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NOTES AND NEWS

DECAPOD DIVERSITY ASSOCIATED WITH DEEP-SEA OCTOCORALS IN THE GULF OF MEXICO

BY

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INTRODUCTION

Decapod crustaceans, such as crabs, squat lobsters and shrimp, are known to form close ecological associations with several species of coral in warm, shallow-water habitats (Abele, 1974, 1976; Abele & Patton, 1976; Patton, 1976, 2013; Stella et al., 2011). However, much less is known about these relationships (both past and present) in cold and dark deep-sea waters, due to the difficulties involved in observing and collecting organisms at great depth (Gatt & De Angeli, 2010; Le Guilloux et al., 2010; Klompmaker, 2013; Purser et al., 2013). Here we describe several observations of associations between decapods and deep-sea octocorals during an ROV (Remotely Operated Vehicle) mission in the Gulf of Mexico.

RESULTS AND DISCUSSION

While conducting observations with ROV "Global Explorer" during a two-week research cruise in the Gulf of Mexico aboard RV "Pelican" from 15 June to 27 June 2015, several decapods were observed clinging to several different species of octocorals. These associations included the chirostylid squat lobster *Gastroptychus formosus* (Filhol, 1884) with *Paramuricea* sp. type B3 (Doughty et al., 2014, Plexauridae), *Paramuricea biscaya* Grasshoff, 1977 (Plexauridae), *Placogorgia* sp.

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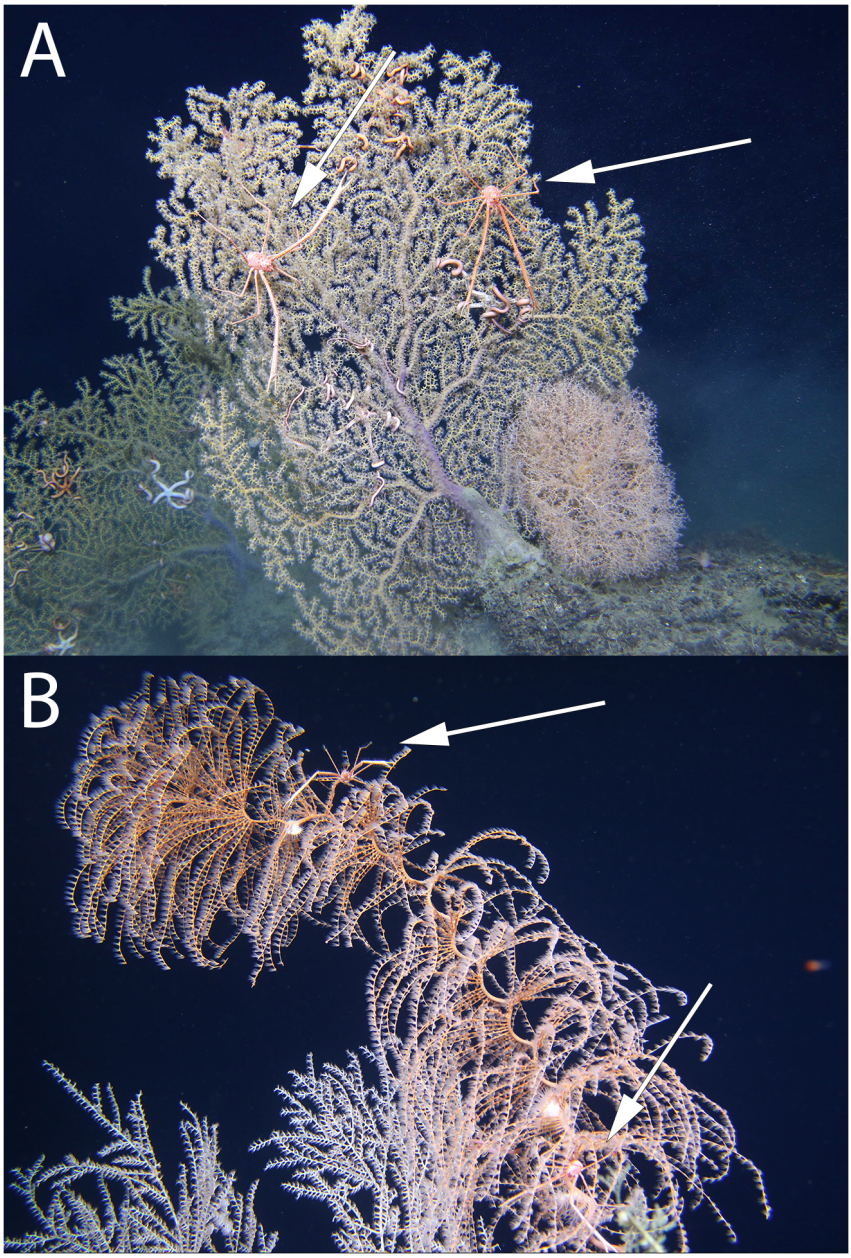

Fig. 1. A, *Gastroptychus formosus* (Filhol, 1884) on *Paramuricea* sp. type B3; B, *Iridogorgia splendens* Watling, 2007. Photograph (A) taken at site AT357, depth 1057 m, position at latitude 27.58 (N) longitude 89.7 (W), ROV dive 15. Photograph (B) taken at site GC852, depth 1400 m, position at latitude 27.11 (N) longitude 91.16 (W), ROV dive 6. Decapod identification by H. Bracken-Grissom and C. Varela. Octocoral identifications by D. DeLeo and A. Quattrini.

(Plexauridae) and *Iridogorgia splendens* Watling, 2007 (Chrysogorgiidae) (fig. 1A, B); the chirostylid squat lobster *Uroptychus nitidus* (A. Milne-Edwards, 1880) with *Chrysogorgia* sp. (Chrysogorgiidae) (fig. 2A); and the bathypalaemonellid shrimps *Bathypalaemonella texana* Pequegnat, 1970, and *B. serratipalma* Pequegnat, 1970, with *Iridogorgia splendens* and *Chrysogorgia* sp. (fig. 2B). In all cases the decapods were found clinging to colony branches.

Due to the fragile nature of these deep-sea communities, only a small subset of observed decapods and octocorals were collected as part of this study. All decapods reported here were collected after in situ imaging, positively identified to species in the lab using taxonomic literature and dichotomous keys (Filhol, 1884; Selbie, 1914; Pequegnat & Pequegnat, 1970; Pohle & Macpherson, 1995; Baba, 2005; Baba et al., 2008) by experts in decapod taxonomy (H. Bracken-Grissom and C. Varela), and deposited as voucher specimens in the Florida International Crustacean Collection (FICC) (table I). All corals were sent to deep-sea octocoral experts (J. Thoma, D. DeLeo and A. Quattrini) and identified using dichotomous keys, or from high-resolution photographs taken by the ROV (Bayer, 1981; Van Ofwegen et al., 2001; Watling, 2007). Not all specimens could be identified to species due to damage, lack of collected material, possible new species, or lack of diagnostic keys. Questionable identifications and associations were omitted from this study.

This study reports the first photo-documentation and in-lab identifications of *Uroptychus nitidus*, *Bathypalaemonella texana* and *B. serratipalma* associated with deep-sea octocorals. Previous studies have reported *Gastroptychus formosus* (cf. Pohle & Macpherson, 1995) and their octocoral associations in the western North Atlantic (Le Guilloux et al., 2010), however, this is the first record of *G. formosus* (see Felder et al., 2009 for Gulf of Mexico checklist) and their octocoral associations for the Gulf of Mexico. Because *G. formosus* has a trans-Atlantic distribution, now ranging from the western to the eastern Atlantic (Canada to the Gulf of Mexico and Ireland to the Canary Islands; cf. Pohle & Macpherson, 1995), a thorough morphological and genetic investigation is needed to determine whether these populations all belong to the same species.

In this study, most decapod species associated with an octocoral had a predictable and specific host preference, and many of the octocoral colonies included at least one decapod species. *Gastroptychus formosus* was most abundant relative to other decapods and occurred either as one or several individuals per colony (fig. 1A, B), often with chelipeds and mouthparts widely extended, likely for capturing suspended food (fig. 3). This species was commonly found on various species of Plexauridae or *Iridogorgia splendens*. All colonies of *Chrysogorgia* sp. collected or photographed with the ROV supported either *Uroptychus nitidus* (fig. 2A), *Bathypalaemonella texana*, or *B. serratipalma*. Both species of

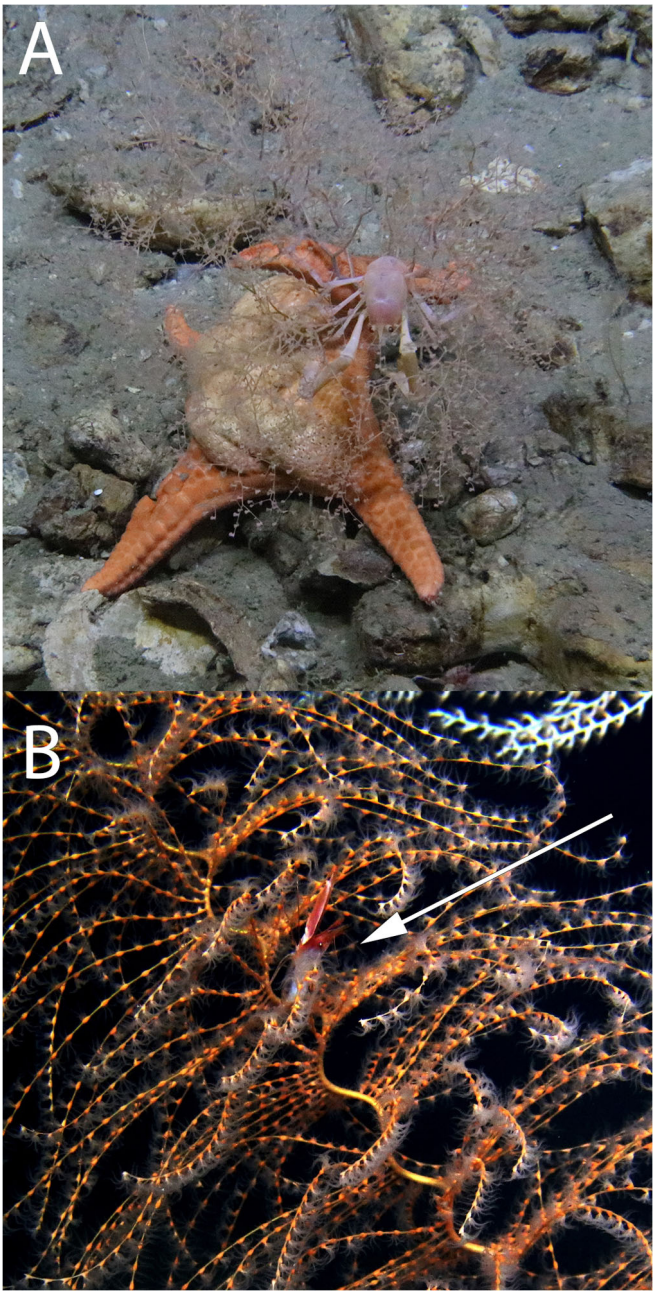

Fig. 2. A, *Uroptychus nitidus* (A. Milne-Edwards, 1880) on *Chrysogorgia* sp.; B, *Bathypalaemonella* sp. on *Iridogorgia splendens* Watling, 2007. Photograph (A) taken at site GB903, depth 1050 m, position at latitude 27.07 (N) longitude 92.81 (W), ROV dive 4. Photograph (B) taken at site GC852, depth 1400 m, position at latitude 27.11 (N) longitude 91.16 (W), ROV dive 6. Decapod identification by H. Bracken-Grissom and C. Varela. Octocoral identifications by D. DeLeo and A. Quattrini.

TABLE I

Taxon list of all decapod species collected as part of this study

Voucher ID	Family	Genus	Species	Station	Dive No.	Latitude (N)	Longitude (W)	Depth (m)
HBG 3776	Chirostylidae	*Gastroptychus*	*formosus*	GB903	9	27.08	92.82	1050
HBG 3777	Chirostylidae	*Gastroptychus*	*formosus*	GB903	10	27.08	92.82	1050
HBG 3778	Chirostylidae	*Gastroptychus*	*formosus*	GB903	11	27.08	92.82	1050
HBG 3779	Chirostylidae	*Gastroptychus*	*formosus*	AC357	8	26.62	91.10	1165
HBG 3780	Chirostylidae	*Gastroptychus*	*formosus*	GB903	2	27.08	92.82	1050
HBG 3781	Chirostylidae	*Gastroptychus*	*formosus*	GB903	19	27.08	92.82	1050
HBG 3792	Chirostylidae	*Gastroptychus*	*formosus*	AC357	11	26.62	91.10	1165
HBG 3760	Chirostylidae	*Uroptychus*	*nitidus*	GB903	15	27.08	92.82	1050
HBG 3761	Chirostylidae	*Uroptychus*	*nitidus*	EX1202L3	9	27.13	90.48	1165
HBG 3789	Chirostylidae	*Uroptychus*	*nitidus*	MC853	5	28.07	89.07	1057
HBG 4109	Chirostylidae	*Uroptychus*	*nitidus*	MC751	7	28.19	89.79	441
HBG 3757	Bathypalaemonellidae	*Bathypalaemonella*	*serratipalma*	GC852	9	27.08	92.82	1050
HBG 3758	Bathypalaemonellidae	*Bathypalaemonella*	*serratipalma*	EX1402L3	4	86.62	91.10	1920
HBG 3759	Bathypalaemonellidae	*Bathypalaemonella*	*texana*	AC357	9	26.62	91.10	1165
HBG 4115	Bathypalaemonellidae	*Bathypalaemonella*	sp.	EX1202L3	10	27.13	90.48	1165
HBG 4120	Bathypalaemonellidae	*Bathypalaemonella*	sp.	MC853	1	28.07	89.07	1057

Fig. 3. *Gastroptychus formosus* (Filhol, 1884) among colonial anemones (zoanthids). Photograph was taken at site AT357, depth 1057 m, position at latitude 27.58 (N) longitude 89.7 (W), ROV dive 14. Decapod identification by H. Bracken-Grissom and C. Varela. Octocoral identifications by D. DeLeo and A. Quattrini.

Bathypalaemonella were also found regularly with *Iridogorgia splendens* (fig. 2B). *Bathypalaemonella texana* or *B. serratipalma* may each have a preferred coral host (*Iridogorgia splendens* or *Chrysogorgia* sp.), although this could not be determined, as the coral host and associate were not always collected at the same time. Although the reasons for such specificity are unknown, we hypothesize that decapods may be using octocorals as mating dens to attract con-specifics. In shallow water, crabs and shrimps use their coral hosts as mating sites, as the branches and outcrops provide shelter and protection after molting and copulation (Castro, 1988; Patton, 1994; Munday et al., 1997; Sin, 1999). As host colonies are often isolated or widely separated, they may serve as visual (via bioluminescence) or chemical markers, or both, to signal members of the same decapod species. The possible joint function of chemoreception and vision would make this hypothesis more plausible. Extensive studies would be needed to test if deep-sea octocorals act as mating dens for particular species of decapods.

The reasons for deep-sea decapod-octocoral associations are unknown, however, they may be beneficial for several reasons. First, such associations with corals are known to provide inhabitants with protection from predators in shallow water (see Stella et al., 2011, for a review). Such complex local habitats offered by colonial anthozoans should similarly provide refuge for mobile organisms in the deep sea. In addition, octocorals produce a variety of chemical compounds important in ecological, antimicrobial and antiviral interactions (Coll, 1992), which would

likely benefit inhabitants that can tolerate these metabolites. Although limited work has been done in the species mentioned here, Almeida et al. (2014) mentioned several cytotoxic products detected in *Paramuricea* spp. Thus, the octocoral branches, among which many deep-sea decapods nestle, can provide both physical (Krieger et al., 2002; Klompmaker et al., 2016) and chemical protection from predators. Secondly, decapod-octocoral associations likely facilitate feeding for both organisms. Deep-sea octocorals are suspension feeders, and many decapods capture suspended prey, so elevated positions in the water column should be advantageous, especially as current velocity typically increases with elevation above the substrate. Food collected but not ingested by the decapod could be consumed by the octocoral. Some shallow-water decapods can feed directly on mucus, tissue and associated detritus produced by corals (Knudsen, 1967; Glynn, 1983; Stachowicz & Hay, 1999), and a similar strategy may apply in the deep sea. In addition, White (2007) and Wagner et al. (2011) found that coral structure influences the hydrodynamic flow surrounding the reef and facilitates particle entrapment. It is thus plausible that zooplankton and other small particles get trapped in coral branches, which would increase the amount of food particles available to the decapod inhabitant. Thirdly, two of these octocorals (*Iridogorgia splendens* and *Chrysogorgia* sp.) are bioluminescent. From the perspective of the decapod occupants, this luminescence may provide protection (Johnsen et al., 2012) by marking or illuminating the decapod's primary predator, making it vulnerable to secondary predators (Haddock et al., 2010; Widder, 2010). All the above-mentioned reasons for decapod-octocoral associations are speculative, but lay the groundwork for studies that will test these hypotheses.

CONCLUSIONS

Herein we reported associations between several species of deep-sea decapods and octocorals. Recognition of such basic components of deep-sea biodiversity is extremely limited due to the difficulty and cost of collection and the expertise needed for taxonomic identification. These observations demonstrate the utility of ROV exploration for augmenting deep-sea biodiversity initiatives and documentation.

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