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LENGTH-WEIGHT RELATIONSHIP AND RELATIVE CONDITION FACTOR OF THE CANINE CATFISH-EEL *PLOTOSUS CANIUS* HAMILTON*

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ABSTRACT

The values of both the constants of length-weight relationships of male and female *Plotosus canius*, tested statistically, indicated their difference to be non-significant. Thus, a general length-weight relationship, applicable to both sexes, has been calculated. 'Cube law' has been found to be not applicable in case of this species as the 'b' value of the length-weight relationship is significantly different from 3. Four periods in the annual cycle of this fish, resulting mailnly due to changes in gonad conditions, are indicated by studying the fluctuations in monthwise relative condition factor.

INTRODUCTION

DETERMINATION of a connecting mathematical relationship between length and weight of the fish has numerous practical applications in fishery biology. Such a derived equation enables conversion of one measure into another. This relationship is also useful in evaluating the condition or general well being of the fish by means of study of condition factor (K) or relative condition factor (K_n).

While working out the detailed biology of *Plotosus canius* Hamilton, an estuarine catfish, forming considerable fishery in estuaries and brackishwater lakes of India, it was felt essential to work out this aspect of the species which has not been touched by any of the earlier workers.

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MATERIAL AND METHODS

The length and weight of the fish samples, collected from commercial catches landed at fish assembly centres at Port Canning and Kakdwip (Hooghly-Matlah Estuary) and Balugaon (Chilka Lake), during the period 1974-'76, were measured upto mm and g respectively in fresh condition. Since raciation studies indicated no difference between stocks of the species of these two localities (Sinha, 1981), the samples were pooled together for analysis. Length and weight measurement data of 827 specimens, compri:ing of 326 males (length range: 114 to 612 mm) and 501 females (length range: 86 to 683 mm), collected throughout the year, were utilised for the present study.

The methods, suggested by Le Cren (1951), were followed to compute both length-weight relationship and month-wise relative condition factor of *P. canius*. According to that, the length-weight relationship can be expressed as:

$$W = C L^b$$

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where 'W' and 'L' are weights and lengths of the fish respectively and 'C' and 'b' are two constants (*viz.* initial growth index and regression constants respectively).

Expressed logarithmically, this equation becomes a straight line and can be written as:

$$\log W = \log C + b \log L$$

Le Cren's relative condition factor (K_n) can be calculated using the formula:

$$K_n = \frac{W}{\hat{W}}$$

where, 'W' is the observed weight and $\hat{W}$ is then calculated (expected) weight of the fish.

COMPUTATION OF LENGTH-WEIGHT FORMULA

The regressions of log length on log weight were first calculated separately for males and females of the sample. The regression formulae obtained were:

Male : $\log W = 2.7459256 \log L - 4.795040$

Female : $\log W = 2.8246038 \log L - 5.056869$

The question whether the two samples (male and female) can be pooled together into one large sample and can one regression line be used for all the observations was answered by applying the test, as per method suggested by Ostle (1966). According to that:

$$F = \frac{(S_T - S_1) / 2 (k - 1)}{S_1 / n - 2k}$$

where

$$S_T = C_T - B_T^2 / A_T$$

$$S_1 = (\Sigma y_m^2 + \Sigma y_f^2) - \left[\frac{(\Sigma xy_m)^2}{\Sigma x_m^2} + \frac{(\Sigma xy_f)^2}{\Sigma x_f^2} \right]$$

k = number of rows (samples) tested

$n = N_m + N_f$

and

$$C_T = (\Sigma Y_m^2 + \Sigma Y_f^2) - \left[\frac{(\Sigma Y_m + \Sigma Y_f)^2}{N_m + N_f} \right]$$

$$B_T = (\Sigma XY_m + \Sigma XY_f) - \left[\frac{(\Sigma X_m + \Sigma Y_f)\ (\Sigma Y_m + \Sigma Y_f)}{N_m + N_f} \right]$$

$$A_T = (\Sigma X_m^2 + \Sigma X_f^2) - \left[\frac{(\Sigma X_m + \Sigma X_f)^2}{N_m + N_f} \right]$$

[Notations given are as applicable in the present case. Suffix 'm' and 'f' denote values for males and females respectively].

In the present case, the different values, calculated as per formulae given above, were found to be as under:

$S_1 = 6.0882$, $k = 2$, $n = 827$,
$C_T = 275.6628$, $B_T = 96.0476$,
$A_T = 34.2264$

So,

$$S_T = 275.6628 - \frac{(96.0476)^2}{34.2264} = 6.1299$$

Thus,

$$F = \frac{6.1299 - 6.0882 / 2 (2 - 1)}{6.0882 / 827 - (2 \times 2)} = 2.82$$

The calculated F value (2.82) obtained was found to be non-significant at 2 and 823 d.f. at 5% level ($F_{.05} = 2.99$). It was, thus inferred that the length-weight data in respect of both sexes of this species, can be pooled together. A general length-weight equation, applicable to both sexes, was thus derived. The relationship found was:

$\log W = 2.803267 \log L - 4.7744456$ ($r = 0.9894$) which can be expressed in general parabolic form as:

$$W = 1.6810 \times 10^{-5}\ L^{2.803267}$$

The data on length and weight, pooled for both sexes, are plotted in Fig. 1 and shows a parabolic form.

To test whether the 'b' value obtained for the pooled data was significantly different from 3 or not, Student's 't' test was applied by estimating the standard error of 'b' with the help of analysis of variance (Snedecor, 1961). The same is shown in Table 1. The 't' value of 13.7676 obtained is highly significant. So it can be inferred that the value of 'b' in case of *P. canius* cannot be accepted as 3.

TABLE 1. *Analysis of variance*

Due to	*d. f.*	*s. s.*	*M. S.*
Regression	1	286.1729245	286.1729245
Deviation from regression	825	6.1347405	0.00743605
TOTAL	826	292.3076650	0.3538834

$$\text{Calculated } t = \frac{\text{Observed 'b'} - 3}{\sqrt{\frac{\text{M. S.}}{x^2}}} = \frac{2.803267 - 3}{\sqrt{\frac{0.00743605}{36.416623}}}$$

$$= \frac{-0.196733}{\sqrt{0.0002041938375}}$$

$$= \frac{-0.196733}{+0.0142896} = 13.7676$$

Inference : SIGNIFICANT at 1% level.

FLUCTUATIONS IN VALUE OF RELATIVE CONDITION FACTOR

Table 2 presents the average monthly values of relative condition factor of females of *P. canius*. It is evident from this table that the peak value (1.1902) was observed during the month of April with a drop in May till July, the lowest value (0.9188) being attained then. Thereafter, it starts suddenly August) and then gradually recover (except a marginal fall in October, probably due to sampling error). The drop in relative condition factor value from that of preceding month was maximum seen in the month of May (-0.1075), with the scaling down being gradual thereafter. Likewise, the rise from that of the preceding month was maximum in March (0.0643) with the same on either side being gradual, except in August, the month immediately after lowest value, when the rise was steep.

TABLE 2. *Month-wise relative condition factor of* P. canius

Month	K_n value
September	0.9793
October	0.9767
November	1.0001
December	1.0314
January	1.0432
February	1.0910
March	1.1553
April	1.1902
May	1.0827
June	0.9969
July	0.9188
August	0.9616

DISCUSSION

The significant difference from 3 in the value of 'b', obtained in *P. canius* in the present study, indicates that the 'cube law' is not applicable in its case. Its being less than 3 proves that the weight of this fish, in general, increases in proportion to slightly less than the cube of its length. Hence, the co-efficient of condition value, suggested by Hile (1936), cannot be made use of, in this case, to know the general well being of the fish, and relative condition factor, introduced by Le Cren (1951), will have to be looked into for the purpose.

Le Cren (1951) while proposing the relative condition factor (K_n), enumerated its superiority over coefficient of condition (K). According to him, while the former (K_n) measures all the variations, not connected with length, such as genetic variations, variations associated with food supply and sexual condition etc. including densimetric variations; the latter (K) fails to do so unless the value of 'b' = 3, which is rarely the case.

Maturity of gonads is the most important single factor responsible for bringing about

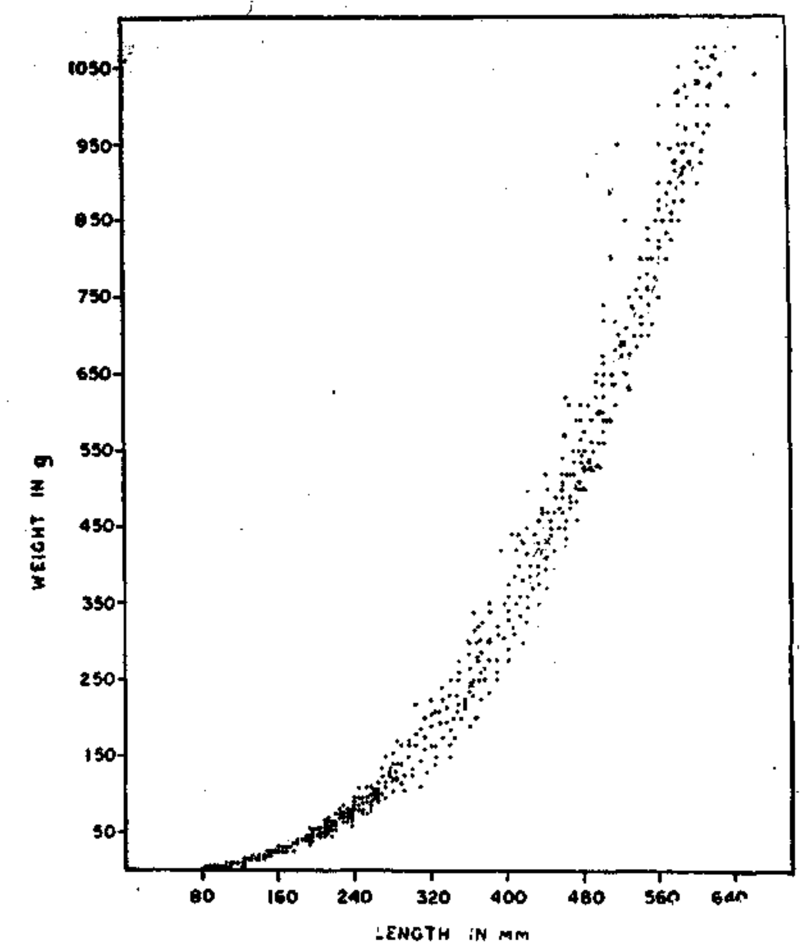

Fig. 1. Length-weight relationship of *P. canius*.

A perusal of Table 2 clearly shows four periods in the annual cycle of *P. canius*. They are: (i) September to January – a period of slow gradual rise in K_n value, (ii) February to April – a period of steep rise in K_n value, (iii) May to July – when there is gradual fall in Kn value, and (iv) August – showing a sudden rise in K_n value.

changes in K_n value. The four periods in the Kn cycle of this species is clearly explained by its maturity cycle (Sinha, 1981). The first period of September to January is the period of normal growth of the species, not effected by maturity. The second period of February to April is the period of active maturation of the species. The third period of May to July is the breeding period of the species.

The fourth period, immediately after breeding, is the period when the feeding intensity in this species is of very high order (Sinha, 1981) and the species compensates for lesser feed intake in preceding months of breeding.

It is, thus, evident that the fluctuations in the values of relative condition factor of *P. canius* results mainly due to changes in gonad conditions and not from changes in the fat content of the fish, observed by Clark (1928), Hart *et al.* (1940), Davies (1956) and Jhingran (1966) in the fish species studied by them. Sinha (1972, 1975) also observed such four periods in annual cycle of *Puntius sarana*, mainly effected by changes in gonad conditions.

References

Clark, F. N. 1928. The length-weight relationship of the California sardine (*Sardina coerulea*) at San Pedro. *Bull. Calif. Fish Game*, **10**: 1-23.

Davies, D. H. 1956. The South African pilchard (*Sardinops ocellata*): sexual maturity and reproduction, 1950-54. *Invest. Rep. Div. Fish S. Afr.*, **22**.

Hart, J. L., A. L. Tester, D. Beall and J. P. Tully 1940. Proximate analysis of British Columbia herring in relation to season and condition factor. *J. Fish. Res. Board Can.*, **4**: 478-90.

Hile, R. 1936. Age and growth of ciso *Lenichthys artedi* (Le Suen) in the lakes of North-Eastern Highlands, Wisconsin. *Bull. U. S. Bur. Fish.*, **48**: 211-317.

Jhingran, A. G. 1966. Studies on the biology and fisheries of clupeoids *Setipinna phasa* (Hamilton) and *Gudusia chapra* (Hamilton) in the Ganga River System. *D. Phil. Thesis. University of Allahabad.* p. 335.

Le Cren, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in perch *Perca fluviatales*. *J. Anim. Ecol.*, **20**: 201-19.

Ostle, B. 1966. *Statistics in Research.* Oxford & I. B. H. Publishing Co., Calcutta, First Indian Edition: pp. 585.

Sinha, M. 1972. Observations on the biology of *Puntius sarana* (Ham.) of Loni reservoir (M. P.). 1. Length-weight relationship, food and condition factor. *J. Inland Fish. Soc. India*, **4**: 122-31.

——— 1975. Observations on the biology of *Puntius sarana* (Ham.) of Loni reservoir (M. P.). 2. Maturity and fecundity. *Ibid.*, **7**: 49-57.

——— 1981. Biology and fishery of the canine catfish-eel *Plotosus canius* Hamilton. *Ph. D. Thesis, University of Calcutta*, p. viii – 225.

Snedecor, G. W. 1961. *Statistical Methods.* Allied Pacific Pvt. Ltd., *Bombay*: p. 534.