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RESEARCH ARTICLE

Studies on food and feeding habits of *Harpiosquilla harpax* (de Haan, 1844) (Crustacea: Stomatopoda) represented in the shrimp trawl net by-catches off Visakhapatnam, east coast of India

Rajendra Prasad D. and Yedukondala Rao P.
Dept. of Marine Living Resources, College of Science and Technology, Andhra University, Visakhapatnam - 530 003, A.P

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Corresponding Author

Rajendra Prasad D

Abstract

The food and feeding habits of mantis shrimp *Harpiosquilla harpax* was studied by collecting from shrimp trawl net by-catches off Visakhapatnam during January to December 2009 on the basis of qualitative and quantitative analysis of gut contents. The index of preponderance and index of relative importance were found to be higher during post-monsoon season as compared to other seasons. The present study shows that *H. harpax* was carnivorus, mainly depending on animal food items, irrespective of size in marine conditions.

Introduction

Stomatopods are commonly called as ‘mantis shrimps’ or ‘Squilla’. Mantis shrimps are belongs to the Order stomatopoda is included within phylum Arthropoda, class Crustacea. Mantis shrimps are primarily distributed throughout tropical and subtropical waters, where they inhabit burrows or crevices within the intertidal and sub-tidal zones (Ahyong, 2001). They are normally captured during benthic trawl operations and used as a dependable source of raw material in fish meal, poultry feeds and fertilizers. They also form a rich source of chitin, chitosan and their derivatives, which have a wide range of applications. However, in some countries they are also eaten as meat is reported to possess medicinal properties (James and Thirumilu, 1993).

Stomach content analysis provides accurate description of mantis shrimp diets and feeding habits also provides the basic for understanding tropic interaction in aquatic food webs. Feeding is one of the important functions of an organism. It consist both the way of food taking and the mode of digestion, growth development and reproduction all takes place at the expense of the energy which enters the organisms in the form of food. Stomatopods landed in considerable quantities in almost all maritime states of India. *Harpiosquilla harpax* an important component of by-catch of the shrimp trawl at Visakhapatnam fishing harbour (Yedukondala Rao *et al.*, 2013). In this paper, qualitative and quantitative analysis of stomach contents of *H. harpax* were presented according to season, size and sex.

Materials and Methods:

For the study of food and feeding habits, a total of 563 specimens of *H. harpax* length range from 75-211mm TL consisting of males and females were collected from trawl net by -catches at Visakhapatnam fishing harbour (Lat: 17º 41' N Long: 83º 18' E) at regular intervals (twice in a month) during Jan to Dec 2009. The stomachs were separated after recording the length, weight and sex of each mantis shrimp. Each stomach was kept separately in 5% formalin. Five categories of stomach fullness namely empty, $1/4^{th}$, 1/2, $3/4^{th}$ and full could be recognized based on the nature of stomach folds (Rao 1964a); and numerical values of 0, 25, 50, 75 and 100 were

assigned respectively to the above categories. The values obtained by all the stomachs examined were averaged according to season, length and sex of the mantis shrimp.

The mantis shrimps are grouped into actively fed (full and 3/4th full stomachs), moderately fed (1/2 full stomachs), poorly fed (1/4th full stomachs) and empty based on their stomach fullness. Each stomach was considered as a unit and the stomach contents were first identified qualitatively to the nearest taxon possible and their quantity was determined by numerical method. The occurrence of each food item in the stomachs was also noted. The numbers gained by each food item in all the stomachs examined in a sample were used to calculate the percentage composition of the different food items (Hynes, 1950). The index of preponderance proposed by Natarajan and Jhingran (1961) and index of relative importance proposed by Pinkas *et al*., (1971) were also calculated to grade the relative importance of food item with regards to the season, size and sex of the stomatopod.

The feeding intensity of males and females were tested by χ^2 test and Non parametric Spearman rank correlation coefficient (Zar, 1974) were also calculated for sex-wise comparison of occurrence, number, volume, index of preponderance and index of relative importance.

Results and Discussion:

Composition of food: Regular food items in the order of importance (overall % composition) were fish, crustaceans, cephalopods, sand, digested matter, plant material, polychaetes, echinoderms and molluscans represented in guts of *H. harpax* off Visakhapatnam (Fig 1).

Active feeding was found in individuals from Jul to Aug. Moderate feeding was observed from Jan to Jul and poor feeding was observed from Jan to Apr. The empty stomachs were dominant during all the months except Aug (Table 1). The average amount of feeding indicated that the *H. harpax* feed actively during monsoon followed by other seasons.

Index of preponderance (IP):

Fish (54.82) first among the food items followed by crustaceans (22.04), cephalopods (11.05), sand (6.98), digested matter (2.44), polychaetes (1.05), plant material (0.97), molluscans (0.54) and echinoderms (0.11) (Fig 2).

Seasonal variations of various food items were presented (Table 2). Fish was most preferred food item in throughout the period of investigation. The high values observed were Jun (91.68), Jul (67.68) and Aug (92.43). Crustaceans were the second important food item, gained high index values Jan (41.30), Oct (52.88) and Nov (46.98). Cephalopods were the third food item and gained high index value during Dec (36.18). The maximum index value of sand was observed during Mar (41.84). The maximum index value of digested matter was observed during Jun (4.06). The maximum index value of polychaetes was observed during Dec (2.45). The maximum index value of plant material was observed during Jan (3.24). The maximum index value of molluscans were observed during Dec (0.61) and echinoderms observed in Jan (10.19).

Length-wise variations of different food items were presented (Table 3). Fish was the most preferred food item in almost all length groups. Crustaceans were dominated in the gut contents at length group 161-180mm TL (34.26) and 181-200mm TL (38.33).

Sex-wise variation of different food items shows that there is no marked difference in the food composition between males and females.

Index of relative importance (IRI):

Index of relative importance of *H. harpax* was calculated from the mantis shrimp samples collected during Jan to Dec 09. The results were presented (Fig 3). Seasonal variations of various food items were presented (Table 4). Length-wise variations of various food items were presented (Table 5).

Sex-wise variation in the index of relative importance of different food items shows that there are no marked differences in the food composition between males and females.

The non parametric spearmen rank correlation coefficient for the Sex-wise comparison of occurrence (r_s = 0.9917), numerical (r_s = 0.9643), volume (r_s = 0.9833), stomach fullness (r_s = 0.90), IP (r_s = 0.9833) and IRI (r_s = 0.9833) respectively of various food items did not reveal significant difference ($p \rangle 0.05$) in their feeding preference.

Kubo *et al*., (1959) indicated that *Oratosquilla oratoria* of Tokyo Bay predates more on Crustaceans and Pisces than Molluscans. Nasima and Qudusi (1984) reported in *O. oratoria* in Pakistan waters crustaceans were the main diet. Hamano and Matsura (1986) while studying the food habits of *O. oratoria* confirmed that it is a predator, which consume mainly crustaceans and Molluscans in the Hakata Bay. Ohtomi *et al.*, (2004) also reported that the shrimps were the major food items in *Squilloides leptosquilla* in Kagoshima Bay. In the present study on food and feeding habits, it is observed that the fish and crustaceans were the most preferred food items to *H. harpax*. The next preferred food item in majority of the forms was cephalopods. Since many of these stomatopods are known to restrict themselves to deeper region they have the ability to feed on benthic organisms like polychaetes, molluscans, echinoderms, plat material and these groups were also found in the gut of stomatopods. The composition of the guts

shown the sand was sometimes in considerable quantities, since they are known to be mainly carnivores the intake of sand type of food may be accidental. Williams (1955) reported that the feeding intensity was minimum in the winter by recording most of the stomachs as empty and good feeding in the other season of the year. In the present study average amount of feeding indicated that feed actively during monsoon compare with other season and highest percent of the empty stomachs were noticed. This may be due to the time taken for the landing to reach the shore from the area of capture extend over 8-12 hours, there is a possibility, that much of the food consumed guts transformed to empty due to partial digestion and absorption into unidentifiable mass. Kuttiyamma (1974) did not find any marked difference in the stomach content of size group of *Penaeus monodon* from Madras. Thomas (1980) did not find any changes in the feeding habits of *P. semisulcatus* in different size group. In the preset study analysis of gut contents in respect of the different size group did not show any significant changes in the food and feeding habits of *H. harpax*. The above authors also revealed that the gut contents of both males and females of this species are similar.

The non parametric spearmen rank correlation coefficient for the sex-wise comparison of occurrence, numerical, volume, stomach fullness, index of preponderance and index of relative importance of various food items did not reveal significant difference ($p > 0.05$) in their feeding preference in the present study.

The present study concluded that the fish and crustaceans were the major food items *H. harpax* marine conditions.

Table 1: Month-wise percentage composition of stomach fullness of *H. harpax* during January – December 2009

Month	No of samples	Fullness	¾ Fullness	½ Fullness	¼ Fullness	Empty
JAN	67	23.88	7.46	10.45	4.48	53.73
FEB	61	21.31	11.48	13.11	11.48	42.62
MAR	111	-	0.90	12.61	9.91	76.58
APR	63	9.52	4.76	20.64	28.57	36.51
MAY	-	-	-	-	-	-
JUN	56	30.36	3.57	17.86	5.36	42.85
JUL	38	2.63	-	36.84	-	60.53
AUG	48	35.42	4.17	20.83	6.25	33.33
SEP	27	-	18.52	18.52	18.52	44.44
OCT	32	12.50	3.12	21.88	21.87	40.63
NOV	63	9.52	12.7	17.46	19.05	41.27
DEC	20	15.00	10.00	25.00	20.00	30.00

Table 2: Month-wise index of preponderance of different food items in gut of *H. harpax* in relation to season during January - December 2009

Month	Fish	Crustaceans	Cephalopods	Sand	Digested matter	Polychaetes	Plant material	Molluscans	Echinoderms
JAN	31.02	41.30	0.90	9.73	1.57	1.52	3.24	0.53	10.19
FEB	32.30	36.13	19.29	5.95	2.70	0.47	2.76	0.12	0.28
MAR	25.28	26.58	5.60	41.84	0.20	-	-	0.10	0.40
APR	34.95	32.42	19.43	7.51	1.44	0.28	2.98	0.33	0.66
MAY	-	-	-	-	-	-	-	-	-
JUN	91.68	1.71	2.48	0.07	4.06	-	-	-	-
JUL	67.68	19.18	7.27	1.10	3.74	-	0.92	-	0.11
AUG	92.43	1.46	2.12	0.12	3.87	-	-	-	-
SEP	56.81	24.81	16.08	-	-	1.53	-	-	0.77
OCT	10.57	52.88	22.22	9.98	1.04	0.52	2.08	0.09	0.62
NOV	12.61	46.98	24.81	9.38	2.18	1.18	1.75	0.02	1.09
DEC	15.32	29.29	36.18	9.20	2.87	2.45	3.06	0.61	1.02

Table 3: Length-wise index of preponderance of different food items in gut of *H. harpax* during January - December 2009

Length	Fish	Crustaceans	Cephalopods	Sand	Digested matter	Polychaetes	Plant material	Molluscans	Echinoderms
81-100	72.73	18.18	-	-	9.09	-	-	-	-
101-120	87.70	3.03	7.88	0.24	1.03	0.03	0.03	0.06	-
121-140	50.41	25.72	6.65	8.53	3.94	1.95	1.91	0.62	0.27
141-160	55.34	23.85	14.58	4.51	0.67	0.41	0.47	0.15	0.02
161-180	29.70	34.26	14.34	12.82	2.16	2.85	2.55	1.13	0.19
181-200	15.00	38.33	10.00	33.33	-	0.84	0.83	0.84	0.83

Table 4: Month-wise index of relative importance of different food items in gut of *H. harpax* in relation to season during January - December 2009

Month	Crustaceans	Fish	Cephalopods	Plant material	Polychaetes	Molluscans	Echinoderms
JAN	62.92	22.01	0.64	10.91	2.30	0.90	0.32
FEB	65.08	24.44	6.93	0.37	2.65	0.43	0.10
MAR	69.77	27.25	2.48	0.41	-	-	0.09
APR	65.38	26.64	4.79	0.57	2.25	0.19	0.18
MAY	-	-	-	-	-	-	-
JUN	11.07	88.06	0.87	-	-	-	-
JUL	37.99	57.81	3.29	0.19	0.72	-	-
AUG	10.06	89.11	0.83	-	-	-	-
SEP	42.63	50.94	4.72	0.91	-	0.80	-
OCT	80.48	13.97	2.91	0.37	1.73	0.50	0.04
NOV	83.68	8.52	5.24	0.72	1.15	0.68	0.01
DEC	63.65	21.34	7.48	1.69	3.33	1.97	0.54

Table 5: Length-wise index of relative importance of different food items in gut of *H. harpax* during January - December 2009

Length (mm)	Crustaceans	Fish	Cephalopods	Plant material	Polychaetes	Molluscans	Echinoderms
81-100	43.36	56.64	-	-	-	-	-
101-120	8.86	65.61	23.65	0.43	0.58	0.87	-
121-140	25.46	46.14	15.10	4.63	3.90	2.95	1.82
141-160	24.42	44.52	26.25	1.98	1.56	0.99	0.28
161-180	30.31	29.22	25.47	5.00	4.81	4.06	1.13
181-200	45.49	20.72	19.38	3.85	3.52	3.52	3.52

Fig 1. Percentage composition of food items in guts of *H. harpax* during January - December 2009

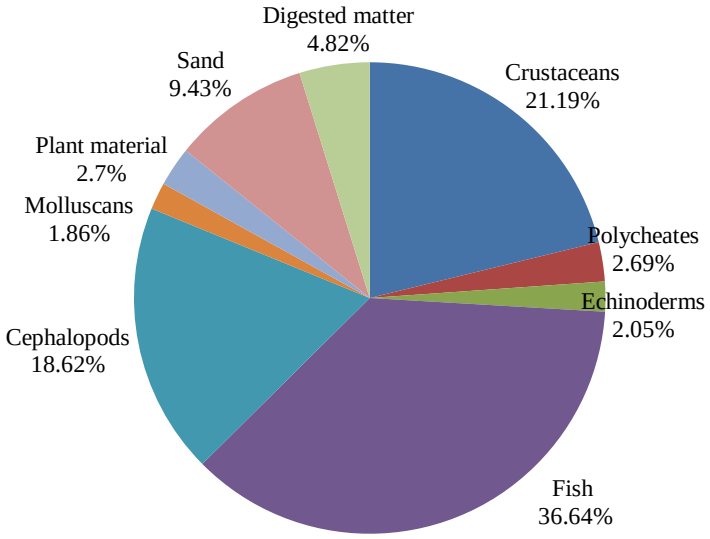


Fig 2. Index of preponderence of different food items in guts of *H. harpax* during January - December 2009

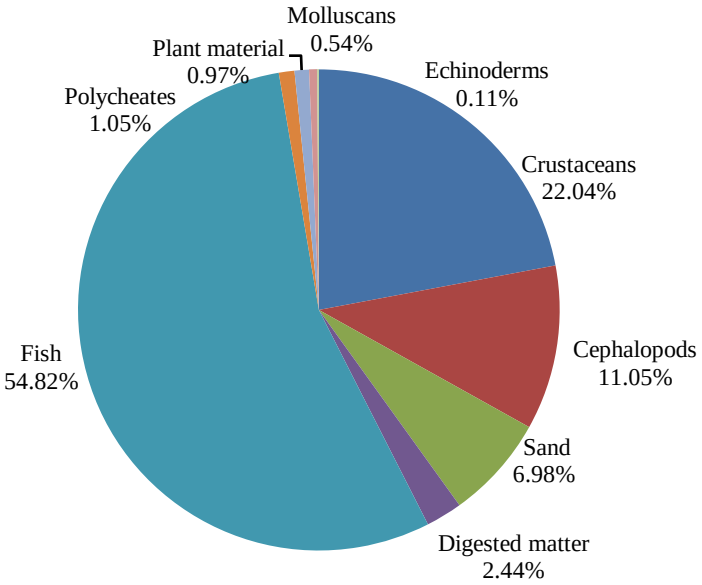
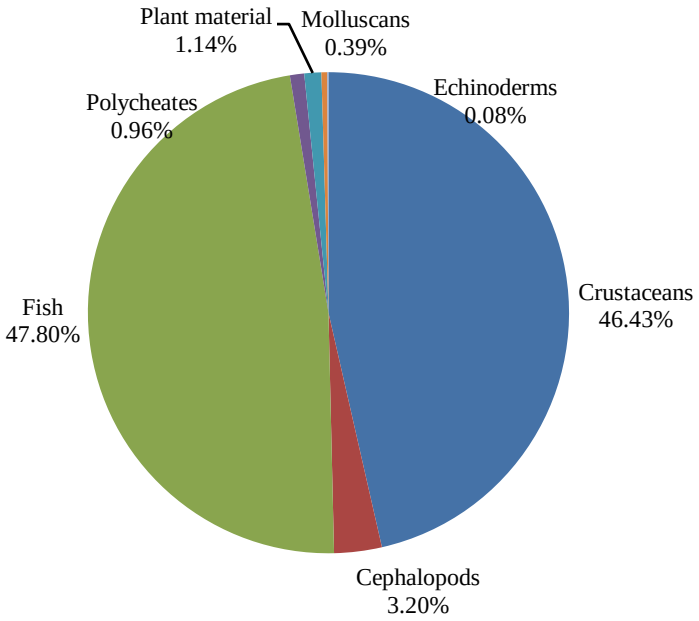


Fig 3. Index of relative importance of different food items in guts of *H. harpax* during January - December 2009



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