A NEW SPECIES OF *HALICYCLOPS* (COPEPODA, CYCLOPOIDA, CYCLOPIDAE) FROM CENOTES OF THE YUCATAN PENINSULA, MEXICO, WITH AN IDENTIFICATION KEY FOR THE SPECIES OF THE GENUS FROM THE CARIBBEAN REGION AND ADJACENT AREAS

Carlos E.F. Rocha, Thomas. M. Iliffe, Janet W. Reid & Eduardo Suárez-Morales

SARSIA

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Halicyclops cenoticola sp. nov. is described from cenotes of the Yucatan Peninsula, Mexico. The new species shares exclusively with *H. caridophilus* and *H. tetracanthus* the presence of 2 inner setae on the leg 5 exopod in the males. As far as is known, the new species is distinguished from all its congeners in having the dorsal caudal seta as long as the outer middle caudal seta; legs 2 and 3 are dimorphic concerning the structure of the 3 inner setae on the terminal endopodal segment; and leg 6 of both the male and female consists of only 2 elements.

An identification key for the *Halicyclops* species known from the Caribbean Region, the Gulf of Mexico, Bermuda, and the coast of French Guiana is included.

Carlos E.F. Rocha, Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Caixa Postal 11461, 05422-970 - São Paulo, Brazil, e-mail: cefrocha@usp.br. – Thomas. M. Iliffe, Department of Marine Biology, Texas A & M University at Galveston, P.O. Box 1675, Galveston, Texas 77553, U.S.A. – Janet W. Reid, Smithsonian Institution, National Museum of Natural History, MRC 163, 20560 Washington DC, U.S.A. – Eduardo Suárez-Morales, El Colegio de la Frontera Sur-Chetumal, A.P. 424. Chetumal, 77000 Quintana Roo, Mexico.

Keywords: Copepoda; *Halicyclops*; Caribbean fauna; cenotes; Mexico.

INTRODUCTION

Very little is known about the specific diversity of the genus *Halicyclops* in the extensive lagoon and estuarine areas along both the Pacific and Caribbean coasts of Mexico. The first Mexican record of the genus was provided by C.B. Wilson (1936), who identified as *H. magniceps* (Lilljeborg, 1853) a female collected from a saline pond at Progreso, on the Yucatan Peninsula. As *H. magniceps* is a European species and also C.B. Wilson did not give any morphological characters, allowing for later checking of his identification, this record was considered questionable, first by Lindberg (1955), and then by other authors dealing with the *Halicyclops* fauna in North America (M.S. Wilson 1958; Reid 1990; Rocha & Hakenkamp 1993). Fiers (1995) suggested that Wilson's *H. magniceps* might correspond to his new species *H. caneki*, probably because the material of both had been collected in the same area in Yucatan. In our opinion, it is impossible to know the true identity of C.B. Wilson's specimen, as it is no longer available for examination, and the environmental conditions of the pools near Progreso have changed so drastically since the sample analysed by C.B. Wilson was taken that a survey conducted by Fiers (1995) revealed no copepods in them at all. In addition, several species of *Halicyclops* can live together in a small area: for instance, Rocha (1981, 1983, 1984) recorded 9 species in about 1.5 km of an estuary in the northeast of Brazil; and Lansac-Tôha & Lima (1993) reported 8 species in the upper part of another estuary in southeastern Brazil. Thus, it is expected that several other *Halicyclops* species, such as the one described below, could be found as more and more brackish habitats in the Yucatan Peninsula are investigated, all of them with the possibility of corresponding to the *H. magniceps* of C.B. Wilson.

As mentioned by M.S. Wilson (1958), another questionable record of *Halicyclops* from Mexico is that of Comita (1951), who listed *H. aequoreus propinquus* Sars, 1905 from a lagoon near Acapulco. Reid (1990) considered Comita's record as doubtful, and accepted Dussart & Defaye's (1985) proposition that it was a misidentification of *H. neglectus* Kiefer, 1935, also a European species.

Suárez-Morales & al. (1986) mentioned an unidentified species of *Halicyclops* as dominating, together with

Mastigodiaptomus albuquerquensis (HERRICK, 1895), the winter zooplankton community of the Laguna de Catemaco, an isolated freshwater volcanic lake located in Sierra de los Tuxtlas, Veracruz. This is an unusual habitat for *Halicyclops*, which has already been reported from freshwater, but always in rivers connected to the sea (ROCHA 1995b).

The above discussion indicates the importance and necessity of intensifying investigations in fresh- and brackish waterbodies in Mexico to improve our knowledge about *Halicyclops* and associated fauna living in these environments.

MATERIAL AND METHODS

Whole specimens were examined in temporary lactic acid mounts in different positions (see ROCHA 1995a). After examination the specimens were returned and preserved in 70 % ethanol.

Dissected and whole specimens were examined for variation in the characters described as well as for preparing and checking the drawings.

The figures were made using an oil immersion lens and a camera lucida on a Leitz Laborlux D phase-contrast microscope.

TAXONOMY

Halicyclops cenoticola ROCHA, sp. nov.
(Figs 1-20)

Material examined

Mexico, Yucatan: Grutas de Santa Maria, Homun, (20°50'50"N, 89°11'40"W), 21 June 1991, 2 females, 4 males from sample #91-016 collected with 93 µm mesh plankton net from water column and sand bottom of cave pool in 0-6 m water depths; Grutas de Tzab-Nah, Tecoh, (20°44'50"N, 89°28'40"W), 27 June 1991, 1 female and 1 male from sample #91-021 collected with 93 µm mesh plankton net from water column and sand bottom of cave pool in 0-8 m water depths; Noc Ac Cenote (21°05'30"N, 89°54'50"W), 7 July 1993, 8 females, 6 males and 9 copepodids from sample #93-044 collected with 93 µm mesh plankton net from water column of cave pool in 10-15 m water depths; Yuncú Cenote (20°34'51"N, 89°36'46"W), 10 July 1993, 2 females, 3 males and 1 copepodid from sample #93-046 collected with 93 µm mesh plankton net from water column of cave pool in 15-30 m water depths; 13 August 1994, 3 females and 1 male from sample #94-023 collected with 93 µm mesh plankton net from water column of cave pool in 0-5 m water depths. Quintana Roo: Mayan Blue Cenote (20°11'06"N, 87°29'45"W), 16 August 1994, 1 female from sample #94-024B collected with 93 µm mesh plankton net from water column of submerged cave passage in 10-20 m water depths; Carwash Cenote (20°16'26"N, 87°29'11"W), 17 August 1994, 1 female and 1 copepodid from sample #94-025B collected with 93 µm mesh plankton net from water column of downstream submerged cave passage in 21 m water depths; Cristal (= Najarone) Cenote (20°11'36"N, 87°29'53"W), 20 August 1994, 1 female from sample #94-027 collected with 93 µm mesh plankton net from water column of submerged cave passage in 16-18 m water depths. All material collected by T.M. Iliffe. Female holotype ((USNM 261781) and 35 paratypes (USNM 261782-261789) deposited in the National Museum of Natural History, Washington DC, USA; 5 paratypes (ECO-CHZ-00313) in the collection of El Colegio de la Frontera Sur, Chetumal, Mexico; and 4 paratypes in the Museu de Zoologia of the University of São Paulo, São Paulo, Brazil (MZUSP 12796).

Habitat description.

Grutas de Santa Maria are located on the northwest edge of the village of Homun. The entrance consists of a 2 m deep, 4 m diameter sinkhole with a breakdown slope descending into a chamber about 15 m in diameter. Two passages extend off from this room. One is partially blocked by a flowstone encrusted Mayan wall, while the other leads to two deep clear pools. The first of these pools is 15 m long by 5 m wide and more than 10 m deep where it opens into a large underwater chamber. The floor of the pool consists of sunken calcite rafts and breakdown. The water was very clear. Mysids (*Antromysis cenotensis* CREUSER, 1936), juvenile amphipods (*Mayaweckelia cenoticola* HOLSINGER, 1977), cladocerans and ostracods were also collected from the pool.

Grutas de Tzab-Nah are located 2 km south of the village of Tecoh on the road to Telchaquillo. The 1.8 m high by 3 m wide entrance is in a gently sloping sink, 100 m east of the road. To the left, walking passage in the cave leads to a bridge across a 7 m deep chasm with a lake at the bottom. Across the bridge and to the right, the main passage of the cave continues past several deep fissure pools and two crawlways to a 30 m diameter lake. Two artificial well shafts enter this large chamber at opposite ends of the lake. Underwater, the sandy bottom of the lake slopes down to a 20 m wide submerged cave entrance at 15 m depth. This underwater passage of solutional origin continues for 130 m to 33 m depth where it abruptly ends. While the water in this section of the cave is exceptionally clear, other pools in the cave are murky and have a thick scum at the surface. This pollution apparently arises from liquid wastes from a heniquen processing plant located above the cave. Aquatic fauna reported from the cave by REDDELL (1977) included mysids (*Antromysis cenotensis*), amphipods (*Mayaweckelia cenoticola*), atyid shrimp (*Typhlatya mitchelli* HOBBS & HOBBS, 1976) and *T. pearsei* CREASER, 1936) palaemonid shrimp (*Creaseria morleyi* CREASER, 1936), blind eels (*Ophisternon infernale* HUBBS, 1938) and brotulids (*Typhliasina pearsei* HUBBS, 1938). In addition, ostracods, isopods (*Creaseriella anops* Creaser, 1936) and thermosbaenaceans were also collected from the last lake.

Noc Ac Cenote is located 1 km south of the village of Noc Ac. The circular, 4 m diameter sinkhole entrance lies directly above a clear deep pool. Depth from the surface of the ground to water level is 3 m. Below the entrance, water depths are 3 m. The rock surrounding the entrance sinkhole is undercut such that a room 22 m long by 14 m wide is present at water level. Directly beneath the entrance, the floor of the pool consists of gravel. Detrital organic matter and large breakdown boulders cover the bottom in areas under the ledge. The water is very clear. At opposite ends of the pool, segments of the cave continue down over breakdown to 35 and 21 m depths but no passage development was found. Numerous fish are present in all sections of the entrance pool. Isopods (*Creaseriella anops*) and shrimp (*Typhlatya* sp.) were collected from the deeper waters in darkness.

Yuncu Cenote is located about 1.5 km west of Yuncu on the west side of an abandoned railroad right-of-way running north to south. The entrance consists of a vertical pit, 7 m in diameter and 10 m deep, descended by a ladder made from railroad track. At the bottom of the ladder, a breakdown slope descends to the edge of a U-shaped pool that continues ¾ of the way around the northern side of the 40 m long by 37 m wide entrance chamber. Large, 1-3 m diameter stalagmitic columns are present in the rear of this chamber. The pool on the east side of the chamber is very shallow - averaging about 1 m deep. However, on the west side, the pool extends down to over 30 m depth where it pinches out between breakdown and the bedrock wall. Large stalactites and stalagmites are present in the submerged portions of the cave. Mysids (*Antromysis cenotensis*), ostracods, thermosbaenaceans, amphipods, and isopods were also collected from the pool.

Mayan Blue Cenote is located about 5 km inland from the Caribbean coast, about 3 km south of Tulum Pueblo. Total survey length of this cave system is 15.5 km making it one of the longest underwater caves in the world. Primary orientation of the cave is perpendicular to the coast suggesting that it serves as a major drainage conduit to the sea. Cave passages are predominantly developed at the halocline in 15 m water depths where mixing corrosion between fresh and salt water occurs. Water above the halocline has an average salinity less than 2, while below the abrupt halocline at 18 m depth, salinity is 35. Shrimp (*Typhlatya* spp. and *Creaseria morleyi*), remipedes (*Speleonectes tulumensis* Yager, 1967), ostracods (*Danielopolina mexicana* Kornicker & Iliffe, 1989 and *Spelaeoecia* sp.), thermosbaenaceans (*Tulumella unidens* Bowman & Iliffe, 1988), mysids (*Antromysis cenotensis*), amphipods (*Tuluweckelia cernua* Holsinger, 1990), isopods (*Bahalana mayana* Bowman, 1987 and *Creaseriella anops*) and fish (*Typhliasina pearsei*) inhabit the cave (Iliffe 1993).

Carwash Cenote is located about 8 km west of Tulum Pueblo on the road to Coba. It is situated about 50 m to the south of the highway and has now been developed into a commercial diving operation. At one time, water from the cenote was used for washing cars which could be driven within a few meters. The open water basin is about 50 m long by 15 m wide and averages 5 m deep. Underwater cave entrances are located at opposite ends of the basin. The upstream entrance is approximately 45 m wide and opens in a large cavern that is well decorated with large stalactites and stalagmites. A halocline is encountered at 21 m depth. Submerged passageways extend both upsteam and downstream from the main pool. Total surveyed length of the cave is 2874 m. Cave fauna is similar to Mayan Blue.

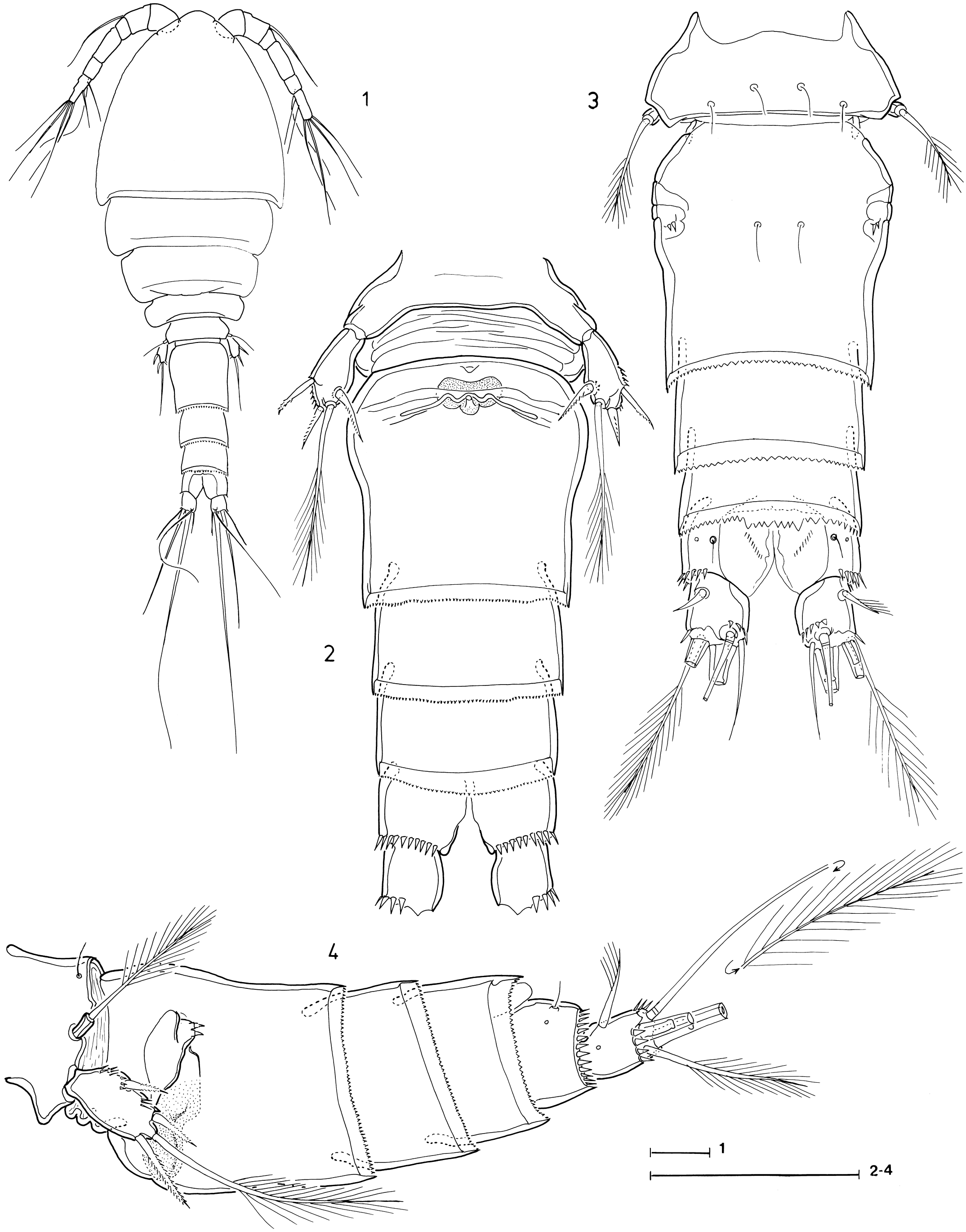
Cristal (= Najarone) Cenote is located on the west side of the Tulum-Chetumal highway, about 3 km south of Tulum Pueblo. This cave is part of the Mayan Blue-Najarone Cave System also know as Systema Naranjal. Najarone Cenote is situated about 1 km inland and upstream from Mayan Blue. It is a popular swimming locale and is commercially operated as such. While the cave walls in Mayan Blue are generally white, a black coating of the iron manganese mineral phreatite covers the walls in Najarone. Cave fauna is similar to Mayan Blue.

Female

Body length, excluding caudal setae, 380-425 µm (n = 7). Prosome: urosome ratio 1.92-2.15: 1. Posterior borders of all prosomites and first urosomite smooth (Figs 1-4). Genital double somite (Figs 2 and 3) as long as wide, swollen proximally. Seminal receptacle as shown in Fig. 2. Hyaline frills of genital double somite and two subsequent somites (Figs 2-4) serrate. Anal pseudoperculum formed by short expansion of hyaline frill irregularly serrate.

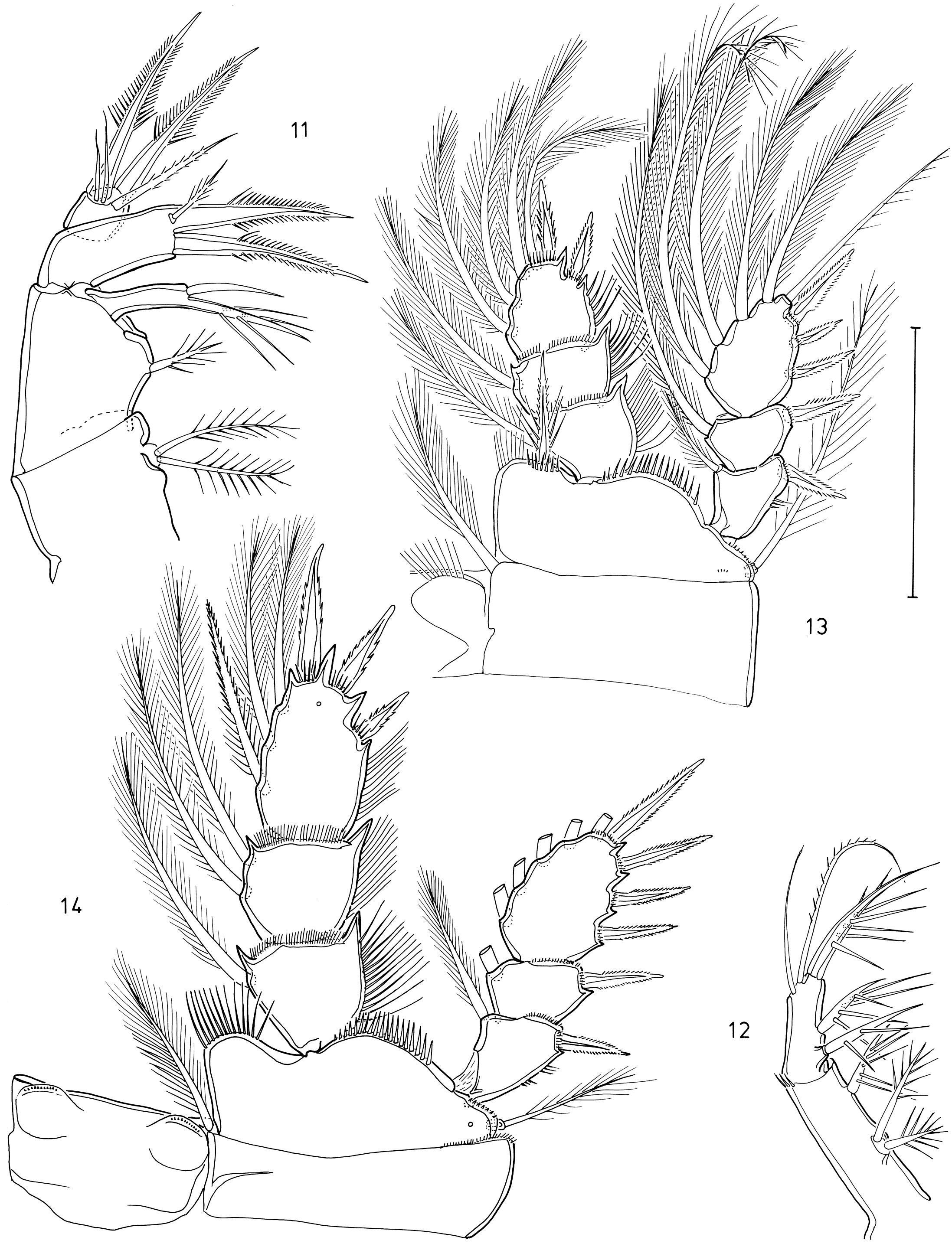
Caudal rami (Figs 2-4) 1.1 times wider than long. Outermost apical seta about 2.8 times longer than ramus. Innermost apical seta reaching half length of outermost apical seta and being 1.6 times longer than ramus. Dorsal seta as long as outer middle apical seta (Fig. 1). Inner middle apical seta twice longer than outer middle apical seta. Proximal half of inner middle apical seta (Fig. 5) sparsely spinulose distally; distal half densely spinulose proximally and plumose terminally. Outer middle apical seta armed with spinules on outer margin; inner margin spinulose proximally and plumose distally.

Cephalothorax without dorsal integumental window. Pattern of integumental pores of prosome not investi-



Figs 1-4. *Halicyclops cenoticola* ROCHA, sp. nov., female. 1. Habitus, dorsal; 2. Urosome, ventral. 3. Urosome, dorsal; 4. Urosome, lateral. Scale bars = 50 μm.

Figs 5-10. *Halicyclops cenoticola* ROCHA, sp. nov., female. 5. Middle apical caudal setae. 6. Antennule, ventral. 7. Antenna, anterior. 8. Labrum, ventral. 9. Mandible, posterior. 10. Maxillule, inner posterior. Scale bars = 50 µm.



Figs 11-14. *Halicyclops cenoticola* ROCHA, sp. nov., female. 11. Maxilla, posterior. 12. Maxilliped, anterior. 13. Leg 1, anterior. 14. Leg 2, anterior. Scale bar = 50 µm.

gated. Genital double somite without integumental window on each side of posterior half. Urosome with few integumental pores located dorsally on first somite as well as on genital and anal somites. Each caudal ramus bearing lateral pore at level of lateral seta. Ventral surface of urosome entirely lacking in pores.

Antennule (Fig. 6) of 6 segments, and armed as follows: 8, 12, 5 + spine, 5, 3 + aesthetasc, 10 + aesthetasc. Segment 4 about 2.3 times longer than wide.

Antenna (Fig. 7) consisting of 4 segments. Coxa reduced and unarmed. Basis with row of few spinules on outer margin proximally, and 2 setae at inner corner; seta representing exopod present. Proximal endopodal segment bearing seta. Terminal endopodal segment with 5 setae on inner margin and 7 setae around apex.

Labrum (Fig. 8) with teeth of different sizes on posterior margin and 2 groups of setules on ventral surface.

Mandible (Fig. 9) consisting of gnathobase and palp represented by 2 setae implanted directly on coxa.

Maxillule (Fig. 10) comprised by praecoxa and 2-segmented palp. Praecoxal arthrite with 3 spines fused to segment and 1 articulated spine on apex; inner surface armament consisting of 6 setae and 1 spine. Palp composed of basis bearing 3 setae on inner margin, and 1 proximal outer seta representing exopodite; endopodite 1-segmented and with 3 setae.

Maxilla (Fig. 11) 4-segmented. Praecoxa fused to coxa on posterior surface and with 2 setae on endite. Coxa with 1 proximal seta inserted on segment and 2 distal setae implanted on well developed endite; seta fused to endite ornamented with 4 long setules. Basis drawn out into claw and armed with 2 setae; strong seta little longer than claw. Endopod carrying 2 short naked setae, 1 sparsely spinulose seta of intermediary size, and 2 strong setae densely spinulose like claw and strong seta of basis.

Maxilliped (Fig. 12) 2-segmented, armed with 3 setae on basal segment and 5 setae on distal segment. Distal seta of basal segment as well as both proximal setae and inner apical seta of distal segment with long stiff setules. Smooth outer apical seta of distal segment almost as long as inner apical seta. Middle apical seta of distal segment longer than inner apical seta and sparsely setulose.

Table 1. Numbers of spines (Roman numerals) and setae (Arabic numerals) per segment of the swimming legs 1 to 4 of *Halicyclops cenoticola* sp. nov.

	Coxa	Basis	Exopod			Endopod		
			1	2	3	1	2	3
Leg 1	0-1	1-I	I-1;	I-1;	III,1,4	0-1;	0-1;	I,I+1,3
Leg 2	0-1	1-0	I-1;	I-1;	III,I+1,4	0-1;	0-2;	I,II,3
Leg 3	0-1	1-0	I-1;	I-1;	III,I+1,4	0-1;	0-2;	I,II,3
Leg 4	0-1	1-0	I-1;	I-1;	II,I+1,4	0-1;	0-2;	I,II,II

Swimming legs 1-4 (Figs 13-15) armed as in Table 1.

Spine inserted at inner corner of leg 1 basis (Fig. 13) reaching distal edge of leg 1 endopod 2. Spines of leg 1 exopod as long as or little shorter than spines of exopods of other swimming legs. Endopod 3 of legs 2 and 3 with proximalmost seta stiff, serrate distally and plumose basally. Both setae of leg 4 endopod 2 plumose, similar in length and not overpassing tip of inner apical spine. Leg 4 endopod 3 (Fig. 15) 2 times longer than wide; inner apical spine about 1.13 times longer than segment, and 1.3 times longer than outer apical spine. Both inner setae spiniform and armed with short stiff setules. Inner distal seta as long as inner apical spine. Inner proximal seta positioned as shown in Fig. 15 in all specimens examined.

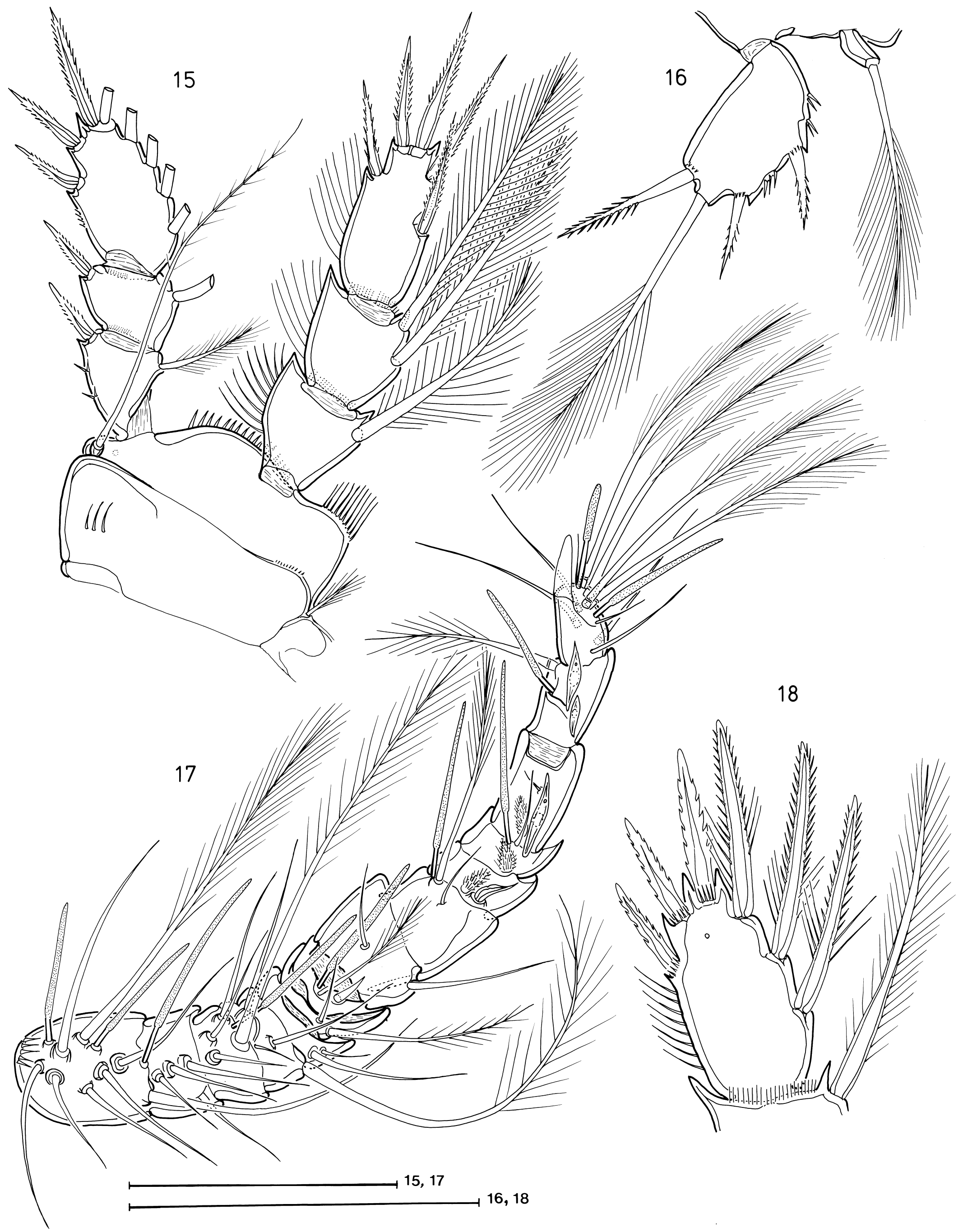
Leg 1 without any integumental pore. Legs 2 and 3 with integumental pore located on anterior surface of basis near insertion area of exopod and another pore on anterior surface of terminal endopodal segment between both apical spines. Leg 4 with pore at outer corner of basis. Intercoxal sclerite of leg 1 with 2 rows of setules on free margin; that one of leg 2 with 2 rows of spinules; sclerites of legs 3-4 naked.

Leg 5 exopod (Fig. 16) elongate, 1.8 times longer than broad, and bearing 3 spines, all shorter than segment, and 1 seta; inner apical spine 1.75 times longer than both outer spines.

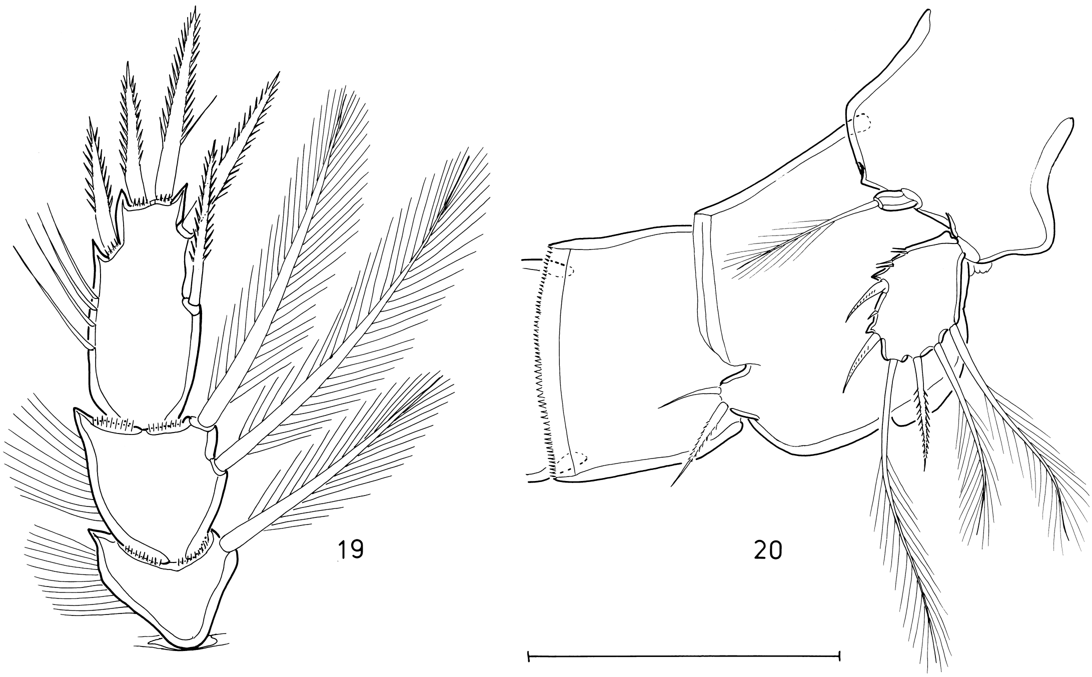
Male

Body length, excluding caudal setae, ranging from 345 to 365 µm (n = 4). Prosome:urosome ratio 1.8-2.0 : 1. Urosome with 6 somites. Antennule (Fig. 17) of l4 segments, armed as follows: 8 + 3 aesthetacs + row of spinules, 4, 4 + 1 aesthetasc, 4, 2, 2, 1 + 1spine + 1 aesthetasc, 2, 2 + 1 aesthetasc, 2 spines, 1 + 1 spine + 1 aesthetasc, 1 + 1 spine + 1 anvil-shape process, 1 + 1 aesthetasc + 2 anvil-shape processes, 10 + 2 aesthetascs. Terminal endopodal segment of legs 2 and 3 (Fig. 18) carrying 3 spiniform setae on inner margin, all of them plumose basally and spinulose distally. Leg 4 (Fig. 19) differing from that of female in having 4 stiff setules on outer margin of terminal endopodal segment. Leg 5 exopod (Fig. 20) oval, 1.5 times longer than wide, with 2 outer spines similar in length each other, 1 apical seta, 1 inner serrate spine twice longer than outer spines, and 2 inner setae. Leg 6 (Fig. 20) represented by inner spine and 1 seta.

The male is identical to the females in all other respects.



Figs 15-18. *Halicyclops cenoticola* ROCHA, sp. nov., female. 15. Leg 4, posterior. 16. Leg 5. Male: 17. Antennule, anterior. 18. Terminal endopodal segment of leg 3, anterior. Scale bars = 50 µm.



Figs 19-20. *Halicyclops cenoticola* Rocha, sp. nov., male. 19. Endopod of leg 4, posterior. 20. Three first urosomites, showing legs 5 and 6, lateral. Scale bar = 50 µm

Etymology

The specific name is derived from the local name (cenote) given to the sinkholes commonly found in the Yucatan Peninsula and the New Latin 'cola', meaning 'dwelling in'.

Remarks

The new species exclusively shares with *H. caridophilus*, described by Humes (1947) from gill chambers of a ghost shrimp from Borneo, and *H. tetracanthus* Rocha, 1995, from Belize, the presence of 2 inner setae on the leg 5 exopod in males. A very close species to *H. cenoticola* is being described from sinkholes of the coastal karst in north-western Australia (Prof. G. Pesce, pers. commn). This led us to link the distribution of the group with the ancient Tethys Sea.

As far as is known from the incomplete descriptions of the great majority of *Halicyclops* taxa, *H. cenoticola* is the only species in the genus possessing leg 6 of the female represented by only two short spines, the dorsal seta, normally found on this leg in the family Cyclopidae, being absent.

The sexual dimorphism observed in legs 2 and 3 of *H. cenoticola* concerning the structure of the inner setae of the terminal endopodal segment has not been observed yet for any member of the genus. In general, those *Halicyclops* taxa for which these legs are described for both sexes, possess both middle and distal setae plumose while the proximal seta is spiniform. An exception to this pattern is the condition observed in *H. tetracanthus,* which has the arrangement of a distal spine plus two spiniform setae in both males and females. In *H. cenoticola* the common pattern described above for the genus is found in the females, but in the males all three inner setae are spiniform.

Another diagnostic character shown by the new species refers to the structure of leg 6 of the male. This leg consists of a ventral spine and two setae in all congeners for which the male has been described. In *H. cenoticola* the armament of this leg is reduced to a spine and a seta implanted on the apex of an unusually well produced protuberance on the ventrolateral margin of the third urosomite.

The length of the dorsal caudal seta also readily separates *H. cenoticola* from all its congeners. Within the genus, *H. pusillus* Kiefer, 1954 and *H. setifer* Lindberg, 1950 are the only species which come close to *H. cenoticola* concerning this character, but their dorsal caudal setae never reach the tip of the outer apical caudal seta as in *H. cenoticola*. Other species such as

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KEY TO *HALICYCLOPS* SPECIES IN THE CARIBBEAN REGION AND ADJACENT COASTAL AREAS

Halicyclops is represented in the Caribbean Region, the Gulf of Mexico, Bermuda and the coast of French Guiana by 17 valid species, which can be identified with the aid of the key presented below.

Additionally, there are the records of two undetermined species of *Halicyclops* in Cuba (Plesa 1981) and in Laguna Catemaco, Mexico (Suárez-Morales & al. 1986). The aforementioned records of European species of *Halicyclops*, herein considered questionable, are not included in the key.

The key was prepared using the descriptions presented in this paper as well as those provided by Kiefer (1936), Lindberg (1954), M.S. Wilson (1958), Herbst (l977, 1982, 1983, 1987), Defaye & Dussart (1988), Lotufo & Rocha (1993), Rocha (1983, 1995a), Rocha & Iliffe (1993) and Fiers (1995). The specimens of *H. exiguus* from the French Guiana and identified by Defaye & Dussart (1988) were considered separately from those from Haiti because of differences from the original description and from Brazilian material of the species examined by one of us (C.E.F. Rocha). Also, the record of this same species in Costa Rica by Collado & al. (1984) is not included in the key, as the text and figures given by the authors do not provide much information warranting their identification.

The key is based mainly on the morphology of the females. References to the males are included in species having sexually dimorphic features which may aid in their identification. The step leading to the identification of a taxon has more than one character in order to make it more consistent and reliable.

1a. Hyaline frills of prosomites irregularly serrate; anal pseudoperculum well developed, serrate, and always notched medially; legs 2-4 endopod 2 with 1 inner seta; caudal rami about twice longer than broad; leg 5 exopod quadrate, with 1 seta and 3 spines shorter than segment in both sexes. Bermuda .... *H. ytororoma* Lotufo & Rocha, 1993
1b. Hyaline frills of prosomites smooth; legs 2-4 endopod 2 with 2 inner setae 2

2a. Leg 4 exopod 3 with 1 seta flanked by 2 spines on outer margin 3
2b. Leg 4 exopod 3 with 3 spines on outer margin 4

3a. Legs 3-4 endopod 3 with inner apical spine weaker and shorter than outer apical spine and turned upwards; leg 4 endopod 3 with 4 spines and 1 shortly plumose reduced seta in female; male with 1 long plumose seta on inner margin of leg 4 endopod 3; leg 5 exopod with 4 setae in both sexes. French Guiana .... H. *aberrans* Rocha, 1983
3b. Legs 3-4 endopod 3 with inner apical spine as thick as and longer than outer apical spine; leg 4 endopod 3 without inner setae in female; male with 2 spiniform setae on leg 4 endopod 3, these setae not reaching tip of inner apical spine; leg 5 exopod with 3 spines and 1 seta in female and 3 spines and 2 setae in male. Gulf of Mexico, U.S.A. (Texas and Louisiana) .... *H. fosteri* M.S. Wilson, 1958

4a. Legs 1-4 exopod 3 with spine formula 3,4,3,3 5
4b. Legs 1-4 exopod 3 with spine formula 3,4,4,3 7

5a. Anal pseudoperculum rectangular, with 2 middle notches flanked by short denticles; legs 3-4 exopod 3 with middle spine shorter than other 2 spines; leg 5 exopod oval in shape, with 3 long and narrow spines, all longer than segment; inner spine of leg 1 basis as long as endopod; antennule segment 4 as long as broad; male unknown. U.S.A. (Louisiana) .... *H. laminifer* Herbst, 1982
5b. Anal pseudoperculum absent; legs 3-4 exopod 3 with spines increasing gradually in length from proximal to distal spine 6

6a. Legs 2-3 endopod 3 with 3 spines and 3 setae; inner middle apical seta of caudal ramus 3.4 times longer than outer one; intercoxal sclerites of legs 1 and 2 armed with rows of spinules on free margin. Specimens from French Guiana .... *H. exiguus* Kiefer, 1934 (sensu Defaye & Dussart 1988)
6b. Legs 2-3 endopod 3 with 4 spines and 2 spiniform setae; inner middle apical seta of caudal ramus 1.7 times longer than outer one; intercoxal sclerites of legs 1-4 armed with rows of spinules on free margin; male with 3 spines and 3 setae on leg 5 exopod. Belize .... *H. tetracanthus* Rocha, 1995

7a. Anal pseudoperculum present 8
7b. Anal pseudoperculum absent 14

8a. Caudal rami as long as wide 9
8b. Caudal rami 1.3-1.5 times longer than wide 13

9a. Caudal ramus with dorsal seta as long as outer middle apical seta; leg 4 endopod 3 with proximal inner seta placed parallel to margin of segment, crossing over the basal portion of distal inner seta; legs 2-3 endopod 3 of male with 3 inner spiniform setae; leg 5 exopod of male with 3 spines and 3 setae. Mexico (Yucatan Peninsula) .... *H. cenoticola* sp. nov.
9b. Caudal ramus with dorsal seta reaching half of length of outer middle apical seta, at maximum; leg 4 endopod 3 with proximal inner seta placed obliquely to margin of segment; legs 2-3 endopod 3 of male with only proximal inner seta spiniform; leg 5 exopod of male with either 3 spines and 1 seta or 3 spines and 2 setae 10

10a. Both inner setae on leg 4 endopod 3 overpassing tip of inner apical spine; genital double somite wider than long (0.8:1); inner middle apical seta of caudal ramus more than 3 times longer than outer middle apical seta. French Guiana .... *H. oryzanus* DEFAYE & DUSSART, 1988
10b. Proximal inner seta of leg 4 endopod 3 not reaching tip of inner apical spine; genital double somite as long as wide 11

11a. Antenna with 5 inner setae on terminal segment; caudal dorsal seta twice longer than ramus. Barbados .... *H. laciniatus* HERBST, 1987
11b. Antenna with 8 inner setae on terminal segment 12

12a. Caudal ramus with outer apical seta about 1.2 times longer than ramus; spine on inner corner of leg 1 basis reaching posterior margin of endopod segment 1. Bermuda .... *H. herbsti* ROCHA & ILIFFE, 1993
12b. Caudal ramus with outer apical seta twice as long as ramus; spine on inner corner of leg 1 basis reaching posterior margin of endopod segment 2. Mexico (Yucatan Peninsula) .... *H. caneki* FIERS, 1995

13a. Anal pseudoperculum formed by widening of hyaline frill bearing tiny denticles on free margin; caudal rami 1.5 times longer than wide; inner spine of leg 1 basis reaching half of leg 1 endopod 3; leg 4 endopod 3 with 4 spines and 1 spiniform seta plumose basally and serrate distally. Gulf of Mexico, U.S.A. (Louisiana) .... *H. clarkei* HERBST, 1982
13b. Anal pseudoperculum well developed and coarsely serrate; caudal rami 1.3 times longer than wide; inner spine of leg 1 basis reaching posterior margin of leg 1 endopod 2; leg 4 endopod 3 with 3 spines and 2 spiniform setae plumose basally and serrate distally. Bermuda .... *H. bowmani* ROCHA & ILIFFE, 1993

14a. Genital double somite expanded proximally, but without lateral aliform protuberances at end of first third 15
14b. Genital double somite produced into lateral aliform protuberances at end of first third 16

15a. Leg 4 endopod 3 with both setae overpassing tip of inner apical spine; leg 5 exopod oval in shape, with long narrow spines, all longer than segment; inner spine of leg 1 basis reaching posterior margin of leg 1 endopod 3; male with 3 spines and 2 setae on leg 5 exopod. Gulf of Mexico, U.S.A. (Louisiana) .... *H. coulli* HERBST, 1977
15b. Leg 4 endopod 3 with proximal inner seta not reaching tip of inner apical spine; leg 5 exopod elongate with only innermost spine longer than segment; male with 3 spines and 1 seta on leg 5 exopod. Specimens from Haiti .... *H. exiguus* KIEFER, 1934

16a. Genital double somite with pointed protuberances curved backwards; leg 5 exopod with reduced spines, all shorter than segment. Antigua .... *H. antiguaensis* HERBST, 1983
16b. Genital double somite with blunt protuberances not curved backwards; spines of leg 5 exopod as long as segment, at least 17

17a. Leg 4 endopod 3 with both inner setae reduced, being shorter than segment; leg 5 exopod with spines similar in length. Haiti, French Guiana .... *H. similis* KIEFER, 1935
17b. Leg 4 endopod 3 with both inner setae longer than segment; leg 5 exopod with inner apical spine longer than other 2 spines. Venezuela, Belize .... *H. venezuelaensis* LINDBERG, 1954

H. brevispinosus meridionalis Herbst, 1953, *H. higoensis* Ito, 1958, *H. tageae* Lotufo & Rocha, 1993 and *H. ytororoma* Lotufo & Rocha, 1993, all of them known from groundwater, have the dorsal caudal seta reaching midlength of the outer middle apical seta.

Besides the dorsal caudal seta, the new species has other setae which are also unusually long for the genus. In general, the inner apical seta of the caudal ramus is very reduced in the greater majority of *Halicyclops* species, this clearly contrasting with the conspicuous inner apical seta observed in the new species. The same can be said concerning the length of the outer seta on the basis of legs 1 and 4, this reaching beyond the apex of the endopod. All these features are here considered as being evolutionary adaptations of the species to life in caves.

Nineteen species of *Halicyclops* are stygophilic inhabitants of groundwater habitats (Pesce & al. 1996). Ten of these species, including the new species described here, were found in anchialine caves and sinkholes. Herbst (1986) listed *H. ryukyuensis* Ito, 1962, *H. troglodytes* Kiefer, 1954 and *H. thermophilus* Kiefer, 1929 from caves in Japan, the Mediterranean Sea, and Madagascar, respectively. Rocha & Iliffe (1993) described *H. herbsti* and *H. bowmani* and recorded *H. ytororoma* from caves in Bermuda. Recently Pesce & al. (1996) found *H. longifurcatus* in a sinkhole and *H. spinifer* in a deep cave in northwestern Australia.

Halicyclops caneki Fiers, 1995 is common in the cenotes of the Yucatan Peninsula (Suárez-Morales & al. 1996).

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