

## THE AEROLITO DE PARAISO – ANCHIALINE SYSTEM: PARADISE FOR ECHINODERMS

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The anchialine cave Aerolito de Paraiso is located in Cozumel Island, Mexico. It is unique because it is mainly inhabited by four classes of echinoderms. After reviewing all of the material collected for this location, we present a taxonomic list composed of 22 species of echinoderms. Ophiuroidea is the best represented class in the anchialine cave with 11 species.

**Key words:** Taxonomic list, Echinoderms, Stygobytes, Anchialine cave, El Aerolito

### INTRODUCTION

Echinoderms are restricted to marine environments, but, given that limitation, they inhabit a wide variety of habitats (HENDLER *et al.*, 1995). They can be found in shallow reef zones but also in extreme habitats such as hydrothermal vents (VAN-DOVER, 2000) and cold seeps (SIBUET *et al.*, 1988).

Anchialine cave fauna is generally composed of crustaceans, but there have been other taxa reported such as sponges, molluscs, annelids, fish and echinoderms (POMORY *et al.*, 2011). Echinoderms living in anchialine systems are rare and they are usually found in low densities. Until 2005, the only echinoderms reported inhabiting these caves were sea cucumbers (SALVINI-PLAWEN & RAO, 1986). Subsequently, sea stars, sea urchins and ophiuroids were reported as well, inhabiting different systems: Tres Potrillos Sinkhole, Cocodrilo System and Aerolito de Paraíso, in Cozumel Island, Quintana Roo, Mexico (MEJÍA-ORTIZ *et al.*, 2005; 2007). Two species have been described as stygobytes, the starfish *Copidaster cavernicola* from Aerolito de Paraiso (SOLÍS-MARÍN & LAGUARDA-FIGUERAS, 2010), described in 2010, and the ophiuroid *Amphicutis stygobita* from Bernier Cave, Bahamas, described in 2011 (POMORY *et al.*, 2011).

The anchialine cave Aerolito de Paraíso is located in the tropical Cozumel Island, in the Mexican Caribbean (20°27'58" N and 86°58'41"W). It is connected to the sea at 240 m from the main entrance, and runs approximately 18 km; its maximum depth is 27 m. The dominant sediment in the system consists of clay and mud (MEJÍA-ORTÍZ *et al.*, 2007; SOLÍS-MARÍN & LAGUARDA-FIGUERAS, 2010).

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**Tab. 1.** Echinoderms of 'Aerolito de Paraiso' cave. Species marked with an asterisk were observed only in one season, while two asterisks indicate a species only one specimen of which was found; a species reproducing in the system is underlined.

<p><b>Class Asteroidea</b></p> <p><i>Astropecten duplicatus</i> Gray, 1840*</p> <p><i>Asterinides pompom</i> (A. M. Clark, 1983)</p> <p><i>Mithrodia clavigera</i> (Lamarck, 1816)</p> <p><i>Copidaster cavernicola</i> Solís &amp; Laguarda, 2010</p> <p><b>Class Ophiuroidea</b></p> <p><i>Ophiura</i> cf. <i>ljungmani</i> (Lyman, 1878)*</p> <p><i>Ophiolepis</i> cf. <i>impressa</i> Lütken, 1859*</p> <p><i>Ophiocoma wendtii</i> Müller &amp; Troschel, 1842</p> <p><u><i>Ophionereis</i> sp. Say, 1825</u></p> <p><i>Ophioderma appressa</i> (Say, 1825)</p> <p><i>Ophioderma ensifera</i> Hendler &amp; Miller, 1984*</p> <p><i>Ophiactis algicola</i> H. L. Clark, 1933*</p> <p><i>Amphipholis squamata</i> (Delle Chiaje, 1829)*</p>	<p><i>Ophiothrix angulata</i> Say, 1825</p> <p><i>Ophiothrix oerstedii</i> Lütken, 1856</p> <p><i>Ophiothrix suensonii</i> Lütken, 1856</p> <p><b>Class Echinoidea</b></p> <p><i>Eucidaris tribuloides</i> (Lamarck, 1816)</p> <p><i>Diadema antillarum</i> Philippi, 1845*</p> <p><i>Lytechinus variegatus</i> (Lamarck, 1816)*</p> <p><i>Brissopsis atlantica</i> Mortensen, 1913</p> <p><i>Meoma ventricosa</i> (Lamarck, 1816)</p> <p><b>Class Holothuroidea</b></p> <p><i>Holothuria</i> (<i>Semperothuria</i>) <i>surinamensis</i> Ludwig, 1875*</p> <p><i>Euapta lappa</i> (Müller, 1850)**</p>
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## MATERIALS & METHODS

Three surveys of the anchialine system were carried out (two in July 2011, one in January 2012). All the material collected was preserved in 70% ethanol. We also examined specimens collected previously and deposited in the National Collection of Echinoderms 'Ma. Elena Caso Muñoz', ICML, UNAM. Identification keys and descriptions from different authors have been used to identify specimens to species level.

## RESULTS

We have found 22 species of echinoderms inhabiting Aerolito de Paraiso (Tab. 1). These are distributed among 4 classes, 9 orders, 18 families and 19 genera. So far, there are two endemic species, one asteroid *Copidaster cavernicola*, and the ophiuroid *Ophionereis* sp. *Ophionereis* sp. is widely distributed in the system and has been found in every survey conducted. Of the 22 species, 11 belong to the class Ophiuroidea, the best represented in the system. It is important to mention that some of the species that have been found in the cave were seen during only one season and have not been observed since. There are also species that are represented inside the cave by just one specimen collected and no other has been found. There are also some species that seem to have been reproducing in the system.

## DISCUSSION

Until now, echinoderms have been found inhabiting only a few anchialine caves throughout the world. Sea cucumbers are the most widely distributed, while ophiuroids have been recorded inhabiting the caves in San Salvador Island, Bahamas, and

Cozumel Island, Mexico. Starfishes and sea urchins are reported only on Cozumel Island, Mexico (SALVINI-PLAWEN & RAO, 1986; SOLÍS-MARÍN & LAGUARDA-FIGUERAS, 2008).

In 2008, Solís-Marín and Laguarda-Figuera reported 8 species of echinoderms inhabiting 'Aerolito de Paraíso'. With this research, we have found that this particular cave is the most species-rich in echinoderms of all known caves of its type.

## CONCLUSIONS

So far, the anchialine cave 'Aerolito de Paraíso' is the most species-rich cave in echinoderms in the world, with 22 species. As a result, especially considering that two of these species are endemic to the system, we propose that the cave be protected.

It is important to mention that there is still a lot of research to carry out in the Aerolito de Paraíso system. The presence of just one or a few individuals of certain species suggests that some species came from the outside the cave, via the sea connection to escape predators or due to environmental changes. The presence of so many organisms from other species implies that members of those species have been reproducing inside the system indicating cave adaptation and reproductive isolation.

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