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## Temporal variations of length, weight and condition of Hilsa shad, Tenualosa ilisha

(Hamilton, 1822) in the Meghna River, Southeastern Bangladesh

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# ABSTRACT

The current study was on temporal variations of length, weight, and condition of Tenualosa ilisha (Hamilton, 1822) from the Meghna River, Southeastern Bangladesh for the period of July 2018 to June 2019. A total of 1433 individuals were collected from the Meghna River (Chandpur and Laxmipur region, SE Bangladesh). Bodyweight (BW) and total length (TL) were measured with 0.01 g and 0.01 cm accuracy for each specimen. The relative condition factor  $(K_R)$  was calculated by the equation of Le Cren (1951):  $K_R = W/(a \times L^b)$  where W is the body weight (g) and L is the total length (cm) and a & b is the length-weight relationship parameters estimated with linear regression analyses. The value of  $K_R \sim 1$  indicates good health, >1 indicates over bodyweight with compare to length, whereas <1 indicates a relatively poor condition of fish. The TL ranged from 15.3-57.8 cm while the BW was 37.17–2250 g. The overall  $K_R$  for T. ilisha was 0.65-1.66 in the Meghna River. The maximum  $K_R$  was found in July while the minimum was in January. The  $K_R$  was strongly correlated with BW in the Meghna River. These findings will help to improve the sustainable management policy of hilsa fishery in the Meghna river ecosystem and other adjacent water bodies.

### INTRODUCTION

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The national fish of Bangladesh, Hilsa shad, *Tenualosa ilisha* (Hamilton, 1822) is a marine, brackish and freshwaters fish belonging the family Clupeidae (Riede, 2004). It is locally known as *ilish* or *ilsha* while the juvenile known as *Jatka* (Shafi and Quddus,

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1982). Hilsa shad is rich in minerals, lipids and amino acids (**De** *et al.*, **2019**). It has great economic importance as 12% of total fish production of the country came from Hilsa (**DoF**, **2019**). This fish species is distributed in Asian countries including Bangladesh, Nepal, Sri Lanka, India, Pakistan, China, United Arab Emirates and also in Myanmar, Iraq, Iran, Malaysia, Oman, Kuwait, Qatar, Saudi Arabia, Thailand and Viet Nam (**Freyhof**, **2014**). It is abundant in the Meghna River, Padma River, Rupsha River, Sibsha River, Biskhali River, Tetulia River, Arial Kha River, Galachipa Rirver, Pyra River and a small number of other rivers in the coastal area of Bangladesh (**IUCN Bangladesh**, **2015**) and worldwide (**Freyhof**, **2014**).

Condition factors are the most constructive parameters for assessing the health of fish species and the whole aquatic community, as well as to act as functional tools for natural population management and conservation (Hossain *et al.*, 2012a, 2012b; Rahman *et al.*, 2012). Moreover, it quantitatively assesses the well-being of fish and predicts its future population success (Richter, 2007; Hossain *et al.*, 2013a, 2016). Furthermore, the relative condition factor ( $K_R$ ) can be used to examine fish health (Rypel and Richter, 2008; Hossain *et al.*, 2009, 2013b) as well as very important to estimate the environmental condition of fishes (Hossen *et al.*, 2019a).

A few studies have been carried out on length weight relationship (Flura *et al.*, 2015), population biology (Islam *et al.*, 1987; Rahman *et al.*, 1998; Amin *et al.*, 2000; Haldar *et al.*, 2001; Ahmed *et al.*, 2008; Hossain *et al.*, 2019), stock assessment (Gupta, 1989; Amin *et al.*, 2004), exploitation status (Amin *et al.*, 2002, 2008) of *T. ilisha*. However, to the best of our knowledge, none of these studies cover the condition of fishes covering year round data in the Meghna River and elsewhere. Therefore, the present study was designed to describe the temporal variations of length, weight and condition of *T. ilisha* in the Meghna River, Southeastern (SE) Bangladesh using one-year-round data.

## **MATERIALS AND METHODS**

The present study was conducted in the Meghna River in Bangladesh during July 2018 to June 2019. A total of 1433 specimens were collected from commercial landing stations in Chandpur (23.23, 90.63) and Laxmipur (22.85, 90.67) region (Figure 1), SE Bangladesh. Total length (TL) was measured by measuring board nearest to the 0.01 cm and body weight (BW) were measured by an electronic balance nearest to the 0.01 g for each specimen.



Figure 1. Sampling site [Chandpur (23.23, 90.63) and Laxmipur (22.85, 90.67) region] of *Tenualosa ilisha* in the Meghna River, Southeastern Bangladesh. (Source: <u>https://www.google.com/maps;</u> Accessed: 15 April 2020).

The relative condition factor  $(K_R)$  was calculated by the equation of Le Cren (1951):  $K_R = W/(a \times L^b)$  where, W is the body weight (g) and L is the total length (cm) and a & b is the length-weight relationship (W =  $a * L^b$ ) parameters. According to Le-Cren (1951), the value of  $K_R$  higher than 1 indicates good health and less than 1 indicates relatively poor condition of the fish.

Statistical analyses were done by GraphPad Prism 6.5 software considered at 5% level of significance (p < 0.05) in the study.

#### RESULTS

During the study, a total of 1433 specimens were collected from the Meghna River. The smallest fish was 15.30 cm in size, while the largest one was 57.80 cm. The BW of *T. ilisha* ranged from 37.17 - 2250.00 g. Monthly variation of TL and BW were showed in Figure 2 and Figure 3, respectively.



Figure 2. Monthly variations of total length of *Tenualosa ilisha* (Hamilton, 1822) in the Meghna River, Southeastern Bangladesh.



Figure 3. Monthly variations of body weight of *Tenualosa ilisha* (Hamilton, 1822) in the Meghna River, Southeastern Bangladesh.

The minimum value of  $K_R$  was 0.65 in January and the maximum value was 1.66 in July. Monthly variations of  $K_R$  were showed in Figure 4 and Table 1. Table 2 Showed correlation between TL *vs.*  $K_R$  and BW *vs.*  $K_R$ .Variations of  $K_R$  with TL were showed in Figure 5.



Figure 4. Monthly variations of relative condition factor ( $K_R$ ) of *Tenualosa ilisha* (Hamilton, 1822) in the Meghna River, Southeastern Bangladesh.

Tabl	e 1. Descriptive statistics	on Relative	e condition	factor (I	K <sub>R</sub> ) meas	surements	and their
95%	confidence limits of the	Tenualosa	<i>ilisha</i> (Har	milton, 1	822) in	the Megh	na River
South	neastern Bangladesh						

Month	n	Relative condition factor (K <sub>R</sub> )			
Wonth		Min	Max	Mean ± SD	95% CL
Jul. 18	72	0.74	1.66	$1.00\pm0.13$	0.98 - 1.03
Aug	103	0.81	1.18	$1.00\pm0.09$	0.98 - 1.01
Sep	120	0.84	1.18	$1.01\pm0.08$	0.99 - 1.02
Oct	130	0.76	1.23	$1.00\pm0.10$	0.98 - 1.02
Nov	124	0.84	1.17	$1.01\pm0.08$	0.99 - 1.02
Dec	226	0.65	1.27	$1.01\pm0.13$	0.99 - 1.02
Jan. 19	72	0.65	1.18	$1.00\pm0.10$	0.97 - 1.02
Feb	76	0.83	1.40	$1.00\pm0.09$	0.98 - 1.02
Mar	35	0.90	1.14	$1.00\pm0.06$	0.98 - 1.02
Apr	79	0.75	1.24	$1.01\pm0.12$	0.99 - 1.04
May	209	0.76	1.22	$1.00\pm0.10$	0.99 - 1.01
Jun	187	0.80	1.26	$1.00\pm0.09$	0.99 - 1.02
Overall	1433	0.65	1.66	$1.00 \pm 0.10$	0.99 - 1.01

*n*, Sample Size; Min, Minimum; Max, Maximum; SD, Standard Deviation; CL, Confidence Limit

**Table 2.** Correlation of relative condition factor ( $K_R$ ) with total length (TL) and body weight (BW) with 95% confidence limits of the *Tenualosa ilisha* (Hamilton, 1822) in the Meghna River, Southeastern Bangladesh

Correlation	r <sub>s</sub> values	95% CL of r <sub>s</sub>	p value	Level of significance
TL vs. $K_R$	0.0226	-0.0308 to 0.0758	0.3927	ns
BW vs. $K_R$	0.1530	0.1005 to 0.2046	< 0.0001	****

 $r_s$ , Spearman rank-correlation values; CL, confidence limit; p, shows the level of significance; ns, not significant; \*\*\*\* very highly significant



**Figure 5.** Variations of relative condition factor (K<sub>R</sub>) with total length of *Tenualosa ilisha* (Hamilton, 1822) in the Meghna River, Southeastern Bangladesh.

#### DISCUSSION

Information on condition of *T. ilisha* in the Meghna River is scant. A large number of specimens of various body sizes were collected from commercial catch of the Meghna River in Chandpur and Laxmipur regions throughout the year. However, absence of smaller than 15.3 cm TL during the study may be attributed to the selectivity of fishing gear or low market price (**Rahman** *et al.*, **2019a**, **b**; **Hossen** *et al.*, **2019b**; **Azad** *et al.*, **2018**).

In the study, we found the maximum length as 57.8 cm TL which was more or less similar to the study (57 cm) of **Rahman** *et al.*, (1999) and **Amin** *et al.*, (2002) in Bangladesh and **Al-Baz & Grove** (1995) in Kuwait but smaller than the study (61 cm) of **Amin** *et al.*, (2004), though FishBase (Froese and Pauly, 2020) showed a maximum length of 60 cm. All other studies (Flura *et al.*, 2015; Sarkar *et al.*, 2017; Roomiani and Jamili, 2011; Bhakta *et al.*, 2019; Mohanty and Nayak, 2017; Bhaumik *et al.*, 2011) found the body length were smaller than the current study. Essentially, maximum length is a helpful tool to estimate the growth parameters *i.e.*, asymptotic length, growth coefficient, thereby important for fisheries management and resource planning (Hossain *et al.*, 2009; 2014). Mean TL and BW were comparatively smaller in January. September-October is the peak spawning season of Hilsa shad (**Hossain** *et al.*, **2014**) and in January they recruit in the adult stock. Another small peak was in February (**Mathur**, **1964**). The juvenile recruit in April and thus they are small in size and weight. In August maximum mean length and weight found as presence of much more food in the River.

During the study, relative condition factor ( $K_R$ ) was studied to evaluate the overall health and productivity of *T. ilisha* in the Meghna River. Mean  $K_R$  value throughout the year indicated a balance habitat for hilsa population. The present study found minimum and maximum  $K_R$  value in January and July, while **Sarkar** *et al.* (2017) stated in August and June in Hooghly estuarine system, India.  $K_R$  value may higher during spawning season (**Khan** *et al.*, 2001). The difference may be occurred due to maturity of gonads, amount of undigested food in the alimentary canal and changes in amount of fat stored in body tissue (**Hossain** *et al.*, 2017).

Smaller size specimen indicated the higher value of  $K_R$  as they have high feeding density. The value gradually decreased with increasing the length as gonadal development occurs. **Mohanty and Nayak (2017)** also indicated same matter for *T*. *ilisha* in the Chilika Lake, India. **Reuben (1992)** stated that an early stage of fish has higher  $K_R$  value. Though, **Welcome (1979)** reported that condition factor in fish decreases with decreasing in size and is also influenced by the reproductive cycle.

Overall  $K_R$  of our study was within 0.99-1.01 while **Mandal** *et al.*, (2018) reported  $K_R$  value varied between 0.98-1.04 and **Sarkar** *et al.* (2017) observed it from 0.98 to 1.05 for *T. ilisha* from India.

#### CONCLUSION

The current study designated temporal variation of length, weight and condition of *T. ilisha* from the Meghna River, SE Bangladesh. This study described on fish health depending on the relative condition factor. The findings of this study will help to improve sustainable management policy of hilsa fishery in the Meghna River ecosystem and other adjacent waterbodies.

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