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Exploring dietary choice a focus on polychaete consumption of some selected benthic fishes from Karwar coast

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Abstract
Stomach contents and polychaete prey were studied in the diet's of three commercially important benthic fish species (*Cynoglossuss macrostomus*, *Pseudorhombus arsius*, bentho-pelagic fish *Otolithes ruber*) in the west coast of Karwar were examined. A total of 4 prey taxa belonging to 6 families of polychaetes were found. The four species were analysed in detail. *Capitella* sp., *Neris* sp., *Glycera alba*, *Mediomastus* sp., *Maldanidae* sp., The frequent species found in the stomach were *Capitella* sp., *Neries* sp., *Glycera alba*. The predator had a clear preference for errant and carnivorous polychaete species probably due to more active behaviour of these prey, and also as of trawl fishing.

Keywords: Gut content analysis, polychaetes, benthic fishes, prey, miscellaneous, Karwar

1. Introduction
There has been little detailed information on the diet's of *Cynoglossuss macrostomus*, *Pseudorhombus arsius*, and bentho-pelagic fish *Otolithes ruber* in Karwar waters. Information of the feeding regimes of fish species is of great importance in the perceptive of ecological communications. The previous study carried out in the study area provides background information on the trophic relationship of fish species (Sorbe, 1981; Velsco *et al*., 2001) [15, 16]. The major source of energy for benthic communities mainly consists of sediment particulate organic matter, detritus particles and resident bottom dwelling organisms in varying proportions (Eldridge & Jackson, 1993) [6]. Berg (1979) [3] and Pillay (1952) [14] reported that the analysis of stomach contents of fish could provide information about the niches of a particular fish in its ecosystem and this has become a standard practice in fish ecology works (Hyslop, 1980) [9]. There are reports (Ahmed 1990; Hadzley, 1997; Jothy *et al*., 1975; Lamp and Mohd Shaari, 1976) [1, 7, 13] that discussed this issue but the distribution of fish as related to the distribution of preys has not been studied extensively. In these studies, the importance of zoological group of polychaete annelids, both in number of individuals and biomass, has been clearly shown in the diet of some species of benthic fish such as due to their delicate structure, fish digest polychaete prey very quickly and consequently, those that are available in a good state for identification purposes at species level are limited. The analysis of the polychaete species found in fish stomachs provides information on both the ecology of the prey and predators, as already reported by studies carried out in other areas (Ben-Eliahu & Golani, 1990) [2]. The gut content observations of these fishes represented the presence of polychaetes in varying proportions during the study period concluding essential service of polychaetes in benthic food web. The aim of this study is to investigate the existing relationship between benthos fauna and to provide first observations of the polychaete composition in the diet of benthic fishes of the Karwar coast.

2. Methodology
In the present investigation for the gut content analysis of two benthic flat fishes such as *Cynoglossuss macrostomus* and *Pseudorhombus arsius* and one bentho-pelagic fish such as *Otolithes ruber* were selected.

Some benthic fishes of Karwar coast

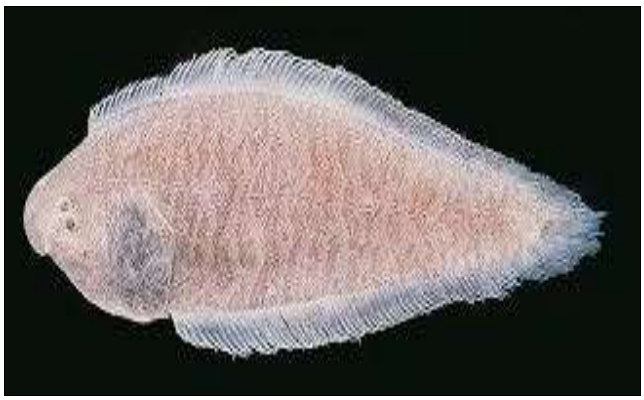


Fig 1: ***Cynoglossus macrostomus*** (Norman, 1928)

Fig 2: *Pseudorhombus arsius* (Hamilton, 1822)

Fig 3: ***Otolithes ruber*** (Bloch & Schneider, 1801)

2.1 Collection and examination of fish sample

The benthic and bentho-pelagic fishes were collected on weekly basis in a fresh condition from the commercial fish landing centre and local fish market from Karwar. Total 500 numbers of *C. Macrostomus*, 200 numbers of *P.arsius* and 500 numbers of bentho-pelagic fish *O.ruber* fishes were studied. Fishes were washed and cleaned thoroughly in the laboratory and dissected for the gut content analysis. The stomach samples were collected and preserved in 5% formalin for the accurate examination. During the present study only the stomach contents were subjected for diet analysis. The relative volume of each group recorded with in the gut samples were assessed semi quantitatively using point method (Hyslop, 1980) [9]. The contents from each gut were placed in Petridis and separated individually for the identification using binocular microscope. Identification of polychaete was done up to the lowest possible taxon depending upon the extent of material available. Prey types are classified mainly as polychates and miscellaneous. The results of the season wise data were pooled to state the percentage occurrence of polychaete as a fish diet in tabular form.

3. Results

The Percentage composition of polychaete and other food items were represented in the (Table1). The major food items and polychaete species were found in the 3 benthic fishes species that were analysed and listed in (Table 2). The gut content of *Cynoglossuss macrostomus* represented the following polychaete (27.3%) species *Prionospio pinnata*, *Capitella capitata*, *Glycera alba*, *Polynoid* sp., *Diopatra* sp., *Spionidae* sp., and *Nereidae* sp., during study period.

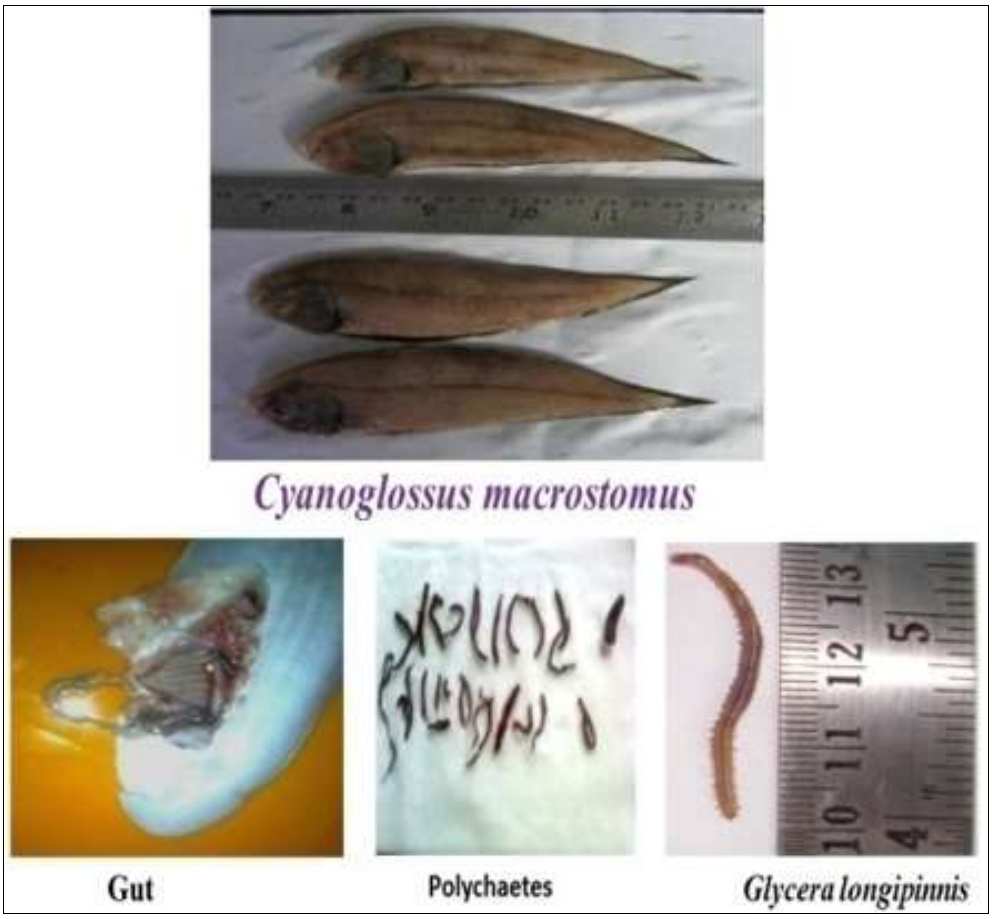
Polychaete species not showed much variation during the study period of which pre-monsoon represented maximum polychaete from the gut of the *Pseudorhombus arsius* the following polychaetes (24.68%) such as *Capitella* sp., Nereis sp., *Glycera alba*, *Mediomastus* sp., *Maldanidae* sp., were recorded during the study period. The gut content of *Otolithes ruber* shows that the polychaetes (18.78%) species like *Prionospio pinnata*, *Nepthyes polybranchia*, Nereis, *Glycera alba*, *Capitella capitata*, Eunicidae. The polychaete proportion is above the average in the pre-monsoon period with not much variation when compared to other season (Table 3).

Table 1: Food content of benthic fishes are divided into 6-categories

Fish species	***Cynoglossus macrostomus***	***Pseudorhombus arsius***	***Otolithes ruber***
Number of fish examined	**(500 no. fish)**	**(200 no. fish)**	**(500 no. fish)**
Food items			
Polychaetes	(27.3%)	(24.68%)	(18.78%)
Crustaceans	(26.09%)	(29.75%)	(28.27%)
Molluscs	(9.42%)	(26.01%)	(17.93%)
Fishes	(0%)	(0%)	(13.89%)
Sand-mud	(35.7%)	(10.8%)	-
Unidentified/semi digested items	-	-	(2.67%)
Miscellaneous	(3.62%)	(7.73%)	(9.46%)

Table 2: The major species identified from each diet component from *Cynoglossus macrostomus, Pseudorhombus arsius and Otolithes ruber*

Food contents	*Cynoglossus macrostomus*	*Pseudorhombus arsius*	*Otolithes ruber*
Polychaetes	*Prionospio pinnata, Capitella capitata, Nereis, Glycera alba, Orbiniids* sp. *Polynoids* sp., *Dioptera* sp.	*Capitella sp., Neries spp, Glycera alba, Mediomastus sp., Maldanidae sp.*	*Prionospio pinnata, Nepthys polybranchia, Nereis, Glycera alba, Capitella capitata,* Eunicidae.
Crustaceans	Penieads, Amphipods, *Squilla empusa*, Copepods, Isopods, Mysis, Porcellain crabs.	*Penaiead* sp., Amphipods, Cephalopods, Isopods, Mysis.	a) Prawns: Penieade prawns, *Metapenaeus monocerus, Parapeneopsis stylifera* b) Crabs: Portunus, Charybdis, Philyra and their larval stages. c) Copepods
Molluscs	Gastropods shells, Bivalve shell, Mytilus sp., Solen sp., Pholladidea sp., Tellina sp., Codelia.	Bivalve shell, *Mytilus* sp., *Solen* sp., *Pholladidea* sp., *Tellina* sp.	a) Gastropods: gastropods were met with as food very frequently and were composed of Oliva, Turitella and Littorina. b) Bivalves: bivalves were represented by fragments of shells.
Fishes	*Cynoglossus* sp.	*Unidentified fish* sp.	Small bony fishes like Leiognathus sp., *Lactarius lacterius* (both in small and big fishes) Lutjanus sp. *Gerres* sp. *Cynoglossus* sp. *Nemipterus* sp. (only in larger fishes).
Sand-mud	Sand grains, Pebbles, gravel and mud	Sand grains, Pebbles, Gravel and Mud.	…… ……
Unidentified/ semi digested items	Semi digested and unidentified specimens.	Semi digested and unidentified specimens.	Many fish gut content were analyzed, contained a high percentage of unrecognizable digested matters.
Miscellaneous	Eyes, head, appendages, chelae, carapace and antennae of crabs and shrimps (Crustacean), Pieces of shells (Molluscs), Scales and eggs of fish, Elytra and remains of tubiculous (Polychaetes), Small fragment of plants Holothurians, pieces of star fish (Echinoderms),	Eyes, Head, Appendages, Chelae, Carapace and Antenna of crabs and shrimps (Crustaceans), Pieces of shells (Molluscs), Scales and eggs of fish, Elytra and remains of tubiculous (Polychaetes), small fragment of plants,	Echiurids, Sipunculids, Mysids, Amphipods, Cephalopods



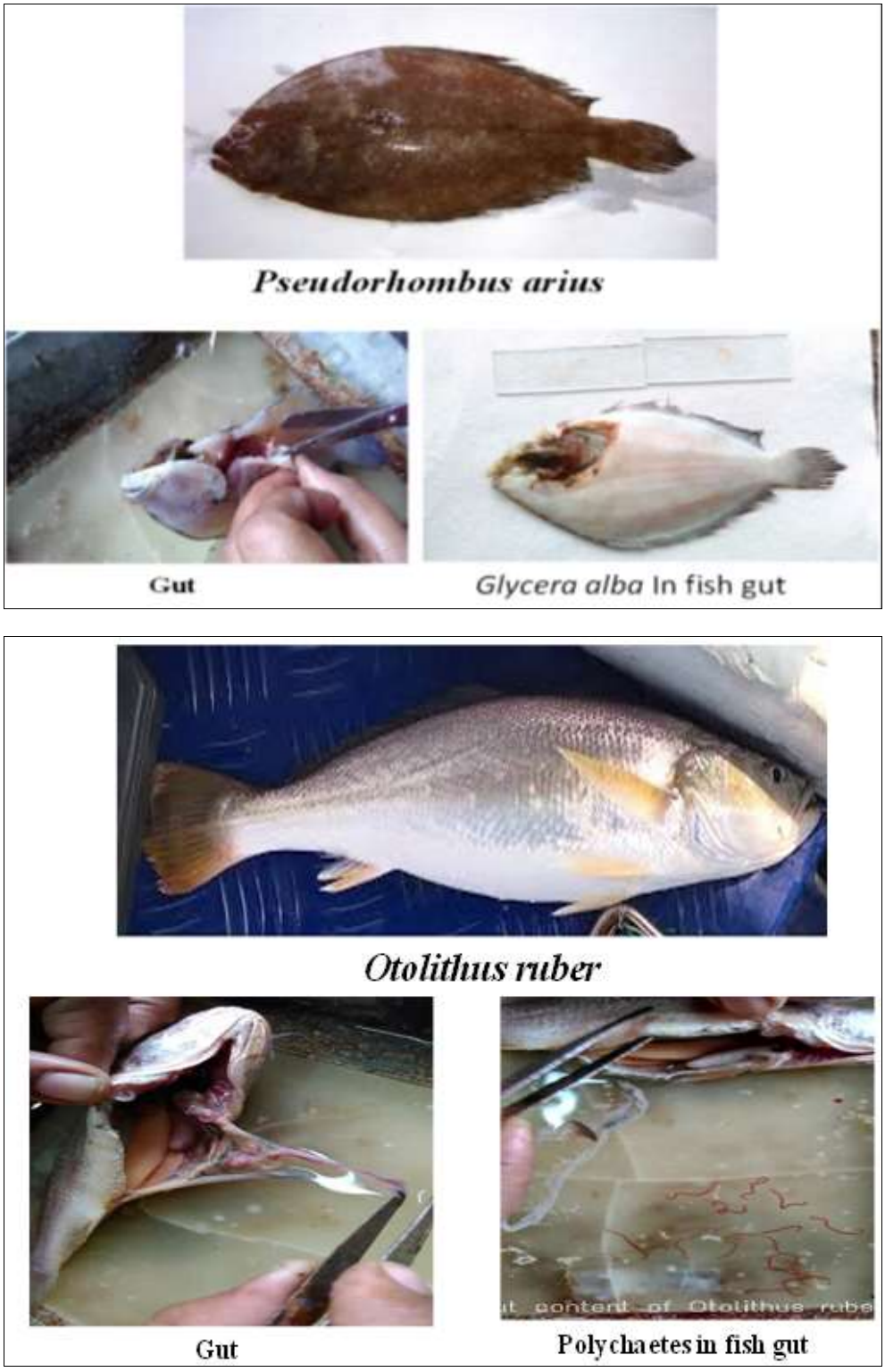


Fig 4: Dissected gut of 1.*C. macrostomus* 2. *P. arsius* and 3. *Otolithes ruber* showing the presence of polychaete

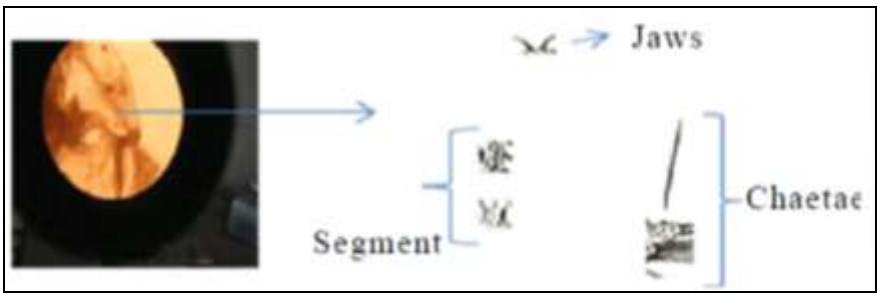
Table 3: Polychaete percentage in the gut content of studied fishes

(Seasons)	*Cynoglossus macrostomus* (500 no. fish)	*Pseudorhombus arsius* (200no. fish)	*Otolithes ruber* (500 no. fish)
(Pre-Monsoon)	30.40%	28.15%	34.62%
(Pre-Monsoon)	22.80%	20.77%	8.92%
(Monsoon)	28.70%	25.12%	12.80%

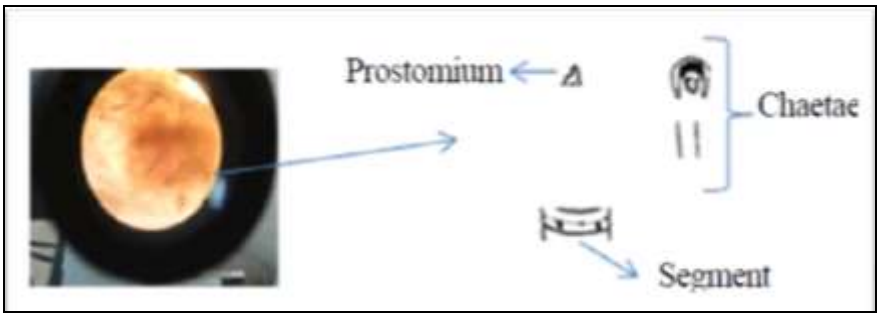
Table 4: Percentage of Miscellaneous items in the gut content of studied fishes

(Seasons)	*Cynoglossus macrostomus* (500 no. fish)	*Pseudorhombus arsius* (200 no. fish)	*Otolithes ruber* (500 no. fish)
(Pre-Monsoon)	69.6%	71.85%	65.38%
(Post-monsoon)	77.2%	79.23%	91.08%
(Monsoon)	71.3%	74.88%	87.20%

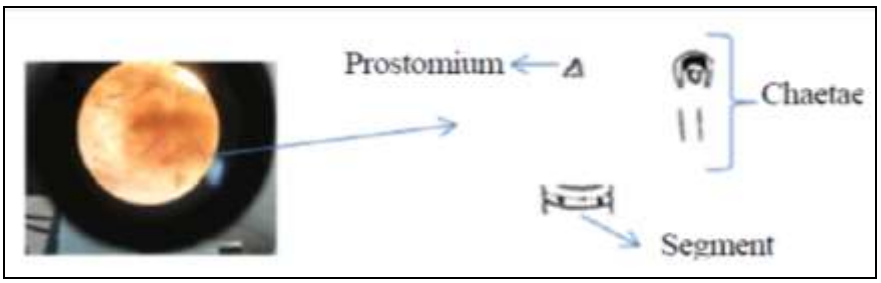
The miscellaneous food items are co-occurring flat fish *Cynoglossuss macrostomus* and *Pseudorhombus arsius* represented almost similar in compositions with the major gut content comprised of shrimps, gastropods, bivalves, copepods, foraminifera's and detritus matter during study period. (Table 2 & 4). The miscellaneous food items of the gut content of the *Otolithes ruber* mainly consists of shrimp, crabs, gastropods, bivalves, cephalopods, fishes and unidentified detritus/semi digested matters in verifying proportions during the studied seasons (Table 2 & 4). The percentages of miscellaneous food volume were higher than the polychaete composition during the study period.



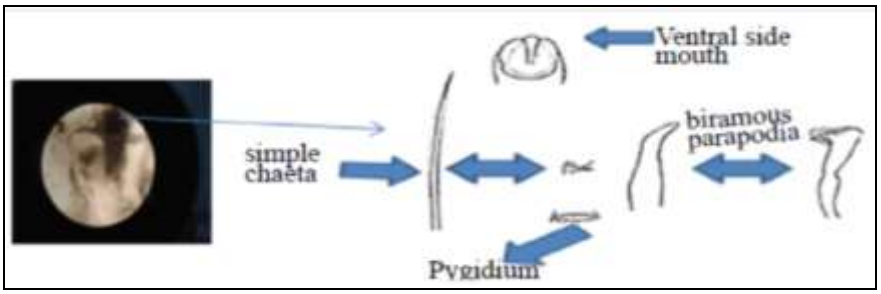
Family: Aphroditidae



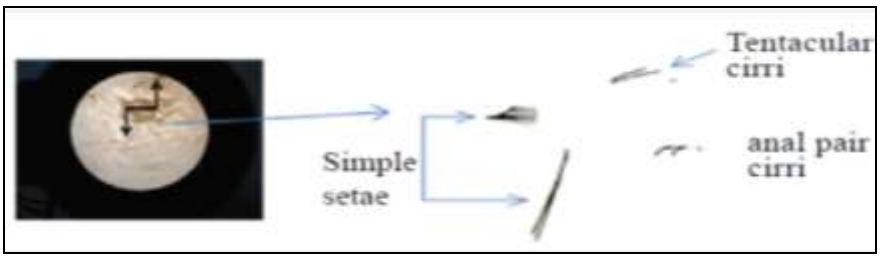
Family: Capitellidae



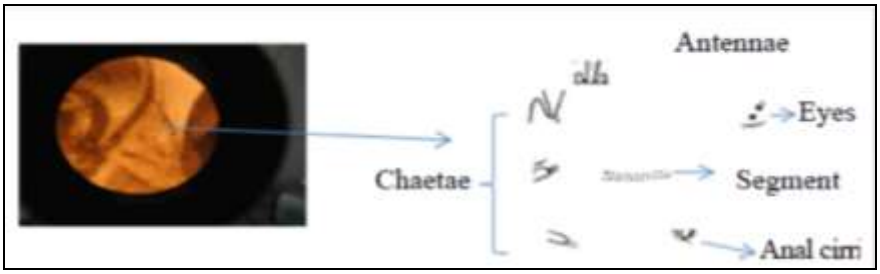
Family: Cirratulidae



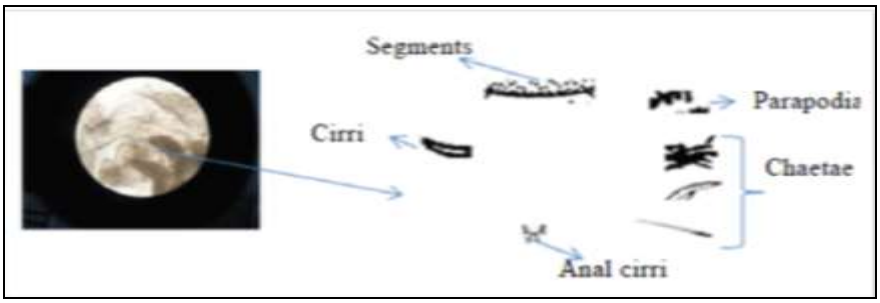
Family: *Maldanidae*



Family: Pilargidae



Family: Syllidae



Polychaete worms

Fig 5: Images showing the polychaetes taxon recorded in the gut contents

4. Discussion

The diet difference between the observed fishes varied in accordance with study period. The diet resemblance overlapped among the studied fishes *C. macrostomus* and *P. arsius* as their co-occurring species in the benthic habitat. Based on the diet composition in its evident that all the studied fishes feed on polychaete on varying proportions. This could be attributed according to the De-Groot (1971) [5] that flat fishes can be categorised as crustacean feeders and molluscan feeders. *O. ruber* considered as carnivore prefers Acetes as its diet. But in this study it is found that *O. ruber* diet is also consists of polychaetes along the Karwar coast indicating its diverse feeding tendency. It is expected that flat fish diet differs with locality and sediment type according to potential prey organism occurring in that particular area. (Hancock & Pearcy, 1978) [8]. Also they tend to feed on more prey available and often change their diet according to the seasonal fluctuations (Klimova & Ivankova, 1977) [12]. Similar observations were made by Bhalekar *et al*. (2018) [4] along the Maharashtra coast where flat fish diets were mainly composed of diatoms, algae, crustaceans, bivalves, gastropods, mysis, copepods and very less composition of polychaete. However along the Kerala coast (Jayaprakash, 2000) [10] recorded flat fishes are mainly bottom feeders and feed actively on polychaetes. Hence, with this study it is concluded that the flat fish *C. macrostomus* and *P. arsius* are mainly prefer polychaete as their dietary composition, while bentho-pelagic fish *O. ruber* opportunistically feed on polychaete.

5. Conclusion

From the gut content study it is evident that the flat fish's major dietary components are polychaetes along the Karwar coast. The polychaete families such as *Nereidae*, Capitellidae, Nephthydiae, Glycereidae, *Spionidae*, Cirratulidae, Eunicidae, Maldnidae, Sabelleridae and Syllidae are major diet compositions. These faunal occurrences in the benthic samples may be considered as indicators for flat fishes resources. Hence, polychaete plays an essential ecological service in the benthic feeding guilds as well as to the fisheries production.

6. Conflict of interest

The author declared that there is no conflict of interest in any way.

7. Author's contribution

The author obtained prior informed consent from the participant of the study. The research design, data collection, formal analysis and interpretation, writing short communication draft; review and editing, writing final draft; data interpretation; investigation.

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