Food and Feeding Habits, Length-Weight Relationship and Condition Factor of Fresh Water Fish Mystus armatus

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Authors’ contributions

This work carried out in collaboration between both the authors. Authors CK designed the study, performed statistical analysis, tabulation, wrote the manuscript. Author RK helps to compilation the work, managed to the literature searches and also provide financial support. Both authors read and approved final manuscript

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ABSTRACT

The present study describes the food and feeding habits, Length- weight relationship and condition factor in Cat fish Mystus armatus. Food contents was measured by frequency of occurrence method. Length-weight relation was measured by correlation regression equation method LogW=aLb. The length weight relationship indicates that relationship between length-weight is allometric growth having high values of b withR²> 0.56 with CI of 95%. The values of condition factor varies from 0.70 to 0.88. The present study is useful to study conservation and sustainable fisheries management. It was concluded that Mystus armatus is carnivorous feeder, length weight relationship is significant, and fish is in poor condition due to various conditions of water.

Keywords: Mystus armatus; length-weight relationship; condition factor; gut content analysis.

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1. INTRODUCTION

*Mystus armatus* (Day, 1865) is commonly called as katarna is one of common catfish founds in rivers and reservoirs of India, Bangladesh, Pakistan, Afghanistan and Nepal. In fisheries biological investigation of food of the fishes has been very important because it regulates or at least influence the occurrence, growth of fish. Feeding habits of fish help to know the inter-specific relationship and productivity of the water bodies. Nutrition and feeding influence the growth, reproduction and health of fish [1].

Food is most important energy source for the growth and survival of all animals. Proper knowledge of food and feeding habits of fish is an important prerequisite for increasing fish production [2]. Dasgupta [3] reported that the diversity in feeding habits of fishes exhibit, are particularly the result of evolution leading to structural adaptation for getting food from the equally great diversity of situations that have evolved in the environment.

Food is the main source of energy and plays an important role in determining the population levels, rate of growth and condition of fishes. Food and feeding habits of fishes have a great significance in aquaculture practice which will utilize all the available potential food of water bodies without any competition with one another but will live in association with other fishes [4].

The dietary habits of fish, based on stomach analyses, are widely used in fish ecology as an important method to investigate trophic relationships in aquatic communities [5]. There is no work done on food and feeding habits in *Mystus armatus*.

The morpho-metric relationships between length and weight can be used to assess the well being of individuals and to determine possible differences between separate unit stocks of the same species [6]. Length–weight relationships (LWRs) are needed to estimate weight from length because direct weight measurements can be time-consuming in the field [7,8]. These parameters are important in fish biology and can provide information on the stock condition [9].

Pauly [10] stated that length-weight relationship (LWR) provides valuable information on the habitat where the fish live, while stressed the importance of LWR in modeling aquatic ecosystems. For proper exploitation and management of the population of fish species, the length-weight relationship is very important [11].

The study of condition factor is important to understand the life cycle of fish species, and contributes to an adequate management of the species and to the maintenance of the ecosystem equilibrium. It also helps to determine the reproductive time of fish species without sacrificing the organisms, and this could be a valuable tool to develop monitoring programs for the species fisheries and culture programs [12]. Study of condition factor in fishes helps to understand survival, growth, reproduction rate, maturity and health of fish [13] and can be used as good indicator of water quality or general health of fish population, in which the fishes are inhabiting [14].

The aim of present study was to determine length-weight relationship, food and feeding habits and condition factor of *Mystus armatus* from Kaigoan Toka, Aurangabad region, which could be useful in the support utilization of this species thereby adding to the existing knowledge of the biology of the species. Our hypothesis is that condition factor of *Mystus* species is very low and can show the real state of the condition of fish. It also helps to support in fish culture to increase production of this species as their natural production is less in other cat fishes.

2. MATERIALS AND METHODS

2.1 Study Area

The research lasted for 12 months, where the fishes were collected. Kaygaon Toka sampling station is situated at 19°37’N 75°01’ E with elevation of 462 m. This dam is located at the backwater area of Paithan dam near to small village Kayagaon in Gangapur taluka of Aurangabad (Maharashtra, India) based on river Godavari. At this station the Pravara tributary joins the main river, hence this point is recognized as Pravara Sangam. The topography of the sampling station is deep black clay soil, depth of water varies from 0.5-10 m and width is in between 70-130 m. This location is dominated by many aquatic weeds and vegetation. During summer and winter seasons the water flow was reduced but during monsoon it was increased and sometimes fully flooded.

2.2 Gut Content Analysis

Total 256 fishes (Sample) were collected for the study of food and feeding habits of fishes,
samples were collected from KaigaonToka Aurangabad (M.S.) from sampling site during the period of January 2018 to December 2018. Specimens were collected by nets, cast nets, dragnets and Bhorjal. Specimens were properly cleaned and total length (measured form anterior tip of the longest jaw to the posterior part of the tail) and total weight of fish were recorded. Specimens were dissected and their stomach removed and the length stomach was recorded and preserved in 10% formalin for further analysis. Analysis of food was done by frequency occurrence method followed by Dewan and Shaha [15]. Frequency of occurrence (Fi)=ni/NT Where, ni= No. of samples containing type of prey (i) NT=Total no. of stomach with food in sample.

2.3 Condition Factor

K was estimated from the relationship 

\[ K = 100 \frac{W}{L^3} \]

Where

\( W \) = weight of fish in grams,
\( L \) = total length of fish in centimeters.

2.4 Length-Weight Relationship

The log transformation formula of Le Cren was used to establish LWRs [13]. The length-weight equation \( W = a L^b \) was used to estimate the relationship between the weight (g) of the fish and its total length (cm). Using the linear regression of the log-transformed equation: \( \log (W) = (a) + (b) \log (L) \), the parameters \( a \) and \( b \) were calculated with ‘a’ representing the intercept and ‘b’ the slope of the relationship.

\[ \log W = aL^b \] (Le Cren, 1951)

where;

\( W \) = Weight of fish (g)
\( L \) = Total Length of fish (cm)
\( a \) = Y – Intercept or the Initial growth index
\( b \) = Slope or the growth coefficient or an exponent

3. RESULTS

3.1 Gut Content Analysis

Gut content analysis of Mystus armatus shows mostly animal types of food consisting crustaceans, small fishes, mollusks and aquatic insects. Fish also feeds on plant material such as algae, aquatic plants, and mud particles but in very small quantity.

In the present study it was observed that percentage of frequency of occurrence of crustacean is highest 25. 9% in the month of February 2018 and lowest in 13.56 in July 2018 (Table 1).

Percentage of frequency of fishes was highest 23.76 in February 2018 and lowest 13.01 in July 2018 (Table 1).

It was observed frequency of occurrence of mollusks as food was highest 10.78 in February 2018 and lowest 0.09 in month March 2018 (Table 1).

The percentage of frequency of occurrence of food aquatic insects was higher 15.78 in December 2018, lower 10.8 in month of February 2018 (Table 1).

The percentage of frequency of occurrence of food algae was highest 10.87 in October, lowest 8.341 in June 2018 (Table 1).

It was observed percentage of frequency of occurrence of food aquatic plant was highest 11.54 in October 2018 and lowest in 7.89 in May 2018 (Table 1).

The percentage of frequency of occurrence of food mud particles was highest 10.78 in October 2018 and lowest in 6.51 in September 2018 (Table 1).

3.2 Length-weight Relationship

Length weight relationship in Mystus armatus is highly correlated. It was found that the weight increases with the length of the fish. The relationship was calculated by regression equation \( \log W = aL^b \). Values of Slope ais-57.3 and b is 5. The values of correlation coefficient \( r \) is 0.89 and of coefficient of determination \( R^2 \) is 0.80. Equation for length weight relationship is \( TW=57.3+5.62TL \).
### Table 1. Percentage of frequency of occurrence of food in *Mystus armatus*

| Food item       | Month & Year | Jan 2018 | Feb 2018 | Mar 2018 | Apr 2018 | May 2018 | June 2018 | July 2018 | Aug 2018 | Sep 2018 | Oct 2018 | Nov 2018 | Dec 2018 |
|-----------------|--------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Crustacean      | Ni           | 11       | 12       | 12       | 8        | 17       | 13       | 11       | 13       | 9        | 16       | 19       | 10       |
|                 | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.478    | 0.545    | 0.631    | 0.533    | 0.68     | 0.541    | 0.5      | 0.565    | 0.642    | 0.727    | 0.678    | 0.526    |
|                 | Fc%          | 18.983   | 25.903   | 21.826   | 17.778   | 22.368   | 18.051   | 13.561   | 20.331   | 19.555   | 20.525   | 25.317   | 17.550   |
| Fishes          | Ni           | 11       | 11       | 10       | 9        | 15       | 14       | 13       | 15       | 10       | 15       | 17       | 11       |
|                 | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.478    | 0.5      | 0.526    | 0.6      | 0.6      | 0.583    | 0.590    | 0.652    | 0.714    | 0.681    | 0.607    | 0.578    |
|                 | Fc%          | 18.983   | 23.764   | 18.194   | 20.013   | 19.736   | 19.452   | 16.002   | 23.461   | 21.748   | 19.226   | 22.683   | 19.285   |
| Mollusk         | Ni           | 5        | 5        | 5        | 5        | 6        | 7        | 6        | 5        | 3        | 4        | 5        | 5        |
|                 | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.217    | 0.227    | 0.263    | 0.333    | 0.24     | 0.291    | 0.272    | 0.217    | 0.214    | 0.181    | 0.178    | 0.263    |
|                 | Fc%          | 8.617    | 10.788   | 0.097    | 11.104   | 7.894    | 9.709    | 7.377    | 7.808    | 6.518    | 5.110    | 6.646    | 8.775    |
| Aquatic insects | Ni           | 7        | 6        | 8        | 6        | 12       | 9        | 9        | 8        | 7        | 9        | 8        | 9        |
|                 | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.304    | 0.272    | 0.421    | 0.4      | 0.48     | 0.375    | 0.409    | 0.347    | 0.5      | 0.409    | 0.285    | 0.473    |
|                 | Fc%          | 12.073   | 10.588   | 14.562   | 13.342   | 15.789   | 12.512   | 11.093   | 12.486   | 15.229   | 11.547   | 10.642   | 15.782   |
| Algae           | Ni           | 5        | 5        | 6        | 5        | 6        | 6        | 5        | 5        | 10       | 6        | 5        |
|                 | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.217    | 0.227    | 0.315    | 0.333    | 0.24     | 0.25     | 0.272    | 0.217    | 0.357    | 0.454    | 0.214    | 0.263    |
|                 | Fc%          | 8.617    | 10.788   | 10.895   | 11.104   | 7.894    | 8.341    | 7.377    | 7.808    | 10.874   | 12.817   | 7.991    | 8.775    |
| Aquatic Plant   | Ni           | 5        | 6        | 4        | 4        | 6        | 6        | 7        | 6        | 4        | 9        | 7        | 5        |
|                 | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.217    | 0.272    | 0.210    | 0.266    | 0.24     | 0.25     | 0.318    | 0.260    | 0.285    | 0.409    | 0.25     | 0.263    |
|                 | Fc%          | 8.617    | 10.788   | 7.263    | 8.872    | 7.894    | 8.341    | 8.624    | 9.355    | 8.681    | 11.547   | 9.335    | 8.775    |
| Mud particles & | Ni           | 8        | 5        | 4        | 3        | 5        | 7        | 6        | 5        | 3        | 6        | 7        | 5        |
| other misc      | NT           | 23       | 22       | 19       | 15       | 25       | 24       | 22       | 23       | 14       | 22       | 28       | 19       |
|                 | Fi           | 0.347    | 0.227    | 0.210    | 0.2      | 0.291    | 0.272    | 0.217    | 0.214    | 0.272    | 0.214    | 0.241    | 0.263    |
|                 | Fc%          | 13.780   | 10.788   | 7.263    | 6.671    | 6.578    | 9.709    | 7.377    | 7.808    | 6.518    | 7.679    | 7.991    | 8.775    |

Where ‘ni’ No. of stomachs containing a type of food & NT= is No. of not empty stomachs examined; Fc%= Fi/NT×100
having the majority of food which consists of indicated that the fish is a carnivorous feeder even on the basis of biomass of food items range of diet including phytoplankton and average for the year. Based on this they the maximum percentage of the of food items, No fish is either genuinely carnivorous or groups; herbivorous, carnivorous and they are broadly divided into the into three similar results were reported by Nath et al. [16] with 11.4% of dietary was formed by plant food while 82.5% was formed by animal food on an average for the year. Based on this they concluded that Mystus cavacius is carnivorous feeder. Charles and Alan [17] have reported the fish as eury-omnivorous fish as it feeds on a wide range of diet including phytoplankton and (57.48%) and zooplankton (42.52). However even on the basis of biomass of food items accounted in the gut of this fish Mystus cavacius during their study they have reported that inclination of Mystus cavacius is towards carnivorous feeding habits.

Chaklader et al. [18] studies on feeding habits Mystus vittatus (Bloch,1794) shows that the food of Mystus vittatus consists of fish, mollusks, crustacean, copepods, diatoms, green algae, worms, insects and plant materials, thus it indicated that the fish is a carnivorous feeder having majority of food which consists of animals.

4. CONDITION FACTOR

Table 2 shows the monthly condition factor Mystus armatus from January 2018 to December 2018. It was observed that the condition factor was highest 0.88 in month of December and the lowest of 0.64 in the month of July2018.

5. DISCUSSION

No fish is either genuinely carnivorous or herbivorous, but taking into consideration the maximum percentage of the of food items, they are broadly divided into the into three groups; herbivorous, carnivorous and omnivorous [16].

Similar results were reported by Nath et al. [16] with 11.4% of dietary was formed by plant food while 82.5% was formed by animal food on an average for the year. Based on this they concluded that Mystus cavacius is carnivorous feeder. Charles and Alan [17] have reported the fish as eury-omnivorous fish as it feeds on a wide range of diet including phytoplankton and (57.48%) and zooplankton (42.52). However even on the basis of biomass of food items accounted in the gut of this fish Mystus cavacius during their study they have reported that inclination of Mystus cavacius is towards carnivorous feeding habits.

Chaklader et al. [18] studies on feeding habits Mystus vittatus (Bloch,1794) shows that the food of Mystus vittatus consists of fish, mollusks, crustacean, copepods, diatoms, green algae, worms, insects and plant materials, thus it indicated that the fish is a carnivorous feeder having majority of food which consists of animals.

In length-weight relationship the value of “b” close to 3 indicates that the fish grows isometrically, Values other than 3 indicate allometric growth which occurs when the fishes change slope during growth and the cubic law was no longer obeyed [19]. The values of b in Mystus cavacius are higher than 3 which show allometric growth. Similar result were also found by Soni and Kathal [20] who studied the length-weight relationship of C. miraga and Cyprinus carpio and found the value of “b” 4.36 and 3.75, respectively. They reported that the “b” value was due to feeding habit of fish. Datta et al.[21] also observed similar results in Channa punctatus with the values more than 3, in different feeding concentration. Khristenko and Kotovska [22] reported that, When the growth was evaluated in terms of length, it was found that the growth in A. brama showed positive allometric growth where b values are more than 3(b>3, P<0.05).

Barnham and Baxter [23] proposed that if the K value is 1.00, the condition of the fish is poor, long and thin. A 1.20 value of K indicates that the fish is of moderate condition and acceptable to many anglers. A good and well-proportioned fish would have a K value that is approximately 1.40. Based on this criterion the sampled fish is in very poor condition and required good care to be taken. Ahmed et al. [24] also reported that the values of Alestesba remose, Eutropius niloticus, Hydrocynus froskalli, Lates niloticus condition factors revealed that 80 of the fish species had their K values less than one, indicating that the wellbeing of fishes are not good in the Roseires reservoir. This could have been caused by adverse environmental factors. According to Gupta et al. [25] the difference in condition factor
Fig. 3. Length weight relationship in *Mystus armatus*

### Table 2. Monthly variations for condition factor

| Month | Condition factor |
|-------|------------------|
| Jan   | 0.78             |
| Feb   | 0.71             |
| Mar   | 0.73             |
| Apr   | 0.7              |
| May   | 0.72             |
| Jun   | 0.67             |
| Jul   | 0.64             |
| Aug   | 0.67             |
| Sept  | 0.73             |
| Oct   | 0.84             |
| Nov   | 0.87             |
| Dec   | 0.88             |

Fig. 4. Monthly variation in condition factor in *Mystus armatus*

could be due to the availability of food organisms at a particular time as well as the difference of gonad development. The condition factor of fishes has been reported to be influenced by a number of factors such as the onset of maturity, Spawning [26,27], sex and maturity [28,29] and Pollution [30,31,32] The present study could not explain what is the factor for poor condition for the sampled fish.

### 6. CONCLUSION

From the above study it was concluded that the gut content in *Mystus armatus* consists of animal...
as well plant type of food but majority of food contents are animals, it was concluded that the *Mystus armatus* is carnivorous feeder. Length-weight relationship shows positive allometric growth with higher values of b due to their feeding habits. On the values of condition factor it was concluded that the condition of sampled fish is poor, due to various reasons such as condition of water, whether it is polluted or not, maturation of gonads, availability of food, space of living etc. and it is recommended that it is very important that ecology of river Godavari from Kaigaontoka region has to be studied in detail.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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