THE PHYLETICALLY IRREGULAR SOCIAL BEHAVIOR OF DIOGENES PUGILATOR (ANOMURA, PAGURIDEA) ¹)

BY

BRIAN A. HAZLETT

Biological Laboratories, Harvard University, Cambridge, Mass., U.S.A. ²)

INTRODUCTION

_Diogenes pugilator_ (Roux) is a common Mediterranean hermit crab (Balss, 1944), which shows a wide range of color variations. Its phylogenetic relationships seem to be somewhat clouded. Based upon adult morphology, _D. pugilator_ is clearly a member of the family Diogenidae although it is placed in a separate subfamily (Diogeninae), the other genera of the family being in the subfamily Dardaninae (Pike & Williamson, 1960). From a study of larval morphology, Dechancé & Forest (1958) concluded that _Diogenes_ shows a number of pagurid features in addition to those characteristically diogenid. Since the two families are believed to have evolved independently (the superfamily Paguridea is, at least, diphyletic) an intermediate position is not immediately conceivable.

The following observations indicate that from a behavioral viewpoint, _Diogenes_ is more pagurid than diogenid-like. The basis for establishing behavioral characteristics for the two families has been a series of ethological observations of hermit crabs in Curaçao, N.A. (Hazlett, 1966a), Florida, U.S.A. (Hazlett, 1966b and unpublished data), Bermuda, and parts of Europe (Hazlett, unpublished data). The behavior of 29 species in the Paguridae and 30 in the Diogenidae have been studied to some degree. In addition, the Pacific species, _Pagurus samuelis_ behaves in a manner similar to other Paguridae (Coffin, 1960) and _Calcinus laevismanus_ behaves like other Diogenidae (Reese, 1962).

THE BEHAVIOR PATTERNS

Groups of individuals of _Diogenes pugilator_ were observed in aquaria at the Naples Zoological Station. The aquaria had sand on the bottom and the animals

¹) Contribution from the Stazione Zoologica de Napoli. This work was supported by grant MH-14,274 from the National Institutes of Health and a Grant-in-Aid of Research from the Society of the Sigma Xi. Thanks are given to Drs. A. J. Provenzano, Jr. and J. Forest for their comments on the manuscript.

²) Present address: Department of Zoology, University of Michigan, Ann Arbor, Michigan, 48104, U.S.A.
appeared healthy and ate well during the several months of observations during early 1966. Individuals moved about rather rapidly, although during the day most were buried in the sand (only eyes, antennae and antennules clearly above the sand) as noted by Schöne (1961), and were quiet. The antennae moved about in the same manner as that described for the filter-feeding species, *Diogenes brevirostris* Stimpson (cf. Boltt, 1961). Around 1800 hrs the crabs emerged from the sand and became active. A red light source was used for observation at night.

*D. pugilator* was very active and ran about and retreated rapidly. The ambulatory legs were curved strongly to the posterior, as is generally true of pagurids. Most diogenids move slowly while pagurids run about rapidly.

Aggressive encounters between individuals were frequent as the crabs moved about the aquarium and came near one another. As in other hermits, encounters were largely exchanges of stereotyped movements of the chelipeds and ambulatory legs. Cheliped movements were more frequently executed by *Diogenes pugilator* than were ambulatory displays. The chelipeds were normally held under the mouth area, the major manus about 50° posterior from a plane perpendicular to the substrate and the minor manus about 45° back (see Hazlett, 1966b for methods of description). The cheliped presentation display involved a rapid movement forward to where the major manus was about 10° forward of perpendicular; the minor manus was about perpendicular in the presentation position. The proximal cheliped segments were approximately horizontal in this and the next display. A cheliped extension movement was frequently executed, both from the neutral and presentation positions. This was a rapid movement forward bringing the manus to about 40° below the horizontal. Cheliped display movements were executed by either the major limb alone, minor, or both together. Sometimes a display was given while the animal’s body was lowered close to the substrate, thus the extended major cheliped was in contact with the substrate. The execution of a display by one animal elicited retreat or the execution of a display (or both) by the recipient animal. The other type of aggressive cheliped movement observed in *D. pugilator*, was a rapid, flick-like movement of the major manus. The manus was moved rapidly out and immediately back through 25°. These flicks were observed when an animal was withdrawn into its gastropod shell and the protruding manus touched by another crab, during dislodging-shaking movements (see below), or when one animal was held from behind by another.

Ambulatory raise display movements also occurred occasionally. An ambulatory leg was moved rapidly straight up and down, through about 35°, to a position 20° below the horizontal. The limb was rather rigid during the movement.

When one crab crawled onto the back of the shell of another, the crab crawled upon jumped straight up and down in short, quick movements. This dislodging-shaking behavior has been seen in all pagurid species examined, but has not been observed in any other diogenid.

Shell fighting was typically diogenid. One crab would get into an opposed position with another (shell apertures facing, forming an angle of about 30°),