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POLYCHAETES FROM THE MAYAN UNDERWORLD: PHYLOGENY, EVOLUTION, AND CRYPTIC DIVERSITY

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Recent cave diving explorations in Cenote Crustacea have led to discoveries of several undescribed annelids inhabiting sediments that lie within the halocline and marine layers. Taxonomic and genetic evaluations support their placement within Acrocirridae and Flabelligeridae, establishing new records from anchialine systems for these families. This study highlights the need for continued exploration and investigations of these mysterious labyrinths.

Key words: cenotes, Annelida, Acrocirridae, Flabelligeridae, Sabellida

INTRODUCTION

In the last 30+ years, exploration of anchialine caves has yielded fascinating and puzzling discoveries of unique stygobitic fauna, microbial life, foodweb dynamics and chemosynthetic processes reminiscent of deep-sea communities. Despite these intriguing discoveries, anchialine caves remain among the last unexplored frontiers in terms of biodiversity, ecology and evolutionary processes. Within the Caribbean, the Bahamas are considered a hotspot for stygobitic crustacean (>130 spp.) diversity relative to Yucatán cenotes, where only ~50 species are known. Thus, highlighting that species diversity of cenotes remains poorly studied, offering considerable opportunities for the discovery of new and ecologically significant non-crustacean organisms, such as polychaetous annelids. In early 2012, polychaetes representing three annelid clades were collected from sediments in the halocline (Sabellida) and in the fully marine waters (Sabellida and sister families Acrocirridae and Flabelligeridae; OSBORN & ROUSE, 2010) of Cenote Crustacea in Quintana Roo, Mexico. Cenote Crustacea, part of the Crustacea cave system is located approximately 10 km south of Puerto Morelos. This system is located 500 m inland from the Caribbean coast, extending to at least 4.5 km of surveyed cave passages. Cenote Crustacea reaches a maximum depth of approximately 19 m, is known to house unusually high abundances of remipedes and stygobitic shrimp and has unique hydrological parameters.

MATERIALS AND METHODS

In January 2012, scientific cave diver (BCG) observed unusual tracks on bottom sediment, approximately 19 m depth and >300 m from cave entrance. This led to the discovery of two benthic polychaetes, which were hand collected. Tubeworms were also collected from neighboring sediments, as well from ledges that lie within

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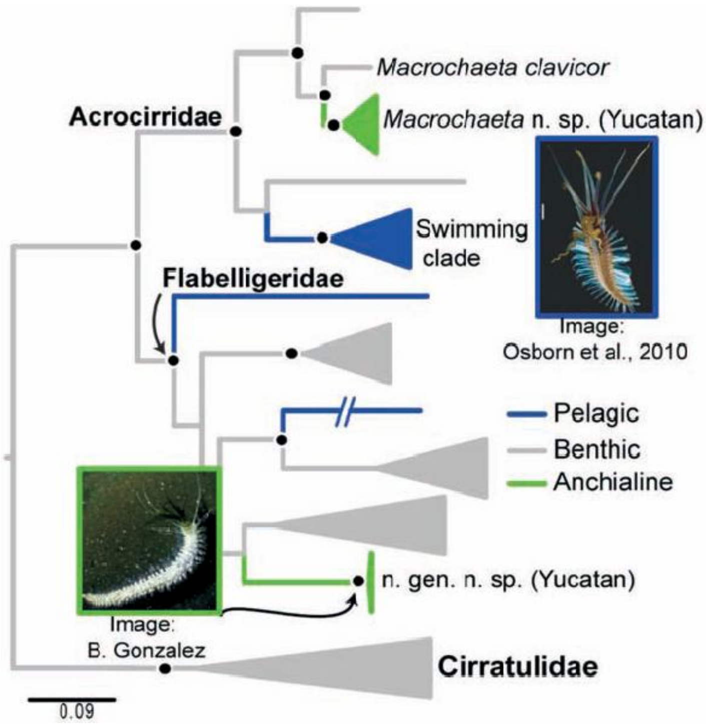

Fig. 1. Phylogeny of Acrocirridae and Flabelligeridae from OSBORN & ROUSE, 2010, including the Cenote Crustacea polychaetes.

the halocline (~14 m). Specimens were preserved in 95% ethanol and 4% formalin, for subsequent molecular and morphological evaluation. Genetic sequence data were collected from two nuclear (18S rDNA, 28S rDNA) and three mitochondrial (COI, CytB, 16S rDNA) genes to evaluate the phylogenetic placement of these species among representatives of their respective families, of which until recently were previously only known from non-cave habitats (e.g. OSBORN & ROUSE, 2010). Morphological characterization was carried out using light and scanning electron microscopy. Additional material is to be collected in January 2013.

RESULTS AND DISCUSSION

A major challenge in this study so far has been the lack of congruence between taxonomy and phylogeny due to inconsistent taxonomic revisions or incomplete available genetic data for Annelida to establish robust phylogenetic hypotheses. Fig. 1 shows our preliminary phylogenetic evaluation of the acrocirrid and flabelligerid cenote specimens (green lineages) and follows the taxonomic representatives and gene data available from OSBORN & ROUSE, 2010. Members of Acrocirridae and Fabelligeridae were previously only known from benthic (grey) habitats. Evaluation of pelagic forms (e.g. OSBORN & ROUSE, 2008, 2010; OSBORN *et al.*, 2009; 2010) of each family suggested multiple independent invasions into the pelagic realm (blue) derived from benthic ancestry. Inclusion of the acrocirrid and flabelligerid cenote specimens suggests that these two species are distinct anchialine cave adapted lineages (green). Morphological evaluation supports that both are new to science, including a new *Macrochaeta* species (Acrocirridae) and a new genus and species allied to *Pherusa* (Flabelligeridae); both previously uncharacterized from caves (DE

LEON *et al.*, 2009). Identification of the tube worms are currently being evaluated, however, given their location within the anchialine cave, we suspect these to be new species or species records from cenotes.

CONCLUSIONS

These findings expand our knowledge of overlooked and poorly studied non--crustacean sygobitic fauna and provide new records of annelids from cenotes. These new discoveries increase our understanding regarding the colonization and adaptations of acrocirrid and flabelligerid worms to anchialine environments. Currently employed collection strategies for stygobitic fauna have a pelagic and crustacean bias that overlooks sediment dwelling and non-swimming fauna, which limits our understanding of the complexities of anchialine systems. Continuing discoveries of anchialine organisms will undoubtedly yield a more thorough understanding of community structure and trophic and food web dynamics. Lastly, this study highlights the current void in the knowledge of anchialine diversity of the Yucatán.

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