

On the Invalidity of *Strilloma* Isaac (Copepoda: Monstrilloida): Observations from the Type Species

Eduardo Suárez-Morales* and Rebeca Gasca

El Colegio de la Frontera Sur (ECOSUR), Universidad Chetumal, Km. 2 Carr, Chetumal-Bacalar, A.P. 424. Chetumal 77000, Mexico

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Eduardo Suárez-Morales and Rebeca Gasca (2004) On the invalidity of *Strilloma* Isaac (Copepoda: Monstrilloida): observations from the type species. *Zoological Studies* 43(2): 292-299. The genus *Strilloma* was erected by M.J. Isaac in 1974 to contain species of Monstrilloida with 4 abdominal somites instead of 3, as in *Monstrilla* and *Monstrillopsis*, or with 2, as in *Cymbasoma*. This genus was described based on a single specimen of its type species, *S. longa* Isaac, 1974, collected 95 years ago in Florida, USA, and deposited in the Museum für Naturkunde in Berlin. *Strilloma* has been considered invalid by several authors, but the type species has not been reexamined since its description, and there are no concrete morphological data besides the roughly sketched original illustrations. A close examination of the holotype of *S. longa* allowed us to confirm that this species clearly belongs to *Monstrilla*. The partial suture around the genital double somite was misinterpreted as complete segmentation, a character state that is absent in the Monstrilloida; therefore, the 4 species previously assigned to *Strilloma* should be referred to *Monstrilla*, including *Monstrilla scotti* (Isaac, 1975), comb. nov. A complete, upgraded redescription of *Monstrilla longa* (comb. nov.) is presented along with a comparison to other closely related species possessing a relatively long distal antennular segment. <http://www.sinica.edu.tw/zool/zoolstud/43.2/292.pdf>

Key words: Marine zooplankton, *Strilloma longa*, Synonymization, Taxonomy.

Monstrilloid copepods have been surveyed for over a century, but they are one of the least known orders among the Copepoda. Their peculiar life cycle and the incompleteness and shallowness of their descriptions have led to complex taxonomic problems (see Grygier 1994a) and poorly diagnosed taxa even at supraspecific levels (Huys and Boxshall 1991). Currently, there are 3 genera recognized as valid: *Monstrilla* Dana, *Monstrillopsis* Sars, and *Cymbasoma* Thompson (see Huys and Boxshall 1991, Grygier 1994a). Grygier and Ohtsuka (1996) announced a fourth genus but have not yet published its formal description. The genus *Thaumaleus*, widely used by many authors, was proven to be invalid by Grygier (1994b), who concluded that all species described under this genus should be accommodated in *Cymbasoma* except for the type species, *T. typicus* which is assignable to *Monstrilla*. Later on, he made a successful petition to suppress *Thaumatoessa* Krøyer

and conserve *Monstrilla* (Grygier, 1995, International Commission on Zoological Nomenclature 1997). *Strilloma* is yet another monstrillid genus whose validity has been discussed. This genus was proposed by Isaac (1974a) based on a female specimen from the Dry Tortugas, Florida, USA. Its validity was questioned by Huys and Boxshall (1991). The holotype specimen of the type species, *S. longa* Isaac, was reexamined in order to determine its status and consequently that of the genus *Strilloma*. This specimen is deposited at the Museum für Naturkunde, Berlin, Germany. The species is redescribed following upgraded standards (Grygier and Ohtsuka, 1995) and compared with other related forms.

METHODS

The specimen was received from the

*To whom correspondence and reprint requests should be addressed. E-mail: esuarez@ecosur-qroo.mx

Museum für Naturkunde preserved in ethanol. The appendages and setae were stiff and fragile. In order to facilitate the observation process, the specimen was transferred to freshly prepared 70% ethanol with glycerin added and then left in pure glycerin with a drop of methylene blue for 1 wk. This process of mild staining caused all the structures to become clearer under the microscope. The microscope used was a standard Zeiss compound microscope with an attached camera lucida. Drawings were prepared using different magnifications. After the taxonomic examination and handling, the specimen was placed again in ethanol with a drop of glycerin thus causing the methylene blue to fade from the tissues.

RESULTS

Systematics

Order Monstrilloida Sars, 1903

Monstrilla longa (Isaac, 1974a)

(Figs. 1-19)

Strilloma longa - Isaac, 1974a, p. 134, figs. 3A-G.

Strilloma longa - Isaac, 1974b, p. 65, figs. 22A-G.

Material examined. Holotype adult female, ethanol-preserved, undissected. Vial labeled *Monstrilla* sp., VI. 1907. Hartmeyer. Collected in the islands of Dry Tortugas, Florida, eastern coast of the United States (24°48'N - 81°34'W). Specimen deposited at the Museum für Naturkunde, Berlin, Germany. Catalogue no. 13864.

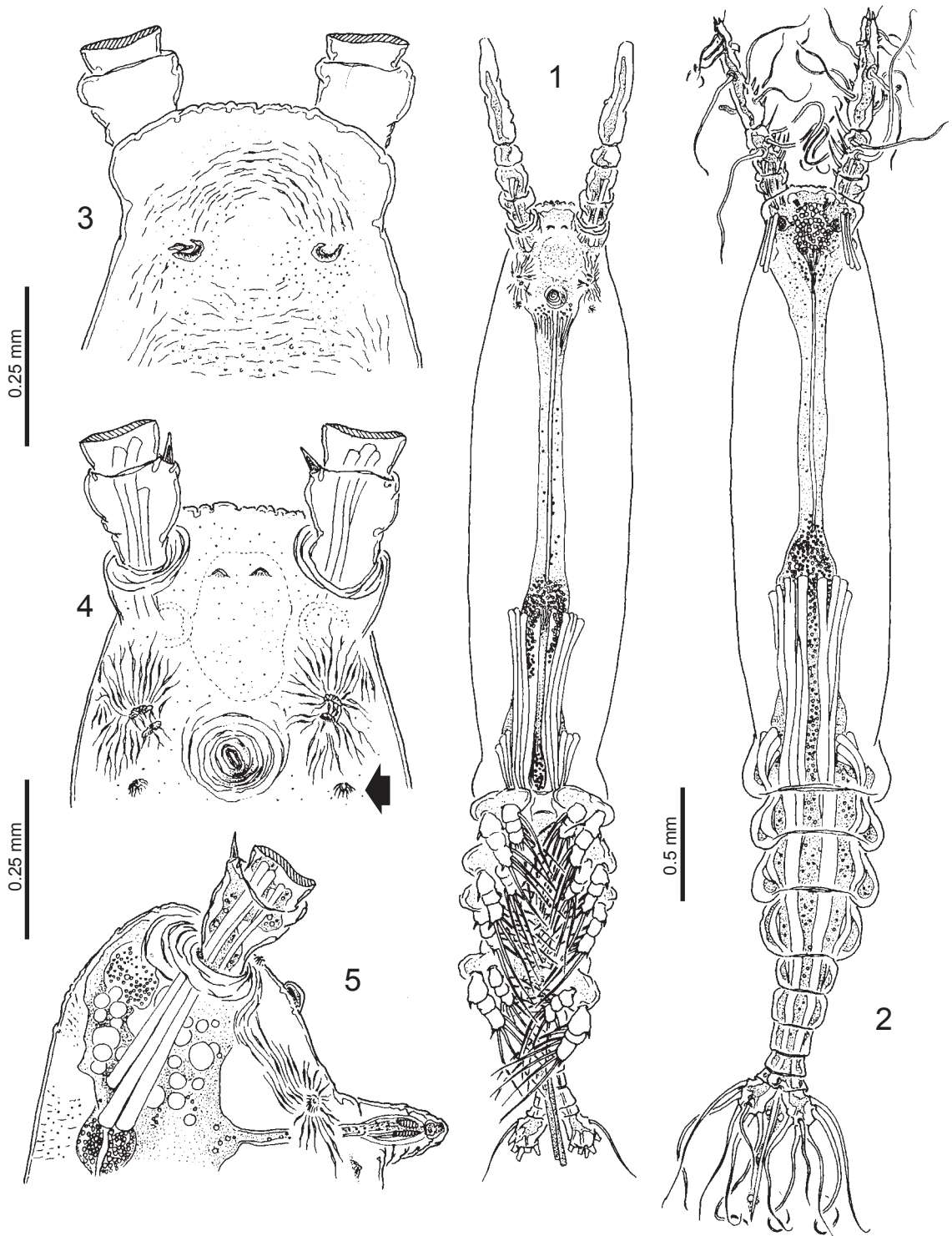
Habitat. The Dry Tortugas consists of a group of small islands, shoals, and reefs located about 117 km west of Key West, Florida. Between this area and Key Largo lies the only living barrier reef ecosystem in the continental US; the reefs are characterized by massive thickets of staghorn coral (Jaap and Hallock 1990). It is an area with extensive (80% coverage) beds of turtle grass (*Thalassia testudinum*). Although the precise site at which this specimen was collected remains unknown, it is safe to assume that it was a shallow, reef-related site, a most suitable habitat for monstrilloids.

Description. Female (holotype). Total body length 3.7 mm. Specimen measured from anterior end of cephalic somite to posterior margin of anal somite. Caudal rami 0.15 mm long. Cephalothorax (incorporating first pedigerous somite) long, relatively slender (Figs. 1, 2), accounting for 66%

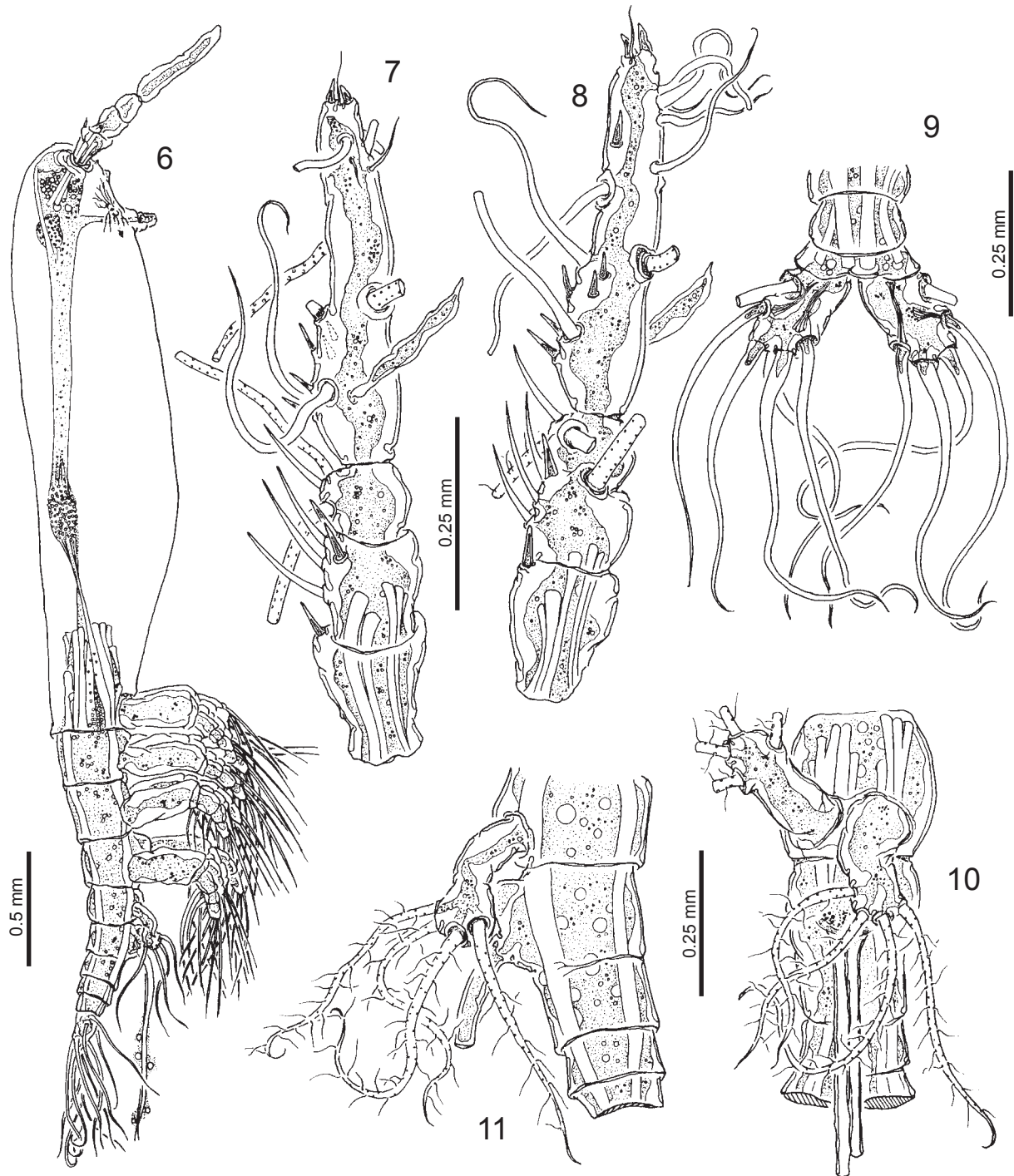
of total body length. Forehead flat in dorsal view, cuticle of forehead moderately coarse, rugose. Antermost part of cephalothorax with ventral and dorsal cuticular ornamentations. Dorsal surface slightly rugose, with semicircular array of striae around ocelli area; pair of vermiform, strongly chitinous dorsal processes near ocelli, possibly muscle insertion points (Fig. 3). Ventral surface of head with low, rounded pair of convex protuberances between bases of antennules, visible in lateral view (Figs. 4, 5); additional midventral conical process visible only in lateral view present anteriorly to convex protuberances (Fig. 5). Two pairs of nipple-like cuticular processes on both sides of oral papilla, processes borne close to each other, both pairs surrounded and connected by field of longitudinal and transverse ridges (Fig. 4). Third pair of nipple-like structures posterior to other 2, smaller, represented by isolated, prominent button surrounded by short, faint concentric ridges (arrow in Fig. 4). Oral papilla distinctly protuberant, located close to anteriormost part of body, midventrally 0.13 of way back along cephalothorax (Figs. 5, 6). Nauplius eye present, weakly developed, ocelli relatively small, widely separated, slightly pigmented, with oblong shape, eyes separated by almost 5 eye diameters.

Antennules relatively long, slender, slightly longer than 20% of total body length, and about 1/3 of length of cephalothorax. Antennule length 0.91 mm. As usual in female monstrilloids, antennule 4-segmented, intersegmental divisions well defined. Last antennular segment longest, representing more than 1/2 length of antennule; ratio of lengths of segments (proximal-distal): 20.7: 15.4: 7.7: 56.2 (= 100). Armature with 0,I; 1,V; 2,I; 10, VIII setae (Roman numerals) and spines (Arabic numerals) (Figs. 7, 8) plus 2 aesthetascs. Following pattern described by Grygier and Ohtsuka (1995) for monstrilloid antennular armature, setae and spines on first (1), second (2d₁₋₂, 2v₁₋₃, IIId), and third (3, IIIv, IIIId) segments complete. Fourth segment with 4v₁₋₃, IVv, IVd, 4d₁₋₂, Vm, Vd, Vv, 5, 6₁, 6₂, 6aes, b₁₋₅, 4aes; missing: b₆ (or at least one of the b-setal group). Setae b₁₋₅ unbranched.

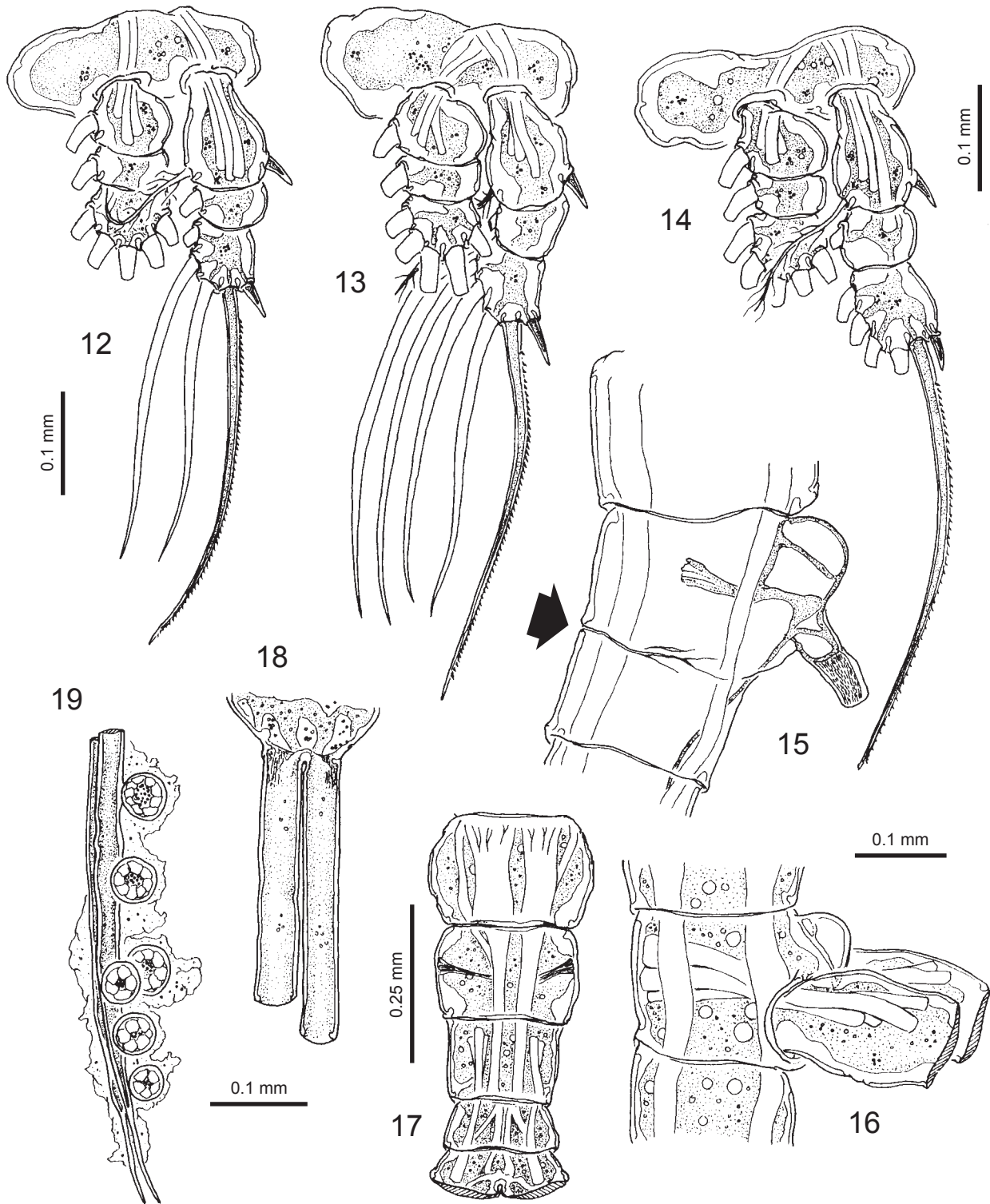
Incorporated first pedigerous somite and 3 free succeeding pedigerous somites each bearing pair of biramous swimming legs. Intercostal sclerite on legs 1-4 rectangular, naked. Basis with diagonal division articulating with large, rectangular coxa. Lateral hair-like setae on basis of legs 1-4 not seen on studied specimen. Natatory legs setae all lightly and biserially plumose.



Figs. 1-5. *Monstrilla longa* (Isaac), adult female, holotype. 1. habitus, ventral view (antennular setae omitted, ovigerous spines and most caudal setae cut short); 2. habitus, dorsal view; 3. head, dorsal view; 4. head, ventral view showing 3rd pair of nipple-like protuberances (arrow); 5. head, lateral view.



Figs. 6-11. *Monstrilla longa* (Isaac), adult female, holotype. 6. habitus, lateral view (antennular setae omitted); 7. left antennule, dorsal view; 8. left antennule, ventral view; 9. first free abdominal, anal somite, and caudal rami with setae (lateral pair of caudal setae cut short); 10. fifth pedigerous somite, genital double somite, first free abdominal somite, and anal somite plus fifth legs (setae of right leg cut short), and bases of ovigerous spines, ventral view; 11. same, lateral view.



Figs. 12-19. *Monstrilla longa* (Isaac), adult female, holotype. 12. first swimming leg, anterior view, protopods greatly foreshortened due to viewing angle; 13. Second swimming leg, anterior view, protopods greatly foreshortened due to viewing angle; 14. fourth swimming leg, anterior, protopods greatly foreshortened due to viewing angle; 15. genital double somite with base of ovigerous spine, showing incomplete suture (arrow); 16. fourth pedigerous somite with protopods of legs, showing broken ventral surface forming protuberance artifact; 17. urosome, dorsal view; 18. base of ovigerous spines; 19. distal part of ovigerous spines with attached eggs.

Endopodites and exopodites of legs 1-4, triarticulated. Third exopodal segment with outermost terminal spiniform seta 4.1 to 4.5 times as long as bearing segment. Setae armed with small spinules along outer margin; inner margin naked (Figs. 12-14). Outer spine on third exopodal segment of swimming legs 1-4 between 52.6% and 90.9% as long as bearing segment. Armature of swimming legs:

	basis	endopodite	exopodite
leg 1	1-0	0-1;0-1;1,2,2	1-1;0-1;1,1,3;
legs 2-4	1-0	0-1;0-1;1,2,2	1-1;0-1;1,1,2,2.

Fifth legs moderately long, 1-segmented, fused medially, each represented by a cylindrical rod armed with 4 long, lightly plumose setae, all subequal in length and breadth, innermost slightly longer. Fifth leg setae reaching distal margin of anal somite; left ramus of legs 5 partially broken and folded upwards in this specimen (Figs. 10, 11).

Fourth pedigerous somite damaged, with torn ventral surface lifted simulating globose protuberance in lateral view (Fig. 16). Urosome consisting of fifth pedigerous somite, genital double somite, and 2 free abdominal somites. Second to fourth pedigers accounting for 18% of total length in dorsal view. Urosome, excluding furcal rami, accounting for 15% of total body length. Genital double somite with partial intersegmental division running around about 1/2 of its circumference and visible in dorsal view; suture absent on ventral surface (Fig. 15). Genital double somite pear-shaped, representing almost 1/2 length of urosome (48%), with anterior half clearly wider than posterior part (Fig. 17); ventral anterior part of somite with rounded protuberance visible in lateral view (Fig. 15). Ratio of lengths of fifth pedigerous somite, genital double somite, and free abdominal somite 20.2: 48.1: 15.6: 16.1 (= 100). Medial ventral part of genital double somite bearing short (0.85 mm), basally separated ovigerous spines (Fig. 18), not swollen but slender at distal 1/5 (Fig. 19); spines representing about 20% of total body length, almost reaching distal ends of caudal setae (Fig. 6). Anal somite with moderately divergent lateral margins. Caudal rami about twice as long as wide, moderately divergent, bearing 6 setae arranged as 2 outer, 2 terminal, 1 inner, and 1 dorsal setae (Fig. 9). Dorsal seta relatively long, more than twice as long as ramus.

Remarks. The specimen studied was in remarkably good conditions for taxonomic examination despite the long time which had elapsed

since its collection in 1907. Most of the antennule elements are present, and the swimming legs and most of their setae are complete. The only missing thoracopodal setae are those on the basipodite external margin, which are commonly very fragile. Most probably, these setae were originally present, showing the usual pattern with the third basipodal seta being longer and stronger than those on the basipodites of legs 1, 2, and 4. Other old specimens of Monstrilloida are usually either badly damaged, broken in 2 or more parts, or their antennular setal armature is lost or incomplete, thus making a comparative study difficult (see Grygier 1994a, Suárez-Morales 2000a). The total length of the specimen (excluding the caudal rami) is 3.7 mm, some 0.5 mm longer than was reported by Isaac (1974a b).

The genus *Strilloma* was erected by Isaac (1974a) to contain species of Monstrilloida with 4 abdominal somites instead of 3, as in *Monstrilla* and *Monstrillopsis*, and with 2, as in *Cymbasoma*. The description was based on the female specimen redescribed herein. *Strilloma* has been considered invalid (Huys and Boxshall 1991), but the type specimen remained unstudied after its description. Hence, this contribution represents the first morphological data subsequent to Isaac's (1974) description and figures. Isaac (1974b 1975) included in this genus several other species described earlier under *Monstrilla* (*M. grandis* Giesbrecht, 1891, *M. lata* Desai & Bal, 1962, and *M. scotti* Scott, 1904). The latter species was based on Scott's (1904) material of supposed *Monstrilla grandis*.

Examination of the type specimen has allowed us to confirm that the type species, *Strilloma longa* (Isaac) in fact clearly belongs to the genus *Monstrilla*. This species is easily placed in the latter genus by the presence of 2 postgenital somites (Isaac 1975) and more than 4 furcal setae. Isaac's (1974b) diagnosis of the genus was in fact quite brief: females with "four abdominal segments". This character is used in his key for the Mediterranean species (Isaac 1975), in which *S. longa* was not included because of it being a western Atlantic species. The original illustrations of *Strilloma longa* show a complete suture around the genital double somite, but in fact this intersegmental division is incomplete (see Fig. 15). It is intriguing that Isaac (1975) did not include in *Strilloma* species with a clear, strong suture around the genital somite, such as *M. longicornis* Thompson, 1890 or *M. conjunctiva* Giesbrecht, 1902; no diagnosis was provided for males. It is not clear how

Isaac determined the limits of the suture extent for sorting the species to be included as *Strilloma* from those to be retained in *Monstrilla*. But it is clear that the author misinterpreted the incomplete fusion of the genital double somite, which is formed by ventral fusion of the genital and a yet undetermined number of abdominal somites; the suture marks the plane of fusion (see Huys and Boxshall 1991). No female monstrilloid retains a fully separated genital somite. The structure of the genital double somite confirms that *Strilloma* is an invalid taxon and should be used no more. The species *M. longa* (comb. nov.), *M. lata*, *M. grandis*, and *M. scotti* (comb. nov.) must remain under the genus *Monstrilla*.

Besides *Monstrilla longa*, several other species of the genus have females with a long cephalothorax (over 60% of the total length) and relatively long antennules. Among these, *M. longa* is most similar to the recently described *M. careli* Suárez-Morales & Dias, 2000. Both species belong to a small group of *Monstrilla* species with the last antennular segment of females representing over 50% of the antennule length and with 4 setae on the fifth leg. This group includes *M. careli*, *M. careloides* Suárez-Morales, 2001, and *M. longa*, which nonetheless differ in several characters (Table 1).

This is the third species of the copepod order Monstrilloida redescribed on the basis of specimens deposited at the Museum für Naturkunde, Berlin, following papers on *M. brevicornis* Isaac,

1974a and *M. javensis* Isaac, 1974a (Suárez-Morales 2000b, Suárez-Morales and Dias 2001).

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Table 1. Comparison of 3 species of *Monstrilla* with distal antennular segment comprising over 50% of antennule length and 4 setae on fifth legs. AI, antennule; TBL, total body length. Data based on Suárez-Morales and Dias (2000) and Suárez-Morales (2001)

Species	<i>M. careli</i>	<i>M. careloides</i>	<i>M. longa</i>
Nipple-like processes	2 pairs	3 pairs	3 pairs
Ventral protuberances between AI bases	Absent	absent	present
Inner lobe on 5th leg	present	absent	absent
Percent length of distal AI segment	55.7%-56.4%	53.1%	56.2%
Genital double somite	barrel-shaped	barrel-shaped	pear-shaped
Preanal/anal somites length ratio	1.5: 1.0	1.0: 1.0	1.0: 1.0
AI/TBL (%)	24.4	16.8	22

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