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Nature and role of newly described symbiotic associations between a sea anemone and gastropods at bathyal depths in the NW Atlantic

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Abstract

The hormathiid sea anemone *Allantactis parasitica* was found living as an epibiont on numerous species of gastropods at depths of 725–1100 m along the continental slope of eastern Canada. The proportion of bathyal gastropods hosting 1–6 sea anemones reached 72.5% in a single trawl. Although *A. parasitica* was occasionally found on other substrata (i.e. empty shells, pebbles), laboratory trials confirmed that they preferably associate with living gastropods. Settlement of planula larvae occurred significantly more often on the shells of live bathyal gastropods than on all other substrata present in the tanks. Juvenile sea anemones (~ 1 mm diameter) readily moved from the mud or other inert substrata onto shells of burrowed bathyal gastropods. Conversely, larvae, juveniles and adults of *A. parasitica* never associated with any shallow-water gastropods when given the opportunity. Trials exposing predatory sea stars (*Leptasterias polaris*) from shallow and bathyal depths to bathyal gastropods (*Buccinum undatum*) with epibiotic *A. parasitica*, and to asymbiotic bathyal and shallow-water *B. undatum*, revealed adaptive behaviours in both prey and predator. Shallow-water gastropods (devoid of epibionts) reacted defensively to *L. polaris*, whereas bathyal gastropods relied mostly on their epibionts to protect them, thus falling prey to *L. polaris* when the epibionts were removed. *L. polaris* from bathyal depths typically ignored symbiotic gastropods, but they consistently preyed on asymbiotic ones, while *L. polaris* from shallow areas initially attempted to prey on all gastropods, but learned to avoid those harbouring sea anemones. Furthermore, living as epibionts afforded sea anemones a means to escape one of their own predators, the sea star *Crossaster papposus*. The mutualistic relationship between hormathiid sea anemones and bathyal gastropods from the NW Atlantic may have evolved in response to predation pressure.

Keywords: *Allantactis*; Deep-sea; Gastropods; Predation; Sea anemones; Symbiosis

1. Introduction

Mutualistic interactions between organisms are widespread and diverse in the marine environment (Bertness and Leonard, 1997; Boucher et al., 1982; McFall-Ngai and Ruby, 2000; Stachowicz, 2001; Wahl and Mark, 1999). Although symbioses between sea anemones and other invertebrates are commonly described in the literature, the emphasis is on associations with hermit crabs (Brooks, 1988a,b; Brooks and Mariscal, 1985a; Brooks and Gwaltney, 1993; Faurot, 1910, 1932; Hazlett, 1981; McLean and Mariscal, 1973; Ross, 1970, 1971, 1974, 1979, 1984). Some of these investigations have demonstrated that hermit crabs are protected from their predators by the sting of the cnidarians, which repels crabs and octopuses (Brooks and Mariscal, 1985b; McLean and Mariscal, 1973; Ross, 1971). In turn, the sea anemones benefit from greater access to food (Ross, 1974). Polychaetes and sea stars can also be deterred from eating sea anemones by their host hermit crabs (Brooks and Gwaltney, 1993).

There have been few studies of associations between cnidarians and gastropod molluscs (Ates, 1998; Brooks and Gwaltney, 1993; Dales, 1957; Hand, 1975; Pastorino, 1993; Riemann-Zürneck, 1994; Ross and Kikuchi, 1976; White et al., 1999). The accounts are of obligate or opportunistic, active or passive, interactions viewed as evolutionary strategies which

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