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FORAGING BEHAVIOR PATTERNS OF FOUR SELECTED COMMERCIALLY IMPORTANT FISH SPECIES IN KASARAGOD DISTRICT, NORTHWEST PART OF KERALA

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Abstract

Commercially important demersal fish specimens were collected from the fish landing centre during January - March 2014 of Azhithala, Madakkara, Meenapees and Kasaragod. The samples were selected randomly and stored in boxes containing ice. The various food items recorded from the stomach of marine fishes such as *Mugil cephalus*, *Nemipterus japonicas*, *Nibea soldado* and *Rastrelliger kanagurta*. Generally, the food items found in the examined stomachs were grouped into sixteen categories namely crustacean, polychaetes, fish larvae, fish scales, fish eggs, bivalves larvae, gastropods larvae, zooplankton, siphonophores, amphipods, sand grains, digested matter, miscellaneous and decomposed unidentified tissue. The fish *M. cephalus* is carnivorous and the food comprises mostly organisms of the crustaceans along with fishes. It feeds mainly on fishes such as, gastropods, copepods (*Acartia danae*, *Eucalanus attenuates* and *Labidocera minuta)* and small prawn were as *R. kanagurta* feed on macroplankton including the larvae of shrimp and fish. The present finding shows that the It feeds mainly on small shrimps (15.35%), gastropods larvae (6.57%) and mysids (4.82%). Based on the results of the study, it can be concluded that there exist complex food and feeding patterns in specific locations. This information is very important for those involved in the management of fishery resources as well as for the efficient exploitation of the species.

Key words: Foraging behaviour, Diet composition, Kasaragod and Commercially important fishes.

1. Introduction

The study of dietary habits of fish based on stomach content analyses is also widely used in fish ecology as an important means of investigating trophic relationships in aquatic communities (Fagbenro *et al.*, 2001).

Understanding how organisms utilize resources allows the identification of factors that affect their distribution and abundance. A compilation of different food items consumed by a fish species may eventually result in identification of stable food preferences and in a preliminary estimate of trophic level (Sa-a P *et al.*,1997). Stomach content studies on fish fauna are almost nonexistent and deal mainly with qualitative information (Alvarez *et al*., 1999). The knowledge of the feeding ecology of non commercial as well as commercial species is necessary for

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implementing a multispecies approach to fisheries management. Traditionally, information on the quality and quantity of food consumed by fish, which can be derived from feeding studies, is made operational for fisheries research through incorporation into appropriate fisheries models (Mohanraj and Prabhu, 2012).

Fish are important in the diet of coastal region of Kerala. Since there has been no much studies happened on fish consumed in north Kerala, the gut content analysis of some important marine fish holds a higher value in research. The aim of the study is gut or stomach content analysis of four commercially important marine fish and determine the composition and abundance of the natural prey population such as zooplankton.

2. Materials and Methods

2.1. Survey area and selection of fish species

Important fish species were selected based on factors such as the high demand of the species for downstream industries and the increase in annual landings in the last decade

2.2. Sampling methods

Fish samples were collected during January - March 2014 from fish landings of Azhithala, Madakkara, Meenapees and Kasaragod. After catching, all the fish collected were placed in an icebox half-filled with ice in order to preserve their gut stomachs were removed and preserved in 10% formalin to prevent any further digestion and decomposition of the contents.

2.3. Identification and Photo documentation of Fish Samples

After the field collection, photo documentation of each fish was done using a digital camera (Kodak EASYSHARE). The fish were identified using the manual of Fish base Worldwide Web Electronic Publication (www.fishbase.com, Froese and Powly, 2005). Dissection of the gut content was conducted right after the photo documentation.

2.4. Gut Content Analysis

Intact stomach was separated from the fish and weighed using Analytical balance. The weight of the stomach and its contents were recorded. Afterwards, the stomach were dissect and its contents will preserve with 5% formalin. The preserved stomach contents were then examined under a stereomicroscope and contents will enumerated and identified to the lowest taxa possible.

3. Results

Table - 1: List of the selected marine demersal fishes for dietary composition studies from Kasargod Distrist, Kerala

S.No.	Scientific name	Common name	Length (cm)	Weight (Kg)
Marine Fishes				
1	*Mugil cephalus*	Mullet	15.58	56.59
2	*Nemipterus japonicas*	Thread Fin Bream	11.9	25.99
3	*Nibea soldado*	Jaw Fish	17.54	54.84
4	*Rastrelliger kanagurta*	Mackerel	20.3	87.73

Table - 2: Percentage occurrence of food items in the diet of fish species

Marine water Fishes				
Food items/ Fishes	***Mugil cephalus***	***Nemipterus japonicas***	***Nibea soldado***	***Rastrelliger kanagurta***
Crustacean				
Crab	1.124	4.3796	1	2.193
Tannaids	1.685	0	0	0
Isopods	2.809	2.1898	0	0
Amphipods	2.247	3.6496	0	0
Small prawn	3.371	0.7299	0	0
Shrimps	1.124	0	3	6.579
Mysids	2.809	17.25	1	4.825
Copepods	3.371	1.4599	7.5	2.193
Lucifer	1.124	2.1898	3	0
Egg and Larva	0.562	0.7299	2.5	0
Polychaetes	1.69	0	1	2.193
Fish	1.12	10.95	0.5	0.877
Fish larvae	0.56	11.68	0.5	0.439
Fish scales	2.81	0.73	5	0.439
Fish eggs	1.12	1.46	0	0.439
Bivalves	0.56	0	8	12.72
Gastropods	14	1.64	13	15.35
Zooplankton	0	3.65	0	0
Acartia danae	14.6	0	0	2.19
Acartia spinacuda	1.12	0	0	0
Eucalanus attenuates	2.25	1.25	0	0.88
Euchaeta concinna	1.12	3.65	0	0.44
Labidocera minuta	2.81	1.46	0	0.88
Oithona rigida	1.12	2.19	14	0.44
Corycacus danae	0.56	0	0	0.88
Euterpina acutifrons	0.56	0	0	11.4
Siphonophores	1.12	0	0.5	0
Amphipods	0.56	0	6	0
Sand grains	10.1	1.46	10.5	13.16
Digested matter	12.4	10.95	6	8.333
Miscellaneous	2.81	8.759	3	2.193
Decomposed unidentified tissue	6.742	1.46	14	10.96

The various food items recorded from the stomach of four economically important marine fishes such as *Mugil cephalus, Nemipterus japonicas, Nibea soldado* and *Rastrelliger kanagurta* during the study period are presented in Table - 1. Generally, the food items found in the examined stomachs were grouped into sixteen categories namely crustacean, polychaetes, fish larvae , fish scales, fish eggs, bivalves, gastropods, zooplankton, siphonophores, amphipods, sand grains, digested matter, miscellaneous and decomposed unidentified tissue.

3.1. *Mugil cephalus*

Mugil cephalus is cosmopolitan in the coastal waters of most tropical and subtropical zones. Flathead grey mullet has a good market in some countries, especially in the southern and eastern Mediterranean region. It is also consumed in many Asian countries. The flathead grey mullet is catadromous, frequently found coastally in estuaries and freshwater environments. Adult mullet have been found in waters ranging from zero salinity to 75‰, while juveniles can only tolerate such wide salinity ranges after they reach lengths of 4–7 cm. Flathead grey mullet is a diurnal feeder, consuming mainly zooplankton, dead plant matter, and detritus. Mullet have thick-walled gizzard-like segments in their stomach along with a long gastrointestinal tract that enables them to feed on detritus. In the present study a total number of 15 specimens in the size range 15.58 cm were examined. *M.cephalus* is carnivorous and the food comprises mostly organisms of the crustaceans along with fishes. This fish occurs in coastal waters from near shore to the continental shelf margin. It feeds mainly on fishes such as, gastropods, copepods (*Acartia danae, Eucalanus attenuates* and *Labidocera minuta)* and small prawn. The analyzed stomach contents included a isopods 2.809%, amphipods 2.247%, small prawn 3.371%, copepods 23.3%, digested matter 14%, decomposed unidentified tissue 6.742% (Table - 1).

3.2. *Nemipterus japonicus*

Japanese threadfin bream, *Nemipterus japonicas* Bloch, 1791 is a demersal species abundant in the muddy or sandy bottom along all the coastal stretches of India. This tropical species live in schools, generally close to bottom normally around depth zones of 50-100 m with high concentration in 80-100 m. It feeds mainly on mysids, small fishes, crustaceans, molluscs (mainly cephalopods), polychaetes and echinoderms. Present investigations we have found that following food items dominant in the stomach of the *Nemipterus japonicas.* The major food items were shrimps including mysids., crabs (unidentified), small, fishes, cephalopods and zooplankton. Unspecified digested materials were also found among the food contents (Table - 1).

3.3. *Nibea soldado* (Lacepede, 1802)

This species Inhabits shallow coastal waters and estuaries distribution of this species Indo-West Pacific, west to India, east to Queensland coasts of Australia. It feeds mainly on crustaceans, copepods (*Oithona rigida),* decomposed unidentified tissue and fishes. This fish is an active carnivore, copepod, *Oithona rigida* (14.0%) and amphipods (6.0%) forming the main constituent of the diet. Other organisms were also found in the stomach (Table - 1).

3.4. *Rastrelliger kanagurta*

The Indian mackerel (*Rastrelliger kanagurta*) is a species of mackerel in the scombrid family (family Scombridae) of order Perciformes. It is commonly found in the Indian and West Pacific oceans, and their surrounding seas. It is an important food fish and is commonly used in South and South-East Asian cuisine. The Indian mackerel is generally found in shallow, coastal waters, where the surface water temperature is at least 17 °C (63 °F). Adults of this species are found in coastal bays, harbours and deep lagoons. They are commonly found in turbid waters rich in plankton. Adult Indian mackerel feed on macroplankton including the larvae of shrimp and fish. The present finding shows that the It feeds mainly on small shrimps (15.35%), gastropods larvae (6.57%) and mysids (4.82%). Other organisms were also found in the stomach (Table - 1).

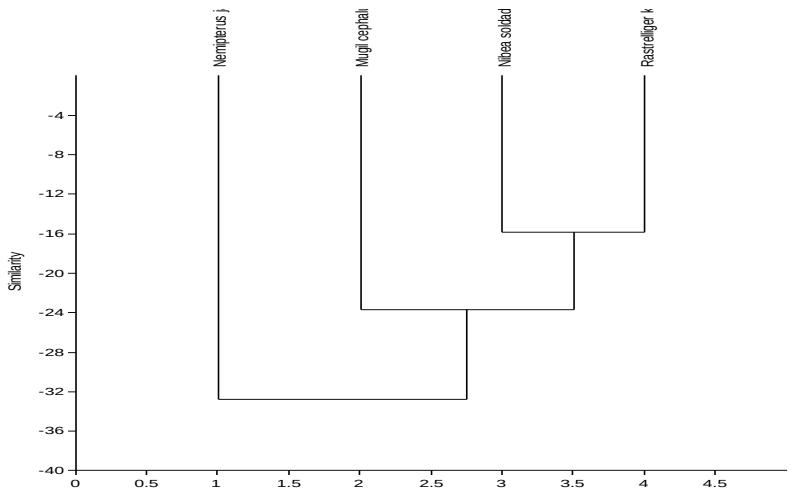

Fig – 1: Cluster analysis result showed that the similarities of feeding habitat among the fish species

3.6. Station association

Dendrogram of fish species association reveal that feeding behaviour. Fish species such as *Nibea soldado* & *Rastrelliger kanagurta* has the shortest distance linkage this close similarity between species (Fig - 1). Its point out for occurrence, the composition of the food in the gut almost similar. Similarly, *Mugil cephalus* form second shortest distance with *Nibea soldado* & *Rastrelliger kanagurta*. From the CA the fish, *Nemipterus japonicas* variation with other species it indicates the distribution of food in the gut of *N.japonicas* highly variable from other species.

4. Discussion

This study dealt with the identification of the diet composition of some commercially important fishes collected from Kasaragod district, Northern Kerala from two seasons post monsoon and summer 2014. There were four fish species such as *Mugil cephalus, Nemipterus japonicas, Nibea soldado* and *Rastrelliger kanagurta.* Results of this study showed a diverse gut composition of fishes. There were sixteen categories namely crustacean, polychaetes, fish larvae, fish scales, fish eggs, bivalves, gastropods, zooplankton, siphonophores, amphipods, sand grains, digested matter, miscellaneous and decomposed unidentified tissue identified.

Fishes being the main consumers in almost all aquatic ecosystems, knowledge of the food and feeding of every species in the habitat is a pre-requisite to understand the energy relationship in an ecosystem. Thus, from the ecological point of view, a detailed study on the food and feeding habits is very valuable to analyse the relation between the concerned feeding on the fishes and there any formation of other organisms such as parasites and abnormal growth. Generally, the stomach is considered for evaluating the food and feeding, however in case of omnivorous fish the alimentary canal is very long and retain most of the food for prolonged period (Venkataraman, 1960).

The *Mugil cephalus* stomach contents as identified feed compositions in the following order; Zooplankton < Digested matter < Sand grains < Decomposed unidentified tissue < Small prawn < Copepods < Polychaetes < Egg and Larva. The *Nemipterus japonicas* contents as identified feed compositions in the following order; Mysids < Digested matter < Miscellaneous < Zooplankton < Fish larvae < Copepods < Isopods < Fish scales. The *Nibea soldado japonicas* contents as identified feed compositions in the following order; Zooplankton < Sand grains < Decomposed unidentified tissue < Gastropods < Copepods < Crab < Siphonophores. The *Rastrelliger kanagurta* contents as identified feed

compositions in the following order; Gastropods < Zooplankton < Sand grains < Decomposed unidentified tissue < Digested matter < Shrimps < Mysids < Crab < Fish larvae.

All the four fishes with very broad feeding habits are much more apt to eat anything offered in captivity and their dietary requirements are easier to meet. This study agreed with previous studies (Colman, 1970).

Among four marine fishes the crustaceans were most dominant food item. The maximum found in the fish *N.japonicas* (29.65%) minimum were found in the fish, *N.soldado* (12%). Venkataraman (1956) and Prabhu (1955) have been observed crustaceans as one of the main food items of marine fishes and polychaetes were the most dominant among food items and could be easily identified by presence of setae, jaws and occasional body segments. Manoharan *et al*. (2012) have been observed polychaetes as one of the main food items of *Terapon jarbua*.

The present study also showed that copepod was the major food item among the fishes, *E.acutifrons* was found in higher in the *R.kanagurta* whereas calanoid copepod, *A.danae* were found higher in the stomach of *M.cephalus* and cyclopoid copepod, *O.rigida* were found in the stomach of *N.soldado*. Analysis of food and feeding of mackerel by previous workers showed that mackerel *R.kanagurta* is a plankton feeder (Venketaraman, 1961; George, 1952 and Noble, 1965).

Gastropods were in high proportions in *R.kanagurta*, while lowest was observed in the *N.japonicus*. This term agreement with earlier studies in different feeding habits of young size to adult fishes along the Indian coasts (Kuthalingam,1955). Thus, the examination of the stomach contents showed the adult fishes to be mainly zooplankton feeder, copepods constituting the single largest item. Zooplankton most dominant food item the maximum found in the fish *M.cephalus* and minimum was observed in the *N.japonicus* (Qasim, 1972). Manoharan *et al.* (2012) have been reported marine fish such as oil sardine feeds mainly on zooplankton.

The incidence of sand particles in the stomach may be due to accidental ingestion of the food items that have been picked up along with sand particles. It was abundant all the fishes maximum was observed in the *R.kanagurta* (13.16), *N.soldado* (10.6) and *M.cephalus* (10.01). The minimum % was recorded in *N.japonicus* (1.46). Digested matters also were occurrences all the fishes. The maximum was observed in the *N.japonicas* and minimum was recorded in the *N.soldado*.

Miscellaneous has formed predominant food item of adult fishes (Qasim, 1972). Darnell, 1927 Indicated that the miscellaneous consists of all types of biogenic material in various stages of decomposition. It has been found to be consumed very often. The presence of sand grains and fish scales in mackerel stomach has been reported by Devanesan and Chidambaram (1948), Bhimachar and George (1952) and Kutty (1965). Pradhan (1956) found that mackerel impounded in the 'rampan'net had 80-90% of sand grains in their stomach. According to Kutty (1965), the presence of sand grains, formaniferans, fish scales and molluscan shell bits noticed in the stomachs of mackerel from Bombay waters suggested that the fish in all probability fed on the bottom ooze in the sea.

In some fishes high values of percentage occurrence of empty stomachs during the gut analysis it indicates a period of poor feeding activity which also coincide with appearance of more number of mature fishes about to spawn. A number of studies revealed that the highest percentage of empty stomachs occurs during reproduction, due to a decrease in food intake in reproduction period. This study is agreed with previously observed on the food and feeding habits of a some marine fishes of *Sardinella longiceps* (Hornell, 1910). In present study of natural diets of marine water fishes especially valuable approach for understanding aspect in biology and ecology of species and also need sustainable management, development of conservation measures.

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