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ORIGINAL RESEARCH ARTICLE

Food and Feeding Habits of Tilapiine Cichlid Fish *Oreochromis mossambicus* (PETERS) from Pichavaram Mangrove, South East Coast of India

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ABSTRACT

Aquatic species of the fishes are most beautiful and remarkable form of vertebrates around in the world. Study of the food and feeding habits of fish is very important in the management of fishery and life studies. It is mainly depends on the energy received from food mostly the behaviour of the biological method due to development, age and growth, spawning and other metabolic activities. The basic knowledge of fish culture are very important a prior understanding of food and feeding habits. *Oreochromis mossambicus* is a vital source of food for people and the social and economic importance. While the food and feeding habits of *O. mossambicus* details are important for the culturing aspects. The specimens of *O. mossambicus* were collected monthly during January 2010 to December 2010 using gillnets of different mesh sizes from Pichavaram mangrove area. It was found to consumption of a variety of substances of plant and animal origins. A total of ten different food components were recorded in the gut of *O. mossambicus.* The different food materials were observed such as crustacean, fish, zooplankton, phytoplankton, polychaetes, nematodes, gastropods, bivalves, sand and miscellaneous. The gonadosomatic index (GSI) of the species varied from the male was 4.93±0.17 to 7.93±0.17 and the female was varied from 5.78±0.36 to 8.73±0.36. The feeding intensity was fluctuated throughout the year and the minimum was observed during June and August similar to the spawning period. The results of the present study may enable to select suitable food material for Mozambique cichlid *O. mossambicus* for cultivable purpose.

Key words: *O.mossambicus*, gut contents, food and feeding habits, mangrove ecosystem, gonadosomatic index.

INTRODUCTION

Food is the basic inevitable for all the animals in the globe. It is one of the most ubiquitous substances in fish life cycles. The nutrition of fish is gain energy from feeding habits. There are main factors of growth, metabolism, migratory movement, maturity, reproduction, survival and more. Feeding habits of fishes depends upon the environmental conditions and slightly vary one place to other places. Individual species alive in particular habitat diet can vary at different periods, similarly the same species occupy in different habitat can vary feeding habits on different types of food. Analysis of the gut contents is useful in the identification of feed compositions and to determine what a fish eats is an important aspect of fisheries management [1, 2]. The feed compositions due to the gut are not the same as the food intake. 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 relationship between fish and food organism is essential for the production and exploitation of the fish stocks. This relationship has been used for the fishery exploited the diversity of the species in a particular region of total fishery. A number of scientists have also studied various aspects of food and feeding habits of several fish species from different waters ecosystem [3-10]. Studies on the food and feeding habits of the *Oreochromis mossambicus* were limited. The Mozambique

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cichlid *O. mossambicus* is a vital source of food for people and are significantly benefit of social and economic importance. Now a days, Mozambique cichlid *O. mossambicus* most upon the people are keeping this is one of the most popular hobbies. The healthy aquarium required there maintains schedule of feeding is very important and it is playing an important role in the culturing system. Majority of the ornamental fishes in the aquarium trade mainly consider for freshwater region. The ornamental fishes caught from wild in the origin of rivers and streams for different there using different fishing methods. There is farm raised, breeding and propagation even in the small to bigger size has shifted to regions near consumer centres and are becoming more profitable because transport coast are greatly reduced and export trade also are high. Many countries in the ornamental fish now cultivated. In India has a big source of river, stream, creek, canal and ponds, even though details of the species diversity is not better and are starting farming, the main problem of feed management. The study of food and feeding habits of Mozambique cichlid *O. mossambicus* will helps in mass scale culture and this in turn helps in conservation of the fish. Hence in the present study, the food and feeding habits of the Mozambique cichlid *O. mossambicus* were undertaken from Pichavaram mangrove regions.

MATERIALS AND METHODS

Gillnets are using the specimens of Mozambique cichlid *O. mossambicus* were collected randomly at Pichavaram mangrove regions during the period of January 2010 and December 2010. After collection, the fish were stored in ice boxes and the gut were removed and fixed in 10% buffered formalin. The gut contents of male and females were later analyzed in the laboratory. Immediately after the collection the standard length of the fish 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 a compound microscope. The food items were identified up to the family level wherever possible. During the analysis, regurgitated gut was discarded [11]. 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 [5, 12]. Gastro somatic index (GSI) was estimated using the method of [13]. **GSI (%) =100 × (weight of gonad /total body weight)**

RESULTS

The percentage composition of food items in the gut content of male and female fish of *O. mossambicus* were observed in different months of the year are presented in (Table 1 & 3). A total of ten different food components were recorded in the gut of *O. mossambicus*, showing varying numerical abundance and relative percentage abundance. The different food materials were namely Crustacean, Fish, Zooplankton, Phytoplankton Polychaetes, Nematodes, Gastropods, Bivalves, Sand and Miscellaneous (**Table 1-4**).

Crustaceans are one of the most important foods of *O. mossambicus.* It is evidenced by occurring in more than 19.2% of the guts during the study periods. The male gut examined specimens contained a maximum 14.29% crustaceans was recorded in the month of June, followed by 14.06% in March of the year and minimum was 7.73% in the month of January of the year. The highest percentage of crustaceans occurred in female gut was 9.57% during the month of July, followed by 8.67% in February and the lowest percentage recorded was 4.52% in the month of June. Crustaceans formed the most important food item, both the males and females of *O. mossambicus* and they occurred in the guts throughout the year. The fish next to the crustaceans is the most important diet of *O. mossambicus* in marine ecosystem, which contributed 41.5% of the total food digested (Table- 1 & 3). It was observed in the guts throughout the year. In male, the maximum of percentage occurrence of fish (29.51%) was recorded in the month of April followed by 26.5% in January and 26.04% in March and minimum 20.9% percentage was recorded in the month of August and 21.18% in June and 23.33% in May (Table 1 & 2). In female the maximum 24.9% percentage occurrence of fish was recorded in the month of January and minimum of 36.4% was recorded in the month of August and 14.36% in December and 14.40% in July of the year (Table 3 & 4).

The next important food items of *O. mossambicus*, were observed in polychaetes. It was occurred in examined gut of *O. mossambicus* throughout the

year. In male, the maximum of 16.35% occurrence of polychaetes was recorded in September and minimum 7.28% was recorded in the month of July (Table 1 & 2). In female, the maximum 13.90% occurrence of polychaetes was recorded in February and minimum of 8.56% was recorded in October (Table 3 & 4). In summer, the maximum of gut were having only tubicolous polychaetes. The examined result showed that nematodes are formed the most also important food item of *O. mossambicus* during the study period. In male maximum 13.30% percentage occurrence of nematodes was recorded in January and minimum of 6.84% percentage was recorded in November (Table 1 & 2). In female the maximum of 12.3% percentage occurrence of nematodes was recorded in the month of October and 11.2% in January and minimum 6.15% was recorded in the month of November and 7.91% in June of the year (Table 3 & 4).

Phytoplankton also formed the significant important item of food of both the males and females of *O. mossambicus*. They were occurred in the gut throughout the year. This food constituent was dominant between post monsoon and summer. In the male maximum of 12.70% occurrence of phytoplankton was recorded in the month of January and the minimum of 7.37% was recorded in the month of November (Table 1 & 2). In female, maximum of 14.2% occurrence of phytoplankton was recorded in the month of April and the minimum of 7.51% was recorded in February 2010 (Table 3 & 4). Zooplankton was the most important diet of *O. mossambicus* and it was observed throughout the year during the study period. In male the maximum of percentage occurrence of zooplankton was recorded 12.78% in the month of May and 12.50% in March and minimum was recorded 7.10% in the month of April and 7.77% in July (Table 1 & 2). In female the maximum of 16.50% percentage occurrence of zooplankton was recorded in the month of August and 15.82% in June and minimum 9.83% percentage was recorded in the month of February and 9.95% in December (Table 3 & 4).

Bivalves larvae, young stages and its shells were observed in the examined gut of *O. mossambicus*. In male the average contribution of bivalves was 5.29 % of the food composition. The maximum of 6.81% in the month of February and minimum value of 4.21% was recorded in the month of November (Table- 1 & 2). In female the average contribution of bivalves was 6.81% of the food composition. The maximum of 8.84% in the month of December and minimum value of 4.26% was recorded in the month of July (Table 3 & 4). Gastropods were also formed the important diet components of *O. mossambicus*. In male, the percentage occurrence of this group was found to be high in October (8.57%) and low in March (3.65%) (Table 1 & 2). In female, the percentage occurrence of this group was found to be high in February (10.40%) and low in January (5.33%) (Table 3 & 4).

The sand grains were also occurred with dominant food items. The sand was frequently seen throughout the year. In male, the maximum percentage was 8.95% in the month of November (Table 1 & 2). In female, the maximum of 15.10% occurrence of sand grains was recorded in the month of November and the male minimum occurrence of sand grains was recorded as 2.78% in the month of May and 4.05% in female the month of February 2010 (Table 3 & 4). Miscellaneous food items were also found to be of most dominant category. It was observed in all the months of study period. In male, the maximum of 12.60% occurrence of miscellaneous food items were recorded in the month of November and lowest of 4.97% was noticed in the month of January (Table 1 & 2). In female, the maximum of 11.30% occurrence of miscellaneous food item was recorded in the month of June and the lowest abundance of 5.33% noticed in the month of January (Table 3 & 4).

The observations on the feeding intensity were based on the mainly gastrosomatic index (GSI) taken on monthly basis and due to results has been presented in (**Table 5**). The GSI for males were ranged from 4.93±0.17 in the month of January to 7.93±0.17 in the month of April and GSI for female were ranged from 5.78±0.36 in the month of February to 8.73±0.36 in the month of October. The showing scatter diagram is one of the tools for data quality and there is a feeding relationship between male and female of *O. mossambicus*. It can provide useful information about a production process and due to data in numerical the correlation refers to the measure of the relationship between male and female of *O. mossambicus* feed compositions. There are positions of data on the horizontal axis in such a case of male and other variable determining the position on the vertical axis in such a case of

female. The data on the male and female of *O. mossambicus* gut contents were analysis scatter diagram, there is a line is not clear, determine whether there is reasonable confidence that a relationship exists. There showing are no relationship exists, the pattern could have occurred by random data. Each food item is then represented by a single point. The pattern of the data are moving from bottom left upward to the right indicate a weak positive correlation between the data. This is an upward sloping data grouping, the dots, which are actually data points, have various relationships however that there formed in degree of correlation is low and a vague relationship between the male and female that is paired together (**Fig 1-12**).

Table 1: Different food items recorded from the gut of male *O. mossambicus* from January-2010 to December- 2010

S. No	Food item	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
I	**Crustaceans**												
1	Crab	3	2	5	3	4	5	1	2	0	2	4	3
2	Shrimps	2	1	3	4	2	3	5	4	1	0	2	1
3	Prawn	3	6	4	5	1	1	3	4	5	6	1	0
4	Amphipods	2	2	1	1	4	7	0	8	2	2	5	1
5	Mysids	3	0	6	5	1	4	2	1	5	1	0	4
6	Lucifer	0	6	4	5	4	6	5	4	1	3	2	2
7	Egg and Larva	1	2	4	0	2	3	1	2	3	5	4	3
	Total	14	19	27	23	18	29	17	25	17	19	18	14
II	**Fish**												
1	Apogonidae	2	3	1	2	1	4	5	1	2	1	2	1
2	Atherinidae	3	1	0	1	0	3	2	3	2	1	3	2
3	Aridae	2	0	3	2	1	2	1	3	2	1	0	3
4	Blenniidae	1	2	2	1	0	3	3	2	1	2	1	2
5	Carangidae	3	2	1	2	1	2	0	1	2	3	2	1
6	Centropomidae	1	3	2	1	2	1	2	1	3	2	1	0
7	Channidae	2	1	3	2	1	0	3	1	2	3	2	2
8	Chirocentridae	0	1	2	0	3	2	1	3	0	1	3	3
9	Clupeidae	3	2	1	2	1	3	0	3	1	2	1	2
10	Cyprinidae	1	0	1	0	2	0	1	2	3	0	2	3
11	Exocoetidae	3	2	1	3	1	1	2	0	2	4	0	4
12	Grammatidae	2	1	3	2	4	2	3	2	1	3	1	2
13	Hemiramphidae	1	2	4	1	1	0	1	0	1	2	3	1
14	Labridae	2	1	3	0	2	3	0	2	3	2	1	2
15	Leiognathidae	1	2	0	4	0	1	3	1	2	1	1	4
16	Lutjanidae	3	1	3	2	1	2	1	2	1	2	3	1
17	Mugilidae	2	1	4	5	4	1	2	3	5	1	1	0
18	Mullidae	4	2	3	6	5	3	4	0	2	1	2	3
19	Scombridae	2	1	4	3	2	1	0	2	1	3	3	1
20	Serranidae	1	4	0	2	1	2	3	3	2	5	2	0
21	Stromateidae	3	1	3	4	2	1	1	0	3	2	1	2
22	Scaridae	0	2	3	2	4	0	3	2	1	4	3	1
23	Fish eggs	2	3	1	0	0	3	2	3	4	5	2	1
24	Fish larvae	3	2	1	2	1	2	4	0	1	2	3	2
25	Fish scales	1	3	1	5	2	1	2	3	1	0	2	1
	Total	48	43	50	54	42	43	49	43	48	53	45	44
III	**Polychaetes**												
1	*Armandia sp*	2	3	1	2	3	2	1	4	5	2	1	3
2	*Cossura sp*	0	2	1	2	1	0	2	1	2	3	3	2
3	*Capitella sp*	2	3	2	1	2	3	2	5	4	1	2	4
4	*Glycera sp*	0	2	1	2	3	2	1	4	5	0	2	1
5	*Eunice sp*	2	1	3	0	1	2	3	2	3	4	1	2
6	*Hesione sp*	1	3	2	1	4	3	2	1	4	2	3	3
7	*Magalona sp*	3	2	1	2	3	2	1	2	3	1	2	4
8	*Nephtys sp*	1	3	2	1	0	1	2	1	4	2	1	0
9	*Ophelia sp*	2	2	1	2	4	3	0	3	2	1	3	2
10	*Onuphis sp*	1	4	3	2	1	2	1	0	2	1	2	0
	Total	14	25	17	15	22	20	15	23	34	17	20	21
IV	**Nematodes**												
1	*Astomonema sp*	2	3	2	1	2	0	1	2	3	1	2	3
2	*Daaptonema sp*	1	2	3	2	1	4	5	1	2	3	1	1
3	*Desmodora sp.*	2	1	1	1	0	2	1	2	3	0	2	3
4	*Draconema sp*	3	2	2	2	1	2	3	0	1	3	1	2
5	*Quadricoma sp*	0	1	3	1	4	1	2	3	2	1	0	3
6	*Steineria sp.*	3	2	0	2	2	0	3	2	3	4	1	2
7	*Theristus sp*	4	3	2	1	3	4	0	3	2	1	2	0
8	*Tricoma sp*	2	0	4	2	1	0	1	2	1	1	0	2
9	*Vasostoma sp*	3	2	0	1	2	3	2	1	0	3	2	0
10	*Viscosia sp*	4	3	1	2	4	1	1	0	2	4	2	1
	Total	24	19	18	15	20	17	19	16	19	21	13	17
V	**Phytoplankton**												
1	*Coscinodiscus sp*	2	3	1	2	1	2	3	2	1	2	1	0
2	*Cyclotella sp*	2	3	3	4	0	1	4	1	2	3	2	1
3	*Diploneis sp*	4	2	1	2	1	2	3	3	2	1	3	4
4	*Ditylum sp*	3	4	2	2	1	2	1	2	3	2	1	2
5	*Navicula sp*	1	3	2	1	4	1	2	1	2	1	2	3
6	*Odentella sp*	4	2	1	0	2	3	3	2	1	2	3	0
7	*Planktoniella sp*	2	3	2	1	2	1	2	3	3	0	1	2

8	*Thalassiosira sp*	3	1	3	6	4	5	4	1	2	3	0	1
9	*Triceratium sp*	2	0	2	4	1	2	3	1	3	2	1	2
	Total	23	21	17	22	16	19	25	16	19	16	14	15
VI	**Zooplankton**												
1	*Acartia sp*	3	2	1	2	1	2	2	3	2	1	1	2
2	*Canuella sp*	2	3	6	1	5	4	1	2	3	2	1	0
3	*Cervinia sp*	1	0	4	3	0	1	0	5	0	4	5	2
4	*Diarthrodes sp*	3	2	1	0	3	2	1	0	2	1	3	1
5	*Eucalanus sp*	1	3	2	1	1	1	2	3	0	2	1	2
6	*Macrosetella sp*	0	2	2	1	4	2	1	4	5	1	2	3
7	*Microsetella sp*	3	1	1	2	3	0	3	2	1	2	3	1
8	*Oithona sp*	2	3	2	0	1	2	1	2	3	1	1	2
9	*Rhicalanus sp*	1	4	4	2	3	1	3	1	1	2	1	0
10	*Sagitta sp*	3	0	1	1	2	5	2	3	2	1	2	2
	Total	19	20	24	13	23	20	16	25	19	17	20	15
VII	**Gastropods**												
1	*Bullia sp*	2	3	1	2	1	2	3	2	1	2	1	3
2	*Cerithium sp*	1	0	2	2	1	3	5	1	2	3	2	1
3	*Cerethedia sp*	2	2	2	1	2	0	3	2	1	5	0	1
4	*Natica sp*	1	3	1	2	3	2	0	1	2	4	1	2
5	*Umbonium sp*	2	1	0	0	2	5	1	2	0	1	2	0
6	*Xancus sp*	0	3	1	4	1	3	2	1	2	3	5	1
	Total	8	12	7	11	10	15	14	9	8	18	11	8
VIII	**Bivalves**												
1	*Arca sp*	3	2	1	2	1	2	3	2	1	2	2	1
2	*Anadara sp*	2	1	2	1	2	2	1	0	3	2	1	2
3	*Cardium sp*	3	2	1	2	1	0	3	4	1	1	1	3
4	*Meretrix sp*	1	4	3	1	0	4	5	1	0	1	2	0
5	*Pecten sp*	2	3	1	2	3	1	1	2	1	4	0	1
6	*Placenta sp*	1	1	2	0	2	2	0	1	3	1	2	4
	Total	12	13	10	8	9	11	13	10	9	11	8	11
IX	**Sand**												
	Total	10	7	8	9	5	12	14	13	14	15	17	15
X	**Miscellaneous**												
	Total	9	12	14	13	15	17	24	26	21	23	24	19

Table 2: Monthly variation in the percentage composition of food of male *O. mossambicus* from January-2010 to December- 2010

S. No	Food item	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	Crustaceans	7.73	9.95	14.06	12.57	10.00	14.29	8.25	12.10	8.17	9.05	9.47	7.82
2	Fish	26.50	22.50	26.04	29.51	23.33	21.18	23.8	20.90	23.10	25.20	23.70	24.60
3	Polychaetes	7.71	13.10	8.85	8.20	12.22	9.85	7.28	11.20	16.4	8.09	10.50	11.70
4	Nematodes	13.30	9.95	9.37	8.19	11.09	8.37	9.22	7.80	9.14	10.00	6.84	9.50
5	Phytoplankton	12.70	11.00	8.85	12.02	8.89	9.36	12.1	7.78	9.13	7.62	7.37	8.38
6	Zooplankton	10.50	10.49	12.50	7.10	12.78	9.85	7.81	12.1	9.12	8.09	10.50	8.40
7	Gastropods	4.42	6.28	3.65	6.01	5.56	7.39	6.80	4.37	3.85	8.57	5.79	4.47
8	Bivalves	6.63	6.81	5.21	4.37	5.00	5.42	6.31	4.85	4.33	5.24	4.21	6.15
9	Sand	5.52	3.66	4.17	4.91	2.78	5.91	6.79	6.31	6.73	7.14	8.95	8.38
10	Miscellaneous	4.97	6.28	7.29	7.10	8.33	8.37	11.7	12.60	10.09	11.00	12.60	10.60

Table 3: Different food items recorded from the gut of female *O. mossambicus* from January-2010 to December- 2010

S. No	Food item	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
I	**Crustaceans**												
1	Crab	1	2	3	2	1	2	4	1	2	1	2	3
2	Shrimps	1	3	0	2	3	0	1	2	3	4	1	2
3	Prawn	3	2	1	4	2	1	2	0	0	2	0	1
4	Amphipods	0	4	3	0	1	2	3	1	3	0	2	3
5	Mysids	2	2	2	3	2	2	1	2	1	1	3	2
6	Lucifer	1	0	3	2	3	0	2	1	4	2	2	1
7	Egg and Larva	3	2	1	1	4	1	5	3	2	3	1	0
	Total	11	15	13	14	16	8	18	10	15	13	11	12
II	**Fish**												
1	Apogonidae	1	2	3	1	5	2	0	2	1	2	3	2
2	Atherinidae	2	1	1	1	0	1	1	0	2	1	1	1
3	Aridae	4	5	2	2	1	1	1	1	0	2	2	0
4	Blenniidae	0	2	3	1	1	0	0	2	3	1	0	1
5	Carangidae	2	1	1	0	2	2	1	1	1	0	1	2
6	Centropomidae	3	2	1	1	1	0	2	1	0	2	1	1
7	Channidae	2	0	0	3	2	1	1	0	1	1	1	2
8	Chirocentridae	1	2	4	0	0	2	3	2	1	2	1	1
9	Clupeidae	0	2	1	2	1	1	1	1	2	1	2	2
10	Cyprinidae	3	2	1	1	1	1	2	1	1	0	0	1
11	Exocoetidae	2	1	0	2	3	0	1	0	1	1	1	2
12	Grammatidae	1	2	4	0	1	3	1	1	0	2	1	0
13	Hemiramphidae	2	1	2	2	2	2	2	0	1	1	0	1
14	Labridae	0	2	3	0	1	1	1	1	0	1	2	1
15	Leiognathidae	4	1	2	1	0	2	0	0	1	2	1	0
16	Lutjanidae	2	2	2	2	1	3	1	2	1	1	2	3
17	Mugilidae	1	1	0	1	3	1	1	0	3	0	2	0
18	Mullidae	0	0	1	0	1	0	2	1	0	3	0	1
19	Scombridae	2	1	0	1	3	2	1	2	1	1	2	0
20	Serranidae	1	0	1	1	2	1	0	1	2	0	0	1
21	Stromateidae	3	2	1	0	0	2	1	0	1	1	1	0

22	Scaridae	2	0	1	2	1	0	1	1	3	2	1	1
23	Fish eggs	1	1	3	3	3	2	2	2	0	1	2	0
24	Fish larvae	3	2	1	0	1	1	1	1	1	1	0	1
25	Fish scales	0	1	3	1	2	2	0	1	2	3	1	2
	Total	42	36	41	28	38	33	27	24	29	32	28	26
III	**Polychaetes**												
1	*Armandia sp*	2	3	1	0	1	2	1	2	1	2	1	3
2	*Cossura sp*	1	3	2	1	2	3	4	3	5	3	4	2
3	*Capitella sp*	2	4	5	3	2	1	3	1	2	1	0	3
4	*Glycera sp*	3	2	1	2	1	3	1	4	1	0	1	2
5	*Eunice sp*	0	1	4	0	1	0	4	0	2	1	2	0
6	*Hesione sp*	3	1	2	1	2	1	0	1	0	1	3	3
7	*Magalona sp*	1	1	0	1	5	4	3	2	1	2	1	2
8	*Nephtys sp*	3	2	1	2	1	0	2	1	2	1	4	3
9	*Ophelia sp*	4	5	1	3	3	1	4	3	1	3	0	3
10	*Onuphis sp*	1	2	1	2	1	2	3	2	3	2	1	1
	Total	20	24	18	15	19	17	25	19	18	16	17	22
IV	**Nematodes**												
1	*Astomonema sp*	2	3	1	2	1	0	1	2	1	2	1	0
2	*Daaptonema sp*	3	2	3	0	2	3	1	0	3	1	0	1
3	*Desmodora sp.*	2	1	2	3	2	1	2	1	2	3	1	2
4	*Draconema sp*	3	2	4	2	1	2	1	2	1	3	2	1
5	*Quadricoma sp*	1	0	1	0	3	1	2	1	2	1	0	2
6	*Steineria sp.*	0	1	3	1	1	2	3	2	0	3	1	1
7	*Theristus sp*	3	2	1	3	2	0	1	2	3	4	1	2
8	*Tricoma sp*	1	3	0	2	1	1	4	3	2	2	1	3
9	*Vasostoma sp*	2	1	3	1	3	3	2	1	5	3	2	2
10	*Viscosia sp*	2	3	2	3	2	1	2	1	2	1	2	3
	Total	19	18	20	17	18	14	19	15	21	23	11	17
V	**Phytoplankton**												
1	*Coscinodiscus sp*	2	1	3	2	1	2	1	2	1	2	1	0
2	*Cyclotella sp*	0	1	2	1	2	3	2	1	2	1	2	3
3	*Diploneis sp*	1	2	1	3	1	4	2	1	2	0	4	3
4	*Ditylum sp*	1	2	0	2	1	2	1	2	3	2	1	2
5	*Navicula sp*	3	0	4	5	0	2	0	2	1	2	1	3
6	*Odentella sp*	3	1	2	1	2	0	4	1	5	1	0	4
7	*Planktoniella sp*	2	3	1	2	5	1	2	1	4	1	2	2
8	*Thalassiosira sp*	0	2	3	4	1	3	2	4	0	5	3	3
9	*Triceratium sp*	2	1	4	3	2	1	3	1	2	1	2	0
	Total	14	13	20	23	15	18	17	15	20	15	16	20
VI	**Zooplankton**												
1	*Acartia sp*	1	3	2	1	2	4	1	5	1	2	8	3
2	*Canuella sp*	2	1	2	1	3	1	5	1	2	3	1	2
3	*Cervinia sp*	3	2	1	5	1	4	1	2	1	2	1	2
4	*Diarthrodes sp*	0	1	2	1	4	1	2	4	1	5	2	1
5	*Eucalanus sp*	3	2	1	4	1	5	0	2	4	1	2	0
6	*Macrosetella sp*	5	1	3	1	0	1	3	1	5	1	1	2
7	*Microsetella sp*	3	0	1	2	4	0	4	3	2	1	5	1
8	*Oithona sp*	2	1	5	1	2	3	2	1	5	4	1	2
9	*Rhicalanus sp*	3	2	4	0	4	7	1	4	1	2	4	3
10	*Sagitta sp*	1	4	1	3	3	2	1	5	1	2	1	2
	Total	23	17	22	19	24	28	20	28	23	23	26	18
VII	**Gastropods**												
1	*Bullia sp*	2	1	2	1	3	2	1	2	4	2	1	2
2	*Cerithium sp*	1	1	2	1	2	1	4	1	2	3	2	1
3	*Cerethedia sp*	2	5	1	2	3	2	3	2	1	2	3	0
4	*Natica sp*	0	2	4	2	0	4	1	2	4	1	2	4
5	*Umbonium sp*	2	5	2	1	2	0	2	2	3	1	5	2
6	*Xancus sp*	2	4	2	2	1	5	4	1	2	3	2	1
	Total	9	18	13	9	11	14	15	10	16	12	15	10
VIII	**Bivalves**												
1	*Arca sp*	1	3	2	1	4	1	2	1	2	1	2	3
2	*Anadara sp*	1	1	4	3	5	2	1	2	1	3	2	4
3	*Cardium sp*	3	2	1	0	1	2	1	0	3	2	1	1
4	*Meretrix sp*	1	1	2	3	2	2	1	4	1	4	4	3
5	*Pecten sp*	2	3	2	1	2	1	2	3	1	3	2	1
6	*Placenta sp*	4	1	3	2	1	2	1	2	4	1	2	4
	Total	12	11	14	10	15	10	8	12	12	14	13	16
IX	**Sand**												
	Total	10	7	9	12	17	15	18	19	24	25	27	23
X	**Miscellaneous**												
	Total	9	14	16	15	17	20	21	18	17	14	15	17

Table 4: Monthly variation in the percentage composition of food of female *O. mossambicus* from January-2010 to December- 2010

S. No	Food item	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	Crustaceans	6.51	8.67	6.98	8.64	8.421	4.52	9.57	5.88	7.69	6.95	6.15	6.63
2	Fish	24.90	20.8	22.04	17.28	20.00	18.64	14.40	14.10	14.90	17.10	15.60	14.40
3	Polychaetes	11.80	13.9	9.68	9.26	10.00	9.61	13.30	11.20	9.23	8.56	9.50	12.20
4	Nematodes	11.20	10.40	10.75	10.49	9.47	7.91	10.19	8.82	10.80	12.30	6.15	9.39
5	Phytoplankton	8.28	7.51	10.74	14.20	7.89	10.17	9.04	8.81	10.30	8.02	8.94	11.10
6	Zooplankton	13.60	9.83	11.83	11.73	12.63	15.82	10.60	16.5	11.80	12.30	14.50	9.95

7	Gastropods	5.33	10.4	6.99	5.56	5.79	7.91	7.98	5.88	8.21	6.42	8.38	5.53
8	Bivalves	7.10	6.36	7.53	6.17	7.89	5.65	4.26	7.06	6.15	7.49	7.26	8.84
9	Sand	5.92	4.05	4.84	7.41	8.95	8.48	9.57	11.20	12.3	13.4	15.10	12.70
10	Miscellaneous	5.33	8.09	8.60	9.26	8.94	11.30	11.20	10.60	8.72	7.49	8.38	9.39

Table 5: Average of gonadosomatic index (GSI) during January-2010 to December- 2010

S. No	Months	Male	Female
1	January	4.93±0.17	6.47±1.23
2	February	5.42±0.45	5.78±0.36
3	March	5.01±0.38	5.95±0.23
4	April	7.93±0.17	6.75±0.71
5	May	5.84±1.32	6.47±0.52
6	June	6.74±143	7.64±1.36
7	July	6.02±0.72	7.18±0.25
8	August	5.15±1.25	6.65±0.41
9	September	5.46±1.42	7.64±1.24
10	October	6.13±0.25	8.73±0.36
11	November	6.51±0.31	6.45±1.32
12	December	6.36±2.3	6.51±0.58

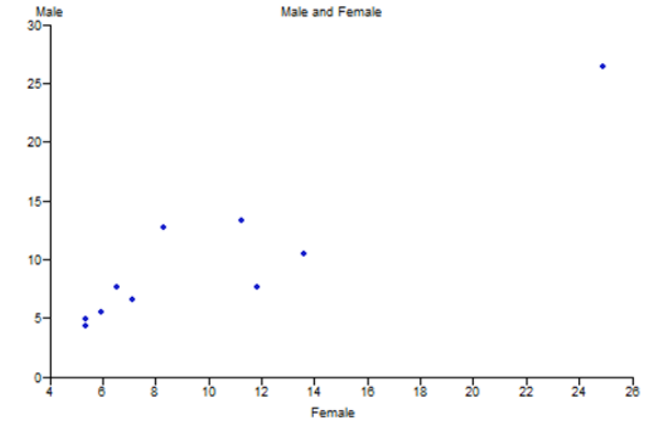

Fig 1: The relationship of different food items between male and female of *O. mossambicus* during January-2010

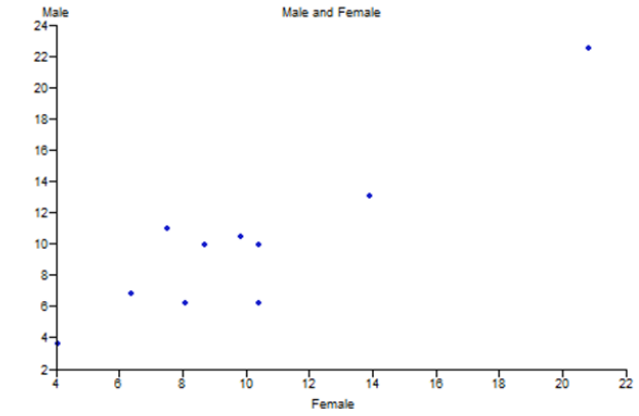

Fig 2: The relationship of different food items between male and female of *O. mossambicus* during February-2010

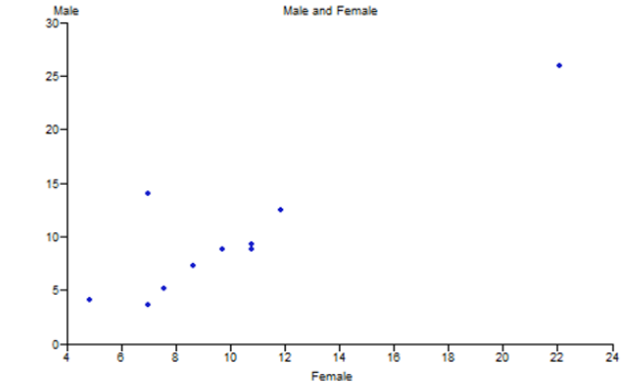

Fig 3: The relationship of different food items between male and female of *O. mossambicus* during March-2010

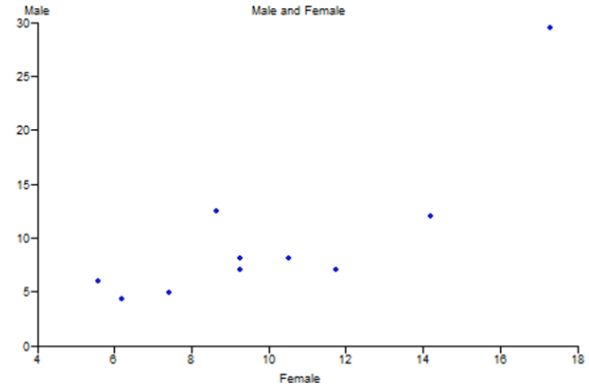

Fig 4: The relationship of different food items between male and female of *O. mossambicus* during April-2010

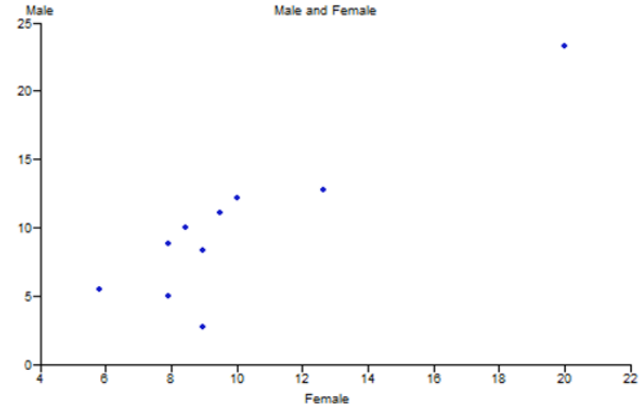

Fig 5: The relationship of different food items between male and female of *O. mossambicus* during May-2010

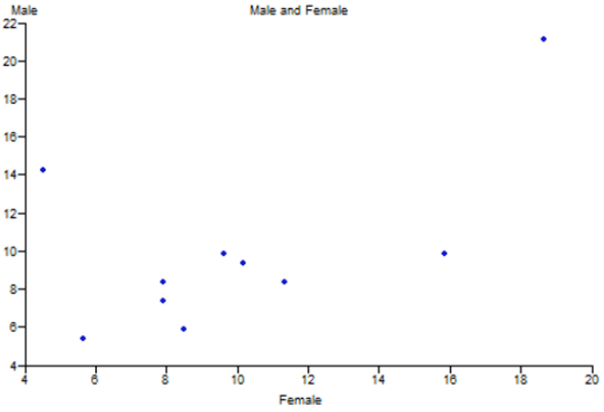

Fig 6: The relationship of different food items between male and female of *O. mossambicus* during June-2010

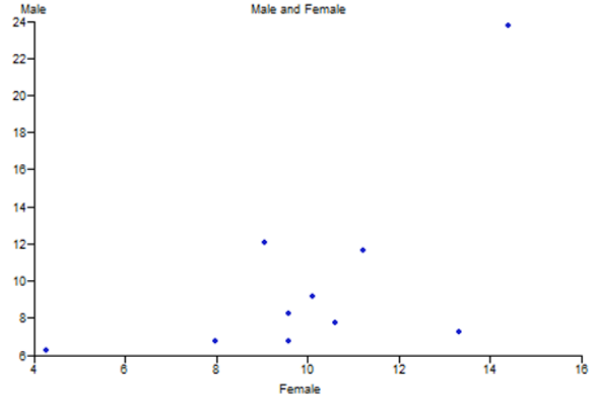

Fig 7: The relationship of different food items between male and female of *O. mossambicus* during July-2010

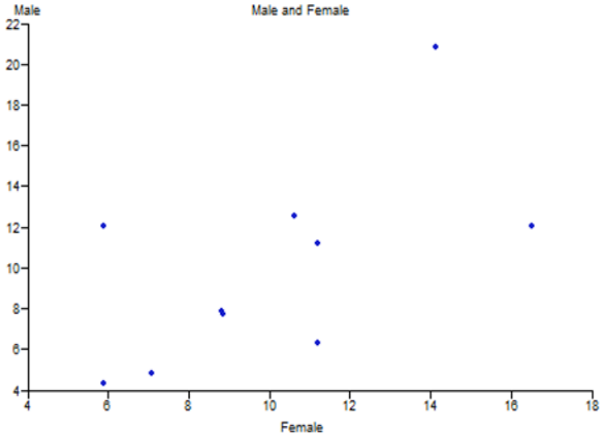

Fig 8: The relationship of different food items between male and female of *O. mossambicus* during August-2010

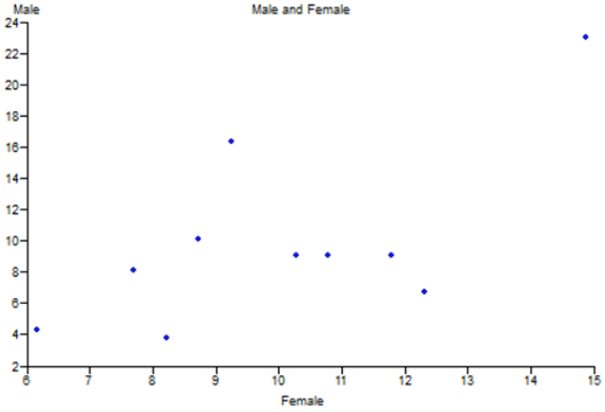

Fig 9: The relationship of different food items between male and female of *O. mossambicus* during September-2010

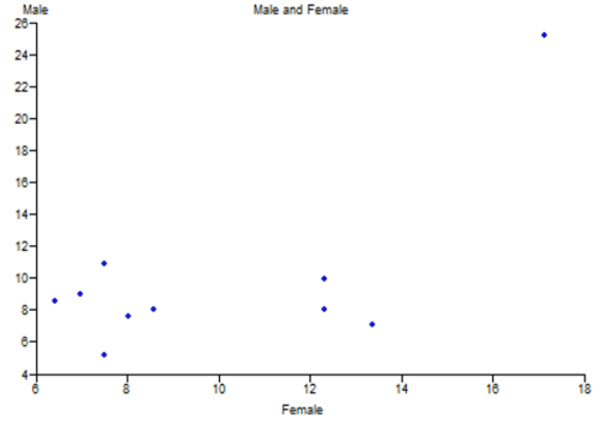

Fig 10: The relationship of different food items between male and female of *O. mossambicus* during October-2010

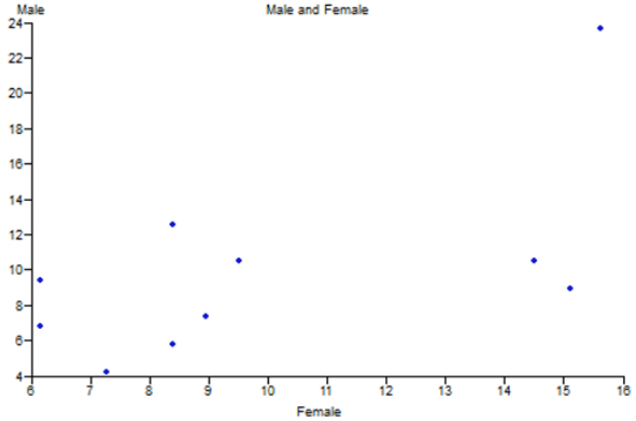

Fig 11: The relationship of different food items between male and female of *O. mossambicus* during November-2010

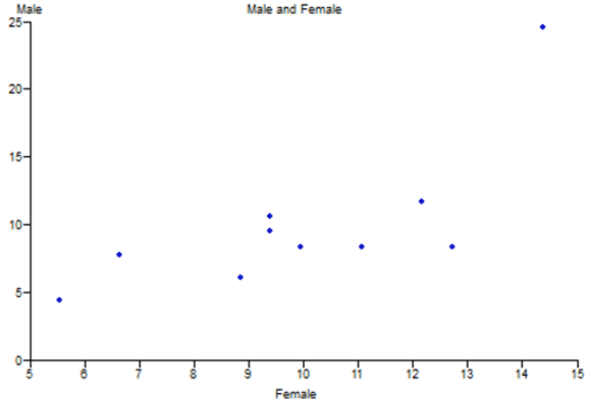

Fig 12: The relationship of different food items between male and female of *O. mossambicus* during December-2010

DISCUSSION

Mozambique tilapia commonly known as *O. mossambicus* is a cichlid fish the members of the phylum Chordata, class Actinopterygii (Ray-finned Fish), Order: Perciformes (Perch and Cichlids), family Cichlidae (Cichlids and Tilapias). They are inhabitants to the coastal areas of the estuaries, rivers, and lagoons in fresh, brackish, and sea water. Occasionally inhabits salt water reefs, mainly alive its shallow water are not initially saline water of marine species. Generally, young ones are freely moving from mouth of river and inshore regions. Juveniles can even survive in freshwater environments. It is one of the popular food fish for ornamental and aquaculture practices in India and other countries. The structure of body with long dorsal fins, there is no spine in front of part. The colour depend the environmental conditions, even though the major ones like dull yellowish or greenish. Maximum the range of size 17 inches on the 37 cm in length and up to 1.15kg can survive. It is also tolerate wide variety of environmental conditions, it will survive for long time for own life cycles. Basically, it is one of the highly omnivorous, they can eating detrital material, live, small fish, crabs, shrimp, worms, insects, spinach, flakes, macroalgae, plant debris. Mostly the people are looking food from marine source because the land source food materials day by day decreased reason of over exploitation and increasing population.

A hectic social life the many people are consuming a different types food. That food is not a good for health even nutritional deficiencies food materials. Still, the peoples easily are having different type of diseases. Many of the health problems can be prevented or alleviated with a healthy diet. Seafood especially fishes an important part of a healthy diet. It will contain high in protein and other quality essential nutrients and low saturated fat and omega-3 fatty

acids. The health institutions can support and advice for people their consuming fishes, the seafood a well balanced diet that can contribute to heart health, young or adult in proper growth and development. Now a days, the marine environments are having many kind problems that is exploitations overexploitation can lead to resource depletion. The small scale fishing vessels operating due to coastal waters in cause of overexploitations, it is mainly on fisheries.

According to the study, the information will have a high socio economic impact, since this species is the most valuable fresh and brackish water living resource in the marine ecosystems. Intensive, semi intensive and any of the culture systems the main problem the schedule of feed management. This is one of the main disadvantages are prober culture for growing species and economical, similarly the feeding or over feeding can cause of diseases due to system. We have started *O. mossambicus* small scale aquarium from our environment at a few days culturing species cannot survive, the problem of feeding schedule and prober management. I have deeply searching from my mind, how this problem can solve and easy way. However, in the present study were consider the food and feeding of *O. mossambicus* from natural environment. Accumulation of nutrition and protective area of Pichavaram mangroves are survives their different kind of vertebrate and invertebrates. I was collected the specimens of male and female in *O. mossambicus* and analysis the gut contents were identified different kind of food items during the study period. The prominent contribution of food items were observed fish remains followed by crustaceans, zooplankton, polychaetes, phytoplankton, gastropods, bivalves, sand, nematodes and miscellaneous. This trend was the same in both males and females of this fish group. But there was slight difference in food composition in the males with that of females, when they are compared separately with each size groups studied. The present study revealed that male fish of *O. mossambicus* gut contents were identified in the following order *viz.,* Fish (23.76%) > Crustacean (12.00%) > Polychaetes (10.09%) > Zooplankton (9.76%) > Phytoplankton (9.42%) > Nematodes (9.21%) > Miscellaneous (9.05%) > Sand (5.81%) Gastropods (5.52%) > Bivalves (5.29%) and the female fish of *O. mossambicus* gut contents was identified in the following order *viz.,* Fish (17.84%) > Zooplankton (12.59%) > Polychaetes (10.68%) > Nematodes (9.81%) > Phytoplankton (9.58%) > Sand (9.49%) > Miscellaneous (8.94%) > Crustacean (7.21%) > Gastropods (7.03%) > Bivalves (6.81%) respectively. Similar study were made by previous studies *viz.,* [14] have studied the feeding habits of *Polynemus indicus* (Shaw), [15] have studied the biology of *Saurida tumbil* (Bloch), [16] have reported that the food and feeding habits of Indian oil sardine, *Sardinella longiceps,* [17] have studied the feeding habits of Indian mackerel, *Rastrelliger kanagurta,* [18] have studied the feeding habits of *Liza macrolepis* (Smith) and *Mugil cephalus* Linn. (Mugilidae), [19] have reported that the on the biology of the catfish *Clarias senegalensis,* [20] have observed the feeding habits of Ribbon fishes, [21] have studied the biology of the silver belly, *Leiognathus bindus* (Val.), [22] have reported that the feeding behaviour of pomfret *Pampus argenteus* (Euphrasen), [23] have studied the biology of Indian oil sardine, [24] have reported that the feeding behaviour of *Nemipterus japonicas,* [25] have reported that food and feeding habits of *Labeo fimbriata* (Bloch), [26] have studied the food chain of *Trichodesmium,* [27] have studied the food and feeding habit of *Pleuronectes plates,* [28] have studied the feeding habits of horse-mackerel, *Caranx kalla.* [29] have reported that food of western North Atlantic tunas (*Thunnus*) and lancetfishes (*Alepisaurus*), [30] have reported that the food habits of the mudskipper, *Pseudapocryptes dentatus,* [31] have reported that the food and feeding habit of the fry of *Glossogobius guiris* (Ham-Buchanon), [32] have studied the seasonal variation in the gut content of *Arius arius* (Hamilton), [9] have studied of food and feeding habits of the spiny eel *Mastacembelus armatus,* [33] have studied of feeding behaviors, mechanisms, and mechanics of sharks. [34] have reported that the food and feeding habits of *Synodontis nigrita.* [35] have reported that the reproductive biology of a catfish *Horabagrus brachysoma,* [36] have studied the food and feeding habits of *Heteropneustes fossilis* (Bloch).

Generally study of the fish diet depends the feeding ecology; food habits and are carried out commonly through dissection and examination of the gut contents. The measuring length of the gut is a helpful index, it can provide an idea of the nature of food consume. The length of the gut of the fish depends upon the feeding habits. The *O. mossambicus* gut contents are having short and straight intestine. The functions useful for the

meat digested more easily. Study on the observations it is clear that *O. mossambicus* is essentially opportunistic feeders preying mainly on meat and plant debris. It is one of the piscivorous as an examination of the gut contents were observed highly in fish particle than there others such a case of plant and animal origins in crustacean appendages, broken shells of molluscs, decaying amphipods, isopods, zooplankton, polychaetes, phytoplankton, nematodes, miscellaneous and sand, they have all been found in the gut contents of *O. mossambicus* during the study period. The food and feeding habits of the fish in qualitative analysis due to data showed large fluctuation in percentage values in different month of the year. Generally different factors are influenced by feed compositions such as endogenetic and exogenous, the factors how they affect difficult to determine.

In the present study on the food and feeding habits of the *O. mossambicus* indicates that the species are totally carnivores. Actively feed on day time when compare night hours. The dominant food item of vertebrates in fish, the examined guts were observed particle on the fish scale, rays and fins. This study agrees with previous studies *viz.,* the food habits of fry of *Glossogobius giuris* was reported by [37], the food habits of *Arius arius* (Hamilton) was reported by [32], the feeding habits of spiny eel *Mastacembelus armatus* was reported by [9], the food habits of sharks was reported by [33]. The feeding habits of *Synodontis nigrita* have reported fishes was the most predominant food items when compare other foods [34]. [26, 38] have reported that mostly fishes feed on crustaceans, bivalves, gastropods and insects. It is probable that the presence of different prey items in the diet also seems to depend on the availability of the same in the habitat. There are opportunistic feeders at the timing availability of preys either plant or animal matters caught are easily. The *O. mossambicus* other prey items of amphipods, isopods and zooplankton were maximum during rainy seasons. This term agrees with previous studies *viz.,* [17] have studied the feeding habits of Indian mackerel, *Rastrelliger kanagurta,* [18] have reported that the feeding habits of *Liza macrolepis* (Smith) and *Mugil cephalus* Linn. (Mugilidae). [19] have reported the biology of the catfish *Clarias senegalensis.* [39] have studied the feeding habits of two common species *Tilapia melanotheron* and *Tilapia guineensis* and observed a zooplankton such as diatoms dominant food preference for the fish. [40] reported that the *Tilapia* sp is plankton feeders. The fishes are settling and nursery for plant origin and the predation on the fighting time there is well protecting place at the time there taken feeding from the bottom of the nature. There is availability of bottom organism are good prey item mainly on the nematodes and polychaetes. *O. mossambicus* polychaetes and nematodes is a dominant food items, it is evidenced of the examined gut contents were observed. The micro and macro faunas are a well food items, through the clearly observed parts of polychaetes were peristomium, prostomium, parapodia, setae, enlarged eye, mouth, anal cirrus, pygidium and parts of nematodes like buccal cavity, sensilla, tail, oesophagus etc. In the examined gut, the abundance of meio and macro fauna was available in throughout the year during the stud period. This term agrees with previous studies *viz.,* [41] reported that the teleosts fishes are predominant prey item of polychaetes. [42] reported the fish consisted to prey items of mainly amphipods, prawns and polychaetes. [43] also reported that the polychaetes are a dominant were observed in the gut content of fish. Sand is playing an important role in the *O. mossambicus* examined gut contents. Generally the fish activities in naturally are different such as respiration, fighting, migration, reproduction, spawning that periods of time the sand particle accidentally in digested with other food items. In the present study, it has been observed that maximum of sand particles were observed in the months of February- May and the minimum and was recorded in the months of September – November. It was rarely observed in the months of July. However, this observation indicates that the sand and stone is the best substrate for keeping aquarium of *O. mossambicus*. Occasional prey items of organic waste material, dead plants material of mangrove, seagrass and seaweed it can eating. The examined gut contents above the prey item is not easily identified prey items because it can half digest or fully digest there having different structure. Generally, miscellaneous has a different colloidal feeds, consists of all types of biogenic material in various stages of decomposition. The occurrence of food items of miscellaneous has a predominantly available throughout the year during the study period. Similar study were observed previous studies [30] the food habits of the mudskipper, *Pseudapocryptes dentatus,* [31] the food and feeding habit of the fry of *Glossogobius guiris* (Ham-Buchanon), [44] the food and feeding habits

of the spiny eel *Mastacembelus armatus*. It has been consumed very often. Fish with empty stomach, which accounted for about 31% of the total, occurred in all sampling months, the maximum in the months of January (15 %), June (25%) and July (30%) and minimum of frequency were observed in the month of February (10%).

Generally, gonadosomatic index (GSI) is playing an important role of index of gonadal activity and index of spawning preparedness. Monthly variations in the GSI were relatively feeding intensity was observed in different months of the year. It can notice that the range in GSI fluctuated between for males were ranged from 4.93±0.17 to 7.93±0.17 and females were ranged from 5.78±0.36 to 8.73±0.36. The feeding intensity was found to decrease with increase in the size of the *O. mossambicus*. The GSI was observed a steady increase from January to May and sudden decrease was observed in June to August. Since it can increasing just the once in the month of September and October. The fluctuations of GSI in females were a pronounced contrast and there high feeding intensity in August to October. The GSI are decreases in the month of June and July. Winter season the feeding intensity was low in that time metabolic rate are low and it is a poikilothermics organisms. The monsoon period mainly on feeding intensity very low, while, those times the stages of gonad are developing. The spawning period of summer season the poor feeding were observed and are notice empty stomachs are high. The cannibalism is possible in the nature environment when they occurs means availability of foods are absent times. The pre-monsoon season the feeds are actively taken in the time feeding intensity are improved after the spawning times. The results obtained from the present study cannot simply be generalized due to large difference in the variation of the habitat in which they occur. They may also vary with the varying environmental conditions. Most fish 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 [24, 38]. In many species changes in diet are associated with habitat shifts [9, 27, 29, 31]. Changes in the size of the mouth and the oral anatomy may also correspond with ontogeny dietary shifts [9, 31, 45]. The predation an important characteristics of *O.mossambicus* is their ability to switch feeding from one group of prey to another group. The fish die in the wild is through predation by other fish and disease or starvation. Because of the immense size of the ocean, it is very difficult to get a good idea for keeping fishes in aquarium. Marine life conservation is generally involved with preserving marine ecosystems and the animals that depend on them. Loss of habitats, the spread of disease, pollution, unsustainable fishing practices and global warming these are all the environmental changes may reduce the marine fish resources and a number of species are endangered from marine life. There is important for better information on the maintain fisheries, preserve diversity, reverse losses of habitat, decrease impacts of pollution and react to global climate change.

In the present study were considerations about the aquatic environment how many species is present don't know, nobody is not estimate exactly. The environmental changes and manmade activities affect the species behaviour, habitat, and the result of demand of food, endangered or loss of species. How it will protect that is a simple way on culture aspects. It is plays an important role in the economy, jobs and additional services. The *O. mossambicus* it is one of the edible fish and a lot of people are keeping aquariums. Fish keeping is the main hobbies of people and enjoyment, satisfaction, and relaxation in the world. It is a basic science and the activities of fish and relating studies were calculate, such as moving, respiration, feeding, metabolic activities, spawning and diseases. In the natural environment a wide variety of *O. mossambicus* were available. These fishes come in a variety of colors, shapes, full of personality, most beautiful, charismatic and behaviour patterns. It is extremely sensitive to water quality changes and feeding schedule and poor maintenance will collapse it. However, they can be manageable if the research findings are using to know the feed which they will consume. The feed management is a difficult one. To start, and to maintain the *O. mossambicus* aquarium, we need more carefulness has been needed; maintenance work for the *O. mossambicus* is not easy and the main problem of cannibalism and feeding schedule. The present study showed that the males and females of this *O. mossambicus* have the same feeding habits and it can adapt itself and if necessary even change its preference to certain other food materials, depending on the accessibility of such items in a particular ecosystem. Mostly knowledge on the

food preference an important for a making sure of the species suitability for aquaculture, since, it can help to determine the eligible species blend in culture systems with an inter species completion for natural food items. In the present observations of the food and feeding habits of *O. mossambicus* under a culture system was omnivorous and mid of bottom feeder in nature. The natural environment providing the information on the feeding habits of the species, it is mainly useful the species for small and large scall culture on any ones and are choosing a correct feed, maintain schedule of feeding their avoiding diseases and can benefit the environment.

REFERENCES

1. Chacko, P.I., 1949. Food and Feeding Habits of the Fishes of the Gulf of Mannar. *Proc. Indian. Acad. Sci.,* 29B: 83-97.
2. Akinwumi, F.O., 2003. Food and Feeding Habits of *Tilapia zillii* (Pisces; Chichildae) in Ondo State University fish farm (Dept of Environmental Biology and fisheries). *Proc. 16th Ann. Con. Fish. Soc .Nig.* (FISON), pp. 195-198.
3. Mookerjee, H.K., D.N. Ganguly and M. Islam, 1946. On the Composition of Food and their Correlation with Weight and Length of the Body in the Development of *Ophiocephalus punctatus* Bloch. *Proc. 33rd Indian. Sci. Cong.,* p. 15.
4. Das, S.M. and S.K. Moitra, 1956. Studies on the Food of Some Common Fishes of Uttar Pradesh, India. Part-I. The Surface Feeders, the Mid Feeders and the Bottom Feeders. *Proc. Nat. Acad. Sci. India,* 25: 1-6.
5. Natarajan, A.V. and A.G. Jhinoran, 1961. Index of Preponderance Method of Grading the Food in the Stomach Analysis of Fishes. *Indian. J. Fish.,* 8(1): 54-59.
6. Qasim, S.Z., 1972. The Dynamics of Food and Feeding Habits of Some Marine Fishes. *Indian. J. Fish.,* 19:11-28.
7. Piska, R.S., B. Ramaswamy and I.P. Devi, 1991. Food and Feeding Habits of Freshwater Cyprinid, *Amblypharyngodon mola* (Ham.). *Indian. J. Fish.,* 38: 126-128.
8. Serajuddin, M. and S. Mustafa, 1994. Feeding Specialisations in Adult Spiny Eel *Mastacembelus armatus. Asian. Fish. Sci.,* 7:63-65.
9. Serajuddin, M.A., A. Khan and S. Mustafa, 1998. Food and Feeding Habits of the Spiny eel *Mastacembelus armatus. Asian. Fish. Sci.,* 11:271-278.
10. Serajuddin, M. and R. Ali, 2005. Food and Feeding Habits of Striped Spiny Eel, *Macrognathus pancalus* (Hamilton). *Indian. J. Fish.,* p. 52(1): 81-86.
11. Hyslop, E. J., 1980. Stomach Content Analysis. A Review of Methods and Their Application. *J. Fish. Biol.,* 17(4):411-429.
12. Pillay, T.V.R., 1952. A Critique of the Methods of Study of Food of Fishes. *J. Zool. Soc. India,* 1: 185-200.
13. Desai, V.R., 1970. Studies on the Fishery and Biology of Tor tor (Ham.) from River Narmada. *J. Inland. Fish. Soc. India,* 2: 101-112
14. Karekar, P.S. and D.V. Bal, 1958. The Food and Feeding Habits of *Polynemus indicus* (Shaw). *Indian. J. Fish.,* 5 (1): 77-94.
15. Kuthalingam, M.D.K., 1959. *Saurida tumbil* (Bloch): Development and Feeding Habits. *Zoo. Soc. India,* 11(2): 116-424.
16. Kagwade, P.V., 1964. Food and Feeding Habits of the Indian Oil Sardine, *Sardinella longiceps* Valenciennes. *Indian. J. Fish.,* 11 A: 345-370.
17. George, P.C., 1964. Our Current Knowledge on the Food and Feeding Habits ""of the Indian mackerel, *Rastrelliger kanagurta* (C). *Proc. Symp. Scombroid. Fishes. Mar. Biol. Asso. India, Pt.* 11:569-573.
18. Luther, G., 1965. The Food Habits of *Liza macrolepis* (Smith) and *Mugil cephalus* Linn.(Mugilidae). *Indian. J. Fish.,* 9:604-26(1962)
19. Thomas, J.D., 1966. On The Biology of the Catfish *Clarias senegalensis,* in a Man-Made Lake in the Ghanaian Savanna with Particular Reference to Its Feeding Habits. *J. Zool.,* 148: 476-514.
20. James, P.S.B.R., 1967. Ribbon Fishes of the Family Trichiurudae of India. *Mar. Biol. Ass. India,* Memoir. No.1 p 226.
21. Balan, V., 1967. Biology of the Silver Belly, *Leiognathus bindus* (Val.) of the Calicut Coast. *Indian. J. Fish.,* 10: 118-134.
22. Kuthalingam, M.D.K., 1967. Observations on the Fishery and Biology of the Silver Pomfret, *Pampus argenatus* (Euphrasen) from the Bay of Bengal. *Indian. J. Fish.,* 10 A (1): 59-74.

23. Antony Raja, B.T., 1969. The Indian Oil Sardine. *Bull. Cent. Mar. Fish. Res. Inst.*, pp.16:128.
24. Kuthalingam, M.D.K., 1969. Notes on the Fishery and Biology of *Nemipterus japoneiis* (Bloch.) With Special Reference to Feeding Behaviour. *Indian. J. Fish.*, 12:500-506.
25. Bhatnagar, G.K. and Karamchandani, 1970. Food and Feeding Habits of *Labeo fimbriata* (Bloch) in river Narbada near Hoshanabad (M.P). *J. Inland. Fish. Soc. India,* 2: 30-50.
26. Qasim, S.Z., 1970. Some Characteristics of a *Trichodesmium* Bloom in the Laccadives. *Deep-Sea. Res.*, 17:655-660.
27. Colman, J.A., 1970. On the Efficiency of Food Conversion of Young Plaice *Pleuronectes platessa*. *J .Mar. Biol. Ass.*, U.K. 50:113-120
28. Kagwade, V.N., 1971. The Food and Feeding Habits of the Horse-Mackerel, *Caranx kalla* (Cuw.& Val.). *Indian. J. Fish.*, 14: 85-96.
29. Matthews, F.D., D.M. Damkaer, W.L. Knapp and B.B. Collette, 1977. Food of western North Atlantic tunas (*Thunnus*) and lancetfishes (Alepisaurus). *U.S. Dep. Commer. NOAA. Tech. Rep. NMFS SSRF*, 706: p 19.
30. Sarker, A.L., N.K. Al-Daham and M.N. Bhatti, 1980. Food Habits of the Mudskipper, *Pseudapocryptes dentatus* (Val.). *J. Fish. Biol.*, 17: 635-639.
31. Bhuiyan, A.S. and M.S. Haque, 1985. The Food and Feeding Habit of the Fry of *Glossogobius guiris* (Ham-Buchanon) Gobidae: Perciforms from the river Padma, Bangladesh. *J. Aquacult.,* 6-7 (1): 31-34.
32. Kohli, M.P.S. and U.C. Goswami, 1996. Seasonal Variation in the Gut Content of *Arius arius* (Hamilton) from Coochin backwater. *Indian. J. Fish.*, 57(1):93-96.
33. Motta, P.J. and C.D. Wilga, 2001. Advances in the Study of Feeding Behaviors, Mechanisms, and mechanics of sharks. *Environ. Biol. Fish.*, 60:131–156.
34. Olojo, E.A.A., K.B. Olurin and O.J. Osikoya, 2003. Food and Feeding Habits of *Synodontis nigrita* from the Osun River, SW Nigeria. *Cent. Quart.*, 26: 21-24.
35. Kurian, M. and N.D. Inasu, 2003. Reproductive Biology of a Catfish *Horabagrus brachysoma* (Gunther) From Inland Waters of Central Kerala. *J. Inland. Fish. Soc. India,* 35(1): 1–7.
36. Karodt, S.A. and C.K., Radhakrishnan, 2010. Food and Feeding Habits of *Heteropneustes fossilis* (Bloch) from the Brahmaputra river system, Assam. *Indian. J. Fish.*, 43(1):97-101.
37. Rao, L.M. and P. Sankara Rao, 2002. Food and Feeding Habits of *Glossogobius giuris* from Gosthani estuary. *Indian. J. Fish.*, 49(1): 35-40.
38. Prasadam , R.D., 1971. Observation on the biology of the pearl-spot *Etroplus suratensis* (Bloch) from the Pulicat Lake. *Mad. J. Inland. Fish. Soc. India,* 3 (12): 2·78.
39. Fagade, S.O., 1971. The Food and Feeding Habits of *Tilapia* species in the Lagos Lagoon. *J. Fish. Biol.*, 3: 151–186.
40. Pauly, D., 1976. The Biology and Potential for Aquaculture of *T. melanotheron* in a small west Africa Lagoon. *Aquacult.*, 1:33-49.
41. Venkataraman, G., 1960. Studies on the Food and Feeding Relationships of the Inshore Fishes off Calicut on the Malabar Coast. *Indian. J. Fish.*, 7 (2): 275-306.
42. George, K.C., M.G. Dayanandan and P. Karunakaran Nair, 1968. Food of Some Demersal Fishes from the Trawl Grounds off Cochin. *Indian. J. Fish.*, (1&2): 81-87.
43. Bhusari, B.V., 1975. Biology and Fishery of *Pseudosciaena sina* (Cuvier) at Ratnagiri, South Maharashtra. *J. Bombay. Nat. His. Soc.*, 72: 357-367.
44. Dutta, S.P.S., 1989. Food and Feeding Ecology of *Mastacembelus armatus* (Lecep.) from Gadigarh stream, Jammu. *Matsya*, 15:66-69.
45. Islam, A.K.M.N., 1974. Preliminary Studies on the Food of Some Fishes. *The Dhaka Univ. Stud. Pt.* B. 22: 47-51.