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SOME BIOLOGICAL ASPECTS OF SADA DATINA *(Pomadasys hasta)* FROM THE SUNDARBANS ECOSYSTEM, BANGLADESH.

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Abstract: The size frequency distribution, length-weight relationship, condition and relative condition factor of 994 specimens of *Pomadasys hasta,* collected from The Sundarban ecosystem, Bangladesh were studied during January, March and July 2001 are presented. The size frequency distribution shows that the fishes of 5.5 - 7.5cm size groups are dominant during those sampling seasons. The total length-weight relationships were established as LogW=-1.331+2.68 LogTL or $W= 0.0467^{2.6587}$.This equation showed that the general length-weight relationship in *P. hasta* follows the cube law. The mean values of condition factor (K) and relative condition factor (K_n) were found to be 0.018 ± 0.0037 and 0.610 ± 0.7973 respectively.

Keywords: Frequency; Length-weight; Condition factor; Relative Condition factor; *Pomadasys hasta*

Introduction

Silver grunt *Pomadasys hasta* (Bloch, 1790) popularly known as "Datina" all over Bangladesh and locally known as 'Sada Datina' of the family Haemulidae is caught along with other fishes in coastal brackish and salt waters of Bangladesh. They enter freshwater at depth range 15-115 m (Pauly, 1996); occur at temperatures ranging from 26 to 29°C (Blaber,1980). They can be marketed fresh or in salted form (Sousa, 1981). This species is also widely distributed in Indo-West Pacific: from the Red Sea to the Philippines (but without record from the Persian Gulf), north to southern Japan (Masuda, 1984), and south to northern Australia; also reported from New Caledonia (Thollot, 1996). Among the biological studies of fish, the size frequency distributions are of paramount importance in fisheries management, culture, regulation and also for ascertaining the environmental suitability of a particular fish in particular area.

The length-weight bears a specific relationship from which the physical well being of a fish can be ascertained for a given body of water at a given time (Tapadar, 2000). It can also provide data of seasonal variation, multiple spawning and variation in food composition. (Tapadar, 2000). Analyses of length-weight relationship were done to find out the physical well being of the fish and to establish the fact as to whether

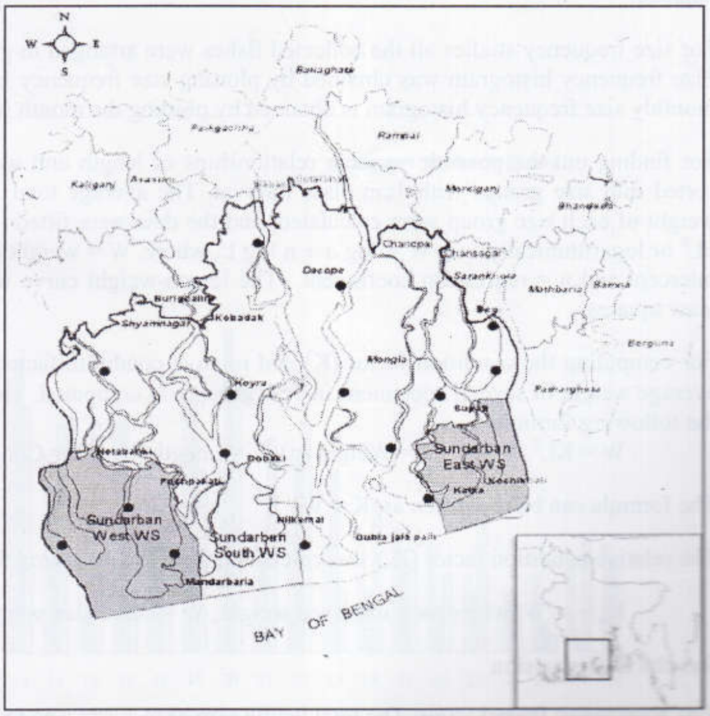

Fig.- 1. Map of Sundarban forest showing study area and sampling

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the fish is ideal in its growth or not, as the knowledge regarding growth is essential for its farming. The length-weight relationship of fish has often been studied to yield biological information (Tapadar, 2000). The determination of a precise mathematical relationship between length and weight of fish has numerous applications in fishery biology. With the help of the derived equation, one measure can be converted into the other (Jhingran, 1968). This relationship is mostly described with the 'cube law' where weight of a fish equals the cube of its length. However, as the form and specific gravity of animals are not constant, the empirical observations do not strictly follow the cube law (Jhingran, 1968). The departures from the general 'cube law' relationship between length and weight are used in fishery biology to investigate environmental suitability, racial discriminations, general well-being or relative robustness of fish by means of a condition factor (Tapadar, 2000). The condition factor also serves as a useful index of the nutritional and biological cycle viz. gonadal development, spawning etc. of the species (Jhingran, 1968).

Considering the importance of the species, the present study comprised observations on the size frequency distribution, length-weight relationship in terms of total length, standard length, fork length, condition factor and relative condition factor of *Pomadasys hasta* from the Sundarbans estuarine ecosystem for the first time in Bangladesh. It is hoped that the present work will generate some information to the future biologists for more intensive research in the culture and management of this fish.

Materials & Methods

A total of 994 specimens of *Pomadasys hasta* ranging from 5.5 cm to 31.5cm were randomly collected from the different rivers in different stations of Sundarbans during January, March & July 2001. Some samples were preserved in 10% formalin and some were preserved in deep freeze for laboratory analysis. After bringing the specimens to the laboratory, the samples were thoroughly washed with clean water and excessive water was dried with blotting paper. The length of the fish was measured to the nearest 0.1 cm from the tip of the snout to the end of the tail for total length, and to the base of the caudal fin for standard length. The fork lengths of the specimen were also measured from the tip of the snout to the median rays of the tail. The weight of the individual fish was measured to the nearest 0.001 g with a precision single pan balance.

For size frequency studies all the collected fishes were arranged in groups having 1cm total length interval. Size frequency histogram was obtained by plotting size frequency in percentage against total lengths. The monthly size frequency histogram is obtained by plotting the month wise frequency against the total lengths.

For finding out the possible variable relationships of length and weight of the species, the samples were sorted into size groups with 1cm class interval. The average total length (TL), standard length (SL) and weight of each size group were calculated, and the data were fitted into the Le Cren's (1951) formula $W = aL^n$ or logarithmically $\text{Log } W = \log a + n \log L$, where, W = weight of fish; L = length (TL/SL) of fish; a = intercept and n = regression coefficient. The length-weight curve was fitted to the data by the method of least squares.

For computing the condition factor (K) and relative condition factor (K_n) values in different size-class the average weight of several specimens in 1cm group was computed. The condition factor can be calculated by the following formula

$W = KL^3$. Where, W= Weight (g); L = Length (cm); K= Condition Factor.

The formula can be re-written as, $K = W / L^3$.

The relative condition factor (K_n) was calculated from the following formula:

$K_n = w/W$. where, w = observed weight; W = calculated weight.

Results & Discussion

Size Frequency Distribution: The total length size of *P. hasta* was found to vary between 5.5-7.5cm to 29.5-31.5cm size class. The maximum and minimum number of *P. hasta* was found in the size group 5.5-7.5cm size class and 29.5-31.5cm size class respectively. The size frequency distribution was found to be unimodal in the length class 5.5-7.5cm and the number of specimens was 150. A look in the month wise distribution of frequency showed maximum specimens are caught in the month of July. The highest frequency 30 was caught in the length of 6cm during the month of July.

Table 1. Monthly size-frequency distribution of *Pomadasys hasta* from the Sundarbans.

Length (in cm)	Total Frequency	January	March	July
6	75	20	25	30
7	57	19	20	18
8	56	15	21	20
9	73	24	23	26
10	70	23	22	25
11	61	23	20	18
12	61	20	19	22
13	61	20	20	21
14	53	18	19	16
15	39	13	11	15
16	34	10	9	15
17	36	17	15	4
18	17	7	7	3
19	45	16	17	12
20	51	12	21	18
21	28	7	7	14
22	35	8	12	15
23	23	7	12	4
24	21	7	4	10
25	20	8	6	6
26	15	7	3	5
27	18	5	4	9
28	10	3	4	3
29	8	5	2	1
30	14	6	1	7
31	13	7	6	0
Total	994	327	330	337

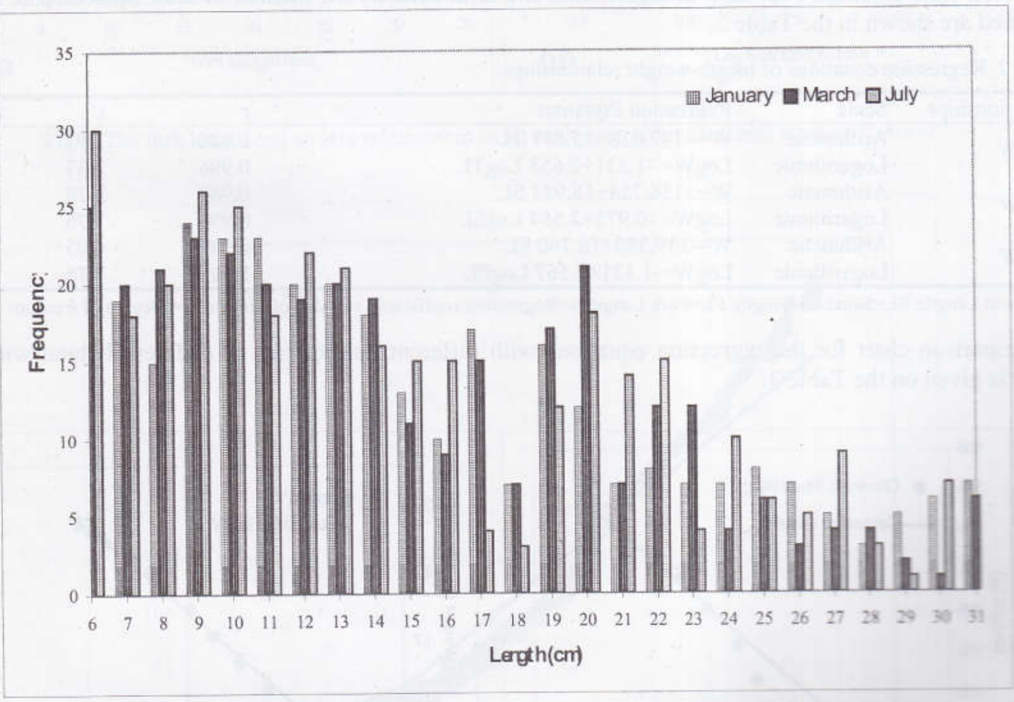

Fig. - 2. Monthly size-frequency distribution histograms of *Pomadasys hasta*

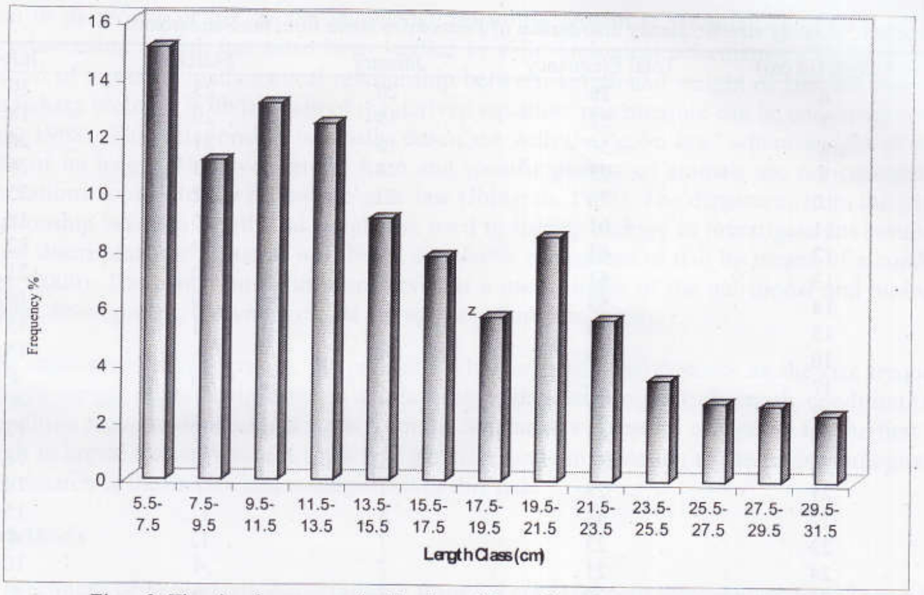

Fig. - 3. The size frequency distribution of *Pomadasys hasta*, all months combined.

The size variation was also prominent in larger size than in smaller size groups of *P. hasta*. The maximum and minimum number of *P. hasta* was found in the size group 5.5-7.5cm size class and 29.5-31.5cm size, where, the total numbers of specimens were 150 and 23 respectively. This indicates that small sized fish dominate during the sampling months.

Length-weight relationship: A total of 994 specimens of *P. hasta* were classified into 13 size classes from 5.5 cm to 31.5 cm with a class size of 2.0cm. When the total, standard length and fork length groups of the fish were plotted against the mean values observed and calculated weights (Table 4, 5, 6) on both the logarithmic and arithmetic scale (Fig: 4, 5, 6) a straight line appeared. On the basis of the figures regression equations were calculated for both in logarithmic and arithmetic by the method of least squares. The results obtained are shown in the Table 2.

Table 2. Regression equations of length-weight relationships.

Relationships	Scale	Regression Equation	r	t	d.f.
TL-W	Arithmetic	W= -147.018+15.881 TL	0.980	3.97	12
	Logarithmic	LogW= -1.331+2.658 LogTL	0.996	7.37	
SL-W	Arithmetic	W= -136.754+18.983 SL	0.982	3.78	10
	Logarithmic	LogW= -0.973+2.564 LogSL	0.995	7.76	
FL-W	Arithmetic	W=-139.350+16.760 FL	0.982	4.05	12
	Logarithmic	LogW=-1.131+2.567 LogFL	0.995	7.75	

TL= Total Length; SL=Standard Length; FL=Fork Length; r=Regression coefficient; t=Value of t-test; d.f. = Degree of freedom.

A comparison chart for the regression equations with different fish species of different habitat with this result is given on the Table 3.

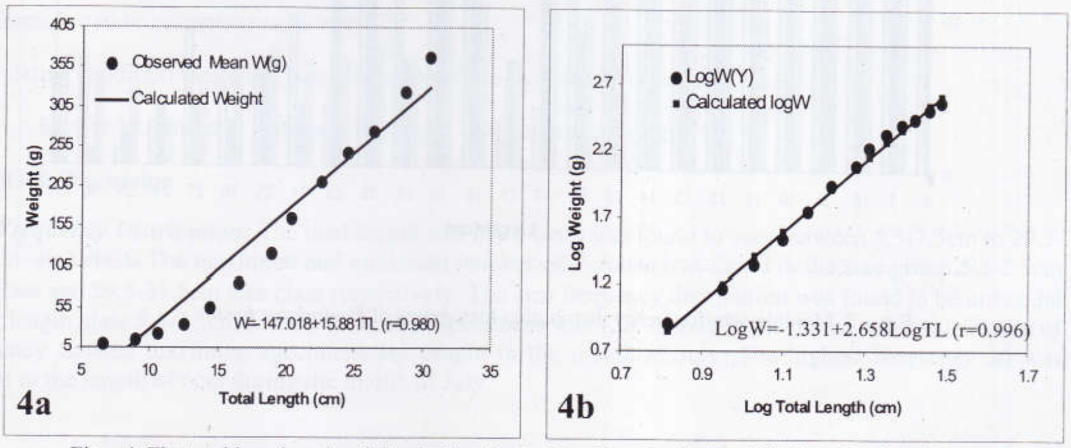

Fig. –4. The total length and weight relationship in (a) arithmetic (b) logarithmic scale of *P. hasta*

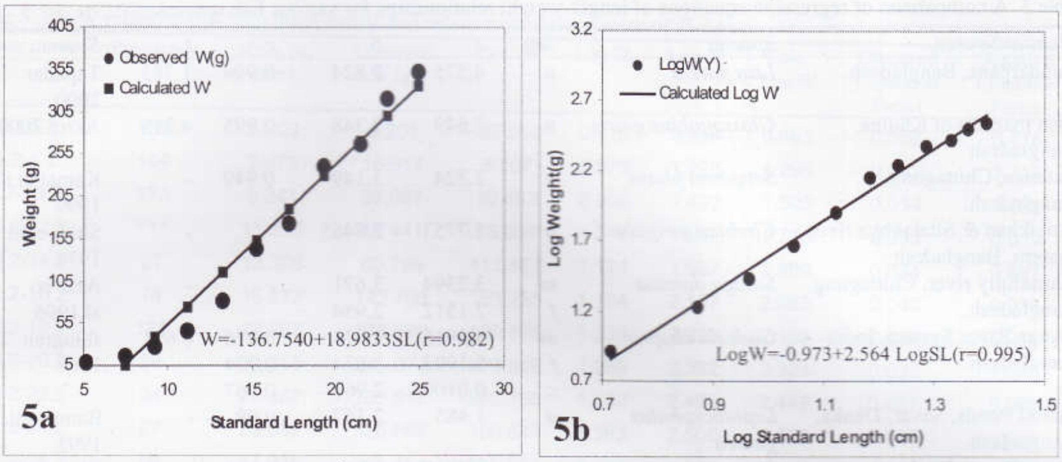

Fig. –5. The standard length and weight relationship in (a) arithmetic (b) logarithmic scale of *P. hasta*

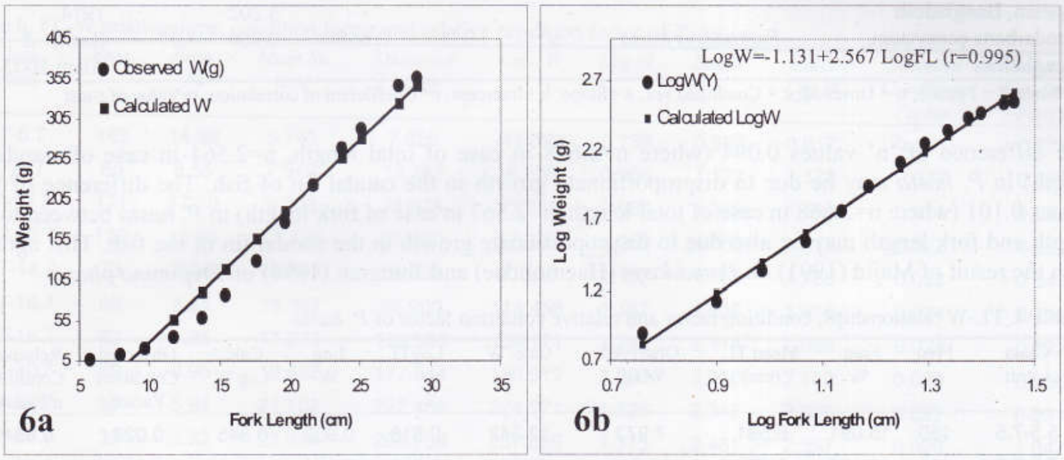

Fig 6. The fork length and weight relationship in (a) arithmetic (b) logarithmic scale of *P. hasta*

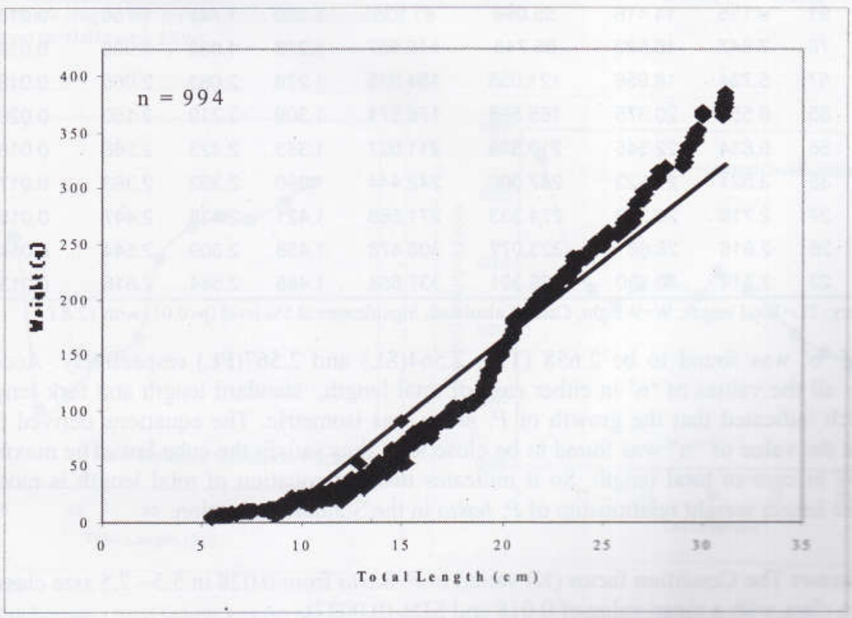

Fig. - 7. The length and weight relationship of *P. hasta* in asthmatic scale from pooled data from January, March & July 2001 from the Sundarban ecosystem of Bangladesh.

Table 3. A comparison of regression equations of length-weight relationships for various fish species.

Habitat/Source	*Species*	*Sex*	*a*	*b*	*r*	*t*	*Source*
Sundarbans, Bangladesh.	*Liza parsia*	*u*	4.575	2.824	0.994	1.783	Tapadar 2000
Fish markets of Khulna, Bangladesh	*Glossogobius giuris*	*u*	3.649	2.348	0.995	4.218	Akter 2000
Patenga, Chittagong, Bangladesh.	*Setipinna phasa*	*u*	2.524	3.149	0.949	-	Kamal et al. 1999
Arialkhan & Sitalakhya river system, Bangladesh	*Cirrhina mrigala*	*u*	1.7753	2.8465	-	-	Shafi et al. 1974
Karnafully river, Chittagong, Bangladesh.	*Sillago domina*	*m* *f*	3.2394 2.1512	3.671 2.954	-	-	Aziz et al.1996
Ganga River System, India-Bangladesh	*Gudusia chapra*	*m* *f* *c*	4.9915 5.1993 0.0100	2.974 3.074 2.961	0.976 0.924 0.967	0.691	Jhingran 1968
Inland Ponds, Savar, Dhaka, Bangladesh	*Lepidocephalus guntea*	*u*	1.485	2.367	0.99	-	Banu et al. 1992
Sham Bazar, Dhaka, Bangladesh	*Mystus tengra*	*u*	0.9737	1.770	0.936	-	Khan et al. 1992
Padma & Meghna River System, Bangladesh	*Hilsha ilisha*	*u*	1.6182	2.768	2.333 3.202	-	Shafi et al. 1974
Sundarbans ecosystem, Bangladesh	*Pomadasys hasta*	*u*	1.331	2.658	0.980	7.37	Basher & Alam 2002

m = Male; f = Female; u = Unsexed; c = Combined sex; a =Slope; b =Intercept; r= Coefficient of correlation; t=Value of t-test

The difference of 'n' values 0.094 (where n=2.658 in case of total length, n=2.564 in case of standard length) in *P. hasta* may be due to disproportionate growth in the caudal fin of fish. The difference of 'n' values 0.101 (where n=2.668 in case of total length, n=2.567 in case of fork length) in *P. hasta* between total length and fork length may be also due to disproportionate growth in the caudal fin of the fish. This agrees with the result of Majid (1991) on *Pomadasys* (Haemulidae) and Jhingran (1994) on *Stepimma phasa*.

Table 4. TL-W relationships, condition factor and relative condition factor of *P. hasta*.

Class Limit	Freq	Freq. %	Mean TL (cm)	Observed W (g)	Calc. W	LogTL	Log W	Calc. Log W	Observed Condition Factor	Relative Condition Factor
5.5-7.5	150	15.091	6.581	7.973	12.342	0.818	0.902	0.845	0.028	0.634
7.5-9.5	111	11.167	8.979	14.919	17.626	0.953	1.174	1.203	0.021	0.756
9.5-11.5	131	13.179	10.683	22.060	22.648	1.029	1.344	1.404	0.018	0.974
11.5-13.5	124	12.475	12.565	34.032	52.539	1.099	1.532	1.591	0.017	0.648
13.5-15.5	91	9.155	14.416	55.099	81.938	1.159	1.741	1.750	0.018	0.672
15.5-17.5	78	7.847	16.533	85.746	115.557	1.218	1.933	1.908	0.019	0.742
17.5-19.5	57	5.734	18.956	121.035	154.035	1.278	2.083	2.066	0.018	0.786
19.5-21.5	85	8.551	20.375	165.598	176.574	1.309	2.219	2.150	0.020	0.938
21.5-23.5	56	5.634	22.545	210.589	211.027	1.353	2.323	2.266	0.018	0.998
23.5-25.5	35	3.521	24.523	247.000	242.444	1.390	2.393	2.363	0.017	1.019
25.5-27.5	27	2.716	26.363	274.333	271.668	1.421	2.438	2.447	0.015	1.010
27.5-29.5	26	2.616	28.681	323.077	308.478	1.458	2.509	2.544	0.014	1.047
29.5-31.5	23	2.314	30.530	366.391	337.854	1.485	2.564	2.616	0.013	1.084

Freq.=Frequency; TL=Total length; W=Weight; Calc.=Calculated; Significance at 5% level ($p<0.01$) with 12 d.f.

The value of 'b' was found to be 2.658 (TL), 2.564(SL) and 2.567(FL) respectively. According to the present study all the values of 'n' in either case of total length, standard length and fork length study was below 3 which indicated that the growth of *P. hasta* was isometric. The equations derived from *P. hasta* indicated that the value of "n" was found to be close to 3, thus satisfy the cube law. The maximum value of 'b' was 2.658 in case of total length. So it indicates that the equation of total length is most suitable for calculating the length weight relationship of *P. hasta* in the Sundarbans region.

Condition Factor: The Condition factor (K) varied in *P. hasta* from 0.028 in 5.5 - 7.5 size class to 0.013 in 29.5-31.5 size class with a mean value of 0.018 and SD± (0.0037).

Table 5. SL-W relationships, condition factor and relative condition factor of *P. hasta*.

Class Limit	Frequency	Mean SL (cm)	Observed W (g)	Calc. W	Log SL	Log W	Calc. Log W	Observed Condition Factor	Relative Condition Factor
4.2-6.2	159	5.203	8.201	-37.993	0.716	0.914	0.863	0.058	0.476
6.2-8.2	144	7.473	16.917	5.107	0.873	1.228	1.266	0.041	3.313
8.2-10.2	170	9.241	27.087	38.663	0.966	1.433	1.503	0.034	0.701
10.2-12.2	111	11.155	46.441	75.004	1.047	1.667	1.713	0.033	0.619
12.2-14.2	97	13.308	80.796	115.881	1.124	1.907	1.909	0.034	0.697
14.2-16.2	74	15.277	143.703	153.255	1.184	2.157	2.063	0.040	0.938
16.2-18.2	121	17.207	173.560	189.885	1.236	2.239	2.195	0.034	0.914
18.2-20.2	39	19.310	241.077	229.819	1.286	2.382	2.324	0.033	1.049
20.2-22.2	24	21.467	265.917	270.755	1.332	2.425	2.442	0.027	0.982
22.2-24.2	27	23.052	320.667	300.847	1.363	2.506	2.521	0.026	1.066
24.2-26.2	28	24.936	353.464	336.609	1.397	2.548	2.609	0.023	1.050

Freq.=Frequency; SL=Standard length; W=Weight; Calc.=Calculated;
Significance at 5% level (p<0.01) with 12 d.f.

Table 6. FL-W relationships, condition factor and relative condition factor of *P. hasta*.

Class Limit	*Freq.*	*Freq. %*	*Mean SL (cm)*	*Observed W (g)*	*Calc. W*	*Log SL*	*Log W*	*Calc. Log W*	*Observed Condition Factor*	*Relative Condition Factor*
4.7-6.7	143	14.39	5.743	7.825	-43.092	0.759	0.893	0.817	0.041	0.773
6.7-8.7	85	8.55	7.940	13.282	-6.276	0.900	1.123	1.178	0.027	0.726
8.7-10.7	171	17.20	9.703	21.975	23.271	0.987	1.342	1.402	0.024	0.944
10.7-12.7	138	13.88	11.728	35.870	57.203	1.069	1.555	1.613	0.022	0.627
12.7-14.7	73	7.34	13.699	58.192	90.239	1.137	1.765	1.786	0.023	0.645
14.7-16.7	68	6.84	15.382	86.900	118.458	1.187	1.939	1.916	0.024	0.734
16.7-18.7	83	8.35	17.633	129.986	156.171	1.246	2.114	2.068	0.024	0.832
18.7-20.7	89	8.95	19.652	177.944	190.012	1.293	2.250	2.189	0.023	0.936
20.7-22.7	59	5.94	21.702	222.458	224.371	1.336	2.347	2.299	0.022	0.991
22.7-24.7	33	3.32	23.688	269.758	257.659	1.375	2.431	2.397	0.020	1.047
24.7-26.7	13	1.31	25.085	293.692	281.068	1.399	2.468	2.461	0.019	1.045
26.7-28.7	17	1.71	27.694	346.471	324.804	1.442	2.540	2.571	0.016	1.067
28.7-30.7	22	2.21	29.000	356.227	346.690	1.462	2.552	2.622	0.015	1.028

Freq.=Frequency; FL=Fork length; W=Weight; Calc.=Calculated;
Significance at 5% level (p<0.01) with 12 d.f.

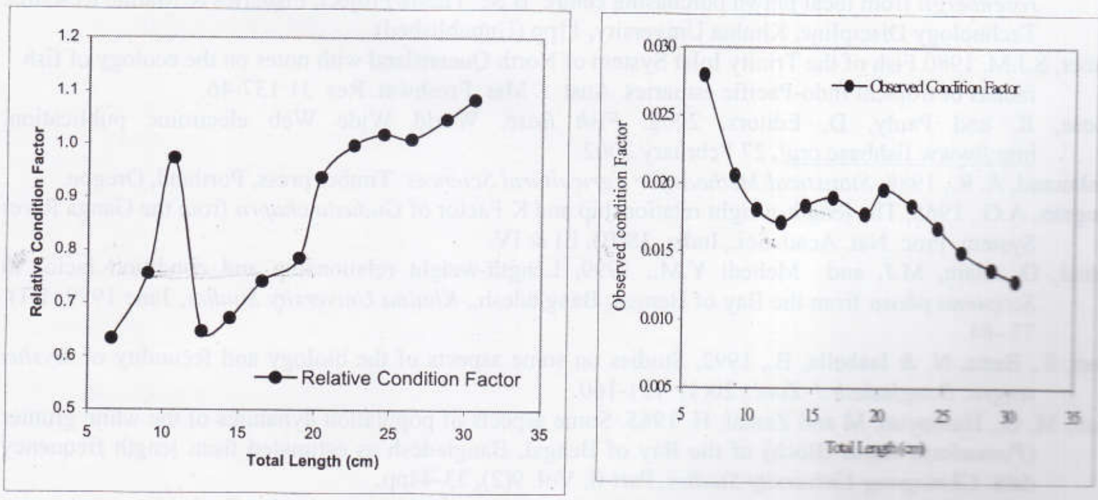

Fig. - 8. Relationship between total length and (a) observed condition factor and (b) relative condition factor in *P. hasta* from the Sundarban ecosystem Bangladesh.

The condition factor, however, is not constant in great majority of fishes. In nature, it has been found to vary in an individual, a species of a population. It fluctuates periodically with season of the year which may be due to heavy feeding, spawning and rebuilding of reproductive system. The peak condition factor (K) values were found in 5.5-7.5 size class. It decreases gradually with the increase of length. The fluctuations in K 'value', related to increase in length of fish have been employed by various workers (Hart, 1946; Menon, 1956; Pillay, 1958 and Natarajan and Jhingran 1963) to determine the size at which fishes attain their sexual maturity. Hart (1946) observed that there is a lower level of condition throughout the seasonal cycle consequent upon the increased metabolic strain of spawning. The point of inflexion on a curve showing this diminution of 'K' with increasing length is this a good indication of the length at which sexual maturity is attained.

Relative Condition Factor: Relative condition factor (K_n) was determined by plotting it against mean values of total length. The relative condition factor (K_n) varied in *P. hasta* from 0.634 in 5.5-7.5 size class to 1.086 in 29.5-31.5 size class in *P. hasta* with a mean value of 0.610 and SD± (0.7973).

The peak relative condition factor (K_n) values was found in 29.5-31.5 size class. The values of K_n were not stable to certain length class; it varied gradually. Relative condition factor (K_n) showed certain variation with total length. This variation might be associated with the smaller sample size or different stages of maturity variation in the weight of food contents in the stomach. Variation in the K_n values due to above causes were also reported by many workers (Tapadar, 2000) on different species of fish.

Conclusion

The size frequency distribution showed that the medium sized species of the fish was normally distributed throughout the sampling months. This might be due to high mortality of small fishes and slower spawning rate with over fishing of larger species during these months. The data in the present study cannot be considered adequate. This sort of analysis involving several thousand fishes of different size range would surely yield a better result and more reliable equations would be much helpful to the future culturist.

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