ANEMONE-CARRYING BEHAVIOUR IN A DEEP-WATER HOMOLID CRAB (BRACHYURA, PODOTREMATA)

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ABSTRACT

A new symbiotic association between a deep-water homolid crab, Hypsophrys inflata Guinot & Richer de Forges, 1981 (Brachyura, Podotremata, Homolidae) and a sea anemone of the genus Isanthis (Anthozoa, Actiniaria, Isanthisidae) is described from French Polynesia. The crab carries the anemone on its modified last pairs of legs. It is suggested that this represents a mutualistic association.

RÉSUMÉ

L'association entre un crabe homolidé de profondeur, Hypsophrys inflata Guinot & Richer de Forges, 1981 (Brachyura, Podotremata, Homolidae) et une anémone de mer Isanthis sp. (Anthozoa, Actiniaria, Isanthisidae) est décrite de Polynésie Française. Le crabe tient et transporte l'anémone avec sa dernière paire de pattes thoraciques modifiées. Il s'agirait d'une association de type mutualisme.

INTRODUCTION

The existence of biotic interactions between cnidarians and crustaceans has been known for a long time (see for instance the reviews by Balss, 1956; Ross, 1967, 1974 a, b, 1983); but it has been only during the last three decades that our knowledge of the behaviour of these animals has increased significantly, viz., with the advent of SCUBA diving, in situ photography, videography, and the use of baited traps. Numerous species display various types of symbiotic associations (see Castro, 1988) that play a major role in their survival.

Carrying behaviour appears to be no uncommon adaptation in the family Homolidae (Wicksten, 1983, 1985, 1986, 1993). This is evident by the special disposition of the last pair of walking legs: their dorsal insertion, increased mobility, and the modification of their last segments to provide a subchelate or chelate terminus (see Guinot & Richer de Forges, 1981 and in press). As in other primitive crabs of the section Podotremata Guinot, 1977, homolid crabs

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as well as the heterotrematous dorippid crabs show several modifications in the propodus and dactylus to adapt the last legs as a prehensile organ to hold and carry objects. This kind of symbiosis involves several homolid crabs, i.e., *Paromola cuvieri* (Risso, 1816), *P. japonica* Parisi, 1915, *Homola orientalis* Henderson, 1888, and *H. vigil* A. Milne Edwards, 1880 (see Guinot & Richer de Forges, in press), that are associated with sponges, antipatharians or gorgonians, and seems to be more frequent or at least more permanent than originally thought.

We present new information concerning the behaviour of the homolid crab *Hypsothrys inflata* Guinot & Richer de Forges, 1981. This deep-water crab was found carrying a sea anemone (Anthozoa, Actiniaria, Isanthidae) of the genus *Isanthus* Carlsgren, 1938, probably a new species. No similar associations between homolid crabs and sea anemones have been previously reported.

MATERIALS AND METHODS

During the biological researches of the “Service Mixte de Contrôle Biologique” (SMCB) in French Polynesia (1986-1990), 3000 baited traps (Noirmoutier type) were set by the R. V. “Marara” at depths ranging from 100 to 1120 m (see Poupin et al., 1990). This type of trap permits the collection of individuals without injuries; this way, crabs will still be able to keep their symbiotic partner. Among species collected and photographed alive, the homolid crab *Hypsothrys inflata* was found with a sea anemone grasped by the crab’s chelate fifth walking legs, P5 (figs. 1-3).

J. Poupin (pers. comm.) has observed more than fifty individuals of *Hypsothrys* always holding sea anemones. Only three samples of the various catches were taken from the entire population and they are now preserved in the Muséum National d’Histoire Naturelle, Paris (MNHN).

Sample 1. French Polynesia, Mururoa atoll, station 223, 21°50.9’S 138°58.2’W, depth 500 m, 15.V.1990 (MNHN-B 24343): a male and an ovigerous female, and two sea anemones separated from the crabs. Colour photographs of live individuals by J. Poupin showing one crab holding a sea anemone with the last legs raised over the body.

Sample 2. French Polynesia, Makemo atoll, station 309, 16°34.2’S 143°38.7’W, depth 580 m, 07.X.1990 (MNHN-B 24446): 1 male specimen still grasping a sea anemone between the dactylus and the propodi of the fifth legs (figs. 1-3).

Sample 3. French Polynesia, Reao atoll, station 70, 18°30’S 136°27’W, depth 300-400 m, 07.VI.1990 (MNHN-B 243311): an ovigerous female and a sea anemone separated from the crab.

Another *Hypsothrys* specimen from a sample collected from the Hao atoll in a baited trap at a depth of 1020 m was photographed with the dactylus of the last pereiopods inside the column of the sea anemone, but was not preserved. Information on the substrata indicates that the symbiotic animals occur on hard bottoms (J. Poupin, pers. comm.).

RESULTS AND DISCUSSION

The genus *Hypsothrys* includes eight species that have been collected at depths between 400 and 2000 m. Seven of these were collected from the Indowest Pacific region (*Hypsothrys superciliosa* Wood-Mason, 1891; *H. longipes*...
Figs. 1-3. *Hypophyrs inflata* Guinot & Richer de Forges, 1981, French Polynesia, Makemo atoll, male specimen (MNHN-B 24446). 1, Dorsal surface view showing how it holds an individual of the sea anemone *I. anomus* sp. with both of its fifth perciopods; the oral disk of the anemone has been turned on its side; 2, ventral view of the crab holding the anemone with the oral disk visible; 3, an enlargement of fig. 1 to show more clearly how the propodi and the dactyli of the last pair of legs of the crab grasp the column of the sea anemone.
Alcock & Anderson, 1899; *H. murotoensis* Sakai, 1979; *H. williamsi* Takeda, 1980; *H. personata* Guinot & Richer de Forges, 1981; *H. inflata* Guinot & Richer de Forges, 1981; and *H. futuna* Guinot & Richer de Forges, in press; the eighth from the Florida coast (*H. noar* Williams, 1974). *Hypsohrysis inflata* was first collected with fishing nets from the bathyal zone (400 m) from the Loyalty Islands, near New Caledonia, and Samoa (Guinot & Richer de Forges, 1981). The more recent collections in Polynesia by the use of baited traps permitted to catch and to observe for the first time on the deck of the boat *H. inflata* associated with the sea anemone *Isanthus* sp. It seems probable that crabs abandon the anemones when they are pulled into the dragging nets but keep holding their living partner when traps are used. There are no previous records of carrying behaviour in the genus *Hypsohrysis*.

Hermit crabs are also known to abandon anemones residing on their shell when disturbed. *Pagurus excavatus* (Herbst, 1791), *Anapagurus laevis* (Bell, 1846) and *Pagurus prideaux* Leach, 1815, which co-exist with the sea anemone *Calliactis parasitica* (Couch, 1842) and *Adamsia palliata* (Bohadsch, 1761), usually abandon their partner when collected with dragging nets, but not when collected with SCUBA (Schmidt, 1972; Chintiroglou & Koukouras, 1991).

The only described species of the sea anemone genus *Isanthus* is *I. capensis* (Carlsgren, 1938). It has been found in shallow water on the west and east coast of the Cape Peninsula, South Africa (Carlsgren, 1938, 1949). The study of the cnidom of our deep-water symbiotic *Isanthus* shows that there are important differences with Carlsgren’s description in addition to a different environment and behaviour, which indicates that it is a new species (Guinot, Doumenc & Chintiroglou, in prep.).

In the case of the homolids, particularly *Hypsohrysis inflata*, we conclude from the special chelate structure of the last pair of legs which is raised over the carapace, that the crab must be the active partner, probably manipulating the anemone with the P5 to take it off the substratum and to establish the association. In our three samples, the grasping of the anemone took place a little above the basal part of the column, while the orientation of the oral disc varied. The anemone was not in contact with the carapace, but the P5 carried it far from the dorsal surface of the carapace, above the body, very much like an umbrella. The backward and forward movement of the sea anemone is made possible by the especially strong mobility of the last legs of the crab.

The grasping of the column of the anemone with the chelipeds is used by other decapods for detaching an anemone from the substratum. Ross (1967, 1974a, 1974b) described the several ways hermit crabs detach anemones (earlier descriptive literature in Balss, 1956).

The carrying of the sea anemone by the homolid *Hypsohrysis* is very different from the behaviour described for the Caribbean “decorator crab” *Stenocionops furcata* (Olivier, 1791). This majid crab manipulates the anemone until it releases its pedal disk, using its cheliped to hoist the relaxed anemone onto its
body. Twenty to thirty individuals of the anemone *Calliactis tricolor* (Lesueur, 1817) can be attached on the carapace and legs (Cutress et al., 1970; Ross, 1974a, 1983).

In the preceding associations, the anemones were attached or carried by the crabs. Wirtz & Diesel (1983) have analyzed social structure and behaviour in *Inachus phalangium* (Fabricius, 1775), a spider crab that is free-living between the tentacles of *Anemonia viridis* (Forskål, 1775) (= *A. sulcata*). It has a long-lasting association with the same individual even if it sometimes moves away. *Inachus phalangium* has also been commonly reported with the back of its body against the column of *Anemonia*, the tentacles of which it can grasp with its fourth and fifth pereiopods (Weinbauer et al., 1982; unpubl. data from Ch. Chintiroglou).

Other brachyuran crabs are known to be associated with sea anemones (Guinot, Doumenc & Chintiroglou, in prep.). Dorippids can carry several types of objects. One example is the “porter crab”, *Dorippoides facchino* (Herbst, 1785), which carries on its back a small shell to which a sea anemone is fixed (Verrill, 1869; Tan & Ng, 1988; Holthuis & Manning, 1990); another one is *Paradorippe granulata* (De Haan, 1841) associated with *Carcinactis ishikawai* Uchida, 1960 (cf. Uchida, 1960). Many majid crabs show decorating behaviour, that is, the deliberate attachment of pieces of debris or sessile marine organisms (sometimes sea anemones) to hooked setae of the exoskeleton (Thomson, 1923; Wicksten, 1979, 1980, 1993). Some calappid crabs, such as *Hepatus chilensis* H. Milne Edwards, 1837, and *H. epheliticus* (Linnaeus, 1763), are associated with a sea anemone that lives on the smooth surface of the carapace (Bürger, 1903; Carlgren & Hedgpeth, 1952; Cutress et al., 1970). Xanthoid “boxer crabs” of the genera *Lybia* H. Milne Edwards, 1837, and *Polyductus* H. Milne Edwards, 1837, hold a small sea anemone in their modified claws (Duerden, 1905; Guinot, 1976).

The selective pressure that predators exert on their prey, favours prey with the capacity to reduce the risk of attack without interfering with other activities. Alcock (1975) distinguishes four basic aspects of antipredatory behaviour: hiding from predators, detection, evasion, and repulsion. The behaviour of homolid crabs seems to be mostly related with the last case and particularly with chemical repellents. According to Ross (1967, 1971) the toxins of the nematocysts of *C. parasitica*, which co-exists with the hermit crab *Pagurus bernhardus* (L., 1758), can repel to some extent cephalopods such as *Octopus vulgaris* Cuvier, 1797. It is known that crustaceans are a significant nutritional source for cephalopods (Wells, 1978). Our study reports something new that confirms the view that homolids “may also use the materials for defence. A pair of thorny antipatharians or a scratchy sponge might be thrust at an oncoming predator, discouraging an attack” (Wicksten, 1985).

Anemones increase their feeding potential when carried by crabs. In the case of anomuran crabs, Stachowitsch (1979; 1980) reported that *C. parasitica* alone can search for food over a substratum area of about 0.5 m²/day but thanks to
the movements of its hermit crab host, about 20 m²/day. Additional benefits
that the crab (H. inflata) gains from the anemone (Isanthus sp.) may include the
cleaning of its carapace from parasites or from the accumulation of detritus.

As compared with the other brachyuran crabs symbiotic with living organ-
isms, homolids provide elaborate anatomical means of attachment through
their movable and specialized hind appendages. When compared to other
homolids that generally use sponges as cover, however, H. inflata can use
anemones for a protection and defence, not merely for camouflage. Isanthus sp.
seems to have no specific modifications related to this association (no pedal disk
covered with a chitone stratum as in the case of the hermit crabs) and we do not
know if it lives isolated from the crab. It seems that the relationship between H.
inflata and Isanthus sp. can be characterized as mutualism.

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