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NOTE:

NEW ASPECTS ON THE SYMBIOTIC RELATIONSHIPS BETWEEN *DARDANUS FUCOSUS* (CRUSTACEA: PAGURIDAE), *CALLIACTIS TRICOLOR* (CNIDARIA: HORMATHIIDAE) AND *PORCELLANA SAYANA* (CRUSTACEA: PORCELLANIDAE)

Mateo López-Victoria, Lina María Barrios, Holger Kraus and Luis Alonso Osorio

RESUMEN

Nuevos aspectos sobre las relaciones simbióticas entre *Dardanus fucosus* (Crustacea: Paguridae), *Calliactis tricolor* (Cnidaria: Hormathiidae) y *Porcellana sayana* (Crustacea: Porcellanidae). Se hicieron observaciones en cautiverio de las interacciones entre cangrejos ermitaños (*Dardanus fucosus*), anémonas (*Calliactis tricolor*) y cangrejos de porcelana (*Porcellana sayana*), todos cohabitando en conchas de dos gasterópodos colectados en la región de Santa Marta. Durante 36 días se realizaron anotaciones esporádicas del comportamiento de los organismos, así como tomas de video y fotografías. Se encontraron nuevas evidencias en favor de relaciones de tipo mutualista y comensal que involucran a las tres especies, sustentadas por el traslado activo de los cangrejos de porcelana (*Porcellana sayana*), y actividades alimentarias de las tres especies.

PALABRAS CLAVE: Dardanus fucosus, *Porcellana sayana*, *Calliactis tricolor*, Mutualismo, Comensalismo.

The associations between anemones and hermit crabs have been broadly documented, since they are considered a typical case of mutualism. The genus *Dardanus* has been one of the most studied cases due to the active transference of its associated anemones (e.g. Ross, 1970), from which it is believed that the hermit crab receives benefit by camouflage, assistance in consecution of food, protection from predators and cover for weak shells (Ross and Sutton, 1961; Ross, 1971). Recent studies show how anemones are also protected by hermit crabs against some of their predators, like polychaets (Brooks and Gwaltney, 1993), nudibranchs (Harry and Howe, 1979), some asteroidal echinoderms (Chadwick, 1987) and some fish (Ates, 1989; Yoshiyama *et al.,* 1996).

In this paper, new information about the symbiosis between the hermit *Dardanus fucosus* (Provenzano and Biffar, 1972), the anemone *Calliactis tricolor* Lesueur, 1817, and the porcelanid *Porcellana sayana* (Leach, 1820) is presented, based on general observations about their behavior in captivity.

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Two associations of hermits, anemones and porcelanids living together in shells of *Chicoreus brevifrons* (Lamarck, 1822) and *Strombus* sp. (very deteriorated), were collected on August 8th, 1999, in Concha Bay (Tayrona Natural Park), Colombian Caribbean. The organisms were installed in an aquarium with filtered seawater, and kept alive for 36 days. Throughout this time, enough food (oysters and fish) were supplied, daily sporadic observations were made, and photographs and video images were taken for their later analysis. After the first week of acclimatization, the two associations of organisms were separated by a glass plate. A new shell was provided to each association, in order to observe the process of moving and transference of organisms.

After moving themselves to the new shell, the two hermit crabs actively transferred their anemones in a period of time of around three minutes for each one, following a similar pattern to that described by Ross (1970). Additional to the transference of the anemones, the active movement of the porcelanids present in the associations occurred as follows: a) once the anemones were transferred the porcelanids "dropped" themselves, swimming with the pleon directly to the new shell or, first to the bottom of the aquarium and then walking to the shell; b) with fast movements they sought out the rear and lateral side of the new associations, and place themselves on the new shell; c) once attached to the new shell they settled themselves just like in the original associations (beside or on the anemones' column). A synthesis of the video images showing the transference of the anemones and the movement of the porcelanids can be obtained in the website http://www.invemar.org.co/redcostera1/invemar/docs/videos/.

In other observations porcelanids and hermits removed with their chelipeds, tissue-like pieces from the anemones'column that were eventually inspected to be later discarded or ingested; the pieces removed by the crabs were rather small (ca. 2-5 mm in diameter) and appeared like dead cells from the epidermis of the anemone. Throughout this activity the porcelanids interrupted intermittently the movement of their third maxillipeds (modified appendages used for filtering), which is their characteristic feeding strategy. This evidence suggests that *Porcellana sayana* can feed in at least two different ways, by filtering suspended particles of food, or by taking it directly from the bottom with its chelipeds.

Also the active movement of the porcelanids towards the frontal part of the assemblage when the hermit was in the process of feeding was observed. In this last case, the porcelanids caught suspended particles of food (using their modified maxillipeds) which were subsequently ingested; part of those particles were caught and ingested by the anemones as well. Thus, the porcelanids and the anemones received a benefit from the hermit's food without interfering with its alimentary process, supporting their commensal relationship.

Associations between hermits of the genus *Dardanus* and anemones of the genus *Calliactis* are frequent, since they protect the crabs from their main predators *Octopus* spp. (Ross, 1971; Brooks, 1989). In a similar manner, the associations between

the porcelanids and other crabs, mollusks, and sea cucumbers, also have been reported as a symbiosis in which the porcelanids take advantage of their hosts as an auxiliary substrate to colonize soft bottoms, otherwise not suitable for them (Werding, 1983).

Taking into account the antecedents and based on the observations, what is presented as evidence of symbiosis between the three studied species is: a) the hermit and the porcelanids are camouflaged and protected, in a passive form, by the anemones; b) the anemones and the porcelanids secure themselves a moving-feeding platform, which ensures them a constant food income in the form of particles from the surrounding waters and also those that escape while the hermit is feeding. In spite of the previous, it must be taken into account that whatever is the degree of symbiosis among the three studied species, there are registries of each one of them living independently, which would make their relationship rather facultative than mandatory. Werding (1983) states that *Porcellana sayana* is found free living in the northern sectors of it's distribution, while in the southern sector is a mandatory commensal. Despite that the presence of all three organisms is not necessary to establish a symbiosis, the active "translation" of the porcelanids presented here, is evidence in favor of their condition of mandatory commensal in the southern sector of the Caribbean. For porcelanids living together with a hermit, it would be fatal to loose their feeding platform when the hermit changes its shell in the middle of a soft bottom, since they would be rapidly hunted by a predator (e. g. fish), and it would be very difficult for them to find their food. Accordingly to those limitations, it's plausible to think that *P. sayana* receives significant benefits when living together with *Dardanus fucosus* and *Calliactis tricolor*.

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LITERATURE

Ates, R. M. L. 1989. Fishes that eat sea anemones, a review. Jour. Nat. Hist. 23: 71-79.

Brooks, W. R. 1989. Hermit crabs alter sea anemone placement patterns for shell balance and reduced predation. J. Exp. Mar. Biol. Ecol. 132 (2): 109-121.

Brooks and C. L. Gwaltney. 1993. Protection of symbiotic cnidarians by their hermit crab hosts: Evidence for mutualism. Symbiosis 15: 1-13.

Chadwick, N. E. 1987. Interspecific aggressive behavior of the Corallimorpharian *Corynactis californica* (Cnidaira: Anthozoa): effects on sympatric corals and sea anemones. Biol. Bull. 173: 110-125.

Harris, L. G. and N. R. Howe. 1979. An analysis of the defensive mechanisms observed in the anemone *Anthopleura elegantissima* in response to its nudibranch predator *Aeolidia papillosa*. Biol. Bull. 157: 138-152.

Ross, D. M. 1970. The commensal association of *Calliactis polypus* and the hermit crab *Dardanus germmatus* in Hawaii. Canad. Jour. Zool. 48:351-357.

_____.1971. Protection of hermit crabs (*Dardanus* spp) from Octopus by commensal sea Anemones (Calliactis spp.). Nature 230 (5293): 401-402.

Ross, D. M. and L. Sutton. 1961. The response of the sea anemone *Calliactis parasitica* to shells of the hermit crab *Pagurus bernhardus*. Proc. R. Soc. Lond., Ser. B, 155:266-281.

Werding, 1983. Komensalische Porcellaniden aus der Karibik (Decapoda: Anomura). Crustaceana 45(1): 1-14.

Yoshiyama, R. M., A. L. Knowlton, J. R. Welter, S. Comfort, B. J. Hopke and W. D. Wallace. 1996. Laboratory bahaviour of mosshead sculpins *Clinocottus globiceps* toward their sea anemone prey. J. Mar. Biol. Ass. U. K. 76: 793-809.

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ADDRESSES OF THE AUTHORS:
Institute of Marine and Coastal Research-INVEMAR, Mailbox 6713, Santiago de Cali, Colombia: mateo@invemar.org.co, lmb2@hm.ac.uk (M.L.V. and L.M.B.); University of Giessen (JLU), Germany: Holger.Kraus@allzool.bio.uni-giessen.de (H.K.); Universidad del Valle, Cali, Colombia: teoxical@msn.com (L.A.O.).