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Second order Polynomial Curve Fitting for Length-weight Relationship of *Catlacatla* from Munj Sagar Talab Dhar, Madhya Pradesh (India)

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Abstract: ***The Catlacatla in the MunjSagartalabDhar was studied for its weight- length relationship for the period of Nov.2006 to Oct. 2008. Length –Weight relationship (LWR)is useful in fishery management for both applied and basic uses.In the present study the value'b' for Catlacatlawas 2.897 Statistical method 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.***

Keyword: Length –Weight relationship, *Catlacatla*, Second order polynomial.

1. 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., *Labeorohita* and *Cirrhinusmrigala* (Ham.) by Khan and Hussain (1941) and Jhingran(1952), Chakaborty& Singh (1963), *Tilapia mosambica* by Doha &Dewan (1967), *Trichiuruslepturus* by Narasimham (1970), *Catfish* by Majumdar (1971), *Clariasbatrachus* by Sinha (1973), *Catlacatla (Ham.)* by Agrwal and Saxsena(1979), *Oreinusplangiostomus* by Quadri and Mir(1980) *Rhinomugilcorsula* by Sugnan and Vinci (1981), *Labeocalbasu*by Vinci and Sugnan (1981), *Alia coila*by Alam*et al*. (1994), *Chandanama*and *Chandaranga* byIqbal*et al*.(1995-96), *Botialohachata*by Mortuza&Mokarrama (2000), *Cirrhinusmrigala*(Ham.)by Solanki*et al.(2004), Rhinomugilcorsula*by Mortuza&Rahman (2006) , *Rita rita by* Laghari*et al.* (2009) and *Catlacatla* & *Labeorohita* by Dagaonkar and Prakash (2009).

2. Material and method

About the water body

MunjSagar is located in the district Dhar. It was excavated by VakpatiMunja (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. MunjSagarTalab 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 MunjSagarTalab 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 *Catlacatla*, were determined. These fishes were collected from MunjSagartalab. 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

$$\log W = \log a + b \log L.$$

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 coefficient of above equation were calculated by the method of least square method with the help of Origin6.0 software.

3. Result

Various measurement taken during 2006-2008 are summarized in table 1&2 and plotted in fig 1&2.

Table 1: Showing various measurement of*Catlacatla*

S.No.	Characterstics	Measurments	
		2006-07	**2007-08**
1	Range of length(cm.)	10.1-37.9	11.5- 38.7
2	Minimum length (cm.)	10.1	11.5
3	Maximum length (cm.)	37.9	38.7
4	Weight of range (gm.)	17.484 -818.70	25.840- 923.780
5	Minimum weight (gm.)	17.484	25.840
6	Maximum weight (gm.)	818.70	923.780
7	Range of b	2.880-2.891	2.770-2.978
8	Average values of 'b'	2.90	2.89

Table 2: Length –weightof*Catla-catla*of MunjSagarTalab, Dhar(Madhya Pradesh) with constant and allometery coefficient

S.No.	Year	Length(cm.)	Weight(gm.)	a	B
1	2006-07	10.10	17.484	0.021	2.912
2		29.50	396.260	0.023	2.880
3		34.10	601.500	0.020	2.918
4		37.90	818.700	0.022	2.896
5	2007-08	11.50	25.840	0.018	2.978
6		28.40	381.483	0.036	2.770
7		32.40	549.500	0.021	2.924
8		38.70	923.780	0.023	2.896
Average					2.897

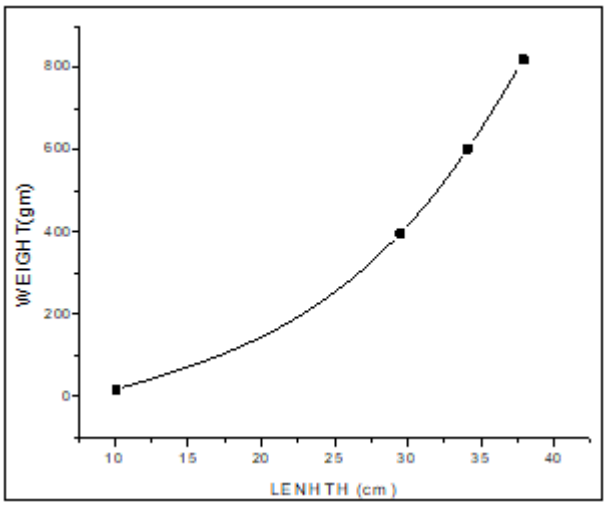

Figure 1: Length-weight relationship curve of *Catlacatla* for 2006-07

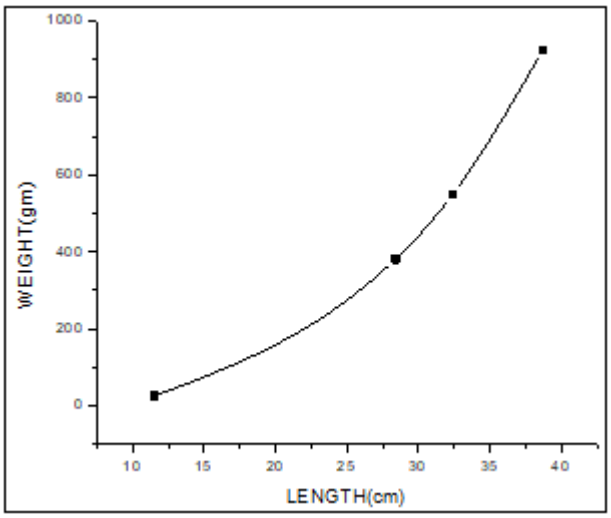

Figure 2: Length-weight relationship curve of *Catlacatla* for 2007-08

Second order polynomial equation

The statistical derivation i.e. constant for the second order polynomial, observed and predicated weight are summarized in table 3 and presented through figs 3 &4

Table 3: Values of constants for second order polynomial fit for LWR of *Catlacatla*and observed and predicted values of weight at MunjSagarTalab ,Dhar(M.P.)

S.No	Years	A	B1	B2	Weight(gm.) Observed	Predicted	R
1	2006-07	153.4427	-24.68986	1.11314	17.484	18.627	0.9999
					396.260	394.803	
					601.500	606.897	
					818.70	817.628	
2	2007-08	177.06632	-26.78142	1.18917	25.840	26.3477	0.99975
					381.483	379.699	
					549.50	557.691	
					923.78	921.633	

Second order polynomial equation for*Catlacatla* for the period 2006-07 is as follows:-

W=153.4427-24.68986*L+1.11314*L*L

Second order polynomial equation for*Catla-catla* for the period 2007-08 is as follows:-

W=177.06632 - 26.78142*L+1.18917*L*

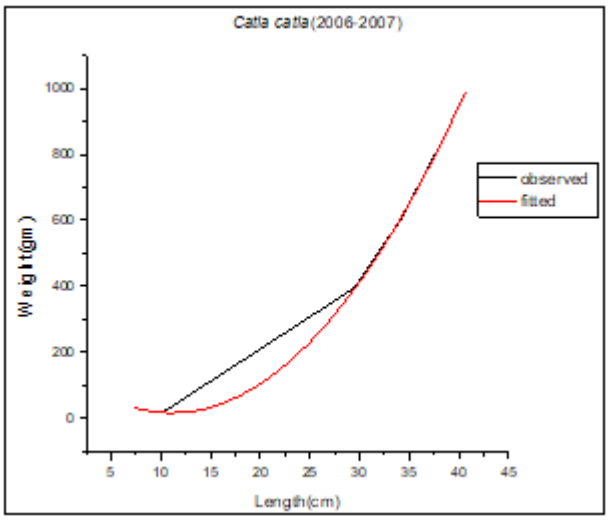

Figure 3: Observed and calculated value curve of *Catla catla*(2006-07)

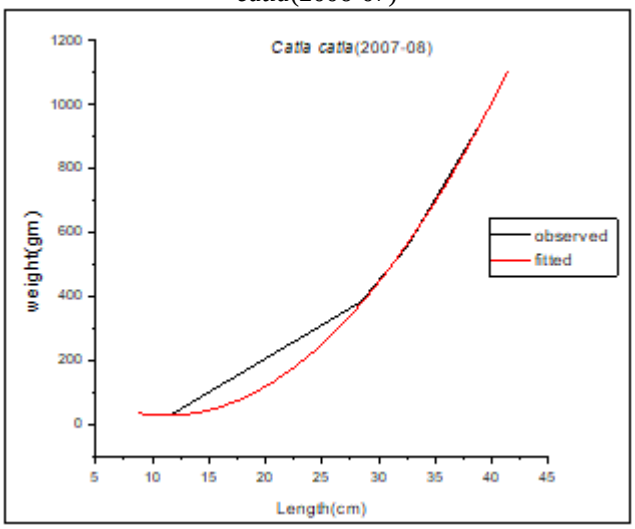

Figure 4: Observed and calculated value curve of *Catla catla*(2007-08)

4. 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 metamorphosis ,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 throught 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 changes in weight in relation to length are generally not on the basis of specific gravity but due to changes in the form of volumes because the density in the organism and that of the surrounding water. Such changes are analyzed by the condition factor(Le Cren, 1951).

Jhingran (1952) reported the value of 'b'as 3.02 for *Catlacatla* .Zafar*et al.* (2003) in their study also estimated same value of ' b' for *Catlacatla* . Ahmed *et al.* (2003) reported the "b" value for *Catlacatla* as 3.021. Jha(2010) described the 'b' value of *Catlacatla*from two different pond –Rohani pond and Karon pond as 3.2134 and 3.1082 respectively. The vale of 'b' equal to 3.18 was estimated by Ahamed andSaha (1996). Similar value of 'b' was observed by Hossain (1995)). In the present study the value'b' for *Catlacatla*was 2.897 which is very nearer to previous value observed in other water bodies . The difference in 'b' value may be due to different ecological condition of water bodies. .

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 *Catla-catla* in MunjSagartalab 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) and 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 Bagenal&Tesch (1978), Goncalves*et al.* (1997), Taskavak and Bilecenoglu (2001), OzaydinandTaskavak.(2007) and Cherif*et al.*(2008), the value of 'b' may vary seasonally , and even daily , and between habitates.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 ofMunjsagar 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 MunjSagartalabis 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 help 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

As the observed and predicted value are almost same and r is almost equal to 1 hence authorproposes 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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