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Length-Weight Relationship of *Catla catla* (Hamilton-Buchanan) from Harike wetland (Ramsar Site), Punjab, India

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Abstract

Harike wetland (Ramsar site) is an internationally important aquatic ecosystem. This water body is widely known for its commercial fishery resources as many fishermen and their families are dependent on this for their livelihood. Fishery resources from natural aquatic ecosystems are depleting with a very fast pace due to various anthropogenic activities. Harike wetland possessing wide array of fish biodiversity but the important commercial fishes are depleting with a very fast rate due to loss of habitat, discharge of industrial effluents, municipality sewerages, pollution from surface runoff, addition of solid waste, etc. It is observed that the catch of commercial fish Catla catla is depleting drastically from this wetland hence study of length-weight relationship has been conducted to know the present status of the fish. The coefficient correlation (r) was found to be 0.94 indicating a significant linear relationship of length and weight. The exponent value 'b' = 3.2028 was indicating positive allometric growth from this wetland.

Key words: Wetland, *Catla catla*, length-weight relationship, isometric growth, fishery management.

Introduction

The length-weight relationship of fishes depicts an increase in length as well as weight. It helps to find out the somatic growth of fishes is either isometric or allometric in a given water body[1]. The relationship of length-weight has theoretical and practical value in fishery management studies and facilitates the conversion of one measurement into another to assess the rate of growth of the fish crop[2-5]. Hence, length-weight relationship data in fishes is very useful for various studies under population dynamic such as estimation of rate of growth, age structure and condition of aquatic ecosystem[6]. Such studies can solve various problems related with determination of spawning season, well-being of the fish, growth rate, size at first maturity and development of gonads. This relationship is very important and widely used to draw comparison of growth among different species from same locality as well as same species in different localities[7-11]. Length-weight relationship study provides basic information about fishery of any water body to fish biologists[12].

Number of authors have reported isometric growth pattern in different fishes in varied localities. A study reported from aquatic ecosystem of southern Rajasthan on juveniles of the *Cirrhinus mrigala*, *Catla catla* from the Gandhi Sagar (Madhya Pradesh) and *Puntius chola* from Islamabad found isometric growth in relation to length[13-15]. A strong and significant linear relationship has been drawn between total length and weight of *Catla catla* from Sukhna lake, Chandigarh and coastal fish species of Azores islands[16,17].

Most of the studies on fishes concluded that the weight increase follows the cube of their length[18]. The growths of fishes from some different localities are not following the cube Law, where length of the fishes is observed to be higher when compared to weight, hence showed allometric growth. It has also been observed by number of authors that length-weight relationship in carps does not follows the cube law and value of 'b' is always more than 3 as in *Puntius sarana* from Loni reservoir (Madhya Pradesh)[19], *Aristichthys nobilis* from Pakistan[20] and in Indian major carps from Mahi Bajaj Sagar, Rajasthan[21].

The isometric growth in fishes shows that water bodies provide suitable environment which is pollution free, availability of plenty of food, free space to thrive well, etc. Hence, length weight relationship studies are ideal to recommend water bodies as fit or unfit for fish growth.

Material and Methods

100 fish samples ranging between 289-875 mm in length and 390-11460gm in weight have been collected for the analysis of length-weight relationship from Harike wetland, Punjab (31.17°N and 75.20°E) during July 2012 to September 2014. Total length (TL) of each was measured in millimeters and weight in grams by digital balance on the spot. Total length (TL) was taken by closing mouth of the fish tightly to measurement it from tip of the snout to caudal fin. The cube law[1] is widely used to describe length-weight relation in almost all fish species. $W = aL^b$

Where: W = Body weight (gm), L =Total length (mm), a = Constant and b= Exponent.

According to this law isometric growth has been observed in fishes, where weight and length increases cubically. The relationship between observed values of length and weight depicts parabolic m by applying $W = aL^b$ or depicts linear relationship when converted into logarithm which is Log W = Log a + b Log L, where 'a' is constant and 'b' is exponent which are calculated by regression analysis. From this it can be calculated that fish grows isometrically, when it retains same shape and value of exponent 'b' would be 3.0. When the value of 'b' significantly fluctuates larger or smaller than 3.0 it gives positive or negative allometric growth respectively.

This relationship was fitted to straight line through the logarithmic form:

$$Log W = Log\ a + b\ Log\ L$$

Where: "a" and "b" represents constant and slope of the line respectively.

Results and Discussion

Present study deals with the length-weight relationship of *Catla catla* from Harike wetland to know its present status as population of this fish shows declining trends. *Catla catla* belongs to family Cyprinidae and is the fastest growing species among three indigenous major carps. Parabolic relationship was observed when original total length of all the specimens was plotted against respective weight of the fish (figure-1) whereas; linear relationship was obtained when these values were converted into logarithmic values (figure-2).

The data analysed from regression equation for length-weight relationship is as follow:

Regression data

$r = 0.941$

$a = -5.373$

$b = 3.2028$

Regression equation:

$$Log\ W = -5.373 + 3.2028 Log\ L$$

$$W = -5.373\ L^{3.2028}$$

Many workers from different regions of India as well as from world have been carried out length-weight relationship studies on various fish species. This relationship is very beneficial for comparison of different fish species from different water bodies. But it is essential that data should be collected at different times of the year and over a period of year[7]. The empirical data on length and weight provides important information on various issues of climate and environmental changes as well as changes caused in human subsistence practices[22]. Further study conducted on *Catla catla* reported the exponent value 3.1517 from different water bodies and value comes to 3.283 irrespective of size and sex from the river Yamuna[23,24]. The value of 'b' has been calculated for *Catla catla* 3.0580 and 3.2297 from Gobindsagar and Harike wetland respectively and suggested better growth of the fish in riverine population than reservoir[25]. The exponent value of other fishes has also been compared with the value of *Catla catla*. The exponent value have been calculated for *C. catla* 3.5445, for *L. rohita* 3.2004 and for *C. mrigala* 2.7532 from Jaisamand lake, Udaipur, Rajasthan[4] and observed the value of 'b' of *C. catla* 3.275 from Mahi Bajaj Sagar (MBS) reservoir[21]. Above said studies revealed that the value of exponent in the general length-weight equation departs mostly from the cube law in *Catla catla* among the three Indian major carps. The value of 'b' observed to be higher than the cube law which shows positive allometric growth in *Catla catla*. During present course of work on *Catla catla*, the length ranges from 289 to 875 mm and weight from 390 to 11460 gm. A significant correlation coefficient 0.941 was found and value of exponent was 3.2028 which show positive allometric growth and increasing vogue in weight.

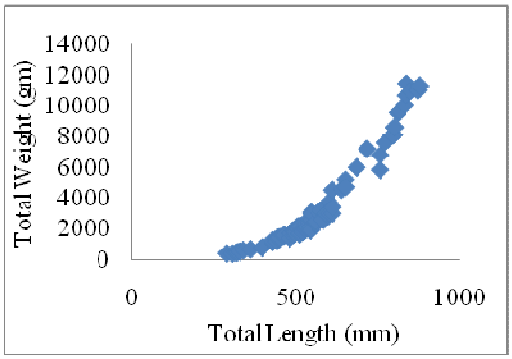

Figure-1
Length-weight relationship of *Catla catla* from Harike Wetland

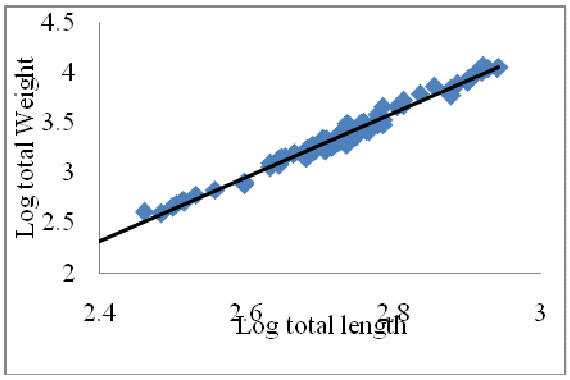

Figure-2
Log length-weight relationship of *Catla catla* from Harike Wetland

Earlier, many workers conducted study on different age groups of *Catla catla* and calculated different exponent values (b) in male and female separately. But pool data almost gives positive allometric growth[4,5,21,23,24]. Similar observations have been

observed during present course of work from the pool data of *Catla catla* from Harike wetland. Though Harike wetland is very big water body and having large reservoir area. The wetland provide adequate space for the fishes to live there and grow significantly, but the declining exponent value i.e.3.2028 revealed that the fish experiences declining vogue as compared with the exponent value of earlier results discussed may be attributed to the presence of pollution, reduction of depth due to siltation, lack of food, competition, overcrowding as fishing is banned in sanctuary, etc.

The length-weight relationships in the fishes facilitate to assess the growth rate of the fishes occurring in any water body. It has most significance in theoretical and practical applications in fishery science. Growth of the fish is generally contributed by increase in weight and length of the fish and their relationship amongst them has an interesting aspect in fish biology. In the fishes where the value of 'b' used to be 3 is considered as isometric growth and this is known as ideal growth of the fish. In riverine ecosystem the value of 'b' is near to 3 and known as ideal habitat for the fish growth. In reservoirs the value of 'b' exceeds 3 and considered as positive allometric growth in which weight of the fish is more as compared to length and disqualified the cubic law[4,5,9,26-28]. Similar results have been observed during the present course of work where value of 'b' is 3.2028. It is observed from the results that this International water body needs to be conserved from fishery aspects for its sustainability in future.

Conclusion

The present study concluded that the fish shows high value of significant correlation coefficient between total length and total weight. The exponent value in this study indicates positive allometric growth in *Catla catla* from the Harike wetland which is not obeying the cube law. Wetland needs conservation and management efforts from fishery aspects.

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