating acutely; proximovenral portion connected to calcified structure or hinge that allows movement of dactylus through small aperture in distoventral margin of propodus (Fig 3B).

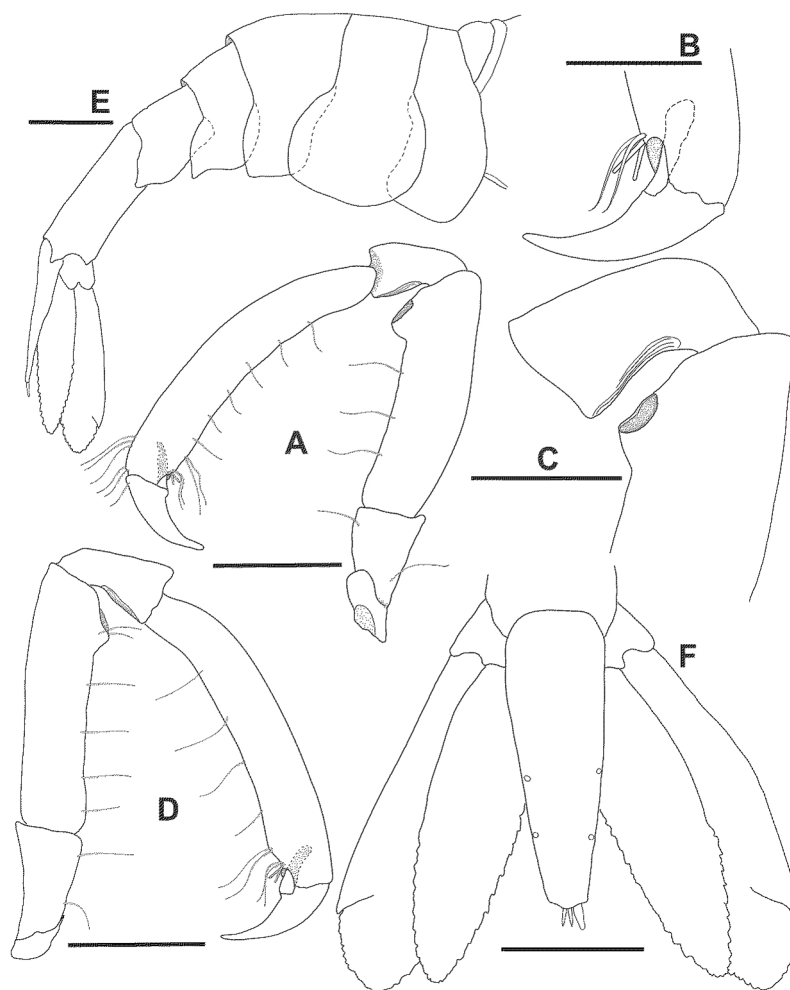


FIGURE 3. *Pseudocoutierea stephanieae* sp. nov., holotype ovigerous female, CL 3.7 mm, eastern Gulf of Mexico (USNM 1292255): A, right third pereopod, mesial view; B, dactylus of same, external view; C, distal end of merus, and carpus, of right third pereopod, mesial view; D, right fourth pereopod, lateral view; E, abdomen, uropods, and telson, lateral view; F, uropods and telson, dorsal view. Scales equal 0.5 mm (A, D, F), 0.25 mm (B, C), and 1 mm (E).

Fourth pereopod (Fig 3D) dactylus reaching distal margin of second antennular segment when fully extended. Fifth pereopod dactylus reaching distal margin part of first antennular segment. Fourth and fifth pereopods with similar morphology on flexor margins of merus, carpus, propodus, and dactylus, including hinge-like structure on dactylus-propodus, to that of third pereopod.

Abdomen (Fig 3E) with ventral portion of pleura of first pleonite rectangular with rounded angles. Pleura of second segment broadly rounded. Pleura of third pleonite subquadrate ventrally, anteroventral angle rounded, posteroventral angle obtuse. Fourth and fifth pleonites each with posteroventral angle acuminate, with rounded tip. Fifth pleonite with distal third of dorsal margin having inconspicuous transversal furrow visible under high magnification. Sixth pleonite about 2.8 times as long as broad, and 1.8 as long as fifth pleonite; posterolateral and posteroventral angles acuminate with rounded tips.

Eggs about 0.45 mm in length by 0.32 mm in width; embryo well developed, with two black eyes visible.

Telson (Fig. 3F) 3 times as long as wide; with 2 pairs of dorsal spines on distal half (spines lost during capture); distal margin slightly convex, with only 2 central, and 1 left intermediate spines present (other spines lost during capture). Uropodal exopod with blunt lateral tooth and short oblique diaeresis, distal margin serrate or pitted to

accommodate setae. Uropodal endopod slightly shorter than exopod, margins serrated or pitted to accommodate setae.

Color. Based on photographs of the freshly collected holotype, the chelipeds, abdomen and pereopods are milky-white. The carapace is yellowish, the color being more pronounced along the junction with the abdomen, and on the gastric and postero-rostral areas of the carapace. Cornea yellowish except for black central portion; ocular peduncle yellowish. Eggs cream yellow, embryos with black eyes.

Habitat. *Pseudocoutierea stephanieae* **sp. nov.** was collected mixed with numerous sponges (*Xestospongia muta*, *Callispongia* sp., among others not identified), tunicates (most commonly, the pleated sea squirt *Styela plicata*), and abundant species of fishes. During the sorting process, small pieces of sponges were found attached to the body of the holotype, although it is not possible to ascertain if this new species is associated with sponges or perhaps tunicates.

Distribution. So far known exclusively from the eastern Gulf of Mexico, off the southwest coast of Florida; depth: 83–92 m.

Etymology. The new species is named after the daughter of the first author, Stephanie Ramos-Colonia, for her commitment to school activities, participation as violinist in musical orchestras, and for all delight and love that she has given to her mother, father, and rest of family. Furthermore this honor is bestowed as a gift for her forthcoming fifteen birthday.

Remarks. During capture, the holotype suffered as follows: right cornea damaged, with only a small portion of the ocular peduncle present; rostrum tip with small distal fracture, causing slight bending to the right; basal part or rostral expansion with small scratch on dorsal carina of rostrum near junction with carapace (Fig. 1A, C, D); chelae of first pair of pereopods missing; telson missing dorsal spines, and several spines of distal margin.

With the description of *Pseudocoutierea stephanieae* **sp. nov.**, there are now seven species in *Pseudocoutierea*, the others being: *P. elegans* Holthuis 1952, *P. antillensis* Chace 1972, *P. conchae* Criales 1981, *P. edentata* Criales 1981, *P. wirtzi* d'Udekem d'Acoz 2001, and *P. dotae* De Grave 2007. All these species can be separated quickly in two subgroups by the shape of the rostral base. In the first subgroup (*P. dotae*, *P. edentata*, and *P. wirtzi*), the rostral base is evenly convex, or slightly angulate but rounded, and lack a distolateral tooth. In the second subgroup (*P. stephanieae* **sp. nov.**, *P. antillensis*, *P. conchae*, and *P. elegans*), the development of the rostral wings or eaves, is remarkably pronounced, ending laterally in an acuminate angle or acute tooth. *Pseudocoutierea stephanieae* **sp. nov.** belongs in the second group, and can be differentiated from all species *Pseudocoutierea* by the presence in this new species of a unique and conspicuous epigastric knob or protuberance on the anterior third of the mid-dorsal region of the carapace. Additionally, *P. stephanieae* **sp. nov.** can be differentiated by the presence of a shallow pterygostomial sinus, whereas in all other congeners the pterygostomial sinus is deep and well defined, and clearly visible in lateral view.

The presence of subparallel marginal and submarginal grooves on the carapace is a character clearly visible in *Pseudocoutierea stephanieae* **sp. nov.** It appears from published description and figures of the other congeners, that the submarginal groove is absent in all but this new species. However, the presence of a submarginal groove in other species may have been easily overlooked, and it is now desirable to reexamine all previously described species to determine the presence or absence of this groove, and thus evaluate whether indeed the double-grooved condition is a unique feature of *P. stephanieae* **sp. nov.** The double-grooved condition is a very consistent feature in shrimps of the Suborder Dendrobranchiata (Pérez Farfante & Kensley 1997), although evidently this character must have evolved independently in these two major groups of shrimps.

In all species of *Pseudocoutierea* except *P. stephanieae* **sp. nov.**, the carapace is depressed or dorsoventrally flattened, a morphological feature that appears to be an adaptation to a mode of life appressed to the surface of branches of gorgonians or antipatharians (Criales 1981; d'Udekem d'Acoz 2001; Wirtz & d'Udekem d'Acoz 2001; De Grave 2007). In contrast, the carapace in *P. stephanieae* **n. sp.** is subovate in cross-section, not depressed, possibly as result of life in association with different type of symbionts than used by its congeners. As previously mentioned, this new species was found among numerous sponges and tunicates.

The structure and function of the hinge-like structure on the base of the dactylus of species of *Pseudocoutierea* was discussed by d'Udekem d'Acoz (2001) in his description of *P. wirtzi*. A similar structure on the dactyl has been reported as well in other carideans by Kemp (1922: fig. 77, for *Dasycaris symbiotes* Kemp, 1922), Bruce (1966: figs 5 a–b, for *Platycaris latirostris* Holthuis, 1952), Monod (1979: figs 32–35, for *Pontonides unciger* Calman, 1939, *Synalpheus demani* Borradaile, 1900 and *S. streptodactylus* Coutière, 1905), Banner [1959, fig. 5, for

Alpheus huikau (= *Metalpheus rostratipes* (Pocock, 1890)], and more recently Bruce (2004: fig 11, for *Balssia antipodarum* Bruce, 2004). Several pereopods of *Synalpheus* spp. found in samples collected in sponges were dissected, and found to also have a hinge-like structure, although of smaller size than in species of *Pseudocoulierea*. In those species of *Synalpheus*, the hinge-like structure is connected to internal muscle inside of the propodus, with two strong tendons situated on the upper and lower margins allowing movement of the dactylus during flexing and retraction. We concur with d’Udekem d’Acoz (2001) in that this type of structure is common in species living associated with other organisms, and its function appears to be to strengthen the grip on the associated organisms without increasing the size of the pereopod. The details of this structure, however, have been overlooked in most previous descriptions of carideans that live symbiotically.

D’Udekem d’Acoz (2001) further discussed in detail the swelling present on the ventrodistal flexor margin on the meri of the third to fifth pereopods of *P. wirtzi*. He found that the proximal surface was well-delimited, decalcified, and with a pair of small setae, and suggested this condition might be part of a gland that may play a role in the associations between the shrimp and its host. In *P. stephanieae* **sp. nov.**, the proximal part of the swelling is calcified, but the distal part clearly exhibits a distinct pore. Additionally, d’Udekem d’Acoz (2001: fig. 11, bottom left) showed in *P. wirtzi* a normal tissue on the flexor margin of the carpus, whereas a peculiar fringe of smooth tissue is present in *P. stephanieae* **sp. nov.** (Fig. 3C) Once again, the function of these structures appears to be complex in both species, and its function is unclear without more detailed anatomical research.

The key to species of *Pseudocoulierea* presented by De Grave (2007: 36) for all species of this genus known at that time, can be expanded one couplet to include *P. stephanieae* **sp. nov.**, as follows:

Key to species of the genus *Pseudocoulierea* Holthuis, 1951

1	Supra-orbital eaves ending in acute anterolateral tooth	4
-	Supra-orbital eaves ending in rounded anterolateral angle, lacking tooth	2
2	Post-hepatic protuberance present	3
-	Post-hepatic protuberance absent	<i>P. edentata</i> (southern Caribbean, Colombia)
3	First pereopod elongate, chelae 6 to 7 times as long as wide	<i>P. wirtzi</i> (eastern Atlantic, Cape Verde, Africa)
-	First pereopod robust, chelae 3 times as long as wide	<i>P. dotae</i> (southwestern Caribbean, Panama)
4	Dorsal midline of carapace smooth, without protuberances	5
-	Dorsal midline of carapace with conspicuous protuberance or gastric knob	<i>P. stephanieae</i> sp. nov. (eastern Gulf of Mexico, Florida)
5	Pleura of third pleonite postero-laterally acuminate	6
-	Pleura of third pleonite postero-laterally rounded	<i>P. antillensis</i> (western Caribbean, Saba Bank, Honduras)
6	Tooth of third pleonite distally placed, propodus of third pereopod with infero-distal spine	<i>P. elegans</i> (Gulf of California, eastern Pacific)
-	Tooth of third pleonite medially placed, propodus of third pereopod without infero-distal spine	<i>P. conchae</i> (southern Caribbean, Bay of Santa Marta, Colombia)

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