Food and feeding habits of Mugil cephalus of Kayamkulam estuary, Kerala

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Abstract Estimates of gut contents are important prerequisites for fishery biological investigations. Food and feeding habits of Mugil cephalus of Kayamkulam estuary (9°2'-9°19'N latitude and 76°26'-76°32' E longitude) were observed on 160 specimens collected at monthly intervals during May-Dec.2010. The values of RLG varied between 2.1-3.35 indicating the omnivorous feeding habit of the fish. Feeding intensity analysis revealed the predominance of poorly fed fishes in the estuary. Proportion of actively fed fishes was maximum (33.34%) during October. Gut contents of the fish comprise diatoms, decayed organic matter, fresh and decomposing algal matter together with sand and mud. Diatoms contribute 58.94% of the total gut contents.

Keywords Feeding intensity; RLG; Gut contents; Mugil cephalus

Introduction

Food and feeding habits is one of the basic aspects of the biology of fish on which its behaviour, habits, morphology and even life cycle depends. Feeding habits of fishes vary according to the amount and type of food present in a particular environment. Information on food and feeding habits is of utmost importance not only for commercial purpose but also for formulation of policy for effective management of its fishery.

Mullus comprise the most important group of fishes that contribute to the fisheries of estuaries, backwaters and inshore areas. Grey mullet Mugil cephalus (Linnaeus) is a widely distributed coastal teleost in temperate and tropical waters and is a universally successful species having highest potential for artificial rearing in brackish water environment. Kayamkulam estuary (9°2'-9°19’N latitude and 76°26’-76°32’E longitude) on the south west coast of India is far richer in availability and abundance of grey mullets and the commercial catches of the estuary present interesting prospects of mullet fishery in the estuary.

1 Materials and Methods

A random sample of 160 specimens of Mugil cephalus, consisting of different size categories, ranging in total length from 110-202 mm and in total weight from 15.14-104.5 g were examined for total length, total weight, gut length, relative length of gut, feeding intensity and stomach contents. Fishes were collected from the cast net catches of the estuary at monthly intervals during the period May – December 2010. Volumetric and numerical methods (Pillay, 1952) were employed for the analysis of stomach contents. The intensity of feeding was determined on the basis of stomachs fullness ranging from full, ¾ full, 1/2 full, ¼ full and empty. For calculating relative length of gut (RLG) the gut length was divided by the total length of fish. The data on total length of fishes was categorized in to 10 size groups and the gut length and RLG were estimated for the different size groups while monthly estimates were taken on feeding intensity and gut contents analysis. For identification of food organisms standard literature such as Newell and Newel (1977) and Conway et al. (2003) were referred.

2 Results and Discussion

The relationship between gut length and body length has been widely used as an indication of the diet of fishes. The values of RLG calculated for the different length groups of Mugil cephalus collected from Kayamkulam estuary is presented in Table 1. In carnivorous fishes RLG values are generally low while herbivorous fishes have higher RLG values. Mugil cephalus is a widely distributed coastal teleost,
capable of living in extreme conditions of environment and it feeds on all available food including diatoms, micro algae, filamentous algae, bacteria, protozoa etc. associated with sand and mud (Odum, 1970; Brusle, 1981; John, 1995; Harridon and Senon, 1997). The fluctuation of RLG values between 2.1 and 3.35 place M.cephalus of Kayamkulam estuary in the category of omnivorous fishes with adequate assimilation efficiency of diatomous diet.

No regular pattern was observed in the intensity of feeding (Table 2.). Of all the specimen collected there was a predominance (>50%) of poorly fed fishes (empty and ¼ full stomachs) in all months and more than 50% were in poor feeding stage. There is an increase in the proportion of actively fed fishes from September with its maximum during October (Figure 1). Monsoon season is characterized by the maximum number of poorly fed fishes (74.63%) while the maximum of actively fed fishes (28.21%) were during the post monsoon period. It is probable that during rainy season bottom flora in the environment is greatly disturbed by the floodwaters and their growth is hampered, thus reducing the overall availability of the food items and reduction in the quantity of food consumed by fish (Sarojini, 1951; De Silva and Wijeyaratne, 1977; Kalita and Jayabal,2000; Al-Marzouqui,2012). While the intensive feeding during the post monsoon period is due to the availability of large quantities of algae and diatoms.

The various categories of food found in the stomach and intestine of M.cephalus indicates the feeding habit of the species on all available food. The gut contents

Table 1 Range and Mean values of length, weight, gut length and RLG in different size categories of Mugil cephalus

| Category (mm) | No. of fishes examined | Length (mm) | Weight (g) | Gut length (mm) | RLG |
|---------------|------------------------|-------------|------------|-----------------|-----|
|               | Range                  | Mean        | Range      | Mean            | Range | Mean |
| 110-120       | 20                     | 110-115     | 111.5±0.99 | 15.14-28.3      | 19.15±1.68 | 319-376 | 331.6±9.45 | 2.77-3.26 | 2.97±0.77 |
| 120-130       | 18                     | 120-129     | 123.9±2.05 | 21.48-28       | 25.21±1.27 | 315-346 | 325.5±4.21 | 2.46-2.88 | 2.63±0.23 |
| 130-140       | 22                     | 130-139     | 134.8±0.80 | 24-35.2        | 27.47±1.84 | 322-373 | 341.4±7.16 | 2.31-2.76 | 2.52±0.34 |
| 140-150       | 29                     | 140-149     | 144.7±1.00 | 28-45          | 29.4±2.42 | 315-456 | 396.4±12.32 | 2.15-3.18 | 2.78±0.32 |
| 150-160       | 14                     | 150-157     | 152.4±1.23 | 34-59          | 49.32±1.70 | 343-511 | 403.6±13.82 | 2.22-3.35 | 2.93±0.41 |
| 160-170       | 12                     | 160-168     | 164.5±1.21 | 43-64.5        | 56.36±2.05 | 367-411 | 394.8±4.10 | 2.18-2.56 | 2.42±0.11 |
| 170-180       | 17                     | 170-178     | 174.5±0.87 | 57-86-71       | 62.85±2.42 | 380-421 | 394.36±5.32 | 2.16-2.47 | 2.32±0.13 |
| 180-190       | 10                     | 180-188     | 184.1±1.55 | 60-104.5       | 68.43±14.32 | 412-535 | 420.16±3.42 | 2.23-2.84 | 2.42±0.27 |
| 190-200       | 12                     | 190-195     | 193.5±0.78 | 69.1-85        | 72.18±6.93 | 416-445 | 428.87±8.40 | 2.13-2.34 | 2.28±0.18 |
| 200-210       | 6                      | 200-202     | 200.8±0.80 | 100-102        | 101.4±0.80 | 421-440 | 428.5±6.44 | 2.1-2.21 | 2.17±0.12 |

Table 2 The percentage of feeding intensities of Mugil cephalus during different months

| Stomachs | May | June | July | Aug | Sept | Oct | Nov | Dec |
|----------|-----|------|------|-----|------|-----|-----|-----|
| No. Examined | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Empty    | 0   | 21.44 | 33.4 | 5   | 0 | 0 | 5 | 0 |
| Trace    | 30  | 28.57 | 22.2 | 30  | 25 | 44.5 | 35 | 50 |
| ¼ full   | 40  | 28.57 | 22.2 | 55  | 30 | 22.3 | 15 | 0 |
| ½ full   | 10  | 14.28 | 11.1 | 5   | 15 | 0 | 20 | 20 |
| ¾ full   | 15  | 7.14  | 11.1 | 5   | 10 | 11.1 | 10 | 20 |
| Full     | 5   | 0    | 0    | 0   | 20 | 22.3 | 15 | 10 |

Figure 1 Monthly fluctuations in feeding intensity (%) of Mugil cephalus of Kayamkulam estuary
mainly consisted of diatoms, decayed organic matter, fresh and decomposing algal matter together with sand and mud (Figure 2). Mullets generally feed by grazing on submerged rock and plant surface and the function of inorganic particles in the diet is suggested in the grinding activity to degrade plant cell walls in the pyloric portion. (Thomson, 1966; Blaber, 1976). In addition to inorganic particles, qualitative analysis revealed 18 other algal food items as Chlorella, Pleurosigma, Biddulphia, Peridinium, Gyrosigma, Coscinodiscus, Bacteriastrum, Nitzschia, Closterium, Navicula, Ceratium, Isochrysis, Rizosolenia and Oscillatoria and zooplanktons Tintinnid, Sagitta, Tabellaria and copepod, few algae like Chlorella, Oscillatoria, Biddulphia and Gyrosigma were the regularly occurring food organisms throughout the study.

Quantitative estimations showed that diatoms are the most abundant among the total gut contents contributing to about 58.44% followed by decayed organic matter (15.02%) and sand and mud (6.69%). The prevalence of motile benthic diatoms and attached diatoms in the gut contents of *M. cephalus*, which fed on the sediment, is common (Oren, 1971; Marais, 1980; Blaber and Whitfield, 1977; Rao and Sivani, 1996). The presence of detritus in the guts of most of the specimens led to infer that *M. cephalus* swallows detritus along with diatoms and it forms an indiscriminate part of the food throughout the year. It is generally observed that decayed organic matter forms an important food item of mullets in estuarine environments, which are associated with thick deposits of silt.

Algal matter consists of a main portion of gut contents (13.73%) and the common constituent was Oscillatoria. These were found almost throughout the period with the peak occurrence during the post monsoon months. Zooplankters were found only a smaller constituent of the food items, with copepods as the predominant, never forming a major food item.

The percentage composition of each food item in the diet of fish during the different months (Figure 3) also indicated marked variations. Gyrosigma was the predominant component during May (33.12%) and June (29.23%) while it decreased from May to September. Decayed organic matter formed the major component during July (25%), October (25.9%), November (21.06%) and December (20.37%). Chlorella forms the frequently appeared food throughout the year whereas Oscillatoria almost missed in July and September. Pleurosigma was totally absent during July but predominant during September (36.16%) and decreases towards December. Feeding on certain food item at different intensities may be an adaptation to minimize the intraspecific competition for food observed in mullets (Blay, 1995).

There is remarkable enhancement in the intensity of feeding during the post monsoon months and lowering in the rainy months. The increased feeding intensity in post monsoon corresponds to the general abundance of algae in the waters. During rainy season there is considerable agitation and disturbance to the flora and a fall in feeding intensity.

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