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RESEARCH ARTICLE

OBSERATION ON THE CONDITIONAL FACTOR AND ALLOMETRY OF FEMALE INDIAN MAJOR CARP, LABEO ROHITA (HAMILTON)

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ABSTRACT

The female specimens of *Labeo rohita* (body weight, 150-750 gm) had been assessed during the period of 15 June to 15 September, 2012. This season was particularly choosen because of the attainment of sexual maturity as well as optimum growth of the female ones. These specimens were assessed in three groups- young, matured and matured but adults. The study revealed that the values of gastrosomatic index (GSI), gonadosomatic index (GnSI), hepatosomatic index (HSI) and conditional factor (K) were 0.408, 0.235, 0.699, 1.618 and 0.395, 0.296, 0.708, 2.169 and 0.413, 0.374 0.982, 2.194 in young, matured and matured but adults respectively. Above index values and conditional factor had been observed to be high in matured but adult females than other female ones. Attempts and achievements of this work showed that the growth rate of female ones was proper and aquatic condition viz. (pH-8.0, alkalinity-66.0mgl^{-1}, free CO_2, dissolved O_2, total solid-114.0 mgl^{-1}, total hardness-60.0 mgl^{-1}, total suspended solid-4.0 mgl^{-1}, Chloride-10.6 mgl^{-1}) was favourable.

INTRODUCTION

The knowledge on fish biology particularly morphometry, length-weight relationship, condition factor, gastrosomatic index, gonadosomatic index, hepatosomatic index, breeding behaviour, food and feeding habit is of upmost importance in advancing the management strategies of fish production (Evans, 2000, Russel, 2002, Das and Patra, 2013). *Labeo rohita* commonly called as rohu is extensively cultured in ponds and is one of the most preferred fish in the Indian subcontinent (Mishra and Samantaray, 2004). Rohu along with two other Indian major carps (*Catla catla* and *Cirrhina mrigala*) contribute to the bulk of fish farm production with over1.8 million tones (FAO, 2003). This work is an attempt to study the conditional factor and allometry of three age groups of fish (i.e. young, matured, matured but adult) of Indian major carp, Labeo rohita. Moreover, general biology of a fish can be properly described on the basis of the data on age and growth, length-weight relationship and condition factor (Soranganba and Saxena, 2007). In general, it has been observed that a number of physical, abiotic and biotic factors affect the body composition (Pradhan *et al.*, 2012). These factors may be morphological, physiological, environmental and genetic in nature (Ali *et al.*, 2001). Also estimation of the mortality rate and assessment of the recuperation of a given stock under natural or exploited condition have been studied (Leveque, 2005).

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MATERIALS AND METHODS

For the present study a total of ten freshly caught matured female specimens within the weight ranging from 150-750 gms were studied after being collected from local fish ponds located in Bhubanswar city and they were classified into three stages ie. 3 young, 4 matured and 3matured but adults. After morphometric measurements (weight=200-750gms, total length=31-42 cms, standard length=23.5-32 gms) dissection was carried out under 100 watt illuminations, the internal organs (stomach, liver, ovary and testis) were exposed and carefully detached from the main body. Then their specific weight were determined by Afcoset Electronic balance (Reheman *et al.*, 2002). The morphometric features like Total Length (TL), Standard Length (SL) and a biotic parameters were measured and determined following the standardized protocols. Thus, from the anterior projecting part of the head to the posterior most tip of the caudal fin was included in total length (Biswas, 1985). Standard length is the distance from the anterior most part of the head to the end of the vertebral column (i.e. caudal peduncle) (Dasgupta, 2004). Condition factor is represented by relating the standard length of the fish to its weight (Beckman, 1948, Evans, 2000). It was calculated basing on the cube law in order to compare the condition of fishes under various culture regimes in numeral terms by using the following formula of Hile (1936).

$K = 100(\frac{W}{L^3})$ where,
'K' is the coefficient of condition.

'W' is the weight of fish (in gm).
'L' is the standard length of the fish (in cm).

Anatomical peculiarities like Gastrosomatic index (GSI), Hpatosomatic index (HSI) and Gonadosomatic index (GnSI) were calculated after measuring the total wt, wt of the stomach, wt of the liver and wt of the gonads to the nearest 0.1g .GSI is defined as the weight of gut as percentage of the total body weight of fish (Desai,1970). It is expressed as:

$$\text{Wt. of gut and its contains in gram x } \frac{100}{wt.\ of\ fish\ in\ gram}$$

HSI is defined as the ratio of liver wt. to the body weight .It is expressed as:

$$\text{Wt. of liver in gram x } \frac{100}{wt.of\ the\ fish\ in\ gram}$$

The development of gonads is estimated by determining its weight relative to the body weight of the fish (Hopkins, 1979). The body mass (gm) and gonad mass were recorded and these datas were used to calculate the GnSI according to the formula of Roff (1983) (Bhattacharya and *et al*., 2005). This is expressed as :

$$\text{Wt. of the gonad (Testis or ovary) in grams x } \frac{100}{wt.\ of\ fish\ in\ gram}$$

It had been observed that there existed certain variation in the value of biological parameters in female samples. In this study, GSI values of the young, matured, matured but adult had been recorded as 0.408 ,0.395 and 0.413, GnSI values 0.235, 0.296 and 0.374, HSI value 0.699, 0.708 and 0.982 and 'K' value 1.618, 2.169 and 2.194 respectively (Table 1 and Fig.4).

Table 1. Morphometric features and anatomical peculiarities of female *Labeo rohita*

Morphometric features and anatomical peculiarities	Adult but matured female	Matured female	Young female
Body weight(gm)	636.6 ±41.76	391.25±25.52	235 ±18.02
Total length(cm)	40.03 ±1.01	33.7 ±0.42	32 ±0.57
Standard length(cm)	30.73 ±0.61	26.225±0.33	24.4 ±0.37
Weight of stomach(gm)	2.63 ±0.54	1.545 ±0.45	0.96 ±0.28
Weight of gonad(gm)	2.383 ±1.03	1.16 ±0.41	0.553±0.12
Weight of liver(gm)	6.253 ±0.40	2.77 ±0.40	1.643±0.054
Gastrosomatic index(GSI)	0.413	0.395	0.408
Hepatoosomatic index(HSI)	0.982	0.708	0.699
Gonadosomatic index(GnSI)	0.374	0.296	0.235
Conditional factor(K)	2.194	2.169	1.618

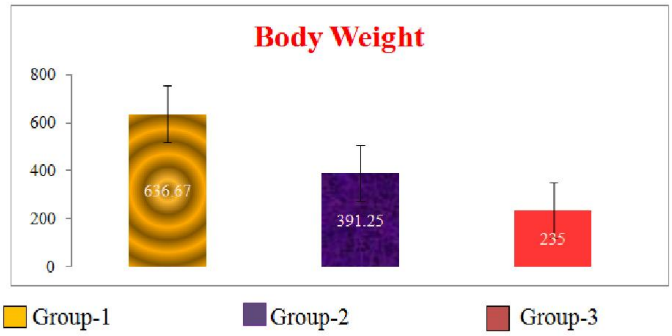

Fig 1. Body weight (in gms) of three groups of female *Labeo rohita*

Table 2. Descriptive statistics of the parameter studied

Parameters	Group 1			Group 2			Group 3		
	Mean	Std. Deviation	Std. Error	Mean	Std. Deviation	Std. Error	Mean	Std. Deviation	Std. Error
Body weight(gm)	636.67	72.34178	±41.7665	391.25	51.05144	±25.52572	235.00	31.22499	±18.02776
Total Length(cm)	40.0333	1.76163	±1.01708	33.7000	0.85245	±0.42622	32.000	1.00000	±0.57735
Standard length(cm)	30.7333	1.06927	±0.61734	26.2250	0.66018	±0.33009	24.4000	0.65574	±0.37859
Weight of stomach(gm)	2.6333	0.93853	±0.54186	1.5450	0.90839	±0.45419	0.9667	0.50083	±0.28916
Weight of liver(gm)	6.2533	1.78733	±1.03191	2.7725	0.83192	±0.41596	1.6433	0.22053	±0.12732
Weight of gonad(ovary)(gm)	2.3833	0.70059	±0.40449	1.1600	0.80837	±0.40419	0.5533	0.09504	±0.05487

Table 3. ANOVA of different body parameters

		Sum of Squares	df	Mean Square	F	Sig.
bodyweight	Between Groups	246774.6	2	123387.3	42.683	0.00012
	Within Groups	20235.42	7	2890.774		
	Total	267010	9			
Total length	Between Groups	109.6823	2	54.84117	36.95971	0.00019
	Within Groups	10.38667	7	1.48381		
	Total	120.069	9			
Standard.Length	Between Groups	64.48683	2	32.24342	50.67254	6.86E-05
	Within Groups	4.454167	7	0.63631		
	Total	68.941	9			
Wt. of Stomach	Between Groups	4.322727	2	2.161363	3.192673	0.103428
	Within Groups	4.738833	7	0.676976		
	Total	9.06156	9			
Wt. of Liver	Between Groups	35.19635	2	17.59818	14.38665	0.003314
	Within Groups	8.562608	7	1.22323		
	Total	43.75896	9			
Wt. of Gonad	Between Groups	5.251517	2	2.625758	6.209284	0.028124
	Within Groups	2.960133	7	0.422876		
	Total	8.21165	9			

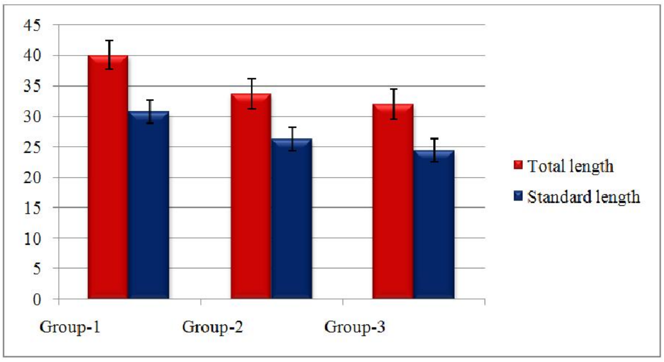

Fig. 2. Total length and Standard length (in cm) of three groups of female *Labeo rohita*

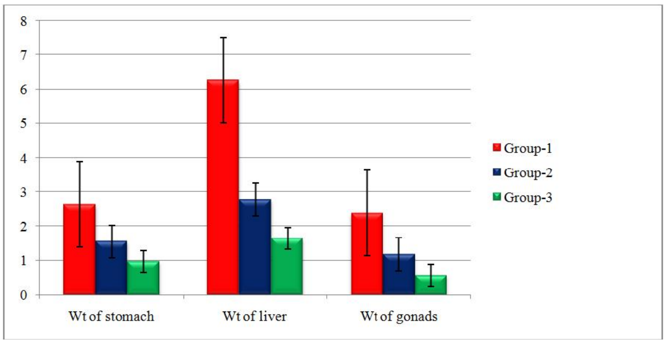

Fig. 3. Wt of stomach,liver and gonads (in gms) of three groups of female *Labeo rohita*

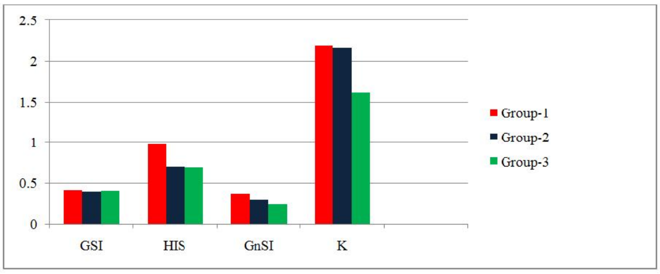

Fig. 4. Value of Gastrosomatic index, hepatosomatic index, gonadosomatic index (ovary) and conditional factor of three groups of female *L.rohita*

Statistical analysis

Mean and standard errors of different traits under study viz. body weight, total length, standard length, wieght of the stomach, wieght of the liver and wieght of the gonad were presented in the Table no. 2 graphically presented in the Figure no. 1-3. The data pertaining to the different parameters of the three groups viz. matured but adult (Goup-1), matured (Goup-2) and young (Goup-3), were analysed statically using Analysis of variance (ANOVA). Duncan's Multiple Range Test (DMRT) was used for separation of means and to know the homogenousity. Mean and Standard errors of the body wt, total length, standard length, wt of stomach, wt of liver, wt of gonad(ovary) were found to be 636.67±41.76 gms, 391.25±25.52 gms, 235.00±18.02gms and 40.03±1.01 cms, 33.70±0.42 cms, 32.00±0.57 cms and 30.73±0.61 cms, 26.22± 0.33 cms, 24.40±0.37 cms and 2.63±0.54 gms, 1.54±0.45 gms, 0.96±0.28 gms and 6.25±1.03 gms, 2.77±0.41 gms,1.64±0.12 gms and 2.38±0.40 gms, 1.16±0.40gms, 0.55±0.05 gms of Group 1, Group 2, Group 3 respectively. The ANOVA for different parameters were presented in the Table no.3. The correlation analysis of various morphological and anatomical parameters regarding to Group-1, Group-2 and Group-3 had been illustrated in Table no. 4 and that of various indices in Table no.5 respectively.

RESULT AND DISCUSSION

The observed data regarding body weight revealed that the adult female fishes attained highest body weight during spawning season. The body weight gradually reached the maximum in October (Lone and Hussain, 2009). Again it was found that the adult female fishes attained highest body weight during spawning due to the enlargement of the ovaries. Positive correlation (Table no.4) was also observed between body wt and total length ($r=0.969$ at $p<0.01$), body wt and standard length ($r=0.981$ at $p<0.01$), body wt and wt of liver ($r=0.807$ at $p<0.01$), body wt and wt of the stomach (0.756 at $p<0.05$), body wt and wt of the gonad (0.722 at $p<0.05$). The morphometric features like total length, standard length had shown gradual increase according to the age, growth and

Table 4. Correlations analysis of morphological and anatomical parameters of female *Labeo rohita*

		bodyweight	To.length	Std.Length	Wt.Stomach	Wt.Liver	Wt.Gonad
bodyweight	Pearson Correlation	1	0.969**	0.981**	0.756*	0.807**	0.722*
Total length	Pearson Correlation	0.969**	1	0.994**	0.724*	0.805**	0.739*
Standard Length	Pearson Correlation	0.981**	0.994**	1	0.704*	0.821**	0.764*
Wt of Stomach	Pearson Correlation	0.756*	0.724*	0.704*	1	0.748*	0.538
Wt of Liver	Pearson Correlation	0.807**	0.805**	0.821**	0.748*	1	0.851**
Wt of Gonad	Pearson Correlation	0.722*	0.739*	0.764*	0.538	0.851**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 5. Correlation matrix(r) of different indices of female *Labeo rohita*

		GSI	HSI	GnSI	K
GSI	Pearson Correlation	1	-.340**	-0.699**	-0.971
HSI	Pearson Correlation	-0.340**	1	0.910**	0.555
GnSI	Pearson Correlation	-0.699**	0.910**	1	0.849**
K	Pearson Correlation	-0.971	0.555	0.849**	1

**. Correlation is significant at the 0.01 level (2-tailed).

maturity of the female fishes. The length (33.70 cm TL) at which 70% of the sample matured ensures that the largest number of the most fish (those in the 33 - 40 cm TL bracket) is in reproductive state. This agrees with the comparative size at maturity in *P. obscura,* as maturity of fish depends on the growth (Odo *et al*., 2012). This had been supported by the fact that females of *C.Catla, L.rohita C.mrigala* and *C carpio* in the fish farm at Gwalior gain weight at a faster rate in relation to its length. Correlation between length and wt during various stages of maturity(young, matured, matured but adult) showed significant differences between the 3 maturity stages in female *L. rohita.* Correlation tests in *C.lida* were made to check the relationship between length and wt during various stages of maturity (immature, maturing and mature) in females showed similar type of significant differences between 3 maturity stages (Rajaguru,1992) . Positive correlation of total length was also observed with standard length ($r=0.994$ at $p<0.05$), wt of liver($r=0.805$ at $p<0.01$) ,wt of stomach ($r=0.704$ at $p<0.05$), wt of gonads ($r=0.739$ at $p<0.05$) .Correlation matrix indicated that wt. of the stomach showed significant correlation with body wt ($r=0.756$ at $p<0.05$), total length ($r=0.724$ at $p<0.05$),standard length ($r=0.704$ at $p<0.05$), wt of liver ($r=0.748$ at $p<0.05$), but negative correlation with of gonad ($r=0.538$ at $p<0.05$) (Table no.4) .Significant correlation is found in the wt of liver with wt of gonad($r=0.851$ at $p<0.01$). Correlation matrix also indicated that wt of gonad showed significant correlation with body wt ($r=0.722$ at $p<0.05$), but negative correlation with wt of stomach($r=0.538$) (Table no.4).

It revealed that the body wt of female *L. rohita* was significantly more in spawning season due to the wt of the mature ovaries .On the other hand it was a well established fact that during the period of gonad's maturation the feeding activity of fishes ceases and become very low at the time of spawning (Alkahem and *et al*., 2002) Correlation matrix among the other parameters like different indices viz. GSI, HSI, GnSI and K was presented in the Table No-5. It was seen from Table no.5 and Fig.4 that condition factor had a definite rise in matured females (2.169) than young ones (1.618) and a slight increase in K value was marked in adult but matured females (2.194) than that of matured ones. A similar study indicated that mature females of *L. gonius* become available from March to August. The period of peak maturity was during May and June. It was clearly indicated that condition factor and maturity of the fiches were interrelated. Thus the K value indicated the spawning period of the fish. Earlier workers had also observed that the fluctuations in the condition factor were related to the maturity cycle of the fish (Hickling,1930, Le Cren,1951). Correlation matrix also indicated that the condition factor of female *L. rohita* shown significant correlation with GnSI ($r=0.849$ at $p<0.01$). It was well established fact that during the period of maturation of gonads the feeding activity of fishes, ceases and becomes very low at the time of spawning. Correlation matrix also expressed similar views as condition factor has negative correlation with GSI ($r=-0.971$) (Table No.5). Correlation table (Table No.5) expressed the view that GSI shows negative correlation with HSI, GnSI and condition factor K. Female *C.arel* showed similar type of inverse relationship between GSI/HIS and breeding cycle with lowest values observed during peak-spawning in January (Rajaguru,1992). This indicated that gut/liver energy reserves may be used for gonadial recrudescence. Similar observation is found in *Mystus cavasius* that the feeding intensity of fish decreases during the spawning which may be due to big size of gonads which in turn allows lesser space for the stomach (Chaturvedi and Saksena, 2013). HSI had negative correlation with GSI and HSI had significant correlation with GnSI (0.910 at $p<0.01$). HSI had no significant relationship with condition factor. (GSI of C.punctatus normally varies from 1.1-3.5 (Chonder, 1999). Parameswaran (1975) indicated that feeding activity of fish(matured) becomes high during February-April. In present study the higher GSI values in matured and adult females than the matured and young females of indicates that the growth in adult females is faster than the matured and young females during breeding period. The GnSI values, the female attains early maturity than the male. Similarly HSI values of adult female establishes higher than young and matured ones, that again signifies the growth and maturity in adult female is faster than others. However the mean GSI value (0.405) of the three group of females is lower than mean HSI value (0.796).

Such results indicate that the spawning season of the fish commences little later (July–September, 2011). Pillay (1954) expressed that the spawning season of *Liza tade* may start in May-June and continue till September. With regards to 'K' value the female again adults show little higher fecundity than matured ones and matured females show little higher fecundity than the young ones. The condition factor 'K' values for *C. mrigala* revealed that with the progression of growth of the fish, the well being of fish increased (Saxena and Saksena, 2013 . The same opinion has been made by Dasgupta (2004). Rehman *et al*. (2002) have mentioned that in *Liza parsia* (35gms) the gastrosomatic index value (1.48) was much higher than the gonadosomatic index value (0.45). The present study agrees with the above observation as mean GSI value (0.405) is much higher than mean GnSI value (0.302). Generally gastrosomatic index is low during the spawning season of fish species (Rehman, 2002). In Colisa fasciatus, Sarkar and Deepak (2009) observed a gradual increase in gonadosomatic index value during pre-spawning period and its peak was reached during spawning period. An idea could also be developed about the carnivorous, omnivorous or herbivorous nature of the finfish by analyzing the values of relative length of intestine and the shape and size of the gill rackers (Soranganba and Saxena, 2007). It is agreed that a firm statement can not be made about the spawning season of the fish unless the fishes are analysed for condition factor of gonads and parameters like gastrosomatic index, gonadosomatic index and condition factor for a continuous period of twelve months(Das and Patra, 2013). Endeavours and achievements of this short piece of study is only a modest beginning , much more in depth study is under progress to have complete understanding about the anatomy, spawning behaviour and biological parameters of any single less studied less found (threatened) finfish species, which will be praiseworthy and of real value.

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