

## A new species of *Cymbasoma* (Crustacea: Copepoda: Monstrilloida) from the Pacific coast of Costa Rica, Central America

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*Abstract.*—A new species of monstrilloid copepod belonging to the genus *Cymbasoma* Thompson is described from a female specimen collected in Bahía Culebra, an embayment on the Pacific coast of northwestern Costa Rica, in Central America. The new taxon, *C. concepcionae*, n.sp., is part of a group of species of *Cymbasoma* with a fifth leg represented by a single lobe armed with three setae. An overall comparison of this morphological group is presented. The new species is distinguished mainly by a combination of characters including a short inner seta on the fifth leg, a slightly globous genital double somite, and transverse cuticular striations nearly encircling the cephalic area. Moreover, the species can be easily recognized by a distinctive cluster of rounded cuticular processes on the middle ventral margin of the fifth pedigerous somite and on the anterior half of the genital double somite. The intercoxal sclerite of the first swimming leg shows a peculiar ornamentation not previously described within the group. This is the first record of a monstrilloid copepod species from marine waters of Costa Rica and of Central America, and the fourth species of *Cymbasoma* recorded from the Eastern Tropical Pacific.

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Monstrilloid copepods are parasitic crustaceans known mainly by their planktonic, non-feeding adult stage. These usually rare copepods are collected mainly in zooplankton surveys of coastal-neritic systems at all latitudes. The order is represented currently by over 100 nominal species contained in three valid genera: *Monstrilla* Dana, *Monstrillopsis* Sars, and *Cymbasoma* Thompson (Huys & Boxshall 1991, Grygier 1994).

*Cymbasoma* is a diverse genus with more than 40 nominal species; its species are distributed world-wide. Most of these species have been reported from either the Eastern Atlantic or the Far East (Razouls 1996). To date three species, *C. californiense* Suárez-Morales, 1999, *C. rigidum* Thompson, 1888, and *C. tumorifrons* Isaac, 1974, are known to occur in tropical waters of the

Eastern Pacific (Suárez-Morales & Alvarez-Silva 2001). Suárez-Morales & Alvarez-Silva (2001) predicted that the regional list of Monstrilloida recorded for the Eastern Tropical Pacific would increase, most likely from the coastal, near-shore environments where monstrilloid copepods are more frequently collected.

As part of a survey of the coastal areas along the northern Pacific coastline of Costa Rica, in Central America, zooplankton samples were collected in Bahía Culebra, a deep embayment that is part of the Gulf of Papagayo. A taxonomic analysis of the zooplankton samples revealed the presence of an undescribed species of monstrilloid copepod belonging to the genus *Cymbasoma*, which is described and illustrated here, following the current description standards set

by Grygier & Ohtsuka (1995) for monstrilloid copepods.

### Systematics

Order Monstrilloida Sars, 1903

Family Monstrillidae Giesbrecht, 1892

Genus *Cymbasoma* Thompson, 1888

*Cymbasoma conceptionae*, new species

(Figs. 1–3)

*Material examined*.—Holotype: adult female from Bahía Culebra, Costa Rica, undissected, ethanol-preserved. Date of collection: 6 November 1999. Vial deposited in the Collection of Zooplankton at El Colegio de la Frontera Sur (ECOSUR), in Cheatumal, Mexico (ECHOCH-Z-01211).

*Etymology*.—The new species honors Mrs. Concepción Morales, mother of the first author (ES-M).

*Type locality*.—Bahía Culebra (10°36'17.0"N, 85°39'36.6"W), northern part of the Pacific coast of Costa Rica; depth of collection: near surface.

*Habitat*.—Bahía Culebra is located within the Gulf of Papagayo, in the northwestern part of the Pacific coast of Costa Rica. It is a deep (35 m average depth), relatively small (20 km<sup>2</sup>), semi-enclosed embayment. Bahía Culebra is influenced by seasonal variations of the coastal current flowing northward off Costa Rica. Because of wind influence, relatively intense coastal upwelling has been reported in the area (Glynn et al. 1983). The bay has a sandy bottom and scattered patches of coral reef (Jiménez 1998). The mean sea surface temperature in the area is 27.5°C.

*Description*.—Female: Total body length of holotype: 1.5 mm measured from anterior end of cephalothorax to posterior end of anal somite. Cephalothorax measuring 0.95 mm, representing almost 61% of total body length (Fig. 1A, B). Oral papilla protuberant (Fig. 1E), located ventrally a quarter the length of cephalothorax (Fig. 1B). Pair of ocelli present, pigment cups joined medially, well developed, weakly pigmented in central portion, round in dorsal view

(Fig. 1A, F). Cephalothorax with irregularly arranged cuticular protuberances on “forehead” (Fig. 1A, D); sensilla not observed in this area. Longitudinal and oblique cuticular ridges overlying part of region of ocelli on dorsal surface; ridges stretch dorsally and end in a transverse pattern (Fig. 1F). Two pairs of nipple-like processes on anterior ventral surface; anterior pair larger, eccentrically conical in shape, small pair regularly concentric (Fig. 1C, D). Other ventral cuticular ornamentation including pair of mammiform processes on anterior surface between bases of antennules (Fig. 1D) and wide zone of transverse ridges covering most of the surface between the oral papilla and small nipples (Fig. 1A, B, D, E); dorsal and ventral transverse ridge zones at same level, but discontinuous on lateral surfaces.

Antennule length 0.25 mm, relatively short, less than 14% of total body length, and 22% as long as cephalothorax. Antennules four-segmented, armed with 0-I; 1-V; 2-I; 8-VIII setae (Arabic numerals) and spines (Roman numerals) (Fig. 2D, E). In terms of pattern described by Grygier and Ohtsuka (1995) for female monstrilloid antennular armature, setae (Roman numerals) and spines (Arabic numerals), element 1 present on first segment; elements on second segment: 2d<sub>1</sub>, 2d<sub>2</sub>, 2v<sub>1</sub>, 2v<sub>2</sub>, 2v<sub>3</sub>, and IId. Third segment with elements 3, IIIId, and IIIv. Segment four bearing element 4v<sub>1</sub>, particularly well developed, asymmetrical, longer on left antennule (Fig. 2D, E); elements 4d<sub>1,2</sub> and 4v<sub>1-3</sub> present, poorly developed, setae IVd, IVv, Vd, Vv, and Vm present. Element 5 absent. Subterminal elements b<sub>1-6</sub> and 6aes, 6<sub>1</sub>, and 6<sub>2</sub> present; 6aes larger on left antennule. Aesthetasc 4aes well developed, on ventral surface (Fig. 2D, E).

First pedigerous somite, fused to cephalothorax, and succeeding three free pedigerous somites each bearing a pair of biramous swimming legs. Pedigerous somites 2–4, together accounting for 21% of total length in dorsal view. Swimming legs 1–4

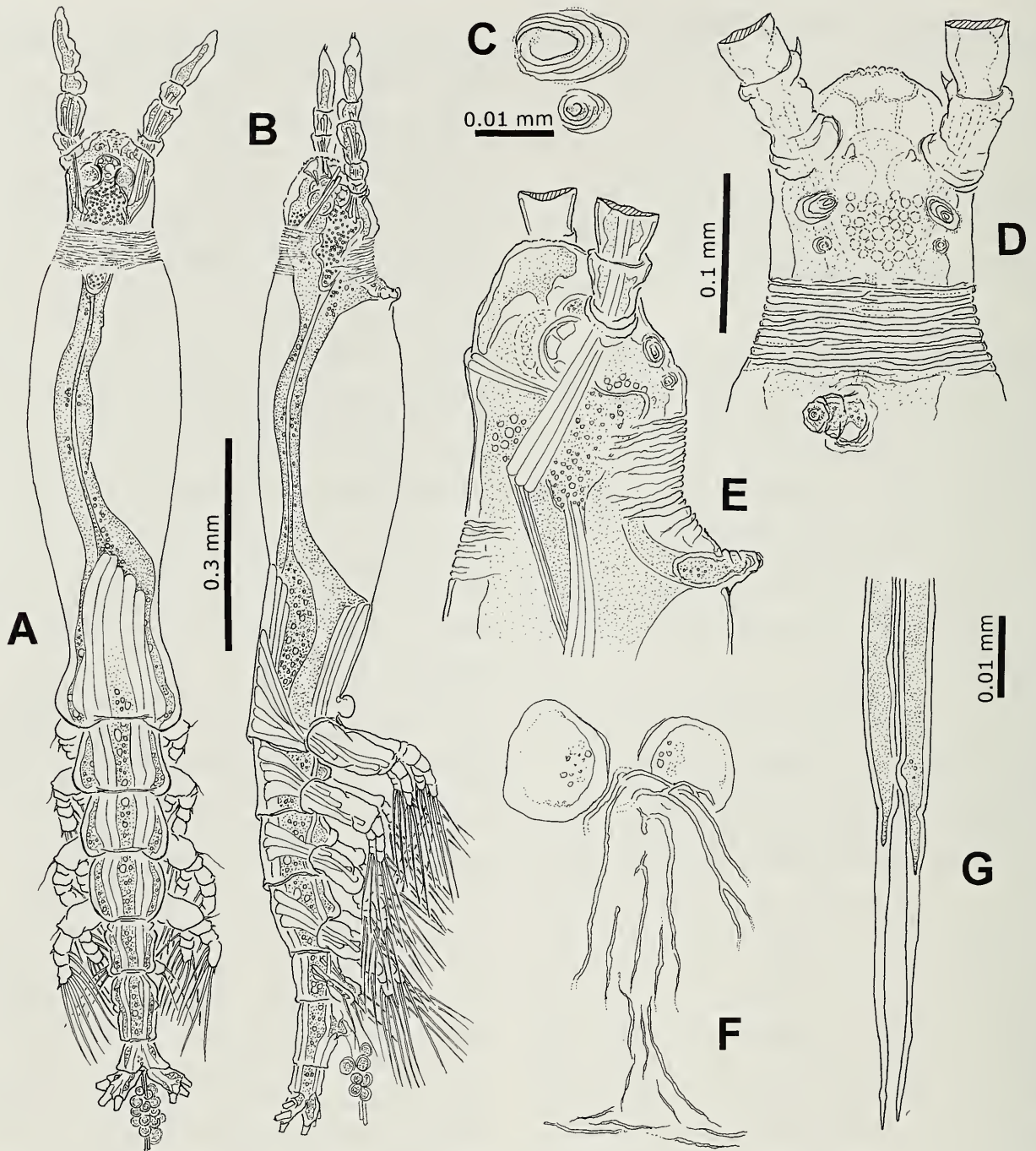


Fig. 1. *Cymbasoma concepcionae*, new species. adult female, holotype from Bahía Culebra, Costa Rica. A. habitus, dorsal; B. habitus, lateral; C. detail of ventral nipple-like processes; D. cephalic area showing ventral cuticular processes; E. cephalic area, lateral view; F. cuticular ridges on dorsal surface posterior to ocelli; G. distal ends of ovigerous spines, ventral.

Table 1.—Armature formula of swimming legs 1–4 of *Cymbasoma concepcionae*, new species. Symbols to left of dash are lateral elements, symbols to right of dash are medial elements; semicolons represent arthrodistal membranes of rami; commas separate lateral, terminal, and medial elements on the distal segment of a ramus; Roman numerals are thicker, rigid elements; Arabic numerals are thinner, flexible elements.

	Coxa	Basis	Endopodite	Exopodite
leg 1	0-0	1-0	0-1; 0-1; 1, 2, 2	I-1; 0-1; I, I+1, 2
leg 2	0-0	1-0	0-1; 0-1; 1, 2, 2	I-1; 0-1; I, I+1, 3
leg 3	0-0	1-0	0-1; 0-1; 1, 2, 2	I-1; 0-1; I, I+1, 3
leg 4	0-0	1-0	0-1; 0-1; 1, 2, 2	I-1; 0-1; I, I+1, 3

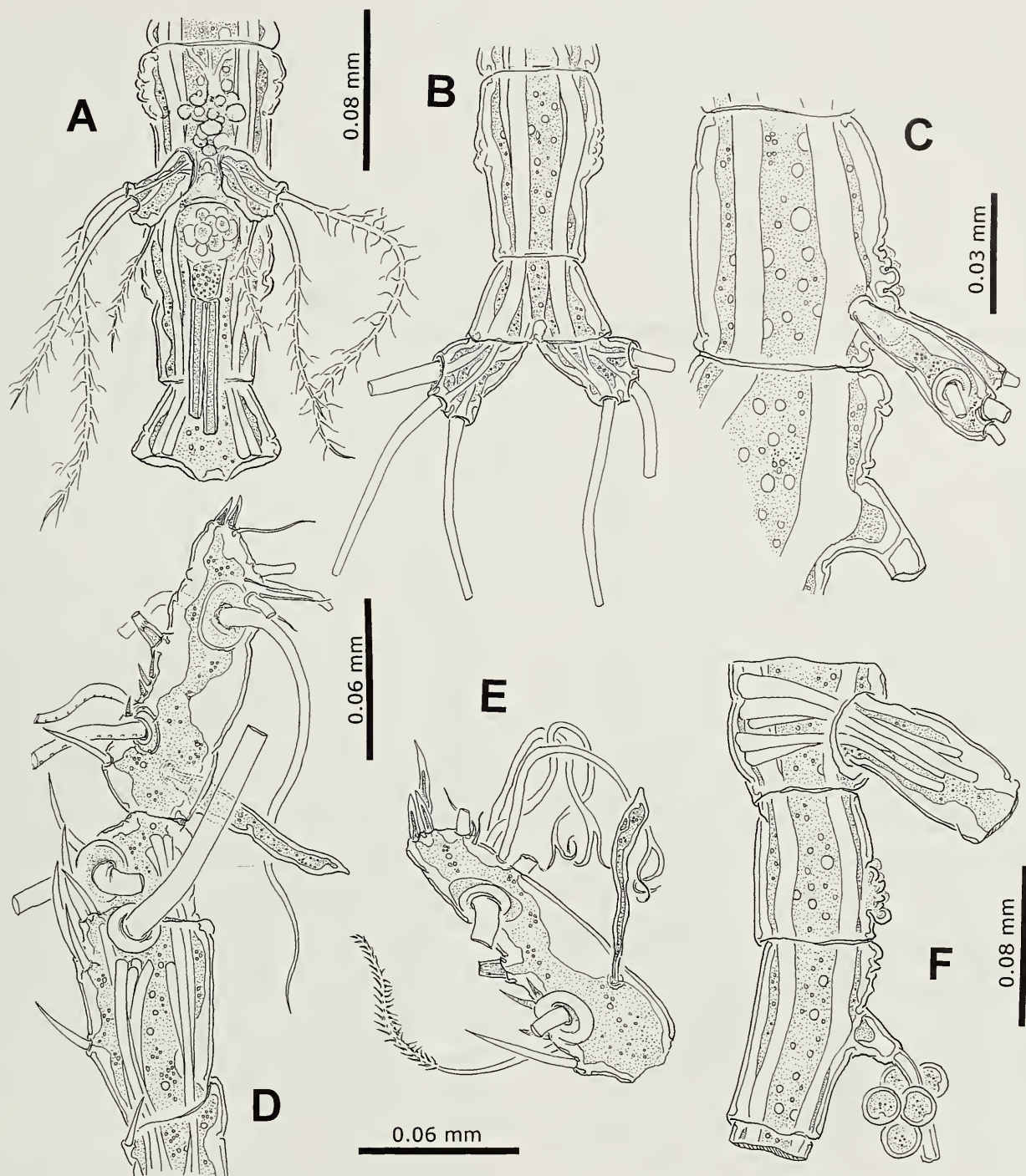


Fig. 2. *Cymbasoma conceptionae*, new species, adult female, holotype from Bahía Culebra, Costa Rica. A. urosome and fifth legs, ventral view; B. genital double somite and anal somite plus caudal rami, dorsal; C. fifth pediger and anterior part of genital double somite, lateral; D. right antennule, dorsal; E. distal segment of left antennule, ventral; F. third free pediger and urosome, lateral view, protoendopod of fourth legs shown, fifth legs omitted to show ventral cuticular processes, caudal rami cut short.

slightly increasing in size posteriorly (Fig. 3A–D), but their intercoxal sclerites decrease in size posteriorly. Intercoxal sclerite of leg 1 with pair of longitudinal semi-cylindrical processes covered with short setae and flanking hairy medial depression. Posterior margin of this intercoxal sclerite flat

at middle, with rounded processes on each side (see Fig. 3E). Intercoxal sclerites of legs 2–4 rectangular, without ornamentation on surface or on posterior margin (Fig. 3F). Basis of legs articulating with large, rectangular coxa along diagonal arthrodistal membrane. Basis with hair-like lateral seta

Table 2.—Comparison of selected taxonomic features in species of *Cymbasoma* with uriramous fifth leg armed with three setae. GDS = anterior half genital of double somite globose; IS = inner seta of 5th leg smallest; IS <50% = inner seta <50% as long as others; L = longest seta on leg 5; OP on CT = position of oral papilla on cephalothorax; A1/CT = relative length (as a percent) of antennule to cephalothorax; = relative length (as a percent) of position of oral papilla anteriorly on cephalothorax; T = transverse striations on “neck” area. Key to species: (A) *C. conceptionae*, new species; (B) *C. reticulatum* Giesbrecht, 1892; (C) *C. bowmani* Suárez-Morales, 1998; (D) *C. quintanarooense* (Suárez-Morales, 1994) (Suárez-Morales & Escamilla 2001); (E) *C. boxshalli* (Suárez-Morales, 1993) (Suárez-Morales 20001a); (F) *C. bali* Desai & Krishnaswamy, 1962; (G) *C. frondipes* Isaac, 1975; (H) *C. striatum* (Isaac, 1974) (Suárez-Morales 2000); (I) *C. claparedi* Giesbrecht, 1892; (J) *C. tumorifrons* Isaac, 1975.

	A	B	C	D	E	F	G	H	I	J
GDS	yes	no	no	yes	yes	no	no	yes	no	yes
IS	yes	no	yes	no	yes	no	yes	yes	no	yes
IS <50%	no	no	no	no	yes	no	no	yes	no	no
L	outer	none	none	none	outer	middle	none	none	none	outer
OP on CT	23	20–25	15	28	18–20	17	?	18	14	25
A1/CT	22	27–30	23	32	22	27	21	33	29	31
OP/TL	43	89	42	47	42	41	?	34	49	36
T	yes	no	no	no	no	?	?	yes	no	yes

on legs 1–4 (Fig. 3A–D); on leg 3, this seta about 4.5 times longer, lightly setulated from distal half, and slightly thicker than those on the other legs (see Fig. 3C). Endopodites and exopodites of swimming legs 1–4 triarticulated. Ramal setae biserially plumose except spiniform outer seta on exopod 1 and 3, and inner seta of first exopodal segment, these latter being short and sparsely setulated (Fig. 3A–D). Also, outermost apical exopodal setae of swimming legs 1–4 with inner margin naked, outer margin lightly spinulose to tip (Fig. 3A–D). Armature of swimming legs in Table 2.

Fifth legs separated at base, unsegmented, each consisting of relatively large, lobe-like expod (Fig. 2A); 3 setae present, outer 25% longer than terminal; inner seta narrower and shorter, about 50% as long as outer seta. All 3 setae with sparse, biserial setules (Fig. 2A).

Urosome of 3 segments: fifth pedigerous somite, genital double somite and free anal somite. Fifth pedigerous somite with a group of rounded protuberances along middle ventral margin between fifth legs lobes (Fig. 2C, F). Genital double somite relatively large, ratio of its length and anal somite: 69.5:30.5 = 100; anterior half expanded laterally, expansion visible in both

ventral (Fig. 2A) and dorsal (Fig. 2B) views, with rounded protuberances along lateral margins of expanded anterior half. Anterior half of ventral surface of genital double somite with similar protuberances as those on fifth pedigerous somite anterior to base of ovigerous spines. Ovigerous spines paired, relatively long (0.65 mm), unbroken, inserted in a protuberant base visible in lateral view (Fig. 2F), separated at base, equalling almost 43% of total body length; adhering eggs covered by gelatinous sheath. Tips of both spines separated from each other, with slight but distinct subterminal narrowing (Fig. 1G).

Caudal rami subrectangular, widely divergent, approximately 1.5 times longer than wide, each bearing 3 well developed setae, all of almost the same length (0.23–0.30 mm) and width.

*Male*.—unknown.

*Remarks*.—The absence of a reliable way to associate females with conspecific males is one of the main problems with the taxonomy of the Monstrilloida, a result of the complex life cycle of these parasitic copepods (see Suárez-Morales 2001b). As is the case of many other monstrilloids (see Suárez-Morales 1993, Suárez-Morales & Dias 2001), *C. conceptionae* is known only from

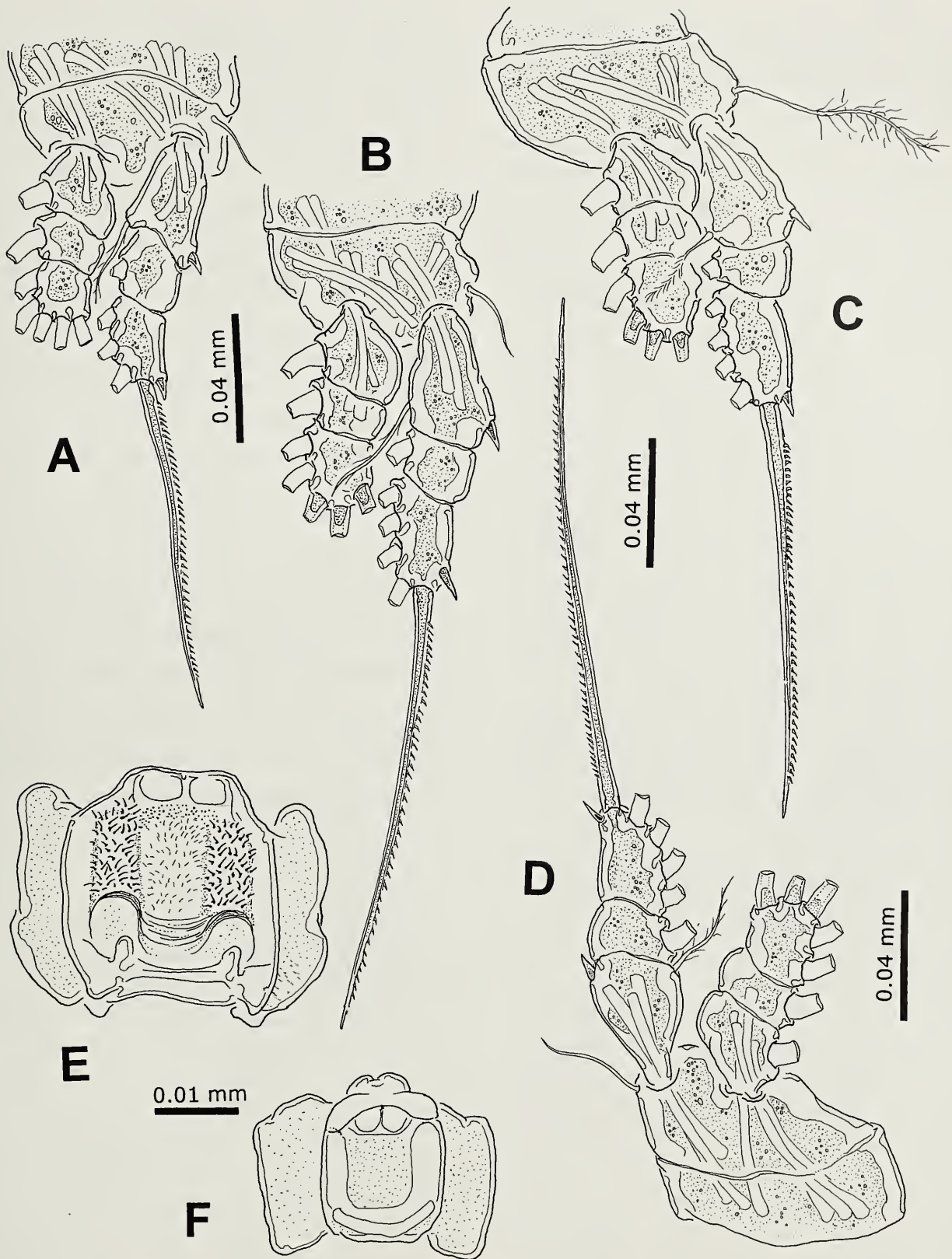


Fig. 3. *Cymbasoma conceptionae*, new species, adult female, holotype from Bahía Culebra, Costa Rica. A. first swimming leg, anterior view, most swimming setae cut short; B. second leg, anterior view, ditto; C. third swimming leg, anterior view, ditto; D. fourth swimming leg, anterior view, ditto; E. intercoxal sclerite, first swimming legs; F. intercoxal sclerite, fourth swimming legs.

the female, and from a single specimen, the common case with monstilloids (Suárez-Morales and Palomares-García 1995, Suárez-Morales 2000).

The new species described here is placed in the genus *Cymbasoma* because of the presence of two urosomites, or only one free somite posterior to the genital double somite, in the female (Isaac 1975, Grygier 1994). Following the most widely used key to the species of this genus (Isaac 1975), and considering a non-striated cephalic segment option in the third couplet, the new species would match (in part) the female of either *C. tumorifrons* (Isaac, 1975) or *C. claparedi* (Giesbrecht, 1892), both found in the Eastern Atlantic. These two species also are members of a group of *Cymbasoma* with a single-lobed fifth leg armed with three setae; the group includes *C. striatum* (Isaac, 1974), *C. frondipes* Scott, 1904, *C. reticulatum* (Giesbrecht, 1892), *C. bali* Desai and Krishnaswamy, 1962, *C. bowmani* Suárez-Morales, 1998 (see Suárez-Morales & Gasca 1998), *C. boxshalli* (Suárez-Morales, 1993), and *C. quintanarooense* (Suárez-Morales, 1994).

The presence of rounded protuberances on the ventral surface of the fifth pedigerous somite and genital double somite of *Cymbasoma concepcionae* separates it from all other members of this group. *Cymbasoma concepcionae* shares with *C. striatum*, *C. quintanarooense*, and *C. tumorifrons* cephalic cuticular striations and a similar structure and armature of the fifth legs. Although *C. concepcionae* and *C. tumorifrons* are similar in the structure and armature of fifth legs and transverse striations of the cephalic area (see Table 2), they differ in the body proportions, the shape of the cephalothorax, the length of the ovigerous spines, and the shape of the genital double somite, which is strongly globose in *C. tumorifrons* (Table 2 and see Suárez-Morales and Alvarez-Silva 2001). Other important differences include the respective cuticular ornamentation patterns and the distinctive ventral rounded processes present in the

urosome of the new species. The new species can be distinguished from *C. quintanarooense* by the ocelli which are very well-developed and intensely pigmented in the latter (see complementary description by Suárez-Morales and Escamilla 2001) vs. normally developed in *C. concepcionae*. The antennules are relatively longer in *C. quintanarooense* than in *C. concepcionae*, and the oral papilla is in a more posterior position. The three setae of the fifth legs are equal in length and breadth in *C. quintanarooense* vs. a short innermost seta in the new species (see Table 2).

*Cymbasoma concepcionae* differs from *C. striatum* by the latter's peculiar cuticular striation pattern covering almost half the length of its cephalothorax, as redescribed by Suárez-Morales (2000); a strongly globose shaped genital double somite vs. a slightly expanded shape in the new species; an oral papilla 18% along cephalic somite in *C. striatum* vs. 23% in the new species; "forehead" with medial protuberance formed by several irregularly arranged bumps; with a pair of sensillae in *C. striatum* vs. lower cuticular protuberances and no sensillae in the new species; ovigerous spines closely set distally and with subterminal rounded protuberances in *C. striatum* vs. distally separated spines with slight but distinct subterminal narrowing in *C. concepcionae*; and an outer, apical exopodal seta of swimming legs 1–4 with setules in *C. striatum* vs. naked in the new species (Suárez-Morales 2000).

*Cymbasoma frondipes* has a very long cephalothorax (over 66% of the total body length) and characteristically massive, short antennules (see Isaac 1975). *Cymbasoma concepcionae* differs from the remaining species shown in Table 2 by a combination of: an anteriorly weakly globose genital double somite; the inner seta of fifth leg shortest and outer seta longest; and transverse striations around the "neck" area. The taxonomic value of the morphology of the intercoxal sclerites has not been compared among these monstilloids, although

recent descriptions suggest a certain degree of ornamentation (Suárez-Morales and Dias 2001). The contours and setation of the first intercoxal sclerite in *C. conceptionae* is definitely the most complex pattern known for species in the group.

*Cymbasoma conceptionae* is the fourth confirmed species of the genus from waters of the Eastern Tropical Pacific (Suárez-Morales and Alvarez-Silva 2001). This also is the first record of a monstrilloid species in Costa Rica or along the Pacific coast of Central America. More records are to be expected from further examination of the zooplankton samples available from the region.

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