

## SHORT NOTES

## Mutualism between the sea anemone *Antholoba achates* (Drayton, 1846) (Cnidaria: Actiniaria: Actinostolidae) and the spider crab *Libinia spinosa* Milne-Edwards, 1834 (Crustacea: Decapoda, Majidae)

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Associations between sea anemones and other invertebrates have been widely studied (1, 2, 3, 4, 5, 6). The relationships between actinarians and spider crabs (family Majidae) are of two sorts: in some cases crabs are found on the column or among the tentacles of the sea anemones (7); in the second case the sea anemone, as well as other invertebrates and algae, are located on the spider crab carapace. Most of those studies were based on species from the northern hemisphere, and the knowledge about actinarian relationships from the austral hemisphere is scarce. BÜRGER (8) described the association between the crab *Hepatus chilensis* Milne-Edwards, 1837 and *Antholoba achates* (= *A. reticulata* Couthouy in Dana, 1846) in Chile. BOSCHI (9) and OLIVIER (10) observed the presence of sea anemones on the spider crab *Libinia spinosa* Milne-Edwards, 1834 from the southwestern Atlantic Ocean, but the actinarians were not identified, while ZAMPONI (11) mentioned the relationship between *Phlyctenanthus australis* (Carlgren, 1950) and *L. spinosa*. This note reports the association between the sea anemone *A. achates* and *L. spinosa* in the Argentinian sea with an analysis of the sea anemone's position on the spider crab, food items and the size relationships of the two species.

Material was collected from Mar del Plata (38°05'S, 57°32'W), Buenos Aires Province, Argentina, during shrimp captures by means of a beam-trawl at a 5-10 m depth on soft muddy-sand during fall 1999 and 2001, and preserved in 5% saline formaldehyde solution. In *L. spinosa*, carapace maximum width was measured and the blotted individuals weighed (without considering appendages since most of them were incomplete or lost). Each individual was sexed and maturity condition determined from abdominal morphology. The position of each anemone on the carapace of the spider crab was recorded on three zones: anterior third, middle third and posterior third of the carapace. The diameter of the basal disk of each anemone was measured in situ using a calliper, and it was then detached, blotted and weighed. Reproductive condition was checked by examining the mesenteries for gonadal tissue.

The gut contents of 167 individuals of the spider crab and 102 individuals of the sea anemone were analyzed and each piece of each food item was considered as one score.

Ninety three individuals of *A. achates* were found on 35 individuals of *L. spinosa* (Fig. 1). The anemones were mainly found on the posterior third of the carapace (55%), 29% in the middle and 16% on the anterior part of the carapace. The *L. spinosa* individuals had a carapace width between 29.3 and 58.5 mm (mean of  $42.56 \pm 6.1$  mm) and a weight between 9.57 and 67.89 g (mean of  $35.42 \pm 14.58$  g); both variables correlated ( $R^2=0.87$ ,  $F=304.29$ ,  $p<0.05$  after log10 transformation). Eighty percent of them were males; only one immature female and six immature males were found. Individuals of *L. spinosa* carried one to seven specimens of *A. achates* on the carapace with an average of three. The mean basal disc diameter of the actinarians, varied from 4 to 37 mm (mean of  $16.03 \pm 7.86$  mm), and weight varied between 0.02 and 12.74 g (mean of  $1.69 \pm 2.12$  g). The regression analysis between basal diameter and wet weight of sea anemones, after log10 transformation, showed a good linear fit ( $R^2=0.947$ ,  $F=1568.15$ ,  $p<0.05$ ). All individuals of *A. achates* were immature.

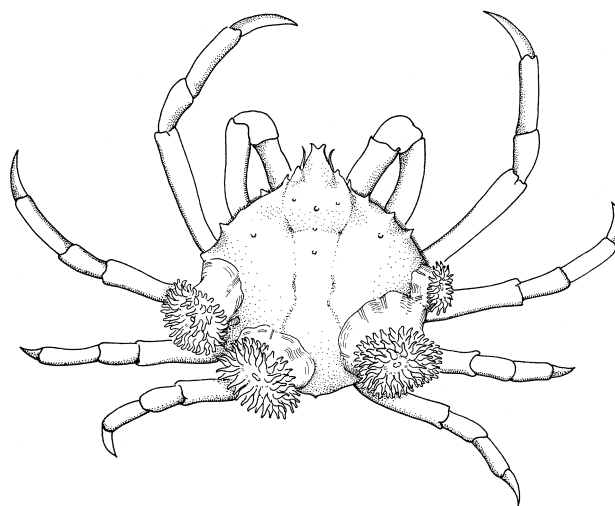


Fig. 1. – Individuals of *A. achates* on the carapace of *L. spinosa*.

There was no relation between the number of anemones and the size of the crabs, but there was a moderate correlation between the size (weight) of the anemones and the size (weight) of the crabs ( $R^2 = 0.449$ ;  $F = 26.12$ ,  $p < 0.05$ ), indicating that the larger crabs carried the larger anemones. This can be expected, since the larger the crab, the longer the intermoult, and the longer the period during which the anemone can grow on the crab.

The contents of the stomach of *L. spinosa* and of the gastro-vascular cavity of *A. achates* were similar in the kind of food items, but the proportions differed. In the spider crab stomachs (Fig. 2) we mainly found unidentifiable detritus, pieces of crustaceans such as the shrimp *Artemesia longinaris* Bate, 1888; the prawn *Pleoticus muelleri* (Bate, 1888); hermit crabs *Pagurus exilis* Benedict, 1892, *P. criniticornis* Dana, 1852 and *Loxopagurus loxochelis* (Moreira, 1901); harpacticoid copepods; juvenile gastropod molluscs such as *Buccinanops monilifer* (Kiener, 1834) and *Adelomelon brasiliana* (Lamarck, 1811); valve pieces of bivalve molluscs; scales and vertebrae of bony fish, hydropolyps and pieces of macroalgae. The main content of the sea anemone gastral cavities was composed of unidentified flesh material (probably molluscs) and also pieces of crustaceans, mainly penaeid shrimps and scales of bony fish. Some nematodes were also present.

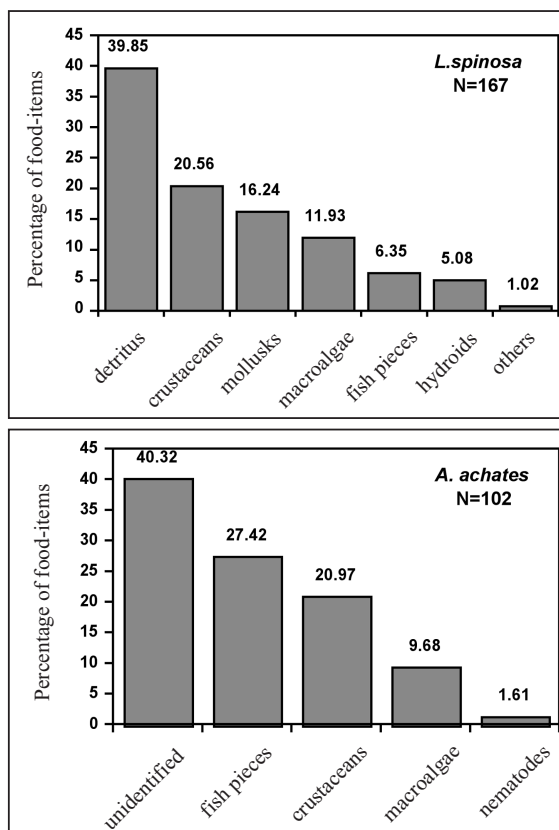


Fig. 2. – Percentage of food items in the spider crab *L. spinosa*, and the sea anemone *A. achates*.

Ectosymbioses between sea anemones and decapod crustaceans may be commensal or mutualistic in nature. In some cases, host and guest demonstrably protect each other from predators, and some anemones are fed by their mutualistic partners (12). In our study, specimens of *A.*

*achates* were located mainly on the posterior part of carapace, so it is improbable that they have any benefit from the crab feeding, and the food items we found in the guts were quite different. According to the analysis of food items, the spider crab *L. spinosa* may be classified as detritivorous-omnivorous and the sea anemone *A. achates* as a polyphagous opportunist (13).

The relationship between *A. achates* and *L. spinosa* is probably mutualistic. The crab is camouflaged by the anemones and protected by the anemone's cnidocysts. The carapace of the spider crab forms a hard substrate where the sea anemone can attach, important for the anemone, since the specimens were captured in a sandy-muddy, soft substrate. The anemone also acquires a greater mobility with additional benefits such as food availability and also gains protection against predators (such as aeolidians).

However, this association is not specific nor obligatory and may be temporary. In captivity, the sea anemone moved from the carapace of the spider crab to the glass wall of the aquarium, but no direct action of the spider crab was observed involving direct transference as does happen in other majid species during the decorating activities (14). *A. achates* occurs frequently on gastropods and other substrates (15). Many other actiniarian species are known to change attachment site, and e.g. the site of larval settlement usually differs from the habitats eventually settled by adults (16). In the studied association, anemones were generally small and all immature, so the relationship clearly starts at the earliest stages of *A. achates*. CHINTIROGLOU et al. (17) observed that the sea anemone *Sagartiogeton undatus* (Mueller, 1778) establishes symbiotic relationships with pagurids at an early age, while CHRISTIDIS et al. (18) found a similar behaviour in *Calliactis parasitica* (Couch 1838) living on anomuran crabs.

As far as we know, *L. spinosa* is the only crab living in the Argentine Sea that carries sea anemones on its carapace. Its association with *A. achates* is mutualistic, probably temporary and restricted to the young stages of the anemone. Future studies with experimental designs will allow us to establish the mechanism by which the mutualistic relationships begin, and the role of both species.

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Received: November 12, 2001

Accepted after revision: October 14, 2002