Journal of Aquaculture Research & Development

Priyadharsini et al., J Aquac Res Development 2013, 4:4
DOI: 10.4172/2155-9546.1000184

Research Article Open Access

Food and Feeding Habits of Red Lionfish *Pterois volitans* from Cuddalore Coast, South East Coast of India

Priyadharsini S[1]*, Subramaniyan A[1], Manoharan J[2] and Varadharajan D[2]

[1]*Faculty of Science, Department of Zoology, Annamalai University, Tamil Nadu, India*
[2]*Faculty of Marine Sciences, Centre of Advanced Study in Marine Biology, Annamalai University, Tamil Nadu, India*

Abstract

The living water jewels have an attractive colored for example a body color, morphology, mode of taking food and have a peculiar characteristic. A number of aquarium fishes the Pterois sp is known to aquarists, while it is easy to breed and very important and interesting tasks of an aquarium keeper is to feed management. Food is playing an important role in maintaining health and preventing diseases. Providing exact diet is essential for fish growth and other activities. Overfeeding or uneaten food contributes to a deteriorating water quality by polluting the water. Some fishes in wild or culturing system are not taken regularly same food and it will be varying due to the inhabitants. The red firefish *P. volitans* is one of the remarkable fish in marine waters. In the present study, the food and feeding habits of lionfish P.volitans, male and female fishes were observed and due to fishes gut contents were analysis. The different food items were recorded from the guts of *P. volitans* during the study period. Generally, the food items found in the examined gut contents were grouped into eleven different categories. The male fish of *P. volitans* stomach contents as identified feed compositions in the following order: viz., Crustaceans >Fish >Zooplankton >Phytoplankton >Miscellaneous >Bivalves >Polychaetes >Gastropods >sand >Nematodes >Digested matter and the female fish of *P. volitans* stomach contents as identified feed compositions in the following order viz., Crustaceans >Fish >Zooplankton >Phytoplankton >Miscellaneous >Bivalves >Polychaetes >Gastropods >Sand >Nematodes >Digested matter, respectively. The present investigation very much useful for this species to be taken up for aquariums in home or office, hotel, hospital, intensive, semi intensive and mass scale culture practices in anywhere in the world.

Keywords: Scorpaenidae; *P. Volitans*; Ultimate world history; Food and feeding habits

Introduction

The food and feeding habits of fishes attracted the attention of fishery biologist from time immemorial. Foods are a key element for the fishes and the maintaining throughout its life span and their future activities [1-3]. It is extremely important that in derived energy is utilized in many important ways; they help us to grow, become stronger, give us energy, survival and reproduction for all the metabolic activities, cell repair, muscular contractions secretory functions, nerve impulse conduction and build up a stronger immune system and to repair old damaged cells and also the maintenance of proper health [4-10]. Most the fishes have become adapted to a wide variety of food. The knowledge about food and feeding habits of any fishes is important because very much useful for understanding the biology of fishes and have been established and the rate of feeding is stimulating on the spawning of the fish [10,11]. The availability of food in fishes it may be influencing the horizontal and vertical movements of the fish stocks. Food and feeding of different ornamental fishes are being studied throughout the world viz., Kader et al. [12] has a *Gobioides rubicundus* from Bangladesh, Priyadharsini et al. [13] has a D*ascyllus trimaculatus* from Gulf of Mannar, Rema Madhu et al. [14] has an ornamentals fish from Mandapam. Morris JA et al. [15] described lionfish as generalist carnivores that feed on a wide variety of fishes and crustaceans. Visual observations of lionfish on invading reefs indicate that lionfish consume prey at high rates, largely during crepuscular periods [16]. Daily patterns of lionfish behaviour appear to be consistent with reports from the native range, with the species most active and foraging out over habitat during low-light crepuscular periods during dawn and dusk [16]. Though consistent with the longish behavior in the native Indo-Pacific, their hunting strategy is largely unique among fish predators in the Caribbean. Lionfish hover motionless over prey with their large pectoral fins extended and are able to approach their prey closely before making a rapid strike. Sometimes, lionfish extrude water jets to orient the prey towards the mouth before striking [17]. Preys are typically consumed whole. During the day, lionfish are often found resting and sheltered under ledges and overhangs, associated with large high-relief structures within the habitat [16,18]. Ambient light levels may significantly affect temporal patterns of lionfish behaviour. Observations of lionfish under variable weather conditions found that activity levels and predation rates during the day were significantly higher during overcast times, when light levels may simulate those of crepuscular dawn and dusk periods [19].

The analysis of the gut content provides necessary information regarding their feed preference in the wild and this will be helpful in establishing a diet for faster growth and reproduction in the culture systems and the fishes and food organism in between relationship is essential for the production and exploitation of the fish stocks. In this relationship have been used for the fishery exploited, due to account and the diversity of the species in a particular region of total fishery. The redfirefish *P. volitans* is a vital source of food for people and are significantly benefitting of social and economic importance. Most people hobby is often concerned about keeping *P. volitans* an aquarium.

***Corresponding author:** Priyadharsini S, Faculty of Science, Department of Zoology, Annamalai University, Tamil Nadu, India, E-mail: priyamano.zoo@gmail.com

Received March 15, 2013; **Accepted** March 24, 2013; **Published** June 04, 2013

Citation: Priyadharsini S, Subramaniyan A, Manoharan J, Varadharajan D (2013) Food and Feeding Habits of Red Lionfish *Pterois volitans* from Cuddalore Coast, South East Coast of India. J Aquac Res Development 4: 184 doi:10.4172/2155-9546.1000184

Maintenance of healthy aquarium proper feeding is essential and plays a vital role in a particular region. While, the more important to study the food and feeding habits of lion fishes because this helps in mass scale culture and this in turn helps in the conservation of this exotic fish. Hence, the present study has been undertaken to gather information concerning the food and feeding habits of *P. volitans.*

Materials and Methods

By using trawl nets the specimens were collected randomly at Cuddalore coast during between January 2012 and December 2012. After collection, the fishes were stored in ice boxes and the stomachs were removed and fixed 10% buffered formalin. The stomach contents were later analyzed in the laboratory. Immediately after the collection the standard length of the fishes was recorded before removing the gut. They were split open by a pair of scissors. After dissecting of the alimentary system, different components of the guts were recorded with the help of zoom dissection binocular microscope. The food items were identified up to the family level wherever possible [13,20]. During the analysis, regurgitated stomach was discarded [21]. Occurrence method is the simplest way of recording the food relating to the number of gut containing one or more individuals of each food item and number were expressed as percentage of all guts those containing food. This method gave the information on the preference of food items [13,20,22].

Results

The *P. volitans* stomach contents of the available specimens during the study period are presented in Table 1. A total of eleven different food components were recorded in the gut of *P. volitans*, showing a varying numerical abundance and relative percentage abundance. The stomach contents were recorded the different food materials namely Crustaceans, Fish, Polychaetes, Nematodes, Zooplankton, Phytoplankton, Bivalves, Gastropods, Sand, Digested matter and Miscellaneous (Tables 1-4 and Plate 1).

Crustaceans

Crustaceans are one of the most important foods of *P. volitans* occurring in more than 68% of the stomachs during the study periods. The male stomach examined specimens maximum in crustaceans 34.2% was recorded in the month of August followed by 26.3% in June and minimum was 17.1% in the month of July (Figures 1-12). The female highest percentage recorded was 52.6% in the month of June followed by 51.1% in December and the lowest percentage recorded was 34.3% in the month of July (Figures 13-24). Crustaceans formed the most important food item of *P. volitans* both the males and females and they occurred in the stomachs throughout the year (Plate 2).

Fish

The fish was the most important diet of *P. volitans* in the marine ecosystem, which contributed 63.3% of the total food ingested (Table 2). The examined stomachs its observed maximum in throughout the year. The male maximum percentage occurrence of fish 24.7% was recorded in the month of June followed by 23.1% in January and 22.7% in March and the minimum percentage occurrence of fish 18.2% was recorded in the month of April and 18.5% in July and 19.1% in December (Figure1-12). The female maximum percentage occurrence of fish 49.4 was recorded in the month of June followed by January to March. The minimum 36.4% was recorded in the month of April and 37.0% in July and 38.2% in December (Figures 13-24 and Plate 3).

Polychaetes

The next important food items, which were ingested by most *P. volitans*, were polychaetes (28.7%). It was occurred the examined stomachs of *P. volitans* in throughout the year. The male maximum percentage occurrence of polychaetes recorded was 21.6% in September and 10.9% in July. The minimum was recorded 5.93% in the month of January (Figure1-12). The female maximum percentage occurrence of polychaetes recorded was 43.3% in October and 21.9% in July and minimum was recorded 11.8% in November and 13.0% in September (Figures 13-24). The polychaetes were observed that in summer the maximum of stomachs was having only tube-dwelling polychaetes in them (Plate 4).

Nematodes

The examined stomachs can be observed that nematodes formed the most important food item of *P. volitans* during the study period. The male maximum percentage occurrence of nematodes recorded was 3.46% in April and 10.8% in May and minimum was recorded 5.7% in December (Figure 1-12). The female maximum percentage occurrence of nematodes recorded was 21.6% in the month of May and 18.4% in July and minimum was recorded 11.9% in the month of December and 13.2% in October (Figures 13-24 and Plate 5).

Zooplankton

Zooplanktons were the most important diet of *P. volitans*, it was observed throughout the year during the study period. The male maximum percentage occurrence of zooplankton recorded was 19.7% in the month of August and 19.0% in December. The minimum was recorded 16.2% in the month of February and 16.4% in March (Figures 1-12). The female maximum percentage occurrence of zooplankton recorded was 39.4% the month of August and 38.0% in December. The minimum was recorded 32.4% in the month of February and 32.8% in March (Figures 13-24 and Plate 6).

Phytoplankton

It's formed the significantly are an important item of food of both the males and females of *P. volitans*, occurred in the stomachs throughout the year. This food constituent was dominant between post monsoon and monsoon. The male maximum percentage occurrence of phytoplankton recorded was 15.3% in the month of March and 15.2% in January. The minimum was recorded 12.5% in the month of April (Figures 1-12). The female maximum percentage occurrence of phytoplankton recorded was 30.53% in the month of March and 30.33% in January. The minimum was recorded 25.0% in April (Figures 13-24 and Plate 7).

Bivalves

Its young stages, shells and larvae were observed in the examined stomach off *P. volitans*. The male average contribution was 10.98% of the food composition. The maximum of 20.9% in the month of June and minimum value of 8.43% was recorded in the month of March (Figures 1-12). The female average contribution was 21.9% of the food composition. The maximum of 41.8% in the month of June and minimum value of 16.87% was recorded in the month of March (Figure 13-24 and Plate 8).

Gastropods

Gastropods were the most important diet components of *P. volitans.* The male percentage occurrence of this group was found to be high in

S:No	Food item	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
I	**Crustaceans**												
1	Shrimps	5.8	8.5	6.5	5.8	10.2	6.8	5.2	5.6	5.6	7.5	8.5	14.5
2	Crab	4.2	4.8	8.5	6.9	6.8	5.6	3.6	6.5	6.8	6.3	5.6	10.2
3	Small prawn	5.7	5.7	6.9	7.5	5.9	4.5	4.2	4.5	7.1	8.2	6.9	8.5
4	Isopods	8.4	8.5	5.8	5.6	6.7	5.6	2.6	7.6	5.6	1.5	8.2	7.6
5	Amphipods	5.9	6.5	7.3	7.9	5.6	5.9	5.8	8.2	6.9	5.8	6.5	5.8
6	Tannaids	8.7	5.9	7.5	8.4	7.4	6.5	10.3	6.3	5.8	6.5	7.01	6.3
7	Mysids	9.1	8.5	4.6	9.8	5.6	6.2	6.5	5.9	5.6	7.5	8.2	5.1
8	Lucifer	8.5	7.9	5.4	8.4	4.6	14.5	2.5	6.1	4.6	5.3	7.6	5.6
9	Copepods	5.8	8.5	5.3	5.7	3.6	13.2	4.5	5.8	5.9	6.2	7.9	7.5
10	Egg and Larva	9.5	10.2	6.5	6.9	5.8	10.2	6.3	5.6	6.2	13.2	8.2	5.6
II	**Polychaetes**												
1	*Armandia sp*	2.6	2.5	4.5	2.8	1.7	5.2	5.2	2.3	2.4	2.6	3.2	6.3
2	*Capitella sp*	7.5	2.8	3.2	3.7	1.8	3.2	2.4	2.4	8.5	2.5	2.4	5.4
3	*Cossura sp*	3.6	3.1	1.5	2.9	1.6	2.7	1.6	1.9	7.9	2.4	2.6	2.5
4	*Eunice sp*	4.5	1.5	1.9	2.4	1.5	2.5	2.6	1.5	8.5	1.9	2.5	1.6
5	*Glycera sp*	2.6	1.6	1.5	2.6	1.2	1.9	2.5	1.2	6.5	1.8	2.4	1.4
6	*Hesione sp*	2.3	2.5	1.4	1.8	1.4	2.8	3.2	2.5	7.5	1.4	2.3	2.5
7	*Magalona sp*	1.8	4.3	2.1	1.4	1.6	2.3	2.5	2.4	6.3	1.2	1.9	2.3
8	*Nephtys sp*	1.5	2.6	2.3	1.5	2.8	2.5	3.2	1.6	5.8	1.3	2.3	3.2
9	*Onuphis sp*	1.2	4.5	2.5	2.6	2.4	4.3	2.5	1.8	6.1	1.2	3.2	3.6
10	*Ophelia sp*	1.3	2.3	2.6	2.8	2.3	5.5	1.5	1.9	5.7	1.5	4.1	3.6
III	**Nematodes**												
1	*Astomonema sp*	2.3	1.9	1.8	2.5	3.2	2.7	3.2	1.8	3.2	1.5	3.2	2.5
2	*Daaptonema sp*	1.5	2.5	1.69	3.2	3.1	2.6	3.6	1.6	2.4	1.6	2.5	2.3
3	*Desmodora sp.*	1.6	2.3	2.7	1.4	2.9	2.5	3.4	5.7	2.6	1.2	2.3	3.2
4	*Draconema sp*	1.8	2.4	2.3	3.5	2.8	2.3	2.8	2.85	2.5	1.4	4.2	1.8
5	*Quadricoma sp*	1.4	1.7	2.4	2.6	2.4	2.1	2.96	3.2	1.8	1.6	3.2	1.5
6	*Steineria sp.*	1.2	1.5	2.6	2.8	3.6	1.8	2.4	2.7	1.6	2.5	2.6	1.2
7	*Theristus sp*	2.3	1.6	2.8	3.2	3.5	1.9	2.5	1.8	1.8	2.4	2.5	1.3
8	*Tricoma sp*	2.5	3.2	3.1	2.3	3.8	1.5	2.6	1.6	1.5	2.3	2.3	1.6
9	*Vasostoma sp*	2.8	2.5	3.2	3.2	3.5	1.2	2.3	1.4	1.4	2.4	2.1	1.2
10	*Viscosia sp*	2.7	2.1	4.1	2.5	3.7	1.7	1.8	1.5	1.3	2.9	2.6	1.3
IV	**Fish**												
1	Apogonidae	1.9	2.3	1.3	1.4	1.8	3.2	2.6	1.6	3.5	4.5	1.8	2.4
2	Atherinidae	2.3	1.6	2.3	1.3	1.6	1.21	2.4	2.3	2.6	2.1	2.1	1.5
3	Aridae	4.1	1.4	2.4	2.3	1.5	2.3	2.3	1.4	2.4	3.2	3.6	1.4
4	Blenniidae	1.2	1.23	2.8	2.4	2.1	1.8	1.5	2.3	1.6	1.5	2.4	1.5
5	Carangidae	1.3	1.6	3.2	1.5	2.3	1.6	1.4	2.5	1.5	1.8	1.6	3.2
6	Centropomidae	3.6	3.5	3.1	1.6	2.8	1.2	1.02	2.1	1.6	1.5	1.8	1.4
7	Channidae	1.3	2.4	4.1	1.5	3.1	2.1	3.2	2.6	1.4	1.6	1.9	1.6
8	Chirocentridae	4.1	2.6	2.3	2.4	3.5	2.3	2.05	2.8	1.9	1.4	2.1	1.5
9	Clupeidae	1.6	1.8	2.1	1.8	3.6	2.5	1.8	2.7	1.5	1.02	2.5	1.2
10	Cyprinidae	1.5	1.7	2.5	1.6	3.2	2.7	1.5	2.4	2.1	2.3	2.3	1.7
11	Engraulidae	1.8	2.3	3.1	1.4	4.1	3.1	1.4	2.5	2.3	2.4	2.4	2.1
12	Exocoetidae	5.8	2.6	4.3	1.3	2.6	2.6	2.3	1.6	2.5	2.1	2.6	2.6
13	Gobiidae	1.3	1.8	2.6	2.3	2.7	3.1	2.1	1.54	2.4	1.6	3.1	2.5
14	Grammatidae	1.7	1.9	1.7	1.7	2.3	3.5	2.4	1.4	2.6	1.4	2.9	2.4
15	Hemiramphidae	2.5	2.3	1.3	1.8	1.8	3.2	1.7	1.6	2.8	1.5	2.5	2.3
16	Labridae	3.9	2.4	1.8	2.6	3.5	3.6	1.5	2.5	1.8	1.6	2.3	2.5
17	Leiognathidae	1.6	2.1	1.3	1.7	2.6	3.4	1.6	2.3	1.5	1.8	2.1	2.1
18	Lutjanidae	2..8	2.8	1.2	1.3	2.1	3.2	1.5	2.7	1.4	2.3	2.3	1.9
19	Mugilidae	3.6	3.1	2.3	1.4	2.8	4.1	1.3	3.1	1.6	2.1	2.4	1.7
20	Mullidae	1.2	2.7	2.1	2.1	2.7	2.8	2.1	2.4	1.3	2.5	1.8	1.6
21	Scombridae	1.3	3.1	2.4	1.6	2.3	1.7	2.3	1.5	1.7	2.6	1.6	1.3
22	Serranidae	1.5	2.56	1.8	1.3	1.8	1.3	2.5	1.8	1.6	2.4	1.5	1.5
23	Stromateidae	3.4	2.3	1.4	2.5	1.6	2.5	2.4	1.6	1.2	2.58	1.4	1.4
24	Scaridae	3.2	1.8	1.9	1.7	1.7	2.4	1.6	1.5	1.3	2.8	1.2	2.1
25	Sciaenidae	2.6	1.9	1.23	1.6	1.3	1.4	1.5	1.2	2.1	2.3	1.3	2.8
26	Teraponidae	2.1	1.2	1.3	1.4	1.4	2.3	1.8	1.3	2.3	1.7	1.21	2.1

27	Triacanthidae	2.4	3.2	2.6	1.6	1.5	3.1	1.9	2.1	2.5	1.6	1.4	2.3
28	Fish eggs	3.1	2.1	2.8	2.4	2.4	2.6	1.2	2.5	2.4	1.8	1.6	1.7
29	Fish larvae	1.5	2.5	3.5	2.8	1.3	1.5	1.3	1.7	2.1	1.6	1.5	1.6
30	Fish scales	1.9	3.2	1.5	2.3	1.4	1.9	1.4	2.3	2.3	1.5	1.3	1.5
V	**Zooplankton**												
1	*Acartia sp*	3.5	4.5	5.8	4.7	5.8	5.9	4.5	4.6	5.8	5.6	5.2	5.3
2	*Canuella sp*	4.5	4.2	4.6	5.3	6.2	5.4	5.6	5.7	6.1	5.9	5.1	5.6
3	*Cervinia sp*	6.5	6.2	6.5	5.5	3.5	5.9	3.45	3.6	3.4	3.6	3.8	3.9
4	*Diarthrodes sp*	5.8	5.6	4.8	4.7	4.5	6.5	3.5	5.8	5.4	5.2	5.6	6.1
5	*Eucalanus sp*	4.7	4.6	4.5	5.1	5.6	5.8	5.6	7.5	6.2	6.3	5.4	5.6
6	*Macrosetella sp*	3.5	5.7	5.6	5.8	5.9	6.2	6.5	6.3	4.7	5.8	5.6	6.8
7	*Microsetella sp*	5.5	5.4	5.6	6.5	6.4	5.6	5.8	6.5	6.4	6.3	5.8	5.98
8	*Oithona sp*	4.5	3.5	2.9	2.8	6.5	3.5	4.5	5.2	5.6	4.8	5.6	5.9
9	*Rhicalanus sp*	5.2	2.5	3.4	5.6	5.4	5.2	5.6	8.5	4.5	6.5	7.5	5.6
10	*Sagitta sp*	6.2	6.4	5.5	6.4	6.8	6.3	5.1	5.4	5.6	5.8	5.6	6.2
VI	**Phytoplankton**												
1	*Coscinodiscus sp*	5.4	5.3	4.8	5.6	6.5	4.5	5.8	6.5	3.5	4.8	5.6	6.2
2	*Cyclotella sp*	4.8	5.8	5.6	4.5	5.96	4.75	8.5	5.6	5.4	5.2	6.2	3.5
3	*Diploneis sp*	5.2	5.6	4.5	3.55	3.4	3.6	3.8	3.8	4.1	4.3	4.5	4.6
4	*Ditylum sp*	4.5	4.6	5.1	5.3	4.8	5.6	4.7	5.6	5.1	5.3	5.4	6.2
5	*Navicula sp*	5.7	5.6	5.4	6.5	6.4	6.3	5.9	5.7	5.8	5.6	5.1	4.5
6	*Odentella sp*	6.1	2.5	4.5	3.5	2.6	4.5	2.5	6.5	5.5	5.1	2.5	4.2
7	*Triceratium sp*	5.4	2.5	6.5	3.1	4.2	2.6	2.4	2.5	2.8	3.1	3.2	3.5
8	*Planktoniella sp*	3.9	3.5	4.1	2.8	2.5	2.6	2.78	2.4	3.6	3.5	3.4	3.5
9	*Thalassiosira sp*	4.5	4.3	5.3	2.6	5.1	4.5	4.3	5.6	3.5	4.1	3.1	4.2
VII	**Bivalves**												
1	*Arca sp*	3.5	3.4	2.5	4.5	4.1	4.3	4.6	5.1	6.3	6.1	6.2	6.5
2	*Anadara sp*	5.4	6.5	3.2	5.6	6.2	5.6	6.52	3.14	5.6	4.3	5.7	4.6
3	*Cardium sp*	4.7	5.8	6.1	5.69	5.1	6.5	4.6	5.6	5.4	6.5	5.9	6.2
4	*Meretrix sp*	3.5	4.8	5.6	6.5	5.6	4.8	6.5	7.5	6.5	6.2	4.5	5.8
5	*Pecten sp*	4.1	5.6	5.4	5.6	5.3	37	4.8	4.69	4.8	4.69	4.2	4.3
6	*Placenta sp*	5.4	6.5	2.5	3.5	4.1	4.5	3.5	2.3	5.4	4.65	4.5	2.9
VIII	**Gastropods**												
1	*Bullia sp*	2.8	2.6	2.4	5.2	3.2	4.5	4.6	3.9	6.5	5.8	5.4	5.6
2	*Cerithium sp*	1.5	4.5	3.5	4.6	5.6	3.7	3.5	8.5	4.6	6.5	2.5	3.9
3	*Cerethedia sp*	4.5	5.4	5.8	6.5	4.5	5.8	5.6	9.5	6.5	5.2	5.6	5.7
4	*Natica sp*	3.6	3.5	4.5	4.1	5.2	5.1	5.3	6.5	5.4	5.6	4.5	4.25
5	*Umbonium sp*	4.5	2.5	2.5	2.4	3.5	2.6	2.5	3.5	4.5	2.6	5.2	5.4
6	*Xancus sp*	2.6	2.4	3.1	2.6	2.4	2.3	2.4	3.1	2.6	2.7	3.4	3.1
IX	**Sand**												
		23.5	25.6	24.5	19.5	21.2	24.5	18.6	25.4	28	28.4	27.6	28.3
X	**Digested matter**												
		15.4	13.6	12.8	11.7	10.6	13.8	12.4	13.6	13	13.6	18.5	14.5
XI	**Miscellaneous**												
		41.5	53.1	45.8	38.6	34.5	29.5	31.5	35.6	40	41.5	43.5	48.5

Table 1: Different food items recorded from the stomachs of *P. volitans* (January-2012 to December-2012).

S:No	Food item	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Monthly average
1	**Crustaceans**	71.6	75	64.3	72.9	62.2	79	51.5	62.1	60	68	74.6	76.7	68.15
2	**Polychaetes**	28.9	27.7	23.5	24.5	18.3	32.9	27.2	19.5	65	17.8	26.9	32.4	28.71
3	**Nematodes**	20.1	21.7	26.7	27.2	32.5	20.3	27.6	24.2	20	19.8	27.5	17.9	23.79
4	**Fish**	69.3	67.99	68.2	54.6	69.4	74.2	55.6	61.8	60	61.1	60.5	57.4	63.34
5	**Zooplankton**	49.9	48.6	49.2	52.4	56.6	56.3	50.2	59.1	53.7	55.8	55.2	57	53.66
6	**Phytoplankton**	45.5	39.7	45.8	37.45	41.5	38.95	40.7	44.2	39.3	41	39	40.4	41.12
7	**Bivalves**	26.6	32.6	25.3	31.39	30.4	62.7	30.5	28.3	34	32.4	31	30.3	32.96
8	**Gastropods**	19.5	20.9	21.8	25.4	24.4	24	23.9	35	30.1	28.4	26.6	28	25.66
9	**Sand**	23.5	25.6	24.5	19.5	21.2	24.5	18.6	25.4	27.5	28.4	27.6	28.3	24.55
10	**Digested matter**	15.4	13.6	12.8	11.7	10.6	13.8	12.4	13.6	12.5	13.6	18.5	14.5	13.58
11	**Miscellaneous**	41.5	53.1	45.8	38.6	34.5	29.5	31.5	35.6	39.5	41.5	43.5	48.5	40.26

Table 2: Monthly Variation in the Percentage Composition of Food of Male and Female in *P. volitans* (January-2012 to December-2012).

S:No	Food item (Male)	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Monthly average
1	**Crustaceans**	23.8	25.0	21.4	24.3	20.7	26.3	17.1	34.2	20.7	20.0	24.8	25.5	22.71
2	**Polychaetes**	9.63	9.23	7.83	8.16	6.1	10.9	9.06	6.5	21.6	5.93	8.9	10.8	10.54
3	**Nematodes**	6.7	7.23	8.9	9.06	10.8	6.7	9.2	8.0	6.67	6.7	9.16	5.9	7.93
4	**Fish**	23.1	22.66	22.73	18.2	23.13	24.7	18.5	20.6	20.0	20.3	20.16	19.1	21.11
5	**Zooplankton**	16.6	16.2	16.4	17.5	18.87	18.8	16.7	19.7	17.9	18.6	18.4	19	17.88
6	**Phytoplankton**	15.2	13.2	15.3	12.5	13.82	13	13.6	14.7	13.1	13.7	13	13	13.70
7	**Bivalves**	8.87	10.9	8.43	10.5	10.13	20.9	10.2	9.44	11.3	10.8	10.3	10	10.98
8	**Gastropods**	6.5	6.97	7.27	8.47	8.133	8	7.97	11.7	10	9.47	8.87	9.3	8.55
9	**Sand**	7.83	8.53	8.17	6.5	7.067	8.17	6.2	8.47	9.17	9.47	9.2	9.4	8.18
10	**Digested matter**	5.13	4.53	4.27	3.9	3.533	4.6	4.13	4.53	4.17	4.53	6.17	4.8	4.52
11	**Miscellaneous**	13.8	17.7	15.3	12.9	11.5	9.83	10.5	11.9	13.2	13.8	14.5	16	13.42

Table 3: Monthly Variation in the Percentage Composition of Food of Male *P. Volitans* (January-2012 to December-2012).

S:No	Food item (Female)	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Monthly average
1	**Crustaceans**	47.7	50.0	42.8	48.6	41.4	52.6	34.3	41.4	40.0	45.3	49.7	51.1	45.43
2	**Polychaetes**	19.26	18.4	15.6	16.3	12.2	21.2	21.9	18.1	13.0	43.3	11.8	17.9	19.14
3	**Nematodes**	13.4	14.4	17.8	18.1	21.6	13.5	18.4	16.1	13.3	13.2	18.3	11.9	15.86
4	**Fish**	46.2	45.3	45.4	36.4	46.2	49.4	37.0	41.2	40.0	40.7	40.3	38.2	42.22
5	**Zooplankton**	33.27	32.4	32.8	34.9	37.7	37.5	33.4	39.4	35.8	37.2	36.8	38.0	35.77
6	**Phytoplankton**	30.33	26.5	30.53	25	27.6	26	27.1	29.5	26.2	27.3	26	26.9	27.41
7	**Bivalves**	17.73	21.7	16.87	20.9	20.3	41.8	20.3	18.9	22.7	21.6	20.7	20.2	21.97
8	**Gastropods**	13	13.9	14.53	16.9	16.3	16	15.9	23.3	20.1	18.9	17.7	18.6	17.10
9	**Sand**	15.67	17.1	16.33	13	14.1	16.3	12.4	16.9	18.3	18.9	18.4	18.9	16.36
10	**Digested matter**	10.27	9.07	8.533	7.8	7.07	9.2	8.27	9.07	8.33	9.07	12.3	9.67	9.05
11	**Miscellaneous**	27.67	35.4	30.53	25.7	23	19.7	21	23.7	26.3	27.7	29	32.3	26.84

Table 4: Monthly Variation in the Percentage Composition of Food of Female *P. volitans* (January-2012 to December-2012).

Plate 1: Different food contents recorded in the stomach of *P. volitans*.

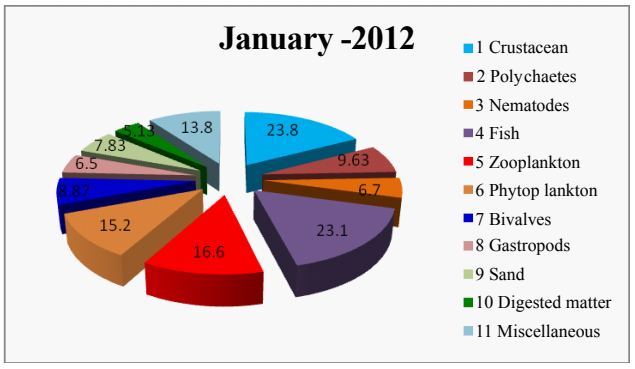

Figure 1: Percentage composition of food items male *P. volitans* in the month of January-2012.

August (11.7%) and low in January (6.5%) (Figures 1-12). The female percentage occurrence of this group was found to be high in August (23.3%) and low in January (13.0%) (Figures 13-24 and Plate 9).

Sand

Sand grains formed the important group on the basis of percentage of occurrence (24.5%). The sand was frequently seen throughout the year. The male percentage fluctuated between 9.47% in the month of October and December (Figures 1-12). The female maximum percentage occurrence of sand grains recorded was 18.9 in the month of October and December. The minimum percentage occurrence of sand grains recorded was 6.5% in male and female 13.0 in the month of April and 3.9% in November (Figures 13-24 and Plate 10).

Digested matter

It was observed that the *P. volitans* predominant food item and the occurrence of these items in their guts throughout the year. The male maximum percentage occurrence of digested matter recorded was 6.17% in the month of November and 5.13% in January. The minimum was recorded 3.5% in the month of May and 3.9 % in April (Figures 1-12). The female maximum percentage occurrence of digested matter recorded was 12.3 the month of November and 10.27% in January. The minimum was recorded 7.07% in the month of May and 7.8% in April (Figures 13-24 and Plate 11).

Miscellaneous

Miscellaneous items were found to be of most dominant category, it was observed all the months of the study period. The male maximum percentage occurrence of miscellaneous recorded was 17.7% in the

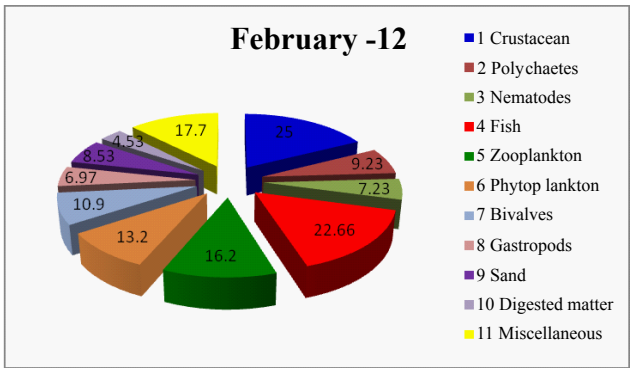

Figure 2: Percentage composition of food items male *P. volitans* in the month of February-2012.

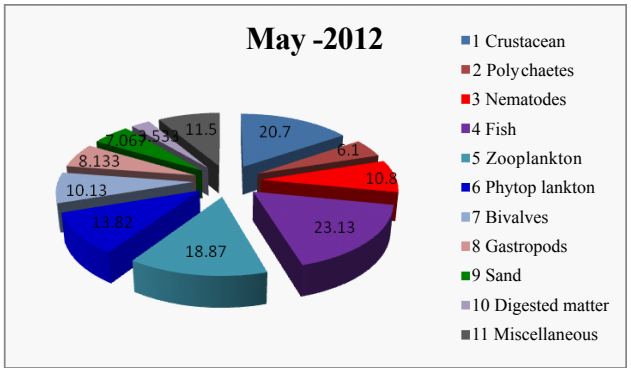

Figure 5: Percentage composition of food items male *P. volitans* in the month of May-2012.

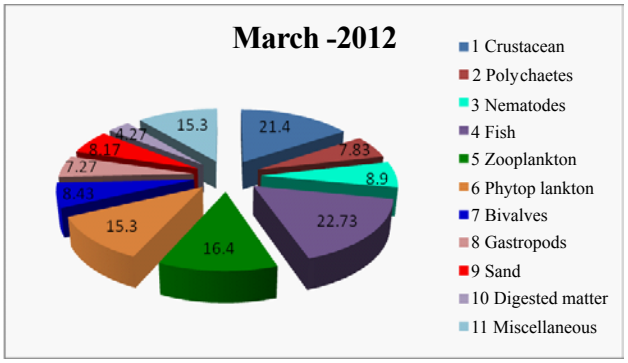

Figure 3: Percentage composition of food items male *P. volitans* in the month of March-2012.

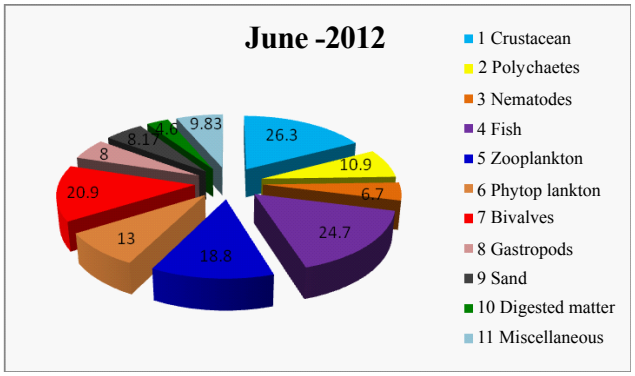

Figure 6: Percentage composition of food items male *P. volitans* in the month of June-2012.

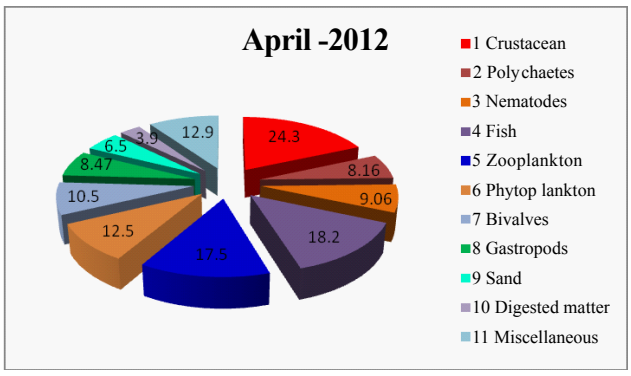

Figure 4: Percentage composition of food items male *P. volitans* in the month of April-2012.

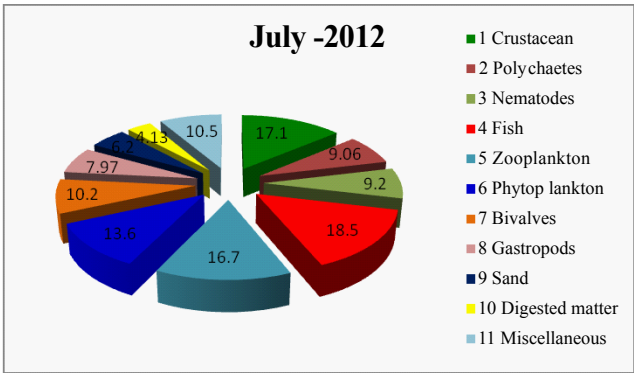

Figure 7: Percentage composition of food items male *P. volitans* in the month of July-2012.

month of February and 15.3% in the month of March and lowest abundance of 10.5% noticed in the month of July (Figures 1-12). The female maximum percentage occurrence of miscellaneous recorded was 35.4% in the month of February and the lowest abundance of 21.0% noticed in the month of July (Figures 13-24 and Plate 12).

Discussion

Food and feeding is an important aspect of biology of any animal which is of economic importance. The knowledge of the food and feeding habits are very important, it gives on more knowledge on growth, distribution and history of the fish. The changes in the feeding spectrum during different seasons, it's very much useful to the migratory patterns of the fish studies. The present revealed the food habits of the lion fish *P. volitans*. This feed on invertebrates such as amphipods, isopods and other crustaceans. This also includes small fishes. The prominent contribution food was by Crustaceans followed by Zooplankton, Phytoplankton, Bivalves, Fish remains, Polychaetes, Gastropods, Sand, Nematodes, Digested matter and Miscellaneous. This trend was same in both male and female of this fish group. But there was a slight difference in feed composition in the males and females,

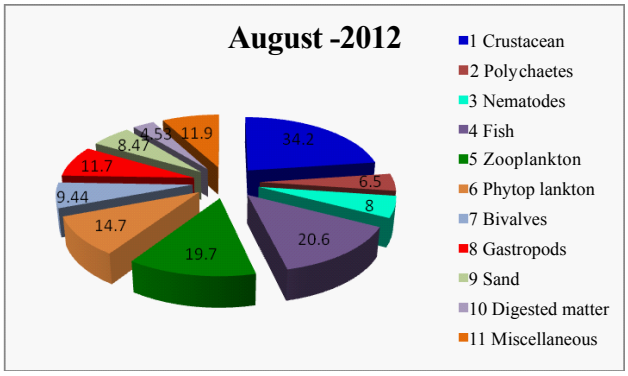

Figure 8: Percentage composition of food items male *P. volitans* in the month of August-2012.

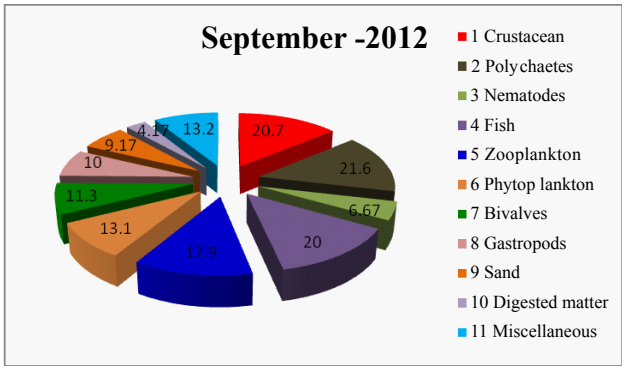

Figure 9: Percentage composition of food items male *P. volitans* in the month of September-2012.

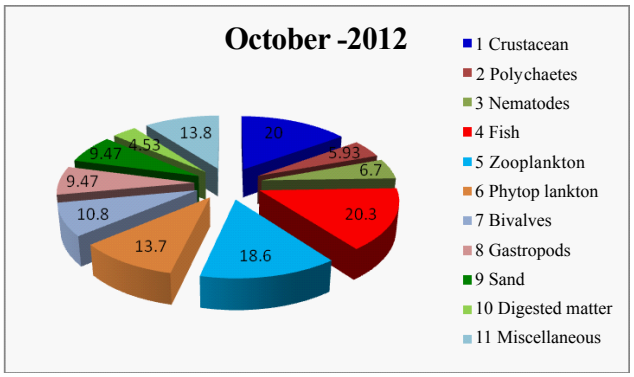

Figure 10: Percentage composition of food items male *P. volitans* in the month of October-2012.

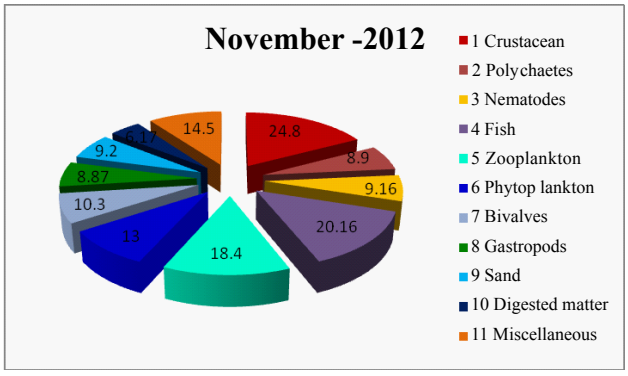

Figure 11: Percentage composition of food items male *P. volitans* in the month of November-2012.

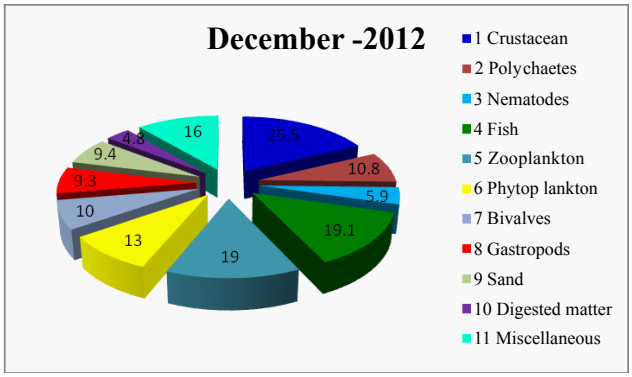

Figure 12: Percentage composition of food items male *P. volitans* in the month of December-2012.

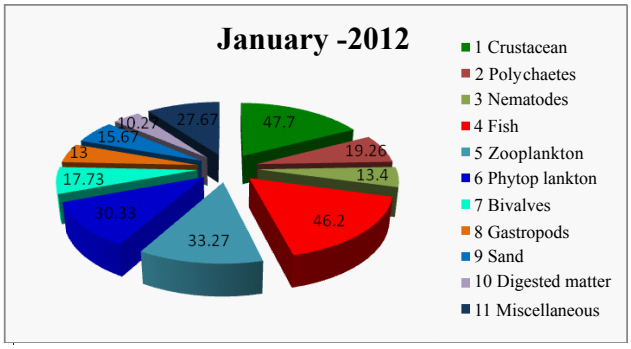

Figure 13: Percentage composition of various food items in female *P. volitans* during January-2012.

when they are compared separately with each size group studied. In the present study the male fish of *P. volitans* stomach contents as identified feed compositions in the following order viz., Crustaceans (22.71) >Fish (21.11) >Zooplankton (17.88) >Phytoplankton (13.70) >Miscellaneous (13.42) >Bivalves (10.98) >Polychaetes (10.54) >Gastropods (8.55) >sand (8.18) >Nematodes (7.93) >Digested matter (4.52) and the female fish of *P. volitans* stomach contents as identified feed compositions in the following order viz., Crustaceans (45.43) >Fish (42.22) >Zooplankton (35.77) >Phytoplankton (27.41) >Miscellaneous (26.84) >Bivalves (21.97) >Polychaetes (19.14) >Gastropods (17.10) >Sand (16.36) >Nematodes (15.86) >Digested matter (9.05) respectively. The fact that male and female *P. volitans* naturally it can survive on a wide variety of food items as revealed by the present study. This term agrees with previous studies viz., [23] *Polydactylus indicus*, [24] the ribbon fish, *Trichiurus haumela*, [25] Indian oil sardine, *Sardinella longiceps*, [26] *Coilia dussumieri*, [27] *Cynoglossus lingua*, [7] *Blennius pholis* and *Centronotus gunnellus* (L.), [28] *Polynemus indicus* (Shaw), [29] *Saurida tumbil* (Bloch), [30] Indian mackerel, *Rastrelliger kanagurta*, [31] *Liza macrolepis* (Smith) and *Mugil cephalus* Linn. (Mugilidae), [10] Indian oil sardine, *Sardinella longiceps*, [32] Ribbon fishes, [33] Biology of the

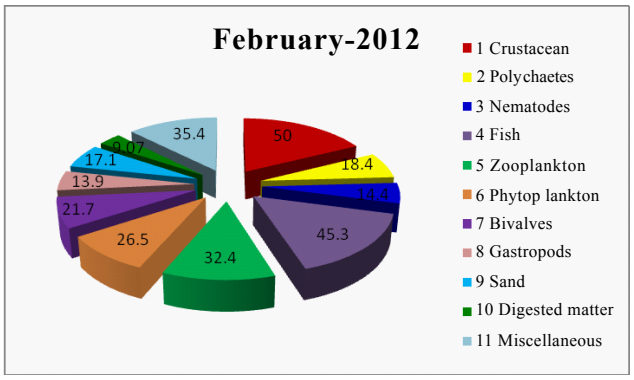

Figure 14: Percentage composition of various food items in female *P. volitans* during February-2012.

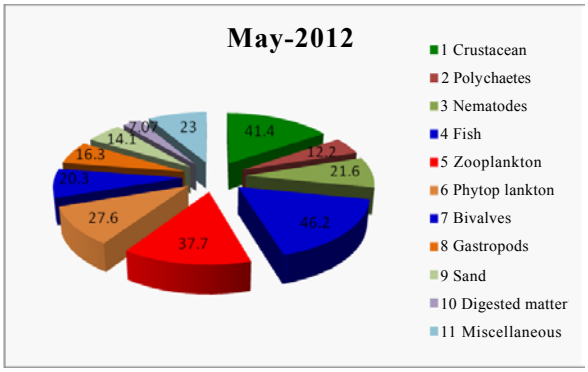

Figure 17: Percentage composition of various food items in female *P. volitans* during May-2012.

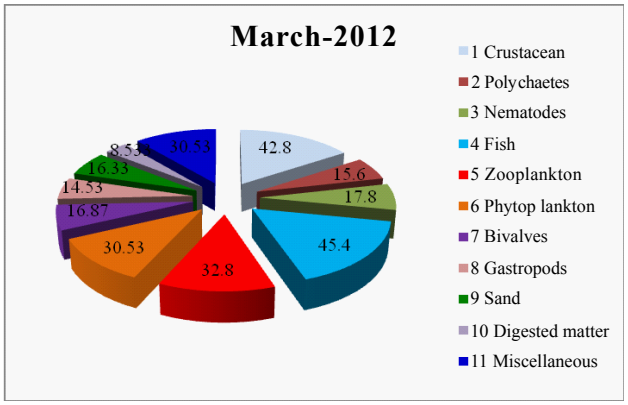

Figure 15: Percentage composition of various food items in female *P. volitans* during March-2012.

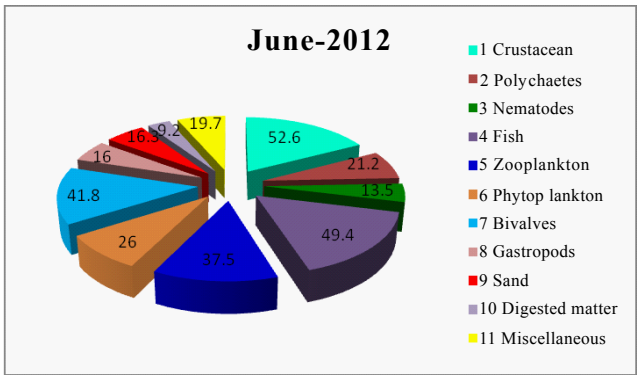

Figure 18: Percentage compositions of various food items in female *P. volitans* during June-2012.

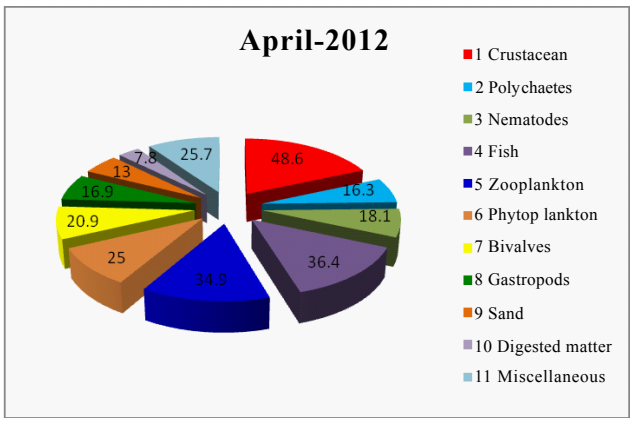

Figure 16: Percentage composition of various food items in female *P. volitans* during April-2012.

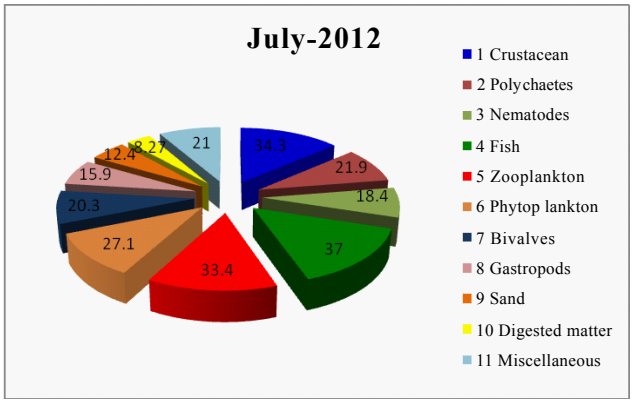

Figure 19: Percentage composition of various food items in female *P. volitans* during July-2012.

silver belly, *Leiognathus bindus* (Val.), [4] pomfret *Pampus argenteus* (Euphrasen), [5] Indian oil sardine, [6] *Nemipterus japonicas*, [34] *Trichodesmium*, [35] Bombay duck, *Harpodon nehereus* (Ham.), [36] *Pleuronectes plates*, [37] horse-mackerel, *Caranx kalla*.

Food and feeding habits are essential to gain information on the main preys and preference or dietary overlap between year classes [38], to determine seasonal and geographical variations in dietary composition [39], to discern the dial rhythm in feeding behavior [13,20], to estimate energy budget [40] and to help in modeling energy flow in a marine ecosystem [41]. The quality and quantity of food is one of the critical determinants influencing the timing of reproduction, age at first maturity, fecundity and the survival of fish. Qasim [1] stated that food and feeding habits of fishes forms one of the main investigations on any study on the biology of fishes. Knowledge of food consumption

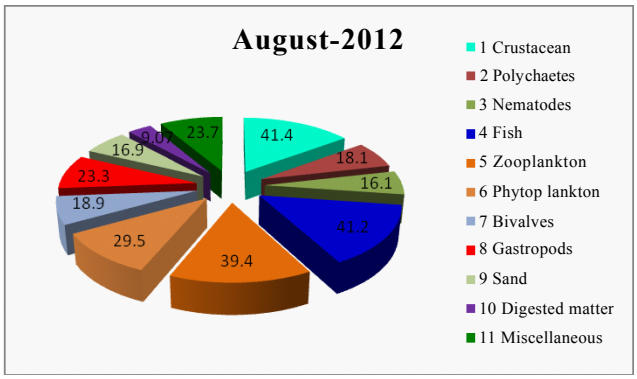

Figure 20: Percentage composition of various food items in female *P. volitans* during August-2012.

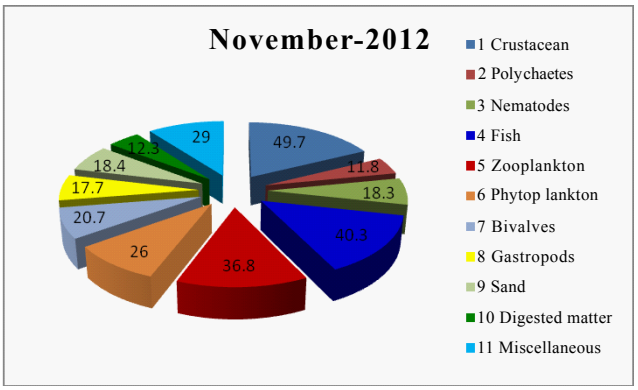

Figure 23: Percentage composition of various food items infemale *P. volitans* duringNovember-2012.

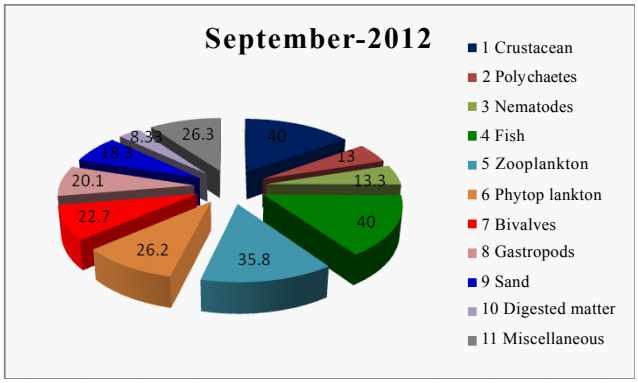

Figure 21: Percentage composition of various food items in female *P. Volitans* during September-2012.

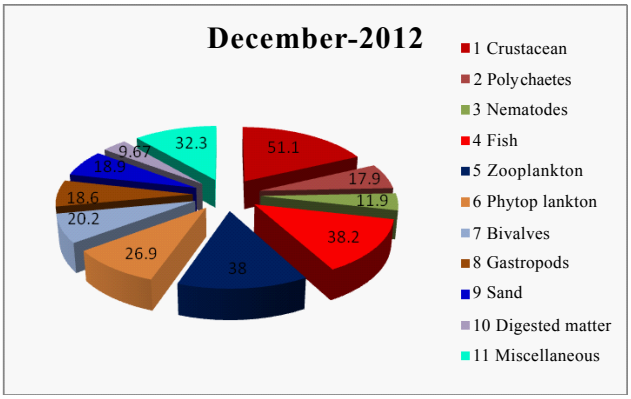

Figure 24: Percentage composition of various food items infemale *P. volitans* duringDecember-2012.

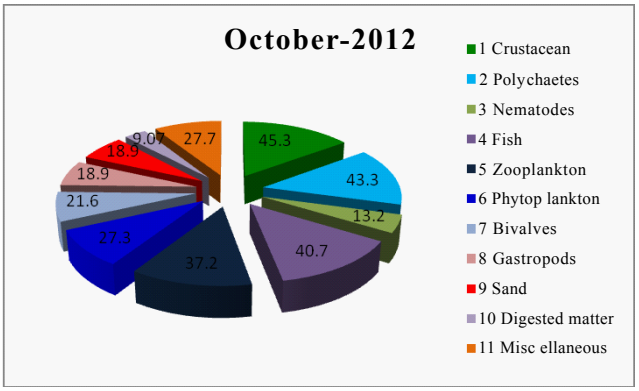

Figure 22: Percentage composition of various food items in female *P. volitans* during October-2012.

Plate 2: Crustaceans recorded in the stomach of *P. volitans*.

in fish population is needed to interpret the influence of a variety of factors on fish production [42]. The present study on the food and feeding habits of the *P. volitans* (males and females) indicated that these species are exclusive carnivores. Feeding habits of the *P. volitans* are different, the prey catching them bilateral swims bladder muscles to provide beautiful control of location in the water column and allowing there are altering its centre of gravity to better attack prey, after that the spreads its big pectoral fins and intake its prey in a single motion.

There were sightings of certain fragments of crustaceans' appendages, broken shells of molluscs, and scales and rays of fishes in large amount of all the stomachs, with some specimen's stomach containing different prey items. Fagade and Olaniyan [43] have been studied *Hemichromis fasciatus* to be feed mainly on fishes. Priyadharsini et al. [13], Manoharan et al. [20], Chacko [44], Pallaoro and Jardas [45] have been reported that the fish stomach found crabs and fishes. Fagade and Olaniyan [43] have been reported many fish feed on mollusc, crustaceans and insects. They are basically opportunistic feeders and easily catching scavenges decaying plant and animal matter. It is a peculiar phenomenon a regular schedule of feeding helps. *P. volitans* seem to most actively feed early in

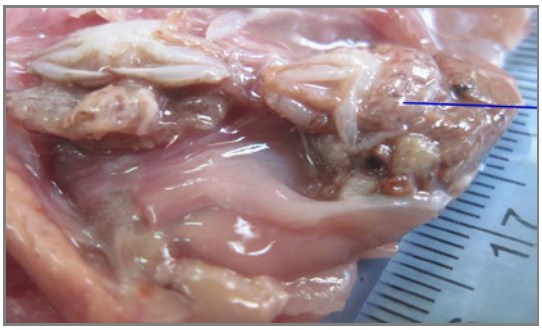

Plate 3: Fishes found in the stomach of *P. volitans*.

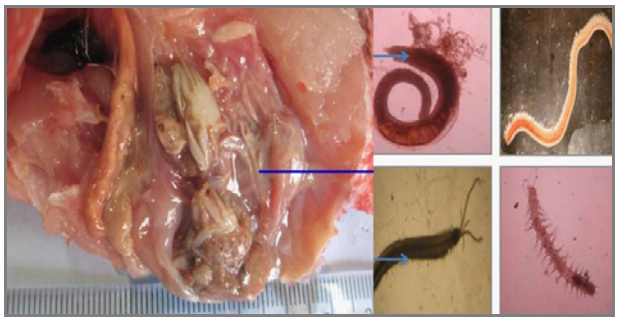

Plate 4: Polychaetes in the stomach of *P. volitans*.

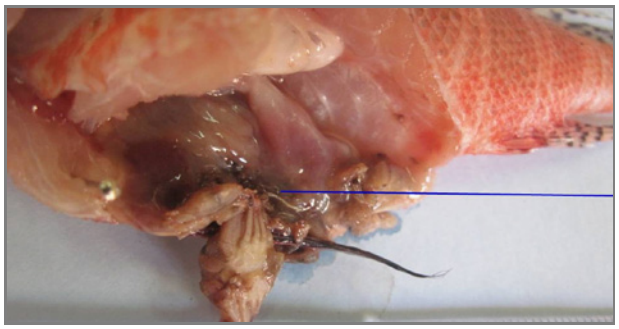

Plate 5: Nematodesfoundin the stomach of *P. volitans*.

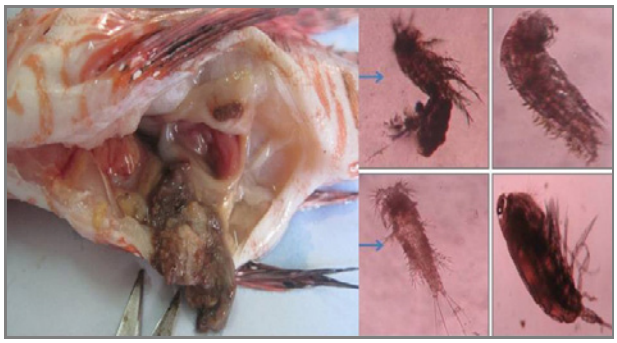

Plate 6: Zooplanktersrecorded in the stomach of *P. volitans*.

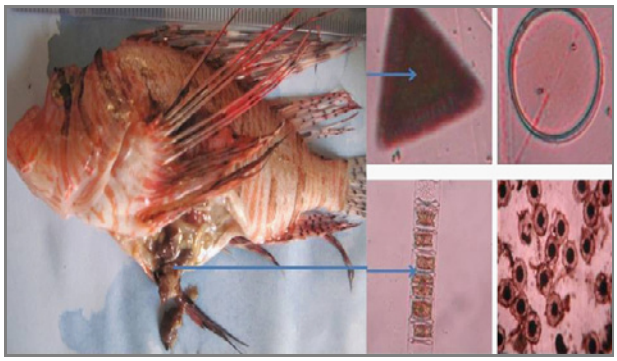

Plate 7: Phytoplankters recordedin the stomach of *P. volitans*.

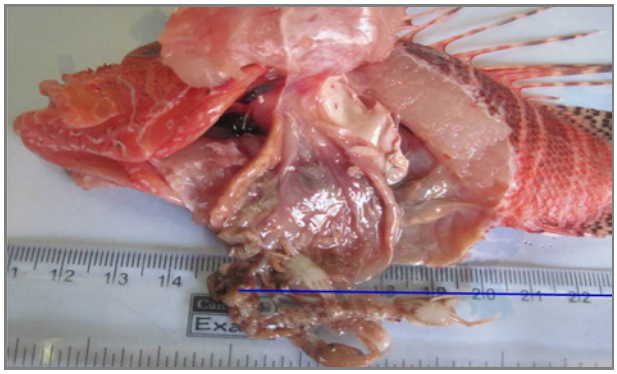

Plate 8: Bivalves foundin the stomach of *P. volitans*.

the morning 6.30 -10.30 am and then again in the afternoon, with a kind of casual foraging in between and hours prior, with a decrease in feeding activity throughout the day, however the *P. volitans* actively hunts in open water at night hours. The contribution of amphipods, isopods and zooplankton was relatively maximum was observed during late rainy season and also the contribution of phytoplankton to the diet of the fish was comparatively little. Nair and Subrahmanyan [25] have been observed zooplankton highly found in oil sardine gut region. Adiase [46] and Pauly [47] have been studied Sarotherodon and Tilapia sp to be plankton feeders. Ugwumba [48] have been studied *C. nigrodigitatus* found to be zooplankton mainly on cladocerans, copepods, ostrocods and mysids. *P. volitans* are primarily inhabited lagoon and reef associated and can be found in turbid inshore areas and the highest values of polychaete and nematodes biomass were found in the ecosystem, that they can eat an amazing amount of food. In the gut contents reveal that meio and macro fauna are an important prey item for *P. volitans* and providing an easily digestible and abundant food source. The identifiable content of meat and macro fauna is not easy ones, although the clearly observed in examining stomach different parts in the case of polychaetes in prostomium, peristomium, enlarged eye, parapodia, site, mouth, pygidium, anal cirrus and nematodes parts of the buccal cavity, sensible, tail, esophagus etc. The examined stomachs the abundance of meio and macro fauna was more during April-May followed by October-December and January-March and July-September. Rajan [49] have been studied the food spectrum of fishes from the Chilka Lake. Manoharan et al. [20] have been studied the polychaetes is a dominant food item in *Terapon jarbua* from Parangipettai coast. *P. volitans* is not directly consume due to sand particle, the activities of fishes can vary, sometimes it can fighting and highly moving periods the sand particle accidental ingestion of the food items. It was observed during the study period throughout the year, maximum was observed in the months of January-June. The minimum was recorded in the

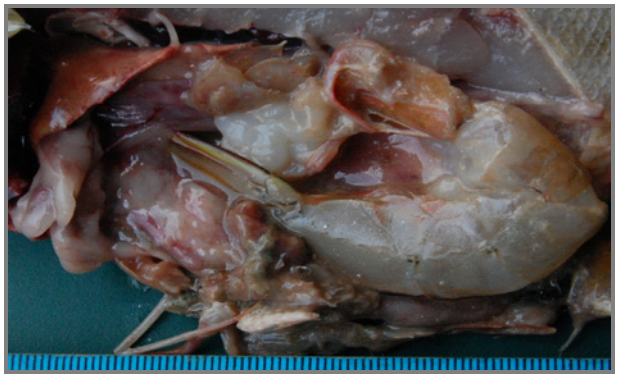

Plate 9: Gastropods foundin the stomach of *P. volitans*.

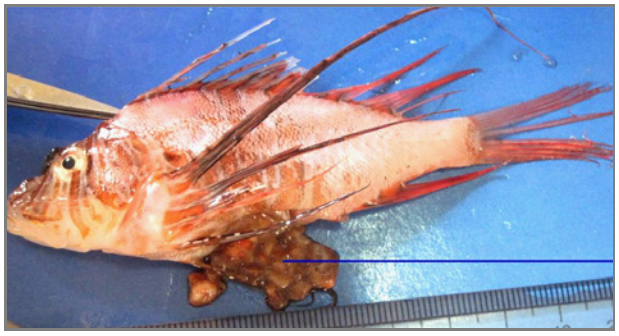

Plate 10: Sand grainsfoundin the stomach of *P. volitans*.

Plate 11: Digested matters found in the stomach of *P. volitans*.

months of October–December. It was rarely observed in the months of July-September. The sand is the best substrate for aquarium use and also the putting sand in an aquarium its recommended *P. volitans* is not directly consumers. Digested matters were recorded throughout the year. The maximum was observed in the months of January-June and minimum were recorded in the month of October-December. Detritus is organic waste material from decomposing dead plants; mangrove, seagrass and seaweed, there is a large number of *P. volitans* that feed directly on detritus. Qasim and Bhattathim [50] have been reported that sea grasses and other macrophyte may provide a source of nutrition of fishes. Darnell [51] have been observed that the detritus has been found to be consumed, very often. Yet if a P.volitans stays in a one position, that time developed gills using to filter the water to take in food, it

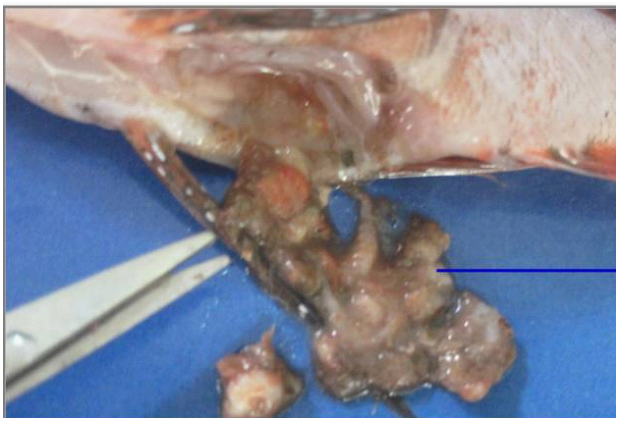

Plate 12: Miscellaneous found in the stomach of *P. volitans*.

will be able to obtain enough food to get by. Keeping in aquarium *P. volitans* it can control the amount of decaying matter. No need of cleaners in each package, there now using man-made actions and cleaning instruments, it's one of the benefits for keeping this aquarium. Miscellaneous is called mixed character it can formed predominant food item of *P. volitans* almost throughout the year. Miscellaneous has a different colloidal feeds consists of all types of biogenic material in various stages of decomposition [52]. It has been found to be consumed very often. Fish with empty stomachs, which accounted for about 27% of the total, occurred in all sampling months. The feeding habits on *P. volitans* are observed in the rainy seasons the stomach is full and dry season it may be decreased. The dry season mostly occurs in high level of empty stomachs. The earlier studies on the food and feeding of lion fish pointed out that they feed on invertebrates such as amphipods, isopods, and other crustaceans [53]. The report of these researchers adds support to the results of the present study. Earlier studies proved that they feed mostly on crustaceans, and small fishes, which include the juveniles of their own species [53].

The results obtained from the present study cannot simply be generalized due to a large difference in the variation of the habitat in which they occur. They may also vary with the varying environmental conditions. Most fishes undergo an ontogenic shift in diet; this may be due to an interaction of changes in external factors such as habitat, food supply and risk of predation and internal conditions like changes in anatomical structure, behaviour and physiological demand [54-58]. In many species changes in diet are associated with habitat shifts [55,57]. Changes in the size of the mouth and the oral anatomy may also correspond with ontogeny dietary shifts [59]. The fish die in the wild is through predation by other fish and disease or starvation. Because of the immense size of the oceans, it is very difficult to get a good idea for keeping fishes in the aquarium. Marine life conservation is generally involved with preserving marine ecosystems and the animals that depend on them. The pollution and global warming are threatening the biodiversity of the world's oceans. Protecting marine flora and fauna can help to preserve one of the world's major food sources and other aspects.

Aquariums are a great hobby most people are interested in keeping fish. There is a large variety of *P. volitans* available for the ecosystem. These fish come in a variety of colors, shapes, full of personality, beautiful, charismatic, robust and behaviour patterns. *P. volitans* are extremely sensitive to water quality changes and feeding schedule so poor maintenance fact in dead fish. However, they can be manageable if

want to research find out what are feeding them can be consumed. The feed management is a difficult one. To start *P. volitans* aquariums very careful when you carry out maintenance work because the lionfish *P. volitans* can deliver a venomous sting. The present study showed that the males and females of this lion fish have the same feeding habits and it can adapt itself and if necessary even change its preference to certain food materials, depending on the accessibility of such items in a particular ecosystem. The information drawn in the present study on the food and feeding of *P. volitans* will be of immense help in choosing the correct feed for the appropriate stages during ornamental culture. This is always seems to be important in so far as the culture of this species in mass scale is concerned. Therefore, data derived from such studies are most directly applicable to hatchery problems, although generalizations concerning the factors influencing feeding and growth may in their natural habitat.

References

1. Qasim SZ (1972) Dynamics of Food and Feeding Habits of Some Marine Fishes. Indian J Fish 19: 11-28.
2. Kuthalingam MDK (1955) Food and Feeding Habits of Juveniles and Adults of Four Fishes of Madras. Madras Univer B 25: 235-253.
3. Kagwade P V (1972) Food and Feeding Habits of *Polynemus heptadactylus* Cuv. And Val. Indian J Fish 16: 188-197.
4. Kuthalingam MDK (1967) Observations on the Fishery and Biology of the Silver Pomfret, *Pampus argenteus* (Euphrasen) from the Bay of Bengal. Indian J Fish 10: 59-74.
5. Antony Raja BT (1969) Patterns Of Sex Ratio in the Oil-Sardine, Sardinella longiceps Val., at Calicut. Indian J Fish 16: 99-109.
6. Kuthalingam MDK (1969) Notes on Some Aspects of the Fishery and Biology of *Nemipterus japonicas* (Bloch) with special reference to feeding behaviour. Indian Fish 12: 500-505.
7. Qasim SZ (1957) The Biology of *Blennius pholis* L. (Teleostei). Proc Zool Soc Land 128:161-208.
8. Qasim SZ, Jacob PG (1972) The Estimation of Organic Carbon In The Stomach Contents Of Some Marine Fishes. Indian Fish 19:11-28.
9. Colman JA (1970) On the Efficiency of Food Conversion of Young Plaice (*Pleuronectes platessa*). J Mar Biol Ass UK 50:113-120.
10. Kagwade PV (1967) The Food and Feeding Habits of the Indian Oil Sardine, *Sardinella longiceps* Val. Indian J Fish 11: 345-370.
11. Luther G (1985) Food and Feeding Habits of the Two Species of *Chirocentrus* from Mandapam. Indian J Fish 32:439-446.
12. Kader MA, Bhuiyan AL, Manzur-I-Khuda ARMM (1988) The Reproductive Biology of *Gobioides rubicundus* (Ham. Buch.) In the Karnaphuli river estuary, Chittagong. Indian J Fish 35: 239-250.
13. Priyadharsini S, Manoharan J, Varadharajan D, Subramaniyan A (2012) Interpretation on The Food and Feeding Habits of *Dascyllus trimaculatus* (Ruppell, 1829) from Gulf of Mannar, South East coast of India. Arch Appl Sci Res 4:1758-1762.
14. Rema Madhu K, Madhu L, Krishnan G, Gopakumar, Rajagopalan M, Boby Ignatius (2008) Larvi-feed Culture for Seed Production of Ornamentals Fishes Central Marine Fisheries Research Institute Mandapam Regional Centre of CMFRI.
15. Morris JA, Akins JL (2009) Feeding Ecology of Invasive Lionfish (*Pterois volitans*) in the Bahamian Archipelago. Environ Biol Fish 86: 389-398.
16. Green SJ, Akins JL, Cote IM (2011) Foraging Behaviour and Prey Consumption in the Indo-Pacific Lionfish on Bahamian Coral Reefs. Mar Ecol Prog Ser 433: 159-167.
17. Albins MA, Lyons PJ (2012) Invasive Red Lionfish *Pterois volitans* Blow Directed Jets of Water at Prey Fish. Mar Ecol Prog Ser 448: 1-5.
18. Darling ES, Green SJ, O'Leary JK, Cote IM (2011) Indo-Pacific Lionfish Are Larger And More Abundant On Invaded Reefs: A comparison of Kenyan and Bahamian lionfish populations. Biol Invas13: 2045-2051.
19. Cote IM, Maljkovic A (2010) Predation Rates of Indo-Pacific Lionfish on Bahamian Coral Reefs. Mar Ecol Prog Ser 404: 219-225.
20. Manoharan J, Gopalakrishnan A, Varadharajan D, Thilagavathi B, Priyadharsini S (2012) Stomach Content Analysis of *Terapon jarbua* (Forsskal) from Parangipettai coast, South East Coast of India. Advan Appl Sci Res 3: 2605-2621.
21. Dan SS (1975) Maturity, Spawning and Fecundity in the Catfish, *Tadiysiirus tenuispinis* (Day). Indian J Fish 24: 96-106.
22. Natarajan AV, Jhingran VG (1961) Index of Preponderance, a Method of Grading In Food Elements in the Stomach Analysis of Fishes. Indian J Fish 8: 54-59.
23. Mohamed KH (1955) Preliminary Observations on The Biology and Fisheries of the Thread-Fin *Polydactylus indicus* Shawin the Bombay and Maurashtra waters. Indian J Fish 2:164-179.
24. Prabhu MS (1955) Some Aspects of the Biology of the Ribbon Fish, *Trichiurus haumela* (Forskal). Indian J Fish 2: 132-163.
25. Nair RV, Subrahmanyan R (1955) The Diatom *Fragilaria oceanica* Cleve, an Indicator Of Abundance Of The Indian Oil Sardine, Sardinella longiceps Cuv Val. Curr Sci 24:41-42.
26. Bal DV, Joshi MS (1956) Studies on the Biology of *Coilia dussumieri* (Cuv. and Val.). Indian J Fish 3: 91-100.
27. Kuthalingam MDK (1957) Life History and Feeding Habits of *Cynoglossus lingua* (Ham.Buch.) Zool Soc India 9: 208-215.
28. Karekar PS, Bal DV (1958) The Food and Feeding Habits of *Polynemus indicus* (Shaw) Indian J Fish 5: 77-94.
29. Kuthalingam MDK (1959) *Saurida tumbil* (Bloch): Development and Feeding Habits. Zool Soc India 11:116-124.
30. George PC (1964) Our Current Knowledge on the Food and Feeding Habits of the Indian Mackerel, *Rastrelliger kanagurta* (C). In: Proceedings of the Symposium On Scombroid Fishes, Mandapam.
31. Luther G (1965) The Food Habits of *Liza macrolepis* Smith and *Mugil cephalus* Linn. (Mugilidae). Indian J Fish 9: 604-626.
32. James PSBR (1967) Ribbon Fishes of The Family Trichiuridae Of India. Mar Biol Ass India, pp: 226.
33. Balan V (1967) Biology of the Silverbelly, *Leiognathus bindus* (Val.) of the Calicut coast. Indian J Fish 10:118-134.
34. Qasim SZ (1970) Some Characteristics of a *Trichodesmium bloom* in the Laccadives. Deep Sea Research 17: 655-660.
35. Bapat SV (1970) The Bombay Duck *Harpodon nehereus* (Ham.). Bull Mar Fish Res Inst 21: 1-75.
36. Colman JA (1970) On the Efficiency of Food Conversion of Young Plaice (*Pleuronectes platessa*). J Mar Biol Ass UK 50:113-120.
37. Kagwade VN (1971) The Food and Feeding Habits of the Horse-Mackerel, *Caranx kalla* (Cuw. & Val.). Indian J Fish 14: 85-96.
38. Clarke TA (1982) Feeding Habits of Stomiatoid Fishes From Hawaiian Waters. Fish Bull US 80: 287-304.
39. Frost WE (1977) The Food of *Charr Salvelinus willughbii* (Gunther) in Windermere. J Fish Biol 11:531-547.
40. Thorpe JE (1977) Daily Ration of Adult Perch *Perca fluuiatilis* L. during summer in Loch Leven, Scotland. J Fish Biol 11: 55-68.
41. Simenstad CA, Miller BS, Nyblade CF, Thornburgh K, Bledsoe L J (1979) Food Web Relationships of Northern Puget Sound And The Strait of Juan De Fuca: A synthesis of available knowledge. Seattle Washington EPA 7: 79-259.
42. Windell JT (1971) Food Analysis and Rate of Digestion. In: Ricker WE (Ed) Methods for Assessment of Fish Production in Freshwaters, Oxford: Blackwell, pp:215-226.
43. Fagade SO, Olaniyan CIO (1973) The Food And Feeding Interrelationship Of The Fishes In The Lagos Lagoon. J Fish Biol 5: 205-225.
44. Chacko PI (1949) Food and Feeding Habits of the Fishes of the Gulf of Mannar. Proc Indian Acad Sci 29B: 83-97.
45. Pallaoro A, Jardas I (1991) Food and Feeding Habits of Black Scorpionfish

(*Scorpaena porcus* L. 1758) (Pisces, Scorpaenidae) Along the Adriatic Coast. Acta Adriat 32: 885-898.

46. Adiase MK (1969) Preliminary Report on the Food of Fishes in the Volta Lake, pp 235-237.

47. Pauly D (1976) The Biology and Potential for Aquaculture of *T. melanotheron* in a small west African Lagoon. Aquacult 1:33-49.

48. Ugwumba (1988) Food and Feeding Habits of Juveniles of Some Culturable Fish Species In Nigeria. Isbn Technical paper, Nigerian Inst. for Oceanography and Marine Research, Lagos.

49. Rajan S (1964) Environmental Studies of the Chilka Lake.1. Feeding Spectrum of Fishes. Indian J Fish 11: 521-532.

50. Qasim SZ, Bhattathim PMA (1971) Primary Production of a Seagrass Bed on Kavaratti Atoll (Laccadives). Hydrobiol 38: 29-38.

51. Darnell RM (1961) Trophic Spectrum of An Estuarine Community, Based In Studies of Lake Pontchartrain Louisiana. Ecol 42:553-568.

52. Darnell RM (1967) Organic Detritusin Relation to the Estuarine Ecosystem. In: Estuaries, G.H.Lauff (Ed.). American Asso Advan Sci 367-382.

53. Bonou CA, Teugels GG (1985) Revision Systmatique Du Genre *Parachanna* Teugels et Daget 1984 (Pisces: Channidae). Rev Hydrobiol Trop 18: 267-280.

54. Luczkovich JJ, Norton SE, Gilmore RG, Jr (1995) The Influence of oral Anatomy on Prey Selection During the ontogeny of Two Percoid Fishes, *Lagodon rhomboids and Centropomus undecimalis*. Environ Biol Fish 44: 79-95.

55. Bailey JE, Wing BL, Mattson CR (1975) Zooplankton Abundance and Feeding Habits of Fry of Pink Salmon, *Oncorhynchus gorbuscha*, and chum salmon, *Oncorhynchus keta*, in Traitors Cove, Alaska, with speculations on the carrying capacity of the area. Fish Bull 73: 846-861.

56. Varadharajan D, Pushparajan N (2013) Food and Feeding Habits of Aquaculture Candidate a Potential Crustacean of Pacific White Shrimp *Litopenaeus vannamei*, South East Coast of India. J Aquac Res Develop 4:161.

57. Godin JGJ (1981) Daily Patterns of Feeding Behavior, Daily Rations, And Diets of Juvenile Pink Salmon (*Oncorhynchus gorbuscha*) in two marine bays of British Columbia. Can J Fish Aquat Sci 38:10-15.

58. Varadharajan D, Pushparajan N (2012) Studies on Peculiar Observations of the Food and Feeding Habits of Painted Pebble Crab *Leucosia anatum*, South East Coast of India. Inter J Pharma Biol Arch 3:1170-1173.

59. Wainwright PC, Richard BA (1995) Predicting Patterns of Prey Use From Morphology of Fishes. Environ Biol Fish 44: 97-113.