FEEDING CHEMORECEPTOR SITES IN THE CRAYFISH
PROCAMBARUS CLARKII (GIRARD)

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INTRODUCTION

Through morphological, behavioral and electrophysiological studies (see review by Hazlett, 1971a) the antennules of a number of marine decapods have been shown to be the main distance chemosensory organs used in feeding. The structures possess distance chemoreceptors. In the freshwater crayfish Cambarus bartoni sciotosis, Hodgson (1958) has confirmed the chemoreceptor function of the antennular inner flagellum, and the dactyls of the first two pairs of walking legs. He did not implicate either the chelae or the mouthparts, although some behavior studies he made indicated that antennule-less animals still located and ate food placed near them. The above study does not show the relative importance of the various chemoreceptive sites as has been shown for marine decapods (Hazlett, 1971a).

In the following study the problem of functional integration of different sense organ input in the crayfish Procambarbus clarkii (Girard) was investigated.

MATERIALS AND METHODS

P. clarkii (45-60 mm in cephalothorax length) flown from suppliers in Ponchatoula, Louisiana, were maintained in 10 gallon aquaria at the Department of Zoology, University of Michigan, Ann Arbor in well aerated water. Animals used in the tests were fed at 2-day intervals. Before the tests, observations were made on the normal feeding behavior of the crayfish.

Feeding behavior

P. clarkii feeds on both live and dead plant material. This constitutes the bulk of its stomach content. It also feeds on animal matter such as broken off appendages of crayfish, dead crayfish, crayfish moults, pieces of meat or fish. Its faeces also contains sand, presumably ingested with detritus.

During feeding, one or both of the first two pairs of walking legs pick up or push the food material toward the maxillipeds which in turn shove the food toward the mandibles. For big food items, the chelae are often used to hold the food down while dismembering by the chelated walking legs proceeds.

A food item or muscle extract placed a considerable distance (e.g., 4 cm) from the animal, evokes the following sequence of activities:
1. Quick flicker of the lateral flagellum of the antennule and a slow motion of the inner flagellum up and down.
2. Movement of the antennae.
3. Increased beat of the bailers.
4. Feeding movements by the mouthparts and the chelate walking legs (and sometimes the chelipeds).
5. Searching while showing feeding movements (these include mouthpart movements and the use of the chelate walking legs in picking motion even on a clear glass bottom).
6. Location and ingestion of the food.

While the first three behaviors are shown prior to searching when the water of an isolated crayfish is disturbed in any way, the last three are peculiar to feeding.

Animals used in the experiments were blinded by painting finger nail polish over their eyes. Several coats of the polish were used to assure that blinding was complete. After applying the polish an object was waved in front of the animal to test if vision was possible. More paint was added until the animal no longer responded to the waving object.

Since ablation of the antennules and the antennae did not appear to have any adverse effect on the animal’s overall behavior, operated animals were used in more than one experiment.

**EXPERIMENTS**

Eight series of experiments were performed. In the first series, the animals were blinded but no structure was ablated. With the animal resting in a flower pot near one end of an aquarium tank, a piece of crayfish killed the previous day or water in which a dead crayfish had been kept was introduced into the tank 18-20 cm away. This was done very gently near the point where an air bubbler had been placed. This procedure greatly reduced disturbance of the water by the introduction of the test material. The time spent by the animal as it went through the various behaviors was recorded.

In the second series, the antennae of the subjects were removed. In the next the antennules were ablated. In the fourth both the antennules and the antennae were removed. In the fifth series the chelae were treated in the following manner. Instead of removing the chelae surgically, the procedure described below was used to prevent water from making contact with the short setae on the inner parts of the dactyls. “Duco” cement (Dupont product), a strongly adhesive and waterproof material, was applied to the inner parts of the pincers. In some trials made on dried hollowed out chelae, it was found that the cement, smoothened out at its edges when applied was very effective in rendering the applied area waterproof. In the sixth series the entire tips of the first two pairs of walking legs were covered with “Duco” cement. In addition both the antennules and the antennae were removed. In the next series the chelae and the first two pairs of walking legs were treated as in series 5 and 6. Lastly only the dactyls of the chelate walking legs were covered with cement.