Food Habits of the Caribbean King Crab *Mithrax spinosissimus* (Lamarck)

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ABSTRACT

Se realizaron experimentos para identificar aquellos alimentos principales aceptados o rechazados por *Mithrax spinosissimus* de varios tamaños y en cautiverio, como primer estimado de la importancia relativa de los diferentes alimentos en la dieta de cangrejos en su ambiente natural. Cangrejos subadultos resultaron ser omnívoros con una tendencia fuerte a suplementar la dieta a base de macroalgas, con un comportamiento carnívoro oportunista. Se determinó la tasa de consumo diario para varios tipos de alimentos y además se hicieron experimentos a largo plazo para evaluar los efectos de varios regímenes prácticos de alimentación en la tasa de crecimiento, supervivencia, y éxito en la reproducción. Hembras adultas de *Mithrax* se reprodujeron a intervalos de una vez al mes. Consecuentemente, el efecto de diferentes regímenes en la reproducción puede ser demostrado más rápidamente usando *Mithrax* que con especies que se reproducen con menos frecuencia. En este trabajo se discute la conducta de cangrejos en su ambiente natural en referencia con la estratégia de alimentación de cangrejos cultivados para llevarlos a tamaño comercial o para reproducción.

INTRODUCTION

Mithrax spinosissimus (Lamarck) is the largest spider crab in the Caribbean region. It is reported to reach weights of 3,000 grams or more and carapace lengths of about 170 mm. The species is widely distributed in the Florida Keys and in the West Indies and has been reported from locations as distant as South Carolina (Rathbun, 1925) and Venezuela (Provenzano and Brownell, 1977). It is found from shallow depths to about 100 fathoms (Williams, 1965). The meat yield and flavor of *Mithrax* has been compared to the Alaskan king crab, and the species has even been proposed as a market substitute for the Alaskan species (Bohnsack, 1976).

However, catch fisheries have not developed throughout most of its range, apparently because marketable size animals are not regularly trapped in profitable numbers. There is increasing interest in *Mithrax* mariculture, spurred by documentation of a relatively short larval period (Brownell *et al.*, 1977) and by suggestions that the species can be reared on a diet exclusively of marine algae (Miller, 1986). Field and laboratory observations have shown that *Mithrax* do consume benthic algae, coelenterates, and detritus(Hazlett and Rittschof, 1975; Bohnsack, 1976; Brownell *et al.*, 1977). The purpose of this study was to investigate the food habits of crabs captured from the wild, and to identify aspects of feeding behavior significant for *Mithrax* mariculture.

METHODS

Juvenile and adult *Mithrax spinosissimus* were captured by divers in shallow waters off Big Pine Key, Florida during June, 1986. Divers observed and photographed *Mithrax* feeding in their natural habitats during the collecting trips. The divers also collected fresh plants and animals from habitats where *Mithrax* were collected and from nearshore waters around Fort Pierce, Florida. The organisms so collected were used to determine food types accepted by recently captured crabs. In the laboratory the crabs were separated into individual 150 l glass aquaria. Each food item was offered to four males crabs ranging in size from 100 to 750 g. Foods of animal origin were offered individually, but several plant species were offered at the same time, to determine preferences. Several foods, including dry commercial feed and frozen fish bait species, were also offered to a larger population to assess their suitability for regular feeding. The latter group included females and juveniles as small as 5 g.

Another 12 male crabs, separated into 4 size classes from 100—1,300 g (60—135 mm CL), were used to determine the amount of food consumed daily, over a series of consecutive 4 day periods. Food was added to the tank periodically through each day, to be certain that fresh food was always available. The remains of earlier meals were removed, weighed, and subtracted from the original weight offered to adjust for the uneaten remainder. A sample of each food was oven dried (90° C) so that consumption could be calculated both as wet weight (as fed) and on the basis of dry food content (dry matter).

Sand filtered water was pumped from the Indian River lagoon through each tank at a 4 l/min rate. Salinity averaged 31 ppt and temperature 30.5° C during the study. Two airstones were placed in each tank to insure that dissolved oxygen levels remained near saturation. Cement slabs (20 x 20 x 3 cm) were provided in each tank to facilitate molting. *Mithrax* would grip the rough surface with all walking legs during the molt process. Crabs were not always successful at removing their appendages from the exuvia when forced to molt on a smooth surface. Diffuse, low level illumination was provided by overhead fluorescent lamps.

RESULTS

Mithrax observed in the field remained in rock crevices and under ledges during the day. They left their crevices about dusk, moving to vertical surfaces, such as limestone canal walls and bridge pilings, to graze indiscriminately among lush algal growths within a meter of the water surface. *Mithrax* were uncommon along walls shaded by tree cover, in unvegetated areas, or on soft bottom substrates.

In the laboratory *Mithrax* depended more on touch and chemotaxis than on visual cues for feeding. Recognition occurred quickly when food contacted setae on the walking legs. *Mithrax* were also able to detect and recover small pieces of food dropped onto their carapace. A piece of food stepped on by *Mithrax*, was pierced by the crab's sharp pointed walking legs, after which it was grasped by the chelipeds and the other walking legs. Large food items were held by one cheliped and were reduced to smaller size either by the other cheliped or by the maxillipeds.

Chopped fish or invertebrates added to a tank stimulated an active search for food. *Mithrax* quickly learned to reach for food as a person approached, but

their coordination was poor. Food dropped from overhead was usually caught in the carpal or coxal joint of the first periopod, if it was caught at all. Crabs in community tanks commonly fought over preferred foods, such as cut fish and clams. Juveniles frequently decorated the spines on their carapace and legs with extra food, and consumed it later.

Nearly every food offered was accepted and consumed (Tables 1 and 2). Only a few fresh foods, such as the sea anemone *Condylactis*, were regularly refused. Soft bodied invertebrates including worms, nudibranchs, and tunicates were consumed entirely and *Mithrax* was able to remove living snails from their shells. Only a small part of a starfish or sea cucumber was eaten at any time. Hard bodied invertebrates, such as bivalves and urchins, were generally ignored until the investigators broke the shell open. Cannibalism of living crabs was not observed, even during several dozen molts which occurred in community tanks and cages. However, dead soft shell crabs and exuvia were consumed by hard shelled crabs. *Mithrax* showed no preference for any particular part of an algal plant, such as the growing tips, but would often drop one piece and begin feeding on another. Females accepted the same types of foods as males, as did 5

Table 1. Marine plants consumed by *Mithrax*.

Phaeophyta
- *Padina pavonica*
- *Sargassum* sp.
- *Dictyota* sp.
- *Spatoglossum schroederi*

Chlorophyta
- *Batophora oerstedi*
- *Ulva lactuca*
- *Valonia* sp.
- *Penicillus dumentosus*
- *Halimeda tridens*
- *Codium ithmocladum*
- *Caulerpa rupestris*
- *Dictyosphaeria cavernosa*
- *Acetabularia crenulata*

Rhodophyta
- *Gracilaria* sp.
- *Halymenia agardhii*
- *Botryocladia occidentalis*
- *Bryothamnion triquetrum*
- *Hypnea* sp.
- *Corallina cubensis*
- *Laurencia* sp.
- *Acanthophora* sp.
- *Eucheuma gelidium*
- *Fauchea peltata*

Table 2. Animal foods consumed by *Mithrax*.

Porifera
- Demospongea - unidentified slime sponge
- *Callyspongia* sp.

Coelenterata
- *Aiptasia pallida*

Annelida
- *Eunice* sp.

Bryozoa
- *Membranipora tuberculata*

Mollusca
- *Bursatella leachi plei*
- *Mercenaria mercenaria*[1]
- *Littorina ziczac*[1]
- *Fasciolaria tulipa*
- *Diodora cayenensis*
- *Mulina* sp.
- Cephalopoda - unidentified squid[2]

Arthropoda
- *Neopanope texana*[1]
- *Penaeus* sp.[3]
- *Callinectes sapidus*[1]
- *Mithrax spinosissimus* [3]

Echinodermata
- *Echinaster sentus*
- *Echinometra lacunter*[1]
- *Holothuria* sp.

Chordata
- *Botryllus planus*
- *Ascidia hygomiana*

Vertebrata
- Assorted marine fishes[3]
- Beef (heart)
- Pork (liver)
- Chicken (muscle)

[1] These hard shelled invertebrates were eaten only after the shell was broken open by the investigators.
[2] Tested only as a frozen product.
[3] Shrimp, fish and other *Mithrax* were not consumed while alive, but were eaten after being frozen or cut open by the investigators.

g juveniles (when the food was reduced to an appropriate size). The small crabs also fed on a benthic diatom film growing in well lighted tanks.

Under reduced illumination *Mithrax* fed on fresh plant and animal foods throughout the day. Dry commercial feeds were acceptable to crabs initially, but were ignored after about an hour in the water. Tank reared *Mithrax* were found to eat less, as a function of body weight, as they increased in size (Figure 1). When fresh reef algae was given, the amount consumed ranged from about 3—8% of body weight on an as-fed (wet) basis (100—3,600 g animals). This is equivalent to 1.0% or less of body weight on a dry matter basis, a relatively low value as compared to cultured finfish species. Consumption gradually declined when a limited variety of algal food was given over a period of several weeks, but increased again when algae types were alternated or when a variety of types were offered at the same time. When *Mithrax* (100—1,300 g) were offered macroalgae and chopped fish at the same time, fish made up about 75% of the diet (on a dry matter basis).

These data should be regarded as a first estimate of food consumption rates. The quantitative data will require recalculation, as new feeding strategies are developed and as new information accumulates about the species environmental requirements in culture.

CONCLUSIONS

Mithrax consume a wide variety of animal and vegetable foods and will graze on macroalgae, but they do not consume large meals as do many cultured species. In order to achieve maximal food consumption and rapid growth for commercial mariculture, it will probably be necessary to feed frequently or to allow the crabs to forage on natural foods. The natural foods preferred by *Mithrax* are most abundant in brightly sunlit areas, despite the fact that the crabs seek cover during the day. Although crabs accept dry pelleted foods through most, if not all of their life, they do not eat pellets which have soaked for several hours. Supplementary foods are more likely to be consumed if offered at dusk or through the night rather than during daylight hours.

The species' omnivorous food habits and the lack of strong cannibalistic tendencies among adults are encouraging in light of current interest in *Mithrax* mariculture. The principle culture strategy proposed to date (Miller, 1986) utilizes natural algal productivity as food for caged crabs. Our investigation confirms that *Mithrax* will consume a wide variety of macroalgae. However, the nutritional contribution of the various possible foods remains to be determined.

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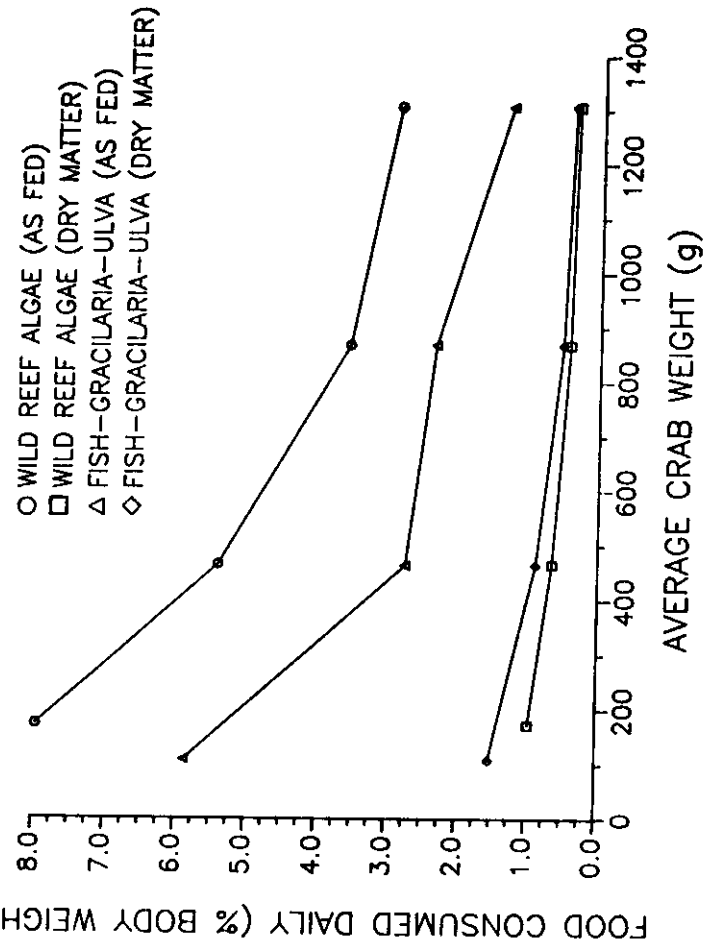

Figure 1. The amount of food consumed daily by *Mithrax spinosissimus* as a function of food type and size of crab, calculated on a wet basis (as fed) and on a dry matter basis.

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