

## Estimation of Size Frequency Distribution, Sex Ratio and Length-Weight Relationship of Hilsa (*Tenualosa ilisha*) in the Bangladesh Water

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**Abstract:** The study is an attempt to estimate the size frequency distribution, sex ratio and length-weight relationship of hilsa (*Tenualosa ilisha*) by the SPSS programme from length-weight data collected from Bangladesh water. Annual mean length of male and female *T. ilisha* was estimated as 29.30 cm and 34.23 cm. The annual mean weight was 265.89 g and 520.38 g respectively. Standard deviation for length was 3.45 cm and 5.15 cm for male and female. Standard deviation for weight was 88.65 g and 276.28 g respectively. Females were on an average about 4.98 cm taller than males ( $p < 0.05$ ). The 95% confidence interval of the difference between two means was 5.35 to 4.60. The bigger size of female hilsa was observed during the month of June to November and mean length was between 35.36 cm and 34.81 cm where as mean weight was between 564.57 g and 521.87 g. A marked decline was observed in mean length and weight of male during the month of September. In case of female, mean length and as well as mean weight decreased from the month of October and it continued up to the month of January and subsequent recovery after this month. This may be the cause of peak spawning period of hilsa in the month of September. The value of regression coefficient and constant was 49.58 and -1173.091 respectively. The logarithmic form of length-weight relationship of *T. ilisha* was  $\text{Log } W = -2.516 + 3.381 * \text{Log } TL$ . The exponential form of equation obtained for the length-weight relation was  $W = 0.00305 * TL^{3.381}$ . The value of co-efficient of correlation ( $r$ ) estimated for the species was 0.93 ( $P < 0.01$ ), which indicated that the relationship between length and weight of the fish was highly significant.

**Key words:** Size frequency, length-weight relationship, *Tenualosa ilisha*, Bangladesh

### INTRODUCTION

*Tenualosa ilisha* (Hamilton), a diadromous fish, locally known as "hilsa" provides the largest single species fishery in Bangladesh especially during the monsoon in almost all the principal river system, estuaries and the sea of Bangladesh. It contributes about 22-25% of the total fish production of the country<sup>[7]</sup>. It is harvested mainly by gill net and about 2% of the total population of Bangladesh is directly or indirectly employed in this fishery. Size frequency distribution of any fish is important to know the status of the population structure of that fish in the nature. Sex ratio and the relationship between body length and weight are of great importance in fishery biology<sup>[9,31]</sup>. This relationship is helpful for estimating the weight of a fish of a given length and can be used in studies of gonad development, rate of feeding, maturity and condition<sup>[5]</sup>. In the present study, the size

frequency distribution, sex ratio and length-weight relationship of *T. ilisha* were estimated to know the status of the hilsa fishery in Bangladesh, which could be helpful for management of the fishery.

### MATERIALS AND METHODS

Statistical Package for Social Science (SPSS) software was used for the present study. For this purpose, length-weight data of male and female *T. ilisha* were collected monthly from the commercial catches at different landing sites (Chandpur, Barisal, Bhola and Kuakata) of Bangladesh from January to December for 1 year of 2003. To avoid gill net selectivity different landing sides were selected as different mesh of gill nets are used to catch the hilsa fish on the availability of different size group of fishes. Total length and weight of 4711 specimens where male was 774 and female was 3937 were measured in 'cm'

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and 'g' by a meter scale and a spring balance, respectively. The data from different landing sites were then pooled month-wise and subsequently grouped into length classes by 2 cm interval. Then the data were analyzed using the SPSS software.

The length-weight relationship was established in the logarithmic form  $\text{Log } W = \text{Log } a + b * \text{Log } \text{TL}$ . The length and weight relationship was determined by the equation  $W = a.L^b$  given by Le Cren<sup>[5]</sup>, where 'a' was a constant and 'b' was exponent.

## RESULTS AND DISCUSSIONS

**Length-frequency distribution of hilsa:** The mean length of male and female *T. ilisha* was 29.30 cm and 34.23 cm and standard deviation was 3.45 cm and 5.15 cm respectively (Table-1). The variance was 11.91 cm and 26.53 cm and standard error was 0.124 cm and 0.08 cm respectively. Maximum length was 37 cm and 49 cm for the male and female respectively. Minimum length was 21 cm in both cases (Table 1).

**Weight-frequency distribution of hilsa:** The mean weight of male and female of *T. ilisha* were 265.89 g and 520.38 g and standard deviation was 88.65 g and 276.28 g respectively (Table-2). The variance was 7858 g and 76333 g and standard error was 3.19 g and 4.40 g respectively. Maximum weight was 550 g and 1350 g for the male and female respectively. Minimum weight was 150 g in both cases (Table 2).

**T-test:** Independent samples t-test was conducted to see the difference between the mean length of male and female *T. ilisha*. The t-test is highly significant ( $p < 0.05$ ) which indicates that the difference between means was statistically significant. Females were on average about 4.98 cm taller than males. The 95% confidence interval of the difference between two means was 5.35 to 4.60 (Table 3).

**Monthly size variation:** The bigger size of female *T. ilisha* was observed during the month of June to November and mean length was between 35.36 cm and 34.81 cm where as mean weight between 564.57g and 521.87g (Fig.1 & Fig.2). The bigger size of male *T. ilisha* was observed during the month of April to August and November and mean length was between 31.53 cm and 31.40 cm (Fig.1). Smaller size of both sexes was observed during the month of December to January (Fig.1 & Fig.2). It was also found that certain decrease of mean length and weight of male during the month of September. In case of female, mean length and as well as mean weight decreased from the month

October and it continued up to the month of January (Fig.1 & Fig.2).

**Sex ratio:** Sex ratio was calculated out to know the ratio in the number of male and female fishes, so that appropriate number of male and female fishes can be mated during artificial spawning and to devise means of ensuring a proportional fishing of the sexes. Total 4711 specimens were examined; among them 774 were males and 3937 were females, indicating a sex ratio of 1 male to 5.09 female (1: 5.09). Table 4 gives the monthly distribution of the two sexes in commercial catches. It was seen from sex distribution that the two sexes did not occur in the same proportion throughout the year. The monthly percentages of males and females observed from the table that the females were predominating throughout the months specially June, July, August, October, November and December (Fig.3).

**Weight estimation:** Regression analysis was carried out to estimate the weight of *T. ilisha* from length. The value of regression coefficient and constant was 49.58 and -1173.091 respectively (Table 5). These values could be used in predicting weight from the length. The equation that predicts weight of *T. ilisha* was as follow:

$$\text{Weight} = \$_0 + \$_1 (\text{length}) = -1173.091 + 49.58 (\text{length}).$$

**Length-weight relationship:** The logarithmic form of length-weight relationship of *T. ilisha* was  $\text{Log } W = -2.516 + 3.381 * \text{Log } \text{TL}$ . The exponential form of equation obtained for the length-weight relation was  $W = 0.00305 * \text{TL}^{3.381}$ . The value of co-efficient of correlation (r) estimated for the species was 0.93 ( $P < 0.01$ ), which indicated that the relationship between length and weight of the fish was highly significant. It was observed that the weight bears a linear relationship after logarithmic transformation (Fig.4). The maximum weight or asymptotic weight was found to be 1580g. The exponent 'b' estimated was close to 3, which indicated that the growth was more or less isometric.

The annual mean length of male and female *T. ilisha* was 29.30 cm and 34.23 cm and standard deviation was 3.45 cm and 5.15 cm respectively. It was clear from the result that female *T. ilisha* was taller than male. Standard deviation of male was smaller than female *T. ilisha*. It was indicated that observations of male length were close to mean than the observations of female length. Standard error for male and female were 0.124 cm and 0.08 cm respectively. Therefore, it could be concluded that sample means of female tend to be similar to each other than male. The annual mean weight of female was 520.38 g, which

**Table 1:** Descriptive statistics for the length of male and female *Tenualosa ilisha*

Descriptive	Gender	Statistics	Std. Error
Mean (cm)	Male	29.30	0.12
	Female	34.23	0.08
Std. Deviation (cm)	Male	3.45	
	Female	5.15	
Variance (cm)	Male	11.91	
	Female	26.53	
Minimum (cm)	Male	21	
	Female	21	
Maximum (cm)	Male	37	
	Female	49	

**Table 2:** Descriptive statistics for the weight of male and female *Tenualosa ilisha*

Descriptive	Gender	Statistics	Std. Error
Mean (g)	Male	265.89	3.19
	Female	520.38	4.40
Std. Deviation (g)	Male	88.65	
	Female	276.28	
Variance (g)	Male	7858	
	Female	76333	
Minimum (g)	Male	150	
	Female	150	
Maximum (g)	Male	550	
	Female	1350	

**Table 3:** Independent samples t-test showing the mean difference in length of male and female *T. ilisha*

	Levene's Test for quality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Length (cm)								Lower	Upper
Equal variances assumed	169.719	.000	-25.759	4709	.000	-4.9760	.1932	-5.3547	-4.5972
Equal variances not assumed			-33.446	1540.187	.000	-4.9760	.1488	-5.2678	-4.6841

**Table 4:** Sex ratio in *Tenualosa ilisha* with percentages of male and female in different months.

Month	No. of Fish	Male	Female	Percentage	
				M	F
Jan	77	18	59	23.38	76.62
Feb	473	121	352	25.58	74.42
Mar	102	47	55	46.08	53.92
April	210	97	113	46.19	53.81
June	559	82	477	14.67	85.33
July	929	101	828	10.87	89.13
Aug	847	65	782	7.67	92.33
Sept	205	92	113	44.88	55.12
Oct	624	76	548	12.18	87.82
Nov	289	21	268	7.27	92.73
Dec	396	54	342	13.64	86.36
Total	4711	774	3937	16.40	83.60

was two times higher than the mean weight (265.89 g) of male. The standard deviation (88.65 g) of male was lower than female standard deviation (276.28 g). Standard error was 3.19 g and 4.40 g for male and female respectively. Maximum weight for female was 1350 g, which was almost

three times higher than the maximum weight (550 g) of male.

The t-test is highly significant (p <0.05) which revealed that the difference between means was statistically significant. Females were on an average about

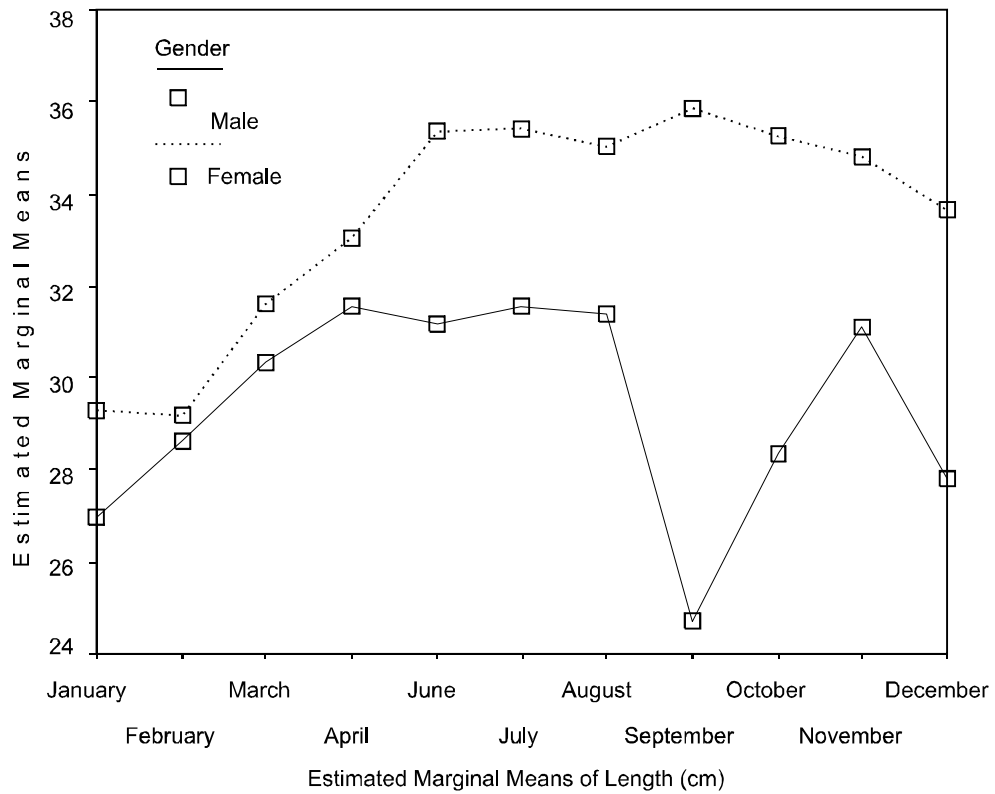


Fig. 1: Monthly variation of mean length of male and female *Tenualosa ilisha*

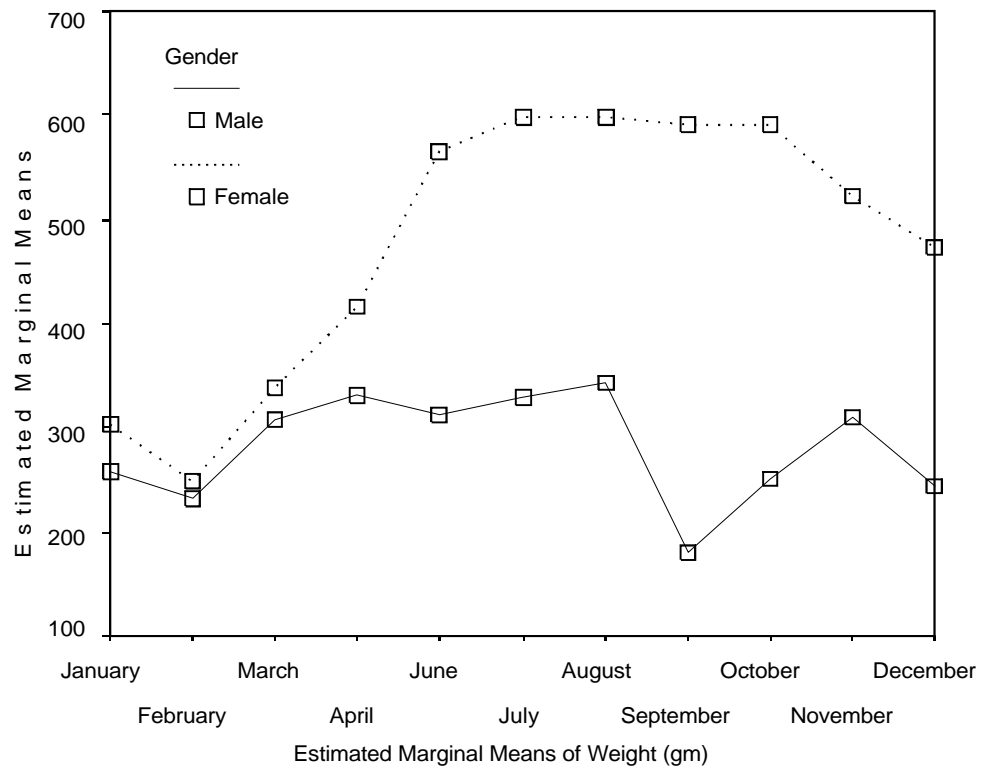


Fig. 2: Monthly variation of mean weight of male and female *Tenualosa ilisha*

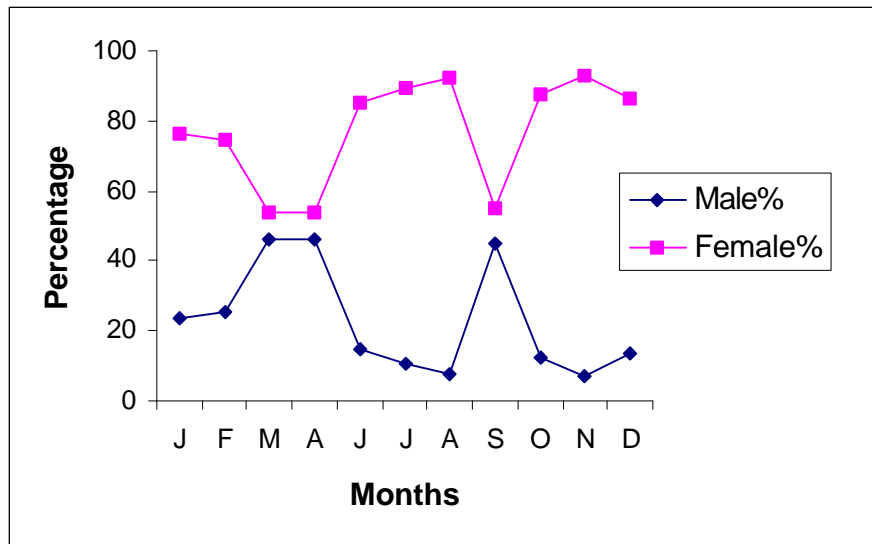


Fig. 3: Percentage composition of male and female *Tenulosa ilisha* in different months of the year

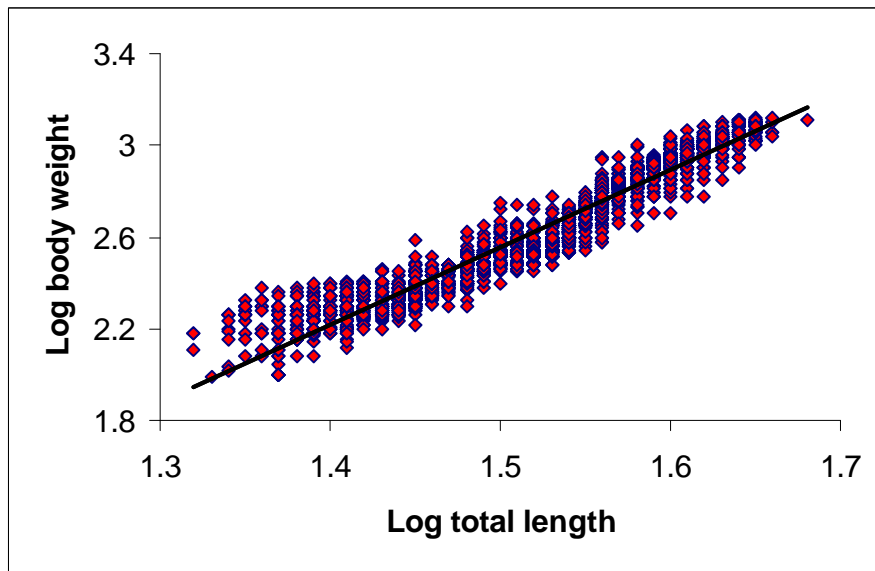


Fig. 4: Relationship between log total length and log body weight of *Tenulosa ilisha*

4.98 cm taller than males. The 95% confidence interval of the difference between two means was 5.35 to 4.60. This meant that the difference of average mean length for male and female varied from 5.35 to 4.60 (Table 3).

A marked decline was observed in mean length and weight of male during the month of September. In case of female, mean length and as well as mean weight decreases from the month of October and it continued up to the month of January and subsequent recovery after this month (Fig.1 and Fig.2). This might be the cause of peak spawning period of *T. ilisha* in the months of September to December.

Disproportionate occurrence of the number of the two sexes of *T. ilisha* (males to females 1:5.09) was observed in the investigated area. Dominance of females over the males in the pre-spawning as well as spawning months of June, July, August, October, November and December agree with the results of Das<sup>[2]</sup> on *Mugil cephalus*.

The value of regression coefficient and constant was 49.58 and -1173.09 respectively (Table 5). These values were used in predicting weight from the length. This meant that with every 1 cm increase in body length, there will be a 49.58 g increase in body weight of hilsa.

The logarithmic form of length-weight relationship of *T. ilisha* was  $\text{Log weight} = -2.516 + 3.381 * \text{Log length}$ . The exponential form of equation obtain for the length-weight relation was  $W = 0.00305 * TL^{3.381}$ . The value of co-efficient of correlation (r) estimated for the species was 0.93 (P <0.05), which indicated that the relationship between length and weight of the fish was highly significant. It was observed that the weight bears a linear relationship after logarithmic transformation (Fig.4). The exponent 'b' estimated was close to 3, which indicated that the growth was more or less isometric. Hile<sup>[4]</sup> and Martin<sup>[6]</sup> showed that the exponent 'b' usually lies between 2.5 and 4.0. Le Cren<sup>[5]</sup> reported different 'b' values for different stages of perch where 'b' value ranged from 3.01 to 3.59 for larval and adult condition. The value of 'b' will be exactly '3' when the growth is isometric<sup>[8]</sup>. The value of 'b' differs not only between species but sometimes also between the stock of the same species due to sex, maturity, seasons and even time of day because of changes in stomach fullness<sup>[1]</sup>. In the present case, the exponent (b) laid between the values mentioned by Hile<sup>[4]</sup> and Martin<sup>[6]</sup> but slightly higher the isometric value mentioned by Ricker<sup>[8]</sup>.

**Conclusion:** The results clearly indicated that the mean length of female was significantly higher than male *T. ilisha*. Disproportionate occurrence of the number of the two sexes of *T. ilisha* (males to females 1:5.09) was observed in the investigated area that should be hypothetically 1:1. The relationship between length and weight of the *T. ilisha* was highly significant.

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