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Length-Weight Relationship of the Toothed Pony Fish, *Gazza Minuta* (Bloch, 1797) from Tuticorin Waters of India

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Abstract- Length-weight analysis for specimen comprising 494 males, 515 females and indeterminants of *Gazza minuta*, collected from Tuticorin fish landing centre was made to assess the relationship between the variables The length-weight relationship was estimated using the exponential equation $W = aL^n$ for one species of pony fish belonging to family leiognathidae, species *Gazza minuta*, in the catches of tuticorin landing centre . The correlation co-efficient ("r" values) of male, female and indeterminants were found to be 0.9750 ($p<0.001$), 0.9800 ($p<0.001$) and 0.8931($p<0.001$) respectively. Length-weight relationship study in G. minuta obeys cube law, particularly in the adults.

***Keywords*:** *Gazza minuta,* indeterminants, exponential equation, Tuticorin fish

I. INTRODUTION

The application of scientific knowledge for the development of fishing industry lies in an intimate knowledge on the biology of fishes. Without full and proper information on the life history, Habits and behavior of fishes, it would not be possible to plan, control and manage the fishery resources in a satisfactory manner. Practically nothing is known about the biology of the vast number of pelagic species which contribute much to the pelagic fishery resources of the east coast. It is only within this objective, the present investigation is initiated to study the biology of Gazza minuta.

Reports on the biology of Gazza are available but are few and spotty [1] has reported the fishery of *G. minuta*. [2] Reported about *G. shettyi*. [3] Studied the osteology of *G .minuta*. [4] made some observation on *G. achlamys*. [5] Analyzed age and growth of G. minuta. [6] observed food and feeding habits and [7] reported on reproductive biology on porto nova waters. No work has been done so far regarding the biology of *Gazza minuta* along the Tuticorin coast. Hence the present work was undertaken to have detailed information about the biology of *G. minuta* along Tuticorin coast. The length-weight relationship studies (LWR) is an important tool in fish biology, physiology, ecology and fisheries assessment [8]. It can be used for converting lengths into biomass, determining fish condition, comparing fish growth among areas, and as a complement to species specific reproduction and feeding studies [9-12]. Thus, if it is properly calculated, it can be very useful to fisheries management. Length weight relationship studies useful references for coastal water management and particularly marine fisheries [13].

The length –weight relationship of fish is usually assessed to yield the following informations:
To find out the mathematical relationship between the two characters, so that if one is known, the other could be computed.
To measure the variation from the general length weight relationship indicating fatness , general "well being" or gonad development [14] while the first category is studied under the term "length-weight relationship ", the second one is studied the term " condition".

The weight of a normal fish has a linear relationship with body length and generally the length-weight relationship could be expressed by a hypothetical cube law $w = cl^3$ where "W" is the weight. "L" length and "C"is a constant. This formula holds good to an ideal fish which maintains the same shape as it grows. However it is not always true Most of the fishes change their shape and form as they grow and so the exponent value may be altered [15]. Consequently, the hypothetical formula can be modified as $W = al^n$ where "W" and "L" are weight and length respectively. "a"is a constant equivalent to "c" and "n" is another constant to be calculated empirically i.e, from the data however , it has been observed that there is no significant variation from the isometric growth (n=3) [16]. The value of "n" is normally between 2.5 and 4.0 [17, 15] but for an ideal fish n=3.

The length-weight relationship studies (LWR) is an important tool in fish biology, physiology, ecology and fisheries assessment [18]. It can be used for converting lengths into biomass, determining fish condition, comparing fish growth among areas, and as a complement to species specific reproduction and feeding studies [19]. Thus, if it is properly calculated, it can be very useful to fisheries management. Length weight relationship studies useful references for coastal water management and particularly marine fisheries [20].

II. MATERIALS AND METHODS

Length-weight analysis for specimen comprising 494 males, 515 females and indeterminants of G. minuta, collected from Tuticorin fish landing centre was made to assess the relationship between the variables. Total length of the fish was measured in cm from the tip of snout to the end of the caudal fin and the weight was measured in gms upto 0.001 accuracy. Specimens with broken tail tips were not considered. Weight was measured after the removal of moisture and dirt. This observation was made for a period of one year from January to December 1989

The parabolic equation $W = aL^n$ is expressed in logarithmic form as

Log W = log a +n log L

i.e., y = a + bx

Where,

a =log a

b = log n

y = log w and

x = log L, which is linear relationship between y and x. This linear equation was fitted separately for male, female and indeterminants and the estimates of parameters "a" and "b" for each category were obtained by the method of least squares.

The correlation co- efficient ("r" values) were checked with "t" test by using following formula

$$t = \frac{r}{\sqrt{1 - r^2}} \quad \sqrt{n - 2}$$

Analysis of covariance was performed to understand the significance of regression co-efficient

III. RESULTS AND DISCUSSION

The regression lines of male, female and indeterminants of G. minuta show a linear relationship between these two variables (length and weight). The correlation co-efficient ("r" values) of male, female and indeterminants were found to be 0.9750 ($p<0.001$), 0.9800 ($p<0.001$) and 0.8931($p<0.001$) respectively. The exponent ("b") values of male female and indeterminants were 2.95, 3.07 and 2.55 respectively. Then "t" test was performed to test the significance of "r" value. The "r" values were found to be highly significant this result giving evidence that the weight increased proportionately to an increase in the length of the fish. It can be noticed from the figures 2-4, that6b the points are very close to the regression line indicating a close relationship between length and weight the linear equation fitted for male, female and indeterminants separately are given below:

Male	log W = -1.7812 +2.9482 Log L.
Female	Log M = -1.9034 +3.0775 Log L.
Indeterminants	Log W = -1.5696 +2.5534 Log L.

In order to understand the difference in regression co-efficient of male, female and indeterminants , analysis covariance was employed as followed by, [14], [21], [22], [23], [24], and [25]. The results are given in tables 1-3. Significant difference could be observed. Analysis of covariance was performed again, in order to find out the differences in regression co-efficient between male and female and between male and indeterminants and similarly between female and indeterminants. The result is provided in Table 4-9 No significant differences were noted between male and female. But "F" values observed for male and indeterminants and between female and indeterminants were found to be significant. The "b" value was found to be around "3" for the pooled data of male and female. The regression line fitted for the pooled data of male and female ids given below.

Log W = 1.85156 + 3.02302 Log L

Table 1: Sum of Squares and products of length-weight data of male, female and indeterminants of Gazza minuta

Groups	N	Sx	Sy	Sx^2	Sy^2	Sxy
Male	494	462.2485	482.8910	434.0524	485.8831	456.3192
Female	515	486.7018	517.5774	462.3298	543.5518	496.4353
Indeterminants	84	52.5799	2.4135	33.5952	5.6504	3.2540

N=Number of fish

Sx, sy = sum of logarithmic values of length and weight respectively

Sx^2, sy^2, sxy=sum of squares and products.

Table 2: corrected sum of squares and products of length-weight data co-efficient of allometry and deviation from the regression

	Sum of squares and products				Errors of estimate		
Groups	**df**	**X^2**	**xy**	**Y^2**	**b**	**df**	**SS**
Male	493	1.5146	4.4657	13.8513	2.9482	492	0.6845
Female	514	2.3713	7.2977	23.3841	3.0775	513	0.9253
Indeterminants	83	0.6827	1.7433	5.5810	2.5534	82	1.1294
Total	1090	4.5686	13.5067	42.8164	8.5791	1087	2.7392

df = degrees of freedom, b = regression coefficient

SS = sum of squares

Table 3: Analysis of covariance for testing differences of regression of log W and log L between male and female and indeterminants of Gazza minuta

Source of variation	df	Sum of squares	Mean squares	Observed F	5% F
Deviation of variation	1087	2.7392	0.002519	28.8889*	2.99
Diffrence between regressions	2	0.1457	0.0728		
Deviation from total regression	1089	2.8849	0.075319		

*significant

Table 4: Corrected sum of squares and products of length-weight data co-efficient of allometry and deviation from the regression for male and female

	Sum of squares and products				Errors of estimate		
Groups	**df**	**X^2**	**xy**	**Y^2**	**b**	**df**	**SS**
Male	493	1.5146	4.4657	13.8513	2.9482	492	0.6845
Female	514	2.3713	7.2977	23.3814	3.0775	513	0.9253
Total	1007	3.8859	11.7634	37.2327		1005	1.6098

df = degrees of freedom, b = regression coefficient

SS = sum of squares

Table 5: Analysis of covariance for testing differences of regression of log W and log L between male and female

Source of variation	df	Sum of squares	Mean squares	Observed F	5% F
Deviation of variation	1005	1.6098	0.016	1.9375*	2.99
Diffrence between regressions	1	0.0127	0.0127		
Deviation from total	1006	1.6225	0.0143		

*Non -significant

Table 6: Corrected sum of squares and products of length-weight data co-efficient of allometry and deviation from the regression for male and indeterminants

	Sum of squares and products				Errors of estimate		
Groups	**df**	**X^2**	**xy**	**Y^2**	**b**	**df**	**SS**
Male	493	1.5146	4.4657	13.8513	2.9482	492	0.6845
indeterminants	83	0.6827	1.7433	5.5810	2.5534	82	1.1294

Total	576	2.1973	6.209	19.4323		574	1.8139

df = degrees of freedom, b = regression coefficient
SS = sum of squares

Table 7: Analysis of covariance for testing differences of regression of log W and log L between male and indeterminants

Source of variation	df	Sum of squares	Mean squares	Observed F	5% F
Deviation of variation	574	1.8139	0.00316	23.196*	2.99
Diffrence between regressions	1	0.0733	0.0733		
Deviation from total regression	575	1.8872	0.07646		

*significant

Table 8: corrected sum of squares and products of length- weight data, co-efficient of allometry and deviation from regression for female and indeterminants.

	Sum of squares and products				Errors of estimate		
Groups	df	X^2	xy	Y^2	b	df	SS
Female	514	2.3713	7.2977	23.3841	3.0775	513	0.9253
indeterminants	83	.6827	1.7433	5.5810	2.5534	82	1.1294
Total	597	3.054	9.041	28.9651		595	2.0547

df = degrees of freedom b = regression co-efficient SS=sum of squares

Table 9: Analysis of covariance for testing differences of regression of log W and log L between female and indeterminants

Source of variation	df	Sum of squares	Mean squares	Observed F	5% F
Deviation of variation	595	2.0547	0.00345	42.203*	2.99
Diffrence between regressions	1	0.1456	0.1456		
Deviation from total regression	596	2.2003	0.14905		

*significant

From the results it is suggested that the growth in male and female and indeterminants shows linear relationship between length and weight .The weight increases with increase in length. But in indeterminants, the weight increase seems to be less than that of the length, when compared with that of the mature ones. [26] observed the weight differences between male and female in L. *bindus* .[27] suggested that weight of male seems to be less than that of the female in L. *dussumieri* [28] and [29] have not considered the sexes separately while studying such relationship. However, [24] found significant “F” values for male and female of *Thryssa dussumieri* along Pakistan waters. Recently (1986) Hussain who has studied length –weight relationship of a culpied fish *Ilisha melastoma* suggested that the cubic law holds good and the equation $W = al^3$ may be the suitable one. In *G. minuta* also the cubic law was found to be the suitable one, particularly for adults.

IV. CONCLUSION

Present study showed that toothed pony fishes community in the tuticorin fishing harbor contributed one of the major by catch composition in the trawler operations. The rate of exploitation on pony fish community in the tuticorin coastal water is believed at crucial stage of which can result in recruitment overfishing phenomena.

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CONFLICT OF INTEREST

Authors declare that there is no conflict of interest

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