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MORPHOLOGICAL OBSERVATION AND LENGTH-WEIGHT RELATIONSHIP OF THREATENED NONDI BALE *Paragobiodon echinocephalus* (Rüppell, 1830)

Shikder Saiful Islam, Sadia Ashrafi, Md. Saifuddin Shah, Mohammad Saifuddin Sumon* and Md. Rayhan Ali

Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna 9208, Bangladesh

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Abstract: The study describes the length-weight relationship, length-length relationship, condition factor and hepato-somatic index of *Paragobiodon echinocephalus*. Forty samples were collected from Mongla at Bagerhat, Bangladesh. Total length, standard length, body weight and liver weight were measured by standard units. The body weight showed a positively correlation with total length and standard length with the regression equation of BW = 2.05TL - 9.35 (r^2= 0. 89) and BW = 2.30SL - 8.55 (r^2= 0.85) respectively. Total length and standard length were found highly correlated with the regression equation of SL = 1.11TL + 0.48 (r^2 = 0.93). A weak positive correlation was observed between body weight and liver weight with the r^2 value of 0.15. Hepato-somatic index showed very weak correlation with condition factor (r^2= 0.01), indicating that the species is in an endangered condition. The b values indicated negative allometric growth pattern which ranged from 2.05 to 2.30 (b<3) for body weight with total length, standard length and hepato-somatic index & condition factor relationship. Whereas, positive allometric growth was observed in case of liver weight and body weight relationship (b= 12.41). This study suggests that necessary steps need to be taken for the improvement of physiological and ecological conditions for higher growth and better survival of *P. echinocephalus*.

Keywords: *Paragobiodon echinocephalus*, length-weight relationship, growth, condition factor, hepato-somatic index

Introduction

Bangladesh is a land of rivers, wet lands, flood plains, lakes, depressed lands, ponds and ditches. The total inland water area of Bangladesh in hectare are rivers and estuaries 8, 53,863; beel 1, 14,161; Kaptai Lake 68,800; flood plains 28, 10,410; ponds and ditches 3, 71,309; baors 5,488 (DoF, 2012). The inland fisheries resources cover an area of 4.47 million hectare of which 90% comprises capture fisheries and 10% closed water fisheries (DoF, 2012). Geographical location and climatic condition of Bangladesh are unique for aquaculture and fisheries resource management. Bangladesh has great potential to culture of indigenous as well as exotic species in ponds, farms and other water bodies.

There are 260 indigenous species have been recorded from the freshwater environment of Bangladesh within 145 genera and 55 families (Craig *et al.*, 2004). *Paragobiodon echinocephalus* is a threatened fish of Bangladesh and is locally known as Nondi bale or Vut bale in our country. It is a small marine and brackish water goby fish. The color

Corresponding author: <sumon.fmrt.ku@gmail.com>

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of the fish is black. They are usually found in river in rainy season. But now a day the fish is not easily available in markets due to less supply and poor numbers in the nature. Many experiments in biology of fishes are available for different fish species in Bangladesh as well as abroad.

The length-weight relationship is important for proper exploitation and management of the population of fish species. Length and weight data are useful standard results of fish sampling programs (Morato *et al.*, 2001). In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent. Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics (Erzini, 1994).

Condition factor K is used in order to compare the "condition", "fitness" or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition. Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rate in fish. A high condition factor reflects good environmental quality; while a low condition factor reflects poor environmental quality.
Hepato-somatic Index (HSI) is defined as the ratio of liver weight to body weight. Poor condition is usually associated with poor feeding and/or environmental conditions and fish in poor condition may suffer increased natural mortality. In adult fish, condition can have dramatic effects on reproductive potentiality. The egg production of fish in poor condition may decrease through lower potential fecundity, or even skipped spawning and the larvae produced by fish in poor condition may be smaller and less likely to survive. All these factors may lead to a relationship between fish condition and recruitment.

But there is little available biological information on *Paragobiodon* sp. Thus that information is a prerequisite for the successful aquaculture and breeding of any fish species. Considering the present biological status of the species and eco-climatic change in the coastal areas of Bangladesh the study was conducted to find out the length-weight relationship, condition factor and hepato-somatic index of *Paragobiodon echinocephalus.*

Materials and methods

About 40 specimens were collected during June to August, 2013 from *Fulkuri* and *Pasur* River near Mongla, Bagerhat to estimate the biological parameters such as length, total weight and liver weight (Fig. 1). After collecting the sample the fishes were stored in deep freeze.

Fig. 1: Location of sampling station

The length-weight relationship was estimated by using the allometric formula, $W = aL^b$, where, W is body weight in g and L is the total length in cm, *a* is intercept of the regression and *b* is the regression coefficient (slope). Parameters *a* and *b* of the length-weight relationship was estimated by linear regression analysis based on natural logarithms, ln (W) = ln(*a*) + *b* ln(L).

Condition factor (K) was determined by the following formula: $K = W (g) \times 100/L^3$ (Fulton, 1902), where, W is the body weight in g and L is length in cm.

Hepato-somatic index **(**HSI) was determined as:

$$HSI = \frac{Liverweight(g) \times 100}{Bodyweigh(g)}$$ (Sadekarpawar and Parikh, 2013)

In order to arithmetic relationship between body weight-total length, body weight-standard length, liver weight-body weight and HSI-K, the values of regression co-efficient was estimated by the least square method (Le Cren, 1951) and the co-efficient of regression was also calculated.

The arithmetic relationships were established as follows-

BW = *a* + *b* TL, BW = *a* + *b* SL, LW = *a* + *b* BW, HIS = *a* + *b* K

Where, BW= Body weight, LW= Liver weight, HSI= Hepato-somatic index

Results

Regression parameters *a* and *b* of the length-weight relationship, 95% confidence intervals of a and b, the coefficient of determination (r^2) of 40 samples of *Paragobiodon echinocephalus* are shown in Table 1. The results indicated a significant relationship between length and weight, as well as other parameters of *P. echinocephalus* at $p < 0.05$ level of significance.

Table 1: Morpho-metric relationships between body weight (BW), total length (TL), standard length (SL), liver weight (LW), hepato-somatic index (HSI) and condition factor (K) for Nondi bale, *P. echinocephalus*.

Equation	n	*a*	*b*	95 % confidence interval of a	95 % confidence interval of b	r^2
BW = *a* + *b*SL	40	- 3.82	3.03	- 4.481 to – 3.151	2.642 to 3.422	0.87
BW = *a* + *b*TL		- 4.72	3.23	- 5.315 to - 4.115	2.907 to 3.545	0.92
TL = *a* + *b*SL		0.29	0.94	0.150 to 0.421	0.856 to 1.015	0.94
LW = *a* + *b*BW		- 4.26	0.65	- 5.204 to -3.306	- 0.026 to 1.330	0.09
HSI = *a* + *b*K		1.13	- 1.48	- 0.430 to 2.688	- 3.297 to 0.345	0.07

b values for BW-TL and BW-SL were more than 3, which indicated a positive allometric growth. Whereas, *b* values for TL-SL, LW-BW and HSI-K relationships were less than 3, which indicated negative allometric growth. The total length and standard length ranges from 8.6 to 5.3 cm and 7.6 to 4.5 cm with the average value of 6.58±0.81 cm and 5.52±0.71 cm respectively. The value of BW ranges from 10.09 to 1.82 g with the mean value of 4.14±1.77 g.

Fig. 2 represents the relationship of body weight with total length and standard length. It was observed that body weight is positively correlated with total length and standard length with the regression equation of BW = 3.23TL - 4.72 and BW = 3.03SL - 3.82 respectively. The r^2 values for both relationships were found to be 0.92 and 0.87 which are near to the maximum value 1.

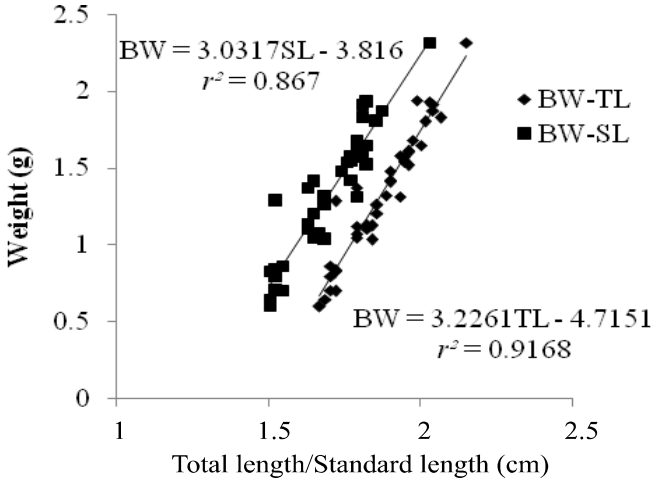

Fig. 2: Relationship of BW with total length and standard length of *P. echinocephalus*

Fig.3 indicated that there is a strong correlation between TL and SL representing the regression equation of TL = 0.94SL + 0.29 with the r^2 value of 0.94.

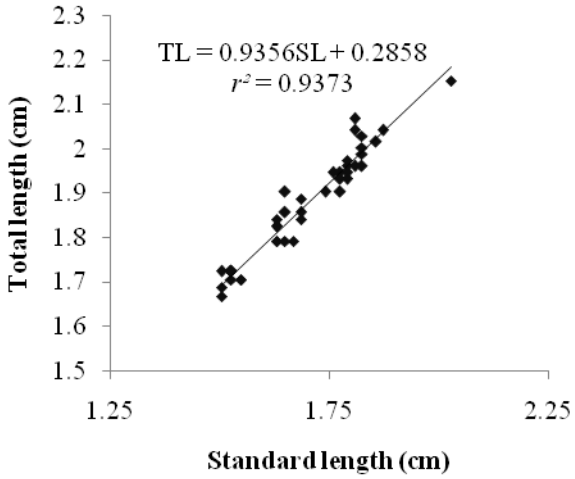

Fig. 3: Relationship between SL and TL of *P. echinocephalus*

The weight of liver ranged from 0.12 to 0.01 g with the mean value of 0.05±0.05 g. The liver weight is positively but very weakly correlated with body weight representing the regression equation of LW = 0.65BW - 4.26 with low r^2 value of 0.09 (Fig. 4). It was observed that some heavier fishes had smaller liver and in some cases thinner species had larger liver.

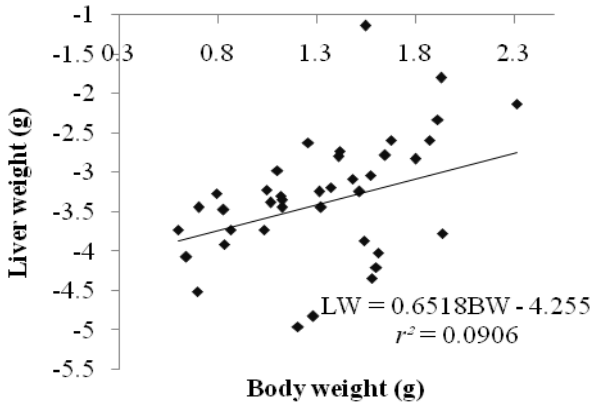

Fig. 4: Relationship between LW and BW of *P. echinocephalus*

The calculated value of K ranges from 1.72 to 3.71 with the mean condition factor of 2.35±0.38. The value of condition factor is also lower than that of the standard value 3.0. For that the body condition of the species was not best suited with the food availability, environmental conditions and other parameters. In addition, the calculated value of HSI ranges from 0.21 to 6.82 with the mean value of 1.19±1.05.

Fig. 5 shows negative correlation between condition factor K and HSI with the regression equation of HSI = -1.48K + 1.13 and r^2 value of 0.07. The negative correlation indicates that HSI of the fish was affected by poor physiological and environmental condition resulting poor growth rate.

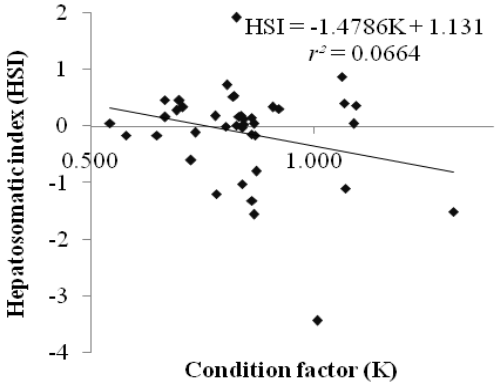

Fig. 5: Relationship between K and HSI

Discussion

The experiment was carried out to observe some morphological characteristics of *Paragobiodon echinocephalus* and to analyze some of the co-relations among those characters to get some information on the biological status of the species. The results of the study

showed that positive and strong co-relation of body weight with total length and standard length, which means that the physiological and environmental condition of the species is compatible for their growth and survival. The results are supported by the findings for *Glossogobius giuris* Goby (Hossain *et al.*, 2009), *Rita rita* (Al-Noor, 2011), *Parachaeturichthy socellatus* Goby (Panicker *et al.*, 2013), *Setipina phasa* (Alam *et al.*, 1997) and also for four Indian major carps *Catla catla, Labeo rohita, Labeo calbasu* and *Cirrhinus mrigala* (FRI, 1991). It is hypothesized that heavier fish of a particular length are in a better physiological condition. So, the relationships might be stronger having r^2 values near to 1, if the physiological and environmental conditions were better.

The highly strong relation between total length and standard length observed in this study is similar to the findings of Hossain *et al.* (2009) for *Mystus vittatus, Ailia coila, Clupisoma atherinoides*, *Eutropiichthyes vacha*, *Ailiichthys punctata*, *Botia lohachata*, *Chanda nama*, *Laubuc alaubuca* and *Mystus cavasius* in Bangladesh.

Liver weight of the species was found to be very weakly co-related with the body weight, which is criticized by the results for *Acanthopagrus latus* and *Pelates quadrilineatus* (Al-Dubakel and Abdulla, 2006); which showed strong positive correlation between body weight and liver weight. The cause of the differences might be due to variations in habitat, lack of feed availability and quality feed, environmental disorder, seasonal fluctuation etc.

The total length and standard length shows positiveallometric pattern of growth which is disagreed by the findings for male *Glossogobius giuris* (b=2.95 for TL, b=2.95 for SL); whereas, those are supported by slight positive allometric growth for females (b=3.29 for TL, b=3.17 for SL) (Hossain*et al.*, 2009). Negative allometric growth also found in *Parachaeturichthysocellatus* Goby (Panicker *et al.*, 2013) for both male and female, *Anabas testudineus*, *Channa striatus* and *Channamaurulius* (Kumar *et al.*, 2013); *Gobius niger, Engraulis encrasicolus*, *S. sprattus* and *Pomatomus saltatrix* (Kalayc *et al.*, 2007). But, the values are different from the finding for *Wallagoattu* (positive allometric) and *Sperata seenghala* (positive allometric); Hossain (2010) for *Ailiacoila* (Isometric); Hossain *et al.* (2009) for *Mystusvittatus* (positive allometric) in the Ganges.

The condition factor does not merely reflect the feeding condition of the adult stage, but includes the state of gonadal development, based on the consumption of fat reserves during the spawning period. However, the poor condition factor of the present study is disagreed with the result for Tank goby, *Glossogobius giuris*. The length weight relationship and relative condition (mean k_n>1) shows the growth of the species is satisfactory in Atrai river Bangladesh (Joadder, 2009).

Hepato-somatic indices of the target species was found to be negatively correlated with condition factor in the present study. Because of poor condition of fish body and environmental factors, the liver of fish contains less energy which is insufficient for higher growth rate and better survival. It can cause higher mortality rate of the species. It can also affect the reproductive potentiality of fish. For generalization, it might be concluded that the species is in endangered condition. So, necessary steps should be taken immediately to improve the physiological and environmental conditions for higher growth rate and better survival of the species.

Conclusion

This study provides an important baseline study on some biological parameters of an emerging fish *Paragobiodon echinocephalus*. The results of the study would be an effective tool for fishery biologists, managers and conservationists to initiate early management strategies and regulations for the sustainable culture conservation of the remaining stocks of this fish species in the Fulkuri and Pasur River ecosystem.

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