

Two new stygobitic species of Cirolanidae (Isopoda) from deep cenotes in Yucatan

by Lazare BOTOSANEANU & Thomas M. ILIFFE

Abstract

Haptolana yunca n. sp. is the 6th described species of an entirely hypogean-adapted genus. *Cirolana (Anopsilana) yucatanana* n. sp. is the 9th described stygobitic and troglomorphic species in this subgenus. Both were discovered by diving in deep waters of cenotes in the Yucatan peninsula, a region from which five stygobitic cirolanid species were known. *Jamaicalana BOTOSANEANU & ILIFFE, 1997*, is synonymized with *Cirolana (Anopsilana)*.

Key-words: Isopoda, stygobitic/troglomorphic fauna, Mexico, taxonomy.

Résumé

Haptolana yunca n. sp. est la 6^{ème} espèce décrite d'un genre entièrement adapté à la vie hypogée. *Cirolana (Anopsilana) yucatanana* n. sp. est la 9^{ème} espèce stygobite et troglomorphe décrite dans ce sous-genre. Les deux ont été découvertes par plongée dans les eaux profondes de cenotes de la péninsule du Yucatan, région d'où 5 espèces stygobites de cirolanides avaient déjà été décrites. *Jamaicalana BOTOSANEANU & ILIFFE, 1997*, est considéré comme synonyme de *Cirolana (Anopsilana)*.

Mots-clés: Isopoda, faune stygobite/troglomorphe, Mexique, taxonomie

Introduction

From subterranean waters of the Yucatan peninsula, five cirolanid species have been described to date: *Creaseriella anops* (CREASER, 1936), "*Bahalana*" *mayana* BOWMAN, 1987, *Haptolana bowmani* BOTOSANEANU & ILIFFE, 1997, *H. belizana* BOTOSANEANU & ILIFFE, 1997, and *Yucatalana robustispina* BOTOSANEANU & ILIFFE, 1999.

Diving exploration by Th. ILIFFE of various cenotes in Yucatan has led in 1999 to discovery, i.a., of two additional new species, which will be described below.

Descriptions of new taxa

Haptolana yunca n. sp.
Figs. 1-20

MATERIAL EXAMINED

Mexico, Yucatan, Yuncu: Cenote Sabakha. Female holotype collected on 1 November 1999 by Th. M. ILIFFE. In the Z.M.A.

DESCRIPTION

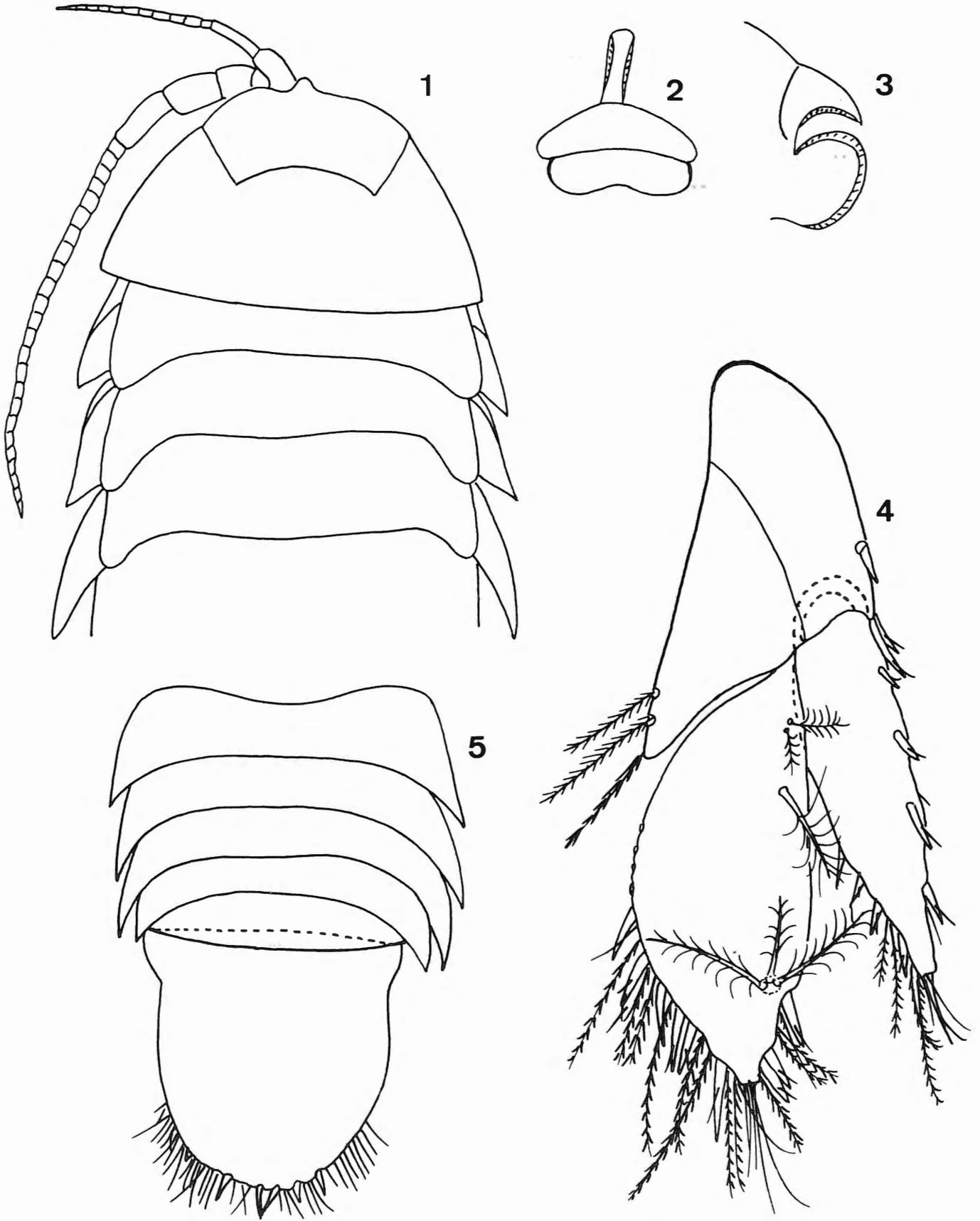
Length of female holotype: ca. 10 mm. Habitus slender, body margins only slightly convex. Completely depigmented, anophtalmous.

Cephalon more than twice wider than maximal length, lateral margins strongly oblique towards median line, posterior margin deeply depressed. Rostrum, as seen dorsally, small and blunt ending, but in lateral view strongly curved ventrad and ending in sharp point without joining lamina frontalis; lamina frontalis in ventral view narrow and remarkably long, apically not globose; but its true shape can be observed only in lateral view: it is, in fact, a vertically placed disk whose distal edge is the only part seen ventrally. Clypeus as strongly developed as the labrum, with blunt lateral ends not leaning on labrum's sides.

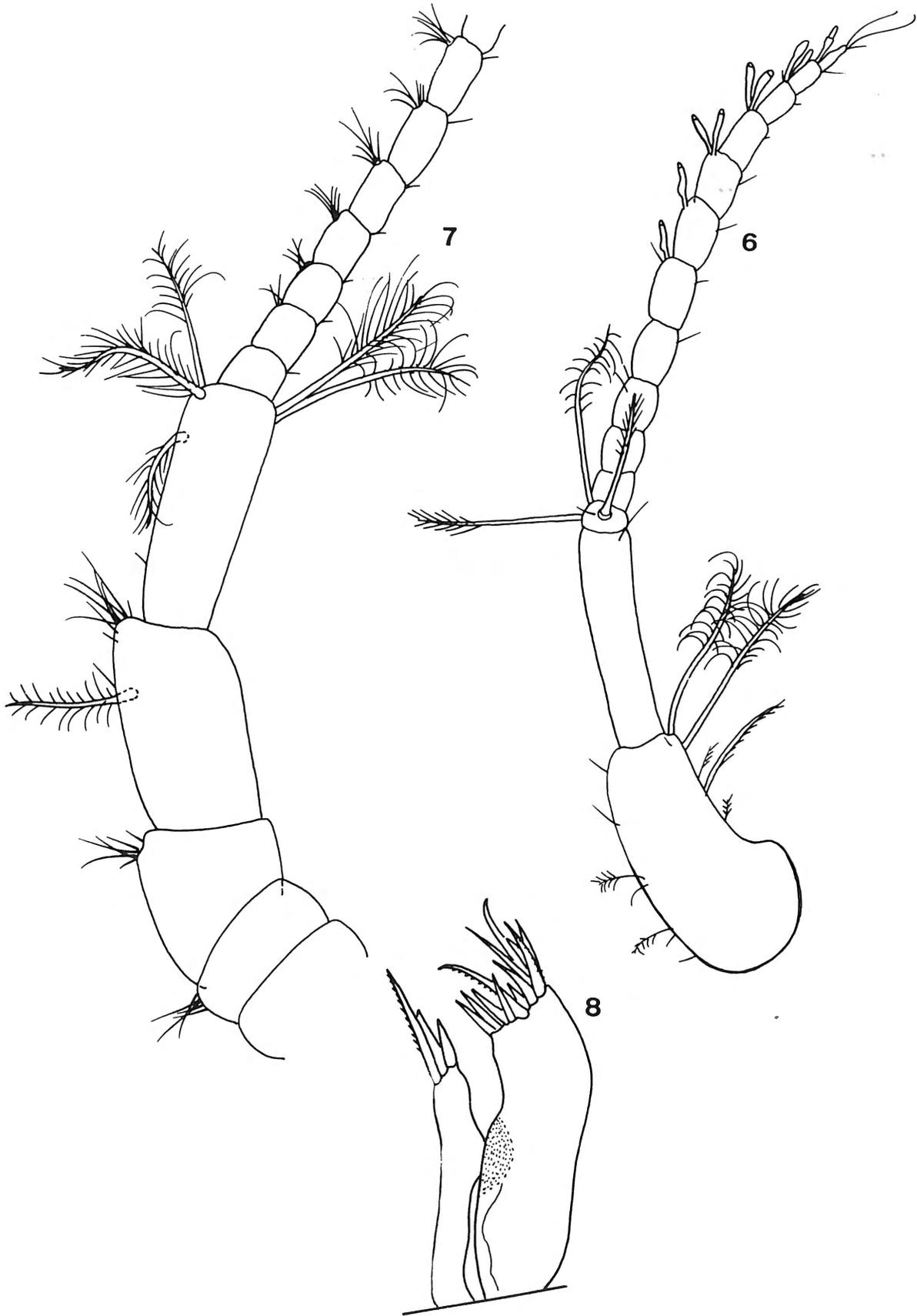
Epimera of pereionites II-VII and of pleonites I-IV strongly developed, ending in sharp points. Epimera of pleonite V concealed under pleonite IV.

AI short, reaching to middle of pereionite II; articles 1 and 2 of peduncle coalescent, the resulting article twisted proximally, laterally with shallow depression receiving the "root" of AII, and much stronger than the distal article which - together with its strongly individualized apical zone - attains the same length as the coalescent basal articles; flagellum: 11 articles, on articles 5 to 10 one or two short aesthetascs.

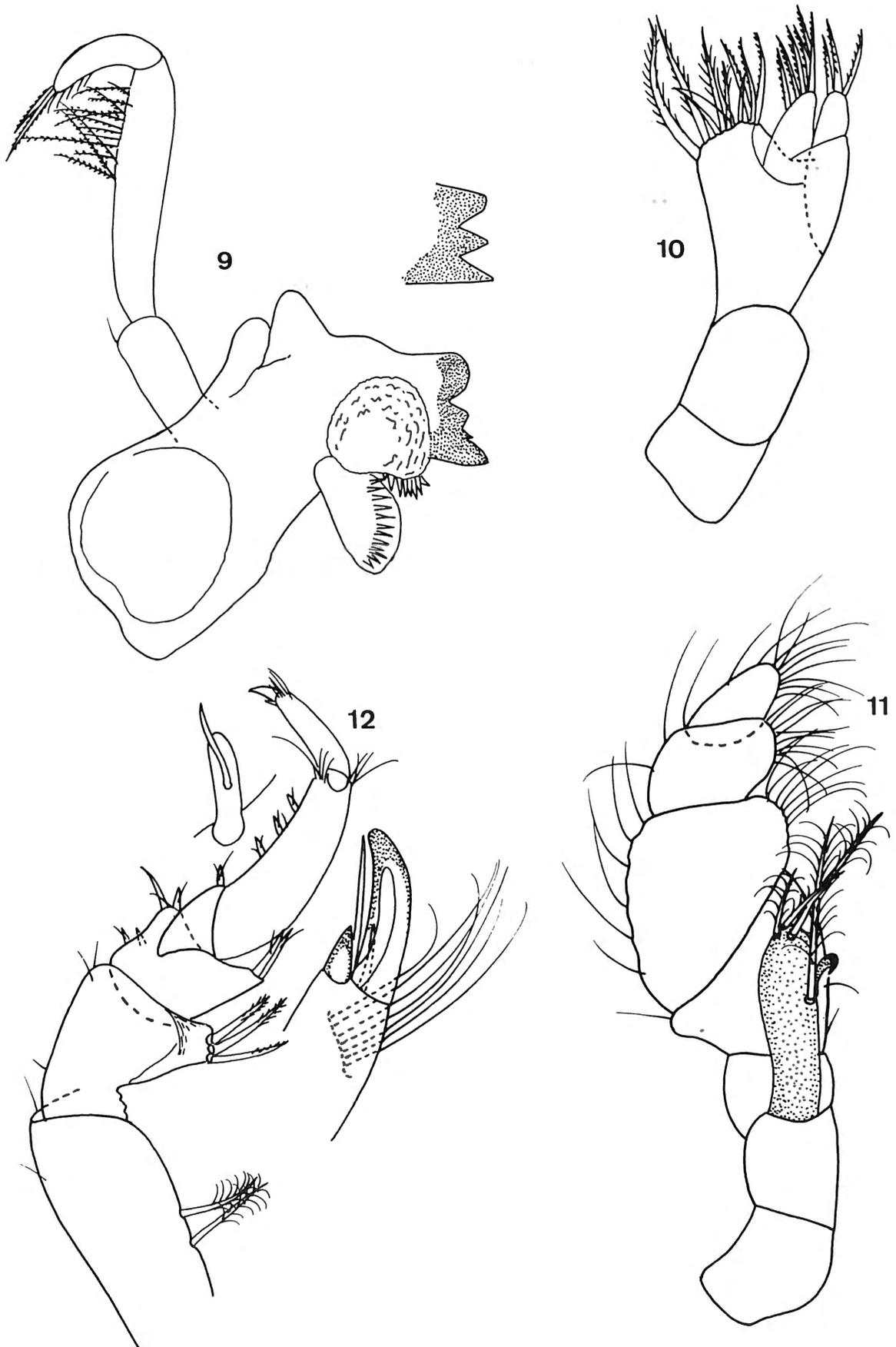
AII relatively short, reaching only to distal margin of



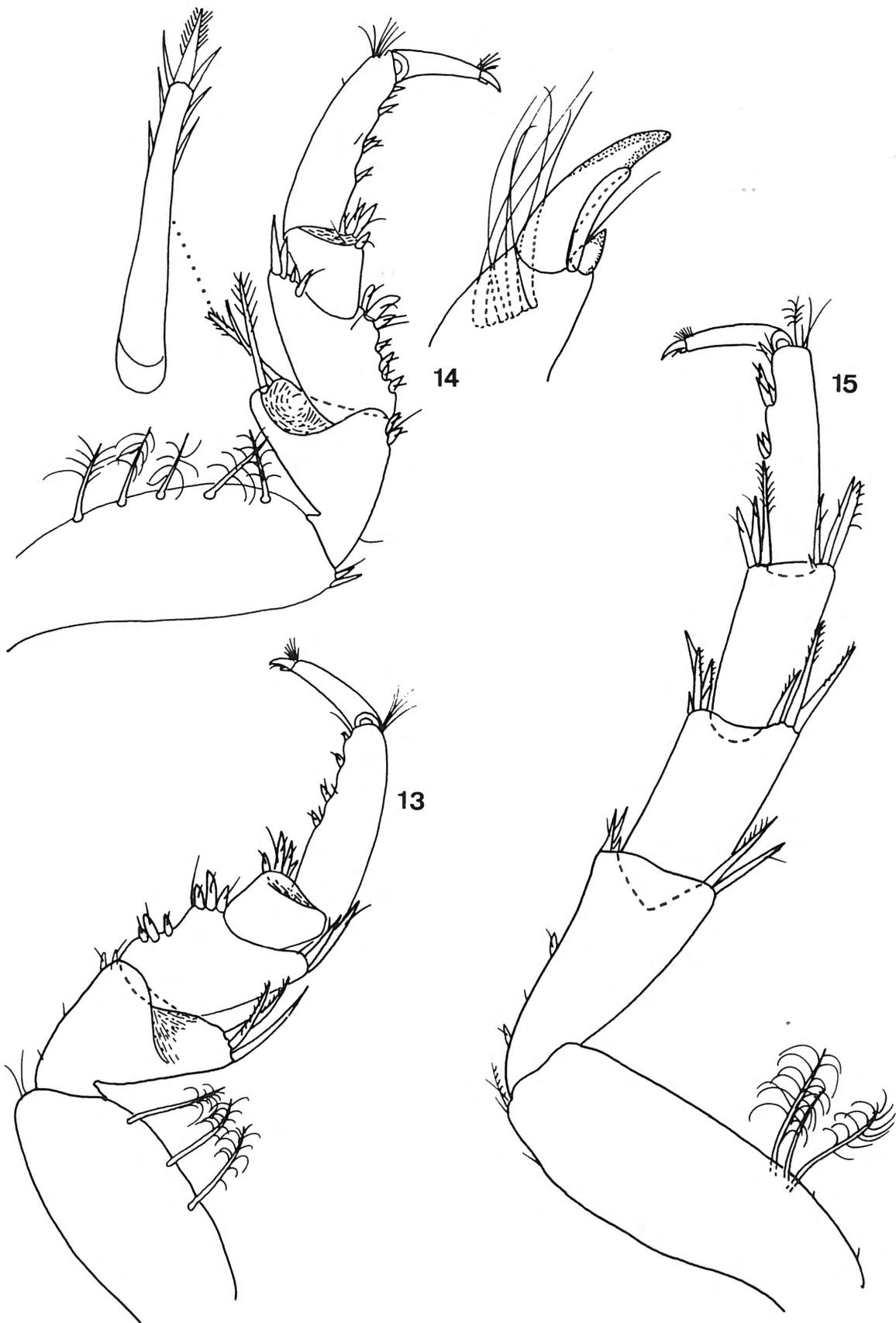
Figs. 1-5. — *Haptolana yunca*, female. — 1. Anterior part of body. — 2. Lamina frontalis and clypeo-labrum, ventral. — 3. Rostrum and lamina frontalis, lateral. — 4. Right uropod, dorsal. — 5. Pleon and pleotelson. Figs. 1 & 5: same scale; figs. 2 & 3: same scale



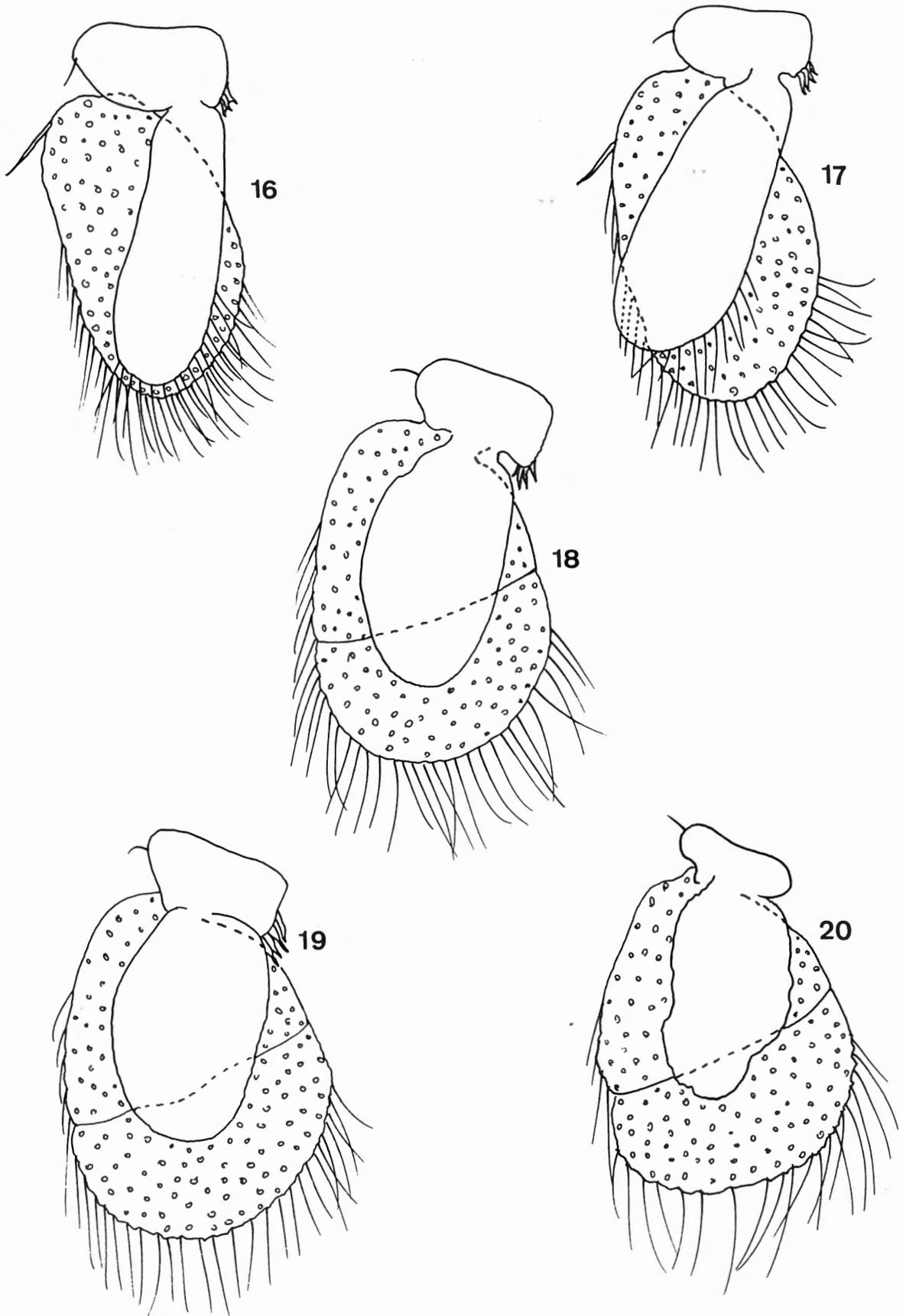
Figs. 6-8. - *Haptolana yunca*, female. - 6. Right AI, dorsal. - 7. Peduncle and first flagellar articles, right A II, dorsal (6 & 7: same scale). - 8. Left Mx. I, ventral.



Figs. 9-12. – *Haptolana yunca*, female. – 9. Left Mdb., dorsal (and acies of right Mdb.). – 10. Left Mx. II, ventral. – 11. Left Mxp., dorsal. – 12. Left gnathopod (with one of the spines on propodial palm, and with dactylian organ and unguis complex, more strongly magnified).



Figs. 13-15. – *Haptolana yunca*, female. – 13. Left P II. – 14. Right P III (with a “serrate trident spine” on ischium, and with dactylian organ and unguis complex, more strongly magnified). – 15. Left P VII. All pereiopods (figs. 12-15): same scale.



Figs. 16-20. – *Haptolana yunca*, female, left pleopods, dorsal.

pereiopite V; peduncle from five articles gradually longer, article 5 not much longer than article 4 (and distinctly shorter than 3+4); flagellum from 25 articles; in the disto-internal angle of peduncular articles 2-5 and of all flagellar articles excepting the first, are inserted bundles of setae.

Acies of the two mandibles rather strongly differing (Fig. 9 and detail); molar process with row of ca. 12 acute points placed far from the process' margin, and devoid of setulae at both ends of this row; all setae of the palp are pectinate.

Mx. I lateral lobe with ca. 12 spines and setae (only two shortly plumose), endite with 3 phanerae - internalmost one longest and shortly plumose; on the preparation illustrated in Fig. 8, it has been possible to see clearly that endite and lateral lobe articulate through a condylus and, respectively, a fossa.

Mx. II: external lobe with 3 setae, middle lobe with 6, internal lobe with 11 or 12 - almost all plumose or, at least, shortly plumose.

Mxp. with endite remarkably long, with 3 circumplumose apical setae (one much longer than the remaining two) and a long 4th one inserted much more proximally; only one coupling hook on the left Mxp.; most setae on the two last articles of the Mxp. are shortly plumose.

The pereiopods do not look very robust, especially because their propodi are slender. They are progressively longer, but the increase in length is not spectacular. There is difference between P I-III and IV-VII owing, i.a., to a) the fact that the strong expansions of the disto-external angles of ischium and merus in P I-III become attenuate in P IV-VII; and b) the more regular shape of ischium, merus, and carpus in P IV-VII. The dactyli, although swinging, are rather thick and short (they attain at most 1/2 of the length of the propodi). The spines arranged, "in V" - one of the characteristics of the genus - are well developed on P IV-VII, and less well on P II-III. Two other interesting peculiarities of all pereiopods should be emphasized: strong development of the dactylan organs (from 7 elements); and presence of two "additional unguis" (or "secondary spines") in the axilla of the main unguis: one long, slightly curved, blunt ending; and one short, conical (moreover, one or two setae).

Pleopods with poor armament of coupling hooks on the coxopodites; only endopodites of P I and II (abundantly) setose, and slender; all exopodites setose, considerably broader (and bipartite) in P III-V. Of course, all setae are plumose.

Uropods. Exopodite slightly shorter than endopodite, with some four spines along internal margin, several plumose setae inserted on this margin just before the truncate apex, and four spines inserted at regular distances along the external margin. Endopodite characterized by the remarkably rich set of phanerae along its internal margin and the distal part of the external one, rather long spines alternating with plumose setae; the equipment of tactile sensors on the dorsal surface of the endopodite is represented by not less than 6 palmate, loosely inserted setae - the distalmost three ones from a "sensory patch".

Pleotelson with length equaling its width at the base; proximal lateral angles strongly salient; along the rounded distal margin six short spines, and, between them as well as exceeding their row on both sides, finely plumose setae.

COMPARISONS

Genus *Haptolana* BOWMAN, 1966, was erected for *H. trichostoma*, a species known from several freshwater caves in Sierra de Cubita, Prov. Camagüey of Cuba. A second species, *H. somala* MESSANA & CHELAZZI, 1984, was collected from wells and springs along Wadi Nogal, northern Somalia. *H. pholeta* BRUCE & HUMPHREYS, 1993, was described from anchialine habitats on Barrow Island, Western Australia. BOTOSANEANU & ILIFFE described (1997) two additional species, *H. bowmani* from a cave in Yucatan, and *H. belizana* from an inland, freshwater "blue hole" in Belize. The 2nd species here described from Yucatan, is thus the 6th one of the genus. The distribution of species in this genus is clearly indicative of a Tethyan origin.

Diagnoses of *Haptolana* were given by BOWMAN (1966) and by BRUCE & HUMPHREYS (1993). Besides characters considered in these diagnoses, we enumerate here, based on our own observations, the following characters possibly shared by all species of the genus: lamina frontalis disk-shaped in lateral view; row of acute points on mandibular molar well distant from the margin; strongly developed dactylan organs on all pereiopods. Also the basal peduncular article of AI with peculiar structure, and the very well individualized apical zone of the distal peduncular article of AI, seem to be shared by all *Haptolana*; nevertheless, these characters are also shared by other stygobitic Cirolanidae (see, for instance, description of *Cirolana (Anopsilana) yucatanica* in the present paper).

The following characters will enable easy distinction of *H. yunca* n. sp. from all already described species: very characteristic shape of the cephalon; very characteristic shape of the clypeo-labral complex, and of lamina frontalis (in ventral view); and - possibly - the presence of two "accessory unguis", one long and one short, in all pereiopods.

H. yunca n. sp. differs from *H. bowmani*, also by: AI flagellum with less articles, much shorter AII with a shorter article 5 of peduncle and with less flagellar articles; pereiopods with more slender propodi and shorter dactyli; longer uropod exopodite; pleotelson wider (as wide as long), with a smaller number of apical spines.

From *H. belizana* the new species will be distinguished also by the following: all pereionial epimeres long, ending in sharp points; AI with shorter terminal article of peduncle and less flagellar articles; much shorter AII, its peduncle with 5 articles, last article much shorter, and less flagellar articles; pereiopods with much shorter and thick dactyli; pleopod coxopodites with much less coupling hooks and plumose setae; pleotelson with strongly salient basal angles, and less numerous apical spines.

It is not impossible that *H. bowmani*, *H. belizana* and *H. yunca* have a direct common marine ancestor. As to the 4th stygobitic species presently known from the Caribbean, *H. trichostoma*, the hypothesis of a direct common ancestry has to be excluded.

DERIVATIO NOMINIS

From Yuncu, the village in whose proximity Cenote Sabakha and probably other potential localities for the new species are found.

HABITAT AND ASSOCIATED FAUNA

Cenote Sabakha ("turbid water") is located 55 km south of Merida near the village of Yuncu (MATTHES, 2000). The entrance pool is an oval sinkhole, 40 m by 60 m, with a 8 m drop from ground level to the surface of the pool. An algal bloom producing greenish, murky water at the surface gives way to crystal clear waters below 15 m depth. At 63 m depth, a hydrogen sulfide layer with reduced visibility is situated at the halocline separating fresh water above and marine water beneath. At this point, the sinkhole has a circular cross section, 76 m in diameter. The top of a central talus cone is located at a depth of 87 m. Following the sides of the talus cone downwards, a depth of 147 m has been reached by divers at which point there was no discernable flow, with visibility of at least 30 m and no walls to left, right or straight ahead and no ceiling nor bottom to be seen. Just above the halocline, at depths of 55 to 60 m, large, horizontal passages extend 123 and 129 m, respectively, away from opposite sides of the entrance shaft. The westward trending tunnel has been named the Blind Cave Fish Café due to the abundant *Ogilbia pearsei* (HUBBS, 1938) observed in this section of the cave. It was from this passage at 60 m depth that a specimen of *Haptolana yunca* was collected by divers. Also collected were numerous copepods and two amphipods (submature specimens of *Tuluweckelia cernua* HOLSINGER, 1990, identified by John HOLSINGER). Also observed were abundant atyid shrimp *Typhlatya* sp. Water characteristics at this depth were salinity 1.4 g/l, temperature 27.45°C, pH 6.4, dissolved oxygen 3.8 mg/l and redox 294 mV.

Cirolana (Anopsilana) yucatanana n. sp.

Figs. 21-30

MATERIAL EXAMINED

Mexico, Yucatan, Mucuyche: Dzonotila. Female holotype and female paratype, collected on 30 October 1999 by Th.M. ILIFFE. In the Z.M.A.

DESCRIPTION

This description is based on the holotype. Length of holotype: 5.9 mm; of paratype: 4.2 mm (both mature). Completely depigmented, anophtalmous. Body regularly oval, rather strongly widened in the middle.

Cephalon large, strongly vaulted anteriorly, lateral margins strongly oblique towards median line, and very slightly depressed, posterior margin slightly depressed; rostrum small, triangular, in lateral view slightly downcurved, its point remaining rather distant from lamina frontalis. Lamina frontalis (ventral view) almost perfectly oval; in lateral view conical, slightly curved dorsad. Clypeus strongly protruding in its middle but with very narrow lateral arms leaning on labrum's sides; labrum with posterior margin rather deeply depressed in its middle.

Pereional epimera (excepting the VIIth) very attenuate, their

tips longitudinally directed, practically not visible dorsally. Pereionite VII not only almost entirely covering the Ist pleonite, but partly covering also the IInd one. Pleonites I-IV well developed (epimera of II and III very large); tips of pleonite V completely concealed behind pleonite IV.

AI reaching posterior margin of pereionite II, first two articles of peduncle coalescent, the resulting article basally twisted and with shallow lateral depression; terminal peduncular article, with its well individualized apical zone, distinctly longer and more slender; flagellum of 10 articles, on articles 4-9 aesthetascs (one on articles 4 and 5, two on 6-9) which are remarkably long, sometimes exceeding the length of two, or even three, flagellar articles.

AII reaching posterior limit of pereionite IV; peduncle with three short basal articles, progressively longer articles 4 and 5 each with one profusely plumose seta; 14 flagellar articles. Mdb. molar with 15-16 acute points near margin, abundant setulae distad from their row, but none proximad from it. Acies of left mandible with very blunt external tooth, pointed internal one, and between them a bipartite tooth (normally shaped in the right Mdb).

Mx. II with remarkably poor setation: only 2 glabrous setae on external lobe, 9 - in two parallel rows - on middle lobe, 7 (mostly only very shortly plumose near tip) on internal lobe. Mxp. endite with 3 circumplumose setae and one coupling hook.

Pereiopods structurally like in all *Anopsilana*, their most interesting peculiarity being their relatively very poor equipment of spines (as shown in figs. 26-29); dactyli relatively thick and progressively shorter from P I to P VII; dactylian organs from a restricted number of elements.

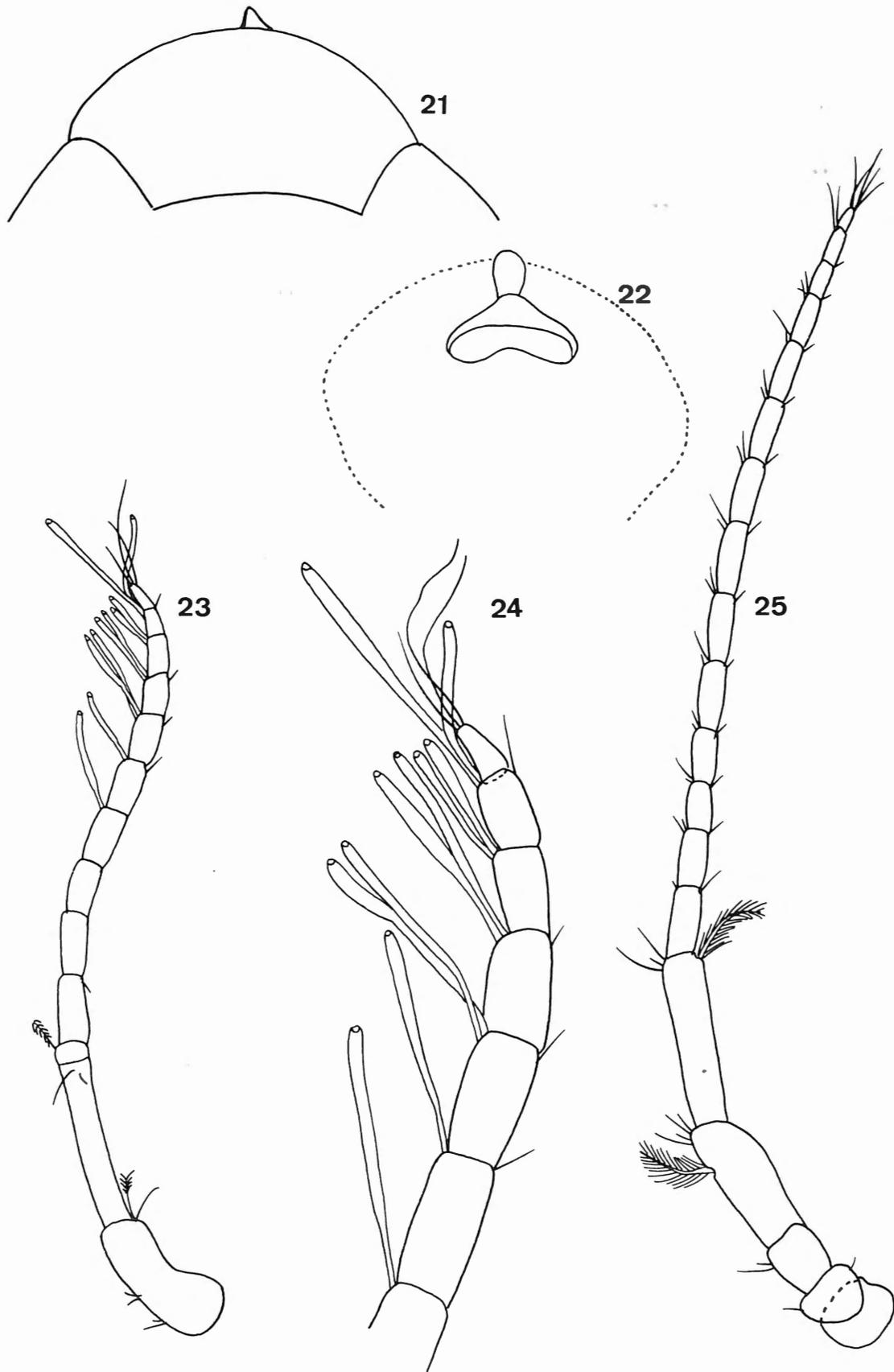
Pleopods typical for *Anopsilana*: endopodites III-IV much smaller than exopodites, endopodites III-V glabrous, exopodites III-V bipartite (but bipartition of III rather indistinct, whereas in exopodite I something like a faint bipartition could be observed).

Uropods slightly reaching beyond pleotelson; internal projection of coxopodite slender, ending in a point, setation very poor; endopodite thick-set, roughly rectangular, apex truncate and with small notch, 6-7 spines inserted on its margins; exopodite shorter, and, although more slender than endopodite, rather thick-set, apex truncate and with small notch, 8 spines inserted on its margins. Most setae of uropod, of course, plumose, the exception being the apical ones of the two rami.

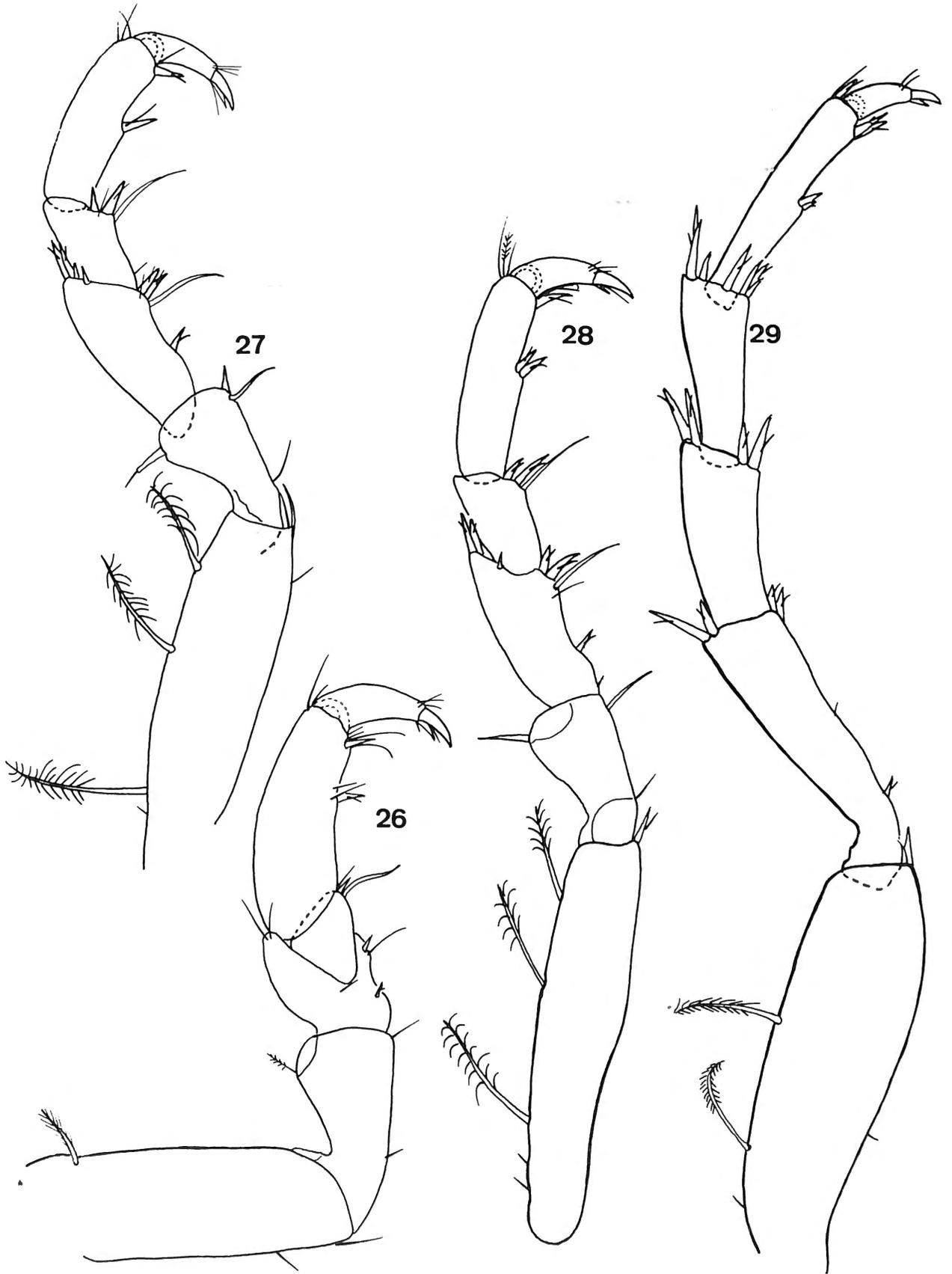
Pleotelson maximum width only slightly exceeding maximum length; lateral margins very slightly converging towards a distal margin which is rounded, without any tendency of becoming truncate or pointed. In middle of distal margin only 4 short, truncate spines, and between them or exceeding their row on both sides, a reduced number (16 in holotype) of plumose setae conspicuously longer than the spines.

COMPARISONS

BOTOSANEANU & ILIFFE (1997) gave *Anopsilana* PAULIAN & DELAMARE DEBOUTTEVILLE, 1956, the status of subgenus of *Cirolana* LEACH, 1818, represented besides a number of non-subterranean (marine, estuarine, mangal-inhabiting)



Figs. 21-25. – *Cirolana (Anopsilana) yucatanana*, female. – 21. Cephalon. – 22. Lamina frontalis and clypeo-labrum, ventral (21 and 22: same scale). – 23. Right AI, dorsal. – 24. Last 7 articles of flagellum, right AI, more strongly magnified. – 25. Right AII, dorsal (23 & 25: same scale).



Figs. 26-29. — *Cirolana (Anopsilana) yucatana*, female, right gnathopod and P II, P III, and P VII (all same scale).

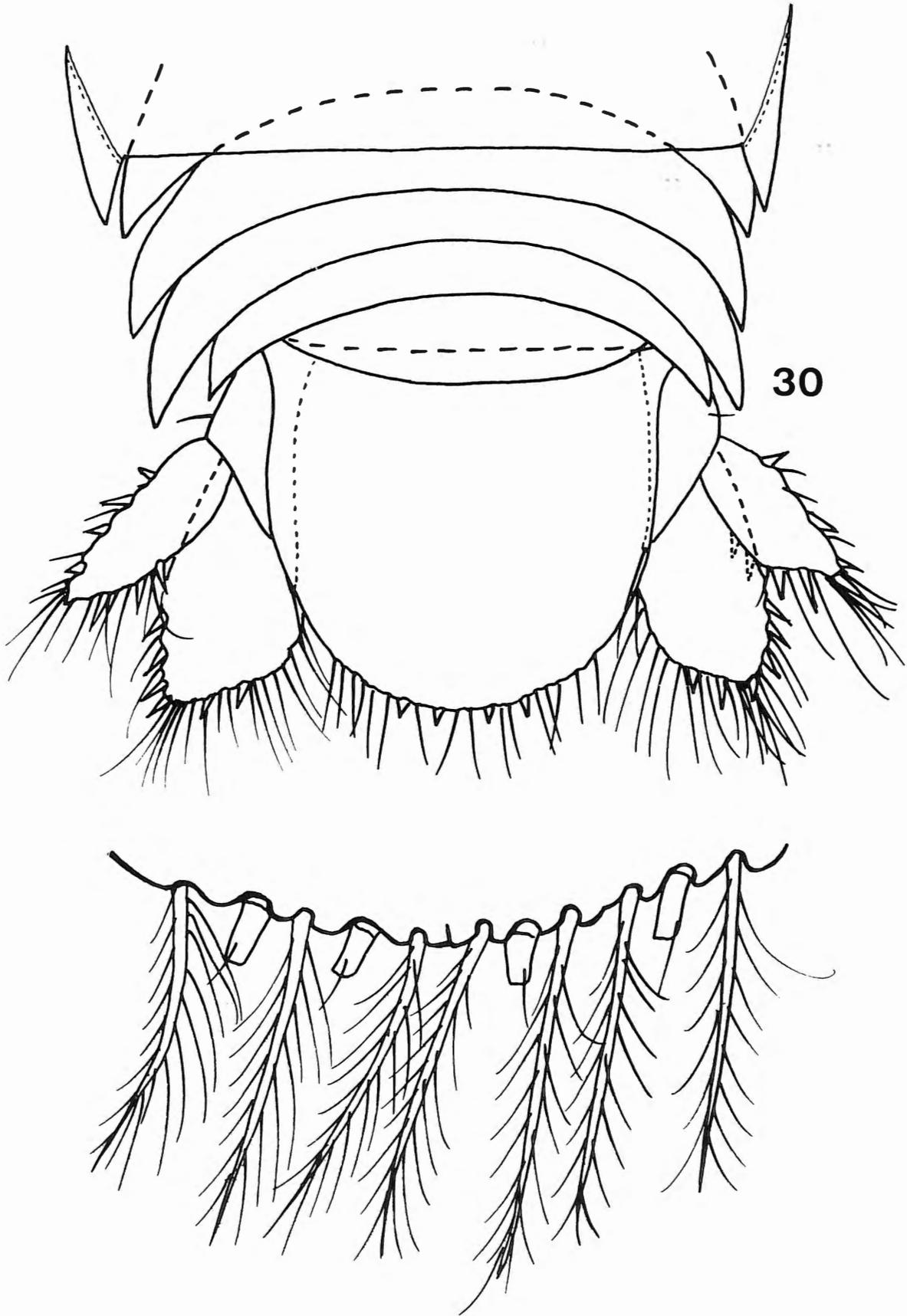


Fig. 30. – *Cirolana (Anopsilana) yucatanana*, female, pleon, pleotelson and uropods (with more strongly magnified median part of distal margin of pleotelson).

species, by several truly stygobitic and troglomorphic species. To this last category belong the following described species: *cubensis* HAY, 1903 (re-described in Rioja, 1956): Cuba; *poissoni* (PAULIAN & DELAMARE DEBOUTTEVILLE, 1956): Madagascar; *acanthura* (NOTENBOOM, 1981) and *radicicola* (NOTENBOOM, 1981): Haiti; *crenata* (BOWMAN & FRANZ, 1982): Grand Cayman Island; *lingua* (BOWMAN & ILIFFE, 1987): Palau Island; *conditoria* (BRUCE & ILIFFE, 1992): Philippines; and *pleoscissa* (BOTOSANEANU & ILIFFE, 1997): Jamaica.

We place *pleoscissa* in this list, considering genus *Jamaicalana*, erected for it, as being a synonym of *Cirolana* (*Anopsilana*): new synonymy. As a matter of fact, the Jamaican species shows, in spite of several impressively distinctive characters (BOTOSANEANU & ILIFFE, 1997: 92-93) much similarity, for instance, with a species like *C. (A.) lingua*, and it should be emphasized that a very striking character considered as being diagnostic for *Jamaicalana*, i.e., the split endopodites of Pl III-V, is found in three other genera of stygobitic Cirolanidae (BOTOSANEANU, 2001), being obviously an element of troglomorphy.

C. (A.) yucatanana n. sp. is a typical member of the subgenus, corresponding in all respects to the diagnosis given by BRUSCA *et al.* (1995) for *Anopsilana*. It is the first species known from Mexico (or from a non-insular locality!). For obvious reasons, it will be compared in detail with the 5 described peri-Caribbean species.

Characters shared with *C. (A.) acanthura*: Shape of AI and of AII peduncle. The n. sp. differs from *acanthura* in: smaller size, AI longer and with longer aesthetascs, AII flagellum with less articles, Mdb. molar with setulae only distad from row of points, Mxp. endite with only one coupling hook, Mx. II setation poorer, gnathopod and P II with less spinose internal margin of ischium-merus-propodus, number and distribution of spines on uropod rami, telson distally perfectly rounded and with much smaller number of spines.

Characters shared with *C. (A.) radicicola*: shape of AI peduncle, spines and setae on distal margin of telson. The n. sp. differs from *radicicola* in: cephalon with very oblique lateral margins, AI longer and its flagellum with much less numerous but considerably longer aesthetascs, AII flagellum with much less articles, Mdb. molar with setulae only distad from row of points, Mxp. endite with one coupling hook and less plumose setae, gnathopod and other pereopods with less spinose internal margin of merus and propodus and with thicker (and in the posterior pereopods also shorter) dactyli, telson distally perfectly round.

Characters shared with *C. (A.) crenata*: shape of AI and AII peduncle; general shape, and spine armament of pereopods. The n. sp. differs from *crenata* in: cephalon longer (longer lateral margins), quite different shape of lamina frontalis, AI longer, AII shorter and with less flagellar articles, Mdb. molar with setulae only distad from row of points, Mx. II setation much poorer, Mxp. endite with only one coupling hook, gnathopod with propodial palm devoid of "scales giving it a scalloped appearance", thicker dactyli, uropod rami distinctly more thick-set and with different number and arrangement of spines, telson distally perfectly round and with less spines.

Characters shared with *C. (A.) cubensis*: length of AI and

shape of its peduncle, Mdb. molar with setulae only distad from row of points, dactyli relatively thick. The n. sp. differs from *cubensis* in: shape of cephalon, AI with less flagellar articles and much longer aesthetascs, shorter AII with much less flagellar articles, Mx. II less setose, Mxp. endite with less plumose setae and only one coupling hook, gnathopod and other pereopods with various articles less spinose, uropod rami less slender and with less rich equipment of spines and setae, telson distally perfectly round and with less spines and plumose setae on distal margin.

Characters shared with *C. (A.) pleoscissa*: AI flagellum with about the same reduced number of articles, setation of the three lobes of Mx. II almost identical (relatively poor), Mxp. endite with only one coupling hook, shape of uropod rami, telson distally rounded (however, more strongly than in *pleoscissa*). The n. sp. differs from *pleoscissa* in: the quite different shape of cephalon, of rostrum, and of lamina frontalis, AI peduncle with only two articles and its flagellum with more and much longer aesthetascs, AII peduncle with 5th article relatively shorter and flagellum with much less articles, Mdb. molar with setulae, merus of gnathopod and P II devoid of very strong spines, all dactyli thicker, accessory unguis longer, endopodites of Pl III-V not split, uropod coxopodite with much less developed and much less setose internal projection, rami with very different number and arrangement of spines, distal margin of telson with less spines and setae (but setae longer).

HABITAT AND ASSOCIATED FAUNA

Dzonot-ila is located 52 km south of Merida, near the town of Abalá. The entrance to this cenote consists of a rectangular well shaft, about 1.5 by 2 m and 12 m deep. This well provides water for cattle kept by the owner of the hacienda. A ladder is used to descend to a 40 m diameter lake room with a shallow breakdown mound in the center. The largest section of the underwater cave consists of a passageway 40 m wide and 30 m high at 24 to 32 m depths. The floor of this passage consists of a ridge of large breakdown blocks running down the center with deepest depths along the walls. At the far end of this passage, 230 m from the entrance, a small restriction leads to an underwater room, well decorated with stalactites and stalagmites. At the opposite side of the lake, a very tight restriction leads to another very well decorated room at 17 m depth. Isopods were collected by divers from the water column in 30-40 m depths. Also collected were amphipods (*Tuluweckelia cernua* identified by John Holsinger), copepods and stygiomysids. Only freshwater has been found within this cave.

It is interesting to note that within a relatively small area, radius of approximately 10 km, are located Cenote Mucuyché and Cenote Yuncu (with *H. bowmani*, see BOTOSANEANU & ILIFFE, 1997: 81); Cenote Sabakah (with *H. yunca*); and Dzonot-ila (with *C. (A.) yucatanana*). The Yucatan Secretaria de Ecología is conducting an inventory of cenotes within the State of Yucatan and has so far catalogued more than 1200 cenotes and 100 caves. Considering that very few of these have been explored by divers, and much less by cave diving biologists, the potential for future biological discoveries in Yucatan is enormous.

Note on *Yucatalana robustispina*

BOTOSANEANU & ILIFFE, 1999

From the type locality (Cenote Papak'al, Eknakan, Yucatan) one additional female specimen was caught by Th. M. ILIFFE on 31 October 1999. This specimen deserves a special mention, because it has 10 pulli in its marsupium - a remarkably high number of progeny for a stygobitic cirolanid.

Acknowledgements

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