Food and feedings of *Mystus tengara* (Hamilton, 1822) from Nagavali River, Andhra Pradesh.

ABSTRACT

Small indigenous fish species perform vital role in indigenous people food habitat and their empowerment. *Mystus tengara* is a well-known and commonly available food fish species, and one of the candidate ornamental fish species in ornamental fish firms. A total of 145 specimens of *Mystus tengara* (Hamilton, 1822) species were collected from a small distributary of Nagavali River of Andhra Pradesh. 35 food items were observed in the gut of *Mystus tengara*. The present study has been performed on the food and feeding habits, Gastro Somatic Index, Relative Length of Gut, Fullness and feeding Intensity, and Gut Content Analysis of *Mystus tengara*. Results of the study present study very close to the earlier studies and revealed that *Mystus tengara* is a carnivorous fish and zooplankton is the basic food group for this fish species and maximum sustainable all the river systems.

Keywords: Small fish, Indigenous, Gut Content Analysis, Gastro Somatic Index, Gut Fullness

Introduction

Mystus tengara commonly populate in both flowing and stagnant fresh waters, distributed throughout the India, Nepal, Bangladesh, and Pakistan (Talwar and Jhingran, 1991). It is a preferred food fish species in indigenous folks, because of taste. Nowadays it is highly valued species in ornamental fish trading industries and also reports proved its high exportations from India (Gupta and Banerjee, 2014). Sustainable planning and management implementations required to create awareness in indigenous people groups, for its ornamental value for livelihood through exportation. Present study focused on food and feeding habits of fish have manifold importance in fishery biology and fisheries management in interior people livelihood and food secuerity.

Materials and methods

Mystus tengara species were collected from January to June of the year 2022 from a small distributary of Nagavali River and local markets, Andhra Pradesh. Different fishing gears i.e. cast net, gill net, drag net, and scoop net were used for the collection of species. The collected fish weight and length were taken at the sampling site, afterward removed the gut and preserved in 4% formalin, further transferred and preserved in 10% formalin for laboratory studies.

Relative gut length (RGL)

The RGL of the fish will be determined by using the general formula (Al-Hussaini, 1949) given below:

$$RGL = \frac{\text{Total Length of Gut}}{\text{Total Length of Fish}}$$

Gastro-somatic index (Ga.SI)

The variation in the feeding intensity of the different size groups in each fish will be calculated by using the standard formula (Bhatnagar and Karamchandani, 1970) given below:

$$Ga.S.I = \frac{\text{Weight of Gut}}{\text{Weight of Fish}} \times 100$$

Index of Fullness

The distension of the stomach was observed and classified as 'full or distended', 'moderate', 'half', and 'empty' by eye estimation (Pillay, 1952).

Gut content analysis

Volumetric and numerical methods (Wolfert and Miller, 1978) with modification will be used for analyzing the gut content. The gut content will be identified by using a light microscope. The frequency of occurrence will be used under the numerical method

$$\text{Frequency of occurrence} = \frac{\text{No. of fish containing particular food item}}{\text{No. of fish with food in their stomach}}$$

Qualitative and quantitative analysis of gut content

Gut analysis provides important feeding patterns of fishes represent an integration of many important ecological components that include behavior, condition, habitat use, energy intake, and inter/intra-specific interactions. Procedure of gut contents analysis are largely divisible into two groupings viz., qualitative and quantitative. The qualitative analysis consists of a complete identification of the organisms in the gut contents. The reckonable methods of analysis are three types viz., numerical, gravimetric, and volumetric. All these types of analysis are widely applied by different researchers. However, in the present study, the volumetric method and numerical method (Wolfert and Miller, 1978) with a little modification were applied similar to earlier study (Majumder et al, 2024).

Thus, for the quantitative analysis, freshly preserved samples of fish were dissected longitudinally and the respective guts of each fish were weighed and preserved in 4% formalin. The gut contents were removed from the gut and transferred into a graduated measuring cylinder to know the volume of gut content after its settlement. This gut content was identified by using a phase contrast microscope up to the generic level depending upon the state of digestion or completeness of the food item. The numerical methods were adapted in different ways to assess the relative importance of food items which was done by following methods:

Frequency of occurrence method

The simplest way of recording data obtained from stomach contents is to record the number of stomachs containing one or more individuals of each food category by using the frequency of occurrence method.

$$\text{Frequency of occurrence} = \frac{\text{No. of fish containing particular food item}}{\text{No. of fish with food in their stomach}}$$

Results

Index of Fullness

Gut fullness was categorized into five classes namely: full, ¾ full, ½ full, ¼ full, and empty. In *Mystus tengara,* full guts were observed in mid of April to May. Fishes with ¾ full gut were observed from February to May with the highest percentages being observed in March and April.

Fishes with ½ and ¼ full gut were recorded throughout the season the highest percentages being observed in February to March. Fishes with empty guts were observed in end of June (Table 1).

The fullness indices determined are 21.44, 10.07, 29.11, 9.10, 28.18.

Table 1: Monthly variation of gut fullness in *Mystus tengara*

Months	Full gut	¾ gut	½ gut	¼ gut	Empty
Jan	20.12	6.1	35.22	17.17	20.25
Feb	26.4	16.7	22.4	14.7	15.27
March	28.5	11.8	32.4	7	18.2
April	32.8	11.5	27.7	3.2	22.8
May	16	12	44.2	2.7	32
June	6	7.2	14.7	12.1	62.5
Indices	21.44	10.07	29.11	9.10	28.18

Gut content analysis of *Mystus tengara*

Different size ranging of 145 specimens of *Mystus tengara* were collected. from 3.12 cm to 11.8 cm total length for gut content analysis. There are 35 food items observed during gut content analysis which were categorized into 6 groups namely plankton (Cladocera, Rotifer, Copepod, Protozoa, Chlorophyta), fish body parts, insects body parts, aquatic insects, phytoplankton (Bacillariophycea, Chlorophycea, Cynophycea, Dinophycea) and miscellaneous items. Plankton (Zoo and Phyto) contributed highest followed by fish body parts and aquatic insects.

An average of 29.70% was contributed by zooplankton. Cladocerons and Copepods were forming the highest food items in the fish gut. Daphnia was the most commonly found genus of Cladocera. Cyclops and Diaptomus were the commonly found genus of Copepods.

An average of 23.48% was contributed by fish body parts. It was forming the third highest group of food in the gut. Scales and shells were the dominant items and scales were found throughout the year.

An average of 14.22 % was contributed by aquatic insects. It was forming the fourth most abundant group of food in the gut. Lepidoptera, Coleoptera, and Ephemeroptera larvae were found. The dominant among them was chironomid larvae.

An average of 25.27% was contributed by phytoplankton, forming second most abundant food group. Bacillariophycea, Chlorophycea, and Cyanophycea were observed. In Bacillariophycea, Cocconeis, Nitzchia, and Synedra were commonly observed. In Chlorophycea, Zygnema, Mogoutia, and Chlorella were observed. In cyanophycea and Ocillatoria were commonly found, comparatively Anabaena observed less (Table 2).

Miscellaneous items were observed with an average of 4.24%. Semi-digested matter and plant twigs were common items. Its plenty was found during April-May.

It had also noticed that it almost equals consumption of animal matter and phyto matter. Aquatic insects, fish body parts were noticed more in larger size groups whereas planktons were maximum in smaller size groups.

Table 2: Mean contribution of different food items of *Mystus tengara* based on percentage volumetric method (points)

Sl no.	Food groups	Average % volumetric (points) method
A.	**Animal matter**	
1	Zooplankton	29.70
2	Cladocera	0.9

3	Rotifera	12.5
4	Copepod	8.97
5	Protozoa	1.24
6	Fish body parts	23.48
7	Insects body part	8.40
8	Aquatic insects	14.22
B.	**Plant matter**	
1	Phytoplankton	25.27
2	Bacillariophycea	7.34
3	Cyanophycea	5.21
4	Cholophycea	7.82
6	Micellaneous items	4.24

Relative length of gut (RLG)

The Size-wise relative length of the gut of *Mystus tengara* values ranged from 0.120 to 0.427 with the lowest value recorded during February-March and the highest value found during May-June. The values were found less than 1 throughout the year which indicated the species is highly carnivorous, indeed we find equal consumption of animal and plant matter.

Gastro-somatic index (GaSI)

In general, the gastro-somatic index indicates the fullness of the stomach. In the present study, the lowest monthly mean GaSI value was found during last week of May to June and the highest value was found during February-March. In general, fishes show less feeding intensity with a low value of GaSI during the spawning season (Table 3).

Table 3: GaSI Variation

Months	Mean GaSI
January	1.04 ± 0.35
February	1.95±0.30
March	2.25±0.54
April	0.92±0.45
May	1.15±0.54
June	0.78±0.25

The relative length of the gut and gastro-somatic index

It is important to know about fish diet and mode of feeding as it is beneficial in the culture, rearing, and larval control. The RLG of different size groups and Ga.SI of different months for *Mystus tengara* was analyzed. The coefficient b, the coefficient of determination R^2 of the species was analyzed.

The regression equation for *Mystus tengara* was obtained as Y= 0.378x-1.544 which depicts that a unit increment in the size TL increases the gut length by 0.378 in the species. The extent of variation in gut length was 19%.

In *Mystus tengara*, the RLG values were observed to vary from to 0.120 cm to 0.427 cm. The lowest value was noticed in the size group 3.4-4.7cm and the highest value in 10.5-12.7cm. The observation of feeding intensity was based on the Gastro-somatic index taken every month. Mean monthly values of the Gastro-somatic index varied from 1.010-0.575 in *Mystus tengara*. The values of Ga.SI was observed to become high during March and started to fall in June, similar to earlier studies.

Discussion

The present study deals with *Mystus tengara* to correlate food and feeding. The species were mainly collected from the small distributary of Nagavali River.

Relative length of gut and Gastro-somatic index

Al Hussaini (1947) earlier enlisted the RLG values for carnivorous (0.5–2.4), omnivorous (1.3–4.3), and herbivorous (3.7–6.0) fishes. Das and Moitra (1963) later reported that RLG value is generally less in carnivorous fish, higher in omnivorous fish, and highest in herbivorous fish. Thus, observation of RLG values in the present study slightly depicts the carnivorous feeding habit of *Mystus tengara* because of observations of equal feeding habit of animal and plant matter.

Present study reveals, the low values of GaSI along with the declining trend from June depict the poor feeding activity for this fish species during this period which is in correspondence to their intense breeding periodicity as observed by (Gupta and Banerjee, 2013). GaSI has been reported to increase gradually after the spawning season with increasing feeding activity and during the pre-spawning season feeding activity has been found to increase maximally represented by high GaSI values during that period.

The extreme feeding activity during the pre-spawning season is associated to food abundance or to storage energy for spawning as found in the present study and it is supported by (Serajuddin et al., 1998; Kanwal and Pathani, 2012). The altering tendency of monthly GaSI values is in synchronization with the changing percentage of gut fullness. The high values of GaSI from April to May resemble to the availability of a high proportion of fishes with full gut during this period; fishes with 3/4 full gut have also been observed with high percentages during this period. Then from June onwards percentage of fish with full guts was found to decrease while the percentage of fish with empty guts has been observed to increase gradually resulting in a gradual decrease of GaSI.

In this study percentage of empty gut-containing fish has been observed to become high afterwards of June, intense breeding period for this fish species. High occurrence of empty gut-containing fish during the intense breeding season due to decreased feeding activity since the mature and ripe gonads occupy more space in the peritoneal cavity, compressing the gut and making feeding more difficult during this period as observed by (Serajuddin et al., 1998).

Index of Fullness

The FI (21.44, 10.07, 29.11, 9.10, and 28.18 % for full, 3/4 full, 1/2 full, 1/4 full and empty guts, respectively) depict high feeding activity for this fish species all through the study. Fishes with medium gut fullness (3/4 full and 1/2 full) have been noticed nearly throughout the season and unfluctuating when fishes with empty guts have been observed with high percentages, the total percentage of fishes with food in their gut has been found to surpass the percentage of fishes with empty gut. This advises that feeding has never been discontinued and even during the breeding season no cessation of feeding has been observed there. A high percentage of fish with gut-containing food also suggests good food availability all through the season in the waterbody from where the fish species have been collected and similar results were found (Ikusemiju and Olaniyan, 1977).

Gut content analysis

Gut content analysis has revealed Zoo and Phyto plankton as the most abundant group among the food classes with an index of preponderance value of 29.70% and 25.27% respectively. Fish body parts have been found as the third most abundant food class with an index of preponderance value of 23.48%. Aquatic insects have been observed as the fourth most abundant food class with an index of preponderance value of 14.22%. Rotifera (12.5%) have been observed as the next abundant food class followed by insect body parts (8.40%), Copepod (8.97%), Bacillariophycea (7.34%) and Micellaneous items (4.24%). Similar results were reported in same species from Tripura (Majumder et al., 2024) and in *Mystus nemurus* (Khan et al., 1994).

Conclusion

The study specified that *Mystus tengara* has high consumable value in indigenous people groups along with fiscal and ornamental value. It is suggested that further study on other aspects of the biology of this fish species is required for its successful breeding and implementing commercial management practices at ground level. Thus, it would help the indigenous people groups in the future to increase fish production at village level. As like earlier studies hereto observed declining of the natural resources of this species due to anthropogenic activities, climate and habitat changes in freshwater water bodies.

Ethical statement

The fish species studied in the present study are not protected under The Wildlife Protection Act, 1972 (Last amended in 2013), Government of India, All the guidelines on animal use and care were followed accordingly.

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