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Studies on food and feeding habits of *Oratosquilla anomala* (Tweedie, 1935) (Crustacea: Stomatopoda) represented in the shrimp trawl net by-catches off Visakhapatnam, east coast of India

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ABSTRACT

Oratosquilla anomala is a carnivore, feeding on fishes, crustaceans, cephalopods, plant material, polychaetes, molluscans, and echinoderms in the order of importance. The index of preponderance and index of relative importance was found to be higher during monsoon season as compared to other seasons. Nature of food does not vary with the length groups. There is no marked difference in food composition between males and females.

Key words: *Oratosquilla anomala,* Food and feeding, Index of preponderance, Index of relative importance.

INTRODUCTION

Oratosquilla anomala commonly called as 'mantis shrimps' or 'Squilla'. There are 412 species known to inhabit the world oceans and seas [1]. Of which, 97 species inhabiting in Indo-Pacific region and about 54 species of stomatopods represented in the seas around India [7, 8]. In India, especially in Andhra Pradesh, stomatopods are non-target species incidentally or accidentally caught by benthic trawl operations. They are treated as by-catch, not used for human consumption 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 [4]. Stomatopods are laded in considerable quantities in almost all maritime states of India. *O. anomala* an important component of by-catch of the shrimp trawl at Visakhapatnam fishing harbour [16]. In this paper, qualitative and quantitative analysis of stomach contents of *O. anomala* were presented according to season, size and sex.

MATERIALS AND METHODS

For the study of food and feeding habits, a total of 703 specimens consisting of males and females of length range from 54-119mm TL were collected from trawl net by-catches landed at Visakhapatnam fishing harbour (Lat. 17º 41' N Long: 83º 18 ' E) during the period 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, one fourth, half, three fourth and full could be recognized based on the nature of stomach folds [13], and numerical values of 0, 25, 50, 75 and 100 were assigned respectively to the above

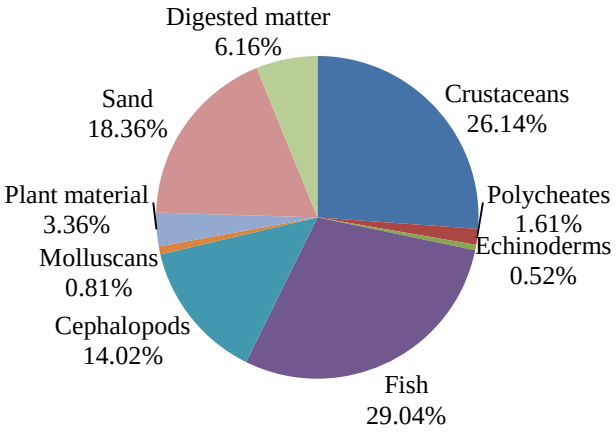
categories. The values obtained by all the stomachs examined were averaged according to season, length and sex of the mantis shrimp.

The mantis shrimps are grouped into actively fed (full and 3/4th full stomachs), moderately fed (1/2 full), poorly fed (1/4th full) 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 [3]. The index of preponderance proposed by [10] and index of relative importance proposed by [12] 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 [17] were also calculated for sex-wise comparison of occurrence, number, volume, index of preponderance and index of relative importance.

RESULTS

Composition of food: Regular food items in the order of importance (overall % composition from Jan to Dec 2009) were fish, crustaceans, sand, cephalopods, digested matter, plant material, polychaetes, molluscans, and echinoderms represented in guts of *O. anomala* off Visakhapatnam (Figure 1).

Figure 1: Percentage composition of food items in gut of *O. anomala* during January – December 2009



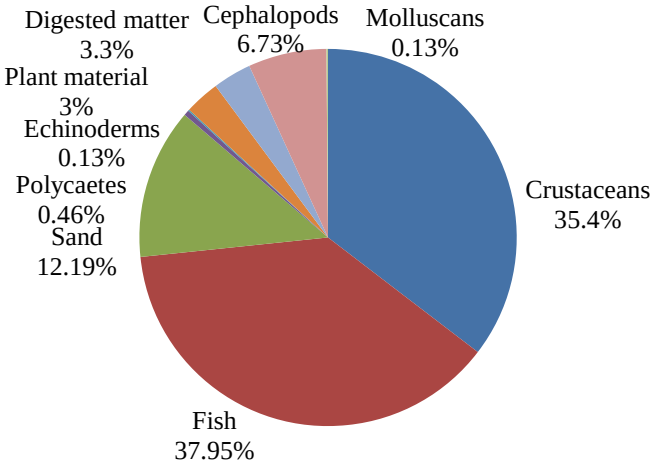
Active feeding was found in individuals from Jul to Jun. Moderate feeding was observed from Sep to Oct and poor feeding was observed from Nov to Sep. The empty stomachs were dominant during almost all months except Jun and Sep (Table 1). The average amount of feeding indicated that the *O. anomala* feed actively during post-monsoon followed by monsoon and pre-monsoon.

Table 1: Month-wise percentage composition of stomach fullness of *O. anomala* during January - December 2009

Month	No. of. Samples	Full	¾ full	½ full	¼ full	Empty
Jan	89	4.49	8.99	6.74	19.10	60.68
Feb	109	2.75	3.67	8.26	14.68	70.64
Mar	111	9.01	8.11	15.32	13.51	54.05
Apr	50	8.00	4.00	18.00	22.00	48.00
May	-	-	-	-	-	-
Jun	38	36.84	13.16	13.16	15.79	21.05
Jul	50	2.00	2.00	12.00	26.00	58.00
Aug	51	15.69	17.65	7.84	-	58.82
Sep	52	1.92	5.77	5.77	44.23	42.31
Oct	48	4.17	6.25	25.00	16.67	47.91
Nov	62	11.29	4.84	14.52	9.68	59.67
Dec	43	11.63	11.62	16.28	20.93	39.54

Index of preponderance (IP):
Fish ranked first, among the food items with index of preponderance (37.95) followed by Crustaceans (35.40), sand (12.90), cephalopods (6.73), digested matter (3.30), plant material (3.00), polychaetes (0.46), molluscans (0.13) and echinoderms (0.13) (Figure 2).

Figure 2: Index of preponderance of different food items in gut of *O. anomala* during January - December 2009



Seasonal variations in the index of preponderance of various food items were represented (Table 2). Fishes were the most preferred food item in throughout period of investigation. The high index value was observed during Jul (77.16) and Oct (49.24). Crustaceans were the second important food item, gained high index value during Jun (73.58). The maximum index value of sand was observed during Nov (21.39). The maximum index value of cephalopods was observed during Mar (27.7). The maximum index value of digested matter was observed during Apr (17.77). The maximum index value of plant material was observed during Jun (20.44). The maximum index value of polychaetes was observed during Aug (1.74). The maximum index value of molluscans was observed during Jun (0.84) and echinoderms in Aug (1.52).

Table 2: Month-wise index of preponderance of different food items in gut of *O. anomala* during January - December 2009

Month	Fish	Crustaceans	Cephalopods	Plant material	Polychaetes	Molluscans	Echinoderms	Sand	Digested matter
Jan	37.32	48.40	3.72	4.45	0.02	0.18	-	5.91	-
Feb	44.01	33.57	1.09	3.29	0.35	0.02	0.02	17.65	-
Mar	34.72	18.18	27.70	0.19	0.40	0.02	0.01	16.75	2.03
Apr	10.66	49.32	0.79	3.85	0.40	0.27	0.03	16.91	17.77
May	-	-	-	-	-	-	-	-	-
Jun	1.55	73.58	0.17	20.44	0.51	0.84	-	2.91	-
Jul	77.16	13.67	-	0.89	-	-	-	5.75	2.53
Aug	28.88	32.16	12.83	1.12	1.74	0.23	1.52	9.82	11.70
Sep	41.69	42.93	2.78	0.87	-	0.05	-	11.68	-
Oct	49.24	18.07	14.83	3.09	1.44	0.05	0.31	11.12	1.85
Nov	28.39	34.14	11.45	0.37	0.71	0.08	0.05	21.39	3.42
Dec	24.04	43.19	6.30	0.40	0.55	-	-	21.14	1.38

Length-wise variations of different food items were represented (Table 3). Fish was the most preferred food item in almost all length groups. Crustaceans were dominated in the gut contents at length group 91-100mm TL (41.57).

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

Index of relative importance (IRI):
Index of relative importance of different food items in gut of *O. anomala* during Jan to Dec 09 results were presented (Figure 3). Seasonal variations of various food items were presented (Table 4). Length-wise variations of different food items were presented (Table 5).

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

Length (mm)	Fish	Crustaceans	Cephalopods	Plant material	Polychaetes	Molluscans	Echinoderms	Sand	Digested matter
61-70	43.47	33.90	2.82	2.37	0.26	0.04	0.14	13.53	3.47
71-80	36.39	34.39	7.94	1.03	0.60	0.05	0.05	17.16	2.39
81-90	41.66	36.20	4.74	1.93	0.28	0.31	0.01	14.33	0.54
91-100	7.31	41.57	6.61	1.12	0.29	-	-	42.22	0.88
101- 110	-	-	-	-	-	-	-	-	-
111-120	65.00	20.00	-	10.00	-	-	-	-	5.00

Figure 3: Index of relative importance of different food items in gut of *O. anomala* during January - December 2009

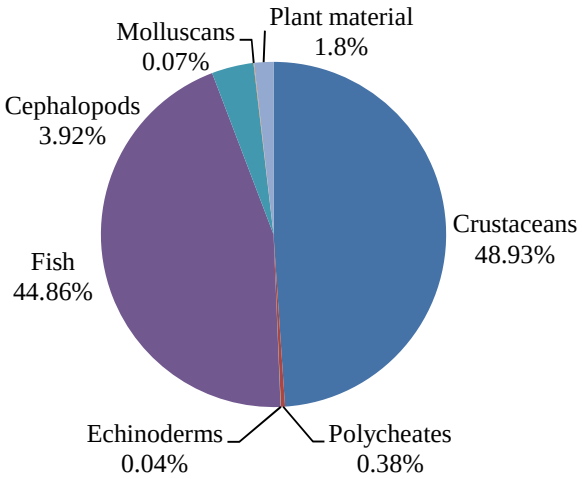


Table 4: Month-wise index of relative importance of different food items in gut of *O. anomala* during January - December 2009

Month	Fish	Crustaceans	Cephalopods	Plant material	Polychaetes	Molluscans	Echinoderms
Jan	27.99	68.12	1.72	2.07	0.01	0.09	-
Feb	43.89	52.22	0.56	3.07	0.22	0.02	0.02
Mar	43.06	40.84	15.52	0.21	0.34	0.02	0.01
Apr	14	81.79	0.41	3.38	0.25	0.15	0.02
May	-	-	-	-	-	-	-
Jun	17.03	72.8	0.07	9.38	0.42	0.3	-
Jul	63.56	35.82	-	0.62	-	-	-
Aug	24.75	62.35	8.22	1.78	1.61	0.19	1.1
Sep	22.1	75.83	1.37	0.66	-	0.04	-
Oct	44.07	38.52	10.31	5.24	1.45	0.05	0.36
Nov	37.3	56.29	5.46	0.44	0.44	0.04	0.03
Dec	25.46	70.71	3.1	0.34	0.39	-	-

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

Length (mm)	Fish	crustaceans	Cephalopods	Plant material	Polychaetes	Molluscans	Echinoderms
61-70	26.86	57.33	2.96	10.34	1.05	0.76	0.70
71-80	24.12	65.95	2.40	5.48	1.03	0.54	0.48
81-90	28.45	54.74	4.08	10.25	1.08	1.00	0.40
91-100	25.40	62.54	6.83	3.69	1.54	-	-
101-110	-	-	-	-	-	-	-
111-120	58.97	35.90	-	5.13	-	-	-

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 = 0.85), numerical (r_s = 0.9643), volume (r_s = 0.9917), stomach fullness (r_s = 0.90), index of preponderance (r_s = 0.95) and

index of relative importance (r_s = 0.79) respectively of various food items did not reveal significant difference (p › 0.05) in their feeding preference.

DISCUSSION

Kubo *et al*., [5] indicated that *Oratosquilla oratoria* of Tokyo Bay predates more on crustaceans and Pisces than molluscans. Nasima and Qudusi [9] reported in *O. oratoria* in Pakistan waters crustaceans were the main diet. Hamano and Matsuura [2] 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*., [11] 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. Cephalopods were the one of the important food item to *O. anomala*.

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 [15] 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 [6] did not find any marked difference in the stomach content of size group of *Penaeus monodon* from Madras. Thomas [14] 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 *O. anomala*. 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. The average amount of feeding indicated that feed actively during post-monsoon in *O. anomala*.

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

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