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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 7 (8): 1394-1398, 2004
ISSN 1028-8880

Fecundity of *Hilsa ilisha* (Hamilton, 1822) from the Bay of Bengal

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Abstract: In the present study fecundity of *Hilsa ilisha* (Hamilton, 1822) was estimated for 20 fully matured females from the Bay of Bengal, Bangladesh. The fecundity (F) was found to range from 10,30,951 to 19,40,620 (mean 13,77,884±2,90,145) in fishes between 39 and 51 cm total length (TL) with the mean of 44.08±3.84 cm. Standard length (SL), body weight (BW), gonad weight (GW), mean diameter of egg and Gonado Somatic Index (GSI) were found to range from 34 to 46 cm (mean 39.45±3.67), from 800 to 1,700 g (mean 1,155.50±260.76), from 71.15 to 217 g (mean 141.33±42.22), from 0.66 to 0.85 mm (mean 0.78±0.06) and from 7.5 to 15.85 (mean 12.15±2.19), respectively. The co-efficient of correlation for F/TL (F= 532.231 $TL^{2.07}$ or, log F = 2.73 + 2.07 log TL), F/SL (F= 1,293.898 $SL^{1.89}$ or, log F= 3.12+1.89 log SL), F/BW (F= 7,703.711 $BW^{0.74}$ or, log F = 3.887+0.74 log BW) and F/GW (F= 71,186.887 $GW^{0.60}$ or, log F= 4.85+0.60 log GW) were obtained as 0.86, 0.85, 0.82 and 0.94, respectively for the logarithmic scale. The regression line for the TL, SL, BW and GW of the fishes were found to be linear when they were plotted against their fecundity on logarithmic scales. Highly significant ($p<0.05$) linear relationship for logarithmic scale was obtained for all the variables. Body weight was found to be the best indicator of the fecundity of *H. ilisha*.

Key words: Fecundity, *Hilsa ilisha*, Bay of Bengal, Gonado Somatic Index

INTRODUCTION

Hilsa ilisha[1] belongs to the Clupeidae family and it is one of the most commercially important fish species of the Bay of Bengal. It is an anadromous fish. The species was first described and figured by Russel[2] from the foreshore waters of Visakhapatnam. Then Hamilton[1] gave the fish its first taxonomic status under the name of *Clupaudon ilisha*. It is however, Regan[3] who created a new genus namely *Hilsa* and named *Hilsa ilisha* of the species.

Contributing more than 30% of the total marine fish production this species is economically most important among 96 fish species of the Bay of Bengal water of Bangladesh, *Hilsa* occupies the most important single species. It gives employment to about 2% (2.5 million) of the total population of Bangladesh[4,5]. This favourite fish of the country is eaten cooked, canned or dried. As a result, its demand is increasing day-by-day in home and abroad.

Fecundity has been defined in various ways[6-8]. In general fecundity may be defined as a season's crop or the number of eggs released by an individual fish during a spawning season. The study of fecundity of any species is important to have a full understanding the periodicity of spawning, no. of eggs released and also stock recruitment relationship to have a better understanding of population dynamics. It must be known to assess the productive potential and to evaluate the commercial potentialities of a fish stock.

Fecundity of fishes varies from species to species, also within the same species due to different factors such as, age, size, body and gonad weight, ecological conditions of the water body, etc.[9]. Variation in fecundity is primarily a reflection of variation in the size of the fish at maturity.

Much attention has been given on the various aspects of biology of *Hilsa* species in our neighbouring country, India[10-13]. But in Bangladesh, very little works have so far been done on fecundity aspect[14-17]. Keeping the above background in mind, the present study was carried out in order to estimate the number of ova shad by individual female of *Hilsa ilisha* during the breeding season and also to establish a mathematical relationship of fecundity with total length, standard length, body and gonad weight. The GSI and egg diameter were also estimated. Statistical analyses, viz., correlation co-efficient, regression and test of significance were done on those parameters.

MATERIALS AND METHODS

For the fecundity study, samples of 20 females of fully matured fish (total length 39 to 51 cm, weight 800 to

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1700 g) were collected from the Patharghata Fish Landing Centre, Chittagong during the period from June to August, 2001. Eye observation and common experience were used in identifying mature fish. Very enlarged abdomen of the female fish could easily be distinguished for gravid stage. The collected fishes were immediately brought to the Laboratory of the Institute of Marine Sciences, University of Chittagong for detailed study.

After washing the fishes thoroughly with tap water, total length and standard length of each fish were measured in centimeter by means of a measuring scale to the nearest 0.1 cm. Body weight of each fish was measured by means of a pan balance in gram. Before weighing the fishes, excess water was removed with blotting paper.

Ovary from each of the fishes was removed by dissecting out the abdomen. The two lobes of each ovary were dried off by removing excess fluid with blotting paper. They were then weighed on a pan balance to the nearest 0.01 g.

Fecundity was determined by following the method of Healy and Nicol[18]. Five cross sectional samples were taken randomly from anterior, middle and posterior regions of the two lobes of each ovary. The eggs in each sample of the five sections were counted and the mean was then calculated. The diameter of eggs was determined with the help of an ocular micrometer. Gonado Somatic Index was computed by following the method of Kader[19].

The value of correlation coefficient (r) between fecundity and total length, standard length, body weight and gonad weight were calculated and the significance of 'r' in each case was tested by the 't-test' at 5% level of significance. The regression lines of fecundity on the aforesaid parameters were established. All of those statistical analyses were carried out by following Spiegel[20] and the mathematical relationships between fecundity and that of the other parameters were determined by following Lagler[9].

RESULTS

Description of the ovary: The female reproductive organ of *H. ilisha* consists of bi-lobed ovary. The lobes of the ovary are elongated and situated in the body cavity, ventral to the kidneys and dorsal to the posterior part of the digestive tract. Both the lobes are full of mature and immature eggs and are slightly narrow tapering anteriorly and broader posteriorly. The lobes are approximately equal in size. But in a few specimens, the right lobe is slightly larger than the left. The two lobes have a common oviduct, which opens to the exterior through the cloaca. The ovarian membrane is highly vascular. Blood vessels

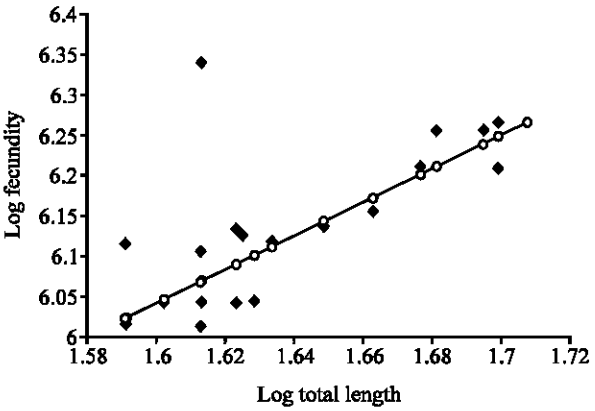

Fig. 1: Regression line between fecundity and total length of the fishes on the logarithmic scale

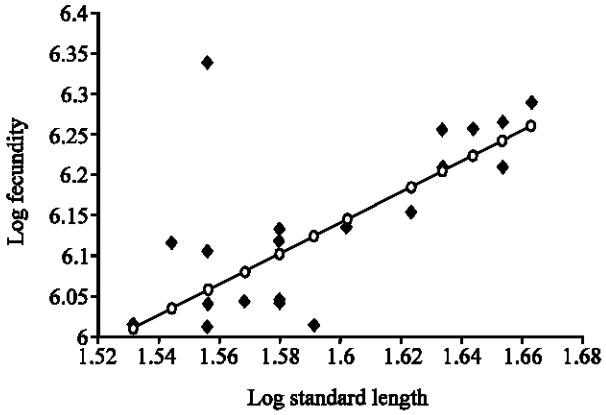

Fig. 2: Regression line between fecundity and standard length of the fishes on the logarithmic scale

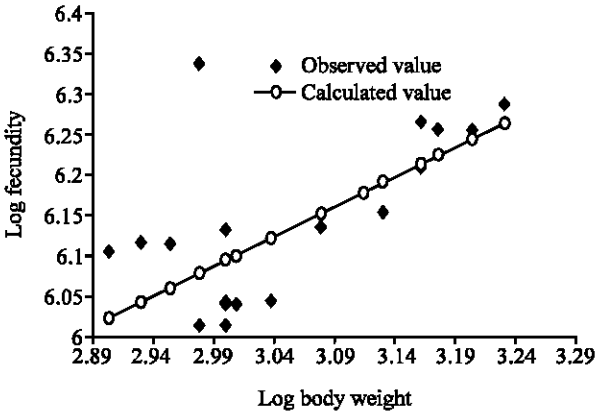

Fig. 3: Regression line between fecundity and body weight of the fishes on the logarithmic scale

are conspicuous in the mature ovaries. The eggs are spherical in shape. The weight of the gonad was found to vary from 71.15 g (sample no. 1) to 217 g (sample no. 20) with the mean 141.33 g.

Table 1: Data of total length, standard length, body weight, gonad weight, estimated fecundity, mean diameter of egg and gonado somatic index of 20 gravid females of *Hilsa ilisha* from the Bay of Bengal

Sample No.	Total length (cm)	Standard length (cm)	Body weight (g)	Gonad Weight (g)	Fecundity	Mean dia. of egg (mm)	Gonado Somatic Index
1	41.0	36.00	800.00	71.15	1030951	0.68	8.89
2	43.0	39.00	1000.00	75.00	1036512	0.67	7.50
3	39.0	34.00	950.00	75.50	1037120	0.66	7.95
4	40.0	36.00	1020.00	105.00	1100242	0.75	10.29
5	42.0	38.00	1000.00	115.00	1100901	0.80	11.50
6	41.5	37.00	1000.00	117.00	1105501	0.78	11.70
7	42.5	38.00	1090.00	123.90	1109845	0.79	11.37
8	41.0	36.00	1000.00	129.50	1275392	0.78	12.95
9	39.0	35.00	900.00	133.90	1305394	0.84	14.88
10	43.0	38.00	850.00	134.70	1312674	0.85	15.85
11	42.0	38.00	1000.00	140.50	1358481	0.83	14.05
12	41.0	36.00	950.00	141.30	1360963	0.84	14.87
13	44.5	40.00	1200.00	142.80	1370314	0.73	11.90
14	46.0	42.00	1350.00	150.30	1428931	0.74	11.13
15	50.0	45.00	1450.00	175.20	1618421	0.76	12.08
16	47.5	43.00	1300.00	176.00	1620683	0.75	13.54
17	48.0	43.00	1600.00	198.50	1798732	0.83	12.40
18	49.5	44.00	1500.00	200.00	1805253	0.82	13.33
19	50.0	45.00	1450.00	204.40	1840748	0.84	14.09
20	51.0	46.00	1700.00	217.00	1940620	0.82	12.76
Mean±S.D.	44.08±3.84	39.45±3.67	1155.50±260.76	141.33±42.22	1377884±290145	0.78±0.06	12.15±2.19

Table 2: Arithmetical and logarithmic relationship between fecundity and different parameters

Mode of relation	Arithmetic regression equation	Logarithmic regression equation
TL – F	$F= 532.231 + TL^{2.07}$	log F= 2.73 + 2.07 logTL
SL – F	$F= 1293.898 + SL^{1.89}$	log F= 3.12 + 1.89 logSL
BW – F	$F= 7703.711 + BW^{0.74}$	LogF=3.89+ 0.74 logBW
GW – F	$F=71186.887+ GW^{0.60}$	LogF=4.85+ 0.60 logGW

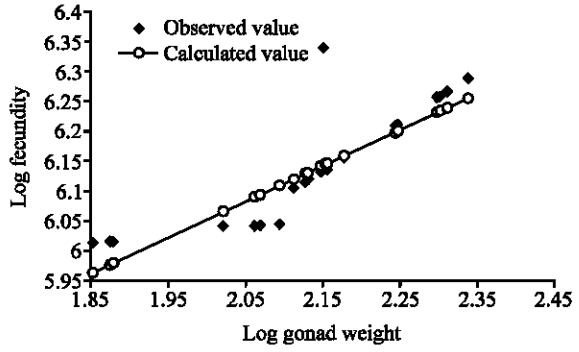

Fig. 4: Regression line between fecundity and gonad weight of the fishes on the logarithmic scale

Estimation of fecundity: In the present investigation, the individual fecundity of the 20 fully matured females of *H. ilisha* was analyzed (Table 1). The fecundity was found to vary from 1030951 (sample no. 1) to 1940620 (sample no. 20). The mean number of eggs was 1377884 for a female fish with mean total length 44.08 cm, mean standard length 39.45 cm, mean body weight 1,155.50 g and mean gonad weight 141.33 g.

The diameter of the egg of *H. ilisha* varied from 0.66 mm to 0.85 mm and the GSI was found to range from 7.5 to 15.85.

Fecundity factors: The regression line was found linear when the total lengths of the fishes were plotted against their fecundity on the logarithmic scale (Fig. 1). The value of correlation coefficient (r = 0.86) was significant in terms of the logarithmic scale as the calculated value of 't' (7.30) was found greater than the tabulated value (2.10) at 5% level of significance with degrees of freedom of 18. The regression line was found linear when the standard lengths of the fishes were plotted against their fecundity on the logarithmic scale (Fig. 2). The value of correlation coefficient (r = 0.85) was found significant in terms of the logarithmic scale as the calculated value of 't' (6.75) was found greater than the tabulated value (2.10) at 5% level of significance with degrees of freedom of 18. The regression line for body weight and fecundity of the fishes was found linear on the logarithmic scale (Fig. 3). The value of correlation coefficient (r = 0.82) was found significant in terms of the logarithmic scale as the calculated value of 't' (6.08) was found greater than the tabulated value (2.10) at 5% level of significance with degrees of freedom of 18. Again, the regression line for the gonad weight and fecundity of the fishes was found linear on the logarithmic scale (Fig. 4). The value of correlation coefficient (r = 0.94) was found significant in terms of the logarithmic scale as the calculated value of 't' (11.63) was found greater than the tabulated value (2.10) at 5% level of significance with degrees of freedom of 18.

DISCUSSION

In the present study, the largest specimen (sample no. 20) was found to carry the highest number of eggs (1940620). However, variation was found in the fecundity of fish of equal length. A fish measuring 41 cm in total length, 800 g in body weight and 71.15 g in gonad weight produced 1030951 eggs, whereas another fish of the same total length 950 g in body weight and 141.30 g in gonad weight produced 1360963 eggs. Such type of variation was also observed in the fish sample of 42, 43 and 50 cm in total length (Table 1). This type of variation was also reported by several workers[1,11-16,21,22] on the same species.

Fecundity of the fish (*H. ilisha*) collected from the river Meghna at Chandpur region was found to vary between 226000 (TL 28.70 cm and BW 275 g) to 1931000 (TL 52.30 cm and BW 1715 g). Again, fecundity was found to vary from 375000 (TL 32.50 cm and BW 425 g) to 1423000 (TL 49.20 cm and BW 1600 g) in the same species collected from the Bay of Bengal near Chittagong region[17]. Fecundity of this fish species in the river Hooghly in India was found to range from 250000 to 1600000 depending on the size of the fish[23]. Mature female of the same species of 910 g in body weight from the river Godavari was found to contain 1282100 ova[12]. The present study more relates with the results shown by the above-mentioned workers. Numerous factors like nutritional status[24], racial characteristics[25], time of sampling and maturity stage[26] and/or environmental features[27], etc. have so far known to exhibit variation in fecundity both within and between fish population.

From the statistical analysis it was revealed that the relationship between fecundity and TL, SL, BW and GW were found significant at 5% level ($p<0.05$). That the fecundity increases linearly with the increase of TL, SL, BW and GW was revealed from the significant 't' values (Table 2). Again, the values of correlation coefficient between fecundity and other parameters shows that variation in fecundity was best explained in terms of body weight. Because in the exponential form, the body weight was raised to a power of 0.74 which is nearer to unity than the other three parameters, e.g., TL, SL, and GW. Body weight was also attributed as the best way for determining fecundity of the same fish[22] as well as in other fishes[28,29]. Significant linear relationships between fecundity and TL, SL, BW and GW also reported earlier[22,15,23,21] on the same fish species and that of the other fish species[31-39].

The average diameter of eggs in the present study was found to vary from 0.66 mm (sample no. 3) to 0.85 mm (sample no. 10). This agrees with the results of Jones and Menon[13], Pillay[23] who found the variation from 0.70 to 0.75 and 0.89 mm, respectively for the same species of fish. The GSI value was found to vary from 7.5 to 15.85 where the later was an indication of collecting the fish species during the peak period of spawning season.

The present study indicated that the fecundity of *H. ilisha* found in the Bay of Bengal is significantly correlated with the TL, SL, BW and GW, but highly correlated with the GW. BW is the best indicator of fecundity of *H. ilisha*.

ACKNOWLEDGMENT

The authors wish to pay their gratefulness to Mr. V. K. Agadi, National Institute of Science Communication, Pusa Campus, New Delhi-110012, India for his critical review of this manuscript.

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