DECAPODA ANOMURA PAGURIDEA: MORPHO-FUNCTIONAL RELATIONSHIPS AND INFLUENCE OF EPIBIOTIC ANEMONES ON SHELL USE ALONG A BATHYMETRIC CLINE

BY

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ABSTRACT

We investigated the morpho-functional relationships underlying shell use and the role of shells as a resource in Pagurus prideaux and Paguristes eremita, collected along a bathymetric cline in the Sicilian Channel (southern Italy). These relationships were influenced by the presence of epibiont anemones, which colonize gastropod shells inhabited by hermit crabs. Sea-anemones appeared to play a different role in the shell use of the two species of crabs. In P. prideaux, relationships with Adamsia palliata determined the use of globose shells (mainly Naticidae with a height/width ratio < 1) and of small and damaged shells; in this case, the shell primarily played the role of a substrate for the settlement of anemones, and consequently its inhabiting and protective function tended to become less important. In P. eremita, relationships with the anemone Calliactis sp. and tube dwelling epibionts are correlated with the use of large, heavy shells with respect to the size of the crabs and also of well conserved shells; these shells offer an extensive surface for anemone settlement. In this case, the shell played a double role: an inhabiting-protective resource for the crab as well as a substrate for the anemone. Further experimental work will aim at testing these hypotheses, in an attempt at validating the proposed models and explaining the observed patterns.

RIASSUNTO

Le relazioni morfo-funzionali alla base dell’uso della conchiglia nei paguri sono state studiate lungo un gradiente batimetrico in due specie mediterranee, Pagurus prideaux e Paguristes eremita. Tali relazioni sono influenzate dalla presenza delle anemoni epibionti che colonizzano le conchiglie abitate dai paguri. Nelle due specie di paguro studiate le anemoni hanno ruoli differenti. In P. prideaux l’anemone Adamsia palliata determina la selezione di conchiglie globose (essenzialmente naticidi), con un rapporto altezza/larghezza<1, di piccole dimensioni rispetto al paguro e molto danneggiate. La conchiglia permane come substrato per l’anemone ma perde la

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funzione abitativa e protettiva nei confronti del paguro. In _P. eremita_ la relazione con l’anemone _Calliactis_ sp. è correlata all’uso di conchiglie in ottimo stato di conservazione e di grandi dimensioni rispetto al paguro. Tali conchiglie offrono ampie superfici per l’insediamento delle anemoni e al tempo stesso assolvono al tipico ruolo abitativo. Ulteriori lavori sperimentali permetteranno di dimostrare la validità dei modelli proposti e spiegare i pattern osservati.

**INTRODUCTION**

Hermit crabs evolved a soft, coiled abdomen enabling or necessitating them to fit into various protective structures available in their habitat (Stachowitsch, 1977; Conover, 1978; Brooks & Marsical, 1986), which usually are empty gastropod shells (Brooks, 1989). Many complex behavioural sequences, almost features, are the result of these conditions (Reese, 1962; Conover, 1978; Mesce, 1993). The significance of some of these features is still unclear and seems to vary among species (Conover, 1978). Volume and weight of shells, for instance, are two parameters analysed in various studies (Kuris & Brody, 1976; Conover, 1978). The first parameter is related to the size of the hermit crabs; the second is related to their ability to carry a shell (Kuris & Brody, 1976; Conover, 1978). Other important features of shells are height, shape, and width of the aperture region (Kuris & Brody, 1976; Blackstone, 1985; Zupo et al., 1989).

Each parameter may be interpreted in relation to local needs of populations inhabiting various habitats. Variability in shell use within a species may depend on local features of colonized habitats (Bertness, 1980; Zupo et al., 1989). Shell selection and use are also triggered by the availability of specific thanatocoenoses (Scully, 1979). Furthermore, the shell is a substrate for settlement of a complex epibiont community (Stachowitsch, 1980). Sea anemones are common epibionts and establish mutualistic relationships with hermit crabs (Ross, 1971; Brooks & Marsical, 1985). The association patterns between the sea anemone _Calliactis_ sp. and several hermit crab genera, and between _Adamsia palliata_ (Bohadsch, 1761) and _Pagurus prideaux_ Leach, 1815, are known in the Mediterranean (Mainardi & Rossi, 1969; Ross, 1971, 1984), but little attention has been paid to the influence of epibionts on shell use (Ross, 1984; Brooks & Marsical, 1985; Brooks, 1989).

Anemones usually have a protective effect against predators, such as cephalopods (Ross, 1971; Brooks & Marsical, 1985) and, carried by hermit crabs, may exploit large areas for their feeding needs (Stachowitsch, 1980). Another common epibiont is the sponge _Suberites domuncula_ (Olivi, 1792) which, as well as sub-tropical species (e.g., _Spongosorites_ spp.), encrusts and may enclose the whole shell, becoming an inhabiting structure itself (Sandford, 1995; Sandford & Brown, 1997). In _P. prideaux_, the crab-anemone relationship is known to be highly evolved: although the two species can live independently, it is an almost obligate