

FIRST FINDING OF THE FAMILY RHYNCHOMOLGIDAE
(COPEPODA: CYCLOPOIDA) IN THE GULF OF MEXICO,
WITH THE DESCRIPTION OF A NEW SPECIES

**Primer hallazgo de la familia Rhynchomolgidae (Copepoda: Cyclopoida)
en el Golfo de México, con la descripción de una nueva especie**

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ABSTRACT

The genus *Critomolgus* Humes and Stock, 1983 represents a group of 34 species of copepods associated with marine invertebrates. Most of these species have been collected in associations with species of the *phyla* Cnidaria and Echinodermata in several localities in the Indian, Pacific and Atlantic Oceans with three species reported in the Mediterranean Sea. This is the first occasion in which a species belonging to the genus *Critomolgus* and the family Rhynchomolgidae Humes and Stock, 1972 is recorded for the Gulf of Mexico. Here, we describe a new species of marine copepod, *Critomolgus walteri* Varela, Price, Middlebrooks *et* Ambrosio, associated with the octocorals *Leptogorgia virgulata* (Lamarck, 1815) and *L. hebes* Verrill, 1869 in 3.3 meters of water in Tampa Bay, Florida. This species possesses characters that unite it with other members of the genus; however, it differs from all other species due to the body length and unique leg 5 and maxilla 1 characters. This new species provides evidence that much diversity remains to be discovered in the waters of the Gulf of Mexico and future sampling efforts should target this region.

Keywords: Crustacea, associated copepod, *Leptogorgia*.

RESUMEN

El género *Critomolgus* Humes and Stock, 1983 representa un grupo de 34 especies de copépodos que viven asociados con invertebrados marinos. La mayoría de estas especies se han recolectado en asociación con especies de los *phyla* Cnidaria y Echinodermata en diferentes localidades de los océanos Índico, Pacífico y Atlántico, solo tres especies se han encontrado en el Mar Mediterráneo. Esta es la primera ocasión en que se registra una especie perteneciente al género *Critomolgus* y la familia Rhynchomolgidae Humes y Stock, 1972 para el Golfo de México. En esta contribución, describimos una nueva especie de copépodo, *Critomolgus walteri* Varela, Price, Middlebrooks *et* Ambrosio, marino encontrado a 3.3 metros de profundidad asociado a los octocorales *Leptogorgia virgulata* (Lamarck, 1815) y *L. hebes* Verrill, 1869. Esta especie posee caracteres que la unen con otros miembros del género; sin embargo, difiere de todas las demás especies debido a la longitud del cuerpo y caracteres únicos de la pata 5 y la maxila. Esta nueva especie proporciona evidencia de que aún queda mucha diversidad por descubrir en las aguas del Golfo de México y los esfuerzos de muestreo futuros deberían ser dirigidos a esta región.

Palabra clave: Crustacea, copépodo asociado, *Leptogorgia*.

INTRODUCTION

Copepods associated with marine invertebrates in the Gulf of Mexico have received little attention from researchers. Only isolated references of these associations are found in the literature, such as Wilson, (1932) who records *Cryptopontius gracilis* Wilson, 1932, associated with 2 species of sponges; Humes (1953) who records *Ostrincola gracilis* C. B. Wilson, 1944 associated with 4 species of bivalve mollusks; Yeatman, (1970) who records *Asterocheres jeanyeatmannae* Yeatman, 1970 associated with two unidentified sponges, Stock (1978, 1979) who records 2 species of the family Lamippidae Joliet, 1882, associated with octocorals of the family Plexauridae (Gray, 1859), and finally Corsetti and Strasser (2003) who record *Clausidium dissimile* Wilson, 1921 associated with two species of ghost shrimp. Members of the family Rhynchomolgidae have 44 genera and more than 240 species distributed worldwide with the majority living in association with cnidarians (Boxshall & Halsey, 2004; Walter & Boxshall, 2021) especially those in the orders Actiniaria Haeckel, 1896 and Alcyonacea Haeckel, 1866. The genus *Critomolgus* currently has 34 species distributed in shallow waters of tropical and subtropical localities of all oceans. These species are found mostly in the Pacific and Indian Oceans with only three species, *C. actiniae* (Della Valle, 1880), *C. astrophyticus* (Humes and Stock, 1973) and *C. titillans* (Humes, 1982) recorded for the Atlantic Ocean. In this work we present the first finding of a species of the family Rhynchomolgidae and genus *Critomolgus* from the Gulf of Mexico.

OBJECTIVES

- To provide the first record of the family Rhynchomolgidae for the Gulf of Mexico and the description of a new species of copepod of the genus *Critomolgus*.

MATERIALS AND METHODS

The type material described herein was collected from a shallow (3.3 m) subtidal artificial reef located at the Sunshine Skyway Bridge within Tampa Bay, FL, USA (27° 38' 504" N, 82° 40' 184" W) on August 14th, 2018 from the RV Bios II using SCUBA. Individual copepods used for this description were selected from a total of 616 individuals collected from seven separate colonies of the gorgonian sea whip *Leptogorgia virgulata* (Lamarck, 1815). Additional materials examined were collected from two different colonies of *L. hebes* (Verrill, 1869) harvested from a shallow (3.6 m) subtidal artificial reef near Egmont Key at the mouth of Tampa Bay, FL, USA (27° 58' 043" N, 82° 76' 1298" W) on December 10th, 2020. Each colony of *Leptogorgia* was harvested by placing a 7.57 L resealable plastic bag over the entire colony and cutting the base of the colony just above the holdfast. Once severed from the substrate, the entire colony was enclosed in the resealable bag and returned to the surface for transport to the University of Tampa's Marine Science Field Station. In the laboratory, each colony was then placed in a shallow dissecting tray filled with seawater harvested during sample collection and visually inspected for epibionts. All observed fauna, including copepods, were collected from host corals using a 5 mL pipet. Colonies were then gently rinsed in a 10 % formalin solution to remove any remaining epibiota. Water from observation trays and rinse solution were filtered through a 90 µm sieve to recover remaining epibionts. All samples were roughly sorted into major taxonomic groups and preserved in 10 % buffered formalin for future identification to species level.

Drawings of the specimens were made using a Wild M5 dissecting microscope with a camera lucida. Total length was measured in millimeters (mm) from the tip of the prosome to the posterior end of the caudal rami, terminal setae of the caudal rami not included in determining

the body length. In all measurements of the different structures, first the length is measured, followed by the width (Xlength x Xwidth). In the formula for the armature of legs 1–4 the Roman numerals indicate spines and the Arabic numerals represent setae. All material has been deposited in the United States National Museum (USNM).

RESULTS

Critomolgus walteri sp. nov.

(Figs. 1–4)

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Diagnosis. Body length less than 2 mm; caudal ramus almost long as wide; antenna with 2 terminal claws stouter and unguiform, 1.4: 1 in length; genital double-somite in dorsal view slightly longer than wide, almost rounded; maxilla with teeth on lash evenly graded, inner seta shorter than the length of the lash; third segment of maxilliped terminated in a conical process, 1 seta and 1 spine; mandible with the convex margin lacking a tapering process; inner seta on the first endopodal segment of leg 4 longer than the width of the segment and free segment of leg 5 with an inner proximal expansion.

Diagnosis. Longitud del cuerpo es menor de 2 mm; rama caudal casi tan larga como ancha; antena con 2 garras terminales gruesas y unguiformes, 1.4: 1 de longitud; segmento genital en vista dorsal, es ligeramente mas largo que ancho, redondeado; maxila con los dientes del flagelo que disminuyen uniformemente en tamaño, seta interna mas corta que la mitad del largo del flagelo; tercer segmento del maxilipedo termina en un proceso conico, 1 seta y una espina; mandíbula con el margen convexo que carece de un proceso puntiagudo; seta interna del primer artejo del endopodo de la pata 4 es mas larga que el ancho de dicho artejo y el artejo de la pata 5 presenta una expansion proximal interna.

Type material. Holotype: non-ovigerous female (Length [L] 0.86 mm) Florida, Tampa Bay, 27° 38' 29.49" N 82° 40' 10.891" W, from the octocoral *Leptogorgia virgulata*, depth 3.3 m, collected by L. Ambrosio and M. Middlebrooks, 14 Aug 2018, USNM 1656958; Allotype: adult male (L 0.74 mm), same collection data as holotype, USNM 165 6959. Paratypes: 35 females, 7 males, same collection data as holotype, USNM 1656960.

Additional material examined. 3 males, 1 female, Florida, near Egmont Key at the mouth of Tampa Bay (27° 34' 53/749" N, 82° 45' 55.588" W), from the octocoral *Leptogorgia hebes*, depth 3.6 m, collected by L. Ambrosio, 10 Dec 2020, USNM 1656961.

DESCRIPTION

Female

Body relatively large (Figs. 1A, 4) with prosome not unusually broad. Length 0.86 mm (0.83 mm–0.91 mm) and greatest width 0.41 mm (0.39 mm–0.43 mm) based on 35 specimens. Prosome 0.58 mm long, occupying more than 65 % length of body. First pedigerous somite separated from cephalosome by weak dorsal furrow. Epimeral areas of the pedigerous segments more or less rounded.

Urosome (Fig. 1B) 5–segmented. Fifth pedigerous somite slightly wider than genital double-somite, 36 µm wide. Genital double-somite 120×110 µm, rounded, slightly longer than wide, with weakly convex lateral margins. Genital area located dorsally anterior to middle. Three abdominal somites from anterior to posterior 26×57, 20×52, and 26×52 µm.

Posteroventral border of anal somite unornamented. Caudal ramus (Fig. 1C) $28 \times 30 \mu\text{m}$, ratio 0.93:1. Slightly wider than long. Outer lateral seta and dorsal seta smooth, other setae plumous. Egg sac not seen. Rostrum broad, with roundly convex posterior margin (Fig. 1D).

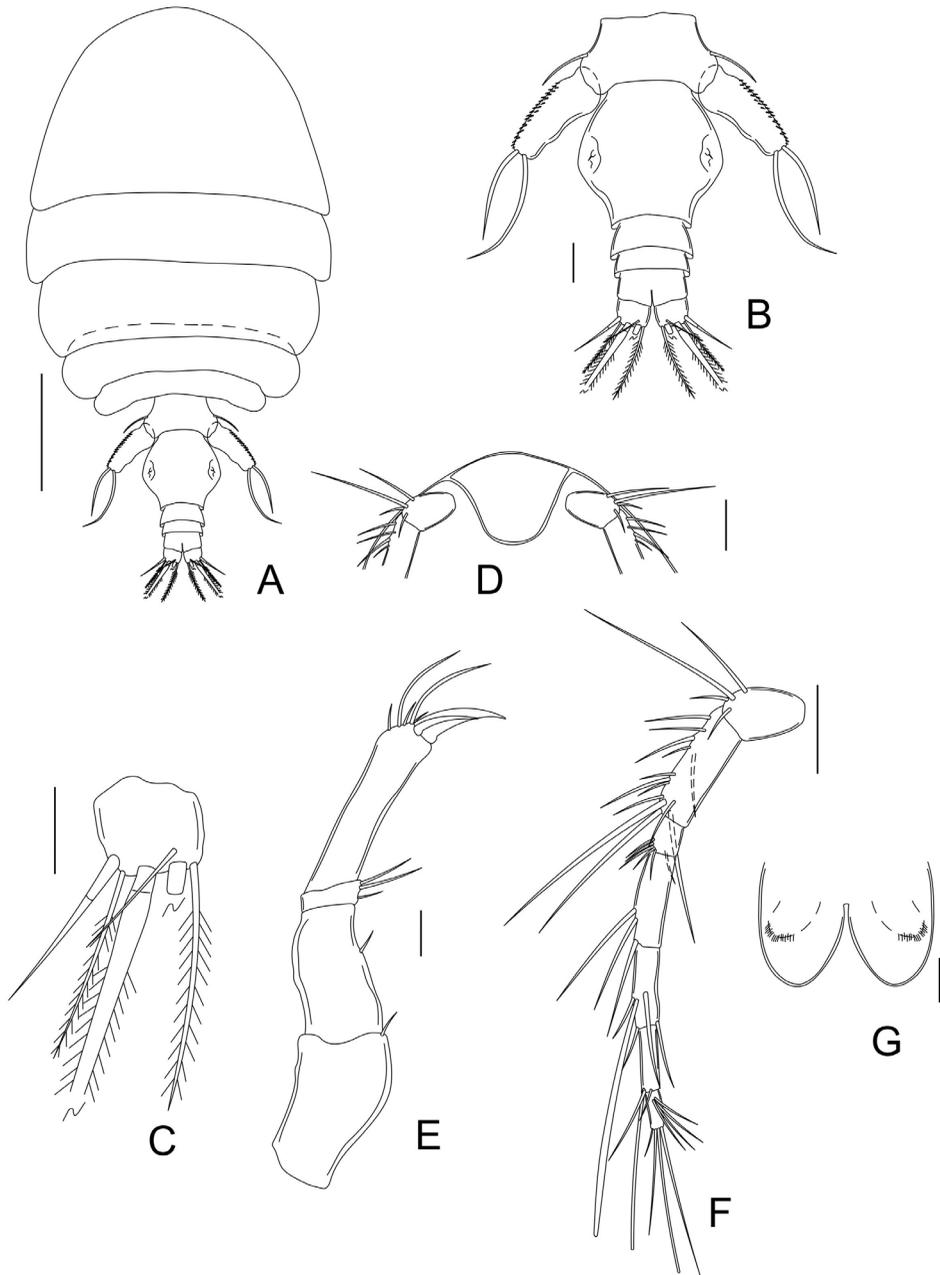


Figure 1. *Critomolgus walteri* sp. nov. (Holotype). Female. A, dorsal view. B, urosome. C, caudal ramus. D, rostrum. E, antenna. F, antennule. G, labrum, with paragnaths (indicated by broken lines). Scale bars: 0.2 mm (A), 0.1 mm (B, E-G) and 0.05 mm (C, D).

Antennule (Fig. 1F) slender and 7-segmented, 361 μm long, with armature formula: 4, 13, 6, 3, 4+1 aesthetasc, 2+1 aesthetasc, and 7+1 aesthetasc; all setae smooth. Antenna (Fig. 1E) slender and 4-segmented, with armature formula: 1, 1, 3, and 5+2 claws. Approximate lengths of first to fourth segments 81, 13, 67, and 84 μm . Two terminal claws nearly equal, 46 μm and 30 μm . Labrum (Fig. 1G) with two elongated posteroventral lobes. Paragnath (indicated by slender broken lines) is a slender haired lobe.

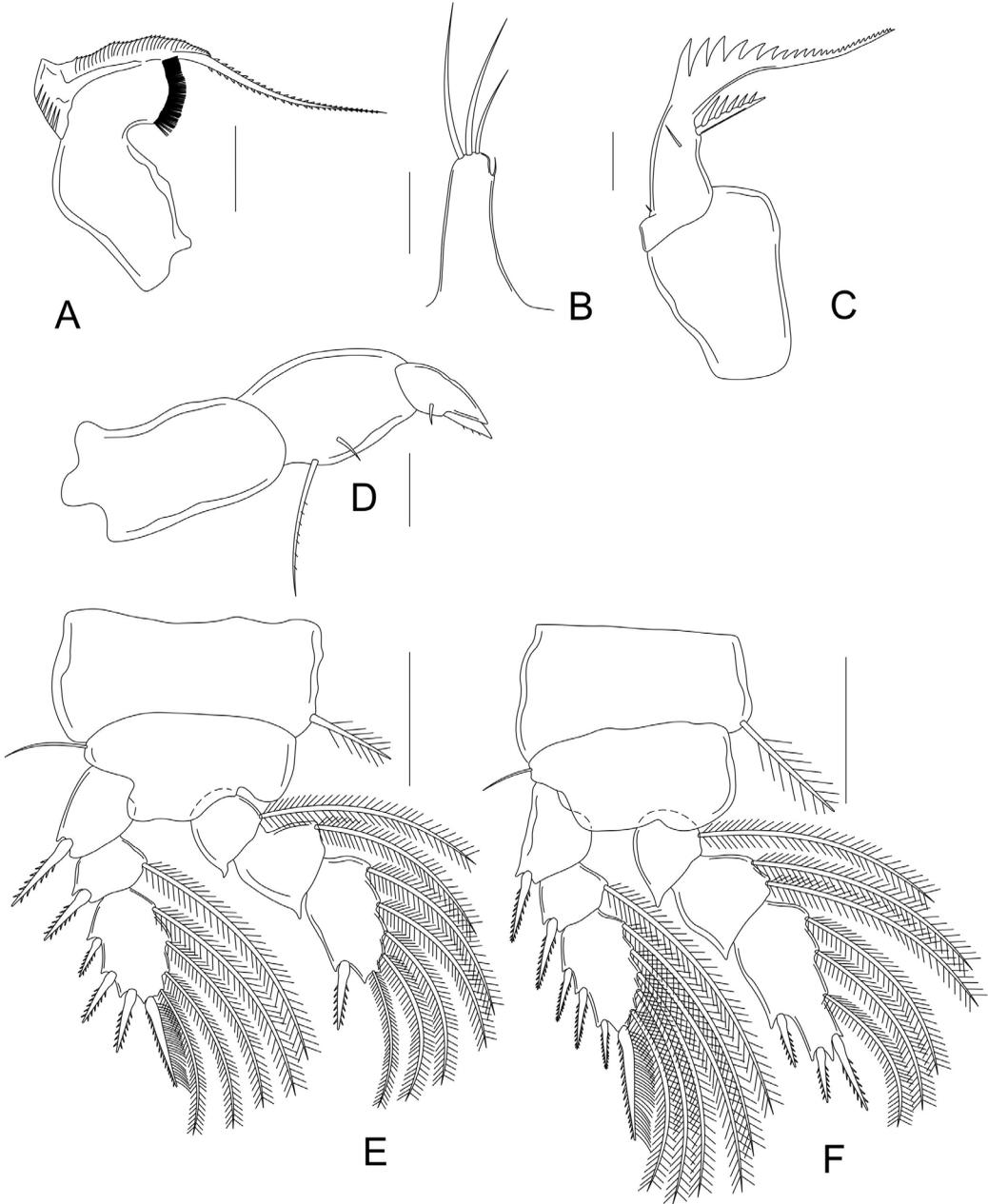


Figure 2. *Critomolgus walteri* sp. nov. (Holotype). Female. A, mandible. B, maxillule. C, maxilla. D, maxilliped. E, leg 1. F, leg 2. Scale bars: 0.01 mm (B), 0.02 mm (A, C-F).

Mandible (Fig. 2A) slender, with broad proximal notch. Inner margin with a scalelike area, and confluent with proximal part of lash. Convex margin with row of minute spinules. Lash long and serrate along both margins. Maxillule (Fig. 2B) with one small lateral and three terminal setae. Maxilla (Fig. 2C) with broad, unarmed first segment. Second segment with 3 setae; inner seta with long spinules along one margin, terminal lash has a row of graduated teeth. Maxilliped (Fig. 2D) 3-segmented. First segment unarmed. Second segment slightly shorter than first, with 2 extremely unequal inner setae. Third segment shortest, terminated by conical process and armed with 1 outer margin spine and 1 small inner seta.

Legs 1–4 with 3-segmented rami except for 2-segmented endopod of leg 4, with following armature formula (Tabla I).

Table I. Armature formula of the legs 1–4

Leg	Coxa	Basis	Exopod	Endopod
1	0–1	1–0	I–0; I–1; III, I, 4	0–1; 0–1; I, 5
2	0–1	1–0	I–0; I–1; III, I, 5	0–1; 0–2; I, II, 3
3	0–1	1–0	I–0; I–1; III, I, 5	0–1; 0–2; I, II, 2
4	0–1	1–0	I–0; I–1; III, I, 5	0–1; II

Inner coxal seta in legs 1–3 large and plumose (Fig. 2E–F and 3A) but this seta in leg 4 small and smooth. Second endopodal segment of leg 4 (Fig. 3B) 2 times as long as wide, inner one of its 2 terminal spines 1.6 times as long as outer one. Free segment of leg 5 (Fig. 3C) elongated, $92 \times 35 \mu\text{m}$, ratio 2.6: 1, with round proximal expansion in the inner margin and rows of minute spinules on the outer margin. Two terminal setae smooth, $70 \mu\text{m}$ (inner) and $102 \mu\text{m}$ (outer).

Male

Body (Fig. 3D) narrower than that of female. Length 0.74 mm (0.70 mm – 0.74 mm) and greatest width 0.27 mm (0.25 mm – 0.27 mm) based on seven specimens. Urosome 6-segmented (Fig. 3E). Fifth pedigerous somite small, 0.46 mm wide. Genital somite distinctly broadened distally, $440 \times 210 \mu\text{m}$, anterolateral corners not defined. Four abdominal somites from anterior to posterior 30×69 , 23×69 , 19×65 , and $23 \times 65 \mu\text{m}$. Caudal ramus resembling that of female $19 \times 23 \mu\text{m}$. Rostrum similar to that of female. Antennule like that of female but with 2 extra aesthetasc added in the segment 2 and one in the segment 4. Antenna (Fig. 3G) resembling that of female, but having small spinules on inner side of first two segments. Maxilliped (Fig. 3I) with second segment bearing 2 inner setae, row of spinules along inner margin. Terminal claw as long as 3 segments combined, with a long proximal seta. Legs 1–4 as in female except for sexual dimorphism in third endopodal segment of leg 1 (Fig. 3H) bearing armature formula I, I, 4. Leg 5 (Fig. 3F) with small rectangular free segment $50 \times 22 \mu\text{m}$, ratio 2: 1, its 2 terminal setae smooth, $105 \mu\text{m}$ (outer) and $44 \mu\text{m}$ (inner).

Color. Live specimens (Fig. 4) are translucent with some opaque white markings on the prosome and urosome. Naupliar eye is red in coloration.

Etymology. The species is dedicated to friend and colleague Chad Walter (Smithsonian Institution, National Museum of Natural History) for his years of dedication, not only in the study of copepods, but also for his tireless work in the World Association of Copepodologists and specifically in the World of Copepods database. This work helps all of us who are dedicated to studying this group of small crustaceans, always full of surprises.

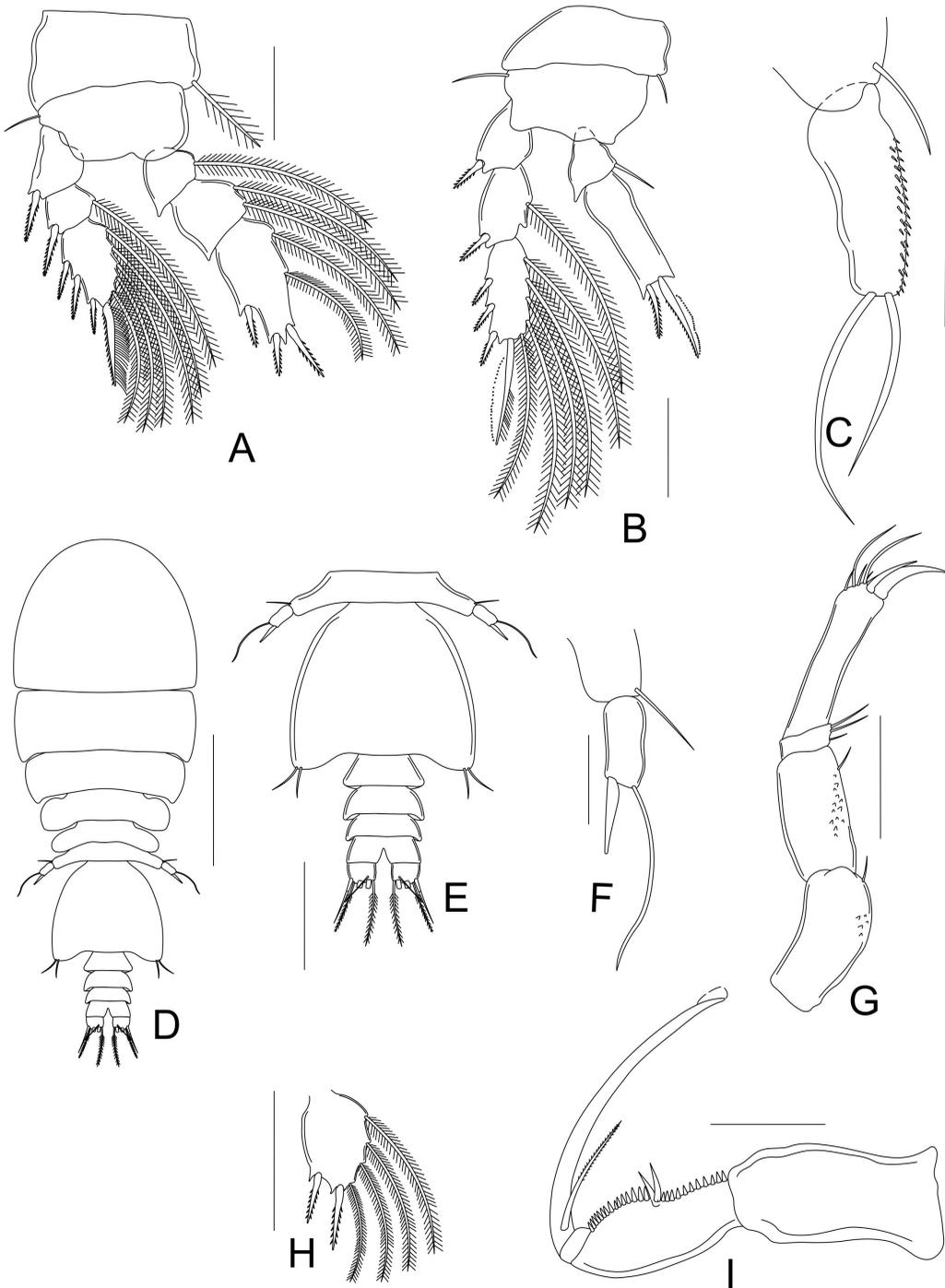


Figure 3. *Critomolgus walteri* sp. nov. (Holotype). Female. A, leg 3. B, leg 4. C, free segment of leg 5 (Allotype). Male. D, dorsal view. E, urosome. F, leg 5. G, antenna. H, third article, endopod leg 1. I, maxilliped. Scale bars: 0.2 mm (C, D), 0.1 mm (E), 0.05 mm (F, G, I) and 0.02 mm (A, B, H).

Habitat. Copepods were found on the branch surfaces of both gorgonian species (*L. virgulata* and *L. hebes*) and appeared to be distributed along the entire colony from holdfast to branch tips. Colonies of *L. virgulata* were the only species of *Leptogorgia* found at the Sunshine Skyway Bridge location and were randomly distributed along subtidal portions of an artificial rock jetty that extended approximately four meters below mean low tide. This site had a salinity and temperature of 32 ppt and 30 °C, respectively. Both *L. virgulata* and *L. hebes* were present at the Egmont Key location (35 ppt, 22.1 °C) and had similar distributions to the Sunshine Skyway Bridge location. In addition to the *Leptogorgia* spp. mentioned above, both collection sites were dominated by a diverse array of benthic macroinvertebrates such as sponges [i.e. *Sphaciospongia vesparium* (Lamarck, 1815) and *Cliona celata* (Grant, 1826)], bivalves [i.e. *Perna viridis* (Linnaeus, 1758), scleractinian coral (i.e. *Siderastrea radians* (Pallas, 1766)], compound and solitary ascidians [i.e. *Styela plicata* (Lesueur, 1823) and *Aplidium stellatum* (Verrill, 1871)], and benthic macroalgae (i.e. *Caulerpa* spp., *Codium* sp., *Bryopsis plumosa* (Hudson) C. Agardh, 1823 and *Sargassum filipendula* C. Agardh, 1824).

Type locality. Florida, Tampa Bay, 27° 38' 504" N 82° 40' 184" W, on *Leptogorgia virgulata*, depth 3.3 m.

Distribution. This species is known only in association with *Leptogorgia virgulata* and *L. hebes* from Tampa Bay, Florida.

Behavior. This species shows a high affinity for hosts *L. virgulata* and *L. hebes*. Live specimens were reluctant to leave the host and quickly returned if removed while examined under the dissecting microscope.

Remarks

In the genus *Critomolgus* only 4 species share with *C. walteri* **sp. nov.**, a combination of characters as follows: body length less than 2 mm, caudal ramus almost long as wide; antenna with 2 claws stouter and unguiform; maxilla with teeth on lash evenly graded and free segment of leg 5 with an inner proximal expansion. They are *C. brevicaudatus* Kim, I. H., 2003 and *C. cladiellae* Humes, 1990, from New Caledonia in the Pacific Ocean; *C. bulbipes* (Stock & Kleeton, 1963) from the Mediterranean Sea and *C. foxi* (Gurney, 1927) from Madagascar in the Indian Ocean (Gurney, 1927; Stock & Kleeton, 1963; Humes, 1990; Kim, 2003).

In *Critomolgus brevicaudatus* the body is large, 1.56 mm long in the female, the genital double-somite in dorsal view is longer than wide and the third segment of the maxilliped in the female terminates in a small knob, 1 spine and 1 seta. In *C. walteri* **sp. nov.**, the body is small, 0.86 mm long in the female, the genital double-somite in dorsal view is slightly longer than wide, almost rounded and the third segment of the maxilliped in the female terminates in a conical process, 1 spine and 1 seta.

In *Critomolgus cladiellae* the body is large, 1.15 mm long in the female, the genital double-somite in dorsal view is longer than wide and the inner seta on the first endopodal segment of leg 4 is small, much shorter than the width of the segment. In *C. walteri* **sp. nov.**, the body is short, 0.86 mm, the genital double-somite in dorsal view is slightly longer than wide, almost rounded and the inner seta on the first endopodal segment of leg 4 is long, longer than the width of the segment.

In *Critomolgus bulbipes* the genital double-somite in dorsal view is longer than wide, inner seta of the maxilla longer than the half of the terminal lash and the terminal claws of the second antenna are almost the same length. In *C. walteri* **sp. nov.**, the genital double-somite in dorsal view is slightly longer than wide, almost rounded, the inner seta of the maxilla is shorter than the terminal lash and the terminal claws of the antenna 1.4: 1 in length.

In *C. foxi* the caudal ramus is slightly longer than wide, the inner seta on the first endopodal segment of leg 4 is small, much shorter than the width of the segment and the convex margin of mandible bears a tapering process. In *C. walteri* **sp. nov.**, the caudal ramus is slightly wider than long, the inner seta on the first endopodal segment of leg 4 is long, longer than the width of the segment and the convex margin of mandible lacks a tapering process.



Figure 4. *Critomolgus walteri* **sp. nov.**, photograph of live female collected from *Leptogorgia hebes* at Egmont Key, FL. Scale bar: 0.2 mm.

ACKNOWLEDGEMENTS

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