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Peracarids (Crustacea: Malacostraca) from cenote Aerolito, Cozumel, Mexican Caribbean

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Abstract: The faunistic composition of the benthic amphipods and tanaidaceans in the cenote Aerolito (Purificación system), Cozumel, Quintana Roo, México was studied. A total of 8823 specimens were examined and identified to species. The following species of amphipods were recorded: *Melita longisetosa*, *Melita planaterga*, *Parhyale hawaiensis* and the tanaid *Hargeria rapax*. All the species mentioned above are new records for Cozumel as well as for cenotes. The tanaid *H. rapax* is the first record for tanaidaceans in cenotes.

Résumé : *Péracarides (Crustacea : Malacostraca) du cénote Aerolito, Cozumel, côtes caraïbes du Mexique.* Le but de cette étude était d'analyser la composition de la faune des Amphipodes et Tanaidacés benthiques du cénote Aerolito (système Purificación) de l'île de Cozumel, état du Quintana Roo, Mexique. Au total, 8823 spécimens ont été examinés et identifiés jusqu'au niveau spécifique. Trois espèces d'amphipodes ont été trouvées: *Melita longisetosa*, *Melita planaterga*, *Parhyale hawaiensis* et une espèce de tanaidacé: *Hargeria rapax*. Toutes ces espèces constituent de nouveaux signalements pour Cozumel ainsi que pour les cénotes. Le Tanaidacé *H. rapax* est le premier signalement de Tanaidacés dans le biotope des cénotes.

Keywords: Amphipoda ● Tanaidacea ● Cenote

Introduction

Peracarids such as amphipods and tanaidaceans are found in a large variety of habitats, from deep marine zones to coastal, estuarine, and freshwater zones, and even inland dwellings (LeCroy, 2001a & b; Winfield & Escobar-Briones, 2007). Recently, amphipods have been recorded in continental water bodies called cenotes in Southeast Mexico (Iliffe, 1993).

Cenotes are hydrological systems created by the progressive dissolution of limestone. The general structure of these systems consists of an underground flooded passage that is eventually left exposed by the collapse of the rock ceiling which leaves an opening to the surface (Palmer, 1991). Since the ground in the Yucatán peninsula

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is mainly composed by calcium carbonate, dissolution occurs commonly; hence, cenotes are the main hydrological feature of the region (Perry et al., 2002). The cenotes of Cozumel are classified as anchialine since they are characterized by a salinity gradient along the tunnels of the system; this gradient is due to the connection of these systems with the sea and it accelerates dissolution, creating extensive passages that allow for a large supply of marine water (Mejia-Ortiz et al., 2006).

Studies on crustaceans in cenotes are scarce; most of the existing biological research focuses on the fauna of the cave regions and not on the open waters of the cenotes (Iliffe, 1993; Suarez-Morales & Rivera-Arriaga, 1998; Mejia-Ortiz et al., 2006 & 2007). Seven amphipod species have been recorded in the cenotes of Southeast Mexico, but no tanaidaceans had been recorded before (Table 1). Of the amphipod species already recorded, *Bahadzia bozanici* Holsinger, 1992, was found in three cenotes of the state of Quintana Roo: Carwash (Aktun-ha), Aerolito, and Cueva Quebrada, the last two on the island of Cozumel; *B. setodactylus* Holsinger, 1992, was found in the cenote Xcan-ha, Cozumel, and *Mayaweckelia yucatanensis* Holsinger, 1977, is only known from the Xtacumbilxunam caves, in the state of Campeche. The localities of the other four species are not specified in the corresponding literature; it is only mentioned that they were recorded in different cenotes from Yucatán and Quintana Roo (Iliffe, 1993; Suarez-Morales & Rivera-Arriaga, 1998) (Table 1).

Material and Method

The cenote Aerolito is located on Cozumel Island in the Mexican Caribbean (20°27'58"N-86°58'41''W). This cenote is a semielliptical-shaped pool of 71 m length and 21 m width with a maximal depth of 6 m. The pool is surrounded by mangrove vegetation (*Rhizophora mangle*) and has a rocky bottom substrate with abundant algal growth. The cenote Aerolito system is connected to the Caribbean at 270 m of the pool entrance by means of a complex system of caves (Mejia-Ortiz et al., 2007).

Two samplings were performed to know the faunistic composition of the algal substrate of the cenote Aerolito: the first in February 2006 and the second in July 2007. Samples were collected manually in four stations of the cenote (North, South, East and West) at a depth of 0.5 m. The recorded salinity was 13.8 in February 2006 and 15 in July 2007. Samples were washed and sieved through a 0.5 mm mesh and the organisms were manually separated. Finally, the peracarids were identified to species level using LeCroy's (2001a & b) and Heard et al. (2003) dichotomous keys.

The specimens collected are deposited in the collection of the Laboratorio de Ecologia y Biodiversidad de Invertebrados Marinos at the Instituto de Ciencias del Mar y Limnologia of the Universidad Nacional Autonoma de Mexico (UNAM).

Table 1. Amphipod species registered in cenotes of the Yucatán peninsula, México in previous studies.

Tableau 1. Espèces d'Amphipodes récoltées dans les cénotes de la péninsule du Yucatán, Mexique, lors d'études précédentes.

Amphipod species	References
Bahadzia bozanici Holsinger, 1992	Iliffe (1993)
B. setodactylus Holsinger, 1992	Iliffe (1993)
Hyalella azteca (Saussure, 1858)	Suárez-Morales (1998)
Mayaweckelia cenoticola Holsinger, 1977	Iliffe (1993); Suárez-Morales (1998)
Mayaweckelia yucatanensis Holsinger, 1977	Iliffe (1993)
Quadrivisio lutzi (Shoemaker, 1933)	Suárez-Morales(1998)
Tuluweckelia cernua Holsinger, 1990	Iliffe (1993); Suárez-Morales (1998)

Results and Discussion

Three species of Amphipoda and one of Tanaidacea were identified from a total of 8823 specimens. The amphipods were distributed in two genera; *Melita* Leach 1814 and *Parhyale* Stebbing, 1897. The dominant species was *Melita longisetosa* Sheridan, 1980 with 2991 specimens (51.2% males and 48.8% females), followed by *M. planaterga*, Kunel, 1910 with 2727 (43.6% males and 56.4% females) and finally *Parhyale hawaiensis* Dana, 1853 with only 178 specimens (36.7% males and 63.3% females). The only species which belongs to the Order Tanaidacea was *Hargeria rapax* Harger, 1879, which was also very abundant, with 2927 specimens (34.5% males and 65.5% females).

AMPHIPODA Latreille, 1816
Gammaridea Latreille, 1802
Melitidae Bousfield, 1973

Melita longisetosa Sheridan, 1980

Diagnostic characters

The specimens were identified mainly by the presence of long and dense setae on antenna one, in articles two and three. On antenna two, setae longer than the width of article four are present. The lack of a median process and the presence of two dorsolateral spines on each side of segment one of the urosome are characteristic of this species.

Geographical distribution

Florida U.S.A., Laguna de Alvarado, Veracruz, Mexico; Caribbean Sea (LeCroy, 2001a; Ortiz et al., 2007).

Habitat

Medium to high salinities, salt marshes, seagrass beds, and mangroves (LeCroy, 2001a). It has also been recorded associated to sea grass beds and muddy substrates (Ortiz et al., 2007).

Remarks

The size of the specimens observed was from 2.5 to 5.2 mm in juveniles, 6.8 to 11.0 mm in males and from 6 to 10.3 mm in females. The propodus of pereopod six is slightly more setose than that of pereopod seven. The dorsolateral spines on segment two of the urosome are subequal in length.

Melita planaterga Kunkel, 1910

Diagnostic characters

The specimens were identified by the presence of a median process on segment one of the urosome and by the presence of a single, long dorsolateral spine on segment two.

Geographical distribution

Florida Keys; Bermuda; Laguna de Terminos, Campeche, Mexico; Caribbean Sea (LeCroy, 2001a; Ortiz et al., 2007).

Habitat

Marine or estuarine. Recorded in sandy bottoms and encrusting communities in mangrove roots (Ortiz et al., 2007). Also found in shallow rocky bottoms covered by algae and in *Thalassia* areas (LeCroy, 2001a).

Remarks

This species ranged in size from 1.8 to 3 mm in juveniles, from 4.1 to 7.8 mm in females and from 3.9 to 7.1 mm in males. The length of the third article of antenna one was between a third and half the length of article two. The setae on articles four and five of antenna two are slightly longer than the width of the articles. No bottle-brush setae are present in either antenna. The basis of pereopod seven is broadly ovate; the dactyl is slender with setae on the flexor margin.

Hyalidae Bulycheva, 1957
Parhyale hawaiensis Dana, 1853

Diagnostic characters

A dense brush of outer setae is present on the third article of the maxilliped palp. The presence of spines on the extensor margin of the propodus of pereopods six and seven is also an important character. The marginal spines on the outer ramus of uropods two and three were also useful to its identification.

Geographical distribution

Circumtropical. Western Atlantic from North Carolina to Brazil (LeCroy, 2001b), including Florida; the Gulf of Mexico and the Caribbean Sea (Ortiz et al., 2007).

Habitat

Commonly found in bays and estuaries of low to medium salinity. Found in the intertidal or shallow subtidal areas with algal growth on hard substrates, sandy bottoms, and in encrusting communities. Also found in mangrove roots and oyster beds (LeCroy, 2001b; Ortiz et al., 2007).

Remarks

The individuals observed measured from 4.9 to 6.3 mm in juveniles and from 7.5 to 12 mm long in both adult males and females. Antenna one is about half the length of antenna two. The third article of the maxilliped palp has a dense brush of outer setae that are very characteristic. The eyes are pyriform. The first gnathopod lacks a mid palmar spine. In this species spines are present on the extensor margins of pereopods six and seven and on the outer ramus of uropods one and two.

TANAIDACEA Dana, 1849
Hargeria rapax Harger, 1879

Geographic distribution

Northwestern Atlantic (Sieg, 1983; Modlin & Harris, 1989), Northeastern shores of the United States down to Florida, Texas; Gulf of Mexico and in the Cayman Islands (Heard et al., 2003) and Caribbean Sea (Sieg, 1983; Markham & Donath-Hernandez, 1990; Markham et al., 1990; Garcia-Madrigal et al., 2004).

Habitat

Warm, brackish and shallow waters. Generally related to benthic algae but also common in mangrove roots (Markham & Donath-Hernandez, 1990; Markham et al., 1990). Tolerant to very low salinities (Heard et al., 2003). Also found in intertidal pools of fine sandy bottoms as dominant in the meiofauna (Modlin & Harris, 1989) and in salt marshes as a main component of the infauna (Whaley & Minello, 2002).

Remarks

The individuals observed measured from 2.9 to 5.2 mm for juveniles and from 4.1 to 8.2 mm for both adult males and females.

The species is newly recorded for the island of Cozumel in this type of environment. In addition, and relative to tanaidaceans, the record of *Hargeria rapax* in the cenote Aerolito is the first of a tanaidacean in a cenote; besides, it is the first record for the Mexican Caribbean. The fact that all four species found in this study occur in estuarine conditions and are halotolerant (Modlin & Harris, 1989; LeCroy, 2001a & b; Heard et al., 2003) provides useful information on the dynamics of the system. Due to its close connection to the ocean, it is very likely that the cenote behaves like an estuary.

Conclusions

Finding these species in a cenote broadens our understanding on the variety of habitats that can be occupied by Amphipoda and Tanaidacea. These characteristic estuarine species also provide information on the characteristics of the cenote. This study highlights the fact that additional research is needed in cenotes, a poorly known and yet important habitat, and that the literature, on both their ecology and taxonomic groups, is scarce and not easily available.

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