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# SOME ADDITIONS TO THE MEXICAN FAUNA: THE FAMILY PARAMESOCHRIDAE (COPEPODA: HARPACTICOIDA)

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A B S T R A C T

Sediment samples were taken during a short-term study of the distribution of meiofauna from a coastal lagoon in Sinaloa (northwestern Mexico). Several species of harpacticoids (Copepoda: Harpacticoida) were observed among the taxa recovered. Some of these species are new to science, whereas some others are new records for Mexican brackish systems. Three species of *Apodopsyllus* (Harpacticoida: Paramesochridae) are described herein. One of them, *A. alejandrovillalobosi* sp. nov. proved to be closely related to its northern congener *A. vermiculiformis* known from California and British Columbia. *Apodopsyllus samuelgomezi* sp. nov. and *A. pseudocubensis* sp. nov. constitute new records of the neotropical *arcuatus-chilensis-cubensis* lineage. *Apodopsyllus samuelgomezi* sp. nov. is unique within this clade in the male P6 with two long inner setae. *Apodopsyllus pseudocubensis* sp. nov. was found to be allied to its Cuban relative *A. cubensis*. These two species share the general shape of female P5 and male P6.

A short-term study about the effects of organic enrichment on the distribution and abundance of meiofauna in Ensenada del Pabellón lagoon (northwestern Mexico) was undertaken during 1991 (Gómez-Noguera and Hendrickx, 1997). The analysis of the sediment samples revealed the presence of at least 63 harpacticoid species, most of which are new to science, and only a few of them constituted new records for Mexican brackish systems. The genus *Apodopsyllus* Kunz, 1962, was observed to constitute only a small fraction of the harpacticoids. This genus was found in the less organically enriched areas characterized by sandy bottoms (stations 1, 6, 7, and 14) (see Gómez-Noguera and Hendrickx, 1997). The present contribution deals with the description of three new species of *Apodopsyllus*.

## Materials and Methods

As part of a multidisciplinary project on the distribution of the crustacean fauna from Ensenada del Pabellón lagoon (Sinaloa, northwestern Mexico), quantitative triplicate sediment cores were taken for the analysis of the distribution and abundance of meiofauna (see Gómez-Noguera and Hendrickx, 1997, for more information on the sample processing techniques). Harpacticoids were separated from the rest of the meiofauna using a stereomicroscope at a magnification of 40 ×. The specimens were then stored in 70% ethanol prior to further investigation. Observations and drawings were made from whole and then dissected specimens mounted in glycerin, at 1,000 × and 2,500 × using a Leica microscope equipped with phase contrast and drawing tube. The type material has been deposited in the collection of the Instituto de Ciencias del Mar y Limnología, Mazatlan Marine Station. The terminology proposed by Huys and Boxshall (1991) for the general description was adopted. Abbreviations used in the text and tables: P1–P6, first to sixth swimming leg; EXP, exopod; ENP, endopod. Because the armature formulae of P1–P4 of the species of *Apodopsyllus* are generally alike and do not bear phylogenetic relationships, they are omitted in the description.

## Results

### Family Paramesochridae Lang, 1944
### Subfamily Paramesochrinae Huys, 1987
### Genus *Apodopsyllus* Kunz, 1962

### ***Apodopsyllus alejandrovillalobosi*** sp. nov.
### Figs. 1–4

*Apodopsyllus vermiculiformis* Lang, 1965, *sensu* Gómez, 2001.

*Type Locality*.—Ensenada del Pabellón lagoon, Sinaloa, México (24°19′–24°35′N, 107°28′–107°45′W).

*Type Material*.—One female holotype mounted onto two slides (EMUCOP-020591–24) and one whole mounted male allotype (EMUCOP-020591–29), three dissected female paratypes (EMUCOP-020591-22, EMUCOP-020591-23, EMUCOP-020591-25), and one dissected (EMUCOP-020591-26) and three (EMUCOP-020591-27, EMUCOP-020591-28, EMUCOP-020591-30) whole mounted male

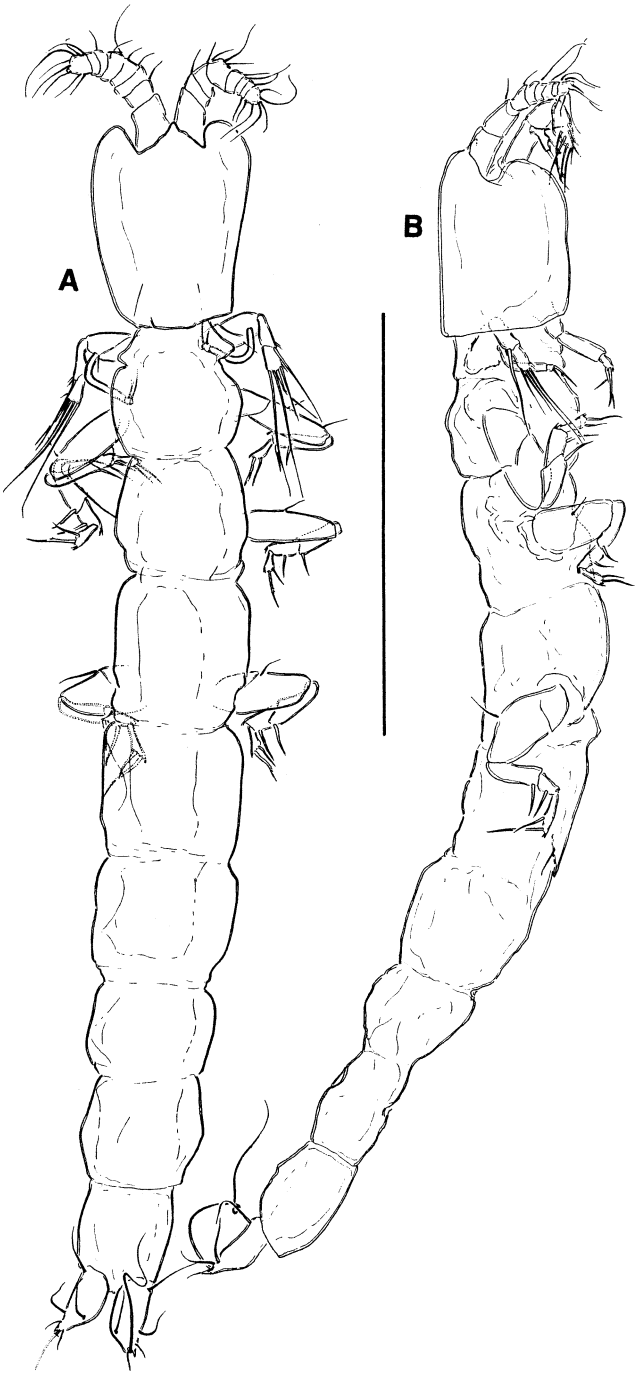


Fig. 1. *Apodopsyllus alejandrovillalobosi* sp. nov., female, holotype EMUCOP-020591-24. A, habitus, dorsal; B, habitus, lateral. Scale bar, 0.1 mm.

paratypes collected from station 1 (see Gómez-Noguera and Hendrickx, 1997 for more details); all collected from intertidal, fine sand; May 1991; at 3- to 9-cm-deep sediment; coll. S. Gómez.

*Etymology*.—The species is named in honour of Dr. Alejandro Villalobos Figueroa (1918–1982) for his work as a pioneer of Mexican carcinology.

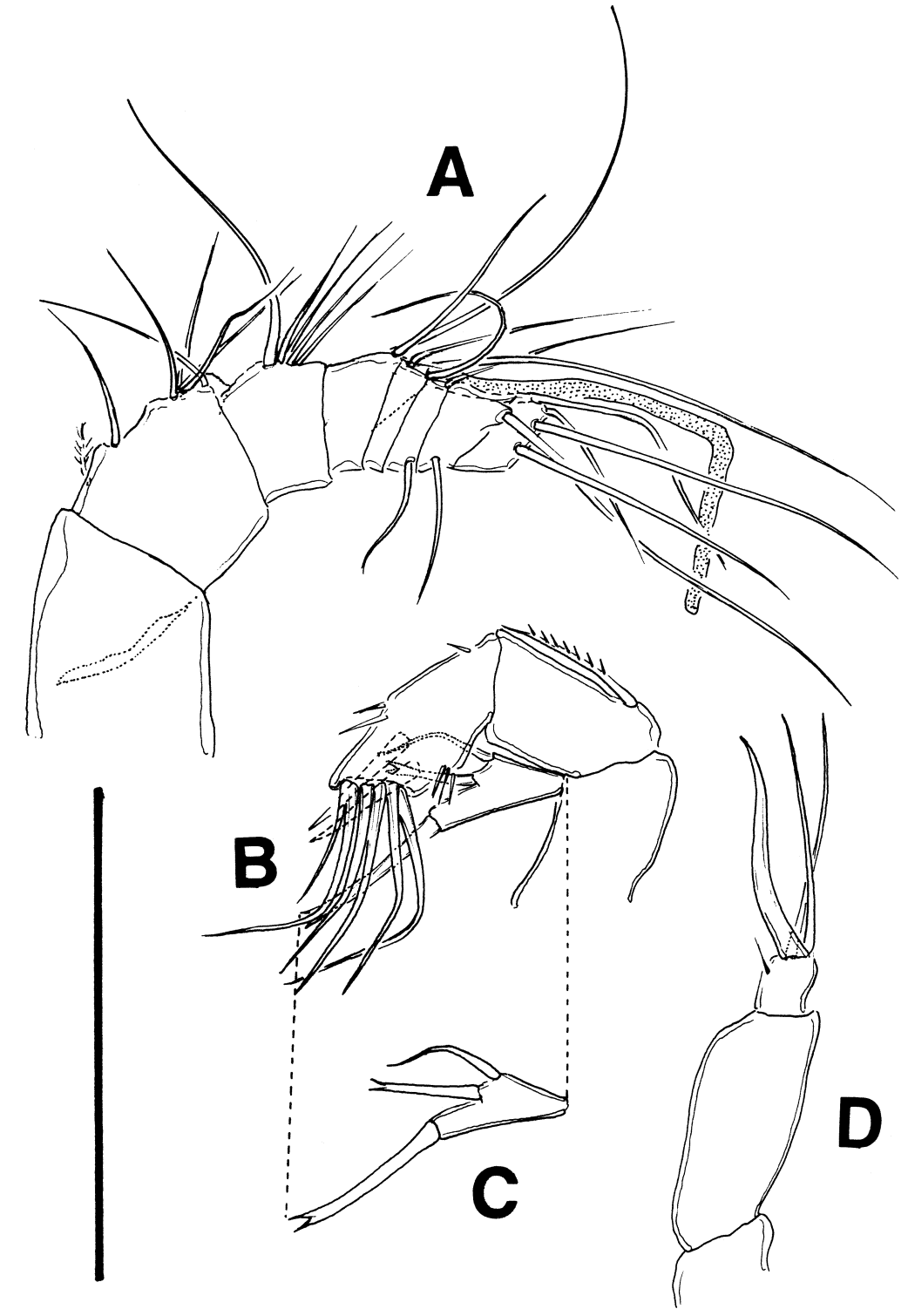


Fig. 2. *Apodopsyllus alejandrovillalobosi* sp. nov., female. A, antennule (paratype EMUCOP-020591-22); B, antenna (paratype EMUCOP-020591-25); C, antennal exopod (paratype EMUCOP-020591-25); D, maxilliped (paratype EMUCOP-020591-23). Scale bar, 0.025 mm.

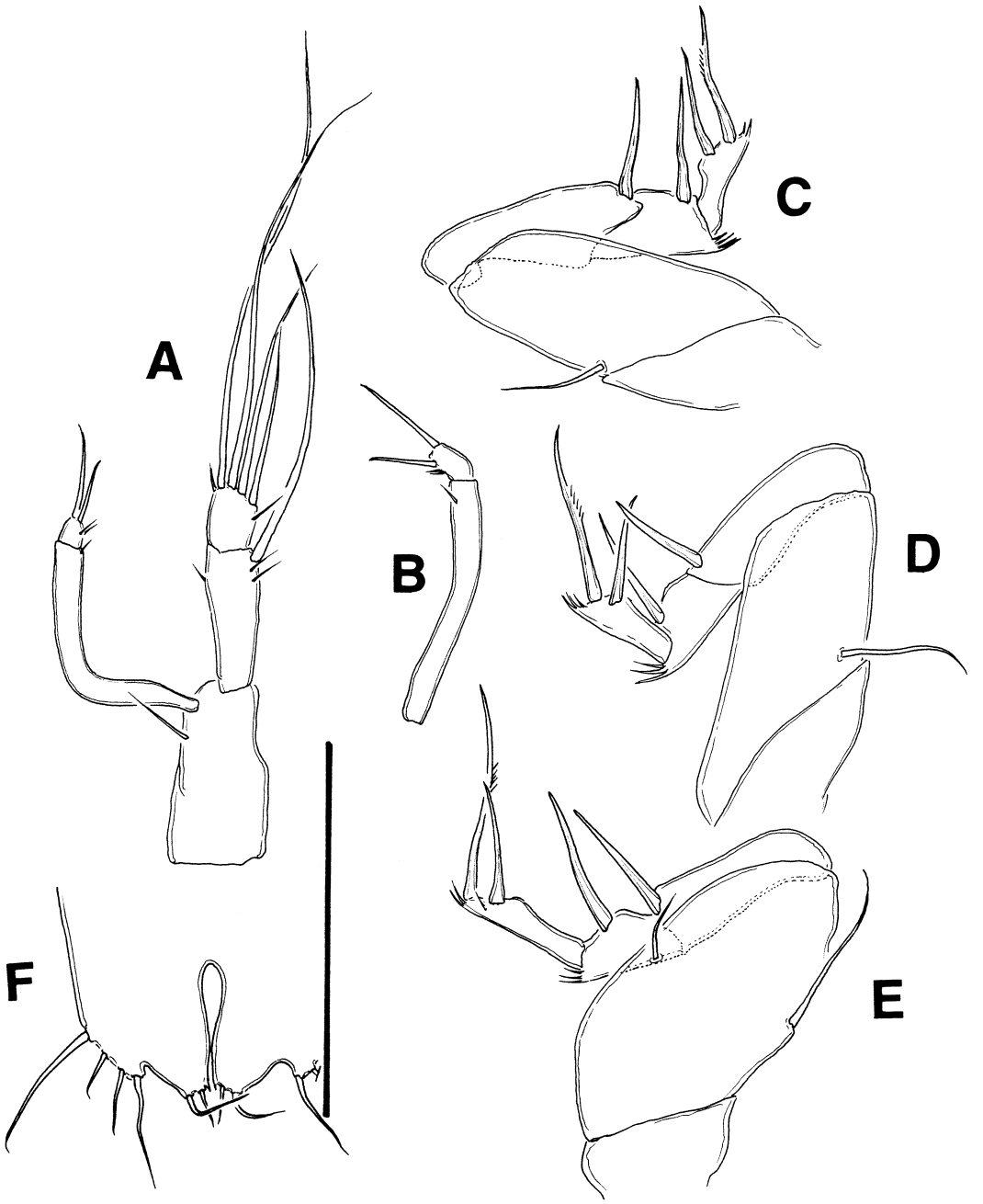


Fig. 3. *Apodopsyllus alejandrovillalobosi* sp. nov., female. A, P1 (paratype EMUCOP-020591-23); B, endopod of P1 (paratype EMUCOP-020591-23); C, P2 (paratype EMUCOP-020591-22); D, P3 (paratype EMUCOP-020591-22); E, P4 (paratype EMUCOP-020591-22); F, P5 (paratype EMUCOP-020591-22). Scale bar, 0.025 mm.

*Description*.—Female. Total length of habitus (Fig. 1A, B) ranging from 250 to 262 μm including rostrum and caudal rami. Body nearly cylindrical; abdomen slightly tapering posteriorly. Cephalothorax about 17% of total body length; wider anteriorly, with small and triangular rostrum fused to cephalothorax. Free thoracic somites and urosomites (except for anal somite) without distinct demarcation dorsally. Anal somite without operculum. Caudal rami subpyriform, with six setae.

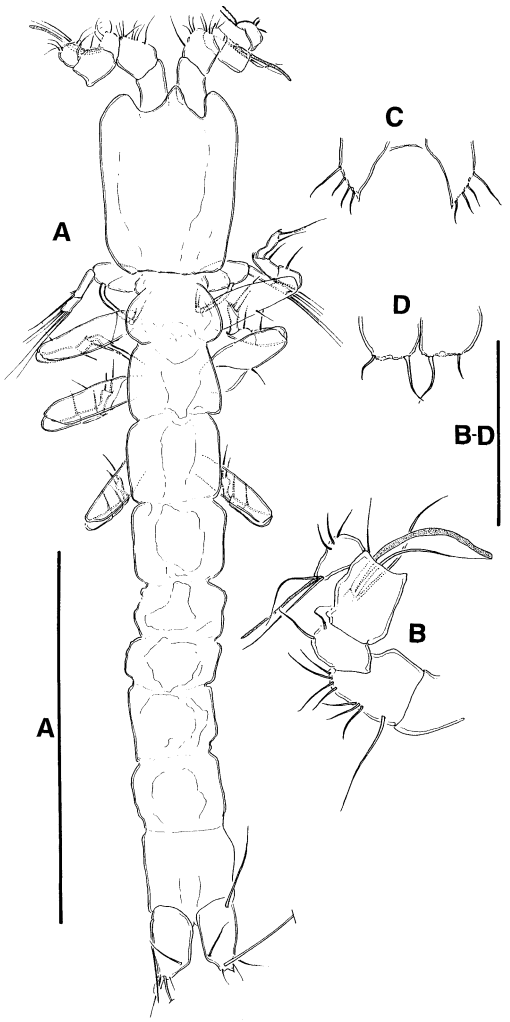


Fig. 4. *Apodopsyllus alejandrovillalobosi* sp. nov., male. A, habitus, dorsal (paratype EMUCOP-020591-26); B, antennule (paratype EMUCOP-020591-26); C, P5 (paratype EMUCOP-020591-30); D, P6 (paratype EMUCOP-020591-30). Scale bar, A, 0.1 mm; B–D, 0.025 mm.

Antennule (Fig. 2A) eight-segmented; armature formula difficult to define; with aesthetasc on fourth (and last?) segment.

Antenna (Fig. 2B, C) with basis; exopod one-segmented, with one long, bifid apical seta and two lateral setae (distal one bifid, proximal one normal and slender); first endopodal segment with inner seta in proximal third and reaching tip of segment proper; second endopodal segment ornamented with small spinules on outer and inner margin, with two subdistal spines and six distal elements (innermost two elements fused at base).

Mandible, maxillule and maxilla are not described. They were either lost during dissection or proved difficult to observe and interpret *in situ* as they tend to lie one on top of the other.

Maxilliped (Fig. 2D) subchelate, two segmented; first endopodal segment without armature/ornamentation; second segment with one strong element and two slender setae; terminal elements about equal in size.

P1 (Fig. 3A, B). Coxa and basis fused, the latter bearing one slender inner seta. Endopod two-segmented; elongate; first segment about 10 times longer than wide; second segment small, as long as wide, with two distal setiform elements, longer element smaller than first endopodal segment. As a rule, the endopod of P1 is straight (Fig. 3B). Due to its length/width ratio (about 10 times longer than wide), the endopod can be bent after dissection (Fig. 3A). Exopod clearly two-segmented; first segment about three times longer than wide, ornamented with spinules subapically and armed with one outer seta, which is about two times longer than supporting segment; second segment as long as wide and about 1/3 length of first segment, with four long setae (two outermost setae shorter).

P2–P4 (Figs. 3C–E). Coxa and basis fused, with outer seta, except for P4 with one additional inner small seta. Exopod three-segmented; first segment as long as second and third segments combined; first and second segments with one outer spine; second and third segments with outer frill (spinules or acute processes?) distally; third segment narrow, as long as preceding segment, with two elements (outermost smaller).

P5 (Fig. 3F). Confluent; exopod and baseoendopod fused, former not defined and represented by three setae. Baseoendopod represented by long outer seta, inner expansion with two elements (innermost smaller).

Male. Total length ranging from 285 to 292 μm (Fig. 4A). Different from female in A1, P5, and P6. Mandible, maxillule, and maxilla are not described. They were either lost during dissection or proved difficult to observe and interpret *in situ* as they tend to lie one on top of the other.

Antennule (Fig. 4B) five-segmented, subchirocer; with aesthetasc on fourth and last segment. Armature formula difficult to define.

P5 (Fig. 4C). Baseoendopod not defined, with one outer seta. Exopod represented by three setae.

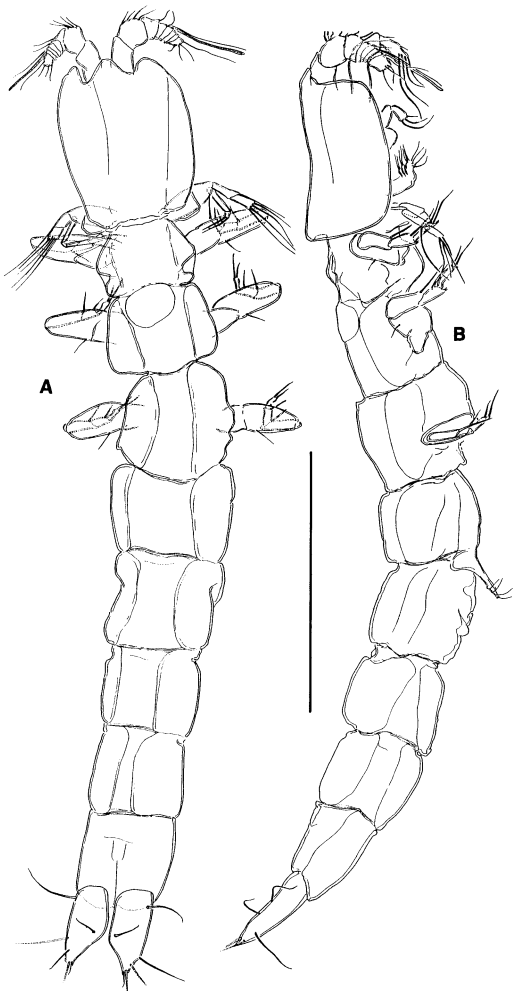


Fig. 5. *Apodopsyllus samuelgomezi* sp. nov., female, holotype EMUCOP-220691-03. A, habitus, dorsal; B, habitus, lateral. Scale bar, 0.1 mm.

P6 (Fig. 4D). Pair of P6 confluent, with one outer and one inner seta each.

### ***Apodopsyllus samuelgomezi*** sp. nov.
Figs. 5–8

*Apodopsyllus vermiculiformis* Lang, 1965, *sensu* Gómez, 2001.

*Type Locality*.—Ensenada del Pabellón lagoon, Sinaloa, México (24°19′–24°35′N, 107°28′–107°45′W).

*Type Material*.—One dissected female holotype (EMUCOP-220691-03), one whole mounted male allotype (EMUCOP-220691-05), and three whole mounted male paratypes (EMUCOP-220691-04, EMUCOP-220691-06, EMUCOP-220691-07), all collected from station 6 (see Gómez-Noguera and Hendrickx, 1997, for more details); intertidal, fine sand; June 1991; at 3- to 9-cm-deep sediment; coll. S. Gómez.

*Etymology*.—The species is named in honour of Dr. Samuel Gómez-Aguirre for his 40th anniversary as a plankton researcher of the Biology Institute of the National Autonomous University of Mexico.

*Description*.—Female. Total length of habitus (Fig. 5A, B) 355 μm including rostrum and caudal rami. Cephalothorax about 18% of total body length; wider anteriorly. Body nearly cylindrical, abdomen slightly tapering posteriorly. Rostrum triangular, very small. Free thoracic somites and first, genital double-somite, fourth and fifth urosomites with plate-like structures dorsally and laterally. Anal segment without plate-like structures dorsally but with subtle suture laterally and pitted ventrally as in *A. pseudocubensis* sp. nov. Genital double-somite fused completely; P6 represented by two slender setae ventrally (not illustrated, lost during dissection) as in *A. pseudocubensis* sp. nov. (Fig. 9C). Fourth and fifth urosomite pitted ventrally and seemingly with central longitudinal remnant of division between plate-like structures (not shown, but similar to *A. pseudocubensis* sp. nov. (Fig. 9C)). Caudal rami about three times as long as broad, nearly as long as anal segment; with pointed end and bearing 6 setae.

Antennule (Fig. 6A), eight-segmented; with aesthetasc on fourth and last segment. Armature formula difficult to define.

Antenna (Fig. 6B), with unarmed basis. Exopod one-segmented; with two lateral setae (proximal one normal, distal one bifid), and two apical bifid setae (one of them about half length of other). First endopodal segment with inner seta on proximal fourth, reaching tip of supporting segment; second endopodal segment as long as preceding one, with proximal and subapical spinules, two subapical spines and six distal elements (two outermost elements fused).

Mandible, maxillule and maxilla are not described. They were either lost during dissection or proved difficult to observe and interpret *in situ* as they tend to lie one on top of the other.

Maxilliped (Fig. 6C), subchelate, two-segmented; first endopodal segment unarmed, second endopodal segment with strong element and two long setae.

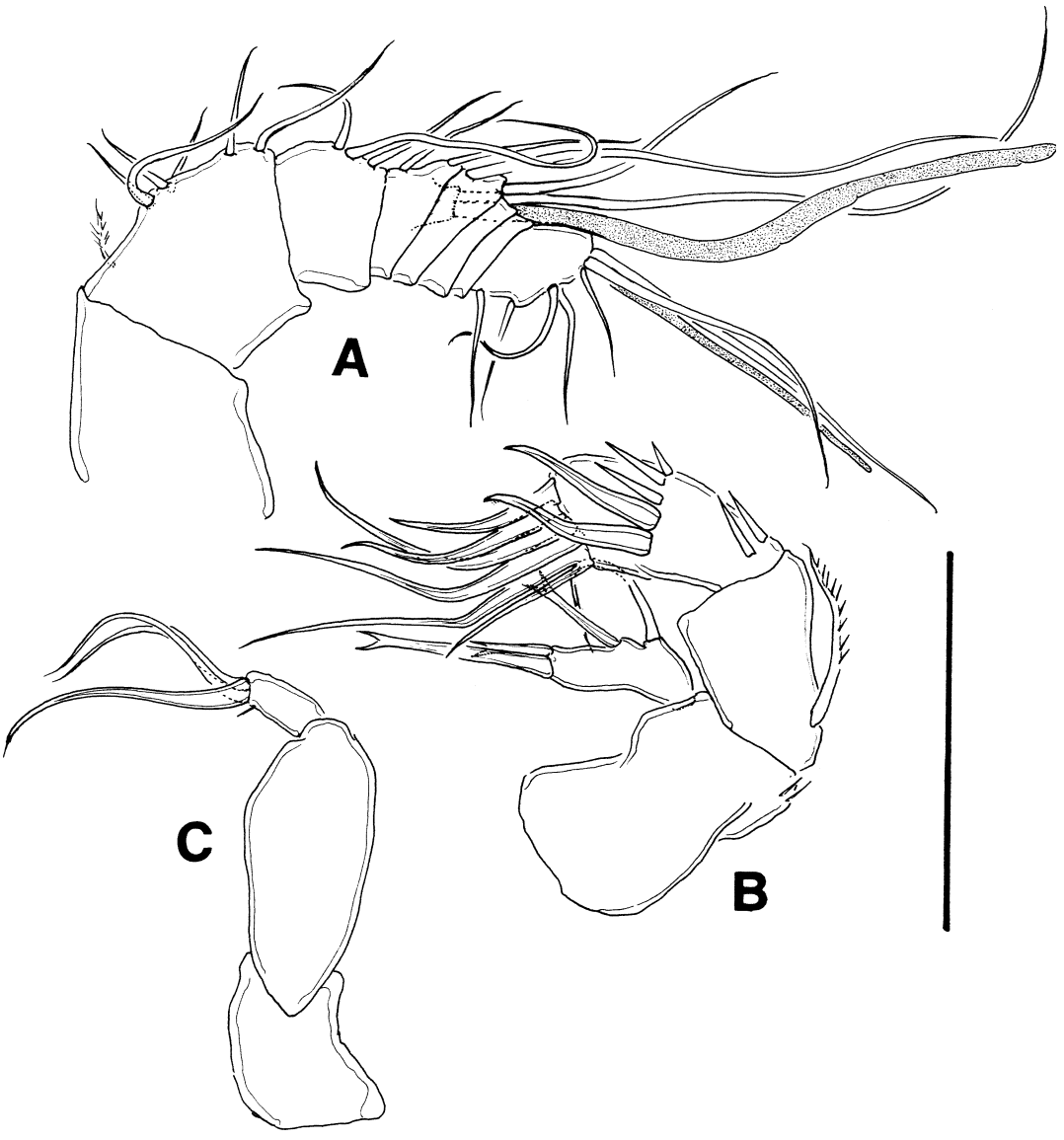


Fig. 6. *Apodopsyllus samuelgomezi* sp. nov., female, holotype EMUCOP-220691-03. A, antennule; B, antenna; C, maxilliped. Scale bar, 0.025 mm.

P1 (Fig. 7A). Basis with inner seta and some spinules on outer edge. Exopod two-segmented; first segment about three times longer than wide, with one long seta about two times longer than supporting segment; second segment about three times longer than wide and about half length of first segment, with four elements in all. Endopod two-segmented, nearly as long as exopod; first segment about five times longer than wide; second segment small, nearly as long as wide, and about 1/5 length of first segment, with two setiform elements of different length, longer one as long or somewhat longer than first endopodal segment.

P2–P4 (Fig. 7B–D), coxa and basis fused; basis of P2 and P3 with outer seta, of P4 with outer and small inner seta. Exopod three-segmented; first segment as long as second and third segments combined, with outer spine; second segment with outer spine and inner distal frill (spinules or acute processes?); third segment narrow, as long as preceding segment, with two distal spine-like elements (outermost smaller).

P5 lost during dissection.

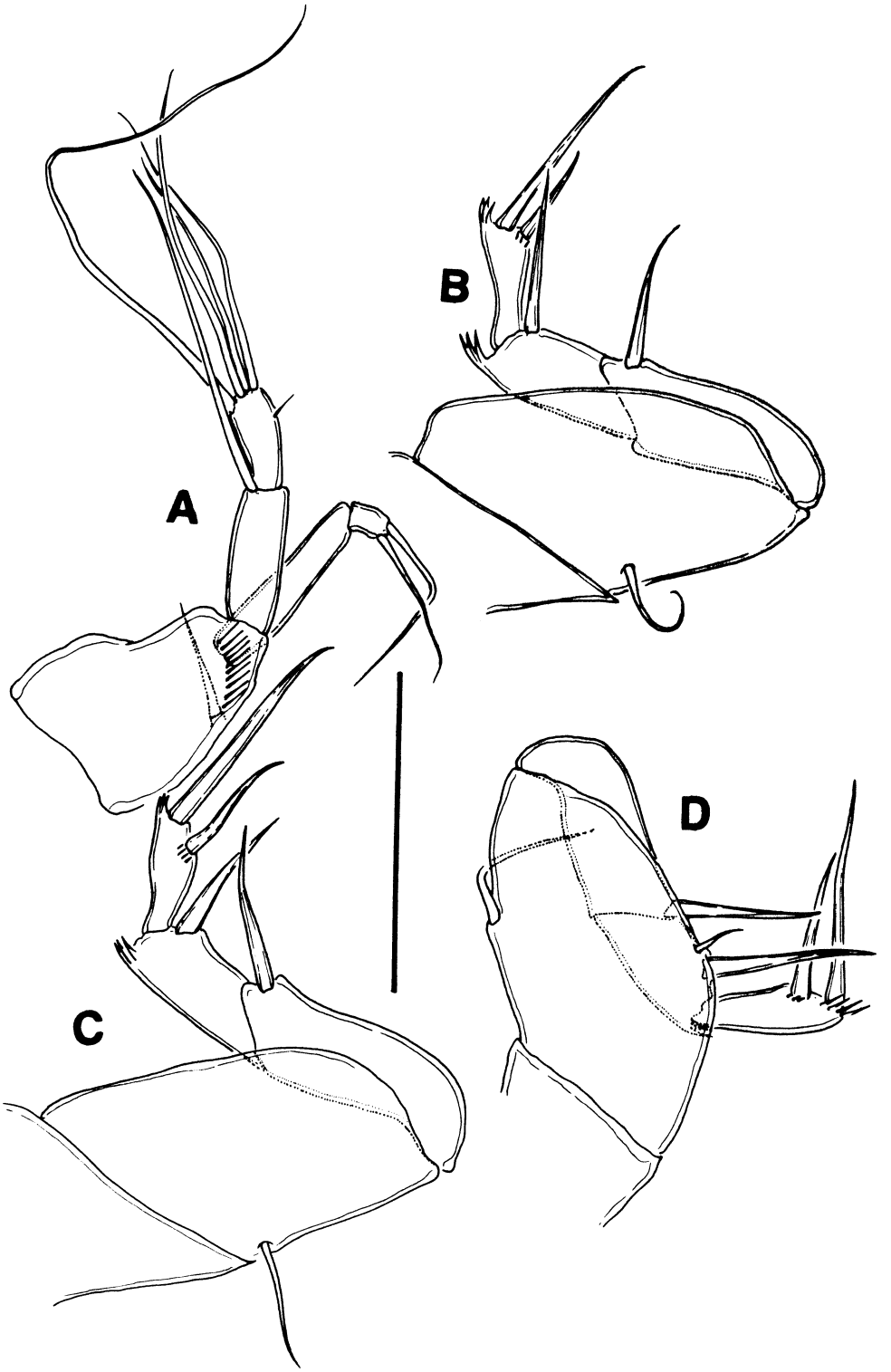


Fig. 7. *Apodopsyllus samuelgomezi* sp. nov., female, holotype EMUCOP-220691-03. A, P1; B, P2; C, P3; D, P4. Scale bar, 0.025 mm.

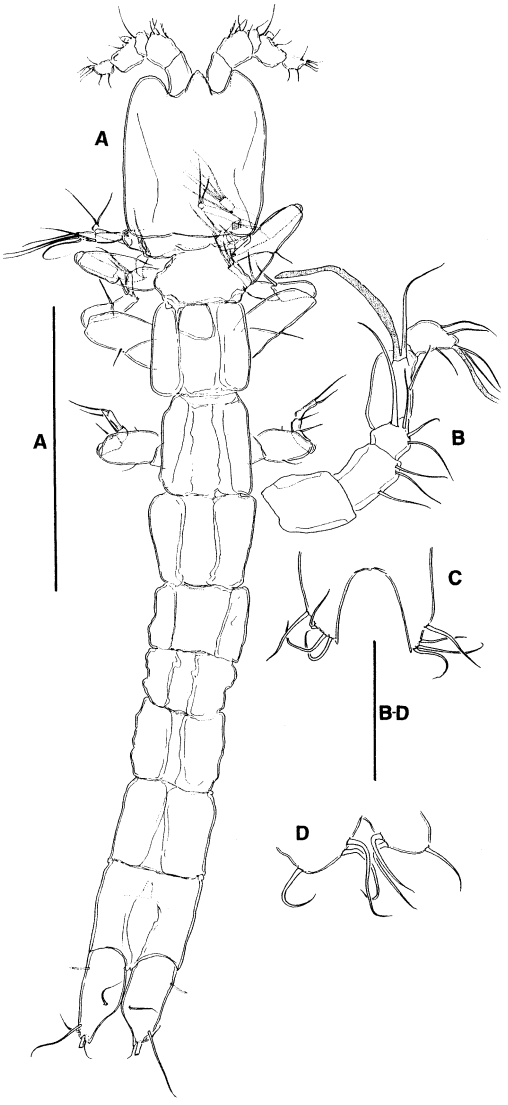


Fig. 8. *Apodopsyllus samuelgomezi* sp. nov., male, allotype EMUCOP-220691-05. A, habitus; B, antennule; C, P5; D, P6. Scale bar, A, 0.1 mm; B–D, 0.025 mm.

Male. Length, including rostrum and caudal rami, ranges 340–370 μm (Fig. 8A). Sexual dimorphism detected in modified subchirocer antennule, P5, and P6 (these two observed before dissection). Mandible, maxillule, and maxilla are not described. They were either lost during dissection or proved difficult to observe and interpret *in situ* as they tend to lie one on top of the other.

Antennule (Fig. 8B), five-segmented, subchirocer; with aesthetasc on fourth and last segment. Armature formula difficult to define.

P5 (Fig. 8C). Both legs fused; baseoendopod and exopod fused; outer extension of baseoendopod represented by proximal long seta; baseoendopod without inner lobe. Exopod represented by three lateral setae.

P6 (Fig. 8D), confluent; each leg with one outer seta at tip of outer lobe, and two inner setae longer than outer element and set close together.

### ***Apodopsyllus pseudocubensis*** sp. nov.
Figs. 9–12

*Apodopsyllus* sp. *sensu* Gómez, 2001.

*Type Locality*.—Ensenada del Pabellón lagoon, Sinaloa, México (24°19′–24°35′N, 107°28′–107°45′W).

*Type Material*.—One whole mounted female holotype (EMUCOP-030192-51), one whole mounted male allotype (EMUCOP-030192-52), two dissected female paratypes (EMUCOP-220691-08, EMUCOP-030192-53), one dissected female paratype mounted onto a slide (EMUCOP-030192-54), and one male paratype (EMUCOP-030192-55) mounted onto two slides, all collected from stations 6, 7, and 14 (see Gómez-Noguera and Hendrickx, 1997, for more details); intertidal, fine sand; June 1991 and January 1992; at 3- to 9-cm-deep sediment; coll. S. Gómez.

*Etymology*.—The species name makes reference to the close relationship of this species to *A. cubensis* Mielke, 1988.

*Description*.—Female. Total length of habitus (Fig. 9A, B) from 261 to 326 μm including rostrum and caudal rami, former triangular and minute. Body nearly cylindrical; abdomen slightly tapering posteriorly. Cephalothorax nearly cylindrical; slightly wider anteriorly; about 1/5 total body length. Free thoracic somites and first, double genital-somite, fourth and fifth urosomites with well-defined plate-like structures dorsally and laterally. Urosomites pitted dorsally and ventrally. Genital double-somite fused completely; P6 represented by two slender setae ventrally (Fig. 9C). Fourth and fifth urosomite with central longitudinal remnant of division between plate-like structures (Fig. 9C). Anal segment without plate-like structures and smooth dorsally, pitted ventrally, with central remnant of division between plate-like structures. Caudal rami about three times as

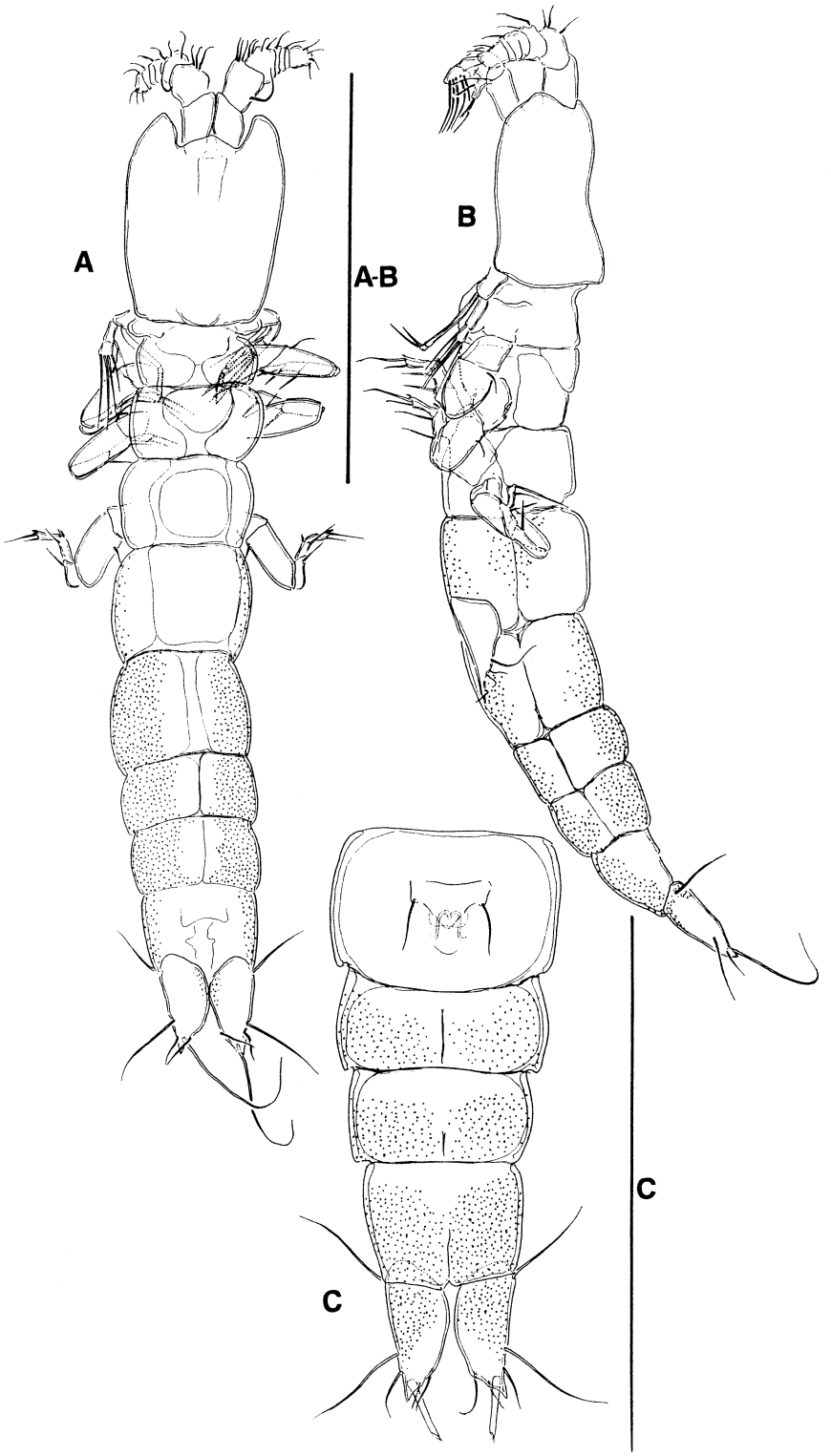


Fig. 9. *Apodopsyllus pseudocubensis* sp. nov., female, holotype EMUCOP-030192-51. A, habitus, dorsal; B, habitus, lateral; C, urosome, ventral (P5 bearing-somite omitted) (paratype EMUCOP-220691-08). Scale bar, 0.1 mm.

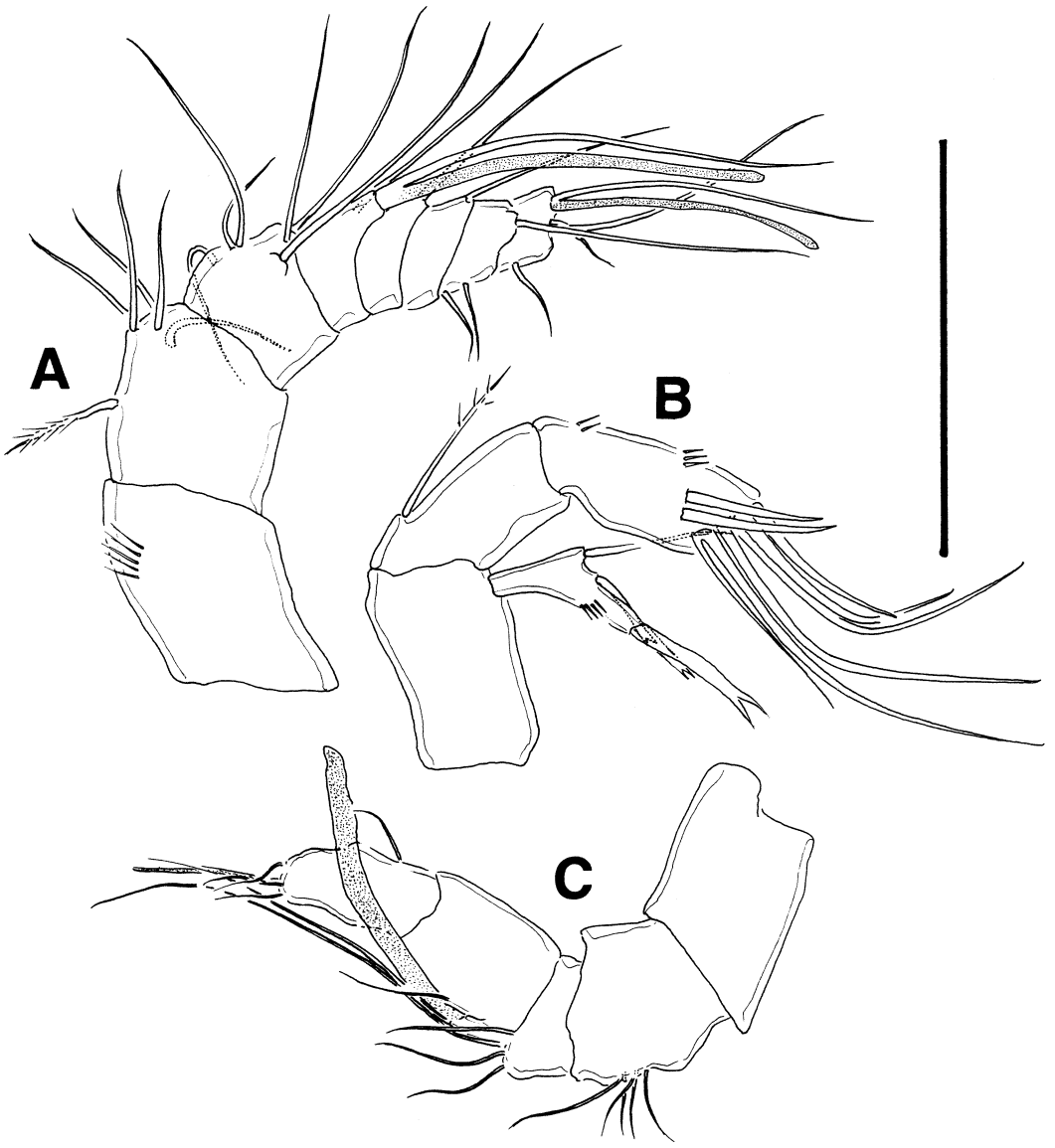


Fig. 10. *Apodopsyllus pseudocubensis* sp. nov. A, antennule, female (paratype EMUCOP-220691-08); B, antenna, female (paratype EMUCOP-220691-08); C, antennule, male (paratype EMUCOP-030192-55).

long as broad, as long as anal somite; with pointed end, bearing six setae.

Antennule (Fig. 10A) eight-segmented; with aesthetasc on fourth and last segment. Armature formula difficult to define.

Antenna (Fig. 10B) with unarmed basis. Exopod one-segmented; with two lateral setae (proximal one normal, distal one bifid), and two apical bifid setae (one of them about half length of other). First endopodal segment with inner seta in proximal fourth, nearly as long as supporting segment; second endopodal segment with proximal and subapical spinules, two subapical spines, and six distal elements (two outermost elements fused).

Mandible, maxillule, maxilla, and maxilliped are not described. They were either lost during dissection or proved difficult to observe and interpret *in situ* as they tend to lie one on top of the other.

P1 (Fig. 11A). Basis with inner seta. Exopod two-segmented, division between first and second segments difficult to see; first segment about four times longer than wide, with some minute

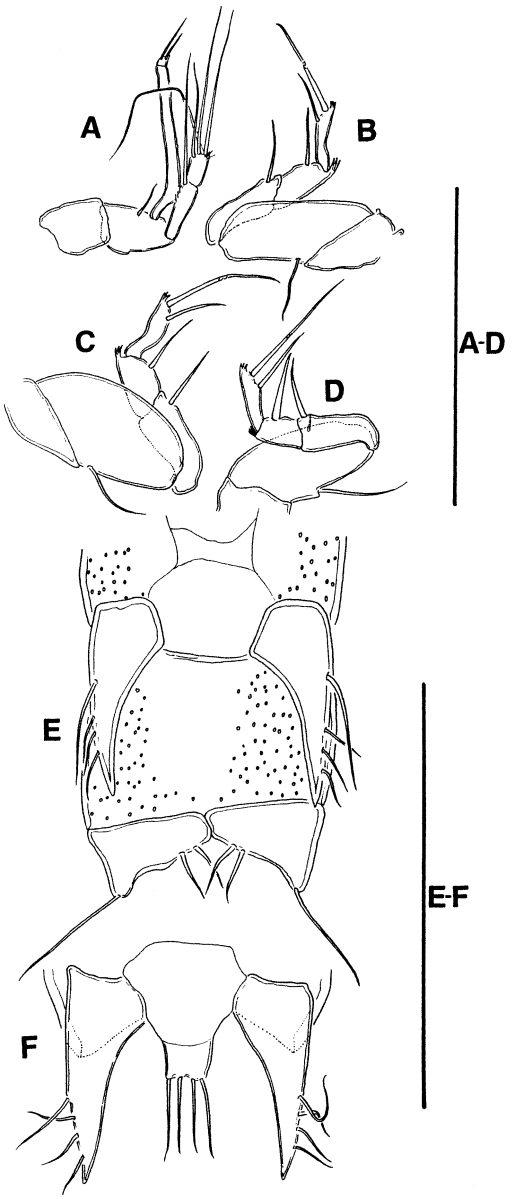


Fig. 11. *Apodopsyllus pseudocubensis* sp. nov. A, P1, female (paratype EMUCOP-030192-53); B, P2, female (paratype EMUCOP-030192-53); C, P3, female (paratype EMUCOP-220691-08); D, P4, female (paratype EMUCOP-220691-08); E, P5 and P6, male (allotype EMUCOP-030192-52); F, P5, female (holotype EMUCOP-030192-51). Scale bar, 0.05 mm.

spinules along outer margin and armed with one seta of about 1.6 times longer than entire exopod; second exopodal segment small, nearly as long as wide and about half length of preceding segment. Endopod two-segmented, about two times longer than exopod; first segment about 14 times longer than wide; second segment very small, as long as wide, with two setiform elements of different length, longer one being smaller than first endopodal segment. As a rule, the endopod of P1 is straight. Due to its length/width ratio (about 14 times longer than wide), the endopod can be bent after dissection.

P2–P4 (Fig. 11B–D) with coxa and basis fused; basis of P2 and P3 with outer seta, of P4 with long outer and small inner seta. Exopod three-segmented; first segment nearly as long as two following segments combined, with one outer spine; second segment with outer spine and frill (spinules or acute processes?) on inner distal corner; third segment narrow, as long as preceding segment, with inner distal frill as in preceding segment, and two elements (outer one smaller).

P5 (Fig. 11F) with outer lobe of baseoendopod and exopod fused, former represented by one long and slender seta; exopod not well defined and represented by three setae; inner lobes of baseoendopod fused and seemingly separated from exopods and outer lobes of baseoendopod by thin suture, reaching middle of exopod, each inner lobe represented by two setae (four in total).

Male. Length, including rostrum and caudal rami, 235 μm (Fig. 12A, B). Sexual dimorphism detected in modified subchirocer antennule, P5, and P6. Mandible, maxillule, maxilla, and maxilliped are not described. They were either lost during dissection or proved difficult to observe and interpret *in situ* as they tend to lie one on top of the other.

Antennule (Fig. 10C), five-segmented, subchirocer; with aesthetasc on fourth and ultimate segment. Armature formula difficult to define.

P5 (Fig. 11E, 12C). Both legs distinct; baseoendopod and exopod fused, former represented by outer seta of basis, latter represented by three lateral setae.

P6 (Fig. 11E, 12C), both legs distinct; each leg with three setae in all, outermost seta long and situated at the tip of outer distal lobe, two innermost setae about half length of outer one and set close together on inner lobe.

## Comparison and Discussion

Coull and Hogue (1978) defined two species groups of *Apodopsyllus* based on the relative length of the P1 endopod when compared to the length of the exopod of the same leg. They (Coull and Hogue, 1978) defined the *madrasensis* group (which included *A. madrasensis*

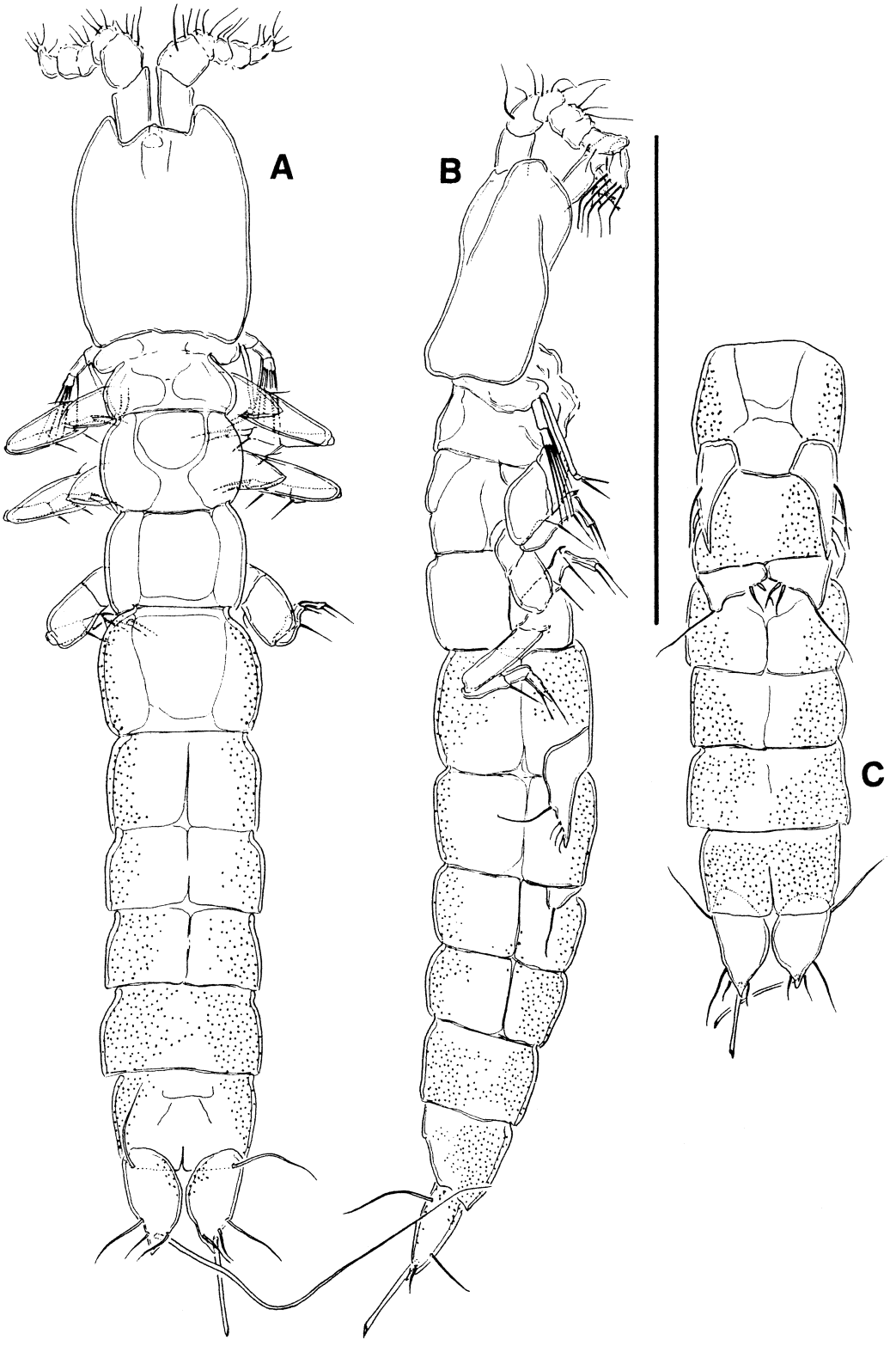


Fig. 12. *Apodopsyllus pseudocubensis* sp. nov., male, allotype EMUCOP-030192-52. A, habitus, dorsal; B, habitus, lateral; C, urosome, ventral. Scale bar, 0.1 mm.

(Krishnaswamy, 1951) and *A. unguiformis* Coull and Hogue, 1978) by the presence of a P1 endopod at least two times longer than the entire exopod. The *littoralis* group (which included *A. camptus* Wells, 1971; *A. arenicolus* (Chappuis, 1954); *A. depressus* (Krishnaswamy, 1957); *A. littoralis* (Nicholls, 1939); *A. adaptatus* (Krishnaswamy, 1957) (= *A. adaptus* in Coull and Hogue, 1978); *A. spinipes* (Nicholls, 1939); *A. africanus listensis* Mielke, 1975; *A. africanus africanus* Kunz, 1962; *A. vermiculiformis* Lang, 1965; *A. bermudensis* Coull and Hogue, 1978; and *A. schulzi* (Noodt, 1964)) was defined by a P1 endopod ranging 1–1.7 times longer than the entire exopod. Coull and Hogue (1978) omitted Cottarelli's (1971) description of *A. lynceorum* Cottarelli, 1971, in their revision of the genus. Seven years later, Cottarelli and Altamura (1985) described another representative of the *littoralis* group, *A. biarticulatus* Cottarelli and Altamura, 1985.

*Apodopsyllus alejandrovillalobosi* sp. nov. is closely allied to *A. vermiculiformis*. The latter is known only from Monterey Bay (California) (Lang, 1965) and British Columbia (Coull and Hogue, 1978). Following Lang's description of *A. vermiculiformis*, the female of these two species could be separated only by the number of segments of the antennule. However, Coull and Hogue (1978), after thorough analysis of Lang's type material, showed that Lang's description was wrong in that the female antennule is eight-segmented instead of seven-segmented as described by Lang. Thus, the females of *A. vermiculiformis* and *A. alejandrovillalobosi* are identical. These two species can be separated only by the armature of the male P6. This leg is armed with one and two equally long setae on outer and inner lobe, respectively, in *A. vermiculiformis*, all these elements being equal in length. *Apodopsyllus alejandrovillalobosi* sp. nov. has reduced sixth legs, represented each by a small plate (both plates are fused at their base) bearing two setae, the inner one being about twice as long as the outer one.

In a series of contributions about new harpacticoids from the neotropics, Mielke (1984, 1987, 1988) described three new species, *A. arcuatus* Mielke, 1984, *A. chilensis* Mielke, 1987, and *A. cubensis* Mielke, 1988, that are characterized by the presence of well-defined plate-structures on the body somites (a synapomorphy for these species). It is clear that they belong to an exclusively neotropical lineage. However, strictly speaking, *A. arcuatus* is attributable to Coull and Hogue's (1978) *madrasensis* group. Coull and Hogue's (1978) species groups are defined by the armature of the second endopodal segment of P1, which in my opinion is a symplesiomorphic character state. Thus, Coull and Hogue (1978: 156) were right in stating that "species groups, of course, have no nomenclatural or taxonomic status,…" They also stated that species groups "serve to illustrate a potential division(s) within any particular genus." This might be the case for several harpacticoid species groups, but both *madrasensis* and *littoralis* species groups are united by a symplesiomorphy and that invalidates the potential use of these two species groups as a division within *Apodopsyllus*.

*Apodopsyllus samuelgomezi* sp. nov. and *A. pseudocubensis* sp. nov. belong to the *arcuatus-chilensis-cubensis* clade united by the synapomorphic character state of the body somites (with a clear plate pattern dorsally and ventrally). *Apodopsyllus samuelgomezi* sp. nov. is unique within this clade in the male P6 that carries two long inner setae.

*Apodopsyllus pseudocubensis* sp. nov. is closely allied to its Cuban relative *A. cubensis*. These species share the general shape of female P5 and male P6. In fact these two species are unique among the species within this clade in the armature of the male P6 with one outer, long seta and two inner, small elements. These two species can be separated by several features such as the presence of a well-developed outer lobe in male P6 in *A. pseudocubensis* (and absent in *A. cubensis*), number of segments of female antennule (eight in *A. pseudocubensis* and seven in *A. cubensis*), inner expansion of baseoendopod of female P5 (hardly reaching the middle of exopod in *A. pseudocubensis* but beyond the middle of exopod in *A. cubensis*; with four setae equal in length in *A. pseudocubensis*, but with two long outer setae and two small inner elements in *A. cubensis*), and length of P1 endopod (twice as long as entire exopod in *A. pseudocubensis*, and about 1.4 times longer than exopod in *A. cubensis*).

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