BULLETIN DE L'INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE, BIOLOGIE, 72: 101-111, 2002
BULLETIN VAN HET KONINKLIJK BELGISCH INSTITUUT VOOR NATUURWETENSCHAPPEN, BIOLOGIE, 72: 101-111, 2002

Stygobitic isopod crustaceans, already described or new, from Bermuda, the Bahamas, and Mexico

by Lazare BOTOSANEANU & Thomas M. ILIFFE

Abstract

This is a new contribution to the knowledge of the isopod fauna of subterranean aquatic habitats in the Western Atlantic. Several species of stygobitic Cirolanidae are recorded from new localities. *Bahalana mayana* (Cozumel and Yucatan Peninsula) is transferred to genus *Metacirolana*; to support this transfer some additional illustration is provided; this is one of the few cases enabling sound speculation about the marine (epigean) ancestors of subterranean adapted cirolanids. A new species of *Bahalana*, the fourth in this stygobitic Bahamian endemic genus, is described from a cave in the Exumas; study of speciation in *Bahalana* by isolation in various fragments of the Bahamian Archipelago could be a rewarding project.

Key words: Isopoda: Cirolanidae, Stenetriidae, Stygal habitats, Bermuda, Bahamas, Mexico, taxonomy.

Résumé

Nouvelle contribution à la connaissance de la faune d'isopodes d'habitats aquatiques souterrains de l'Atlantique Ouest. Plusieurs espèces de cirolanides stygobies sont signalées de nouvelles localités. *Bahalana mayana* (Cozumel et Yucatan) est transférée au genre *Metacirolana*; à l'appui de ce transfer on présente un supplément d'illustration; il s'agit ici d'un des rares cas permettant une saine spéculation sur les ancêtres marins (épigés) de cirolanides stygobies. Une nouvelle espèce de *Bahalana*, la quatrième de ce genre stygobie et endémique des Bahamas, est décrite d'une grotte des Exumas; l'étude de la spéciation dans ce genre, par isolation dans les divers fragments de l'archipel des Bahamas, pourrait être un projet prometteur.

Mots-clés: Isopoda: Cirolanidae, Stenetriidae, habitats du Stygal, Bermuda, Bahamas, Mexico, taxonomie.

Introduction

During exploration by diving, in almost all cases by the second author, of caves, "blue holes", or cenotes, 6 species of stygobitic isopods have been sampled during 2000 and 2001. For several species localities are new. Study of additional material of the Mexican cirolanid described as *Bahalana mayana* allows transferring it to the mainly marine (epigean) genus *Metacirolana* which thus appears to include two subterranean – adapted species. In the strictly endemic Bahamian genus *Bahalana*, besides new localities for *B. yagerae*, we can give the description of a very distinct new species from a cave in one of the Exumas. All specimens mentioned in the present paper are kept in the Zoological Museum of the University of Amsterdam (ZMAN).

Systematic part

CIROLANIDAE

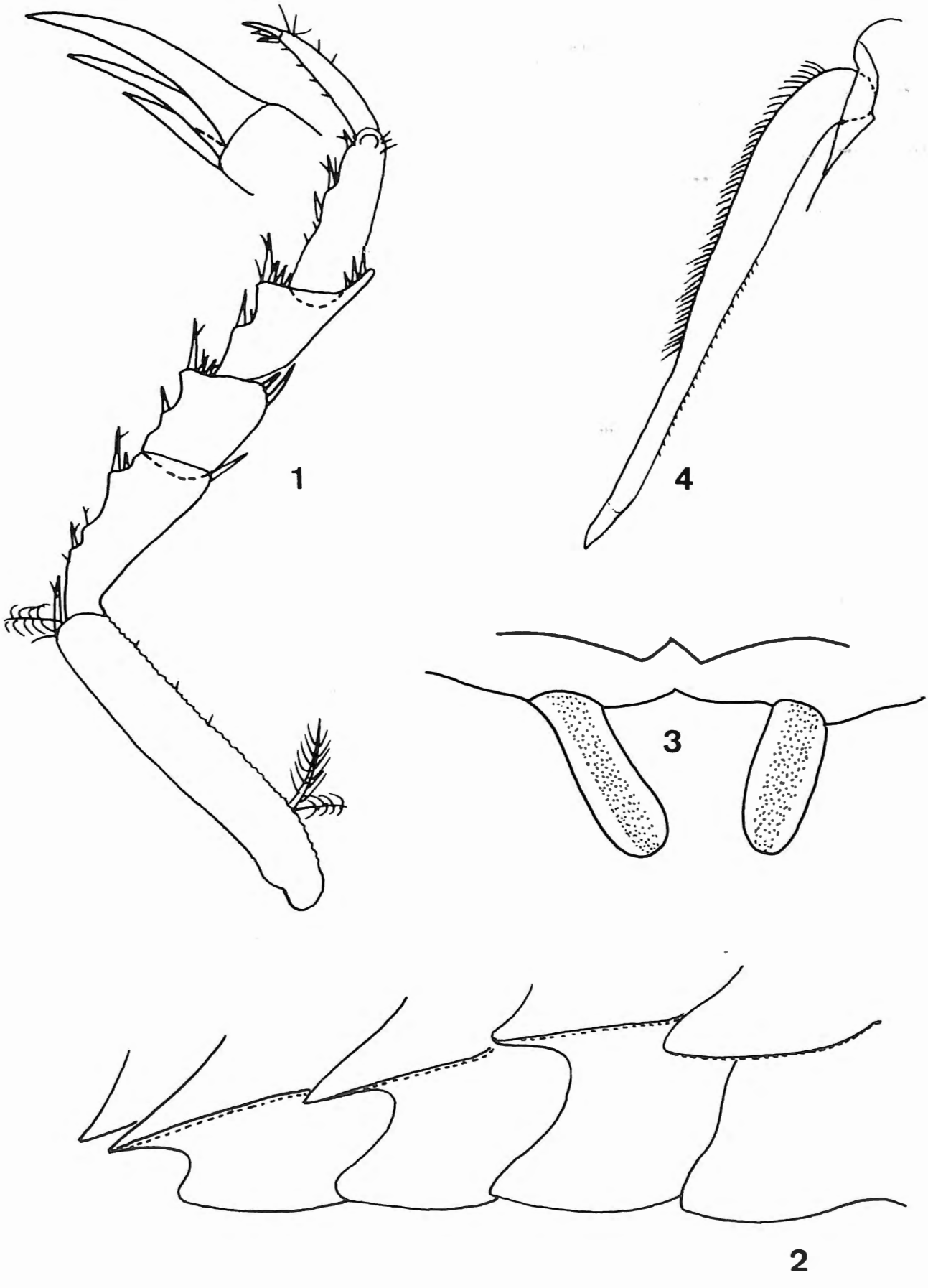
Creaseriella anops (CREASER, 1936)

One female of this Mexican species known from numerous caves or cenotes, has been sampled on 14.VII.2000 from Cenote Carwash, Tulum, Quintana Roo, Yucatan (from water column in 15-20 m. depths). Another female has been caught on 21.III.2002 from Cenote Ucil, Cenotillo (from 6-70 m. water depths). A male has been sampled on 31.III.2002 from Cenote Cervera, Dzilan de Bravo (from 15-27 m. water depths). Finally, 8 specimens, mostly completely rolled into a ball, have been sampled on 3.IV.2002 from Buya, Dzilan de Bravo (from 5-10 m. water depths). All new localities for the species, all in Yucatan, last two being caves on the northern (Gulf of Mexico) coast of the peninsula.

Metacirolana mayana (BOWMAN, 1987)

Figs. 1-4

BOWMAN (1987) described as *Bahalana mayana* a stygobitic cirolanid from two anchialine caves on Cozumel Island and the adjacent Yucatan Peninsula, comparing it with the two species described at that time in *Bahalana* CARPENTER, 1981. It became later clear that this species does not belong to this distinct Bahamian genus (CARPENTER, 1994: 174; BOTOSANEANU & ILIFFE, 1997: 93 – in this last publication an opinion, i.l., of Dr. N.L. BRUCE being quoted, according to which *B. mayana* is "..... a straight forward eyeless *Metacirolana* having all the characters of that genus"). Taking into account the fact that a stygobitic cirolanid from an anchialine cave lake on Cabrera, Balearic Islands, had already been described in *Metacirolana* (*M. ponsi*: JAUME & GARCIA, 1992), and that comparison of its description with *B. mayana* strongly supported the idea of congenerity, this last species is here transferred to *Metacirolana* NIERSTRASZ,



Figs. 1-4. *Metacirolana mayana*. 1. Left pereiopod IV, with unguis more strongly magnified. 2. Right side pleonal coxal plates with their perpendicular "keels", lateral. 3. Penes. 4. Appendix masculina.

1931.
Besides the two localities in the original description, *Metacirolana mayana* (BOWMAN, 1987) had been recorded from two cenotes on Cozumel and in the Tulum area (BOTOSANEANU & ILIFFE, 1999). For the present publication specimens from the following Mexican localities have been examined: Quintana Roo, Puerto Morales, Cenote Aayin Aak, from water column and rock and sand bottom (fully marine waters) in 10-20 m. depths: 24.VII.2000, 1♂, 7♀, 1 juvenile; Quintana Roo, Akumal, Cenote 27 Steps, from water column in 0-23 m. depths: 25.VII.2000, 1♂; Isla Cozumel, Cenote Tres Potrillos: 9.XI.2001, 1♀ larger than all specimens in the original description; Isla Cozumel, Cenote Aerolito: 9.XI.2001, 1 large ♂, 2 very small juvenile specimens.
We can supplement here the illustration in the original description with some relevant details. The robust pereiopod IV, left undescribed in BOWMAN (1987) is clearly of a type intermediary between the strongly raptorial PI-PII and the ambulatory PV-PVII. The pleonal epimera I-IV are characterized by sharp "keels" perpendicularly directed downwards and distally with sinuses. Appendix masculina has a characteristic shape in contrast with the extremely simple one in most stygobitic Cirolanidae and matching that found in *M. ponsi*, the same being true for the relatively short and thick-set penes.
The case of the two described stygobitic species of *Metacirolana* is one of the very few enabling sound speculation about the question: what was the appearance of the marine ancestors of present-day subterranean-adapted Cirolanidae?

Bahalana yagerae (CARPENTER, 1994)

Specimens examined (all new localities): Andros Island, Conch Sound Blue Hole, from "New Room" ca. 1 mile in from entrance, at 15 m. depth, 7.VII.2001, 1♀ with at least 16 big eggs; Grand Bahama Island, Sweeting's Cay, Virgo Blue Hole, from 15-21 m. depths of large room, 2.XII.2001, 1♀; Grand Bahama Island, Sweeting's Cay, Sagittarius Blue Hole, from 18-25 m. depths, 3.XII.2001, one large ♀ and 3 smaller or very small specimens nevertheless fully developed and with 6 pereiopods; Grand Bahama Island, Sweeting's Cay, Lucy's Cave, from 18-25 m. depths, 4.XII.2001, 3♀, 1♂. With the exception of Conch Sound which is an ocean blue hole, all other sites for *B.yagerae* are inland, anchialine caves.
It is possible that study of intraspecific variability in this species will lead to some results.

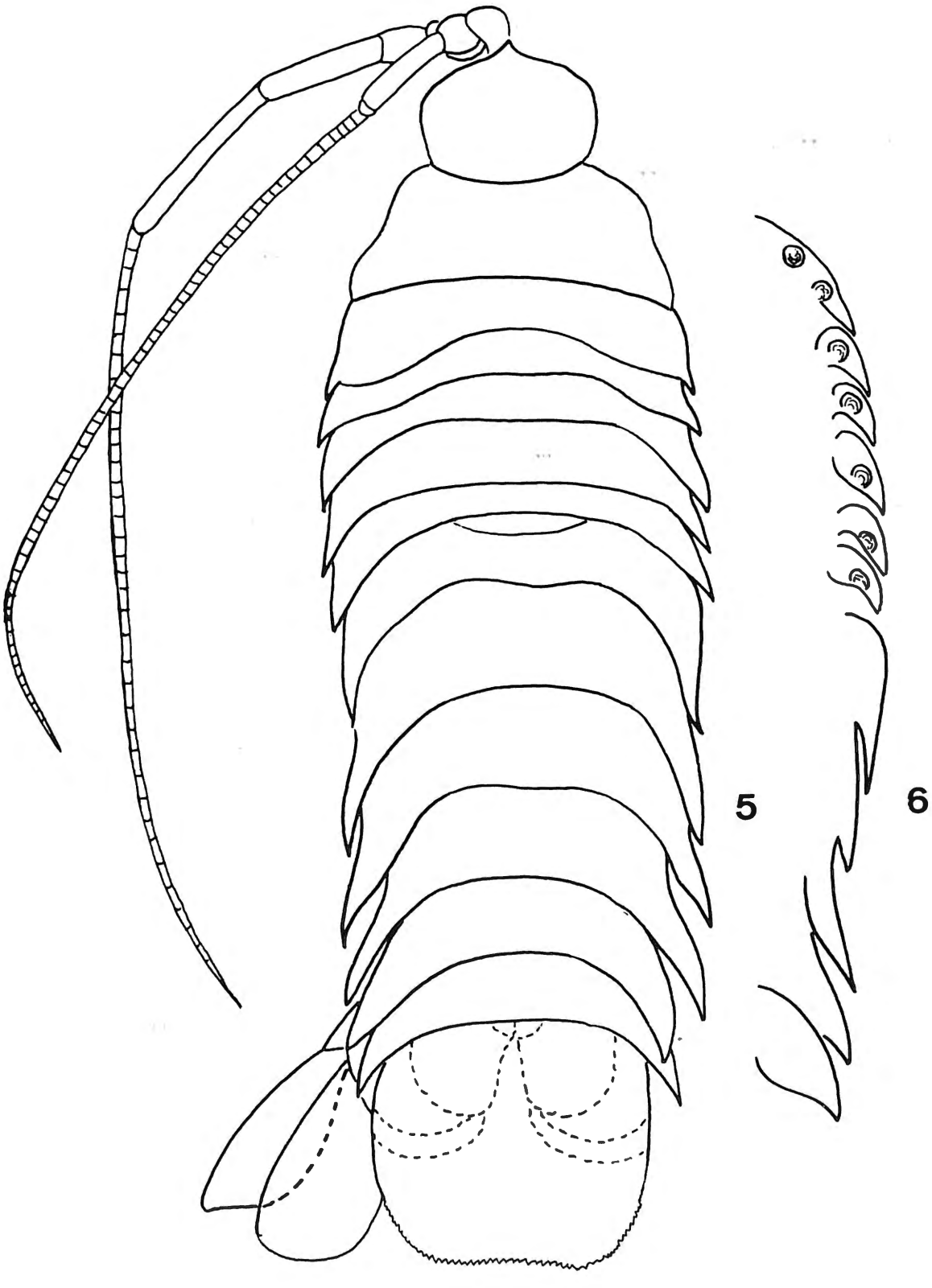
Bahalana exumina n.sp.
Figs. 5-27

MATERIAL EXAMINED

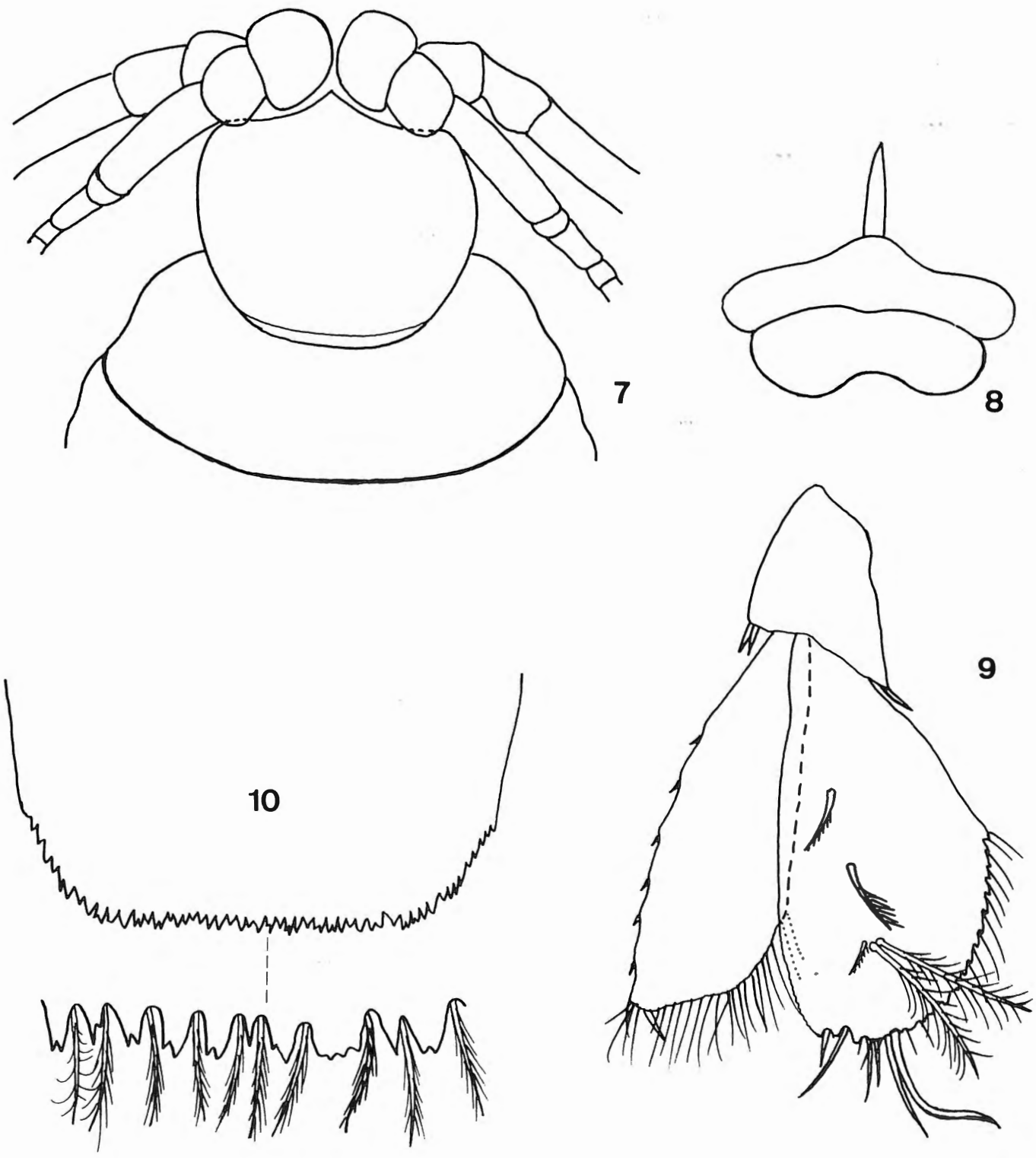
Male holotype sampled on 25 July 2001 by Brian Kakuk from Oven Rock Cave, Great Guana Cay, Exumas, the Bahamas (from main passage just past old bat roost at 15 m. depth; at the location where the specimen was collected, water has fully marine salinity). In the ZMAN crustacean collection (Is. 205829).

DESCRIPTION OF MALE HOLOTYPE

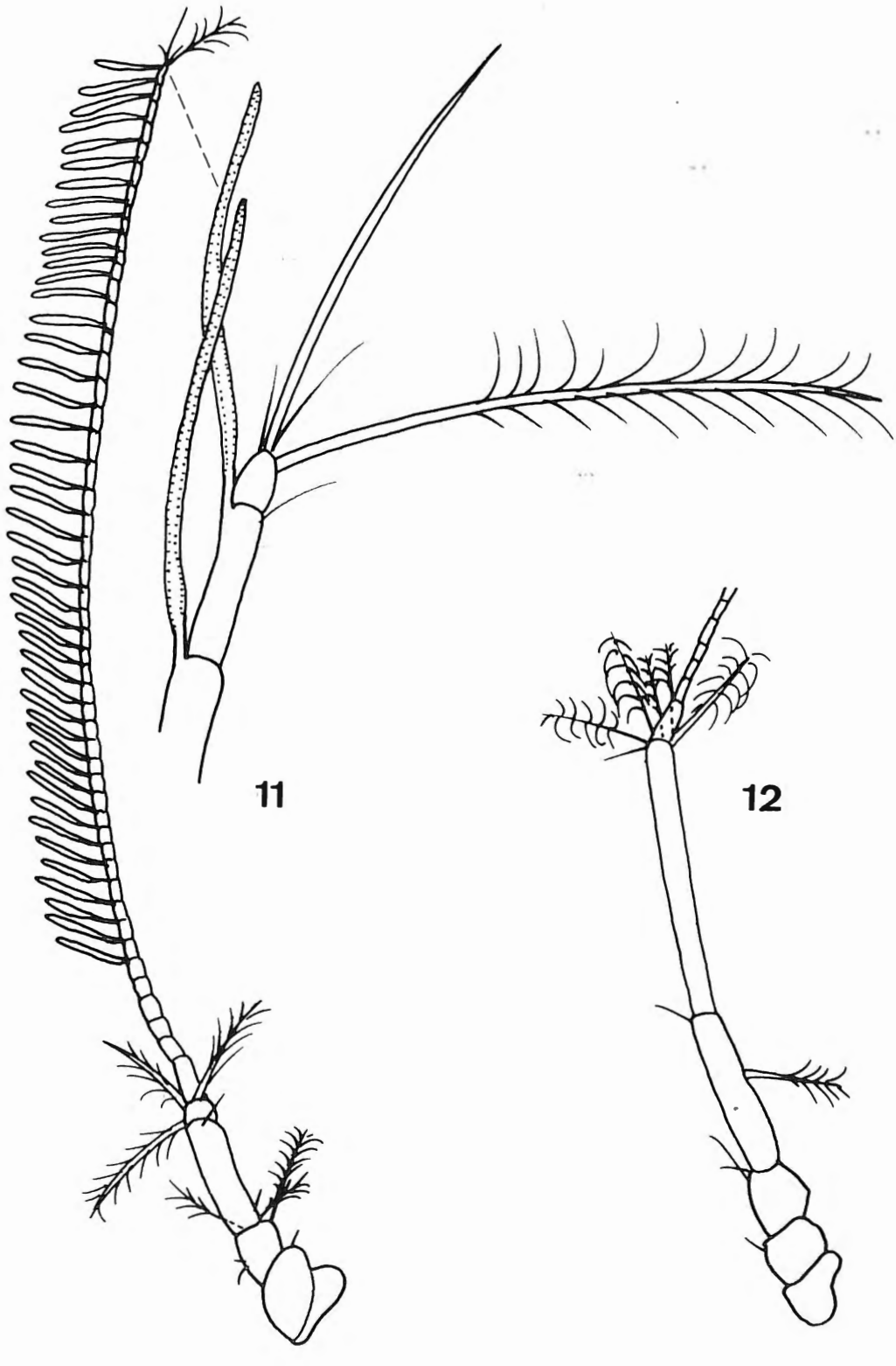
A fragile animal, some appendages (especially PIV-VII) easily coming off. Length from rostrum tip to middle of pleotelson: 7 mm. Habitus: fig. 5. Completely depigmented, eyeless.
Cephalon very well individualized, only very feebly built-in the large first pereional segment; lateral and posterior margins gently rounded; anterior margins, converging towards a short but distinct rostrum, may appear slightly sinuate. Lamina frontalis narrow, elongate, ending in sharp point; clypeus with strongly obtuse lateral ends laterally outrunning the labrum but not descending along its sides.
Pereionite I devoid of coxal plates; those of pereionites II-VII all very small, in contrast with those well developed of pleonites I-V (those of pleonite I long, sharply pointed, remaining ones stronger, all ending in points).
Pleotelson roughly square, lateral margins feebly rounded, posterior margin maybe very feebly emarginate; this margin is clearly crenelate (not simply festooned), the denticles irregular, and between all of them one short plumose seta is inserted.
Antennula reaching at least the limit between pleonites II and III; 2nd peduncular article shorter than 1st, 3d slightly longer than 1st and 2nd together, and with well individualized apical zone; the remarkably long flagellum has no less than 50 articles (1st one longer than following, last ones longer than those preceding); on each article – excepting only the five basal ones and the apical one – a slender aesthetask with short petiole.
Antenna II reaching at least the end of pleon. Peduncle with 3 short, thick-set basal articles, article 4 more slender and as long as 1-3 together, article 5 even more slender and as long as 1-4 together; flagellum from about 34 articles. In both AI and AII the basal peduncular article has a shape probably related to coupling.
The only fact worth a mention about the mandibles is the strong asymmetry of the two acies. Maxilla I lateral lobe with 12 glabrous spines; endite with two longer glabrous spines, one ciliate in the median corner, one minute in the lateral one, and also with a fine seta. Maxilla II: external lobe with 2 setae, median lobe with 4, internal lobe with 5 glabrous setae and with 2- longest and internalmost ones-plumose. Maxillipedal endite with either 3 or 4 plumose setae (the 4th one minute), and with one "coupling spine" (no hook).
The pereiopods I-III, although built on the very characteristic *Bahalana* pattern, show numerous structural or allometric peculiarities distinguishing them from those of already described species. The propodus of PIII is distinctly shorter and narrower than that of PI or PII. The unguis of all three is rudimentary, reduced to a minute, hyaline, indistinctly limited cone. Internal margins of carpus, propodus, dactylus, as well as of several long projections, are finely but distinctly crenelate. On PI only merus is armed with a long internal projection (devoid of subdistal spines). On PII there are two projections of the merus (one short internal, one very long



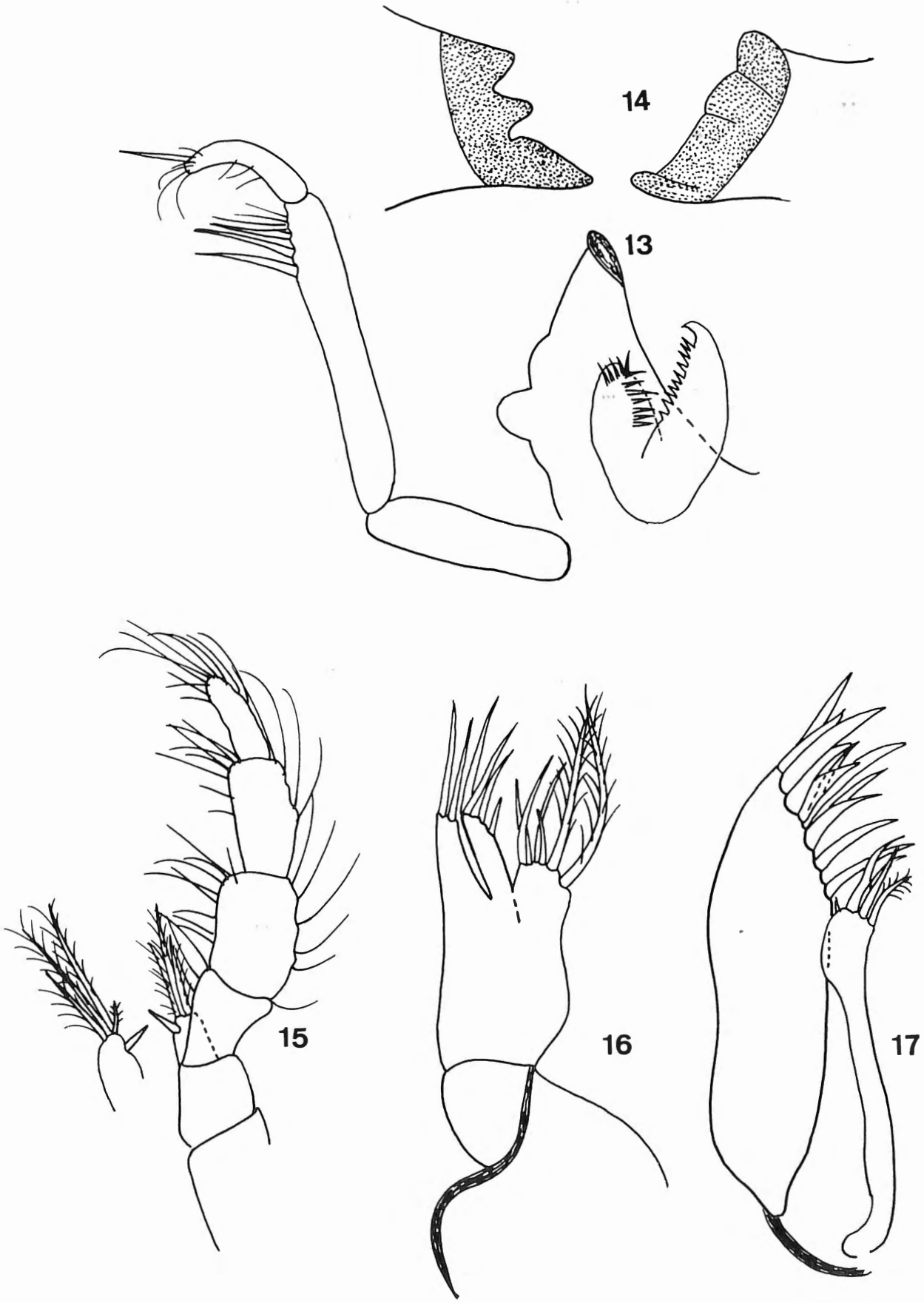
Figs. 5-6. *Bahalana exumina*, male holotype, habitus, and left side coxal plates in ventral view.



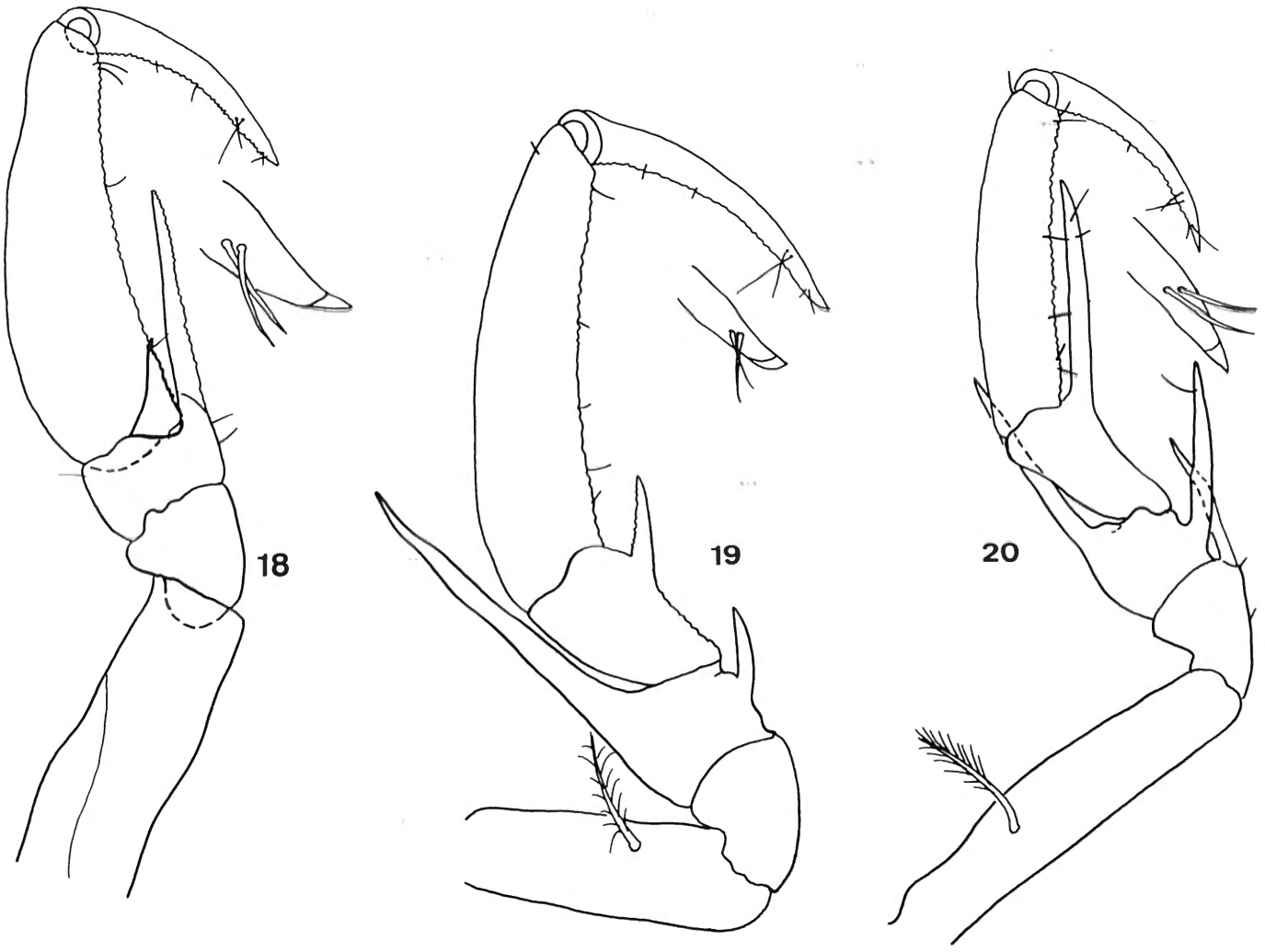
Figs. 7-10. *Bahalana exumina*, male holotype. 7. Cephalon and first pereional segment, slightly different position than in fig. 5. 8. Lamina frontalis and clypeo-labrum, ventral. 9. Left uropod, dorsal. 10. Distal margin of pleotelson, with even more strongly magnified detail.



Figs. 11-12. *Bahalana exumina*, male holotype. 11. Right AI, with more strongly magnified last flagellar articles. 12. Right AII peduncle.



Figs. 13-17. *Bahalana exumina*, male holotype. 13. Left Mdb. with its palp, dorsal (imperfect) view. 14. Acies of right and of left Mdb., ventral. 15. Left. Mxp. ventral, and endite of right Mxp. 16. Right MxII, ventral. 17. Right MxI, ventral.



Figs. 18-20. *Bahalana exumina*, male holotype, right pereiopods I-III with more strongly magnified tip of dactylus and rudimentary unguis.

external), whereas carpus has one short internal projection. PIII is armed with 4 projections: ischium has one internal, slender and of medium size, merus one internal long and one external even longer, whereas the internal projection of carpus is the longest of all.

We have illustrated PIV and PVII: like PV and PVI in extreme contrast, from all points of view, with PI-III.

Despite careful observation, no penes have been found.

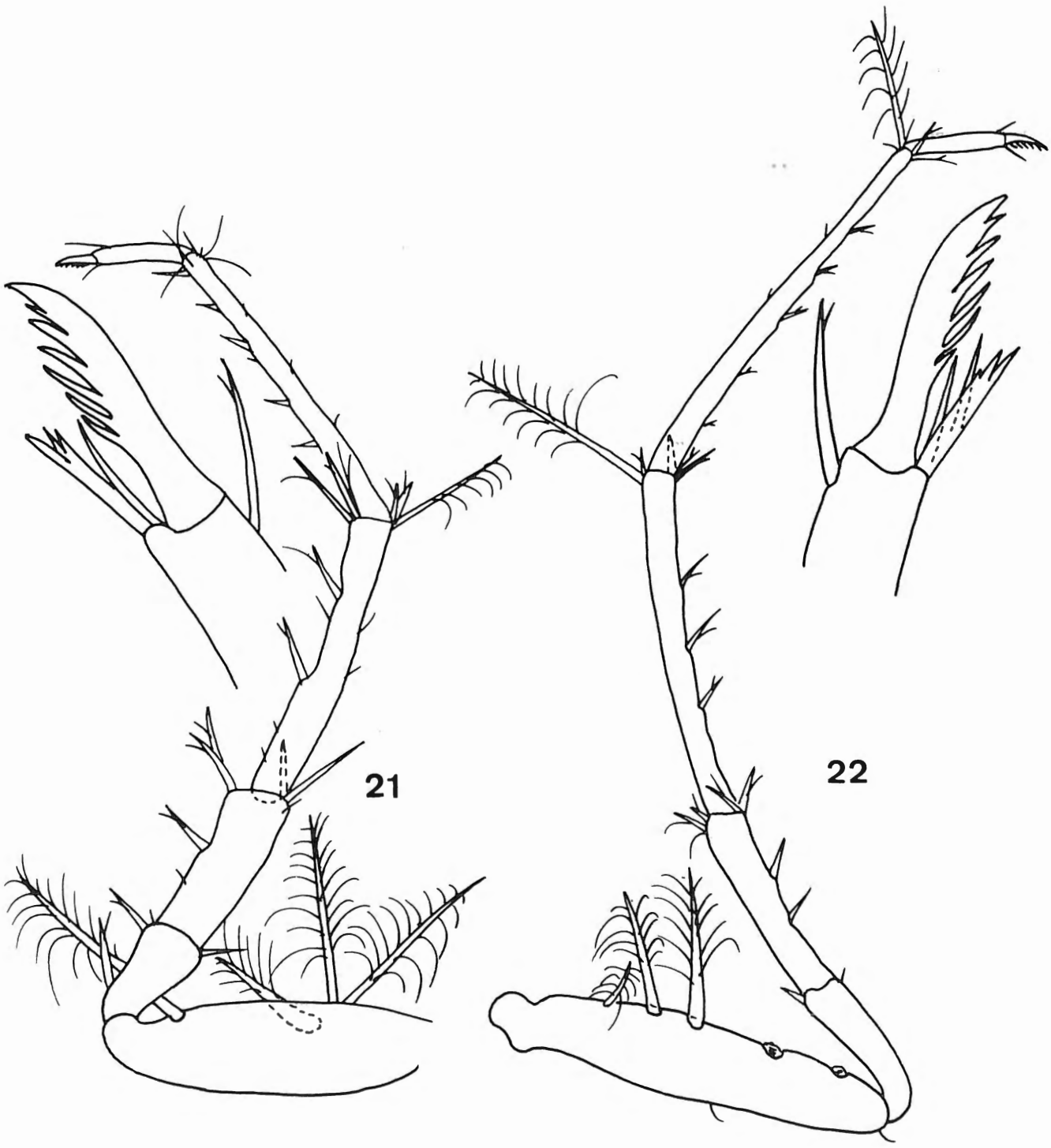
Pleopods (figs. 23-27). Exopodites III-V distinctly and completely bipartite (an extremely faint bipartition line can be "guessed" for Pl. I-II). All endopodites with distal setae, abundant on Pl. I-II, and gradually less so on Pl. III-V. Of course, all setae of exo-and endopodites finely plumose. Appendix masculina basally inserted, longer than endopodite, only very slightly curved towards the pointed tip.

Uropods of about the same length as the pleotelson. Coxopodite roughly trapezoidal, disto-internally only very slightly produced. Exopodite shorter and narrower than endopodite (maximum width of exp. about 1/3 of maximum width of enp.); the exopodite is foliaceous, along external margin with 6 short spines at regular intervals, apically with short tuft of glabrous setae and one spine, along distal third of internal margin with ca. 24 plumose setae. Endopodite with proximal half of internal margin abruptly oblique towards median line, distal half strongly denticulate, apically with pair of small sinuses; on dorsal surface 5 plumose setae – three of them bundled on a "sensory patch" (of course, all setae, short or long, along internal or distal margin are plumose).

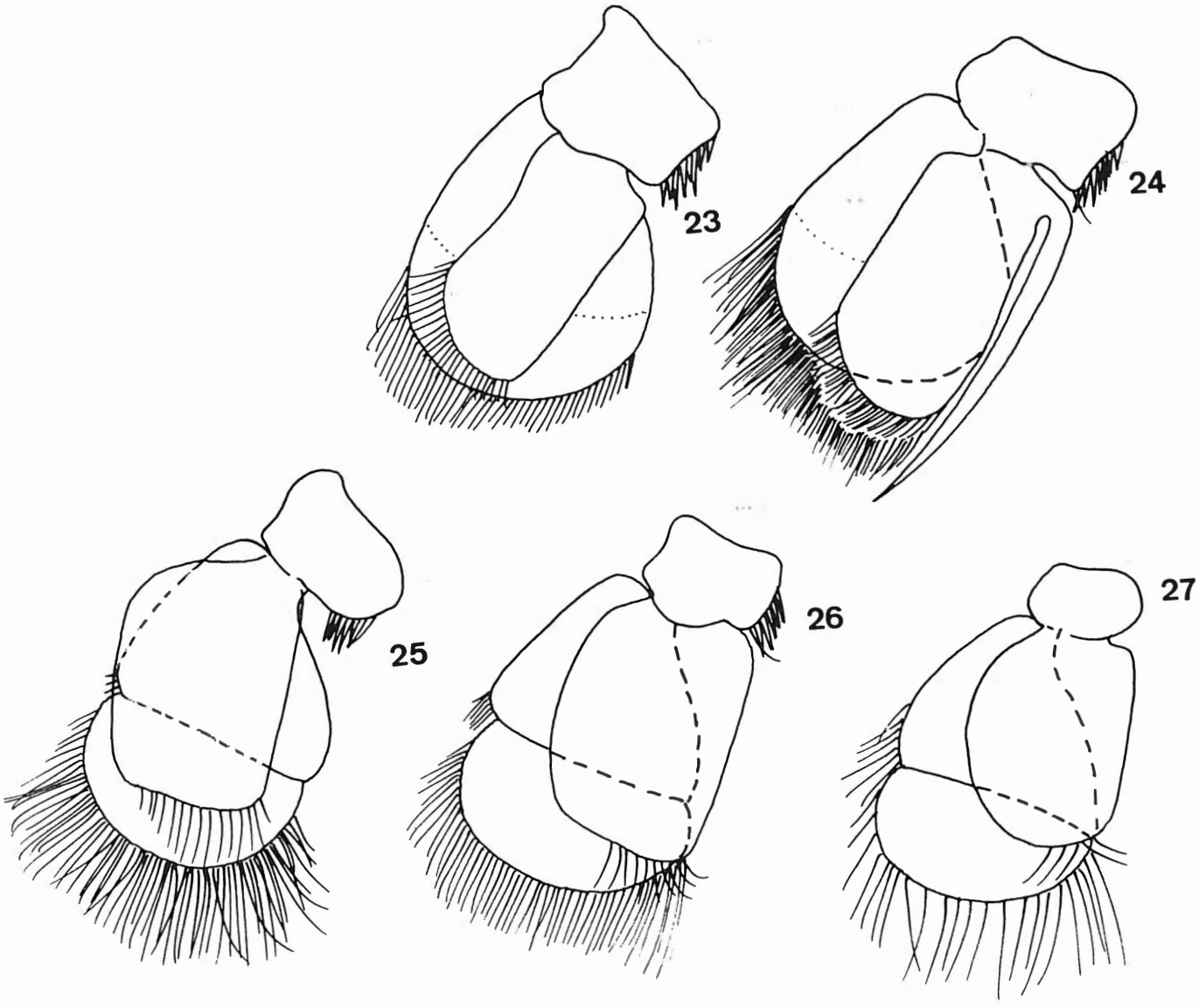
AFFINITIES

Bahalana exumina n.sp. is the 4th described species in this Bahamian endemic genus. It is clearly distinct from *B. geracei* CARPENTER, 1981 (San Salvador), *B. cardiopus* NOTENBOOM, 1981 (Mayaguana; Acklins: BOTOSANEANU & ILIFFE, 1999), and *B. yagerae* (CARPENTER, 1994) (Grand Bahama, Sweeting's Cay; Andros: present paper). It may be restricted to the Exumas. Speciation of *Bahalana* in subterranean waters of the Bahama Archipelago seems to be an exciting study subject.

As shown by BOTOSANEANU & ILIFFE (1999) *B. geracei* and *B. cardiopus* are very closely related species; *B. yagerae* is in many respects very distinct from this pair. The same may be



Figs. 21-22. *Bahalana exumina*, male holotype, right pereiopods IV and, respectively, VII, with more strongly magnified unguis.



Figs. 23-27. *Bahalana exumina*, male holotype, left pleopods I-V, ventral.

said about the new species which, nevertheless, seems to have more in common with *geracei* and *cardiopus* (and, maybe, more with *geracei* if a character like the presence of setation on Pl. III-V endopodites is thrown in the balance). Maybe the most easily seen distinctive character of *B. exumina* is the shape of its cephalon not built-in the 1st pereional segment. But probably the most impressive one is its particularly long AI flagellum with its very rich equipement of chemoreceptor organites: the new species must be a very sensitive one! Among other characters enabling distinction from one or another of the described species – or from all of them – are: the strong contrast between pereional and pleonal coxal plates; the shape of the lateral ends of the clypeus; 3d article of AI peduncle only as long as art. 1 and 2 together; many morphological details of pereiopods I-III; the strongly pectinate unguis of PIV-VII; many details of the armature of spines and setae of the uropods, and also of the proportions of their coxo-endo- and exopodites.

HABITAT

B. exumina inhabits a cave already known for its rich stygobitic fauna (details for Oven Rock Cave and its fauna i.a. in BOTOSANEANU & ILIFFE, 1997: 81 and 1999: 94). Deserves mention the fact that another stygobitic cirolanid *Cirolana (C.) troglexuma* BOTOSANEANU & ILIFFE, 1997 has been described, and later re-discovered, from this cave.

Yucatalana robustispina BOTOSANEANU & ILIFFE, 1999

A new locality for this remarkable Yucatan endemic is Cenote Kakuel, Mucuyche, where 7 specimens have been sampled on 21.VII.2000 from ledges along bedrock wall in 10 m. depth of a freshwater cave lake. Another one is Cenote Chuih-Hol Dos, Mucuyche, where 5 specimens (2♀, 2 manca, 1 juvenile) have been caught on 27.III.2002 (from 5-15 m. water depths). It seems that this species has quite restricted general distribution, with the various known localities apparently supporting important populations.

STENETRIIDAE

Stenobermuda iliffei KENSLEY, 1994

From the type locality of this species (Walsingham Cave, Hamilton Parish, Bermuda) 1♂ (2.4 mm) as well as 2 juvenile specimens (1.4 and 0.9 mm) have been sampled on 30.XI.2000 from water column in 3-20 m. depths between Walsingham and Deep Blue entrances. The species has been described and illustrated (KENSLEY, 1994) with eyes "consisting of 4 close-set ommatidia", but it has not been possible to detect them in our mature specimen (not to speak of the immature ones).

Acknowledgements

Cave investigations in the Bahamas were supported by grants to T. ILIFFE from the US National Science Foundation, Biotic Surveys and Inventories Program (NSF#9870219) and the Caribbean Marine Research Center of the National Oceanic and Atmospheric Administration (NOAA). Specimens were collected under a Marine Resource Collection Permit issued by the Bahamas Department of Fisheries to T. ILIFFE. Sincere appreciation is extended to Dan MALONE and the crew of the M/V Ocean Explorer for providing space on their December 2001 Sweeting Day (Bahamas) cave diving expedition. We thank cave divers Brian KAKUK and German YANEZ MENDOZA for assistance with cave collections in the Bahamas and Cozumel, respectively. This paper is a contribution of the DIVERSITAS-IBOY project "Exploration and Conservation of Anchialine Faunas".

References

BOTOSANEANU, L. & ILIFFE, T. M., 1997. Four new stygobitic Cirolanids (Crustacea: Isopoda) from the Caribbean- with remarks on intergeneric limits in some Cirolanidae. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie*, 67: 77-94.

BOTOSANEANU, L. & ILIFFE, T. M., 1999. On four new stygobitic cirolanids (Isopoda: Cirolanidae) and several already described species from Mexico and the Bahamas. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie*, 69: 93-123.

BOWMAN, T. E., 1987. *Bahalana mayana*, a new troglobitic cirolanid isopod from Cozumel Island and the Yucatan Peninsula, Mexico. *Proceedings of the Biological Society of Washington*, 100(3): 659-663.

CARPENTER, J.H., 1981. *Bahalana geracei* n.gen., n.sp., a troglobitic marine cirolanid isopod from Lighthouse Cave, San Salvador Island, Bahamas. *Bijdragen tot de Dierkunde*, 51(2): 259-267.

CARPENTER, J.H., 1994. *Dodecalana yagerae*, new genus, new species, a troglobitic marine cirolanid isopod from Grand Bahama Island, Bahamas. *Journal of Crustacean Biology*, 14(1): 168-176.

JAUME, D. & LL. GARCIA, 1992. A new *Metacirolana* (Crustacea: Isopoda: Cirolanidae) from an anchihaline cave lake on Cabrera (Balearic Islands). *Stygologia*, 7(3): 179-186.

KENSLEY, B., 1994. Records of shallow-water marine isopods from Bermuda with descriptions of four new species. *Journal of Crustacean Biology*, 14(2): 319-336.

NOTENBOOM, J., 1981. Some new hypogean Cirolanid isopod crustaceans from Haïti and Mayaguana (Bahamas). *Bijdragen tot de Dierkunde*, 51(2): 313-331.

Lazare BOTOSANEANU
Zoölogisch Museum
University of Amsterdam
Plantage Middenlaan 64
1018 DH Amsterdam
The Netherlands

Thomas M. ILIFFE
Department of Marine Biology
Texas A & M University at
Galveston
Galveston, Texas 77553-1675
U.S.A.