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Food and Feeding Habits of the Spiny Eel, *Mastacembelus armatus*

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Abstract

Seasonal changes in the feeding habits and food items of the spiny eel, *Mastacembelus armatus*, were investigated. There was no major shift from the basically car-nivorous orientation of the fish, which is highly predacious in nature, during its various life stages. Macro-crustaceans (especially shrimps) and forage fish were the main food of adults while annelids and aquatic insects were eaten by young specimens. Feeding inten-sity was high in early maturity and was relatively lower in fish with ripening gonads. Adult specimens consumed more food in summer than winter and the rainy season. Food intake in younger specimens was greater during the post-monsoon period and in autumn. The maximum number of empty guts were found in adults during spawning and in win-ter.

Introduction

The spiny eel, *Mastacembelus armatus,* is one of the more common species of teleosts found in Asia. *M. armatus* is an economically important inland water fish which is quite palatable as a table fish and is nutritious too. Demand for the fish almost always exceeds supply, particularly in India and its neighboring countries such as Pakistan, Sri Lanka and Bangladesh, although the fish has also been reported in Myanmar, Thailand, Malaysia and southern China. In northern and eastern India, the fish is very popular when sold alive. It occurs in a variety of freshwater habitats in the plains as well as in the hills of India. Despite its abundance, palatability and consumer appeal, no published information is available on the biology of *M. armatus,* except in the studies of Dutta (1989, 1990) and Serajuddin and Mustafa (1994) on feeding specialization of adult fish of this species, Sikder and Das (1980) on the skin structure of *M. armatus* and Saxena *et al.* (1979) on the cytological details of its oocytes. Keeping in mind the paucity of information on the biology of this species, the present study focusing on the food and feeding habits of *M. armatus,* known in India as "baam," is undertaken.

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Materials and Methods

Monthly samples of fish were obtained for a period of 12 months from January to December 1993, with each sample comprising about 20-30 fish. The fish were caught from Kalinadi, a tributary of the Ganga river system at Aligarh (27° 34' 30" N, 78° 4' 26" E), by using cast and drag nets, and brought to the laboratory packed in ice. The time of collection was fixed during the early hours of the morning to minimize the possible effects of diet on feeding and differential digestion of food items.

Total length of each fish was measured from the tip of the snout to the longest caudal fin ray to the nearest 0.1 mm. Their weight (g) was recorded on an electric balance sensitive to 0.001 g. The fish (size range 5-50 cm) were sexed and divided into five length groups on the basis of their size (Table 1). Except for group one, where it was 5 cm., length range of each group was 10 cm. Gonadal condition was examined and the stage of maturation of the samples was determined following the scheme of classification used by Qayyum and Qasim (1964a) for *Ophiocephalus punctatus*.

The intensity of feeding was studied by determining the gastrosomatic index (gut weight expressed as percentage of body weight) using the method suggested by Khan *et al.* (1988).

For the analysis of gut contents, methods like the frequency of occurrence, numerical counts and gravimetric method were applied as summarized by Lagler (1956). Qualitative analysis (identification of prey items in the gut contents) formed an important part of the gut content analysis; and it was on the basis of qualitative analysis that the above-mentioned all-relative quantitative assessments were made. For this purpose, the prey items were identified and categorized according to their systematic status.

Results and Discussion

Well-developed dentition, absence of gill rakers, strongly built stomach and short intestine, together with the dominance of animal matter in the gut contents, described the carnivorous and active predatory habits of *M. armatus*. Body width in all life stages of *M. armatus* was about 5.56% of total body length, resulting in a slender body. This also pointed towards an actively mobile lifestyle suited to its predatory nature. Body width and total length were found to have a significant correlation (0.9227).

Relative gut index

Relative gut indices of *M. armatus* are given in Fig. 1. The absence of appreciable differences in this index in juvenile and adult fish indicates that growth does not involve any major shift in the basically carnivorous habit of the fish. In the present study, gut length/body length ratio varied from 1:0.50-1:0.68. Interestingly, this variation was noticed in both young and adult fish, thus ruling out any substantial change in diet. In view of the consistency in the gut length/body length ratio over the entire size range of the fish inclusive

Table 1. Gastrosomatic index of *M. armatus* in different seasons.

Month	Size range according to sex														
	(5-10cm)			(11-20cm)			(21-30 cm)			(31-40 cm)			(41-50 cm)		
	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined
January	1.8	1.2	1.3	2.2	1.8	2.1	3.2	3.2	3.4	2.6	2.9	2.6	1.6	1.7	1.6
February	1.8	1	1.4	2.2	1.6	2.2	3.1	3.2	3.5	3.2	2.9	3.4	2.8	2.5	2.6
March	1.5	1.5	1.6	2.5	2.0	2.2	3.5	3.4	3.4	3.6	3.7	3.1	2.9	2.8	2.8
April	1.3	1.6	1.8	2.3	2.5	2.4	3.6	3.5	3.5	3.3	3.8	3.4	3.5	3.5	2.4
May	1.6	1.8	1.7	2.6	2.3	2.5	3.7	3.5	3.6	3.8	3.3	3.5	3.6	3.4	3.4
June	-	1.8	1.8	2.5	1.9	2.4	3.8	3.2	3.5	3.6	2.7	3.4	3.8	2.6	3.7
July	-	-	-	2.3	2.5	2.4	2.9	2.8	2.9	1.4	1.8	1.9	3.6	2.6	3.2
August	-	-	-	2.6	2.6	2.5	2.1	2.6	2.5	1.9	1.6	1.8	2.1	1.8	2.1
September	-	-	-	2.5	2.3	2.6	3.5	2.9	3.2	1.8	1.8	1.7	1.9	1.7	1.8
October	3.1	1	2.6	2.7	2.6	2.6	3.6	3.2	3.1	1.9	2.3	2.0	2.0	1.6	2.0
November	2.4	0.9	2.1	1.9	1.9	2	3.7	2.8	2.9	2.6	3.0	2.9	1.7	3.0	1.8
December		0.8	0.8	1.7	1.7	1.8	3.6	2.5	2.9	2.4	2.7	2.6	1.5	1.7	1.6
Mean ± SE	1.7 ± 0.20	1.3 ± 0.11	1.6 ± 0.14	2.3 ± 0. 08	2.1 ± 0.08	2.3 ± 0.07	3.4 ± 0.14	3.1 ± 0.12	3.2 ± 0.10	2.7 ± 0.23	2.7 ± 0.20	2.7 ± 0.20	2.6 ± 0.24	2.3 ± 0.19	2.4 ± 0.20

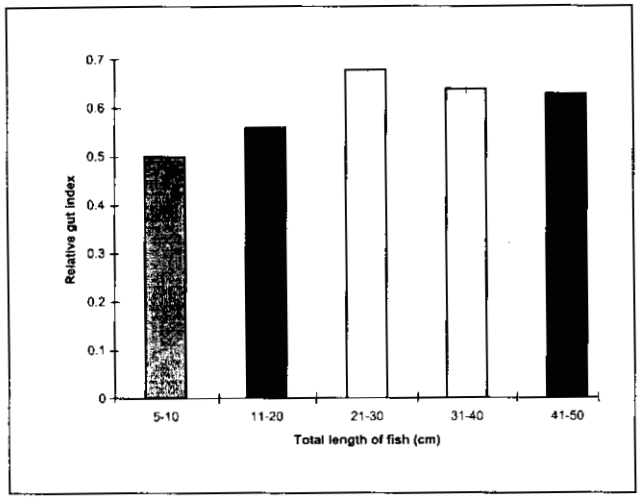

Fig. 1. Relative gut index of *M. armatus* of different sizes.

of both juveniles and adults, it was possible to express the relationship between gut length and body length through the equation :

Log gut length = 0.2788+1.0477 Log body length (cm)

There was a significant correlation between gut length and body length. The value of correlation coefficient 'Y' was 0.943 ($p<001$).

Intensity of Feeding in Relation to Seasons

The values of gastrosomatic index (GSI) for different months are given in Table 1 and Fig. 2. It was found that individuals in the size range 21-50 cm consumed more food during summer (March-June) than during the rainy season and winter (July-February). The younger specimens (5-20 cm) were found to be feeding heavily during the post-monsoon and autumn periods (September - November). Like adults, however, they too consumed a lesser quantity of food during winter. While pronounced feeding activity in the younger individuals of both sexes was observed in the month of October, it was extremely low in December. In adult female specimens, a higher GSI was recorded for all sizes in April. In these cases, low GSI varied with size. The lowest values for the size groups 31-40 cm and 41-50 cm were observed in August and October, respectively. A maximum number of empty guts were found during spawning and during the winter season.

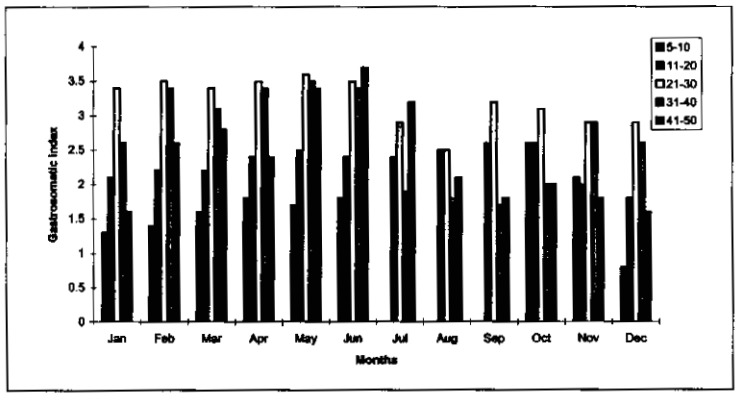

Fig. 2. Seasonal variations of gastrosomatic index with respect to size in *M. armatus*.

The findings of the present study left no doubt that the foraging activity of this fish fluctuated during the rainy season, which is also its spawning season. The intensity of feeding declined when fish became ripe and were ready for spawning. The stress brought to bear on the alimentary canal of the fish by its developed gonads appeared to be the causative factor in the decline in feeding. The occurrence of poor feeding in other fishes coinciding with peak breeding has been reported in previous studies (Desai 1970; Bhatnagar and Karamchandani 1970; Wijeyaratna and Costa 1988; Khan *et al.* 1988). Low feeding intensity in adult *M. armatus* was also recorded in other months, including August and December. The low feeding rate during these months may be due to the non-availability of food organisms and the effect of certain abiotic factors such as temperature and turbidity.

Feeding Intensity in Relation to Maturity Stages

Feeding intensity in males and females at different stages of their maturation is indicated in Fig. 3. It is interesting to note that in both sexes the most active feeding period was found in the gonad ripening stage, which is the third stage of the sexual cycle. This suggests that, at this stage, the fish feed more voraciously because of a higher energy demand associated with gonad development. Fish with medium gut fullness in almost all the months suggest that feeding was never discontinued and, even during the breeding season, there was no cessation of feeding. Khan *et al.* (1988) also reported the same type of feeding intensity in relation to the stage of maturity in the freshwater catfish, *Mystus nemurus*.

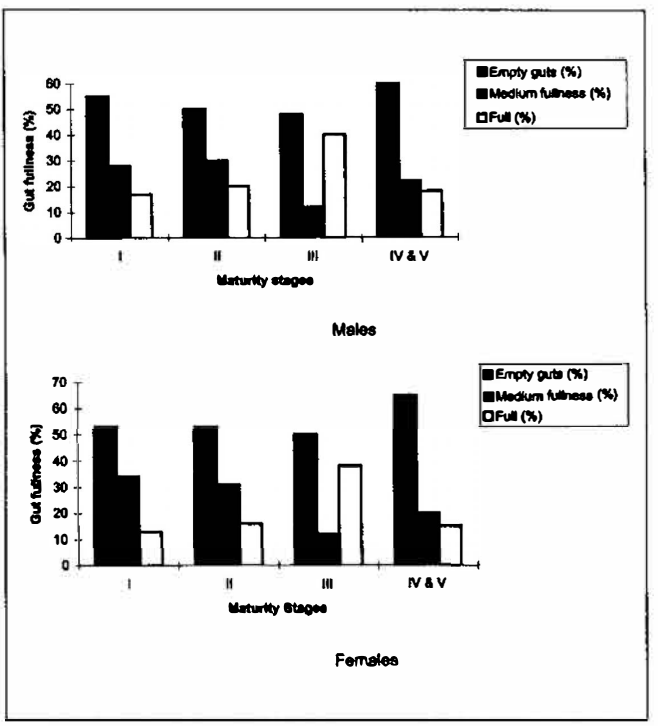

Fig. 3. Variations in feeding intensity in relation to maturity stages of *M. armatus*.

Food Composition

Freshwater shrimps (*Macrobrachium* spp.) were the preferred prey organisms (Table 2). Other organisms consumed were dipteran lavae, brine shrimps (*Branchipus* spp.), earthworms (aquatic oligochaetes) and minor carps (cyprinids), depending on the frequency of their occurrence. Food categories of lesser importance include aquatic vegetation, fish eggs and barbels which may have been accidently swallowed by the fish while it was voraciously feeding on other food organisms. Following the criteria proposed by Nikolosky (1963), food eaten by *M. armatus* could be divided into three categories: crustaceans and forage fish as basic food for the adults (Table 2 and Fig. 4) and annelids and aquatic insects as basic food for the juveniles. Aquatic annelids and insect larvae could be considered as the secondary food for adults, while forage fish and crustaceans together represented the secondary food of juveniles. Molluscs and aquatic vegetation could be regarded as incidental items for both juveniles and adults. Khan (1934) reported *M. armatus* as carnivorous and emphasized that it is detrimental to eggs and fry of other fishes. Das and Moitra (1955) pointed out that this fish mainly feeds on crustaceans and Jhingran (1982) described it as piscivorous. Dutta (1989, 1990) carried out stomach content analysis of *M.*

Table 2. Gut contents of the spiny eel, *M. armatus*.

Food Items	Numerical count (%)	Frequency of ocurrence (%)	Gravimetric index (%)
Crustacea			
Macrobrachium	82	55.7	97.52
Eubranchipus	25	28.8	0.97
Daphnia	18	11.5	
Teleostomi			
Puntius	14	23.0	27.52
Esomus	08	07.6	09.57
Osteochilus	04	05.7	12.32
Unidentified	25	48.0	62.20
scale	40	38.4	0.98
Aquatic insects (larval stage)			
Ephemeroptera	Numerous	19.2	06.80
Diptera	Numerous	30.7	08.52
Hemiptera	02	05.7	0.43
Unidentified	30	11.5	02.32
Annelids			
Aquatic earthworm	Numerous	26.9	15.00
Mollusca			
Gastropods	05	03.8	0.21
Digested matter		36.5	35.00
Aquatic vegetation		03.8	04.32
Fish eggs	Numerous	07.6	02.35
Barbels	40	17.3	0.53

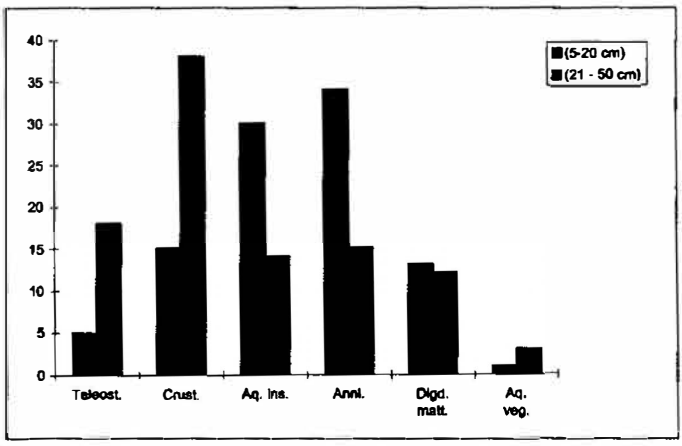

Fig. 4. Percentage composition of food of *M. armatus*.

armatus collected from Gadigarh stream (Jammu, India) and reported it as selective insectivorous fish. Contrary to the present findings indicating carnivory, Mookerjee *et al.* (1947) reported this species to be herbivorous.

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