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RESEARCH ARTICLE

Plastic ingestion by goby fish *Parachaeturichthys ocellatus* (Day 1873) from Vasai creek, Mumbai.

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Abstract

Plastic debris was observed in the gut contents of goby fish *Paracheaturichthys ocellatus* (Day 1873) (Perciformes: Gobiidae) from Vasai creek. It was observed in 86 of the 210 fishes studied between January 2011 to December 2011 in the length group of 66-155mm. The average frequency of occurrence was 42.35%. The plastic debris was found mostly in the form of small pieces of packaging materials like cellophane paper (29.07%), plastic bags (65.12%) and occasionally net filaments of nylon (5.81%). Plastic pieces were of size less than 5mm. The number of pieces observed ranged between a minimum of 1 and a maximum of 6 pieces per fish. Plastic debris was maximum in the gut of fish in month of May (62.5%) and minimum during August (26.92%). Length wise analysis of fish having plastic in the gut revealed maximum occurrence in the length group of 106-115 (22.09%) and minimum in length group of 146-155 (5.81%). No abrasion was observed in the gut of fish due to plastic ingestion nor was any plastic pieces in the gills of the fish. The plastic pieces might have entered the gut by ingestion due to high occurrence of plastic in the creek water in the form of small pieces and its resemblance with planktons. Conservation actions and further study with this regard is highly recommended.

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Introduction

The plastic accumulation in the seas, oceans, rivers and creeks is found all around the world (Carpenter *et al* 1972). Along the Mumbai coast plastic debris are discarded on the beaches, basins of seas and estuaries in the form of plastic bags, plastic bottles, packaging materials, nylon ropes, threads, nets etc. The plastic materials get entangled between the roots of mangroves and remains there for long period. These mangrove roots are the feeding and reproductive grounds for large number of fishes and plastic may be ingested by fish along with natural food. Ingested plastic particles can potentially reduce food intake, cause blockage of the digestive tract and be a source of contaminants like Poly carbonated biphenyl's (Derraik, 2002). Plastic fragments of smaller sizes are more abundant than larger items, fragments and fibres in water as noted by (Browne *et al.* 2010). Increase in the quantity of plastics in the environment may affect the ability of the fish to distinguish

between plastic and the natural food of fish (Possatto *et al* 2011).

Parachaeturichthys ocellatus is a goby fish inhabiting the muddy creeks of Mumbai coast. These are found in abundance along the Vasai creek. The Vasai creek is highly polluted with plastic wastes carried down by wind and water. The present study focuses on the ingestion of these plastic along with natural food by the goby fish *P. ocellatus*.

Material and Methods

A total of 210 specimens of *P. ocellatus* were collected from the fishermen of Vasai creek twice in a month from January 2011 to December 2011. The specimens were cleaned properly. Total length of the fish was measured to the nearest millimeter. The gut of the fish was dissected and preserved in 5% formaldehyde for further study. The gut contents were sorted out and categorized as natural and non-natural food, the latter especially in the form of plastic. The frequency of occurrence of the plastic

pieces in the gut of the fish as well as the number of pieces of plastic occurring in the gut of the fish was recorded. The size of the plastic pieces was measured to the nearest millimeter using measuring scale. The type of plastic was characterized as cellophane paper, plastic bag fragments and nylon nets.

Result

The study of gut content of *P.ocellatus* revealed that it fed on crustaceans, molluscs and fish larvae. Ingested plastic was observed in the gut content of some of the fishes. The visual observation did not reveal any obstructions, abrasion or ulceration of the gut. No plastic pieces were found to be entangled in the gills.

Out of 210 fishes studied, 86 specimens showed ingestion of plastic. The number of pieces of plastic varied in size, none was more than 5mm. The relative percentage of ingested plastic observed was as follows: 29.07% cellophane paper, 65.12% plastic bag fragments and 5.81% nylon net filaments. The percentage of the type of pieces was as shown in Table No.1. Seasonal variation was observed in the quantity of plastic ingested by *P.ocellatus*. Maximum

ingestion of plastic was observed in the month of May, amounting to 62.5% while minimum ingestion amounting to 26.92% was observed in the month of August as shown in Fig No. 1.

Analysis of the group of fishes based on total length and those that had ingested plastic revealed the following facts: Length group of 106-115mm showed highest frequency of occurrence of plastic in the gut of the fish to the tune of 22.09%.The length group of 146-155mm showed lowest frequency of ingested plastic at 5.81%. Surprisingly the frequency of occurrence of ingested plastic in juveniles in the length group of 66-75mm registered 11.63%.

A total of 236 pieces of plastic ranging from 1-6 pieces averaging 3.56 per fish were collected from the guts of *P. ocellatus*. The numbers of plastic pieces were of percentage 21.56, 26.22, 21.84, 19.53, 6.33 and 4.52.

The highest average observed was 8.67 pieces in the length group of 106-115 and the lowest was 2.50 pieces in the length group of 146-155mm as in table no.2. Fig 2 shows percentage frequency of occurrence of plastic in different length groups.

Type of plastic	Cellophane paper	Plastic bag fragments	Nylon net
Percentage	29.07	65.12	5.81

Table No 1.The percentage of the type of plastic pieces in the gut of *P.ocellatus*.

Length group in mm	Percentage frequency of occurrence	Average pieces of plastic per fish
66-75	11.63	3.83
76-85	13.95	5.83
86-95	10.47	5.00
96-105	11.63	4.50
106-115	22.09	8.67
116-125	9.30	2.83
126-135	8.14	3.00
136-145	6.98	3.17
146-155	5.81	2.50

Table No 2. The percentage frequency of occurrence and average plastic pieces in different length groups.

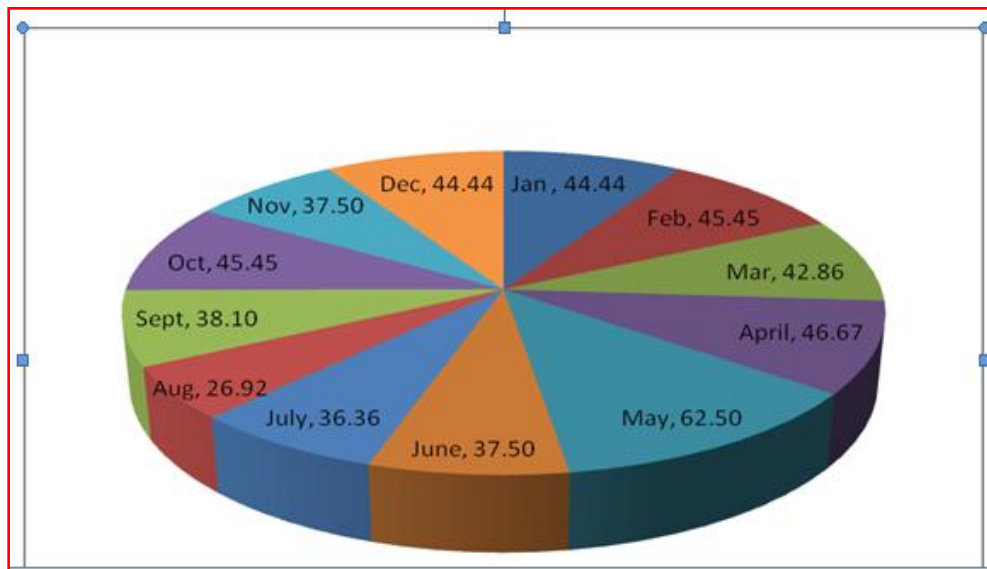


Figure No. 1 Percentage frequency of occurrence of plastic pieces in the gut of *P.ocellatus* in different months

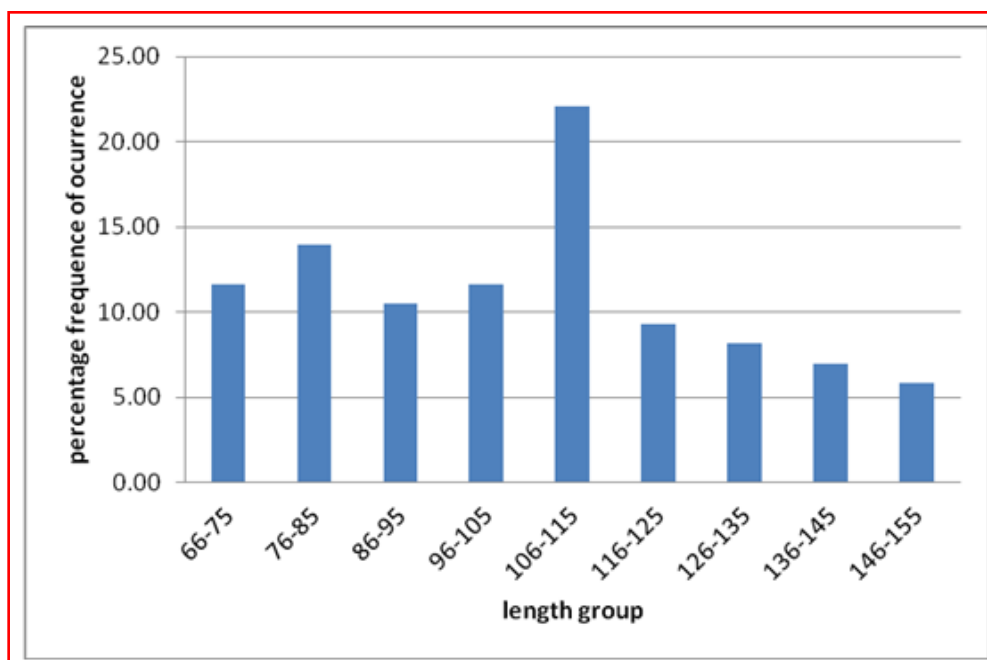


Figure No.2 Percentage frequency of occurrence of plastic in *P.ocellatus* in different length group

Discussion

In the present study 40.95% of fish sampled were found to have plastic pieces in their guts indicating

high occurrence of plastic debris in Vasai creek. Many authors suggested that organisms confuse the marine debris with prey (Carpenter *et. al.* 1972, Derraik 2002, Moore 2008). The goby fish *P.ocellatus* feed in

the mangrove roots and tidal creeks during high tide. The tidal regions are the major habitat where plastic can get deposited together with sedimentation particles as recorded by (Browne *et.al* 2010).

The high occurrence of plastic in the gut of *P.ocellatus* during the month of May coincides with lesser inflow of tidal and river waters into the creek and thereby reduced availability of food. Plastic fragments in the marine environment break into smaller pieces and increases the potential for

ingestion by smaller marine organisms (Browne *et al.* 2008). The plastic pieces ingested by the goby fish *P.ocellatus* were mostly fragments measuring less than 5mm. Possatto *et al.* (2011) reported that such fragments of plastics can be easily be ingested by benthic and demersal fishes.

The high frequency of occurrence of plastic in the length group of 106-115mm appears to be due to high feeding intensity of maturing adults. The ingested plastic was found to decrease with increase in length of the fish. The largest sized individual in the length group 146-155mm was found to have lowest occurrence of ingested plastic. The juveniles and maturing fishes in length group of 66-105 mm showed high frequency of occurrence of ingested plastic. It was observed that the larger fish fed on large sized crustaceans and fishes hence the occurrence of plastic pieces were less compared to smaller fishes.

The plankton feeding fish have no control over ingestion of plastic which is floating with the plankton. The ingested plastic however may lead to reduction in the amount of natural food for the fish and may ultimately amount to undernourishment proportional to ingested plastic. It would be interesting to study effect of gut enzymes on ingested plastic.

Conclusion

The presence of plastic debris in 40.95% of sampled fish makes an important contribution to understand the problem of plastic debris in the creeks of Vasai. It is alarming and demands urgent attention of biologists and environmentalists. All species of fishes living in the creeks or visiting creeks are under the threat of ingesting plastic debris. The threat may also extend to larger fishes preying on the smaller ones that have ingested plastic. Further study in this regard is needed to understand effect of plastic debris on:

1. Growth and life cycle of these fish
2. The transfer of the plastic debris to higher trophic levels.

There is also an urgent need to explore possible actions to prevent and protect our creeks and its organisms from plastic pollution.

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