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FOOD AND FEEDING HABITS OF *ETROPLUS SURATENSIS* (BLOCH, 1790) IN VELLAYANI LAKE, KERALA

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Abstract: Composition of the diet of *Etroplus suratensis* collected from Vellayani Lake, Kerala was studied and described. The guts of 110 specimens were collected during June 2017 to May 2018. Analysis of gut contents based on the frequency of occurrence and points method revealed that the species is a predominant macrophytic aquatic plant (33%) and filamentous algae (31%) feeder in this ecosystem. The other components included detritus and digested matter (12%), diatoms (11%), miscellaneous matter (7%), zooplankton (5%) and molluscs (1%). The composition of diet did not vary between length groups (5-10 cm, 10-15 cm and >15 cm), however, it differed significantly between seasons (pre-monsoon, monsoon and post-monsoon). Relative gut length (RGL) of pearlspot ranged between 1.5797 and 5.9829 with an average of 4.0426±0.84. The quantitative changes in food contents were also verified by the analysis of gastrosomatic index (GaSI) which ranged from 0.78 to 7.02 (Mean: 2.9451±1.23). The present investigation on *E. suratensis* is indicative of predominant herbivoric food preference of the species in Vellayani Lake.

Keywords: Pearlspot, Gastrosomatic Index, Relative gut length

INTRODUCTION

Study of food and feeding habits of fish is a crucial requirement for the success of aquaculture practices which has great possibilities in a developing country like India. Knowledge on the natural diet of an organism is essential for understanding the nutritional requirement of the species. The gut content indicates what the fish would feed on (Lagler, 1949) and also provides information on trophic interactions in aquatic food webs. The food and feeding habits of fish depends upon the available food materials in the water body (Bruton, 1979) along with the stages of life and ecological conditions. The feeding ecology of fishes varies with the time of the day, size of the fish and season of the year (Azadi *et al.*, 2009). *Etroplus suratensis* is an important food fish contributing to inland capture fisheries as well as culture fisheries in Kerala. The species holds great potential for expansion of aquaculture in the state due to its high market demand and price. The euryhaline species is available in diverse aquatic ecosystems depending on locally available food materials making understanding of its complex feeding biology an important aspect of culture technology. It is an indigenous fish making major contributions to the fishery of Vellayani Lake, both in quantity and revenue.

The food and feeding behaviour of *Etroplus suratensis* was studied by several authors (Jhingran and Natarajan, 1969; Prasadam, 1971; Gopalakrishnan, 1972; Devaraj *et al.*, 1975; Jayaprakas, 1980; Vijayaraghavan *et al.*, 1981; Costa, 1983; De Silva *et al.*, 1984; Jayaprakas and Padmanabhan, 1985; Keshava *et al.*, 1988; Ushakumari and Aravindan, 1992; Sultana *et al.*, 1995; Bindu and Padmakumar, 2008 and Vidhya and Nair, 2012). It can thrive well both in fresh and brackishwaters, notwithstanding that the availability of food in these ecosystems may vary. The present study was undertaken to find out the feeding habit of *E. suratensis* in Vellayani freshwater ecosystem.

MATERIALS AND METHODS

Study area

Vellayani Lake (8°25' 35.21"N and 76°59' 35.87"E) is a tropical shallow freshwater lake in Kerala, India. It is one of the three rain fed freshwater lakes in Kerala occupying an area of about 3.312 km^2 and has a depth of 1 to 2.5 m during summer and 3 to 4 m during monsoon (Radhika and Devi, 2007) and major portion of the lake expanse is covered by macrophytic vegetation (Sukumaran, 2003). The lake plays important roles in irrigation, as drinking water source and provide abundant fishery resources. Vellayani Lake is a unique ecosystem with rich diversity of flora and fauna**.**

Sample collection, preservation and identification of gut contents

Fish samples were collected at fortnightly intervals from the fish market as well as caught directly from the Lake using cast net (15 mm). Collected fishes were stored in ice boxes and transported to laboratory. A total of 110 specimens of *E. suratensis* (TL – 5.25 to 22.5 cm; Mean: 13.80±0.343 cm) were collected and guts were analyzed. The specimens were measured for total length to the nearest 0.1 cm using a scale and body weight to the nearest 0.1 g using an electronic balance and were further grouped into different length groups (5-10 cm as juveniles, 10-15 cm as sub-adults, >15 cm as adults). The collected specimens were also grouped based on the seasons (monsoon, post-monsoon and pre-monsoon). The guts were dissected out and preserved in 5% formalin to prevent further breakdown of the food materials. The total length, weight and fullness of the guts were recorded. The intensity of feeding was recorded based on the state of distension of the gut and the amount of food contained therein. The gut contents of fishes were further analyzed in the laboratory. They were emptied into a clean petridish and various food items were separated and sorted into major groups such as macrophytic plant parts, filamentous algae, detritus, diatoms, molluscs, zooplankton, miscellaneous items, etc. The contents were suspended in a few drops of water on a slide and identified up to generic or species level, wherever possible, using a compound microscope following standard text books (Ward and Whipple, 1959; Needham and Needham, 1962; Prescott, 1962; Tonapi, 1980; Edward and David, 2010 and Jose and Francis, 2013).

Analysis of gut content

The methodology used for this study comprised of Frequency of Occurrence (FO) (Hyslop, 1980) and Points method (P) (Hynes, 1950; Hyslop, 1980).

a) Frequency of Occurrence method (Hyslop, 1980)

The number of stomachs in which each item occurs is recorded and expressed as a percentage of the total number of stomachs studied.

Frequency of Occurrence= Ji / P; where, Ji = number of fish containing prey i, P = the number of fish with food in their stomach.

b) Points (Numerical) Method

Hynes (1950) employed the points method in the quantitative estimation of different food items. Since the gut contents of *E. suratensis* in the lake was dominated by vegetable matter, the Points method of Swynnerton and Worthington (1940), modified by Frost (1943); Hynes (1950) and Venkataraman (1960) and subsequently adopted by Parimala (1983) and Jayaprakas and Padmanabhan (1985) was followed.

Feeding intensity

The intensity of feeding was assessed based on the state of fullness of the gut and the amount of food contained in it, and categorized into different groups as empty, poor, moderate, good, full and gorged and the points were allotted as 0, 10, 20, 30, 40 & 50 respectively following Kow (1950).

Relative gut length (RGL)

The Relative gut length (RGL), *i.e.*, the ratio between gut length and body length, was determined following Al-Hussaini (1949).

RGL = Total length of gut / Total length of fish

Gastrosomatic index (GaSI)

The Gastrosomatic Index (GaSI), *i.e.*, the gut weight expressed as percentage of body weight. (Bhatnagar and Karamchandani, 1970).

GaSI= (Weight of gut / Weight of fish) × 100

Data analysis

The data collected were subjected to statistical analysis to find out variation in gut contents between different length groups and seasons. The non-parametric Kruskall Wallis Test was used to analyze the difference between length and climate classes.

RESULTS AND DISCUSSION

Frequency of occurrence of gut contents: The frequency of occurrence data was dominated by diatoms (78%), macrophytes (77%), filamentous algae (76%) and detritus (72%) followed by miscellaneous items (58%), zooplanktons (36%) and molluscs (11%). The frequency of occurrence of different food components such as macrophytic plants, filamentous algae, diatoms, and detritus showed similar trend in different length groups and seasons (Fig. 1&2). Most of the food items occurred throughout the year. There is no significant variation in frequency of occurrence of different components between length groups and seasons ($P>0.05$)

Percentage of food composition: The fish is predominantly herbivorous in feeding habit in the Lake with incidental occurrence of small amount of animal matter and the gut contents showed a general dominance of both macrophytic plant parts (33%) and filamentous algae (31%) followed by detritus and digested matter (12%), diatoms (11%), miscellaneous items (7%), zooplankton (5%) and molluscs (1%) (Fig. 3). The macrophytes, filamentous algae and diatoms observed in the gut of *E. suratensis* are presented in the Table 1. The molluscan shells and zooplankton occurred rarely in some of the samples in small quantities. Gopalkrishnan (1972) observed that the species is a vegetable feeder, depending mainly on aquatic plants, filamentous algae, and phytoplankton for food. Earlier studies also indicated the preponderance of aquatic weeds followed by detritus and algae in the diet of the adult *E. suratensis* from Pulikat Lake and Nethravati-Gurpur estuary (Prasadam, 1971; Keshava *et al.*, 1988). Ward and Samarakoon (1981) opined that *E. suratensis* is a complete herbivore while De Silva *et al.* (1984) documented it as a predominant macrophytic feeder and not a complete herbivore. Bindu and Padmakumar (2008) reported that the filamentous algae *Spirogyra, Oscillatoria, Lyngbia* and *Fragillaria* formed the primary food of *E. suratensis*, in Vembanadu Lake. Kannan *et al.* (2015) observed that the fish is a herbivore which sometimes switched to omnivorous feeding habit in Thamirabarani river, Western Ghats of India. Habitat type is recognized an important factor influencing the feeding strategy of a species while determining foraging opportunities (Rozas and LaSalle, 1990; Rountree and Able, 1992; Craig and Crowder, 2000).

The gut content analysis of various length groups are presented in Table 2. The values did not differ significantly in statistical analysis ($P>0.05$).

The juveniles and sub-adults were predominantly algae feeders while the adult relied more on macrophytes. This observation is in agreement with Jayaprakas (1980) and Jayaprakas and Padmanabhan (1985) and Reni (1994). Earlier workers have reported that the food of the species changed as it grew from larva to adult (Alikunhi, 1957; Jayaprakas, 1980; Jayaprakas and Padmanabhan, 1985; Reni, 1994). Gopalkrishnan (1972) reported that the juvenile stages of the fish is an omnivore and transforms into a herbivore as it grows . A change in diet with increase in size of fish was noticed by Vidhya and Nair (2012). However, all the previous reports on the percentage composition of gut content of the species were carried out on specimens collected from brackishwater, moreover, the present study used specimens collected from market and caught in cast net, all of which were above 5 cm in length.

The seasonal variation in the food items is a reflection of the available food in the aquatic ecosystem. Most of the food items occurred throughout the year. But the percentage composition of different food components varied between seasons. Both macrophytic plants (30-33%) and filamentous algae (31-34%) dominated in food components in both pre-monsoon (February-May) and monsoon seasons (June-September). During post-monsoon season (October-January) the major constituents were macrophytes (37%), diatoms (21%) and detritus (20%) in the diet (Fig. 4). The submerged aquatic plants formed the major constituent throughout the year as the availability of aquatic plants was high in this ecosystem. In Vembanadu ecosystem also submerged aquatic plants formed an important food item throughout the year (Bindu and Padmakumar, 2008). The results of Kruskal Wallis test for comparison of different groups showed significant difference between seasons ($P<0.05$), major groups varied were filamentous algae and diatoms. Highest value for diatom was observed in October and the lowest in March. However, the lowest value for filamentous algae was also recorded in October.

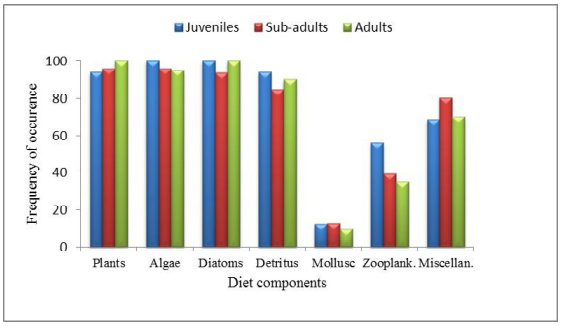

Fig. 1. Frequency of occurrence of food items in various length groups of *E. suratensis*

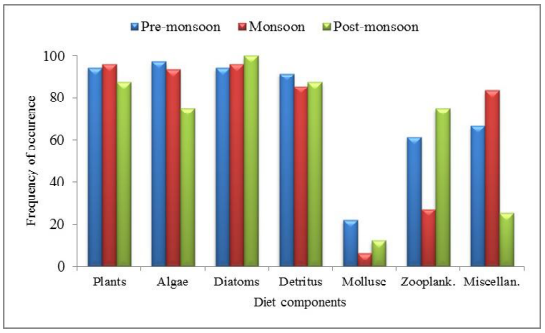

Fig. 2. Frequency of occurrence of food items in *E. suratensis* at various seasons

Table 1. Commonly occurring food components of *E. suratensis* from Vellayani Lake

Macrophytic plants	Fialmentous algae	Diatoms
Utricularia, Nitella, Chara, Hydrilla, Elodea, Pistia, Vallisneria, Ipomea, Nelumbo nucifera, Nymphea, Eichhornia	*Oscillatoria, Lyngbya, Ulothrix, Spirogyra, Fragilaria , Microcystis, Spirulina, Scytonema, Microchaete, Aphanizomenon, Anabaena*	*Navicula, Scenedesmus, Coscinodiscus, Aulacoseira, Pinnularia, Aphanocapsa, Xanthidium, Melosira, Frustulia, Ankistrodemus, Thalassiosira, Aulacodiscus, Stephanodiscus, Selenastrum, Desmidium, Coelastrum, Scenedesmus, Staurastrum, Hydrococcus, Arthrodesmus, Pleurotaenium, Gyrosigma, Gomphonema, Nitzchia, Cymbella, Phacus, Trachelomonas*

Table 2. Percentage composition of gut content in three life stages of *E. suratensis*

Food Items	Juveniles	Sub-adults	Adults
Macrophytes	30	31	37
Filamentous algae	32	35	25
Diatoms	11.5	9	13
Detritus	14	11	13
Mollusc	0.5	2	1
Zooplankton	6	4	7
Miscellaneous	6	8	4

All values as % of gut content

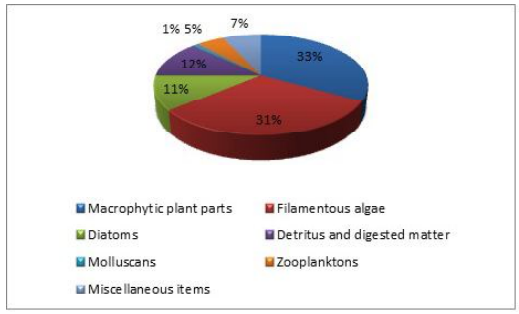

Fig. 3. Diet composition of *E. suratensis* from Vellayani Lake

Feeding Intensity: The adults were found to be with predominantly more poor and empty guts (72%) while the growing stages recorded higher intensity of feeding. More poor and empty (40%) guts were also found in the monsoon months (Fig. 5). The high percentage of empty and poor guts during monsoon months (June- September) coincided with the breeding season (Jayaprakas and Nair, 1981; Bindu and Padmakumar, 2008). Keshava *et al.* (1988) reported that the feeding intensity of *E. suratensis* might be related to maturation of gonads, spawning activity and also food availability.

Gastrosomatic Index: Gastrosomatic Index (GaSI) varied between 0.78 and 7.02 with a mean value of 2.954±1.23. The 5-10 cm length group showed an average value of 3.39±1.66 while it was 3.20±1.28 in 10-15 cm length group and 2.25±1.003 in >15 cm length groups. An average value of 2.53±1.35

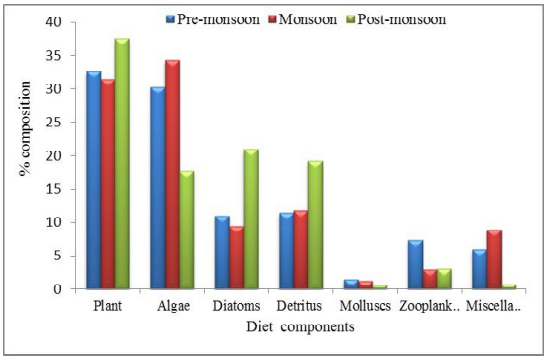

Fig. 4. Percentage composition of food components in different seasons

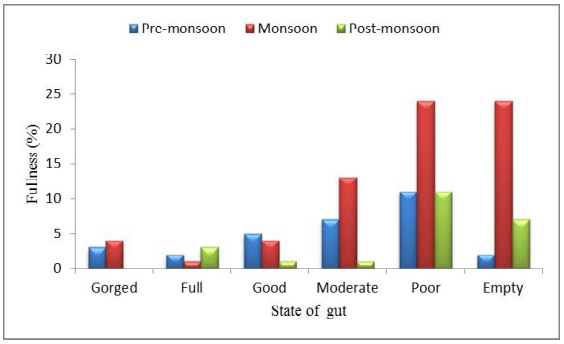

Fig. 5. Fullness of gut of *E. suratensis* from Vellayani Lake in different seasons

was observed in pre-monsoon, 3.13±1.30 in monsoon season and 2.66±1.12 in post monsoon season.

Relative Gut Length: The relative gut length (RGL) in *E. suratensis* was found to vary between 1.58 and 5.98 with a mean of 4.04±0.84. The RGL of most of the fishes falls between 4 and 4.5 (Fig. 6.). The structure of alimentary canal has a direct bearing on the food and feeding habit of the fish (Bindu and Padmakumar, 2008). The extremely long and coiled gut of *E. suratensis* indicates its adaptation for better digestion and absorption of the plant and phytoplanktonic matter (Desai, 2003; Serajuddin and Ali, 2005). According to De Silva *et al.* (1984), the ratio of intestinal length to the total length in *E. suratensis* ranges from 1.02 to 4.95 in euryhaline waters and 2.45 to 5.54 in freshwater.

The position of the mouth and dental morphology of pearlspot is adapted to its feeding habit (De Silva *et al.*, 1984). Meenakumari (1993) observed that salinity affects the dietary habits of *E. suratensis*, in freshwater habitats it prefers more vegetable matter and in the saline environment (brackish water) the preference shifts to animal matter. With their opportunistic ability to feed on a variety of alternative food resources, cichlids are considered extensively adapted to trophic specializations. From the present results it may be concluded that *E. suratensis* is a predominantly herbivorous fish, feeding mainly on aquatic macro and micro vegetation in the Vellayani freshwater lake ecosystem.

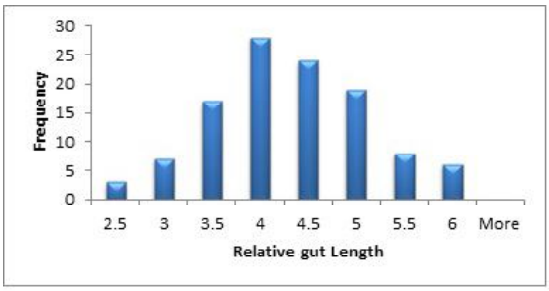

Fig. 6. Histogram showing the relative gut length of *E. suratensis*

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