SYMBIOSIS OF THE SEA STAR SHRIMP, *PERICLIMENES SOROR* NOBILI, 1904 (DECAPODA, PALAEMONIDAE), AND CUSHION STAR, *CULCITA NOVAEGUINEAE* MÜLLER & TROSCHEL, 1842 (ECHINODERMATA, ASTEROIDEA, OREASTERIDAE): HOST FINDING AND BENEFITS

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ABSTRACT

Symbioses play an integral role in community structure and act as significant selective forces in evolution; hence these relationships have been the subject of much scientific interest. The symbiosis between the pontoniine shrimp, *Periclimenes soror* Nobili, 1904 and the cushion star, *Culcita novaeguineae* Müller & Troschel, 1842 was investigated using laboratory experimentation. Host-seeking behavior and benefits imparted to shrimp symbionts were examined. Results from a Y-maze experiment revealed that *P. soror* appears to actively orient to its hosts, and that chemical cues may play a role in the orientation process. Results from a survivorship experiment suggest that *P. soror* may be an obligate associate of its host and likely receives almentation through its relationship with *C. novaeguineae*. Results from a hiding experiment and color-match experiment indicate that *P. soror* may also obtain protection from predators through this association by both behaviorally hiding on its host, and also actively changing color to reside cryptically on *C. novaeguineae*. The findings of this study provide insight into the relationship between *P. soror* and *C. novaeguineae* as well as help contextualize this association with symbioses in general.

RÉSUMÉ

Les symbioses jouent un rôle important dans la structure des communautés et agissent comme des forces sélectives significatives au cours de l’évolution ; aussi, ces relations ont suscité un large intérêt scientifique. La symbiose entre la crevette Pontoniinae, *Periclimenes soror* Nobili, 1904 et l’étoile de mer « coussin » *Culcita novaeguineae* Müller & Troschel, 1842 a été étudiée lors d’expérimentations au laboratoire. Le comportement de recherche d’hôte et les bénéfices acquis par les symbiotes-crevettes ont été examinés. Les résultats d’une expérimentation utilisant un labyrinthe en Y ont révélé que *P. soror* semble s’orienter activement vers ses hôtes, et que les signaux chimiques jouent un rôle dans le processus d’orientation. Les résultats d’une expérience de survie suggèrent que *P. soror* pourrait être un associé obligatoire de son hôte et qu’il reçoit probablement son almentation par sa relation

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avec *C. novaeguineae*. Les résultats d’expériences de cachette et d’adaptation aux couleurs indiquent que *P. soror* peut aussi obtenir une protection contre les prédateurs grâce à cette association, à la fois en se cachant, par son comportement, sur son hôte, et aussi en changeant activement de couleur et vivant ainsi dissimulé sur *C. novaeguineae*. Les résultats de cette étude fournissent un aperçu sur la relation entre *P. soror* et *C. novaeguineae* et aident à considérer cette association dans le contexte des symbioses en général.

**INTRODUCTION**

Symbiotic relationships are biological associations in which individuals of different species engage in close and often long-term interaction with one another. Due to the fact that symbioses play an integral role in community structure and act as significant selective forces in evolution, these associations have been the subject of much scientific interest (Leung & Poulin, 2008). In ecosystems with exceptionally high levels of biodiversity, such as coral reefs, understanding the intricate relationships among species is essential to our comprehension of ecosystem structure.

In the marine environment, Crustacea are of notable interest when examining symbioses because they have been documented in a prolific number of inter- and intra-phyla symbiotic associations (Green, 1961). Shrimps, in particular, are often found in symbiotic relationships with a diverse group of organisms, including sponges, cnidarians, echinoderms, and fish (Bruce, 1976a, b; Wear, 1976; Fautin, 1995; Poulin & Grutter, 1996; Crandall et al., 2008; Duris et al., 2011). Analysis of the stomach contents of several species of sponge-inhabiting pontoniine shrimp, including *Typton carneus* Holthuis, 1951, *Periclimenaeus caraibicus* Holthuis, 1951 and *Onycocaris spinosa* Fujino & Miyake, 1969, revealed that the spongobionts often interact parasitically with their hosts by feeding directly on sponge tissue. It is thought that these shrimp colonize their host during the postlarval stage and subsequently live permanently on their host as a solitary individual, in a male-female pair, or in small groups. The shrimps’ large chelae are hypothesized to be utilized in repelling conspecifics that would compete for limited host resources (Duris et al., 2011). *Ancylomenes pedersoni* (Chace, 1958), a pontoniine associate of the anemone *Bartholomea annulata* (Lesueur, 1817), places itself in a prominent location on or near its host and sways back and forth while whipping its antennae in order to attract reef fish, which are subsequently cleaned by the shrimp. The relationship between *A. pedersoni* and *B. annulata* is thought to be relatively dynamic, as *A. pedersoni* has been observed to frequently switch between host anemones (Limbaugh et al., 1961).

In Mo’orea, French Polynesia, the pontoniine shrimp, *Periclimenes soror* Nobili, 1904, is commonly found on the cushion star (*Culcita novaeguineae* Müller & Troschel, 1842). Little is known about the relationship between these two species.