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SECOND ORDER POLYNOMIAL CURVE FITTING FOR LENGTH-WEIGHT RELATIONSHIP OF *CIRRHINA MRIGALA* FROM MUNJ SAGAR TALAB DHAR, MADHYA PRADESH (INDIA)

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ABSTRACT
The *Cirrhina mrigala* the Munj Sagar talab Dhar was studied for its weight- length relationship for the period of Nov. 2006 to Oct. 2008. Length –Weight relationship (LWR) is useful in *Cirrhina mrigala* was 2.869 Statistical methods such as co-relation, smoothing of data, regression and cluster analysis and polynomial curve fitting are helpful in predicting and planning of the ecosystem. The Second order polynomial was found to be a best fit for LWR in present study.

KEY WORDS: Weight relationship, *Cirrhina mrigala* Second order polynomial, allometery coefficient and constant of proportionality.

INTRODUCTION

The length-weight relationship is very important for proper exploitation and management of the population of fish species. To obtain the relationship between total length and body weight are very much essential for stabilization of taxonomic characters of the specie. Among the freshwater fishes, length-weight relationship has been done by many researchers, *viz*., *Labeo rohita* and *Cirrhinus mrigala* (Ham.) by Khan and Hussain (1941) and Jhingran(1952), Chakraborty & Singh (1963), *Tilapia mosambica* by Doha & Dewan (1967), *Trichiurus lepturus* by Narasimham (1970), *Catfish* by Majumdar (1971), *Clarias batrachus* by Sinha (1973), *Oreinus plangiostomus* by Quadri and Mir(1980) *Rhinomugil corsula* by Sugnan and Vinci (1981), *Labeo calbasu* by Vinci and Sugnan (1981), *Alia coila* by Alam *et al*. (1994), *Chanda nama* and *Chanda ranga* by Iqbal *et al*. (1995-96), *Botia lohachata* by Mortuza & Mokarrama (2000), *Cirrhinus mrigala* (Ham.)by Solanki *et al.(2004), Rhinomugil corsula* by Mortuza & Rahman (2006), *Rita rita by* Laghari *et al.* (2009) and *Catla catla* & *Labeo rohita* by Dagaonkar and Prakash (2009).

MATERIALS & METHODS

About the water body

Munj Sagar is located in the district Dhar. It was excavated by Vakpati Munja (993AD), who was the famous rulers of Paramaras dynasty. Munja was a great general, a poet of repute and a great patron of art and literature. Munj Sagar Talab is geographically located at $22^0$30'06.67" North latitude and $75^0$17'42.67" East latitude. It covers an area of about 49.596 h .The altitude of Munj Sagar Talab is 554m.In Year 2005 it was deepen by removing the bottom soil. This water body was basically constructed for drinking water purpose but Now-a days its water is mainly utilize for irrigation and fish culture

Length -Weight Relationship

The length-weight relationship (LWR) of *Cirrhina mrigala*, were determined. These fish were collected from Munj Sagar talab. They were collected using cast nets with mesh size of 10 mm.. Total length (cm) of individual fish was taken from the tip of the snout to the extended tip of the caudal fin using a measuring board. Body weight was taken to the nearest gram using a top Mark Electronic Balance after blot-drying of excess water from the body. Length-weight relationship was expressed by the following equation:-$W = aL^b$ and was logarithmically transformed into

logW =loga +blogL
Where,
W = weight of fish in grams,
L = total length of fish in centimeters,
a = constant of proportionality and
b =allometry coefficient.

Polynomial curve fitting

The general polynomial equation for the curve fitting is
Y = A + B1*X + B2*X^2 + B3*X^3 + B4*X^4 + B5*X^5
Where Y= dependent variable, X= independent variable, A, B1. are numerical coefficient. The numerical coefficients of above equation were calculated by the method of least square method with the help of Origin6.0 software.

RESULTS

Length-weight relationship.

Length-weight relationship in *Cirrhina mrigala* are reported in table 1 and presented in figs. 1&2

TABLE 1: Showing various measurement of *Catla catla*

S.No.	Characterstics	Measurments	
		2006-07	2007-08
1	Range of length(cm.)	9.70 to 37.30	10.30 to 38.40
2	Minimum length (cm.)	9.70	10.30
3	Maximum length (cm.)	37.30	38.40
4	Weight of range (gm.)	12.98 to 505.80	13.64. To 1058.04
5	Minimum weight (gm.)	12.98	13.64
6	Maximum weight (gm.)	505.80	1058.04
7	Range of b		2.89-2.91
8	Average values of 'b'		2.90

TABLE 2: Length –weight relationship of *Cirrhina mrigala* of Munj Sagar Talab, Dhar Madhya Pradesh with constant and allometery coefficient

Sn.	Year	Length	Weight	a	B
1	2006-07	9.70	12.98	0.02	2.85
		13.60	39.40	0.02	2.89
		25.40	222.70	0.02	2.88
		37.30	505.80	0.02	2.80
		10.30	13.64	0.02	2.80
2	2007-08	19.40	109.10	0.02	2.90
		26.70	240.76	0.02	2.86
		38.40	1058.04	0.02	2.98
Average					2.85

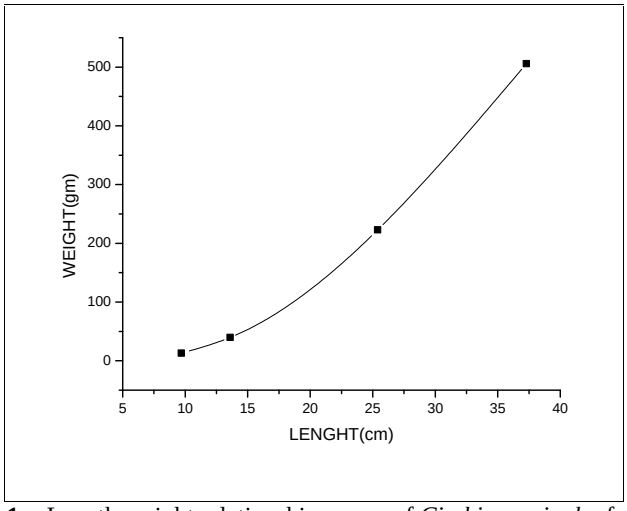

FIGURE 1: Length-weight relationship curve of *Cirrhina mrigala* for 2006-07

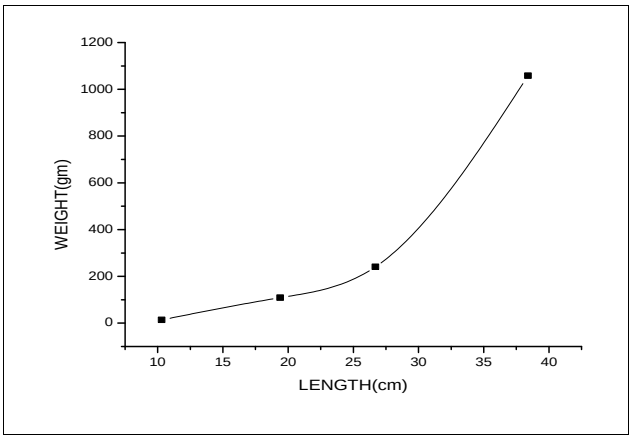

FIGURE 2: Length-weight relationship curve of *Cirrhina mrigala* for 2007-08

Second order polynomial equation

Constant for the second order polynomial, observe and predicted were reported in the table 3 and shown in figs from 3 and 4 .

TABLE 3: values of constants for second order polynomial fit for lwr of C*irrhina mrigala* and observed and predicted values of weight at Munj Sagar Talab Dhar

Sn.	YEARS	A	B1	B2	Observed	Predicted	R
1	2006-07	-25.13216	-0.012095	0.38555	12.98 39.64 222.70 505.80	11.026 46.014 223.8286 510.828	0.99975
2	2007-08	348.00411	-48.94579	1.74897	13.64 109.10 240.76 1058.04	29.5 57.0165 288.57 1048.683	0.9922

Second order polynomial equation for *Cirrhina mrigala* for the period 2006-07 are as follows:- W=-25.13216-0.012905*L+0.38555*L*L

Second order polynomial equation for *Cirrhina mrigala* for the period 2007-08 are as follows:- W= 348.00411-48.94579*L+1.7498*L*L

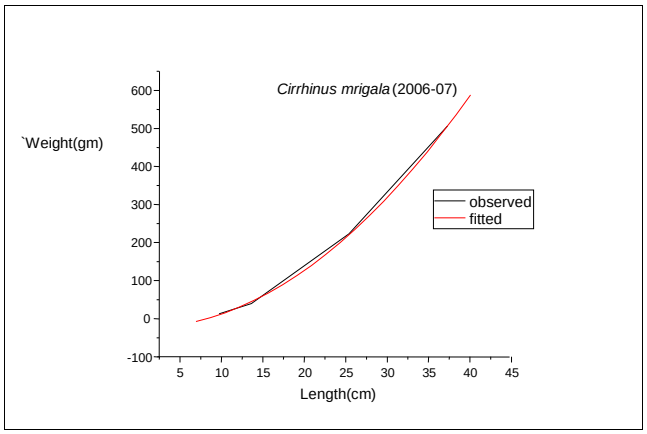

FIGURE 3 : Observed and calculated value curve of *Cirrhina mrigala* (2006-07)

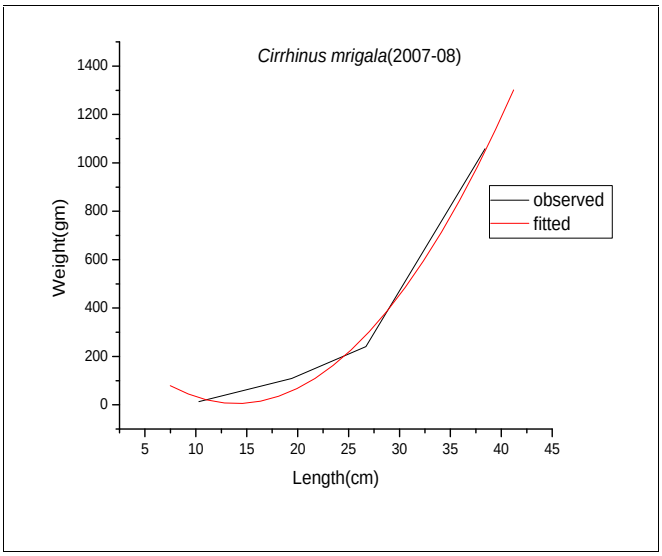

FIGURE 4 : Observed and calculated value curve of *Cirrhina mrigala* (2007-08)

DISCUSSION

Length –Weight relationship (LWR) are useful in fishery management for both applied and basic uses (Pitcher and Hard, 1982). The study of length- weight relationship of fishes is vital importance to the fishery, in setting up yield equation in the study of population dynamics, taxonomic differences, events in life history like metaphorphosis, maturity. (Le Cren, 1951). Length –weight relationship allow fisheries scientists to convert growth-in –length equation to growth-in – weight in stock assessment models (Dulcic and Kralijevic 1996; Goncalves *et al.*, 1997; Morato *et* al., 2001; Stergiou and Moutopoulos 2001, and Ozaydin *et al.,* 2007). According to Hile (1936) and Martin (1949) the value of "b" usually lies between 2.5 and 4.0. (1938) suggested that the value of 'b'remains constant at 3.0 for an ideal fish. Tesch(1968) viewed the value of 'b' '3' , which indicates the specific gravity of the tissue remains constant through its life for an ideal fish. Probably due to this reason the, 'b' value is found to be very close to 3 in many cases. The value of 'b' for *Cirrhina mrigala* reported by many researchers. Javaid and Akram (1972) reported the 'b' value equal to 4.56. Chakraborty and Singh (1963) reported the value of higher than 3. Ahmed and Saha (1996) estimated the value of less than 3 during their study ('b'=2.657). Jha (2010) calculate 'b' value of the same fish from two different pond – Rohani pond Karon pond as 2.6922 and 2.7173 respectively. In the present study the value for "b' for *Cirrhina mrigala* was 2.869, which is less than 3 and thus corroborate with finding of previous authors. Depending on the deviation of b value from "3" fishes can be classified into three groups; b=3 where the body form of fish remains constant; b<3 when fish becomes more slender as the length increases and b>3 when fish grows more slouter with increase of length (allometric), with these fact we conclude that growth of *Cirrhina mrigala* in Munj Sagar talab may be considered to be allometric. Depart from the cubic law in the present study may be due to fact that the fish normally do not retain same shape of the body throught their life span. Sinha (1973), Das (1982) suggested that seasonal fluctuation in environmental parameters , physiological condition of the fish at the time of collection, gonad development and nutriation condition of the environment of the fishes are the causes for this variation. According to Begenal & Tesch (1978), Goncalves *et al.* (1997), Taskavak and Bilecenoglu (2001) and Ozaydin and Taskavak (2007), the value of 'b' may vary seasonally, and even daily, and between habitats. Present authors also agree with the statement of these authors, that the length –weight relationship in fish is affected by number of factors including gondal maturity, sex, stomach fullness, health and preservation techniques as well as season and habitat. Present study lead us to conclude that physico- chemical and biological conidtion of Munj sagar is not optimum for the growth of fishes and shows that still there is a need of lot of management in the physico-chemical and biological parameters in Munj Sagar talabis required to get the value 'b' equal to 3 or more which is good sign of growth. Polynomial Curve fitting may be considered as a mathematical tool which helps us in finding a value of a variable (dependent) with another known variable (independent). A polynomial curve fitting is said to be a best fit if the value of regression coefficient (r) is 1 or near to 1. In the present study several order of polynomial fitting was tried among the different parameters using the Origin 6.0 software. The Second order polynomial was found to be a best fit for LWR

CONCLUSION

As the observed and predicted value is almost same and r is equal to 1 hence author proposes the use of second order polynomial equation to determine the length-weight relationship (LWR) as:

$W = A + B_1 * L + B_2 * L * L$

With, r = 1, where r is regression co-efficient and A, B_1, and B_2 are constants

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