ADAPTATIONS OF A SPECIES OF HERMIT CRAB (DECAPODA, PAGURIDEA) INHABITING SESSILE WORM TUBES

BY

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INTRODUCTION

Most hermit crabs occur in gastropod shells which are carried by the abdomen, but a few species occur in other protective coverings, e.g., sponges, scaphopod shells, coral, and bamboo. Fenizia (1933) reported a specimen of Calcinus ornatus (Roux) from a serpulid worm tube attached to a gastropod shell; Dardanus arroso (Herbst) (cited by Fenizia as Pagurus striatus) inhabited the gastropod shell so that the total habitat of the worm tube and gastropod shell were motile. Calcinus ornatus, however, also is known from non-motile habitats: Zibrowius (1978) showed it to be often found in the sessile vermetid gastropod Vermetus triqueter Bivona, and he gave an enumeration of the records of Calcinus ornatus from both serpulid and vermetid tubes. Discorsopagurus schmidtii (Stevens) inhabits attached (sessile) worm tubes of the species Sabellaria cementarium Moore and Serpula vermicularis L. along the North Pacific coasts from Japan to Puget Sound (McLaughlin, 1974). Morphological adaptations of the hermit crab to these worm tubes include a secondarily symmetrical abdomen and symmetrical uropods (as found with other tube dwelling hermit crabs, e.g., Orthopagurus and Pylopagurus in scaphopod shells).

Male Discorsopagurus schmidtii occasionally are captured in broken places of worm tubes but females occur almost exclusively in attached worm tubes. Nyblade (unpubl.) suggests that the sexual differences in habitats (sessile vs. movable worm tubes) are reflective of reproductive activities whereby males can seek sexually active females. It is generally assumed that D. schmidtii is a detrital feeder which depends on water currents to deposit food materials around the worm tube opening.

MATERIALS AND METHODS

Specimens of Discorsopagurus schmidtii were dredged from waters northeast of San Juan Island (Puget Sound, Washington, U.S.A.) in tubes of Sabellaria cementarium. Feeding observations were conducted with the aid of a stereomicroscope. Sized particles of silicon carbide (60 and 90 μm) and diamond (15, 30, and 45 μm) were used to assess filtering ability and small pieces of shrimp were placed
near the tube opening during macromaterial ingestion observations. Stomach contents were examined in 145 specimens. Respiratory currents were examined by placing the hermit crab in a small glass tube (internal diameter, 4 mm) and observing the movement of either carmine particles or methylene blue in seawater solution.

Intraspecific aggression was tested in laboratory experiments with artificial crowding, either more hermit crabs than available worm tubes or by placing the worm tube openings ca. 4 mm apart. The effect of residence by the scale worm, *Lepidonotus squamatus* (L.), the only other colonizer of *Sabellaria cementarium* tubes collected in this study, was conducted by placing a tubeless hermit crab with a worm tube inhabited by *L. squamatus*. The ability of *D. schmitti* to displace *S. cementarium* from its tube was tested by placing tubeless hermit crabs with living sabellarids.

**OBSERVATIONS AND EXPERIMENTS**

**Feeding**

*Discorsopagurus schmitti* utilizes its antennae to filter water currents. There are four rows of simple setae extending the length of the antennal flagellum: dorsal, ventral, and lateral. The setae arise from the base of each flagellar article and are acutely inclined distally. Space between the setae varies with the length of the antennal article and the flexure of the antennae, but particles as small as 30 μm were retained during feeding experiments while particles of 15 μm were not retained.

In the presence of strong water currents (≥10 cm sec⁻¹) the crab extends its thorax from the worm tube. The chelipeds and first two pair of walking legs are spread laterally with the ventral surface of the crab directed into the current. Setae on the thoracic appendages retained suspended material which was subsequently cleaned and ingested. In currents >17 cm sec⁻¹ the crab withdraws into its tube.

Additional material is fortuitously obtained from the area immediately surrounding the opening of the tube. If a food object, usually a dead animal, a broken piece of plant material, or large settling detritus, falls within a centimeter of the tube opening, the hermit crab slowly approaches the object, grasps it with the major chela, and quickly retreats back into the worm tube. Pieces are torn from the food object with the mouthparts and minor chela; the major chela maintains a grasp on the food object.

Stomach contents verify *Discorsopagurus schmitti* as a nonselective omnivore feeding on suspended and settled detritus (85% of the combined stomach contents), zooplankton (mainly amphipods and copepods, 8%), and algae (6%).

**Cleaning and particle ingestion**

Material entrapped by the antennae is removed by the third maxillipeds. Each antenna is flexed ventrally as the endopodites of the third maxillipeds are extended anterolaterally. As the third maxillipeds move medially, the antennae are sand-