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THE DISTRIBUTION OF THE FAMILY HAPALOCARCINIDAE (DECAPODA, BRACHYURA) ON THE FLORIDA MIDDLE GROUND WITH A DESCRIPTION OF PSEUDOCRYPTOCHIRUS HYPOSTEGUS NEW SPECIES

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ABSTRACT

An investigation of the Florida Middle Ground, the northern-most hermatypic coral reef in the Gulf of Mexico, reveals two species of the coral inhabitating family Hapalocarcinidae. Pseudocryptochirum corallicola was collected from three coral species: Manicina areolata, Scolymia lacera, and Mussa angulosa. A new species of Pseudocryptochirus established herein as P. hypostegus was found inhabitating canopy-like burrows on the coral Agaricia fragilis.

The occurrence of these gall-forming crabs is probably related to the Loop Current which brings water up to the Middle Ground from the Florida Keys.

KEY WORDS: Pseudocryptochirus, Hapalocarcinidae, Florida Middle Ground, Agaricia, Loop Current, Gulf of Mexico, Zoogeography.

THE DISTRIBUTION OF THE FAMILY HAPALOCARCINIDAE (DECAPODA, BRACHYURA) ON THE FLORIDA MIDDLE GROUND, WITH A DESCRIPTION OF *PSEUDOCRYPTOCHIRUS HYPOSTEGUS* NEW SPECIES

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Introduction

The Florida Middle Ground located in the northeastern Gulf of Mexico approximately 137 km southeast of Appalachicola, Florida, and 129 km west of Tarpon Springs, Florida, is the northernmost hermatypic coral community in the Gulf of Mexico, (1). Through early support from the State University System of Florida and later by way of contract work with the Bureau of Land Management, the authors have been fortunate to spend a considerable amount of time using SCUBA to make observations and site-specific collections.

During June and September 1975, and February-March 1976 we made specific collections of scleractinian corals from six pre-selected sites which were repetitively occupied. We first observed the occurrence of gall-forming crabs in June of 1975 (in the field), but it remained until early 1976 before we were able to make careful studies which allowed us to realize that a new species was involved. The authors contacted Professor John Garth, Curator Emeritus, Allan Hancock Foundation who confirmed our impression.

The literature involving the Hapalocarcinidae has evolved considerably since Potts' (2) review of their commensal habits (3-11). It is noteworthy that virtually all of the above [except Rathbun, (5); and Monod, (17)] involve Indo-Pacific forms. It is understandable that the Pacific with its preponderance of coral species and its extensive reef formations should produce such a high diversity within the family Hapalocarcinidae; on the other hand, it is an unexplained enigma to discover that heretofore only one member of the entire family has been described from the west Atlantic and Caribbean. This is especially true in view of the coral reef studies undertaken in this area during recent years (12-15). The discovery of a host-specific *Pseudocryptochirus* from *Agaricia fragilis* Dana along with a new host record, *Scolymia lacera* (Pallas), for *P. corallicola* (Verrill) on the Florida Middle Ground recorded herein is a first step in developing a better understanding of these reef inhabitants in the West Atlantic and Caribbean seas.

Results

Genus *Pseudocryptochirus* Hiro, 1938

Pseudocryptochirus corallicola (Verrill, 1908) (Figs. 2b, 3b).

Troglocarcinus corallicola-Verrill, 1908 p. 427, pl. 28, fig. 8; figs. 48-49 a, b, c, (type in Peabody Museum, Yale Univ.).-Balss, 1922, p. 87 (as *T. balssi*, Monod, 1956, p. 63, figs. 620-627).-Fizé and Serène, 1957, p. 8.-Serène, 1966, p. 395.

Cryptochirus corallicola-Edmondson, 1933, p. 5.-Shen, 1936, p. 22-Rathbun, 1937, p. 262, pl. 78, figs. 5-7; figs. 47.-Hiro, 1937, p. 140. -Garth and Hopkins, 1968, p. 40.

Pseudocryptochirus corallicola-Utinomi, 1944, p. 298, figs. 11a, 12d, 14a, 15d.

Material examined

Troglocarcinus corallicola Verrill, 1908, female holotype from *Mussa*, Dominica Island, Yale Peabody Mus. 7612, 1908. *Cryptochirus corallicola* (Verrill), 2 female (ovig.), 2 male from *Meandra (=Manicina) areolata*, Dry Tortugas, Florida, H. Boschma, July-August, 1925, USNM 59964. 3 female (ovig.), 3.0-4.8 mm (CL), 2.4-3.5(CL); 1 male 2.6 mm (CL), 2.3 mm (CW); from *Scolymia lacera*, MAFLA Station 146, Florida Middle Ground, 28°41' N 84°23'W, 27 m, K. Shaw, *R/V Bellows*, 28 June 1976. 5 female (ovig.) 3.7-4.7 mm (CL), 2.7-3.5 mm (CW); 2 males, 2.5-3.0 mm (CL), 2.2-2.4 mm (CW); from multiple polyp *Scolymia*, MAFLA Station 146, Florida Middle Ground, 28°41'N 84°23'W, 27 m, K. Shaw, *R/V Bellows*, 28 June 1976.

Diagnosis

Carapace depressed; front abruptly bent downward, spines along anterior lateral margin; inner orbital angles spinose; frontal region heavily setose; inhabits lunate pits oblique to surface of living corals of families Mussidae and Faviidae.

Remarks

The frontal slope beginning at the cephalothorax is at an angle of 60° from the posterior region of the female carapace. This large angle depicts the modification of the carapace by oblique burrowing forms for plugging the pit. The opercular action of the frontal carapace and first ambulatory legs have been previously described (6, 7, 10). The generic term *Troglocarcinus* Verrill was discarded as a synonym of *Cryptochirus* Heller by Edmondson (17), and Rathbun (5), Hiro (18), and Utinomi (6), however, placed *C. corallicola* within the genus *Pseudocryptochirus* Hiro 1938 based on the following

characters: 1) broad and depressed carapace, 2) presence of a rudimentary exopod on the first pleopod of the female, 3) lobe-like extension of the first ambulatory leg, and 4) inhabiting lunate pits oblique to the surface of the coral.

Fizé and Serène (8) and Serène (9) did not examine specimens of *Pseudocryptochirus corallicola*; however, the similarities of *Troglocarcinus* subgenus *Mussicola (=Troglocarcinus)* were recognized. These included the biramous appendage of the female first pleopod and the host specificity of the crab to the coral family Mussidae. The specificity of *P. corallicola* for the Mussidae is not appropriate, as shown by Verrill (16) (Mussidae, Faviidae, and Trochosmiliidae) and Rathbun (5) (Mussiidae, and Faviidae). In his revision of the generic status of several species of *Troglocarcinus* in the Indo-Pacific, Serène (op. cit.) elevated the subgenera *Favicola* and *Fungicola* to generic status and established *Troglocarcinus* for those species in the subgenera *Mussicola, Pseudocryptochirus,* and *Troglocarcinus.* The creation of these genera appears to be based primarily on their specificity for a particular family of coral host. Species of *Pseudocryptochirus*, however, have been reported from corals of the families Agariciidae, Faviidae, Merulliniidae, Pectiniidae, Dendrophyllidae, and Acroporidae.

It is proposed that *Pseudocryptochirus corallicola* be retained within this genus not because of its overlap in coral host families, but also because of its overall similarity with *P. viridis* Hiro, the genotypic species, and *P. cresentus* (Edmondson) in morphology and habitat [(6), (10), (18)].

Ecology

Pseudocryptochirus corallicola has been found inhabiting three species of corals from two families. These include *Mussa angulosa* (Pallas) (Family Mussidae), *Manicina areolata* (Linnaeus) (Family Faviidae), *Dichocoenia* (Family Meandrinidae). *Scolymia lacera* (Pallas) (Family Mussidae) which is abundant on the Florida Middle Ground constitutes a new host species for *P. corallicola.* Nearly every colony greater than 5 cm contained one or more crabs. The burrow is rather cup-shaped and lies between the radiating calyces. Thus, the crab is oriented vertically; the frontal region of the carapace and the first ambulatory legs form an operculum (fig. 2b). Crabs were less abundant on multiple polyp *S. lacera* and also were observed in pits on dried specimens of *Manicina areolata. Stephanocoenia michelini* contained small crabs from burrows which closely resemble *P. corallicola,* but further investigation may indicate still another species of *Pseudocryptochirus.*

Distribution

Known only from Western Atlantic: Dominica Island on *Mussa;* Bermuda Islands on *Mussa, Meandra (=Manicina)* and *Dichocoenia;* Dry Tortugas, Florida on *Meandra (=Manicina) areolata* and *Meandrina;* Florida Middle Ground on *Scolymia lacera*, multiple polyp *Scolymia,* and *Manicina areolata.*

Pseudocryptochirus hypostegus new species
(Figure 1, 2a, 3a)

Holotype

1 female (ovig.) USNM 168532 (CL), 4.0 mm; (CW), 3.3 mm, MAFLA Station 147, Florida Middle Ground about 137 km west of Tarpon Springs, Florida 28°30'49"N, 84°20'30"W, 27 m, SCUBA, K. Shaw, *R/V Bellows* from *Agaricia fragilis* Dana, 29 June 1976.

Paratypes

1 male USNM 168533; 2 males; 6 females (5 ovig.), Invert. Mus. Coll., Dauphin Island Repository; MAFLA Station 147, Florida Middle Ground, about 137 km west of Tarpon Springs, Florida, 28°30'49"N, 84°20'30"W, 27 m; SCUBA, K. Shaw, *R/V Bellows*, from *Agaricia fragilis* Dana, 29 June 1976.

Diagnosis

Carapace depressed; frontal region gradually sloping downward; tuberculations pronounced in anterior half; fingers of chelipeds curved;sternum with transverse rows of tubercles; inhabits canopy-like burrows of *Agaricia fragilis* (Family Agariciidae).

Description

Female holotype (Fig. 1a-g); carapace subovate posteriorly, anterior region thick, bent downward at 40° angle; tuberculate in anterior half, large tuberculations pronounced along lateral and frontal margins and cephalothoracic ridge. Orbits distinctly incised; outer orbital angles blunt; inner orbital angles spinose, protruding slightly beyond outer orbital angles. Lateral margin spines blunt, increase in size posteriorly. Slight concavity on either side of median line in antennal region.

Eyes small on thick short stalks, extending to less than half length of basal antennular article. Basal article of antennular peduncle longer than broad, heavily toothed, extending to midlength of distal article; remaining articles smooth, with setae; flagella biarticulate. Antenna small, as long as eyestalk.

Ischium of third maxilliped broader than long, broadly rounded on inner distal margin, fringed with setae; inner margin crenulate, outer margin toothed, outer surface tuberculate. Merus as long as broad, outer distal margin slightly protruding and crenulate. Exopodite armed with setae, two-thirds as long as outer margin of

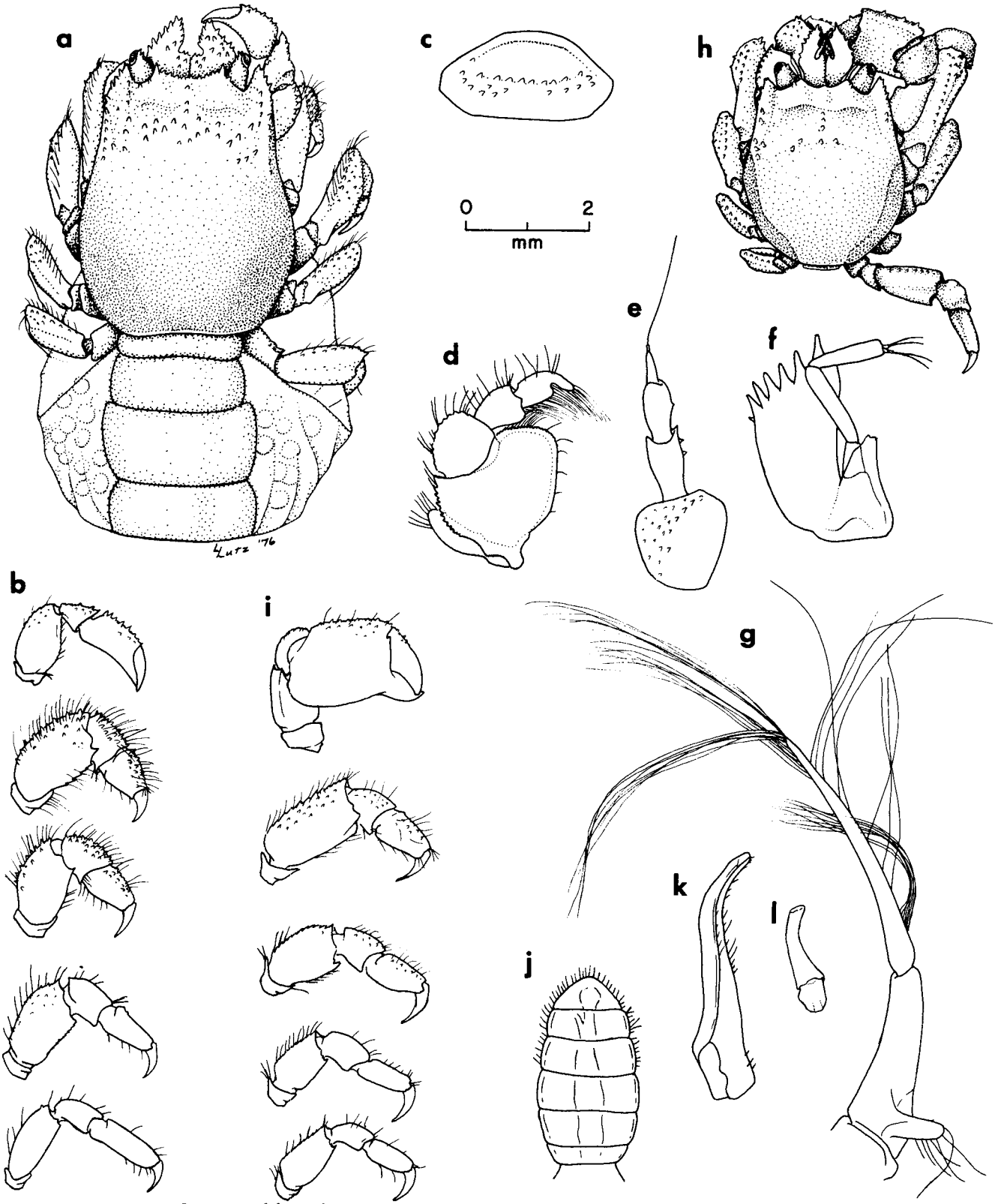

FIGURE 1. *Pseudocryptochirus hypostegus* n. sp., female holotype a, b; female paratypes c-g; male paratype, h-l; a, dorsal view; b, pereiopods; c, sternum; d, 3rd maxilliped; e, antenna; f, antennule, ventral view, g, 1st pleopod; h, dorsal view; i, pereiopods; j, abdomen; k, 1st pleopod; l, 2nd pleopod. Scale 2 mm for a, b, h, i.

ischium. Sternum concave along buccal margin; transverse rows of tubercles medially.

Chelipeds of equal size; fingers curved; propodus long and slender, ratio of length to width 2.4; dactylus less than half length of propodus; dorsal surface of merus, carpus, and propodus with tubercles. Cheliped much weaker and shorter than ambulatory legs. Merus, carpus, and propodus of first and second ambulatory legs flattened; dorsal surface tuberculate and setose. Merus of ambulatory legs decreasing in length from first to fourth leg; propodus increasing in length from first to fourth ambulatory leg. Third and fourth ambulatory legs slender and smooth; fourth leg longest.

First pleopod biramous, composed of two segments; rudiment article with several long setae; second and third pleopods with two articles and setae.

Male paratype (fig. 1h-l, fig. 2); carapace not bent anteriorly as in female; dorsal tubercles reduced; inner orbital angle rounded. Palm of chela robust, ratio of length to width of propodus 1.8; ambulatory legs slender, decreasing in size posteriorly; merus, carpus and propodus of first and second legs granulate. Abdomen elongate-oval, twice as long as wide; last three segments with many short setae. First pleopod with 20 curved mesial spines.

Color

Preserved coloration of female paratypes, but not holotype, in isopropyl alcohol reddish-brown, pattern mottled. Male paratypes with a large U-shaped color pattern on carapace white, posterior lateral margins maroon.

Measurements

Female holotype; 4.0 mm (CL), 3.3 mm (CW). Male paratypes; 2.4 to 3.4 mm (CL), 2.0 to 2.8 mm (CW). Female paratypes; 1.9 to 4.4 mm (CL), 1.6 to 3.7 mm (CW).

Remarks

Pseudocryptochirus hypostegus n. sp. more closely resembles *P. crescentus* than the genotype *P. viridis* in morphological characters. Similarities with *P. crescentus* are found in the general shape of the carapace, third maxilliped, male abdomen, male pleopods, and female pleopods. Similarities with *P. viridis* are the shape of the antenna and third maxilliped, and the propodus length/width ratio of the cheliped. *P. hypostegus* is distinguished from *P. corallicola* primarily by having: expanded posterior lateral margins and tubercles rather than parallel lateral margins with spines; different slope angles of the frontal region (40° vs. 60°); a granulate sternum; chelipeds with curved fingers; the dactylus less than half the cheliped length; spine-like setae as opposed to feathered setae on the first male pleopod; and female pleopod article counts of 2 (+1), 2, 2 rather than 3 (+1), 2, 1. Carapace outlines of the two species show distinct differences (Fig. 2).

There is little variability in the shape of female carapaces, however, tubercles increase in number and size with the increase of carapace length. McCain and Coles (14) provided an interesting discussion on the variability of rudiment appendages of the female first pleopod of their new species of *Pseudocryptochirus, Favicola rugosus* (Edmondson), *F. minutus* (Edmondson), *Hapalocarcinus marsupialis* Stimpson, and *Pseudohapalocarcinus ransoni* (Fizé and Serène). They suggested a revision of the hapalocarcinid classification that relies on more extensive morphological characteristics rather than the primary diagnostic character of the biramous first pleopod with rudiment. Variability of the rudimentary appendage of the female first pleopod was not noted for *P. hypostegus*.

Ecology

Pseudocryptochirus hypostegus inhabits the coral *Agaricia fragilis* Dana. It is found within a canopy-shaped tunnel on the surface of the plate forming coral (fig. 3a). The length of the tunnel ranges from 1.0 to 2.8 cm with an opening of 2.0 to 4.0 mm in height and 4.0 to 9.0 mm in width. The opening appears large enough for the animal to exit. The tunnel narrows from the opening to about half the width at the enclosed end. Generally, a depression is present indicating the point at which the animal initially settles between the furrowed calyces.

It appears that formation of the burrow is a two-step process. As the crab settles within the furrow between the calyces, the coral grows upward around the crab, similar to *P. viridis* [Utinomi, (6), p. 714]. However, the colony of *Agaricia fragilis* grows laterally in a plate-like fashion, overgrowing the shallow pit formed by the presence of the crab. Continued growth and movement of the crab keeps the opening of the tunnel enlarged as it grows in length. Depending on size of the crab and growth rate of the coral, the crab appears to have much room within the burrow. After removing the coral from sea water, several crabs were observed to crawl completely out of their tunnels. As many as four animals with burrows have been collected from a single colony of *Agaricia fragilis*.

Variation in the slope of the frontal regions of the carapaces of *Pseudocryptochirus corallicola* and *P. hypostegus* suggests that the angle is associated with pit-formation in their respective hosts (fig. 3a, b). It is suggested that the lesser angle (40° in *P. hypostegus*) is an adaptation for the superficial horizontal covered dwelling formed by *Agaricia*; the crab conforms with the canopy at the opening of the tunnel.

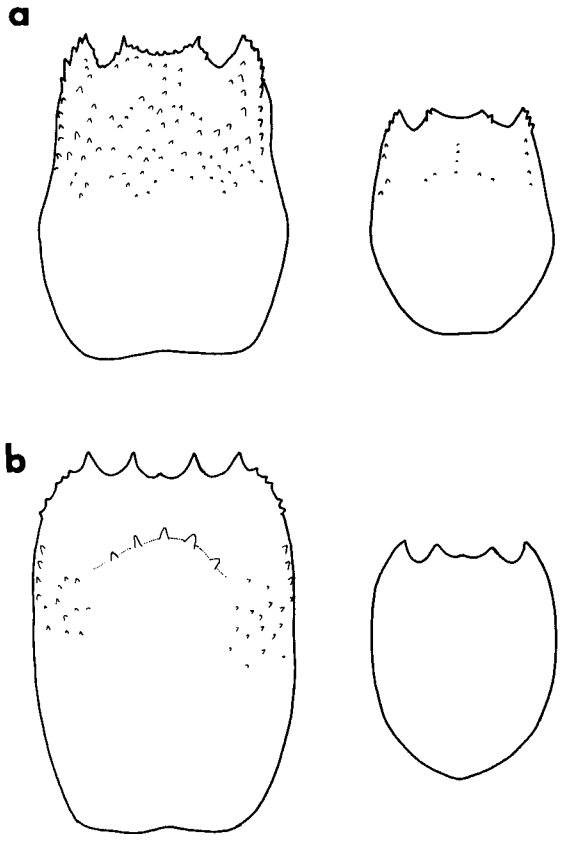

Figure 2. Carapace outlines. a. *Pseudocryptochirus hypostegus* n. sp., female, male; b. *Pseudocryptochirus corallicola*, female, male.

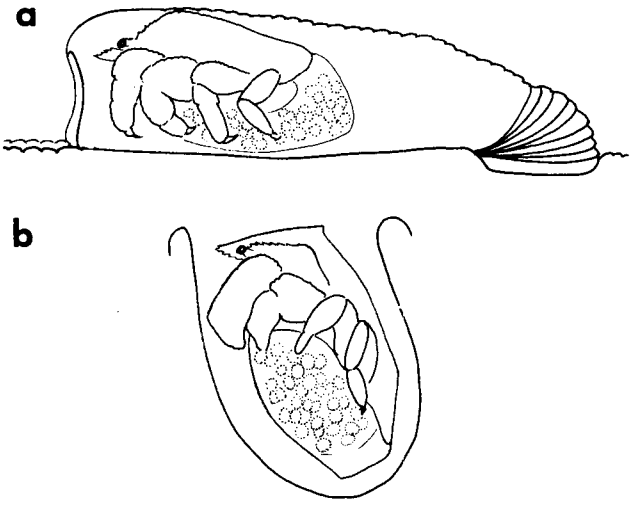

Figure 3. a. *Pseudocryptochirus hypostegus* n. sp. habitat in *Agaricia fragilis*. b. *Pseudocryptochirus corallicola* habitat in *Scolymia lacera*.

Etymology

The species name is derived from the Greek *hypo*=under and *stegos*=roof. This refers to the canopy or roof-like habitat of the animal formed by the coral host *Agaricia fragilis*.

Distribution

Known only from the eastern Gulf of Mexico on the Florida Middle Ground, in 25-30 meters, on *Agaricia fragilis*.

Discussion

Since *P. hypostegus* n. sp. is only the second known hapalocarcinid from the northwestern Atlantic and occurs with *P. corallicola*, it is logical to assume that it may have arisen out of the same gene pool, but evolved in response to a very different host animal. It is noteworthy that neither of these species is reported by Tresslar (15) in association with scleractinian corals on the West Flower Garden Bank in the Northwestern Gulf of Mexico. This may very well be explained by the apparent circulation patterns which bring larvae to the respective areas. Hopkins (19) has proposed that the Florida Middle Ground is maintained by the Loop Current (20) bringing water from the Bahamian and Florida Keys environments, whereas the West Flower Garden Bank is maintained by the Mexican Current (21). A principal argument for this contention is the dissimilarity of the Florida Middle Ground invertebrate fauna with that of the West Flower Garden Bank (19), and the fauna of the reefs of the Mexican east coast (22).

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