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Food and feeding habits of *Johnnieops sina* (Cuvier, 1830) along Cochin coast of India

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ABSTRACT

Food and feeding habits of *Johnnieops sina* were studied along the Cochin coast during the period 2008-2010. *Johnnieops sina* mainly feed on crustaceans followed by teleost fishes and the juveniles mainly feed on *Acetes*. Highest percentage of penaeid prawns and fishes was observed in 190-199 mm and 160-169 mm length groups, respectively. Incidence of empty stomach was high in all months. Intense feeding in male fishes was observed during April, September, October and November, whereas the females fed intensively during December and January.

Keywords : Cochin, Food and feeding habits, *Johnnieops sina*

Feeding is one of the vital functions of living organisms to generate nutritional source for various fundamental biological activities. Growth, nutritional requirements, breeding and migration of any fish species are known from information on their feeding habits. The distribution and abundance of any fish species is greatly influenced by availability and prey potentiality in the region. The horizontal and vertical movement of fish stock is also greatly influenced by the variations in seasonal and diurnal abundance of the prey. Hence, study on food and feeding habits of fishes form one of the main aspects in the study of its biology (Qasim, 1972). It also helps in forecasting the movements of fish and improving the harvest of commercial fisheries. Feeding habits of similar fish species is varied in different environments. There are many regional factors like environmental condition, kind of prey availability, defence mechanism of prey and attractive nature of prey which alter and affect the feeding characters of fish species. The spectrum of prey consumed by a species helps to define its fundamental niche (Hutchinson, 1957). Thus, it is imperative to examine food and feeding behaviour of similar species on a regional basis.

Studies on food and feeding habits of *Johnnieops sina* are restricted to few investigations. Venkataraman (1960), George *et al.* (1968), Nair (1980), Suseelan and Nair (1969) and Manoj Kumar (2003) have made attempts to study the feeding habits of *J. sina* from Indian waters. However, no detailed investigation on the feeding behaviour has been carried out so far. This paper presents the results of the studies carried out on food and feeding habits of *J. sina* caught along the Cochin coast during the period 2008-2010.

Samples were collected weekly from three major landing centres such as Munambam, Vypin and Cochin Fisheries Harbour during the period January 2008 - June 2010. A total of 1141 individuals (pooled) of *J. sina* in different size groups ranging from 99-209 mm were sampled for the present study. In order to

understand the seasonal variations in feeding habits, samples were collected in different seasons during the study period. However, samples were not collected in July being the annual trawl ban period on fishing in Kerala. After collecting required data on total length and weight, specimens were dissected for removing guts for further analysis. All the individuals were segregated sex-wise for examining the gonadal maturity stages. The stomachs were preserved in 5% formalin for further analysis. The gut contents were weighed and cut opened for recording degree of fullness of stomachs. Stomach condition was classified based on quantity of food materials present in the gut as gorged, full, 3/4th full, 1/2 full, 1/4th full, trace and empty.

Prey items in the stomachs were emptied in a clean petri-dish and segregated to study the composition. Both occurrence and volumetric displacement methods were used for qualitative and quantitative analysis, respectively. Qualitative analysis was adopted and prey items in recognisable condition were identified up to either species or generic level. Food items in advanced state of digestion were categorised as digested, semi digested and traceable. Following the volume displacement method (Pillay, 1952), volume of each food item was measured with a measuring jar. *J. sina* being a carnivore, the index of pre-ponderance method (Natarajan and Jhingran, 1961) was attempted as it is suitable for carnivorous fishes. This method has also the advantage of considering both qualitative and quantitative assessment. The index was calculated using the following equation:

$$I = \frac{V_i O_i}{\sum V_i O_i} \times 100$$

where V_i and O_i represents the percentage of volume and percentage of occurrence indices of each food items respectively and I the index. Qualitative analysis of stomach contents of *J. sina* showed its preference for larger organisms in shallow

waters. Some of the most dominant prey organisms were teleosts, penaeid prawns, squilla and *Acetes* sp. A detailed list of the food components is given in Table 1.

Stomach analyses indicated that food composition of *J. sina* consisted mainly of two groups, crustaceans and teleost fishes (Table 1). Among the crustaceans, penaeid prawns constituted major portion followed by *Acetes* sp., crab and *Oratosquilla nepa*. Studies in other sciaenid species have indicated similar food preference (Venkataraman, 1960; George, 1968; Bhusari, 1975; Rao, 1979; Dukhande, 1991; Chakraborty *et al.*, 2000). *Saurida* sp., *Nemipterus* sp., *Leiognathus* spp. and *Cynoglossus* sp., were the major species dominating the fish diet. Studies on *J. sina* from Kerala coast reported a wide range of preference to many demersal and midwater species like *Stolephorus* sp., silverbellies, juveniles of *Saurida* sp., flatfish and mackerel (Chakraborty *et al.*, 2000). Squid was also observed in the stomach, but molluscs were negligible compared to crustaceans and fish.

Table 1. Food composition of *Johnnieops sina* observed in the present study

Group	Species
Penaeid prawns	<i>Parapenaeopsis stylifera</i>
	<i>Metapenaeus affinis</i>
	<i>Metapenaeus dobsoni</i>
	<i>Metapenaeus monoceros</i>
Teleosts	<i>Leiognathus</i> spp.
	<i>Stolephorus</i> spp.
	<i>Cynoglossus</i> spp.
	<i>Nemipterus</i> spp.
	<i>Saurida</i> spp.
	Sciaenids
	<i>Upeneus</i> spp.
Non-penaeid prawn	<i>Acetes</i> sp.
Stomatopod	<i>Oratosquilla nepa</i>
Molluscs	Squids
Other crustaceans	Crabs

Juveniles and adults of this species demonstrated varied prey preference. Diet of juveniles of *J. sina* in the present investigation consisted mostly of crustaceans, while the contribution of fish was minimal. *Acetes* sp. dominated the crustacean diet followed by juveniles of *Saurida* spp. Occurrence of *Acetes* sp. is recorded extensively in the diet of many sciaenid species (Venkataraman, 1960; Bhusari, 1975; George *et al.*, 1960; Dukhande, 1991; Chakraborty *et al.*, 2000).

Diet of juveniles mainly composed of *Acetes* sp., while the adult diet comprised of a wide choice of prey items like penaeid prawns, many teleost species, stomatopods and molluscs. The diet of juvenile *J. sina* from Calicut waters consisted of copepods, whereas adult prefer fishes and penaeid prawns (Nair, 1980). Dukhande (1991) also reported similar observation on *J. sina* from Mumbai waters. The diet difference between juveniles and adults could be attributed to the diverse environment in which they live (Nair, 1980). Juveniles remained mostly at the bottom of sea and therefore their diet was largely dominated by bottom fauna, while the diet of adults consisted of a wide range of food items from all layers of the water column.

Month-wise food composition is shown in Table 2. The diet in most of the months was dominated by crustaceans. Among crustaceans, penaeid prawns were present mostly in all the months and was found to be an important food item. *Acetes* sp. was the only non-penaeid prawn found predominantly in all the months. Apart from crabs and squilla, the second food item observed in the stomach in all the months was fishes.

The occurrence and volume of different prey items in the stomach of *J. sina* are shown in Table 3. Index calculation of prey items indicated crustaceans as the dominant food item followed by fish. Penaeid prawns ranked first (37%) followed by *Acetes* sp. (36.4%). Fishes were the second dominant prey item consisting of *Saurida* spp. as the dominant item (1.8%) followed by *Nemipterus* spp. (0.8%) and *Cynoglossus* spp. (0.5%). Feeding on squids by *J. sina* was observed occasionally and it contributed 0.5% of all the food items. Digested matter

Table 2. Month-wise percentage composition of different food items in the stomach of *Johnnieops sina*

Prey items	Months											
	Jan	Feb	Mar	Apr	May	Jun	Aug	Sep	Oct	Nov	Dec	
<i>Saurida</i> spp.	16.3	10.9	11.2	7.9	13.3	-	2.5	2.2	18.6	-	-	
<i>Nemipterus</i> spp.	-	-	5.7	4.7	14.9	-	1.5	10.1	-	-	9.4	
Sciaenids	2.0	-	2.4	10.6	-	17.0	-	-	8.6	7.9	11.4	
<i>Cynoglossus</i> spp.	-	-	6.8	4.3	-	-	-	2.6	12.4	8.3	11.0	
<i>Leiognathus</i> spp.	4.3	-	-	-	-	-	-	-	6.6	2.5	-	
<i>Upeneus</i> spp.	-	-	2.2	2.2	1.00	-	-	9.2	6.2	3.8	-	
<i>Stolephorus</i> spp.	-	-	1.0	-	-	-	-	-	-	3.5	3.1	
Squids	13.0	-	4.0	-	-	-	-	-	-	4.6	3.3	
Crab	5.9	10.7	10.4	2.00	5.5	40.8	-	-	8.0	-	-	
<i>Acetes</i> sp.	6.1	14.2	14.8	16.4	6.2	11.0	42.5	12.1	16.7	20.5	17.6	
Penaeid prawn	22.1	34.0	10.9	23.7	27.3	11.4	20.0	27.8	10.5	23.1	22.1	
<i>Oratosquilla nepa</i>	7.51	6.0	8.2	3.7	6.9	3.4	6.5	3.8	-	-	-	
Semi-digested matter	12.1	11.0	11.9	11.0	11.6	5.7	7.2	18.3	2.5	16.5	16.9	
Digested matter	10.8	13.2	10.5	13.6	13.5	10.7	19.8	14.2	9.9	9.3	5.2	

Table 3. Index of preponderance in *Johnnieops sina* caught along the Cochin coast

Prey items	Occurrence	% of occurrence (O _i)	Volume (V) (ml)	% of volume (V _i)	O _i V _i	Index of preponderance
<i>Saurida</i> spp.	12	3.0	71.5	8.6	25.9	1.8
<i>Nemipterus</i> spp.	9	2.3	43.5	5.2	11.8	0.8
Sciaenids	7	1.8	22.5	2.7	4.7	0.3
<i>Cynoglossus</i> spp.	8	2.0	31.25	3.8	7.5	0.5
<i>Leiognathus</i> spp.	5	1.3	10	1.2	1.5	0.1
<i>Upeneus</i> spp.	7	1.8	20.5	2.5	4.3	0.3
<i>Stolephorus</i> spp.	5	1.3	16.5	2.0	2.5	0.2
Squid	10	2.5	22.5	2.7	6.8	0.5
Crab	10	2.5	42	5.1	12.7	0.9
<i>Acetes</i> sp.	110	27.5	160	19.3	53.3	36.4
Penaeid prawn	95	23.8	188.4	22.7	539.2	37.0
<i>Oratosquilla nepa</i>	14	3.5	26.22	3.2	11.1	0.8
Semi digested matter	26	6.5	78.4	9.4	31.4	4.2
Digested matter	82	20.5	96.5	11.6	238.4	16.4

ranked third with a contribution of 16.4%. Food composition with respect to different length groups is given in Table 4. Quantitative analysis of stomach content of 392 males and 487 females were carried out to gain insight into feeding intensity of *J. sina* (Table 5 and 6). They were categorised into different groups based on the quantity of food in the content with stomach of fishes with gorged, full or 3/4th full condition as actively fed, ½ full, moderately fed, and ¼ or as poorly fed.

Length-wise preference of *J. sina* for different diets is shown in Table 4. The length group between 90-109 mm consisting of juveniles preferred *Acetes* sp. whereas adults (180-189 mm) mostly fed on fishes. Fishes varied from lowest of 1.16% in 120-129 mm length group to highest (59.61%) in 160-169 mm length group. Molluscs were not found in the diet of juvenile length group, but recorded in adult length ranging between 160 and 189 mm with maximum of 2.97% in 170-179 mm length group and minimum of 0.15% in

160-169 mm length groups. Prey preference seems to vary with increase in size of the fish. Highest percentage of penaeid prawns was observed in 190-199 mm length group (71.78%).

High feeding intensity in males was observed during April, September, October and November, whereas in females feeding intensity was high during December and January. Maximum percentage of gorged stomach was observed in October in both the sexes. The percentages of actively fed juveniles were higher than that of adults and percentage of poorly fed fishes increased with the size of the fishes. High incidence of poorly fed fishes was observed during most of the months. These probably indicate absence of regular periodicity in the intensity of feeding in different seasons. Nair (1979) reported predominance of poorly fed fish in most of the months which shows absence of seasonal intense feeding activity. The frequent occurrence of empty stomachs may be attributed to the faster digestion due to strong gastric juice in carnivorous fishes (Qasim, 1972)

Table 4. Diet composition (%) in relation to the length of *Johnnieops sina*

Length group (mm)	<i>Acetes</i> sp.	Fish	Squid	Crab	Squilla	Penaeid prawn	Digested matter
90-99	100						
100-109	90.40	9.6	-	-	-	-	-
110-119	76.79		-	-	-	3.41	19.83
120-129	75.01	1.16	-	-	-	13.69	10.96
130-139	38.19	17.40	-	-	-	22.07	22.34
140-149	48.27	24.24	-	-	2.16	15.49	9.79
150-159	18.27	43.34	-	-	-	24.29	14.10
160-169	12.41	59.61	0.15	0.90	1.79	13.94	11.14
170-179	10.97	39.88	2.97	3.54	1.26	18.66	4.75
180-189	6.32	25.97	2.63	6.94	-	41.22	18.86
190-199	6.90	33.83	-	-	4.06	71.78	7.49
200-209	7.69	48.91	-	-	-	42.45	11.45

Table 5.. Month-wise feeding intensity of male *Johnnieops sina*

Months	Active feeding		Moderate feeding		Low feeding		Empty
	Gorged	Full	3/4 th full	½ full	¼ full	Trace	
January	-	15.86	6.25	18.43	12.49	2.0	41.57
February	-	-	17.13	27.42	1.82	14.35	39.48
March	-	20.35	12.90	11.13	2.45	5.64	43.51
April	6.54	27.78	11.11	16.67	-	5.55	33.34
May	-	13.64	4.58	10.90	20.02	6.89	41.19
June	-	2.29	12.00	26.75	-	2.89	56.07
August	-	4.57	26.72	-	2.63	-	66.08
September	5.78	29.50	3.44	18.89	5.46	8.95	46.02
October	6.97	12.18	12.93	9.65	15.57	5.35	37.38
November	-	22.86	15.75	14.27	6.73	12.11	28.28
December	-	15.12	8.90	20.38	11.10	-	44.50

Table 6. Month-wise feeding intensity of female *Johnnieops sina*

Months	Active feeding		Moderate feeding		Low feeding		Empty
	Gorged	Full	3/4 th full	½ full	¼ full	Trace	
January	-	23.55	10.96	13.61	6.48	6.45	37.87
February	-	19.35	6.72	12.16	10.81	2.34	48.62
March	-	11.04	3.00	25.60	15.15	6.80	38.41
April	3.23	9.98	12.45	10.84	3.28	-	60.22
May	4.62	14.45	15.20	8.39	14.20	15.63	26.79
June	7.28	6.76	19.10	15.80	13.35	12.15	35.67
August	3.13	13.34	3.00	35.91	5.55	-	39.77
September	-	17.86	12.20	18.07	-	10.79	41.38
October	9.54	8.79	7.69	22.38	6.93	5.15	29.62
November	8.47	12.28	11.71	18.86	9.39	12.70	26.68
December	6.76	29.31	20.76	4.78	-	5.55	32.84

From the present study, it could be inferred that the diet of *J. sina* comprised of two major groups, the crustaceans and the teleosts. There is a shift in the preference for food items from juvenile to adult. Juveniles have limited prey options as food compared to the adults. While the Juveniles fed on *Acetes* sp. as the most preferred, adults mostly preferred paenied prawns and teleost fishes. There is no definite pattern in the relationship between feeding intensity and size of the fish. However there may be geographical difference in food and feeding pattern as it depends on the availability of different food items in the habitat. Food is the most important limiting factor in the distribution and abundance of a particular species in a region.

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