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FOOD AND FEEDING HABITS OF THE MUD CRAB, *SCYLLA SERRATA* FORSKAL INHABITING THE NEGOMBO LAGOON IN THE WEST COAST OF SRI LANKA

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Abstract

The Mud crab, Scylla serrata *is an economically important crustacean, inhabiting the lagoons of the west coast of Sri Lanka. Currently there is interest in mass rearing of the species in ponds. Thus, a study was carried out to identify the food and feeding habits of* Seylla serrata *in the Negombo Lagoon. The stomach contents of crabs of different sizes caught by unbaited gears were screened to identify the food constituents and it was found that crabs of medium size (sub-adults) mainly fed on molluscs and the small ones (juveniles) on crustaceans. Monthly samples were also studied and found that there is no seasonal variation in the food items. Diurnal studies were carried out to determine the feeding time and it became evident that the crabs feed continuously during the night and only at the high tide in the daytime.*

Key words: *Scylla serrata*, Food and Feeding, Negombo Lagoon.

1. Introduction :

Scylla serrata Forskal is a large edible crab, found in estuaries, lagoons and mangrove areas of the Indo-West-Pacific region, which has been extensively studied by several authors in the region (Matilda and Hill, 1980). Its large size, delicious taste, and wide market acceptance has attracted aquaculturists to attempt breeding and rearing of the species. Philippines (Arriola, 1940) Thailand (Varikul, etal 1970), Japan (Cowan, 1982), Taiwan (Cowan, 1982), and Sri Lanka (Jayamanne, 1981) are some countries which have shown considerable interest in culture of this species.

The nutritional biology of *Scylla serrata* has been studied by several authors in the past, particularly, with the intention of determining various culture requirements of the species. Hill (1976) studied the food constituents of all stages of the crab and described the species as predators of sessile and slow moving benthic invertebrates. In a subsequent study he has found that their major prey groups were attached and burrowing bivalves and small crabs and also that they locate their food by chemoreception (Hill, 1979). Later Lijauco et al., (1980) found that only 5% of the natural diet of *Scylla serrata* consists of fish and that it cannot thrive on a fish diet alone. There have been various other studies on the nutritional biology of *Scylla serrata* in different parts of the region (Matilda and Hill, 1980).

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Along with the rapid expansion of prawn breeding and culture in the west coast of Sri Lanka as an export industry in the last decade crabs became increasingly popular among the fishermen and traders because of the good price offered for the large crab *Scylla serrata* in both export and local markets (Jayamanne, 1991). As a result an interest is now growing among investors to start culture of crabs in mud ponds in areas neighbouring the three lagoons, Negombo, Chilaw and Puttalam in the west coast. Therefore, an investigation on the food and feeding habits of *Scylla serrata* in the Sri Lankan situation could be of use. This paper is to present some of the results of a study carried out from 1985 to 1989 on the bionomics of *Scylla serrata* inhabiting the Negombo Lagoon.

2. Materials and Methods

Samples of crabs of varying sizes were examined to identify their food in the natural environment. Samples were collected from the fishermen immediately after capture. Dip nets and gill nets were used to capture crabs. Carapace width of the crabs were measured using a Vernier caliper. Then the crabs were dissected in the field and the stomachs were separated and preserved in 5% formalin. The crabs caught by the most common gear, baited trap, was avoided to prevent possible contamination of the stomach contents by the bait.

For the analysis, stomachs of 392 crabs of different size groups ranging from 2 to 11 cm in carapace width, were used. The stomach contents were analyzed for individual crabs and attempts were made to identify the types of food ingested by crabs of different size groups. Stomach contents were identified to the nearest taxon, their number recorded by counting the number of heads in the case of prey. The number of empty stomachs were also recorded.

Qualitative as well as quantitative analyses were made on stomach contents. Quantitative analysis of stomach contents was done by employing the displacement method and gravimetric method. The total volume of water displaced by stomach contents and by each item of food was measured. Per centage composition of food in *Scylla serrata* was calculated using these data.

For the gravimetric studies, the total weight of food in each size group of crab was determined in a chemical balance with a precision up to four decimals. Then each item was separated and dried in an oven at 60 °C. After they were dried to a constant weight each item was weighed separately in a chemical balance with a precision up to four decimals. Using these data percentage composition of food items on dry weight basis were calculated.

The relative abundance of organisms constituting the diet was determined by the percentage occurrence method (Qayyum and Qasim, 1964). The crabs examined were grouped into 1 cm size intervals to determine the percentage occurence of various food items in crabs of different sizes.

Monthly variation of the food items was calculated from the total number of the crabs examined each month. Relative abundance of the food items in each month was determined by employing the displacement method.

Further, an attempt was made to observe the feeding time and feeding intensity of mud crabs. Three diurnal studies were carried out in the lagoon by using dip nets and by capturing crabs at every 4-hour intervals. The crabs caught at different hours were dissected and the stomach volumes were measured in each crab.

3.0 Results

3.1 Percentage composition of the food items

Percentage composition of the food items of *Scylla serrata* by volume and by dry weight are shown in Tables I and II respectively. Crustaceans formed the chief item of food in smaller size groups (juveniles) while bi-valves formed the chief item of food in the sub-adult groups which are over 8.0 cm in carapace length (Tabie I).

Fish remains and gastropods were generally present in crabs of the size groups 7.0-11.0 cm though absent in juvenile crabs (Table I).

Composition of food items on dry weight basis also gives similar results (Table II). Smaller groups (4.0-7.0 cm in carapace width) contained crustaceans in their food while sub-adults contained bi-valves as the major food.

3.2 Percentage occurrence of different food itesm

The observations made on stomach contents of crabs of different sizes are presented in Table III. The stomach contents of *Scylla serrata* comprised crustaceans, bivalves, small crabs, gastropods, small fish, plankton and plant debris. A pretty percentage of crabs contained sand particles with their food. Almost all the crabs of smaller size groups contained sand particles in their diet. This may be due to the fact that small fish and crabs need more sand to soften food since the denticles are less developed. A marked variation is demonstrated in the percentage occurrence of food items in different size groups of *Scylla serrata*. The crabs of smaller length groups (less than 7 cm) fed predominantly on small crustaceans while those in higher length groups (7-11 cm) preferred bivalves. Plant matter was observed in 37.5% of crabs of the size group 3.0-3.9 cm. The other food items gastropods and fish were found in 5%-40% in the crabs 4.0-11.0 cm length range and 5%-20% in the crabs of 5.0-9.0 cm length range.

3.3 Seasonal variation of the food items

The stomach contents of samples of *Scylla serrata* were analyzed monthly during the period from January 1988 to December 1988. The food constituents of the samples obtained in each month are presented in Table IV. The

Table I. Percentage composition of food items in *Scylla serrata* (by volume) at different size groups.

Size range	*No. analysed*	*small crust*	*bivalves*	*Gastropods*	*Fish*	*sand*	*Plant matter*	*Crabs*
2.0 — 2.9	50	90	—	5	—	5	—	—
3.0 — 3.9	64	85	—	—	—	3	10	—
4.0 — 4.9	76	70	—	—	20	10	—	—
5.0 — 5.9	48	75	10	5	—	5	—	5
6.0 — 6.9	52	75	15	—	—	5	—	5
7.0 — 7.9	46	—	70	—	10	15	—	5
8.0 — 8.9	28	30	—	10	40	15	—	5
9.0 — 9.9	16	20	40	5	20	15	—	—
10.0 — 10.9	12	—	65	15	05	13	—	—

Table II. Percentage composition of food items in *Scylla serrata* (dry weight basis) at different size groups.

Size range	*Number*	*crustacea*	*sand*	*Digested matter*	*bivalves*	*Gastropods*	*Fish*
4.0 — 4.9	2	11.97	2.99	19. 2	—	—	63.89
5.0 — 5.9	6	13.19	60.80	26.00	—	—	—
6.0 — 6.9	7	53.35	11.00	—	35.64	—	—
7.0 — 7.9	5	—	19.33	37.20	60.86	—	—
8.0 — 8.9	3	—	49.94	19.48	—	30.58	—
9.0 — 9.9	1	—	50.35	6.47	43.18	—	—
10.0 — 10.9	2	—	75.59	—	24.41	—	—

Table III. Percentage occurrence of food items in different size groups of *Scylla serrata*.

Size Range	*Number dissected*	*Small crustaceans*	*Bi-valves*	*Gastropods*	*Fish*	*Sand*	*Plant*	*Small*
	dissected	*crustaceans*	*Bi-valves*	*Gastropods*	*Fish*	*Sand*	*Plant matter*	*Small crabs*
2.0 — 2.9	50	80.00	—	20.00	—	100.pp	—	—
3.0 — 3.9	64	56.25	—	12.50	—	100.00	37.50	—
4.0 — 4.9	76	78.95	5.26	5 26	5.26	10.00	5.26	—
5.0 — 5.9	48	45.00	10.00	10.00	5.00	78.00	—	—
6.0 — 5.9	52	75.00	25.00	—	8.33	76.66	—	5.00
7.0 — 7.9	46	—	62.50	—	12.50	70.28	—	8.33
8.0 — 8.9	28	60.00	—	40.00	40.00	85.00	—	12.50
9.0 — 9.9	16	—	33.33	33.33	33.33	78.00	—	20.00
10.0 — 10.9	12	—	66.66	33.33	33.33	75.21	—	—

Table IV. Relative abundance of food items in different months of *Scylla serrata* in the Negombo Lagoon during May 1988 to December 1988.

Items of food	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Small crustaceans	51.34	61.28	57.25	50.18	40.68	51.34	45.37	48.12
Bi-valves	37.80	20.42	30.18	28.23	37.34	46.20	38.02	25.28
Gastropods	5.12	—	4.28	11.45	8.45	—	4.12	9.28
Fish	—	2.42	3.82	4.36	1.64	—	—	—
Sand	3.74	16.98	4.47	15.28	8.89	2.46	10.49	17.32

sample comprised crabs of all size groups in the range of 2.0-11.0 cm. As the results indicate the crustaceans dominated the food throughout the year. B-i valves, gastropods aud sand particles were also found in significant quantities throughout the period of study. There is no seasonal variation in the food constitnuts of *Scylla serrata* in the Negombo Lagoon.

3.4 Feeding time

Juvenile crabs caught by hand nets were used to determine the feeding time of *Scylla serrata* in the Negombo Lagoon. The degree of fullness of the Juvenile crabs caught at every 4-hr. intervals within a 24-hour duration were recorded. Then the stomachs were graded into 6 categories: empty, 1/4 full 1/2 full, 3/4 full, full and gorged. Percentage fullness of the stomach at 4 hr. intervals with the tide level and salinity at the corresponding time of sampling are presented in Figure 1. The results show that the stomachs of juveniles are full from 10.30 p.m.-6.30 a.m. indicating that they feed mostly during this period. The studies on tidal cycles indicate that this is the second high tide (night) which brought in food material. During the first high tide crabs feed less as they are nocturnal in behaviour.

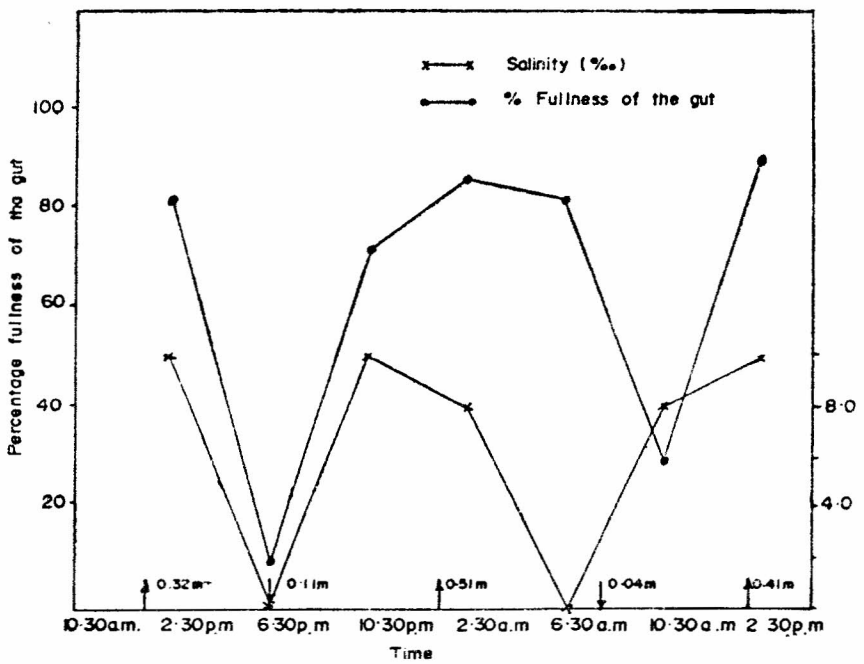

Figure 1. Variations in the percentage fullness of the gut of juvenile *Seylla serrata*, salinity (ppt) and tide level at four hour intervals during a day in the Negombo Lagoon.

4. Discussion

The findings of the present study clearly reveal that *Scylla serrata* is predominantly a carnivore, feeding in the benthic zone of the lagoon with a variety of food selected as its prey depending on its size, smaller crabs fed more on plant matter and crustaceans. Less developed denticles which are not yet capable to crushing bi-valve shells may be the reason for this preference among the smaller crabs. As they grow they prefer hard shelled food such as gastropods and bivalves since they can crush them with well developed denticles. They feed continuously throughout the night and at high tide during the daytime. The food and feeding habits of *Scylla serrata* in the Negombo Lagoon show not much differences from those studied elsewhere. Arriola (1949), observed *Scylla serrata* as an omnivore, a scavenger and a cannibal, The presence of small crustaceans, bi-valves, gastropods, fish, plant matter, crab remains and sand in the food of *Scylla serrata* in the Negombo Lagoon agree with the observations of Arriola, in particular his observation that it is an omnivore.

Hill (1979b) has identified molluscan remains and crustacean remains as major stomach contents of *Scylla serrata* in Queensland. Their prey groups were further identified as burrowing bivalves, attached bivalves and smaller crabs. In the present study the food of much larger groups were not determined due to the difficulty in capturing big crabs without using a bait. However, the main food of juvenile (2-7 cm) and sub-adult (7-10 cm) crabs; crustaceans and burrowing bivalves respectively as determined by the study agree with the findings of Hill (1979b).

The rare occurrence of fish remains in the crab food agree with similar findings of Hill (1976), and particular, Lijauco et al., (1980) that only about 5% of the natural diet of *Scylla serrata* contain fish. The preference of small crabs for small crustaceans proves the predatory behaviour of *Scylla serrata* which too has been an earlier finding reported by Hiatt (1944), in Hawaii. The observation that there is no significant seasonal variation in the food constitutuents of *Scylla serrata* has also been reported earlier by Hill (1976).

The findings of the diurnal study that *Scylla serrata* start feeding with the onset of the high tide in the daytime and ceases to feed with the onset of the low tide and that they feed continuously throughout the night has shown to be somewhat parallel to findings of Hill (1976) in Queensland that *Scylla serrata* remain buried during the day time and emerges at sunset to feed intermittently throughout the night.

Finally, it is important to note that although the mud crab, *Scylla serrata* in the Negombo Lagoon fed predominantly on bivalves and crustaceans it has also demonstrated cannibalism to some extent. This is an interesting phenomenon with regard to its culture which warrants further investigation.

These findings suggest that, if culturing of crabs is to be undertaken, their diet has to be changed with the size. When they are in the size range of 2.0-7.0 cm small crustaceans and leafy matter can be used as food. They can be fed with gastropods and bi-valves when they are in sub-adult stage. Remnants of crabs were seen only in the size range of 5.0-9.0 cm showing that they are more cannibalistic in nature. Therefore, they can be more cannibalistic when they are reared in monoculture ponds, which suggests that they should be given sufficient protein.

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