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## New species, corallivory, *in situ* video observations and overview of the Goniasteridae (Valvatida, Asteroidea) in the Hawaiian Region

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### Abstract

Two new species of Goniasteridae, *Astroceramus eldredgei* n. sp. and *Apollonaster kelleyi* n. sp. are described from the Hawaiian Islands region. Prior to this occurrence, *Apollonaster* was known only from the North Atlantic. The Goniasteridae is the most diverse family of asteroids in the Hawaiian region. Additional *in situ* observations of several goniasterid species, including *A. eldredgei* n. sp. are reported. These observations extend documentation of deep-sea corallivory among goniasterid asteroids. New species occurrences presented herein suggested further biogeographic affinities between tropical Pacific and Atlantic goniasterid faunas.

**Key words:** Goniasteridae, Valvatida, deep-sea, Hawaiian Islands, predation

### Introduction

Recent discoveries of new genera and species from deep-sea habitats along with new *in situ* video observations have provided us with new ecological insight into these poorly understood and formerly inaccessible settings (e.g., Mah *et al.* 2010, 2014; Mah & Foltz 2014). Hawaiian deep-sea Asteroidea are taxonomically diverse and occur in an active area of oceanographic and biological research (Chave and Malahoff 1998). New data on asteroids in this area presents an opportunity to review and highlight this diverse fauna.

Deep-sea asteroids from the Hawaiian region were first monographed by Fisher (1906) following expeditionary collections by the United States Fisheries Commission Steamer *Albatross* in the spring and summer of 1902. Subsequent additions to the deep-sea fauna of this region were made by Fisher (1911, 1925). Checklists of asteroids from deep-sea settings of this area were compiled by Fisher (1925) and later by Mah (1998). New additions to the deep-sea Hawaiian asteroid fauna includes *Circeaster pullus* Mah 2006 and *Hippasteria muscipula* Mah *et al.* 2014.

The Hawaiian Islands region possesses a much higher number of deep-sea (>55 species) versus shallow-water species (n=20) (Mah 1998; Hoover 2006). It is therefore surprising that given the relatively large number of deep-sea asteroids in this region, surprisingly little is known about them. Grigg *et al.* (1987), Chave and Jones (1991) and Chave and Malahoff (1998) provided further occurrence data, *in situ* observations and a summary of deep-sea asteroids, including goniasterids, *Henricia pauperrima*, and several echinoids and holothurians based on submersible video observations. Yeh and Drazen (2009) noted the role of *Ceramaster bowersi* and *Mediaster ornatus* as scavengers in the Hawaiian Islands region.

The Goniasteridae includes 15/56 (27%) of the total number of known asteroid species for this region, making them the most diverse group of asteroids in the area. To put this into perspective, there are nearly as many goniasterids occurring in Hawaiian deep-sea settings as there are species inhabiting shallow-water Hawaiian settings. Globally, the Goniasteridae are the most species-rich group of Asteroidea (Mah & Blake 2012) occurring primarily on continental shelf habitats and shallow-water settings in all the world's oceans. However, in spite of their diversity, very little is known about their biology and ecological significance.

might have occurred as late as 12.9 Ma (early middle Miocene) during a period when the Panamanian seaway could accommodate deeper-water taxa. This is in contrast to shallower water “geminate” taxa, which diverged more recently, in association with the closure of the Panamanian seaway (e.g., Lessios *et al.* 2003). Mah’s (2006) morphology based phylogeny showed the Atlantic *C. americanus* as a derived member relative to the other Indo-Pacific *Circeaster* species. Biogeographic hypotheses for *Gilbertaster* and *Apollonaster* are more ambiguous given that they represent the only two known species of their respective genera.

There are other genera of Hawaiian goniasterids represented in the Atlantic, including *Anthenoides*, *Ceramaster*, *Evoplosoma*, *Hippasteria*, *Mediaster*, *Peltaster*, *Plinthaster* and *Sphaeriodiscus*. However, most are either poorly understood or showed no relevant patterns. Although phylogeography of the species in *Hippasteria* was studied, no clear Atlantic-Pacific species pairs were observed (Mah *et al.* 2014; Foltz *et al.* 2013). *Anthenoides* includes several species with a distribution pattern similar to *Circeaster*, but species in *Anthenoides* occur more widely and no data are available indicating which of the Indo-Pacific species is the sister species to the species in the Atlantic.

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