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STOCK EVALUATION OF *LABEO CALBASU* AND *L. BATA* BASED ON LENGTH-WEIGHT RELATIONSHIP, AGE AND FREQUENCY DISTRIBUTION IN KODAR RESERVOIR OF CHHATTISGARH

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The length frequency, length-weight relationship and age of two carp species, *Labeo calbasu* and *L. bata* were studied in Kodar reservoir of Chhattisgarh. Length of *L. calbasu* and *L. bata* varied between 17.4 – 46 cm and 13 – 46.39 cm, respectively with three age groups in the reservoir. Age group 3+ was dominant for both the species. The growth of *L. calbasu* in the reservoir was not satisfactory, as it did not follow the cube law and exhibited negative allometric pattern of growth. The growth of *L. bata* in this reservoir was ideal. Both *L. bata* and *L. calbasu* in Kodar reservoir belonged to the age classes of 0+ to 3+ years.

INTRODUCTION

The relationship between length and weight has been referred by Haimovici and Velasco (2000) as a very important key, which has widely been used in fish biology for several purposes. This tool provides important information concerning the structure and function of fish populations (Anderson and Neumann, 1996). Moreover it has been used in various aspects such as 1. to predict the weight from measured length in yield assessment (Ecoutin and Albaret, 2003), 2. to calculate the standing crop biomass (Martin-Smith, 1996), 3. to evaluate the index of well–being of the fish population (Safran, 1992) and 4. to assess growth rates and age structure of the fish population as well as to make morphometric comparisons between species and populations (Hossain, 2010). This relationship is helpful for estimating the weight of a fish of a given length and well-being of a fish in terms of condition factor.

Size frequency distribution of any fish is important to know the status of the population structure of that fish in the particular ecosystem. By this abundance, we can improve the management practices with the help of mesh size regulation to maintain the stock as well as to improve the population. Length frequency method is based on the expectancy that frequency analysis of the individuals of a species of any one age group collected on the same date will show variation around the mean length according to normal distribution.

Studies on the age and growth of fishes are of paramount importance, since these are required for proper understanding of the age class structure of the stock and the role played by various year classes in the fluctuation of the fishery. It is necessary for stock assessments and to develop management or conservation plans for a particular environment. Prediction of age in fishes through the rings or annuli on a scale is an important technique for understanding their growth pattern, harvestable size, sexual maturity and, survival and mortality rate (Jhingran 1959). Continuing studies of age and growth in a particular ecosystem will show the normal fluctuations from year to year and over a period of years.

The present work was thus undertaken to evaluate the length-weight in relation to growth, length frequency measurement and to determine the age of two different carp species such as *Labeo calbasu* and *L. bata* in the Kodar reservoir of Chhattisgarh.

MATERIALS AND METHODS

Kodar reservoir is located near Tumgaon, 4 km towards Saraipalli on NH-6, in the district Mahasamund of Chhattisgarh state. The geographical co-ordinates for the selected site is 21°47′-21°31′N latitude and 82°14′-82°19′E longitude. The full surface level (FSL) is 3588 ha and the dead storage level (DSL) is 512 ha, so the average water spread area is 2080 ha. The average depth is 19 m. The fish production recorded from this reservoir in the year (2008-09) was 60.90 tons as per records of Directorate of fisheries of the state Government.

An outdoor study was conducted for 180 days to evaluate some biological aspects of *L. calbasu* and *L. bata* from this reservoir. The number of specimens collected was 324 for *L. calbasu* and 432 for *L. bata*. The measurements on total length and total weight were taken at the landing site of the reservoir. Length of the fishes was recorded with the help of fish board. The weight of the fishes was also taken with the help of electronic or spring weighing balance. Cubes law was applied to know the length-weight correlation. The well-known equation adopted is $W = aL^{b}$, where, W = weight in kg, L = length in cm, a is the intercept of the regression and b is the regression coefficient (Hayes *et al.*, 1995). Parameter a and b of the length-weight relationship were estimated by linear regression analysis based on logarithms: Log W = Log a + b Log L. The statistical significance of the isometric exponent (b) was analyzed by a function: $ts = (b - 3)/ S_b$ (Sokal and Rohlf, 1987) where, ts is the t Student's statistics test value, 'b' is the slope and 'Sb' is the standard error of the slope. Correlation between length and weight of the carps were also calculated.

The age of a fish was calculated through annual rings present on the scales. The scale samples were taken uniformly from the lateral side directly below the dorsal fin and

above the lateral line. The scales were studied under magnification (profile projector by Sipcon Instrument Industries, India). The collected scales (10 scales per fish) were washed in tap water and rubbed in between fingertips for proper cleansing and removal of extraneous matter and mucus. To make the scales more clear and soft, they were dipped in a solution of 1% KOH for about 5-10 minutes. The scales were then washed in tap water and dried in the air. Small size scales were mounted between two glass slides and then observed with the help of hand lens. For clear observation, the small scales were stained with Alizarine red and mounted in glycerine. The scales were finally stored in envelops with proper label. After determination of length frequency, ten numbers of scale samples were collected individually for age calculation. Based on the complete annual rings it was again correlated with length frequency to work out the age group of fishes.

Fishes were divided into different age groups depending on number of annuli present on the scales. The occurrences of number of individuals in various age groups were recorded. Every effort was made to ensure collection of random samples. For each sample, the length frequency distribution was studied; the length measurements being classified into size groups with a class interval of 5 cm.

RESULTS AND DISCUSSION

Length frequency of carps

The age group 2+ and 3+ were dominant in the commercial catches for *L. calbasu*. Variable mesh size has been used in different years for harvesting in the reservoir. Therefore, length group 22-26 cm of age group 1+ and length groups 42-46 cm of age group 3+ could not be recorded in greater numbers. However, it was clear from the length frequency table that except the above said length for age group 3+, rest showed satisfactory result. The population is highly variable in different age groups as is evident in the length groups of 22–26 and 27–31 cm representing age group 1+ (Fig. 1). This indicated that initially the growth in *L. calbasu* is faster and gradually it gets reduced with age. However, El-Haweet *et al.* (2005) reported the length frequency data by the end of each year of life in *Boops boops* to be 9.5, 13.4, 16.2, 18.4, 20.5 and 22.5 cm for age groups from I to VI, respectively and age group III had the highest abundance, followed by age group II and

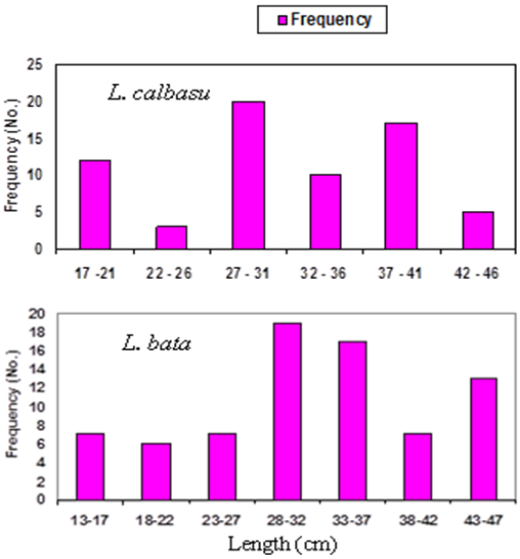

Fig. 1. Length frequency of *L. calbasu* and *L. bata* in Kodar Reservoir

age group IV. In the present study, a minimum length of 13 and maximum of 46.39 cm was recorded with three age groups in *L. bata*. Length frequency in *L. bata* of 2+ age group (28–32 cm) indicated maximum harvest. Sarojini (1957) conducted a study on *Mugil parsia* in the river Matla in Bengal for a period of three years. As the data collection period was longer, it showed a better result as compared to the present study. She used bag net samples, while gill net samples of variable mesh size were used in the present study and hence, there was a variation in the stock harvest.

Large number of variations was observed in the reservoir. Some possible reasons responsible for this wide fluctuation of individuals are variability of unit effort, lower number of individuals and smaller duration of data collection.

Length-weight relationship in carps

The length and weight of *L. bata* in Kodar reservoir varied from 13-46.1 cm and 0.25–3.3 kg, respectively. The correlation coefficient 'r' value was high (0.924), which shows that length was highly correlated to weight (Fig. 2). Such trend was also recorded in tilapia by Ujjania (1998). He observed that samples between size ranges of 17-43.5 cm length and 80-1620 g weight had a strong relationship with the highest 'r' value of 0.986.

The equation for *L. bata* and *L. calbasu* in Kodar reservoir were as follows: Bata - Log W = 1.9519 Log L – 2.7024 and Kalbasu - Log W = 1.391 Log L – 2.108.

Hile (1936) observed that the value of regression coefficient (exponent) 'b' usually lies between 2.5-4.0, while, according to Martin (1949), an ideal fish maintains the shape at b=3. Depending upon the deviation of the value of 'b', fishes are classified into three groups; 1. b=3, when the body form of fish remains constant at different lengths (isometric) (Allen, 1938), 2. b<3, when fish becomes more slender as the length increases (negative allometric) (Allen, 1938) and 3. b>3, when fish grows more stout with increase of length (positive allometric) (Grover and Juliano, 1976). In the present study, the value of regression coefficient for *L. bata* in Kodar reservoir was 2.70, which is close to 3 and therefore, *L. bata* follows the cube law and the growth is isometric (Fig. 2). However, the physico-chemical and biological conditions, biotic interaction between species, colonisation

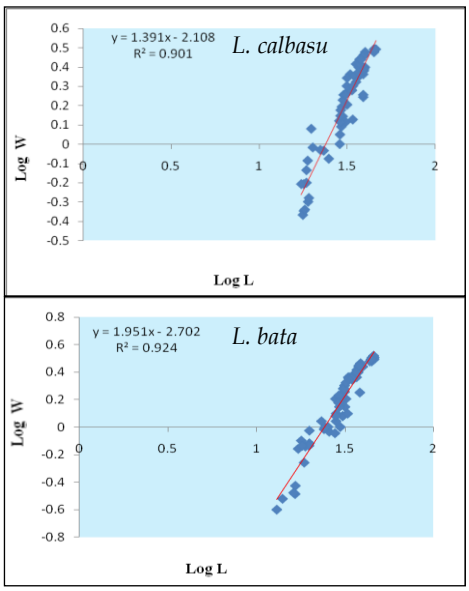

Fig. 2. Correlation between length and weight of *L. calbasu* and *L. bata* in Kodar reservoir

and environmental disturbance might be responsible for the fluctuation among population size, structure and recruitment in this species. On the other hand, *L. calbasu* deviates from the cube law and therefore, has negative allometric growth i.e., the weight does not increase in proportionate to the length (Fig. 2). Pathak (1975) however, reported the value of 'b' as less than 3 for *L. calbasu* from Soni River and, concluded that there was a linear growth and the equation followed the cube law. In the present study, a curvilinear relationship was observed between these variables; which might be due to low plankton population with nutrient deficiency, showing negative allometric growth. Allochthonous supply to the reservoir by drainage from the surrounded deciduous forest was not sufficient to fulfill the amount required by the fishes.

Age studies in carps

Present studies of growth rings or annuli in the scales of *L. calbasu* and *L. bata* showed a maximum of four rings. Tandon and Johal (1996) observed spawning marks on the scale and considered it valid for age determination. Spawning stress, high temperature and scarcity of food are responsible for formation of annuli. Ujjania *et al.* (1998) used key scales and observed the age and growth of tilapia *(Oreochromis mossambicus*) from Lake Jaisamand, Udaipur, India. Maximum three annual rings or annuli were recorded and used to assess the growth data in the samples representing 0+ to 3+ year classes. In the present study, maximum number of specimen belonged to the age group 2+ and 3+, followed by 0+ and 1+, for both the species (Fig. 3). It is seen that the first annual ring appears after attaining 0.9 kg and a fish below 0.9 kg may be categorized under zero age group. 1+ to 2+ year class was found in between 23 to 29.1 cm where the mean weight was 0.924 and 1.5 kg, respectively. 3+ age group fishes were available between 2.3 to 3.1 kg having lengths between 33.1 to 46.2 cm. One fish (*L. calbasu*) from Kodar was found to be 4+ year class, where the length was 46.1 cm and weight was 3.3 kg.

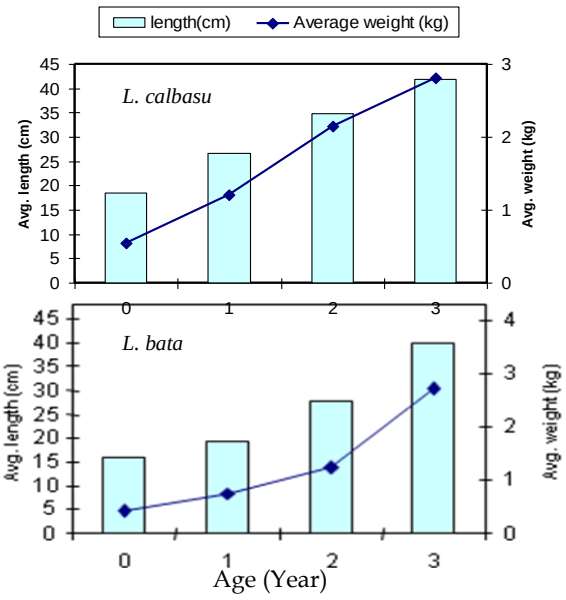

Fig. 3. Relative growth of *L. calbasu* and *L. bata* in Kodar reservoir

The overall findings of the present study indicating the discrepancies pertaining to length-weight relationship, age and length frequency distribution in *L. calbasu* and *L. bata* in Kodar reservoir may be attributed to various types of destructive

fishing activities practiced in the reservoir system e.g. different types of agricultural and industrial practices in catchment areas affecting fish fauna, overfishing with inappropriate fishing gears and, introduction of exotic and alien species competing for space and food availability.

CONCLUSION

From the preset study it is concluded that environmental factors highly influence the growth performance of an organism in a particular ecosystem. It is thus highly essential to know the abundance as well as the well-being of a fish by the length frequency and length-weight relationship of fishes, so that it will be easier to maintain the culture system with best management practices. Growth of *L. calbasu* in the reservoir did not follow the cube law. It was negative allometric and not satisfactory, which might be due to lack of food availability. The growth of *L. bata* in these reservoirs was ideal and isometric. The abundance of age group 1+ with the length 27-31 is more in case of *L. calbasu* where as in *L. bata* age group 2+ is dominant. The fish yield from the reservoir fluctuates conspicuously depending upon the efficiency of the fishermen. Skill of fishermen needs to be improved with proper nets in adequate quantities so that fishing efficiency is sustained all through the years. Ecological studies of the reservoir covering its morphometric, climatic, physico-chemical and biological parameters, which altogether govern the fish productivity, are needed to be studied for better management and development of fishery of the reservoir.

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