FAUNA OF FIVE ANCHIALINE CAVES IN COZUMEL ISLAND, MEXICO

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Abstract

The fauna from five anchialine caves in the Cozumel Island were collected in order to know the cave diversity species from this area. Macro and micro crustaceans and echinoderms were collected from each cave using tramps and by hand during explorations of these anchialine habitats. The principal species identified were *Agostocaris bozanici*, *Yagerocaris cozumel*, *Janicea antiguensis*, and *Somersiella sterri*. Also we report here by first time the existence of echinoderms in anchialine caves. Also we registered new localities for the anchialine shrimps *Procaris* spp., and for the first time we report the existence in the Cozumel Island of shrimps of genus *Barburia* and thermobaenacean of genus *Tulumella*, both potentially new species. We discuss about the geographical distribution and relationships of these species with those reported in the Yucatan Peninsula and other Caribbean Islands.

Introduction

The caves can be classified in relation to the amount of water that it can content, if are whole dry or with subterranean rivers. From it last caves, in Mexico we can found those that show freshwaters or well those that are exclusively marine. Also, we can found anchialine caves which have (subterranean) one area where there

are interactions between epicontinental freshwater and the marine waters, and also show gradients of salinity in their conduits, this type caves are very closer to coast and in Mexico are found mainly in the Yucatan Peninsula, and has been namely from old times by mayan people as cenotes or sinkholes (Álvarez *et al.*, 2000).

An important underwater caves number has been previously surveyed with scientific objectives. However, still that has been reported and described an important species number mainly from crustaceans (Botosaneanu, 1986; Botosaneanu *et al.*, 1998; Botosaneanu e Illife, 1999; Bowman, 1973; 1977; Bowman e Illife, 1988; Creaser, 1936; Fiers *et al*., 1996; Hart y Manning, 1981; Hobbs y Hobbs, 1976; Hobbs *et al*., 1977; Holsinger, 1977; 1992; Holthuis, 1977; 1986; Kensley *et al.*, 2001; Kornicker e Illife, 1989, 1998; Navarro-Mendoza y Valdés-Casillas, 1990; Proudlove *et al.,* 2001; Rocha *et al.*, 2000; Schmitter-Soto, 1998), due the difficult that have the explorations of it systems, still there are a high number of cenotes or caves that not has been explore with aim that know the diversity species that living in this places. A large amount of this sites in Yucatan Peninsula have a recreational use, in order to tourism that arrive in this area from Mexico, and very management planning from this environments has been made with total not to know of fauna that in they inhabit. Is necessary consider that this anchialine fauna show an atypical distribution and have biogeographically relationships with species adapted to this environments in other Caribbean Islands or another areas from the world. For this reason, the aims from present work is show the species richness from macro and micro crustaceans from four sinkhole (cenotes) in the Cozumel Island and show the first analysis of another fifth sinkhole in order to understand their relationships with other congeners located in another Caribbean Islands or well in the Yucatan Peninsula.

Material and methods

Cozumel Island have 482 km^2 from extension, and is located at 20°48'00'' & 20°16'12'' of north latitude and between 87°01'48'' & 86°43'48'' from western longitude. This Island is on the north-eastern area from Yucatan Peninsula in the Mexican Caribbean Sea, and their main source from water is in the Cenotes and Subterranean water table. The sinkholes (cenote) that were studied in this work are: El cenote el Aerolito or Sistema Paraiso, Sistema Cocodrilo, Cenote Tres Potrillos and Cueva la Quebrada Chankanaab (Fig. 1). Also, we start the explorations in the Cenote Xcan-ha showing preliminary outcome.

The organisms were sampled handled in several surveys to each cenotes. Also were collected using tramps during 24 hours with chicken as bait. The animals were identified to species level and some organisms only to genus level.

Results

a) Cenote Aerolito o Sistema Purificación

This system have 6100 m from longitude. Have a connection with Caribbean Sea at 240 m from main entrance. Their conducts were formed mainly by rocks dissolution. Show formations from stalagmite and stalactite, and also have speleothems. The sediments is clay and mud. The water temperature were en average from 25°C, and showed a halocline at 7 m of depth (fig. 2a, b & c). The crustaceans species collected in this sinkhole were: *Procaris* sp. (Fig. 2d); *Yagerocaris cozumel* (Fig 2e) and *Bahalana sp.* (fig. 2f).

Also two species of Asteroids were found. The first one *Asterinides* sp., was located in brackish waters at 256 meters from the entrance. These animals show depigmentation on their bodies, and were only located in the inside of the sinkhole (Fig. 3a & b).

The second group of Asteroids was located in marine waters at 45 meters from the entrance. These animals show pigmented bodies (Fig. 3c & d).

Specimens of Ophiuroids were located in salt waters at 40 and 336 meters from the entrance of the sinkhole (Fig. 3e & f). This ophiuroids bear pigmented bodies.

b) Cocodrilo System

This sinkhole is located on the east side of Island. Have two main entrance with three meters of deep. Posterior have a main passage that have stalagmites and stalactites formations (Fig. 4a, b & c). The water temperature has been between 20 and 22° C. In this cenote we recorded the follow taxas: *Tullumella* sp. (Fig. 4d, e & f).

c) Cenote Tres Potrillos

This cenote have a maximum depth of 40 m in vertical, and have a small passage at 12 m with a longitude of 40 meters approximately. This conduct have formations such as stalagmites and stalactites. In this cenote we recorded the follow organisms. *Procaris* sp.; *Barburia* sp.; *Mayawekelia* sp. (Fig. 5a, b & c)

d) Cueva la Quebrada, Chankanaab

This cave is located on the east coast of the island of Cozumel. It has five surface openings and 2759 m of surveyed passage possibly making it Mexico's longest completely submerged cave. The deepest point in the cave is only –12m. Brackish water is discharged in the form of reversing tidal currents from entrance along the coast. The organisms that we found here are *Procaris mexicana* (Fig. 6a &b),

Mayawekelia sp. (Fig. 6c); *Bahadzia* sp.; *Bahalana mayana* (Fig. 6d), *Janicea antiguensis* and *Somersiella sterri.*

e) Cenote Xcan Ha

This cenote have two main entrance in vertical, approximately of 20 m of deep both. Subsequently in the bottom there are a main passage with formations as stalagmites and stalactites (Fig. 7a) In this sinkhole we did find the follow crustaceans: *Agostocaris bozanici* (Fig. 7b) *and Bahadzia* sp. (Fig. 7c)

Discussion

Is evident that the species richness from each sinkhole to crustaceans group is high, and there are species o members of each genus in almost the cenotes surveyed now by us. However, there are aspects in where is necessary to make emphasis, to animals from *Procaris* genus to December of last year the organisms recorded to Island remain undescribed but with the Sternberg y Shotte (2004) work this organisms collected from Quebrada Cave has been named *Procaris mexicana*. However, with the recent explorations we registered two cenotes that have members from this genus and very probability will be the same species. This species is very interesting because there are phylogenetics relationships with organisms from Bahamas and Hawaii Isles. To this moment, the animals not has been recorded to Yucatan Peninsula, and although has been reported to several localities around the world we not excuse that can be living in the underwater caves from Yucatan.

According with crustaceans from *Tulumella* genus, although has been reported termobaenaceans to Cozumel Islands specifically to Cueva Quebrada, we recorded another cave that not showed others crustaceans and this we determined that are members of genus *Tulumella*, this genus is monotypic and only has been reported in some closed systems to Tulum locality in Quintana Roo. However, the termobaenacens has been reported mainly to Italy and in some cases to Bahamas Islands, but with other genera.

Another crustaceans very interesting is the animals from Barburia genus located from a Cenote in the Cozumel Island. Update the genus have a unique species *Barburia cubensis* and has been reported for other islands. However never has been reported to Mexico. We know that there are samples from some organisms from this genus collected from nearby of Tulum, but it are fewer organisms and has been not determined. Is very probable that this animals will be a new species to science.

Another interesting result are the organisms of genus *Bahalana* spp. In the different sinkhole surveyed in the present work is possible that this populations still

have a genetic interchange between them, that although is probably that it is isolated, also their caves that this animals inhabit have conduits or passages where the genetics fluxes can exist. For this organisms we next step will be the use of molecular techniques to determined the isolated or interchange between this populations.

Also about the location of some organisms that has been reported to another islands such as *Somersiella sterri* and *Janicea antiguensis* in the Cozumel Island we understanding that this animals have a high dispersion capacity in all Caribbean region.

However, as we can see in the results although in this work only we reported five natural and underwater caves from Cozumel Island, and some crustaceans species has been described and reported from this systems, still there are lot work, since from Cozumel is poorly know, in general only from some anchialine systems the scientific know the water characteristics (Back *et al.,* 1978; Hall 1936; Alcocer *et al.*, 1998; Sánchez *et al*., 2002; Alcocer *et al*. 1999; Schmitter-Soto *et al.*, 2002) whilst that the so much authors has focus efforts on described the sites and the fauna that in this environments living, making some notes on biology and ecology from these specialised organisms (Yager, 1987; Illife, 1993 & 1992; Kallmeyer y Carpenter, 1996; Suárez-Morales *et al.*, 1996; Escobar-Briones *et al.*, 1997; Suárez-Morales & Reid, 1998). Also, there are few studies on hypothesis that answer the evolutionary questions from this animals in relation with geological history from this area (Holsinger, 1986; 1990; Wilkens, 1982 & 1986).

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Headings from figures

Fig 1.- Location of study area

Fig 2.- Cenote Aerolito.

Fig. 3.- Echinoderms from cenote Aerolito

Fig. 4.- Cenote Cocodrilo

Fig. 5.- Cenote Tres Potrillos

Fig 6.- Cenote Chankanaab

Fig 7.- Cenote Xcan –ha.