

On Some Caligids (Copepoda: Caligidae) from Plankton of a Coastal Lagoon in the Gulf of Mexico with a Description of a New Species of *Metacaligus*

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Eduardo Suárez-Morales, Il-Hoi Kim, and Benigno J. Escamilla (2012) On some caligids (Copepoda: Caligidae) from plankton of a coastal lagoon in the Gulf of Mexico with a description of a new species of *Metacaligus*. *Zoological Studies* 51(6): 804-818. A collection of zooplankton from a coastal system of the southern Gulf of Mexico contained several caligid copepods that were taxonomically examined. The following species were identified: *Caligus rufimaculatus* Wilson, 1905, *C. undulatus* Shen and Li, 1959, *Caligus* sp., *Metacaligus rufus* (Wilson, 1908), and an undescribed species of *Metacaligus* Thomsen, 1949. The 1st species (*C. rufimaculatus*) was previously reported and redescribed from specimens collected in this system. *Caligus undulatus* is known only from plankton surveys; our specimens show subtle differences with respect to other known populations. *Metacaligus rufus* is redescribed based on adult male and female specimens collected from Chelem; this species has not been redescribed since its original description. Both *C. undulatus* and *M. rufus* represent new geographic records in the Gulf of Mexico and the Northwestern Tropical Atlantic region. *Metacaligus yucatanensis* sp. nov. is described based on male individuals and a single female with a unique combination of characters including: 1) leg 1 with all elements of the distal segment inserted on the inner margin, and 2) the absence of an outer spine on the 2nd exopodal segment of the 2nd leg. This is the 5th species of the genus currently known. <http://zoolstud.sinica.edu.tw/Journals/51.6/804.pdf>

Key words: Planktonic crustaceans, Parasitic copepods, Plankton ecology, Zooplankton, Invertebrate taxonomy.

Caligid copepods, commonly known as sea lice, are members of the family Caligidae Burmeister, 1835, which together with the Lernanthropidae Kabata, 1979 (+150 species) are among the most diverse groups of parasitic siphonostomatoid copepods (Ho et al. 2011). The Caligidae currently comprises 28 genera and more than 400 species and is the most diverse fish-parasitizing group among the Copepoda (Boxshall and Halsey 2004, Ho and Lin 2004a b). Caligids are usually recorded as parasites of marine teleosts, to which they remain firmly attached during the adult phase. The systematics of the

genus is based on the morphology of adult females collected from their hosts; males are scarcely referred to in the literature. It was realized that adult males and some females of several species are consistently found in plankton samples; the host remains unknown for some of them. These findings indicate that the diversity and life mode of these copepods are relatively unexplored (Venmathi Maran and Ohtsuka 2008).

Chelem Lagoon is a shallow coastal karstic system located on the northern coast of the Yucatan Peninsula, in the southern Gulf of Mexico (21°17'N, 89°40'W). The lagoon is partially

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protected from the marine front by a sand barrier, and it is influenced by waters from the Gulf of Mexico and Caribbean Sea. The zooplankton community of this system has been surveyed for several years (Escamilla et al. 2001), and its copepod fauna was examined (Suárez-Morales and Escamilla 1997 2001, Escamilla and Suárez-Morales 1999, Escamilla et al. 2011), including a report of caligid copepods in those samples (Suárez-Morales et al. 2003). When examining samples collected in different months of 1987-1989, several additional specimens of caligid copepods were obtained and taxonomically examined. In this report, we present the results of that analysis including a description of a new species of *Metacaligus*.

MATERIALS AND METHODS

In total, more than 100 zooplankton samples were collected from Laguna de Chelem, Yucatan, Mexico during various months of 1987, 1988, and 1989 by performing surface tows at 8 sampling stations. In all cases, a standard plankton net (30 cm in mouth diameter, 120 cm long, and 0.33 mm in mesh size) was used to sample the water column; the net was trawled for 5 min at each station. Sampling was conducted during daytime (08:00-14:00). The biological material was fixed in a sodium borate-buffered formalin solution in seawater. Caligid copepods were sorted from the zooplankton samples and preserved in 70% ethanol. The dissected parts and appendages were examined under a microscope; drawings were prepared with the aid of a drawing tube. Specimens were deposited in the collection of Il-Hoi Kim (Univ. of Kangreung, Kangreung, South Korea) and the collection of Zooplankton at El Colegio de la Frontera Sur (ECO-CHZ) in Chetumal, Mexico.

TAXONOMY

Order Siphonostomatoida
Family Caligidae Burmeister, 1835
Genus *Caligus* Müller, 1785
***Caligus rufimaculatus* Wilson, 1905**

Material examined: 1 adult ♀, Laguna de Chelem, plankton, coll. 11 July 1989, sta. 17 (ECO-CHZ 07544); 2 ♂♂ from same site, coll. 11 July 1989, I-H Kim laboratory, Kangreung Univ. Two

young ♂♂, Laguna de Chelem, plankton, coll. 27 Jan. 1987, sta. 4 (ECO-CHZ 07540).

Remarks: This species was redescribed from male and female specimens collected in Chelem (Suárez-Morales et al. 2003). The 2 male specimens examined are slightly larger (2.63 and 3.13 mm) than those recorded in a previous survey (the largest of 4 specimens measured 2.6 mm). This is probably the most frequent caligid species in plankton samples from Chelem.

***Caligus undulatus* Shen and Li, 1959** (Figs. 1, 2)

Caligus undulatus Shen and Li, 1959: 12, 16, pl. 1 (specimens from plankton); Pillai 1966: 123, fig. 1; Montú 1982 (Brazil); Venmathi Maran and Ohtsuka 2008: 206, figs. 3I-O, 4A-M.

Material examined: 1 ♂ (dissected), Laguna Chelem, Yucatan, Mexico, coll. 12 May 1987, plankton, sta. 2; 1 ♂, same site, plankton, coll. 4 Oct. 1988, sta. M-1, specimens at I-H Kim laboratory, Kangreung Univ.

Remarks: The males collected in the present study (2.82 mm) are smaller than those reported from China (3.08 mm) (Shen and Li 1959), India (3.50 mm) (Pillai 1966), and Japan and Korea (3.52 mm) (Venmathi Maran and Ohtsuka 2008). Venmathi Maran and Ohtsuka (2008) reported both legs 5 and 6 in males of this species, but in our specimens from Chelem, the latter appendage was reduced, represented by a pair of minute setules which were difficult to observe. A pair of adhesion pads on the ventral surface of the body near the tip of the oral cone recorded by previous authors was also weakly developed in our specimens. The underdevelopment of these appendages appears to be related to the relatively small size of our specimens, which are probably not fully grown adults.

Caligus undulatus is closely related to its congener *C. chelififer* Wilson, 1905 (Kabata 1972, Venmathi Maran and Ohtsuka 2008); there is a record of the latter species in neritic waters of the Gulf of Mexico (Suárez-Morales et al. 1998). However, both species differ by the length of the 3 outer setae on the distal exopodal segment of leg 1 (Fig. 1J) (relatively shorter in *C. chelififer*) and by the different shape of the inner process on the 1st maxillipedal segment of the male. All previous reports on *C. undulatus* were based on specimens from plankton samples, and no host of this species is known. This species was originally described from specimens in plankton samples from China

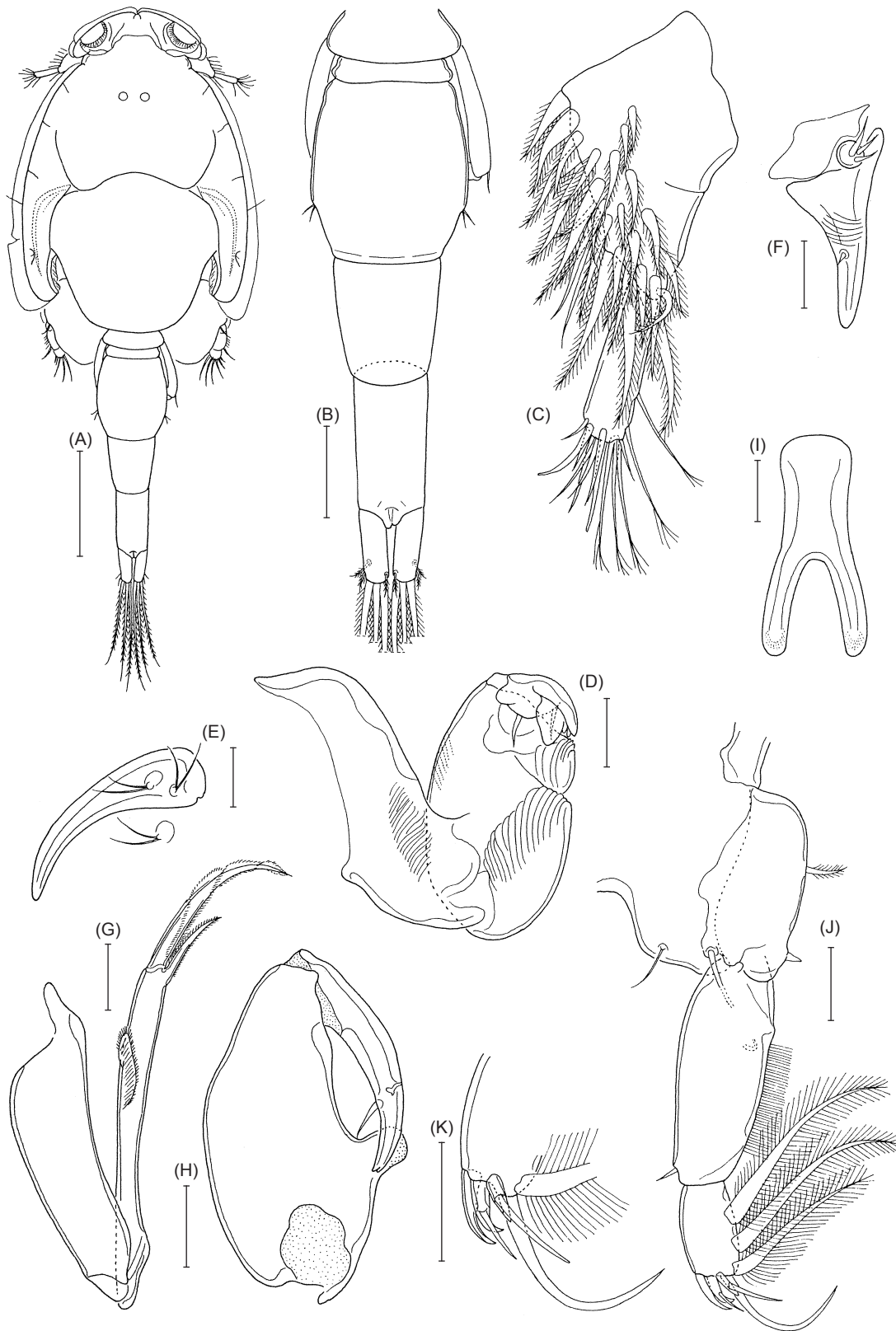


Fig. 1. *Caligus undulatus* Shen and Li, male from Laguna Chelem, Mexico. (A) Habitus; (B) urosome, dorsal; (C) antennule; (D) antenna; (E) postantennary process; (F) maxillule; (G) maxilla; (H) maxilliped; (I) sternal furca; (J) leg 1; (K) distal part of exopod of leg 1. Scale bars: A = 0.5 mm; B = 0.2 mm; C-G, I-K = 0.05 mm; H = 0.1 mm.

(Shen and Li 1959). Later on, it was recorded from Brazil (Montú 1982), India (Pillai 1966), Japan, and Korea (Venmathi Maran and Ohtsuka 2008). However, *C. undulatus* has not hitherto been reported as a parasite on any host, but *C. chelifer* was found as a parasite of several teleost hosts (Wilson 1905, Cressey 1991, Venmathi Maran and Ohtsuka 2008). It is expected that a detailed parasitological survey of the fish fauna of Chelem, represented by 39 species (Hernández-Vázquez 2002), could provide new information about the life

cycle of this species.

***Caligus* sp.**
(Figs. 3, 4)

Material examined: 1 ♀, Laguna Chelem, Yucatan, Mexico, coll. 16 Jan. 1989, plankton, sta. 16; 1 ♂, same site, 10 Nov. 1987, plankton, sta. 18. Specimens ethanol-preserved, undissected, at I-H Kim laboratory, Kangreung Univ.

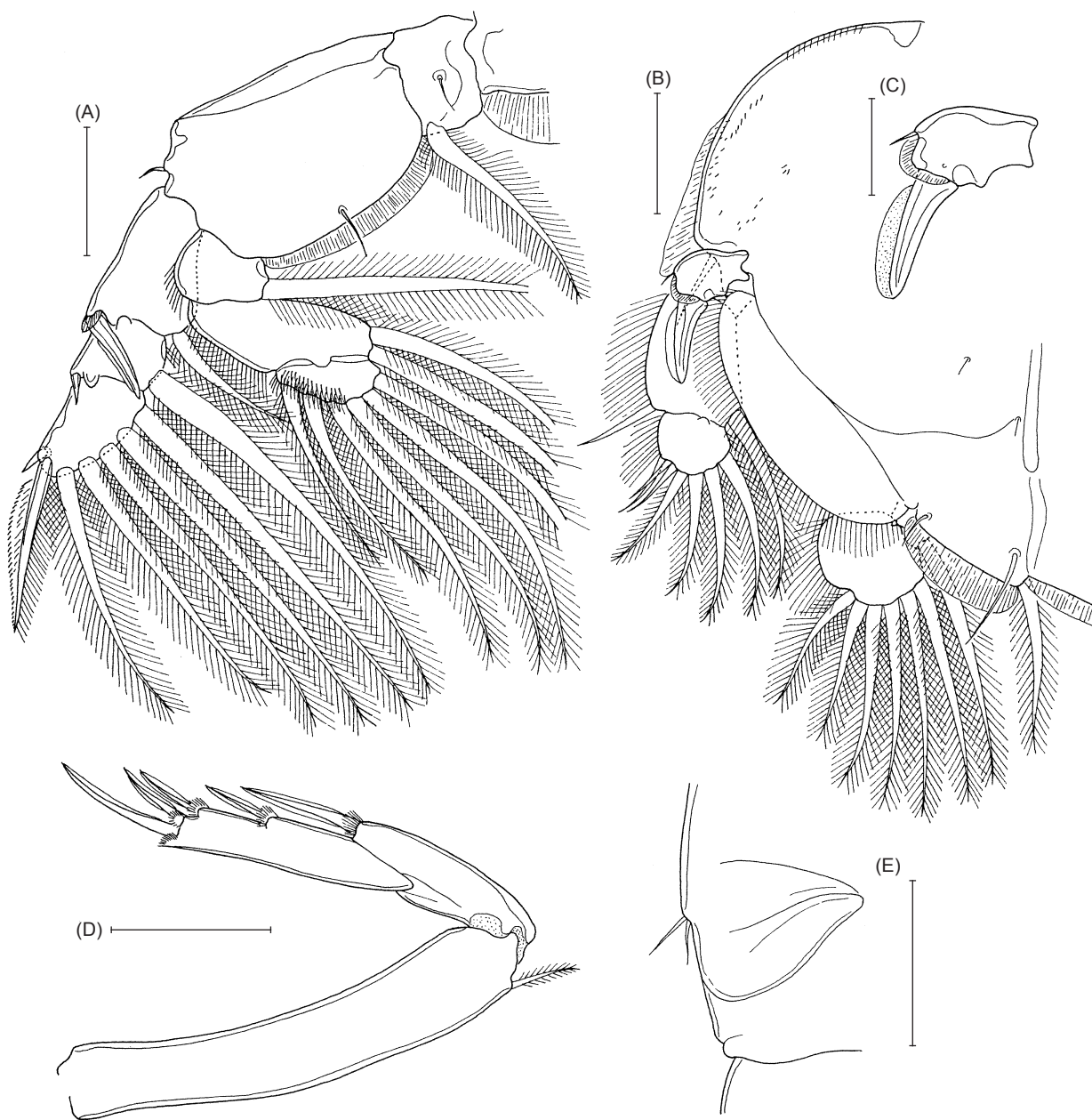


Fig. 2. *Caligus undulatus* Shen and Li, male from Laguna Chelem, Mexico. (A) Leg 2; (B) leg 3; (C) 1st exopodal segment of leg 3; (D) leg 4; (E) genital area, ventral. Scale bars: A, B, D = 0.1 mm; C, E = 0.05 mm.

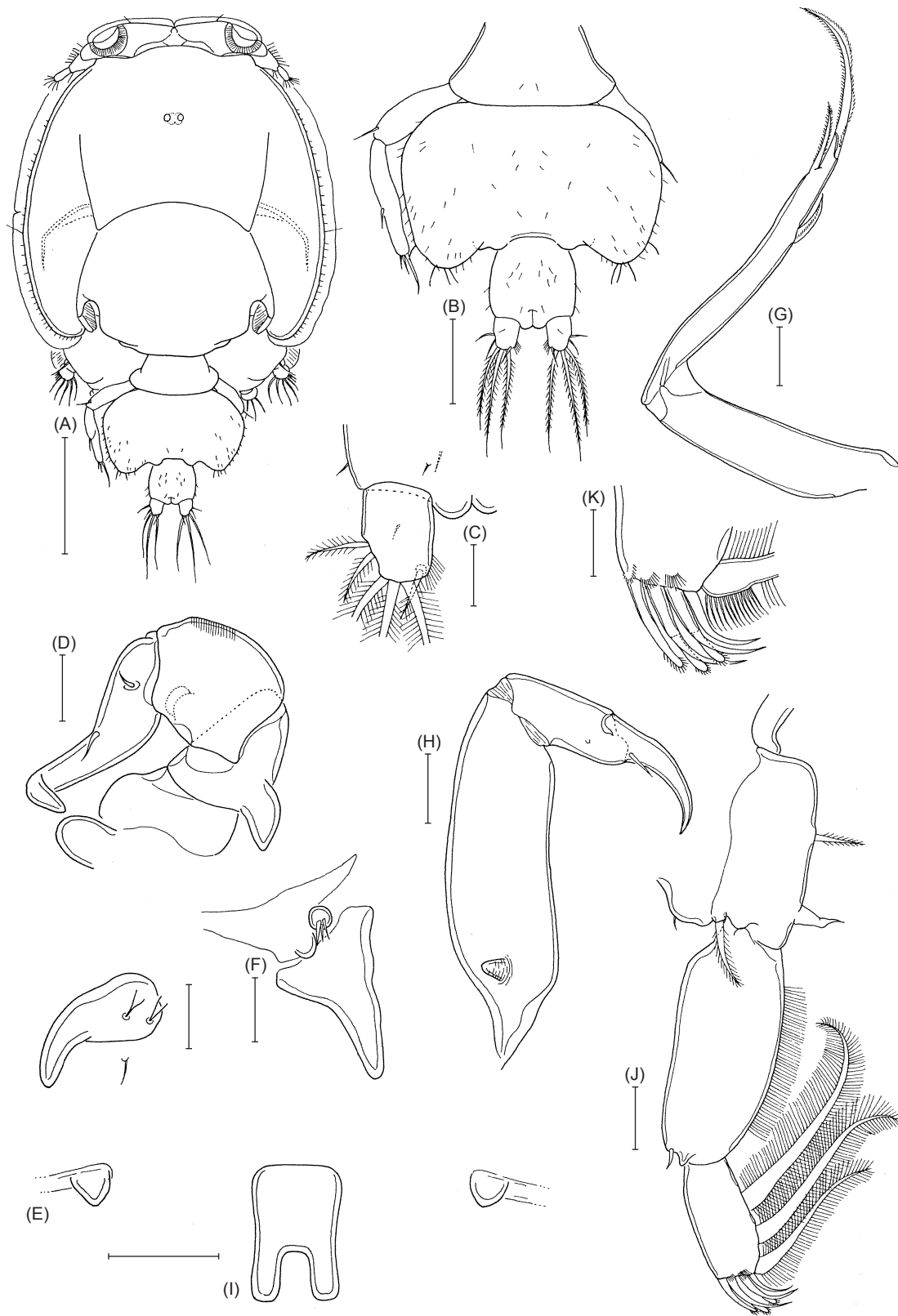


Fig. 3. *Caligus* sp., female from Laguna Chelem, Mexico. (A) Habitus, dorsal; (B) urosome, dorsal; (C) right caudal ramus, ventral; (D) antenna; (E) postantennary process; (F) maxillule; (G) maxilla; (H) maxilliped; (I) sternal furca and lateral processes; (J) leg 1; (K) distal part of exopod of leg 1. Scale bars: A = 0.5 mm; B = 0.2 mm; C-J = 0.05 mm; K = 0.025 mm.

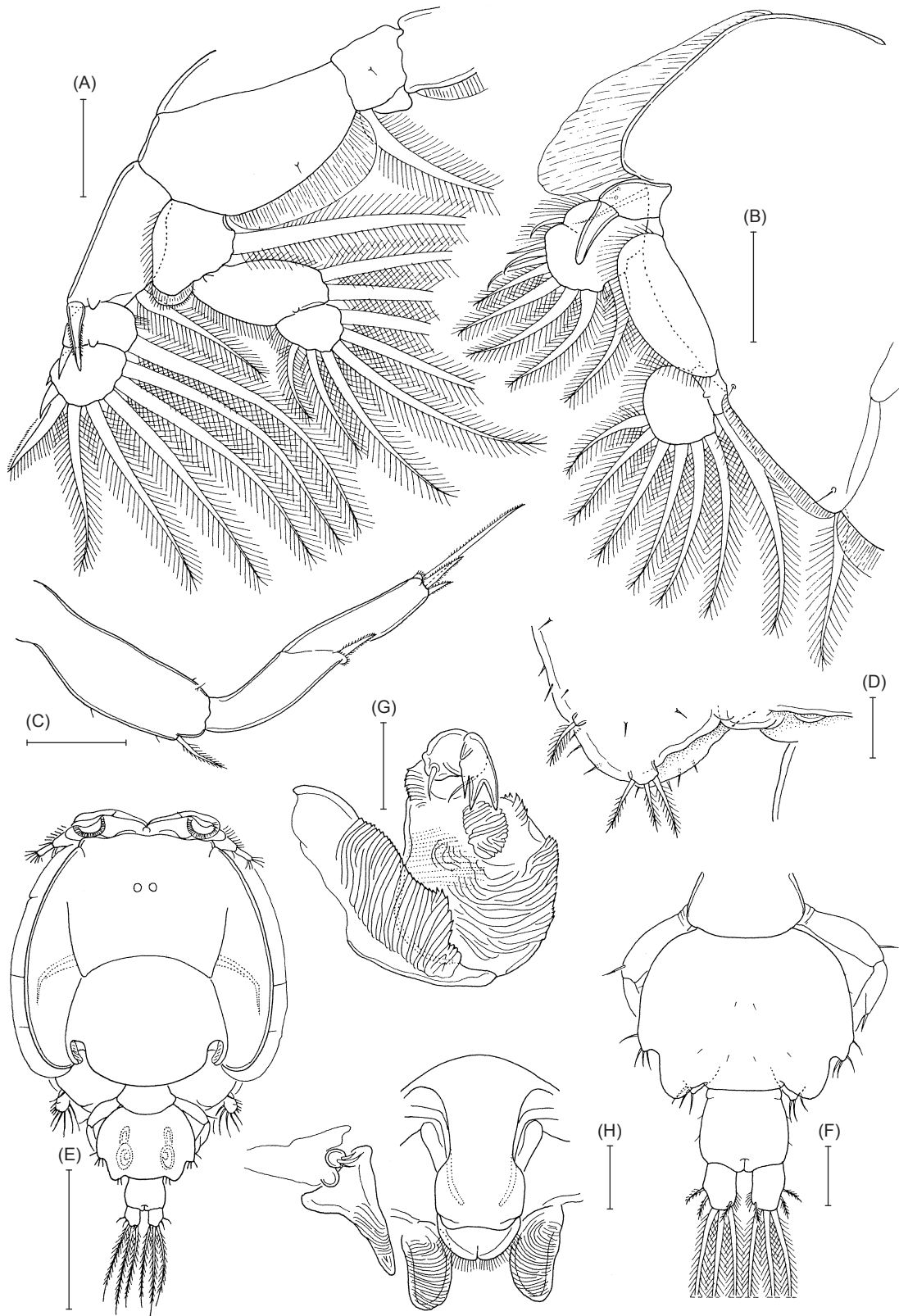


Fig. 4. *Caligus* sp., female from Laguna Chelem, Mexico. (A) Leg 2; (B) leg 3; (C) leg 4; (D) right leg 5 and genital area, ventral. Male: (E) habitus, dorsal; (F) urosome, dorsal; (G) antenna; (H) oral cone, maxillule, and post-oral adhesion pads. Scale bars: A-C, F = 0.1 mm; D, G, H = 0.05 mm; E = 0.5 mm.

Remarks: Although both sexes are available, this species has not yet been identified. This species appears to be related to *C. orientalis* Gusev, 1951 and similar forms. It shares with that species a similar body shape, including a general resemblance of the genital complex of both the male and female, the structure of leg 1 including the presence of accessory processes on the middle 2 spines of the distal exopodal segment, and the structure and ornamentation of legs 2 and 3. Most importantly, both species have a 4th leg bearing 4 spines on the exopod, with the formula I-0; III (Fig. 4C). However, our specimens differ in details of the genital complex of both sexes (Figs. 3A, B, 4E, F), the proportions of the female caudal rami (Fig. 3C) (relatively longer than in *C. orientalis*), the length of the maxillary spines (Fig. 3G), the shape of the sternal furca (Fig. 3I), and the male antenna (4G). Interestingly, *C. orientalis* was also recorded from plankton samples in China (Shen 1957). The male also somewhat resembles *C. epidemicus* Hewitt, 1971 considering the shape of the genital complex and the structure of the 5th leg and antenna (with bifurcate projections on the distal segment). The female specimen appears to be a young adult, so any attempt to perform a complete evaluation of its characters and taxonomic status would be misleading. Hence, we include illustrations of this species with the expectation of eventually finding fully developed females either in the plankton or associated with a teleost host in Chelem Lagoon in order to determine its status.

Genus *Metacaligus* Thomsen, 1949

***Metacaligus yucatanensis* sp. nov.**

(Figs. 5, 6)

Material examined: Type material: Holotype: adult ♂ from plankton sample, Chelem Lagoon, Yucatan Peninsula, Mexico, collected, 12 May 1987, sta. 22, undissected specimen, ethanol-preserved (ECO-CHZ 07542). Paratypes: adult ♂ from plankton sample, same site, collected 12 May 1987, dissected, slide (ECO-CHZ 07542). Allotype: adult ♀ from Chelem Lagoon, same site, collected 11 July 1989, undissected, appendages damaged, ethanol-preserved, vial (ECO-CHZ 07541).

Description: Male: Body (Fig. 5A) small, 1.4-1.6 mm long excluding setae on caudal rami. Cephalothoracic shield roughly ovoid, 0.76-0.78 mm long, 0.52-0.53 mm wide (excluding marginal hyaline membranes: 0.02 mm in both

specimens). Frontal plates well-developed and carrying moderately large lunules separated by 1.5 lunule diameters; free margin of thoracic zone projecting beyond tips of lateral zones; sinuses moderately deep. Fourth pediger separated from genital complex, roughly hexagonal, about twice wider than long. Genital complex subrectangular. Abdomen (Fig. 5B) represented by 2 somites; proximal somite subquadrate, slightly wider than long, anal somite 1.46-times as long as wide. Caudal ramus 70 µm long, 33 µm wide (ratio 2.12:1), bearing 3 short (1 inner, 2 outer) setae, and 3 long terminal setae. Medial margin naked.

Antennule (Fig. 5C) 2-segmented; proximal segment armed with 27 setose and 2 simple setae on anterodistal surface; distal segment subrectangular, armed with 1 subterminal inner seta and 11 setae plus 2 aesthetascs on distal margin.

Antenna (Fig. 5D) 3-segmented; proximal segment slender, armed with corrugated pad on outer surface; middle segment robust, armed with large corrugated field; terminal segment smallest, armed with 2 basal setae and 2 distally bifid overlapping cuticular flaps.

Postantennary process (Fig. 5E) elongate with 2 papillae bearing tuft of 4 (proximal) and 15+ setules (distal); another similar papilla nearby on sternum bearing about 15 setules. Process acute, slightly curved, heavily sclerotized.

Maxillule (Fig. 5F) comprising obtuse, dentiform process bearing large basal papilla armed with 1 slender and 2 basally robust setal elements.

Maxilla (Fig. 5G) 2-segmented; proximal segment (lacertus) unarmed, slightly shorter than brachium; distal segment (brachium) with terminal unequal elements (canna about 1/2 as long as calamus).

Maxilliped (Fig. 5H) robust, with prominent, pointed proximal process on inner margin; strong subchela bearing terminal medial seta; short terminal claw distally acute, naked. Sternal furca absent.

Leg 1 (Fig. 5I) protopod with long plumose outer seta and adjacent papilla on outer margin bearing single short seta. Endopod represented by reduced tapering process. First segment of exopod with naked posterior margin, small seta inserted on outer distal corner. Distal segment with 3 small, naked subdistal setae and 1 large, strongly recurved, naked seta on inner margin; 3 large plumose setae on same inner margin. Distal margin naked.

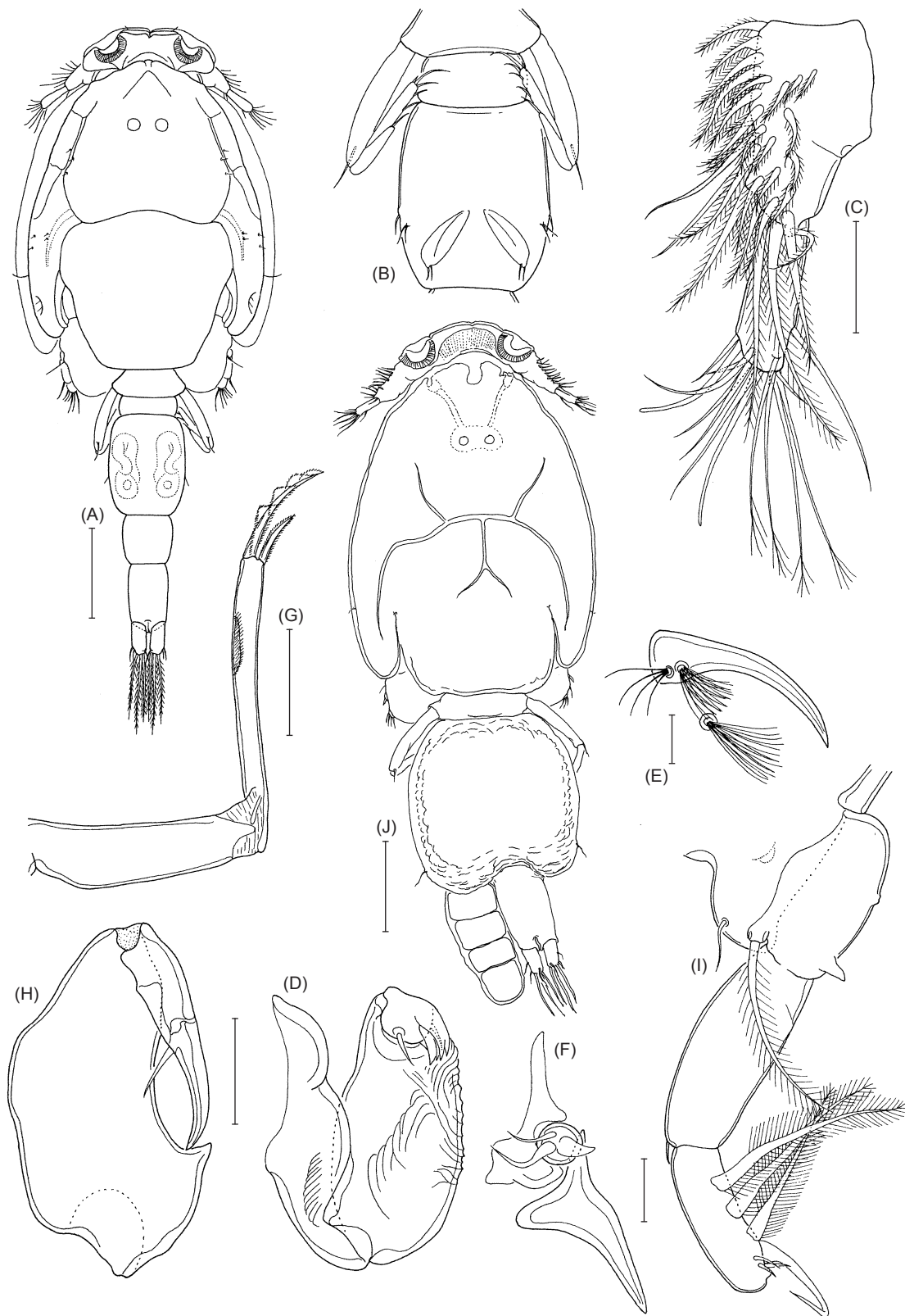


Fig. 5. *Metacaligus yucatanensis* sp. nov, holotype male from Laguna Chelem, Mexico. (A) Habitus, dorsal; (B) urosome, ventral; (C) antennule; (D) antenna; (E) postantennary process; (F) maxillule; (G) maxilla; (H) maxilliped; (I) leg 1; (J) allotype adult female, habitus, dorsal. Scale bars: A, J = 0.2 mm; B = 0.1 mm; C, G, H = 0.05 mm; D-F, I = 0.02 mm.

Leg 2 (Fig. 6A) coxa armed with large plumose inner seta on posterior margin and a setule-bearing papilla on ventral medial surface. Basipod bearing short naked seta on outer margin plus single long setule on ventral surface. Anterodistal surface of basipod and 1st segment of exopod with narrow marginal membrane. Second exopodal segment without a spine on outer margin. Outer margin of distal 2 endopodal segments with a tuft or row of small setules, proximal endopodal segment naked.

Leg 3 (Fig. 6B, C) protopod with small outer

and large inner plumose setae, in addition to narrow outer and posterior marginal membranes; ventral surface of protopod with small setule-bearing papilla at both ends of membrane; velum moderately developed and fringed with marginal setules.

Leg 4 (Fig. 6D) protopod large, with subdistal plumose seta inserted on outer distal corner; exopod 2-segmented, 1st segment with pinnate spine. Second segment armed with 2 subdistal and 2 distal pinnate spines, apical one longest. Pectinate processes at base of 2 distal spines.

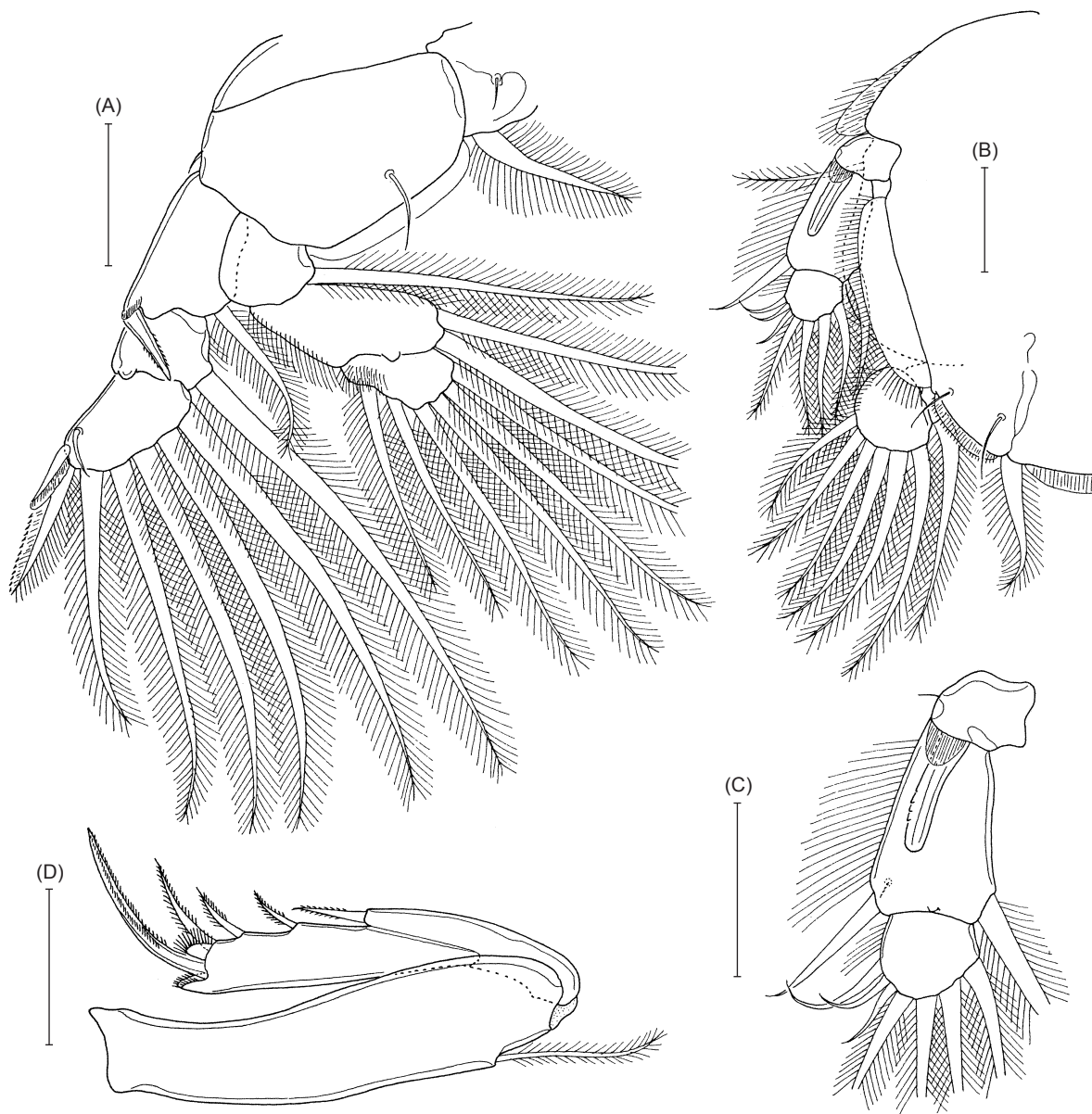


Fig. 6. *Metacaligus yucatanensis* sp. nov., holotype male from Laguna Chelem, Mexico. (A) Leg 2; (B) leg 3; (C) exopod of leg 3; (D) leg 4. Scale bars: 0.05 mm for all.

Armature of rami of legs 1-4 as follows (Roman and Arabic numerals respectively indicating spines and setae):

| | Exopod | Endopod |
|-------|---------------------|-------------|
| Leg 1 | 1-0; 3, 1, 3 | vestigial |
| Leg 2 | I-1; 0-1; 1+I, I, 5 | 0-1; 0-2; 6 |
| Leg 3 | I-0; I-1; III, 4 | 0-1; 6 |
| Leg 4 | I-0; II, II | absent |

Leg 5 (Fig. 5B) located in middle region of lateral margin of genital complex, represented by 2 papillae, one (proximalmost) armed with short seta and other with 2 short, slender setae.

Leg 6 represented by ventral processes on genital complex with distal protuberance armed with 2 short, slender setae (Fig. 5B).

Female: Body (Fig. 5J) of allotype specimen small-sized, slightly longer than male, 1.5 mm long, excluding setae on caudal rami. Cephalothoracic shield roughly ovoid, 0.86 mm long, 0.55 mm wide (excluding narrow marginal hyaline membranes: 0.012 mm). Frontal plates well-developed and carrying moderately large lunules separated by 1.8-times lunule diameter. Fourth pediger separated from genital complex, roughly hexagonal. Genital complex globose, subquadrate, ridged. Abdomen relatively short (0.20 mm), about 1/2 length of genital complex. Caudal ramus about twice as long as wide, bearing 3 short (1 inner, 2 outer) setae, and long terminal setae. Medial margin naked. One egg-sac present in our specimen, containing 4 eggs.

Antennule with 27 setae on proximal segment. Antenna and cephalic appendages partially damaged but observable, appendages as in males. Armature of legs 1-4 as described for males.

Remarks: This species is known from only 2 males and a single female; several appendages of the latter (herein deemed a paratype) are damaged but the species' diagnostic characters were observable. Hence, the description is based on the male specimens. In this case, the specimens examined were obtained from plankton. These specimens were included in the genus *Metacaligus* Thomsen because they possess the following distinctive generic characters: the absence of a sternal furca, lack of an accessory process on the terminal spines of leg 1 exopod, and possession of only 1 outer spine on the terminal exopodal segment of leg 2 (Ho and Lin 2002 2004a). The genus currently includes 4

species: *M. uruguayensis* Thomsen, 1949; *M. rufus* Wilson, 1908; *C. unguidentatus* (Rangnekar and Murti, 1950); and *M. latus* Ho and Lin, 2002. The new species, *M. yucatanensis* can be easily distinguished from its congeners by the presence of 2 exclusive characters: 1st is the peculiar leg 1 on which all setal elements of the distal segment of the exopod are inserted along the inner margin, thus leaving the distal surface of this segment naked. Also, these elements are weakly developed in the new species (see Fig. 5I). In other species of *Metacaligus* and in most caligids, these elements are distal and are well-developed pinnate spiniform setae in both males and females (Shen 1957, Pillai and Lal Mohan 1967 as its synonym *M. hilsae*, Ho and Lin 2004a). Second is the absence of an outer spine on the 2nd exopodal segment of leg 2, which is reduced but present in *M. latus* and *M. uruguayensis* (Ho and Lin 2004a), and well-developed in *M. unguidentatus* (Shen 1957, Pillai and Lal Mohan 1967 as *M. hilsae*), and in *M. rufus* (Fig. 7F, G). The combination of characters found in the males and female recorded from Chelem appears to be sufficient evidence to name a new species of *Metacaligus*, which is the 5th species known in the genus.

Etymology: The new species is named in reference to the Yucatan Peninsula, Mexico.

***Metacaligus rufus* (Wilson, 1908)**

***Caligus rufus* Wilson, 1908**

(Figs. 7, 8)

Metacaligus rufus Ho and Bashirullah 1977, p. 712, fig. 5B, F.

Material examined: 1 ♀, Laguna Chelem, Yucatan, Mexico, plankton sample, coll. 25 Mar. 1987, sta. 4; 2 ♀♀, same site, coll. 11 July 1989 (ECO-CHZ 07543); 1 ♂, same site, plankton, sta. 22, 8 Nov. 1988, I-H Kim laboratory, Kangreung Univ.

Redescription: Female. Body (Fig. 7A) size: 3.25-3.79 mm long excluding setae on caudal rami. Cephalothoracic shield oval, longer (1.91-2.08 mm) than wide (1.39-1.54 mm), excluding narrow (0.05 mm) marginal hyaline membranes. Fourth pediger wider than long. Genital complex roughly subrectangular, longer (0.71-0.79 mm) than wide (0.56-0.61 mm). Abdomen widest at proximal part, 1.33-times as long as wide, margins tapering posteriorly. Caudal rami 3.09-times longer than wide, furnished with 3 long and 3 short plumose setae.

Antennule (Fig. 7B) 2-segmented; proximal

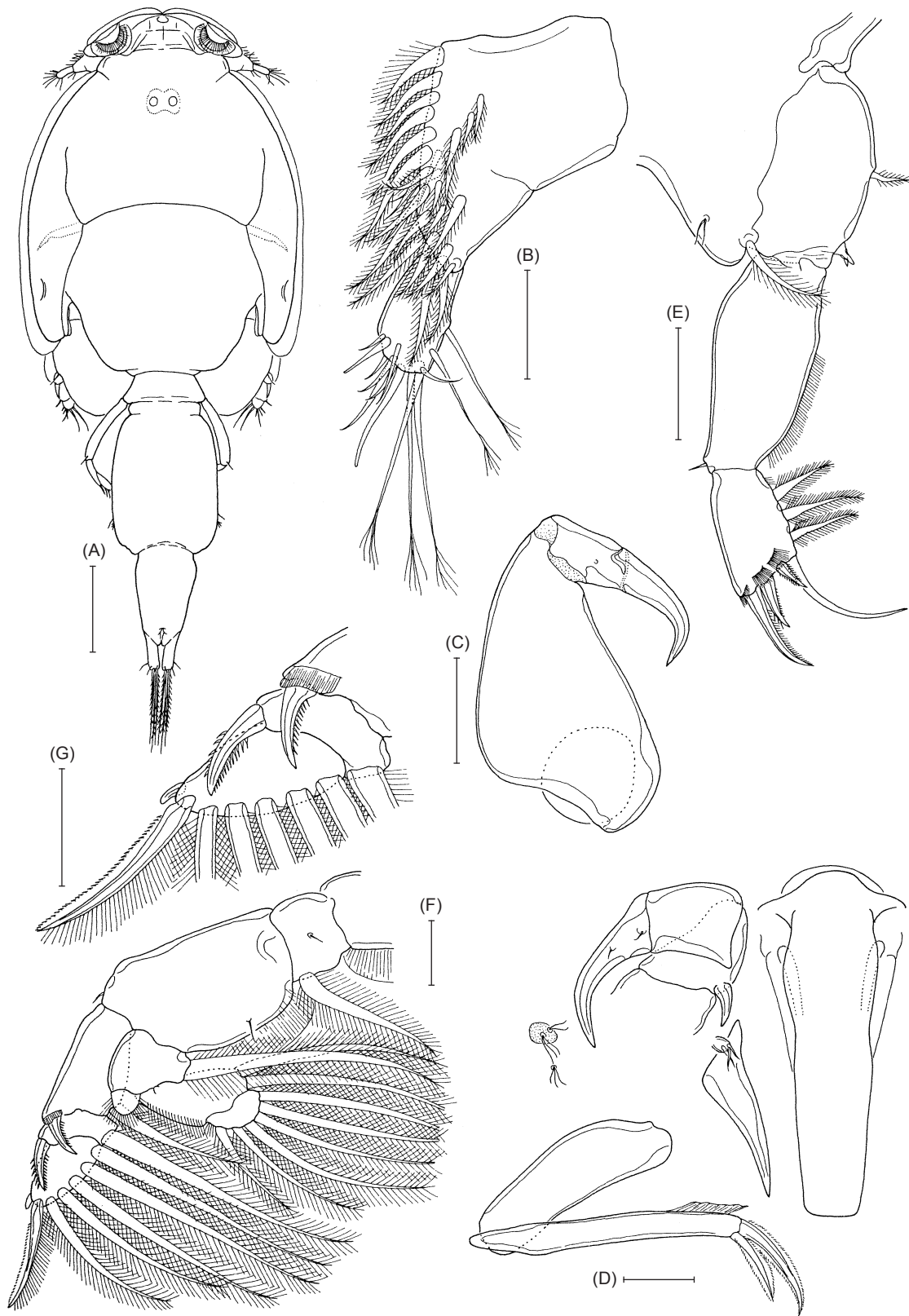


Fig. 7. *Metacaligus rufus* (Wilson), female from Laguna Chelem, Mexico. (A) Habitus, dorsal; (B) antennule; (C) maxilliped; (D) oral area (oral cone, antenna, maxillule, and maxilla); (E) leg 1; (F) leg 2; (G) distal segments of exopod of leg 2. Scale bars: A = 0.5 mm; B, D-G = 0.1 mm; C = 0.2 mm.

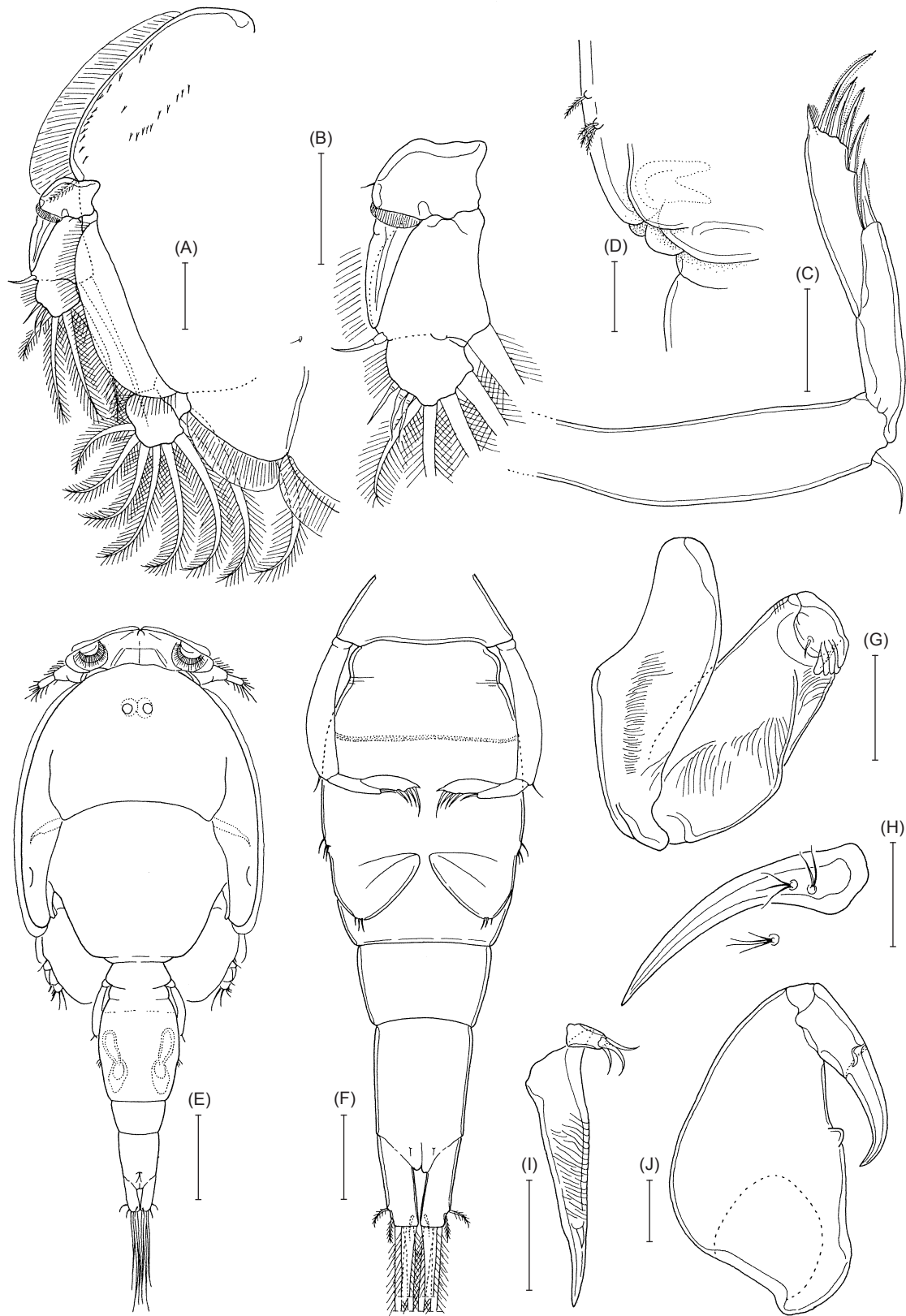


Fig. 8. *Metacaligus rufus* (Wilson), female from Laguna Chelem, Mexico. (A) Leg 3; (B) exopod of leg 3; (C) leg 4; (D) right leg 5 and genital area, ventral. Male: (E) habitus, dorsal; (F) urosome, ventral; (G) antenna; (H) postantennary process; (I) maxilla; (J) maxilliped. Scale bars: A-D, G-J = 0.1 mm; E = 0.5 mm; F = 0.2 mm.

segment armed with 27 setae on anterodistal surface; distal segment armed with 2 inner subterminal setae and 10 setae of different lengths plus 2 aesthetascs on distal margin.

Antenna (Fig. 7D) 3-segmented; proximal segment with curved basal spiniform process. Middle segment unarmed; distal segment with claw bearing 2 small setae on both basal and middle surfaces. Postantennal process rudimentary, represented by small sclerotization (Fig. 7D) with 2 papillae bearing 2 and 3 setules, respectively; another papilla nearby on sternum with 3 setules. Maxillule (Fig. 7D) comprising elongate, distally acute process with proximal papilla bearing 3 short setae.

Maxilla (Fig. 7D) 2-segmented, lacertus unarmed; slender brachium with subterminal flabellum on inner margin, calamus about 1.5-times as long as canna.

Maxilliped (Fig. 7C) 3-segmented; 1st segment (corpus) expanded proximally but gradually narrowed distally; 2nd segment (shaft) short and unarmed; 3rd segment forming strongly curved claw. Sternal furca absent.

Armature on rami of legs 1-4 as follows (Roman and Arabic numerals respectively indicating spines and setae):

| | Exopod | Endopod |
|-------|-------------------|-------------|
| Leg 1 | 1-0; III, I, 3 | (vestigial) |
| Leg 2 | I-1; I-1; I, I, 5 | 0-1; 0-2; 6 |
| Leg 3 | I-0; I-1; III, 4 | 0-1; 6 |
| Leg 4 | I-0; I, III | (absent) |

Leg 1 (Fig. 7E) bearing coxa with papilla on outer margin carrying 2 setules; basis with long plumose outer and short plumose inner setae; vestigial endopod represented by small, bifurcate process; 1st segment of exopod with row of spinules on inner margin and short outer distal spiniform seta. Middle two of 4 terminal elements on distal segment of exopod about 1/2 length of outer terminal element; innermost one of these 4 elements long and naked.

Leg 2 (Fig. 7F, G) basis with small, naked, outer seta and medial papilla bearing short setule; both outer and medial margins of basis fringed with marginal membrane; similar membrane on outer margin of 1st exopodal segment; outer exopodal spines on 1st and 2nd segments of similar length. Leg 3 as in figure 8A and 8B, leg 4 as in figure 8C.

Leg 5 (Fig. 8D) represented by 2 papillae, proximalmost bearing 1 short seta, the other with

3 short setae on posterolateral margin of genital complex.

Male: Body (Fig. 8A) 3.59 mm long excluding setae on caudal rami. Cephalothoracic shield longer (2.03 mm) than wide (1.47 mm). Fourth pediger wider than long. Genital complex (Fig. 8F) 1.48-times longer than wide, with transverse line of sclerotization on anterior 1/3 of ventral surface. Abdomen 2-segmented; anal somite 1.16-times as long as wide and 1.41-times as long as 1st abdominal somite. Caudal ramus 0.215 mm long, 0.07 mm wide (ratio 2.95: 1) and armed as in female. Antenna as in figure 8G. Postantennary process (Fig. 8H) large and elongate. Maxillule as in figure 8I. Maxilliped (Fig. 8J) with small papilliform process in middle of inner margin of 1st segment.

Remarks: This species has not been re-described since its original description which was made from a catfish host *Bagre marinus* (Wilson 1908). The type locality is Beaufort, NC, USA. Ho and Bashirullah (1977) incorporated this species in *Metacaligus*. Female specimens from Chelem are smaller (3.25-3.79 mm) than the type specimens from North Carolina (4.4 mm) (Wilson 1908). Appendages in individuals from Chelem are as originally described except for a shorter flabellum on the maxillary brachium, that barely reaches the distal margin of the segment (Fig. 7D), whereas it appears to be more strongly developed in the type specimens (Wilson 1908, fig. 18), as its distal end clearly extends beyond the terminal margin of the segment.

DISCUSSION

Interesting work by Venmathi Maran and Ohtsuka (2008) provides evidence that finding adult stages of caligiform copepods among plankton is far from rare. Documented cases of species recorded mainly or only from the plankton were reported from different geographic regions. It is interesting to mention that the teleost hosts of at least 5 species of *Caligus* (Venmathi Maran and Ohtsuka 2008) are still unknown. One of these is *C. undulatus*, herein recorded for the 1st time in the Northwestern Tropical Atlantic and in Mexican waters; the question of how this species reached the Americas is still open, but it was probably introduced by aquaculture activities as have other Asian fish parasites (Suárez-Morales et al. 2010). In Chelem, males of this species were recorded during 2 distinct seasons, thus suggesting that they

are in the water column year round in this system. Their distribution is probably related to that of their potential hosts but also to environmental factors which affect the general zooplankton community, such as salinity, as was observed in various estuarine systems (Hwang et al. 2010). There have been no parasitological surveys of the fish in Chelem Lagoon; such a study would probably provide more information about the caligid fauna of this lagoon and also determine if there is a local fish host for this species.

The genus *Metacaligus* now has 2 representatives in Middle America, *M. yucatanensis*, and *M. rufus*, both recorded from Chelem; other species known in the Americas are *M. uruguayensis*, distributed in South America (Uruguay, Venezuela, and Brazil) and *M. rufus* also known from Brazil (Takemoto and Luque 2002). *Metacaligus unguidentatus* (Rangnekar and Murti, 1950) was only recorded in Chinese and Arabian waters (Shen 1957, Pillai and Lal Mohan 1967). Except for *M. yucatanensis*, teleost hosts are known for most species of *Metacaligus*, as follows: *Metacaligus uruguayensis* from *Trichiurus haumela*, *Tri. lepturus*, *Tri. savala*, and *Trichiurus* sp. (Trichiuridae); *M. unguidentatus* from *Tenualosa reevesi*, *Ten. toli* (Clupeidae); *M. latus* from *Tri. lepturus* (Ho and Lin 2004a, Takemoto and Luque 2002), and *M. rufus* with a wide variety of teleost hosts in the western Atlantic (Wilson 1908, Cressey 1991, Luque and Tavares 2007). In the Gulf of Mexico and Florida subregion, it was found as a parasite of 2 species that are known to occur at Chelem: *Eucinostomus gula* (Quoy and Gaimard) and *Lagodon rhomboides* (Linnaeus) (Cressey 1991). In Chelem; however, hosts of the other caligids found in the plankton remain unknown.

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REFERENCES

- Boxshall GA, SH Halsey. 2004. An introduction to copepod diversity. London: The Ray Society.
- Cressey R. 1991. Parasitic copepods from the Gulf of Mexico and Caribbean Sea, III. *Caligus*. *Smithson. Contrib. Zool.* **497**: 1-52.
- Escamilla JB, E Suárez-Morales. 1999. Lista preliminar de copépodos (Crustacea) de la laguna de Chelem y aguas marinas adyacentes, Yucatán, México. Invierno 1988/99. *Rev. Centr. Grad. Invest. Inst. Tecn. Mérida Mex.* **37**: 31-38.
- Escamilla JB, U Ordóñez-López, E Suárez-Morales. 2011. Spatial and seasonal variability of *Acartia* (Copepoda) in a tropical coastal lagoon of the southern Gulf of Mexico. *Rev. Biol. Mar. Oceanogr.* **46**: 124-136.
- Escamilla JB, E Suárez-Morales, R Gasca. 2001. Distribución del zooplancton durante flujos de marea opuestos en el complejo lagunar de Chelem, Yucatán, México. *Rev. Biol. Trop.* **49**: 47-52.
- Hernández-Vázquez T. 2002. Estructura de la comunidad y ensamblaje de peces juveniles, en la laguna de Chelem, Yucatán (nortes - secas). Bachelor thesis, Escuela de Biología, Univ. Autónoma de Puebla, Puebla, Mexico.
- Ho Js, AKM Bashirullah. 1977. Two species of caligid copepods (Crustacea) parasitic on marine fishes of Venezuela, with discussion of *Metacaligus* Thomsen, 1949. *J. Nat. Hist.* **11**: 703-714.
- Ho Js, CL Lin. 2002. New species of *Metacaligus* (Caligidae, Copepoda) parasitic on the cutlassfish (*Trichiurus lepturus*) of Taiwan, with a cladistic analysis of the family Caligidae. *Zool. Sci.* **19**: 1363-1375.
- Ho Js, CL Lin. 2004a. Sea lice of Taiwan (Copepoda: Siphonostomatoida: Caligidae). Keelung, Taiwan: Sueichan Press.
- Ho Js, CL Lin. 2004b. *Caligus planktonis* Pillai (Copepoda, Siphonostomatoida) parasitic on the large scale mullet of Taiwan. *Crustaceana* **76**: 1201-1209.
- Ho Js, WC Liu, CL Lin. 2011. Six species of the Lernanthropidae (Crustacea: Copepoda) parasitic on marine fishes of Taiwan, with a key to 18 species of the family known from Taiwan. *Zool. Stud.* **50**: 611-635.
- Hwang JS, R Kumar, CW Hsieh, AY Kuo, S Souissi, MH Hsu et al. 2010. Patterns of zooplankton distribution along the marine, estuarine, and riverine portions of the Danshuei ecosystem in northern Taiwan. *Zool. Stud.* **49**: 335-352.
- Kabata Z. 1972. *Caligus chelifera* Wilson, 1905 (Copepoda: Caligidae), with a description of the male. *Proc. Biol. Soc. Wash.* **85**: 389-398.
- Luque JL, LER Tavares. 2007. Checklist of Copepoda associated with fishes from Brazil. *Zootaxa* **1579**: 1-39.
- Montú M. 1982. Alguns copépodos parasitas de peixes do sul do Brasil. *Arch. Biol. Tecnol. Curitiba* **25**: 329-339.
- Pillai NK. 1966. Notes on copepods parasitic on South Indian marine fishes. *J. Mar. Biol. Assoc. India* **8**: 123-140.
- Pillai NK, RS Lal Mohan. 1967. Description of the male of *Caligus hilsae* Shen (Copepoda, Caligidae). *Crustaceana* **13**: 45-50.
- Rangnekar PG, NN Murti. 1950. A new caligid copepod parasitic on the fish *Clupea toli*. *J. Univ. Bombay* **18**: 21-28.
- Shen CJ. 1957. Parasitic copepods from fishes of China. II. Caligoida, Caligidae 1. *Acta Zool. Sin.* **9**: 351-377.
- Shen CJ, HL Li. 1959. Parasitic copepods from fishes of China. IV. Caligoida, Caligidae (3). *Acta Zool. Sin.* **11**: 12-20.
- Suárez-Morales E, JB Escamilla. 1997. An undescribed monstrolloid copepod (Copepoda: Monstrolloida) from the northern Yucatan Peninsula, Mexico. *Bull. Mar. Sci.* **61**: 539-548.
- Suárez-Morales E, JB Escamilla. 2001. Taxonomic report on some monstrolloids (Copepoda: Monstrolloida) from southeastern Mexico with the description of a new species of *Monstrilla*. *J. Nat. Hist.* **35**: 1433-1445.

- Suárez-Morales E, IH Kim, JB Escamilla. 2003. An illustrated record and complementary description of *Caligus rufimaculatus* Wilson (Copepoda, Siphonostomatoida) from Mexico. *Carib. J. Sci.* **39**: 151-154.
- Suárez-Morales E, IH Kim, I López-Salgado. 1998. An illustrated record and range extension of *Caligus chelifera* Wilson (Copepoda: Siphonostomatoida) in the Gulf of Mexico. *Gulf Res. Rep.* **10**: 57-60.
- Suárez-Morales E, A Paredes-Trujillo, D González-Solís. 2010. Three endangered Neotropical cichlid teleosts, hosts of the Asian parasitic copepod *Neoergasilus japonicus* (Harada) (Cyclopoida: Ergasilidae). *Zool. Sci.* **27**: 851-855.
- Takemoto RM, JL Luque. 2002. Parasitic copepods on *Oligoplites* spp. (Osteichthyes, Carangidae) from the Brazilian coastal zone, with the redescription of *Tuxophorus caligodes* Wilson, 1908 (Siphonostomatoida, Tuxophoridae). *Acta Sci. Maringá* **24**: 481-487.
- Venmathi Maran BA, S Ohtsuka. 2008. Descriptions of caligiform copepods in plankton samples collected from East Asia: accidental occurrences or a new mode of life cycles? *Plankt. Benthos Res.* **3**: 202-215.
- Wilson CB. 1905. North American parasitic copepods belonging to the family Caligidae. Part I. Caliginae. *Proc. US Nat. Mus.* **31**: 479-672.
- Wilson CB. 1908. North American parasitic copepods. New genera and species of Caliginae. *Proc. US Nat. Mus.* **33**: 593-627.