DETECTION AND RESPONSE TO FOOD VERSUS CONSPECIFIC TISSUE IN THE CRAYFISH CAMBARUS BARTONII (FABRICIUS, 1798) (DECAPODA, CAMBARIDAE)

BY

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INTRODUCTION

The chemical nature of feeding stimulants for decapod crustaceans is a basic determinant of daily behaviour (Rittschof, 1992). Understanding what factors drive the feeding system is important to both commercial interests, and basic sensory ecology (Atema et al., 1988). Another fundamental behaviour system, less studied in decapod crustaceans, is predator avoidance (Stein & Magnuson, 1976; Blake & Hart, 1993; Willman et al., 1994). Chemical detection of recent predation on conspecific animals is often the first detection of predator presence, which can lead to an appropriate response, thereby reducing predation risk. This avoidance response of a crayfish could have a cost in terms of interruption of ongoing behaviour, e.g., feeding. It could also have a differential benefit, that might vary with the perceived immediacy of predation danger. There is little information on the response of crayfish to this type of environmental information. Therefore we decided to compare the behavioural response of crayfish to both a chemical feeding stimulus and conspecific tissue. This comparison was made in two different contexts: one in which the subject was actively engaged in feeding, and the other in which the subject was actively attending to a conspecific animal which it could see. Our objectives were: (1) to define the response profile to conspecific tissue, in comparison with that to a feeding stimulant, and (2) to determine whether the presence of food, or the presence of a conspecific, affects a crayfish's response to the two water-borne chemical stimuli. Does the cost of leaving food, or the possibly enhanced credibility of an injured conspecific nearby, influence the crayfish's response profile?

METHODS

Collection and maintenance of animals. — One hundred and twenty Form I (reproductive form) male Cambarus bartonii were collected from Clayton Lake near Dorset, Ontario, Canada (45° N 79° W), and held together in a plastic group holding tank (150 (l) x 56 (w) x 43 (h) cm), filled with 220 l of dechlorinated municipal supply water. Twenty-five pieces of grey and black PVC plumbing elbows (diameter 6 cm, length 22 cm), were provided for shelters. An air stone diffused compressed air in the tank. Every 5 days the tank was cleaned, and 2.0 ± 0.05 g of Purina brand "trout chow" was provided. The
photoperiod was 8 hr light : 16 hr dark, with light from 3 overhead incandescent 300 W ceiling lamps, beginning at 09.00 h. The room was maintained at 5.0° ± 0.5°C.

Experimental design. — Sixteen males were randomly selected and placed in individual glass aquaria, measuring 31 (l) x 16 (w) x 21 (h) cm, and containing 4.0 l of water from the group holding tank, and 2 cm of coarse (diameter 0.5 cm) white gravel. Each test crayfish was subjected to four experimental tests, in random order, to measure response to: (1) conspecific tissue homogenate while interacting with a conspecific; (2) sucrose solution while interacting with a conspecific; (3) conspecific tissue homogenate while feeding; (4) sucrose solution while feeding. A four day period between successive tests consisted of one day with food and three days of food deprivation and social isolation. A crayfish to be tested was taken in its tank to a test room, which was maintained at a temperature of 15.0° ± 0.5°C, and lit by eight overhead 34 W fluorescent tubes. The tests were conducted at a water temperature of 9°C. After 30 minutes the experiment began.

Preparation of control water. — Water from the group holding tank containing the remaining one hundred and four Cambarus bartonii was strained through a 200 µm screen. This ‘control water’, used to fill all of the test tanks, served as a vehicle for the homogenate and sucrose solutions described below, and functioned as the control stimulus in the experiments. The control water used on a given day (80 l), was collected 4 days prior, and used to fill the sixteen experimental tanks in use that day. The holding tank was re-filled with 80 l of dechlorinated municipal supply water on the same day.

Preparation of Cambarus bartonii tissue homogenate. — Muscle tissue was extracted from the abdomen, thorax and chelae of a male Form I Cambarus bartonii. Then 0.5 ± 0.05 g of tissue was placed in a 8.0 cm diameter mortar with 1.0 ± 0.05 ml of control water, and ground with a pestle into a homogeneous paste. The paste was then diluted with 5.0 ± 0.05 ml of control water and filtered through Cenco qualitative smooth filter paper. The filtrate was prepared fresh on each experimental day, and maintained at 9°C.

Preparation of sucrose solution. — Tierney & Atema (1988) found sucrose to be one of the most potent feeding stimuli in their assessment of crayfish chemostimulants. Based on this finding, sucrose was chosen as the feeding stimulus. 0.5 ± 0.05 g of reagent grade sucrose was dissolved in 6.0 ± 0.05 ml of control water. This preparation was made fresh on each experimental day, and maintained at 9°C.

Social interaction treatment. — One male C. bartonii was used as the social interactant in all tests. He was placed in an open, water tight, Plexiglas box, 9.9 (l) x 6.5 (w) x 9.8 (h) cm, with 12 ml of control water. The box was placed in the centre of the experimental tank, on top of a white plastic disk, 15.0 cm in diameter. The top of the open box was above the surface of the water in the experimental tank.