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Interrelationship between the Alimentary Tract, Food and Feeding Habits of Plueronectiform Fishes of Southeast Coast of India

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ABSTRACT: This paper examines the interrelationships between the morphology of the alimentary tract, the type of food and the feeding behaviour in 22 sps. of flatfishes obtained from Cuddalore coast, Tamilnadu, India. 1051 specimens (Psettodidae-52, Bothidae-355, Pleuronectidae-37, Soleidae-364 and Cynoglossidae-243) were procured from trawls operated at a depth of 15-25 fathoms along the Cuddalore coast. To study the functional morphology of the alimentary canal of flatfishes, the nature of mouth, kind of teeth, gillrakers, number of pyloric caeca and the position of stomach, intestine and rectum were examined. Frequency of occurrence methods were employed for their stomach contents analysis. The result of the present study related to the type of food with the morphology of the alimentary tract shows flatfishes obtained from Cuddalore coast categorised into 3 groups i.e. Fish feeders (Psettodidae and Bothidae type-I), Crustacean feeders (Bothidae type-II, Pleuronectidae and Cynoglossidae) and Polychaete-Mollusc feeders (Soleidae). In Psettodidae and Bothidae type-I, the relative length of buccal cavity and stomach were much greater than in Bothidae type-II, Pleuronectidae and Cynoglossidae. However in Soleidae these two sections of the alimentary tract were less important. For the intestine the reverse was evident whereas the rectum exhibits similarity in all faltfishes.

Key words: Flatfish, Plueronectiform, Feeding behaviour, Alimentary Tract

Introduction

The flatfishes of the order: Plueronectiforms (Heterosomata) includes a number of valuable food fishes, marketed as plaice, sole, flounder halibut and turbot [1] which are considered as highly delicious table fishes. Generally these fishes are marine, bottom dwelling, carnivorous fishes distributed between Artic and Equatorial shelf. They are particularly abundant on open continental shelf and prefer smooth- sand or muddy bottom, but few species inhabit gravels as well as sandy areas [2]. Flat fishes are characterised by asymmetrical body primarily that of eyes in the adults which lie on one side of the head either right or left. In addition, the two sides of a flatfish generally differ in colour, nature of the scales and the newly hatched larval forms are normal in being symmetrical with an eye on each side of the head [3]. However, with growth, one or other eye migrates over the top of the head.

Study of the food and feeding habits of fishes has attracted the attention of fishery biologists from the beginning of the last century. Much work on flatfishes has been done in other parts of the world although the number of species around Indian coasts is comparatively more. One of the important problems of fishery research is the investigation on the nutrition of fishes, which is most useful for understanding the qualitative and quantitative connection between them and their food organisms. This provides valuable data, not only for the determination of the food chain, but also to understand the shoaling and migratory habits of fishes, besides forecasting the prospects of commercial fisheries on the coast. The food habits of fishes provide information on their shoaling and migratory habits and feeding adaptations as well. Therefore any information on this topic will contribute to the knowledge required for efficient management of fish stocks [4]. Gut content analysis of fishes generally provide information on the food chain, in view of the competition between species or indicates seasonal, geographical or daily variation in food composition and feeding rate and related migration pattern of the availability of different food sources. From a quantitative and qualitative study of the feeding habits of fishes, it is possible to gather information about the food requirements of fishes which will be useful for ecological and aquaculture studies.

The diet of fishes is related to their digestive morphology and mouth structure. Morphology of the alimentary canal varied considerably in different fishes with different feeding habits. The digestive organ of fishes depends on their phylogeny as well as their feeding habits and may not therefore necessarily possess similar digestive organs. The interrelationships of the alimentary canal of fishes to their, food are particularly evident in the form of mouth, size, shape structure of the pharynx, dentition, gill rakers, structure of the oesophagus, presence or absence of pylori caeca, shape of stomach, intestine and relative length of the gut. All these structures are subject to diverse and significant variations and modifications in accordance with the feeding habits of different fishes. The diversity in feeding habits that the fishes exhibit is particularly the result of evolution leading to structural adaptation for getting food from the equally great diversity of situations that have evolved in the environment. Conversely the importance of food in the daily life of a fish is “reflected” in the form of mouth, jaw, dentition, the shape and size of the gillrakers etc. and therefore, the differences in the feeding habit.

However, no published information is available either on the food or the interrelationships between the alimentary tract and the food of flatfishes occurring along the Cuddalore coast. Hence, the present study is an attempt to gather information on the food and feeding habits and the interrelationships between the food and the morphology of the alimentary tract in 22 sps. of flatfishes (Pleuronectiformes) obtained from the Cuddalore coast.

Scope of the present study

Studies on interrelationship between the morphology of the alimentary tract and food and feeding habits of fishes are essential to a complete understanding of the functional role of fishes in aquatic ecosystems. The successful management of various fish stocks must include an understanding of the interaction between fish population and their prey [5]. In recent years various aspects of flatfishes have been subjected to the matter of discussion owing to the importance of both in capture and culture fisheries. However, until quite recently comparatively little attention was paid to the morphology of the alimentary tract in relation to the food of faltfishes.

Cuddalore is one of the important fishing centres along the South east coast of India. Varieties of fishes and shellfishes are landed regularly. Nevertheless, no published information is available on the Ichthyofauna of Cuddalore coast. The present study proceeds with the following objectives.

1. To understand the qualitative analysis of the food of flatfishes of the Cuddalore coast.
2. To study the nature of gillrakers, the number or absence of pyloric caeca and their role in the feeding behaviour of flatfishes.
3. To study the relative length of the alimentary tract and their role in the feeding habits of flatfishes and to categorise the flatfishes based on the food habits.

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4. To understand the interrelationships between the morphology of the alimentary tract and the food and feeding habits of the flatfishes occurring along the Cuddalore coast.

Study area

The specimen used for the present study were procured from trawl catches off the Cuddalore fishing harbour (Lat. 11° 42 N: Long. 79° 46' E) located along the Southeast coast of India. It is one of the important fish landing centers in Tamil Nadu. The river Pennaiyar Gadilam, Paravanar and Uppanar merges with the Bay of Bengal near Cuddalore, forming a dynamic estuarine environment before discharging their waters into sea. This fishing harbour is banked on the northern side about 1 Km from the mouth of Uppanar and Paravanar estuarine complex. The Cuddalore open waters are relatively rough throughout the year. The beach as well as sea bed are sandy in nature. The region receives an annual average rainfall of nearly 86% contributed by Northeast monsoon and rest from the Southwest monsoon. The Cuddalore coastal waters are bestowed with rich variety of fauna and flora, which may perhaps be due to the mixing of Pennaiyar, Gadilam, Paravanar and Uppanar rivers resulting in high production. The harbour is capable of handling about 12,000 to 14,000 tonnes of fishes per year. Nearly 10,000 non-mechanized boats, 850 catamarans and 250 mechanized boats (trawlers) have been deployed in fishing activities, which includes 18.24m sized boats. Varieties of gear are employed for the exploitation of resources however the most effective gear being the trawl net, with mesh size ranging from 3mm to 12mm. Among the varieties of fishes landing at the Cuddalore harbour, flatfishes constitute a significant proportion, throughout the year. The specimens employed for the present study were collected from the trawl catches landed at the Cuddalore harbour.

Material and Methods

A total of 1051 specimens (Psettodidae-52 Bothidae-355, Pleuronectidae-37, Soleidae- 364 and Cynoglossidae-243) were procured from trawls operated at a depth of 15-25 fathoms along the Cuddalore coast. In order to study the functional morphology of the alimentary canal of flatfishes, the nature of mouth, the kind of teeth, gill rakers, number of pyloric caeca, the position of stomach, intestine and rectum were carefully studied. To investigate the relative importance of the different parts of alimentary canal of flatfishes, the method described by [6] was followed here. For each individual of the species investigated, the sketch was made for the gillrakers and the viscera in situ. Then the following measurements were recorded.

Length of whole alimentary tract uncoiled from lips to anus.
Length from lips to esophagus (buccal and pharyngeal cavity).
Length of esophagus and stomach to pyloric valve.
Length of duodenum.
Length from the intestinal rectal calve to anus.

For gut analysis, each specimen was examined in fresh condition. The total length, standard length, gut length and weight of each individual were recorded. The alimentary tract was dissected out and preserved in 5% formaldehyde. Entire digestive tract was examined as the food items were noticed throughout the alimentary canal.

The stomach contents were examined separately with the aid of binocular microscope, then sorted and identified to the lowest possible taxa and enumerated. Hence, in the present study, the frequency of occurrence method [7,8,9,10] was adopted. In this method, the number of guts containing a particular item of food is expressed as percentage of the total numbers of guts examined. The method was carried out in two steps. Firstly, all the food items were sorted out and presence and or absence in a particular gut were recorded. Secondly, the number of guts in which particular food items is noted down and the data for all the food items is pooled and converted into percentage. The percentage occurrence of each item was noted and the preference of particular food items of flatfishes was also checked.

Morphology of the alimentary tract of flatfishes

The morphology of the alimentary tract in 22 sps. of flatfishes belonging to 5 familes (Psettodidae, Boothidae, Pleuronectidae, Soleidae, Cynoglossidae) obtained from Cuddalore coast is presented below.

Psettodidae: (Fig.2, No.1)

Psettodes erumei is the only species collected in this family and 52 specimens were studied. In this fish, the stomach region is large and the intestine is very simple. The buccal cavity to stomach region constitute more than half (55%) of the alimentary tract (Fig.1, Table.1). Brush like teeth, which act as gill arches in this species are evident. The pyloric appendices lie in a bundle, numbering from 10-18 is seen in between the stomach and midgut region.

Bothidae:

Seven representatives of the family Bothidae presented a more complicated picture. It is possible to distinguish two types according to the form of the intestine. The seven species of Bothids studied could be divided into two groups, Bothidae type-I and Bothidae type-II.

Bothidae Type-I: (Fig.2, Nos. 2-5)

Totally 204 specimens belonging to four species (Type – I) (32 specimens of *Pseudorhombus dupliciocellatus*, 66 specimens of *Psuedorambus triocellatus*, 58 specimens of *Pseudorhombus arsius* and 48 specimens of *Engyprosopon grandisquama*) were analysed. Though these, fishes also have a large esophagus, the stomach region constitutes more than half (40-62%) of the alimentary tract (Fig.1, Table-1). Gillrakers are well developed, as broad as long palmate like with pointed serrae. The pyloric caeca numbering 4 in between stomach and intestine was evident.

Bothidae Type-II (Fig.2, Nos. 6-8)

A total of 151 specimens belonging to 3 species of this family were (*Pseudorhombus malayanus*-47, *Pseudorhombus elevates*-57, *Crossorhombus valderostratus* -47) studied presently. The buccal and stomach region in this group contributes less than half (48%) of the alimentary canal (Fig.1, Table-1). However the intestinal loop is not well developed but the pyloric appendices numbering 1 to 3 in Bothidae (Type-II) was evident.

Pleuronectidae: (Fig.2, No.9)

Only one species of this family (*Samaris cristatus*) was collected from Cuddalore coast. 37 specimens were studied in this group. In all aspects it is similar to Bothidae Type- II. However, buccal cavity to stomach part in this fish is below half of alimentary tract 43 % (Fig.1,Table-1). The gill rakers were present numbering 1-3 in this group. The intestinal loop is still complex.

Soleidae: (Fig.2, Nos.10-16)

A total of 364 specimens belonging to 7 species of this family were analysed (*Hetromycteris oculus*-23, *Aesopia cornuta*-57, *Zebrias synapturoides*-68, *Zebrias quagga* -63, *Zebrias altipinnis*-35, *Synaptura albomaculata*-62, *Synaptura commersoniana*-56). The buccal cavity to stomach region is less than (10-32%) a third of the alimentary tract (Fig.1, Table-1) but the intestinal loop is more complicated, comprising 53.33% to 66.3%. The gill rakers are absent on the gill arches, similarly the pyloric appendices were also absent.

Cynoglossidae: (Fig.2, Nos.17-22)

In this group 243 specimens belonging to 6 species were investigated presently (*Paraplagusia bilineata*-23, *Cynoglossus arel*-45, *Cynoglossus punticeps*-50, *Cynoglossus semifasciatus*-46, *Cynoglossus monopus*-22, *Cynoglossus lida*-57). These fishes have a well developed oesophagus and stomach however the buccal cavity to stomach region comprises 30-35% (Fig.1, Table-1) in the entire alimentary tract. Intestinal loop in *Cynoglossidae* was more complicated with 4-8 convolutions constituting 50 – 60 % (Table -1). The gill rakers and pyloric caeca were absent in this group.

In Psettodidae and Bothidae type-I the relative length of buccal cavity and stomach were much greater than in Bothidae type-II, Pleuronectidae, and the Cynoglossidae (Table-1). However, in Soleidae these two sections of the alimentary tract were less important. For the intestine, the reverse was evident whereas the rectum exhibits similarity in all flatfishes.

Table: 1. Percentage of relative lengths of different parts of alimentary tract in 22 species of flatfishes

Species	Buccal and Pharyngeal cavity	Oesophgus and stomach	Intestine	Rectum
Psettodes erumei	20.21	35.9	36.05	8.65
Pseudorhombus dupliciocellatus	17.02	45.76	23.40	13.82
Psuedorhombus triocellatus	12.67	45.07	36.81	8.45
Psuedorhombus arsius	12.80	44.00	33.6	9.6
Engyprosopon grandisquama	21.42	25.25	43.81	9.52
Pseudorhombus malayanus	12.51	36.47	41.35	9.67
Pseudorhombus elevates	10.29	39.70	38.25	11.76
Crossorhombus volderostratus	8.88	40.55	40.15	10.42
Samaria cristatus	10.33	23.15	53.30	13.22
Heteromycteris oculus	7.14	14.68	66.27	11.91
Aesopia cornuta	5.84	22.12	63.84	8.20
Zebrias synapturoides	5.25	20.30	64.41	10.04
Zebrias quagga	4.71	25.12	62.78	7.39
Zebrias altipinnis	5.61	20.96	62.44	10.99
Synaptura albomaculata	2.61	7.10	59.58	37.11
Synabtura commersoniana	6	24.25	57.75	12
Paraplagusia bilineata	9.20	20.08	56.48	14.22
Cynoglossus arel	7.38	27.85	56.25	8.52
Cynoglossus punticeps	8.33	23.2	51.85	16.62
Cynoglossus semifaciatus	8.06	20.74	60.82	10.38
Cynoglossus monopus	7.85	22.77	57.60	11.78
Cynoglossus lida	8.60	15.05	59.15	17.20

Fig.1. Relative lengths of different parts of alimentary tract in 22 species of Flatfishes

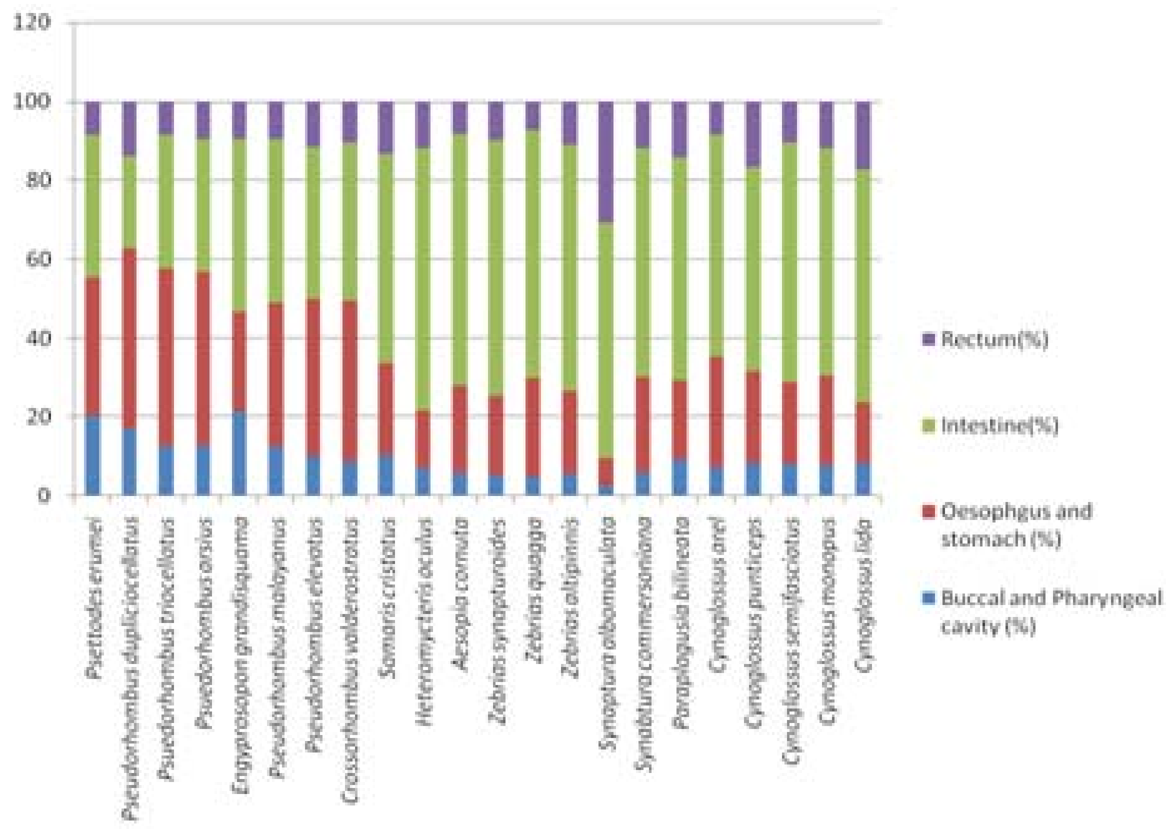
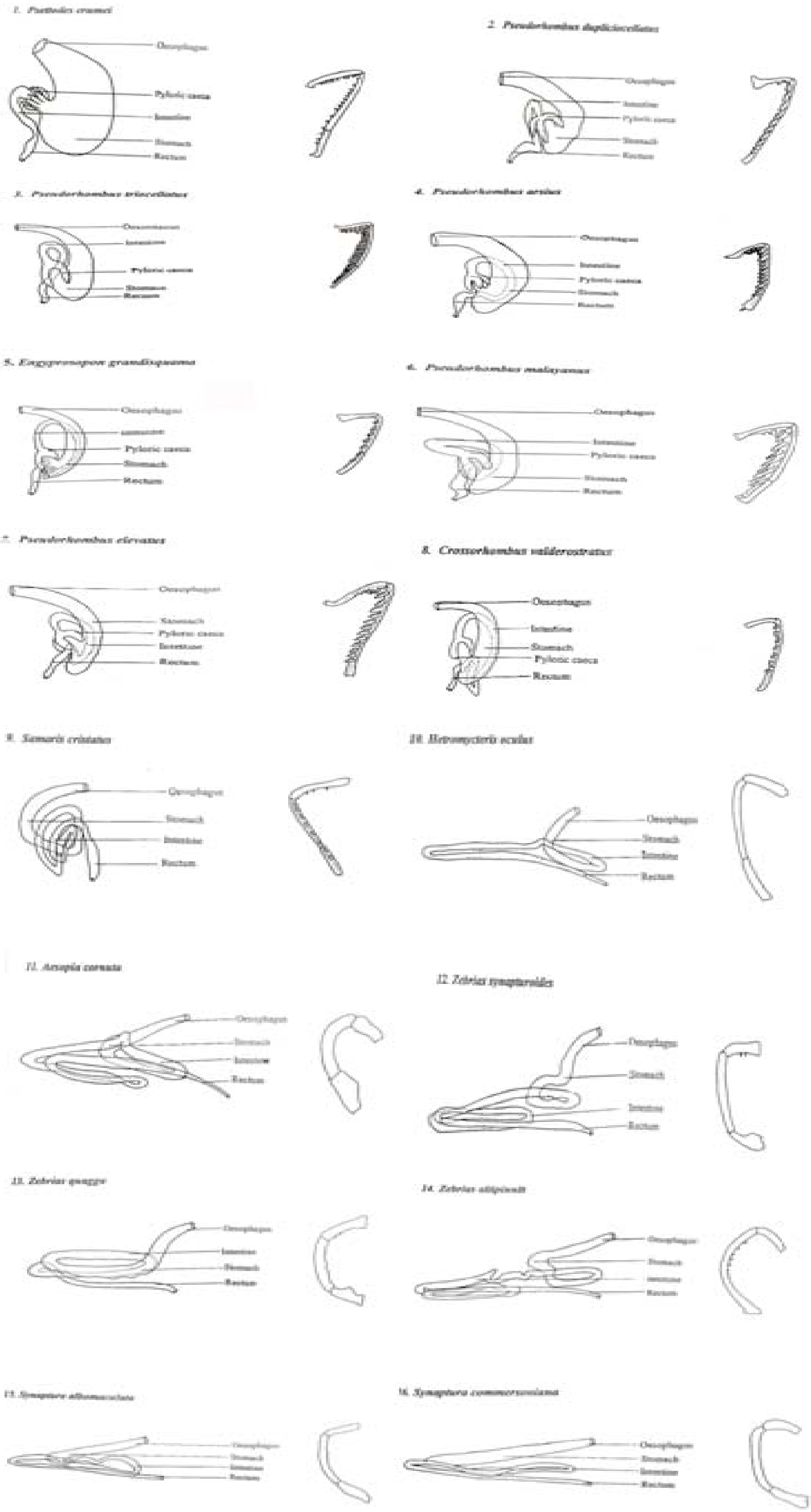
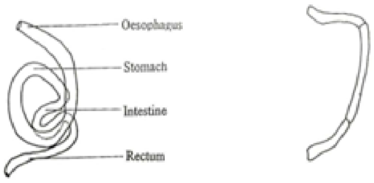


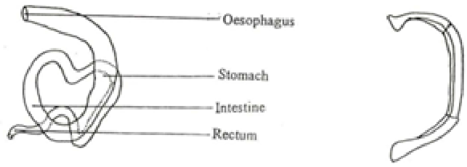
Fig. 2. Shape of alimentary tract and structure of the gillrakers in 22 species of flatfishes collected from Cuddlore coast.



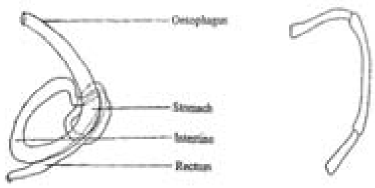
17. *Paraplagusia bilineata*



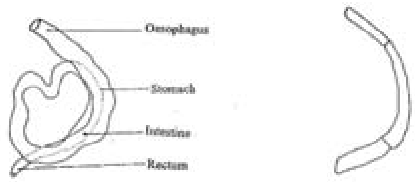
18. *Cynoglossus arel*



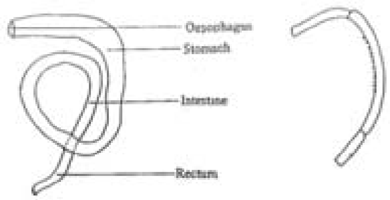
19. *Cynoglossus puncticeps*



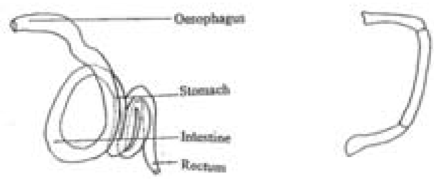
20. *Cynoglossus semifasciatus*



21. *Cynoglossus monopus*



22. *Cynoglossus lida*



Food and feeding habits of flatfishes

The results obtained in the present investigation on the food composition of flatfishes have been summarised below.

Psettodidae:

Fifty two specimens of *Psettodes erumei* were analysed. From the analysis, it was found that they subsist mainly on fishes like gobiid fishes, *Stolephorus* sp. and other teleosts. Of the 52 specimens investigated, the stomachs of 33 specimens were found to contain fishes (Table- 2). Other organisms such as squids, small crabs, amphipods and polychaetes also constituted the food items of *Psettodes erumei*.

Bothidae:

Based on the composition of food, the 7 species of Bothidae could be divided into two types, Bothidae type-1 and Bothidae type-II.

Bothidae Type-I:

Of the 204 specimens belonging to *Psedorhombus dupliciocellatus* (32 specimens) *Pseudorhombus triocellatus* (66 specimens) *Pseudorhombus arsius* (58 specimens) and *Engyprosopon gradisquama* (48 specimens) analysed, the stomach of these species contained predominantly fishes (more than 45%) (Table-3), supplemented by amphipods, prawn larvae, polychaetes etc. Crustacean constituted the second largest food item in this group (nearly 30%). Hence, it may be concluded that Bothidae are fish feeders.

Bothidae Type-II:

Pseudorhombus malayanus, Pseudorhombus elevatus, Crossorhombus valderostratus constituted the Bothidae type-II. Totally 151 specimens were analysed for the gut contents. On an analysis of gut content, it was evident that crustaceans constituted the largest group (Table-2). From this it is concluded that Bothidae type-II predominantly feeds on crustaceans.

Pleuronectidae:

Only one species of this family (*Samaris cristatus*) was collected from Cuddalore coast. Totally 37 specimens were analysed. On analysis it was evident that the stomach of 18 specimens contains crustaceans (Table-2). Further, crustaceans constituted nearly 40% (Table-3) among the total food items, supplemented by polychaetes, molluscs and detritus. From this it is concluded that pleuronectids feed on crustaceans.

Soleidae:

A total of 364 specimens belonging to 7 species of this family (*Heteromycteris oculus*-23, *Aesopia cornuta*-57, *Zebrias sysnapturoides*-68, *Zebria quagga*-63, *Zebrias altipinnis*-35, *Synaptura albomaculata*-62, *Synaptura commersoniana*-56) were studied, and it was found that a major portion, nearly 50% (Table-3), of their food is formed by polychaetes. Amphipods, isopods, molluscs and fish scales also constituted the food items in this group. Hence, it can be concluded that Soleids are polychaete-molluscs feeders.

Cynoglossidae:

Totally 243 specimens belonging to 6 sps. were investigated (*Paraplagusia bilineata*-23, *Cynoglossus arel*-45, *Cynoglossus puncticeps*-50, *Cynoglossus semifaciatus*-46, *Cynoglossus monopus*-23, *Cynoglossus lida*-57). The observations showed that these fishes mostly consumed crustaceans (Table - 2), which constituted more than 50% (Table-3) of the total food items. This main food items (crustaceans) includes the juvenile penaeids, amphipods, prawns, crabs and squilla. The other minor food components observed are polychaetes, molluscs and detritus.

Table: 2. Frequency of occurrence main type of food in the stomachs of 22 species of flatfishes

Species	Fish	Crab	Prawn	Amphipod	Squilla	Polychaete	Mollusc	Detritus
Psettodes erumei	33	6	10	3	2	3	8	4
Pseudorhombus dupliciocellatus	24	8	4	3	1	8	4	-
Psuedorhombus triocellatus	43	8	-	10	-	4	11	17
Psuedorhombus arsius	30	21	-	-	-	7	3	-
Engyprosopon grandisquama	18	5	4	3	-	7	14	3
Pseudorhombus malayanus	12	17	13	6	-	-	3	-
Pseudorhombus elevatus	5	17	13	-	23	-	7	-
Crossorhombus volderostratus	-	12	14	13	14	3	2	-
Samaria cristatus	4	7	6	5	-	9	15	-
Heteromycteris oculus	-	3	4	5	-	16	4	-
Aesopia cornuta	2	12	9	3	-	36	4	-
Zebrias synapturoides	5	-	20	4	-	32	6	-
Zebrias quagga	-	7	8	2	7	32	6	-
Zebrias altipinnis	-	4	6	-	-	21	8	7
Synaptura albomaculata	4	3	6	-	-	32	30	4
Synabtura commersoniana	7	-	-	3	-	38	12	2
Paraplagusia bilineata	2	-	-	3	-	38	12	2
Cynoglossus arel	14	9	8	-	12	7	3	-
Cynoglossus punticeps	3	8	13	7	7	21	12	
Cynoglossus semifaciatus	5	12	6	12	-	8	6	3
Cynoglossus monopus	6	4	8	-	-	-	12	2
Cynoglossus lida	-	12	13	8	9	11	7	2

Table: 3. Percentage composition of different types of food in 22 species of flatfishes

Species	Fish	Crustacean	Polychaete	Mollusc	Others
Psettodes erumei	47.82	13.41	4.34	11.59	5.79
Pseudorhombus dupliciocellatus	46.15	28.83	15.83	9.61	-
Psuedorhombus triocellatus	46.23	19.35	4.35	11.84	18.20
Psuedorhombus arsius	48.87	34.42	11.47	4.91	-
Engyprosopon grandisquama	33.32	22.22	12.96	25.94	5.50
Pseudorhombus malayanus	23.52	70.58	-	5.88	-
Pseudorhombus elevatus	7.69	81.53	-	10.76	-
Crossorhombus volderostratus	-	91.37	5.18	3.45	-
Samaria cristatus	8.69	39.13	19.56	32.59	-
Heteromycteris oculus	-	37.50	50	12.5	-
Aesopia cornuta	3.03	36.35	54.54	6.06	-
Zebrias synapturoides	7.04	33.79	45.07	8.45	-
Zebrias quagga	-	34.76	46.37	15.94	2.89
Zebrias altipinnis	-	21.75	45.65	17.39	15.21
Synaptura albomaculata	5.06	11.38	40.50	37.96	5.06
Synabtura commersoniana	11.29	4.83	61.29	19.35	3.22
Paraplagusia bilineata	8.69	60.86	21.73	6.69	-
Cynoglossus arel	26.41	54.71	13.20	5.66	-
Cynoglossus punticeps	4.34	47.81	30.43	17.39	-
Cynoglossus semifaciatus	9.60	57.67	15.38	11.53	5.76
Cynoglossus monopus	18.75	37.50	-	37.50	6.25
Cynoglossus lida	-	67.72	17.74	11.29	3.22

Based on the observation, it has been concluded that the members of the family Psettodes and Bothidae (Type-I) are fish feeders, whereas representatives of Bothidae (Type-II) and Cynoglossidae are crustacean feeders. Species belonging to Soleidae are polychaete- mollusc feeders.

Discussion

[11] rightly pointed out that the shape of the digestive tract of a fish provides a useful taxonomic character but he has not correlated the shape of the digestive tract with the nature of food. But this in turn was attempted by various authors [12,13,2]. The diet of fishes is related to their digestive morphology and mouth structure [14]. Fishes have evolved organs to seek out food according to the characteristics of their feeding behaviour [15]. [16] have found that the size of the mouth relative to body length was correlated with the size of food organisms in Bothid flounder. Symmetry of the jaws also plays an important role in the mode of feeding. Species with symmetrical jaws generally take free-swimming food, while those with asymmetrical jaws mainly subsist on bottom material [17]. Flatfishes that feed on polychaete and molluscs typically have smaller stomachs, larger intestine, but smaller gill rakers with fewer teeth than flatfishes feed on other items [18].

The findings of the present study on 22 species of flatfishes belonging to five families show that it is possible to relate the type of food with the morphology of the alimentary tract. On analysis of the gut content, adopting the frequenting of occurrence methods, it is possible to divide the flatfishes obtained from Cuddalore coast into 3 categories.

Category 1 Fish feeders: *Psettodes erumei* belonging to Psettodidae and *Pseudorhombus triocellatus*, *Psuedorhombus arsius*, *Engyprosopon grandisquama*, belonging to Bothidae (Type-I) may be categorized as fish feeders.

Category 2 Crustacean feeders: *Psueudorhombus malayanus*, *Pseudorhombus elevates, Crossorhombus valderostratus* belonging to Bothidae (Type-II) and *Samaris cristatus* belonging to Pleuronectidae and *Paraplagusia bilineata*, *Cynoglossus arel*, *Cynoglossus puncticep,* *Cynoglossus semifasciatus*, *Cynoglossus* *monopus*, *Cynoglossus lida* belonging to Cynoglossidae may be categorized as crustacean feeders.

Category 3 Polychaete - mollusc feeders: *Heteromycteris oculus, Aesopia cornuta, Zebrias synapturoides, Zebrua quagga, Zebrias altipinnis, Synaptura albomaculata, Synaptura commersoniana* belonging to Soleidae may be categorized as polychaete – molluscs feeders.

The buccal and the pharyngel cavities together with the oesophagus and stomach constituted more than 50% of the alimentary tract in Psettodidae and Bothidae (Type- I), between 30%-50% in Bothidae (Type-II), Plueronectidae and Soleidae, where as in Cynoglossidae it is about 20- 40 %. These variations have been related to the differences in the food consumed by these fishes.

Psettodis and Bothids (Type –I) mainly consumed fish and they may be considered as fish feeders. In order to accommodate the large sized food organisms, the buccal cavity up to the stomach region is relatively large. Most of the food is digested in the stomach region itself, but only a part of the undigested food was observed in the intestinal region [6]. The Soleids, being polychaete mollusc feeder, they mainly consumed as small items. As the polychaete and mollusc are fragile and soft, they do not need large storage space but a long intestine (more than 60% of the gut) is very useful in digestion and absorption. However Bothids (Type–II), Plueronectids and Cynoglossids appear to occupy an intermediate position since they mostly feed on crustaceans.

The shape and size of gillrakers also appear to have a close relationship with the type of food consumed as reported by [6]. The gillrakers were very well developed in fish feeders (Psettodids, Bothids Type–I), but absent in polychaete- mollusc feeders (Solides). Gillrakers were slightly developed in most crustacean feeders (Bothids Type-II, Cynoglossids, Pleuronectids). In fish feeders, since the prey is large and active swimmers, the well developed gillrakers will be useful to prevent them from escaping. Whereas, in the case of polychaete-mollusc feeders, since the prey items were easily caught, the gillrakers may not be of much use and have not developed. In crustacean feeders, it is seen that the gillrakers are just developed in order to prevent the food items capable of swimming, from escaping.

In the present study, the numbers of pyloric appendices was found to vary in the different groups as observed. In fish feeders (Psettodis, Bothids Type-I), the number of pyloric appendices were found to be more, whereas in crustacean feeders (Bothids Type-II, Pleuronectids, Cynoglossids), it is limited in number (2-4). The polychaete – molluscs feeders (Soleids) do not possess pyloric appendices, which is in agreement with the finding [19]. However, the pyloric appendices increase in number with the size of the food.

Though the present findings on the food and feeding habits and the interrelationships between the morphology of the alimentary tract of the flatfishes collected from the Cuddalore coast are in general agreement with the findings of [19] and [20], it differs from the observation of [6] on Netherland flatfishes.

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