Food and feeding habit and length-weight relationship of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Vadavar River, Lower Anicut, Tamil Nadu

Victor Raj M, Sivakumar R, Mathialagan R

1. CAS in Marine Biology, Annamalai University, Parangipettai-608 502, Tamil Nadu, India
2. P.G. and Research Dept. of Zoology, Government Arts College (Autonomous), Kumbakonam-612 001, Tamil Nadu, India

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ABSTRACT

This study aimed to provide information on the food and feeding habit and length-weight relationship of freshwater catfish *Mystus vittatus* (Bloch, 1794) based on 360 specimens (Juveniles 41, males 138 and females 181) collected from the Vadavar river, Lower Anicut, Tamil Nadu during the period between December 2009 to November 2010. *M. vittatus* is one of the commercially important catfishes and is also mainly a carnivorous fish. Its food consists mainly of fishes, insects, green algae, blue green algae, diatoms and crustaceans were reported throughout the study period. Monthly variations in the percentage composition of the food items were noticed. No variation of food items between the juvenile and adult specimens. Length-weight relationship of *M. vittatus* ranging from 85-205 mm in total length and 6.0-76.5 g in total weight. Length-weight regression equations were derived for juvenile, male and female specimens in order to find out the regression parameters and growth pattern. LWR in juveniles, males and females are Log W = 1.457+2.366 Log L; Log W = -1.428+2.405 Log L; Log W = -1.987+2.873 Log L respectively. Where as in pooled sexes Log W = -1.816+2.732 Log L. Correlation coefficient values ranging from 0.728-0.851 and regression coefficient were 0.531-0.725. Mean condition factor (K) ranged from 0.4±1.6. The ‘b’ values indicate the growth patterns of *M. vittatus* were found to be negative allometric.

Key words: Percentage composition, Numerical method, Negative Allometric, Condition factor.
1. INTRODUCTION

The fishes of the teleostean order siluriformes popularly called as ‘catfishes’ (in tamil-keluthi) which are an important part of the ichthyofauna in wetlands and many of them are economically important with high nutritive value living both in sea and freshwater. It is comprising approximately 35 families (437 genera and about to 2734 species) are found in world level. Even though there are about 158 species of inland catfishes from 51 genera belonging to 13 families in India (Talwar and Jhingran, 1991; Jayaram, 2010). Among the 13 families the family of Bagridae is the richest and most important of the teleostei class and its members are widely distributed throughout the world (Day, 1878) with Indian subcontinent including India, Pakistan, Sri Lanka, Nepal, Bangladesh, Bhutan but it has been also reported from Myanmar, Malaysia, Laos, Vietnam and Combodia (Froese and Pauly, 2006). Being that Siluriformes are the most abundant group of fishes, like the Mystus species are an important component of riverine and brackish water fisheries in India (Talwar and Jhingran, 1991). In addition it found in canals, irrigation channels and usually inhabits marginal vegetation in lakes and swamps with muddy substrates with feeds on plants, shrimps, insects, mollusks and fishes (Pethiyagoda, 1991). Among the Mystus genus as Mystus vittatus (Bloch, 1794) is one of the leading fish species as well as economically important and distributed in the freshwater system in Lower Anicut, Tamil Nadu (South India). It is an important target species for small-scale fishermen; they are a variety of fishing gear.

Though, the freshwater fishes are captured from rivers, lakes and reservoirs and such other bodies of water, they are very important from the culture point of view. Besides, the most important qualities of cultivable fishes are good taste, rapid growth and the ability of breeding. Especially selection of such fishes therefore depends upon the knowledge of their fishery biology which has a bearing on its culture. Rapid growth may be linked with the type of food it eats, which means knowledge of the natural food of the species is essential. A biological study of the fish can provide this information, but it may so happen the particular body of water where it is proposed to be cultured may not have such food (James, 1973). It is a well known fact that the knowledge of fish biology particularly on morphometry, length-weight relationship, condition factor, reproduction, food and feeding habit, etc. is of greatest important not only to fill up the lacuna. The present academic information in the effectiveness of the knowledge is increasing the technological efficiencies of the fishery entrepreneurs for evolving judicious pisciculture management (Piska and Naik, 1972). Furthermore, food is the main source of energy and plays an important role to determine the population levels, rate of growth and condition of fishes. There is a considerable variation in the food and feeding habits of different fishes depending on the availability of food in the environment (Alam et al., 2011). Food and feeding habits of fishes have a great significance in aquaculture practices and also dominant activity of the entire life cycle of fish (Royce, 1972). It helps to select such species of fishes for culture which will utilize all the available potential food of the water bodies without any competition with one another but will live in association with other fishes (Begum et al., 2008). Studies on the food and feeding habits of M. vittatus have been made by different workers (Azadi et al., 1987; Reddy and Rao, 1987).

As a result, knowledge of the relationship between length and weight of a species is necessary to transform to the length structures obtained during these surveys, into the weight of fish captured. Although the length-weight relationships are mainly useful for fishery biologists for monitoring the state of health of such population (Ecotun et al., 2005). LWR’s also useful in fishery management for both applied and basic uses (Pitcher and Hart, 1982) to convert length distributions into weights for biomass estimates (Gerritsen and McGrath, 2007). In the direction of (i) the estimate weight from length observations; (ii) calculate production and biomass of a fish population; and/or (iii) provide information on stocks or organism condition at the corporal level. Length-weight relationships are of great importance in fisheries research because they provide information on population parameters (Ecotun et al., 2005) and also important in fisheries management for comparative growth studies (Moutopoulous and Stergiou, 2002).

Condition factor is a quantitative parameter of the state of well-being of the fish with reflects recent feeding conditions that will determine present and future population success by its influence on growth, reproduction and survival. The condition of a fish reflects recent physical and biological circumstances, and fluctuates by interaction among developmental stages, feeding conditions, parasitic infections and physiological factors (Le Cren, 1951). Besides the condition of the juveniles is most important as they are the ones used in stocking fish farms (Olorin et al., 2006). Subsequently, the aim of the present work was to carry out the first comprehensive description of the feeding biology and LWR’s in Tamil Nadu, only few studies have been conducted on the feeding ecology of catfish (Ragvanathan, 2003). However, not much work has been done on the condition factor or well-being of fishes in M.vittatus especially at the juvenile stage of development in this region. To the best of our knowledge, there is no previous information on food and feeding habits and LWRs of this species from Vadavar River, Lower Anicut. In view of above the lack of information, it was considered a useful to report on the biological and growth aspects of this species. Though the present information providing an insight into the fish biology of this species is compulsory for the management of the fishery.
2. MATERIALS AND METHODS

2.1. Study area

A branch of Vadavar river was selected for this present study (Figure 1) which is located in the region of 11º 08’ 03” N latitude and 79º 27’ 05” E longitude. It has 22.7 km length 40 feet breadth and 14 feet depth and ends in Veeranam Lake. Lower Anicut is a Lower dam and about 40 culture ponds located in the first 10 km of surrounding river area. In some ponds catfishes are cultured and more than 500 people involved in fishing activities throughout the year. They are operating the cast net from catamaran. Thermocole teppam (floating device) are also used as a craft for catfish catching.

The fishery occupies a prominent place in the landing centre of Vadavar river, Lower Anicut.

2.2. Sampling design

Totally 360 specimens (juveniles 41, males 138, females 181) of Mystus vittatus were collected in Vadavar river, Lower Anicut during December 2009 to November 2010 ranging from 85-205 mm in total length and 6.0-76.5 g in total weight. Specimens were kept chilled in an ice box immediately after capture and brought to the laboratory for further examinations. The specimens were mopped on filter paper to remove excess water from their body surfaces. Total lengths (mm) were measured using a ruler nearest to mm as the distance from snout to tip of the caudal fin and total weight was taken nearest to g of each specimen. Sex was determined externally by the presence of genital papilla which are cone like projections on the genital aperture of the males and are absent in females. The stomach of each one was taken out and weight of the gut was noted with the help of electronic balance (DIGI’ Arts maximum=1000 g to d=0.5 g). Then, every gut was opened and contents were preserved in 5% formalin in order to prevent digestion of food items.

2.3. Food content analysis

The stomach content of individual specimen was transferred properly in the Petridish. Then, the random samples of the gut contents were taken and dropped on slides with a dropping pipette and observed under the binocular microscope. The food items were identified to the species level following the keys of Ward and Whippelie (1959) and APHA (1998). The contents of the stomach were clearly mentioned that the Numerical Method the number of each food items was expressed as the percentage of the total number of food items found in the stomachs (Costal et al. 1992 and Kariman et al., 2009).

2.4. Length-weight relationship

The length-weight relationship was calculated by the least square method applying the Le Cren (1951) formula W=a L^b or its logarithmic form, Log W= log a+b log L. A scatter plot of log body weight against log total length was made for the species. The regression of weight against length was computed from the relationship.

W=a L^b

where; W = weight (g); L = Total length (mm); a = Constant; b = Exponent of values between 2 and 5 (Tudorancea, 1988).
The log transformed data gave a regression equation: \( \log W = \log a + b \log L \); where: \( L = \text{Length (mm)} \); \( W = \text{Weight (g)} \); \( a, b = \text{constants} \).

2.5. Condition factor
Condition factor (K) was calculated from the relationship \( K = 100 \frac{W}{L} \); where, \( L = \text{Total length (mm)} \); \( W = \text{Weight (g)} \); \( b = \text{Regression co-efficient (Tudorancea, 1988)} \).

3. RESULTS
The gut content analysis of Mystus vittatus from various months are presented in Figure 2. The stomach contents were made up of 12 categories. It consists of fishes (46.63%), insects (12.43%), diatoms (10.65%), green algae (9.40%), crustaceans (9.24%), blue green algae (4.28%), plant matter (3.32%), worms (2.39%), cladocerans (0.81%), copepods (0.71%), molluscs (0.64%) and rotifers (0.10%). The gut content analysis of fishes showed that the fish feed on variety of food items. Food organisms are found in the stomachs such as fishes (small size of fish and body parts), insects (body parts), green algae (Chlamydomonas globosa, Crucigenia apiculata, Closterium linula, Palmella miniata, Tetraspora lubrica, Euglena granulata, Euglena proxima, Chlorella vulgaris, Ankistrodesmis falcatus, Scenedesmus quadricauda, Pediasiastrum tetras, Pediasiastrum simplex, Pediasiastrum simplex, Cladophora glomerata), diatoms (Cyclotella meneghiniana, Cyclotella stelligera, Fragilaria crotonensis, Diatoma vulgare, Diatoma elongatum, Melosiera sp., Navicula gracilis, Navicula salinarum, Synedra ulna, Pinnularia gibba, Cymbella prostrate, and Cymbella rutteni), crustaceans (prawn body parts, Nauplius and Cypris (Amphibalanus amphitrite), blue green algae (Oscillatoria currice, Anabaena circinalis, Anabaena fertilissima, Anabaena variabilis, Anabaena oryzae, Nostoc carneum, Nostoc commune, Nostoc spngiaforme, Microcystis protocystics, Phormidium sp.), plant matter, worms, Cladocerans (Daphnia carinata), copepods (Cyclops vicinus), Molluscs and rotifers (Brachionus calciformius, Brachionus rubens, Leane bulla) are shown in Figure 4.

3.1. Percentage composition of food items in relation to months
The monthly percentage composition of food items of Mystus vittatus (Figure 2) shows that highest percentage composition of fishes was reported in the month of August 2010 (79.31%) and the lowest in December 2009 (27.97%). Percentage compositions of insects were observed high in the month of December 2009 (32.16%) and low during March 2010 (1.40%). Green algae were recorded high during February 2010 (14.30%) and low in June 2010.
Highest percentage composition of diatoms was noticed in June 2010 (26.34%) and lowest in May 2010 (3.70%). Percentage composition of crustaceans was recorded high during March 2010 (28.87%) and the low in December 2009 (0.23%). The highest percentage of blue green algae was observed in May 2010 (13.31%) and lowest in March 2010 (0.28%). Plant matter was recorded in high during December 2009 (8.62%) and low in July 2010 (0.24%). Worms were observed high in December 2009 (4.89%) and low in April 2010 (0.24%). Cladocerans were recorded high during December 2009 (4.66%) and low in January 2010 (0.4%). High percentages of copepods were recorded in January 2010 (4.48%) and low in February 2010 (1.99%). Molluscs were reported high in February 2010 (2.91%) and low in January 2010 (0.20%) and also rotifers were observed during December 2009 (0.93%) only. This results clearly indicates that the *M. vittatus* prefer the food item like fishes and insects in all months.

### 3.2. Percentage composition of food items in relation to sex

Percentage composition of gut contents in juvenile *M. vittatus* consisting fishes (35.83%), insects (26.30%), green algae (11.56%), diatoms (10.40%), plant matter (4.62%), cladocerans (4.62%), blue green algae (3.17%), worms (2.31%), molluscs (0.57%), copepod (0.28%) and crustacean (0.28%). The percentage composition of gut contents were noticed in male *M. vittatus* consisting fishes (51.83%), diatoms (11.70%), green algae (10.80%), insects (7.57%), blue green algae (5.85%), crustacean (3.52%), worms (3.07%), plant matter (2.10%), mollusc (2.02%), cladocerans (1.05%) and copepods (0.45%). Percentage composition of food items were recorded in female *M. vittatus* consisting fishes (50.30%), diatoms (12.17%), insect (10.86%), green algae (10.49%), crustacean (7.25%), plant matter (2.41%), blue green algae (1.88%), worms (1.76%), copepod (1.43%), mollusc (0.82%), cladoceran (0.41%) and rotifers (0.16%). Fish, insects and diatoms were the preferable food items in all specimens and they were most prominent and abundant it. Moreover, this high percentage composition encountered throughout the study period of both sex. Green algae are the next in abundance after the fish, insects and diatoms.

### 3.3. Percentage composition of food items in relation to seasons

Following, the food items were commonly found for all the seasons (Figure 4). During post monsoon (December 2009 – February 2010) fishes (40.66%) and insects (14.85%) are dominant food items whereas green algae (11.44%), diatoms (8.05%), crustaceans (6.46%) and plant matter (6.44%) comprised in low level. Moreover, summer and pre-monsoon (March 2010 – May 2010) fishes (41.08%), crustaceans (18.93%), insects (11.87%), diatoms (10.11%) and green algae (10.06%) are high. Blue green algae (5.83%), worms (1.37%) and plant matter (1.02%) are low. Similarly in order to fishes (58.16%), diatoms (13.81%), insects (10.57%) and green algae (6.73%) are high whereas worms (3.57%), blue green algae (3.13%), plant matter (2.51%) and crustaceans (2.35%) in low level. Subsequently, during monsoon (September 2010 – November 2010) fishes (54.9%), diatoms (14.57%), insects (12.15%) are high and green algae (7.67%), blue green algae (4.27%), plant matter (2.14%) and worms (1.69%) in low. Hence, the present findings are clearly indicates that food items are significantly varied among the seasons (Figure 5 & 5a).

### 3.4. Length-Weight Relationship

Length-weight relationship in juveniles ranged between 85 and 127 mm in total length and 6.0-19.1 g in total weight and it was expressed by the regression equation (Table 1 and Figure 6) \( \log W = -1.457 + 2.366 \log L \) \( \left( r^2 = 0.549 \right) \).
whereas in males ranged between 105 and 163 mm in total length and 6.4-76.5 g in total weight and it was expressed by the regression equation Log W = -1.428+2.405 Log L (r²=0.531) (Figure 7). The LWR in females ranged between 100 and 205 mm in total length and 6.6-66.5 g in total weight and it was expressed with the regression equation Log W= -1.987+2.873 Log L (r²=0.698) are shown in Figure 8. While the LWR in pooled sexes ranged between 85 and 205 mm in total length and 6.0-76.5 g in total weight and it was expressed by the regression equation Log W = -1.816+2.732 Log L (r²=0.725) has been presented in Table 2 & Figure 9.

The overall length-weight relationship of both male and female Mystus vittatus shows the relationship is linear. The exponent ‘b’ values is 2.366, 2.405, 2.873 and 2.732 in juvenile, male, female pooled sexes of Mystus vittatus respectively, the ‘b’ values are less than (b<3) 3 indicates negative allometric growth. The correlation coefficient of female (r=0.835) is found to be higher when compared to that of male (r=0.728). From this trend it might be presumed that the female gained more weight with increase in length than male. Monthly variations of length-weight relationship of Mystus vittatus are presented in Table 2 with the growth pattern in all the months were performed in negative allometric growth. Month-wise values of regression co-efficient were found to be low (r²=0.556) in April 2010 while the high value (r²=0.961) obtained in the month of January 2010. The values of regression co-efficient consisting r²=0.556, 0.647 and 0.654 during April, February and August 2010 when compared to other months the r² values were not less than r²=0.703. Moreover, the results of length-weight relationship were significant in all months during the period of observation with highly significant in the month of January and April 2010.

3.5. Condition factor

Monthly mean condition factor of Mystus vittatus are shown in Figure 9. In general, monthly condition exhibited a highest peak in the month of April 2010 (2.7±0.9) and somewhat lowest during January 2010 (0.6±0.1). Condition factor (K) values are greater than one indicates that a fish or fishes become a specific length-weight more than the
average weight, or in a better condition. This condition could indicate an aquatic system of greater productivity or that the fish populations are structured (predator prey ratio) allow to rapid growth. The weight per unit length of a fish is greater when it is growing rapidly.

4. DISCUSSION

*Mystus vittatus* feed on variety of food items such as fish, molluscs, crustaceans, cladocerans, copepods, diatoms, green algae, blue green algae, worms, insects, plant materials and rotifers in their gut indicated that this species prefer animal food (Figure 2). Based on the present report the food item was noted that this fish their gut with fish (parts), diatoms, green algae and insects. Other food items eaten by the fishes were regarded as not abundantly. Present status on the food of *M. vittatus* strongly suggested that this fish is an omnivorous. The presence of sand and mud in their gut of these fishes furnishing the evidence about their feeding at the bottom (bottom feeder). Azadi et al. (1987) reported that the food and feeding habits of *M. vittatus* was mainly feed on plankton with preference to zooplankton in addition to fed mainly on copepods, cladocerans, rotifers, ostracods, insects, oligochaetes, chlorophyceae, baccillariophyceae and debris. A comparative study on the food and feeding habits of *Puntius stigma* and *Mystus vittatus* has been reported by Ahmed et al. (1993). From the analysis of food in the gut contents, it is evident that the *M.vittatus* is neither a true surface feeder nor a true bottom feeder, rather its food substance namely fish parts, crustaceans, molluscs, insects, plant parts, algal filaments and sand and mud were distributed throughout the different layers of the water bodies. On the basis of different food items found in the stomach contents of this species may therefore be conveniently regarded as an omnivorous catfish. Begum et al. (2008) reported that the food items in the stomach of *Mystus gulio* suggest that they are euryphagous (i.e. feeding on a wide range of organisms). It was also observed that *M.gulio* can be classified as an omnivorous feeder as the diet covers a wide spectrum of food ranging from various types of plankton to invertebrates and plants. The fish also exhibits an overlapping in food and feeding habits in order to avoid inter and intra specific competition for available food. Such as an euryphagous feeding beahviour is documented in most of the species of catfishes (Thomas, 1966). From the above

![Identification of photographic phyto and zoo plankton images from gut content analysis of M.vittatus; Scale bars =100μm](Figure 5a)
findings it can be concluded that the different food groups varied monthly in their abundance in the gut contents of the fish.

In general despite many variations in fish forms between species, the 'b' is closed to 3, indicating that fish grow isometrically; with the values significantly different from 3.0 indicate allometric growth (Negative and Positive) (Tesch, 1971). The LWR with 'b' values significantly different from 3.0 were often associated with the narrow size ranges of the examined specimens. Moreover, such LWR should be used only within the respective size range (Hossain et al., 2009). However, the changes of 'b' values depends primarily on the shape and fatness of the species, also depends upon by series of factors like habitat, temperature, salinity, food (quantity, quality and size), sex, stage of maturity, specimen examined, condition of places of sampling, sampling season, health and preservation techniques and differences in the observed length ranges of the specimen caught all of which were accounted for the present study (Hossain et al., 2006; Subodha Kumar et al., 2012). Length-weight relationship of the exponent 'b' values are 2.366 ($r^2=0.549$; Figure 6), 2.405 ($r^2=0.531$; Figure 7), 2.873 ($r^2=0.698$; Figure 8) and 2.732 ($r^2=0.725$; Figure 9) in juvenile, male, female and pooled sexes respectively which indicate are negative allometric growth (Table 2). Similar findings were reported by Tripathi et al., (2010) in the river of Ghaghrab belt of Eastern U.P. in India.

Following that the length-weight relationship of M.vittatus in juvenile, male, female and pooled sexes were confirmed the growth is negative allometric with the relationship is linear. Moreover, the length-weight relationship for some Siluriformes fishes had negative allometric based on the regression co-efficient ($r^2$). Martin-Smith (1996)
reported that the value of \( b=2.875 \) (\( r^2=0.917 \)) for pooled sexes in negative allometric of Mystus baramensis, in diverse tropical freshwater community. Hessain et al. (2006) found that the \( 'b' \) value 2.959 (\( r^2=0.953 \)) for males as negative allometric with some degree of changing 3.134 (\( r^2=0.965 \)) for females and 3.058 (\( r^2=0.958 \)) pooled sexes in isometric growth of Mystus vittatus (Bloch, 1794) at Mathbhanga River, Southwestern Bangladesh. Venkateshwarlu et al. (2007) observed the length-weight relationship and condition factor (K) of freshwater catfish, Mystus cavasius (Hamilton-Buchanan, 1822) from Bhadra reservoir, Karnataka with the equation of LWR was \( W=0.0309 L^{2.493} \) for male and \( W=0.0648 L^{2.740} \) female was assessed in negative allometric growth pattern.

Moreover, the condition factor is used to compare the 'condition', 'fatness' or 'well being' of fish and are based on the hypothesis that the heavier fish of a given length are in better condition (Bagenal and Tesch, 1978). Monthly mean relative coefficient condition values are presented in Figure 10. As the variation in the regression constant corresponds to the mean condition factor values is subject to seasonal oscillations and its variation can interfere in the variations of the regression coefficient. Fluctuations of the condition factor of many fishes were observed in relation to their reproductive cycle (Narejo et al., 2002), feeding rhythms or physico-chemical factors of environment, age and physiological state of fish or some other unknown factors (Kalita and Jayabalani, 1997). Condition factor (K) value of less than one indicates that a fish is growing slowly, which may be attributed to overcrowding, parasites, diseases, or low productivity. There are some major differences in the condition factor have been interpreted as a measure of several biological events, such as fat reservations, adaptation to the environment and gonadal development (Marcus and Gerson Arajo, 2003). Thus from the present investigation on length-weight relationship and mean condition factor of Mystus vittatus indicate that the growth rate is quite satisfactory.

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