Length-weight relationships of three freshwater eel species from the floodplain ecosystems of northeastern Bangladesh

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Research Article

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Abstract

This study reports the Length-weight relationships (LWRs) of three freshwater eel species from the northeastern wetlands of Bangladesh. A total of 2684 specimens of *Mastacembelus armatus*, *Macrogathus aculeatus* and *Macrongathus pancalus* were sampled between in the months of June and December 2019 using different nets and eel traps at every 4 days working schedule per month. The calculated a values of the LWRs ranged from 0.008 to 0.020; b values ranged from 2.35 to 2.70, and r^2 from 0.907 to 0.944. The lowest values of regression coefficient found for *M. aculeatus* and the highest for *M. pancalus*. All the regression parameters for LWRs found highly significant ($p \leq 0.001$). These results will provide baseline information for sustainable management and conservation of the fisheries resources in the northeastern floodplain region of Bangladesh.

Introduction

The floodplain ecosystems in northeastern Bangladesh are considered as one of the most promising sectors for inland capture fisheries with around 858,460 ha of resource area and at least 143 indigenous fish species (BHWDB, 2012). The length-weight relationship (LWRs) data of fish species is an important biological parameter that provides information on the condition of fish stock, allows estimation of biomass and to determine whether somatic growth was isometric or allometric (Ricker, 1975; Froese, 1998; Moutopoulos & Stergiou, 2002; Gonzalez Acosta *et al.*, 2004; Duan & Tan, 2016). The LWRs are also important in converting the body length into biomass when direct weight measurement in the field is difficult and time-consuming (Martin-Smith, 1996; Koutrakis & Tsikliras, 2003). However, the LWRs data for the indigenous fish species in the northeastern wetlands of Bangladesh are still scarce. Therefore, the present study aimed to estimate the LWRs of three indigenous freshwater eel species *Mastacembelus armatus* (Lacepède, 1800), *Macrogathus aculeatus* (Bloch, 1786) and *Macrongathus pancalus* (Hamilton, 1822) from the northeastern floodplains in Bangladesh, which have not yet recorded in FishBase (Froese & Pauly, 2016). *Mastacembelus armatus* is a freshwater spiny eel having great economic value in India and Bangladesh; *Macrogathus aculeatus* is a near threatened highly valuable small indigenous species in Bangladesh with toothsome nutritive value and notable aquarium importance and *Macrogathus pancalus* is a commercially important and palatable as a table fish which fetches a good price when sold alive. The wild population of these species has steadily declined mainly due to habitat degradation, introduction of alien invasive species, over-exploitation, diseases, pollution, poisoning, and other destructive fishing. The results from this study on the LWRs of these eel species will serve as baseline information for online fish database and accelerate sustainable management and conservation of less studied freshwater fishes in northeastern Bangladesh.

Materials And Method

A total of 2684 specimens of three freshwater eel species were collected from different Beels in northeastern Haor region of Bangladesh during June to December 2019 from the fishermen catches. The selected species were represented by *M. armatus* (n = 795), *M. aculeatus* (n = 823) and *M. pancalus* (n = 1066). Fish were caught by different types of fishing gears including fish nets and eel traps. All the specimens were identified at species level in the field, total length was measured by using measuring scale and weight were measured by using digital balance.

The LWRs of each fish species were calculated using the log-transformed equation $W = aL^b$, to derive a linear relationship: $\ln BW = \ln a + b \ln TL$

where, BW is the total weight of fish (g),

TL is the total length of fish (cm),

a is the intercept and

b is the slope of regression coefficient.

Intercept (a) indicates the body structure of species and slope (b) indicates their growth pattern. All the length-weight data transformed to natural logarithm prior to performing regression analysis using MS Excel and the outliers removed following Froese & Pauly, (2015). The regression parameter b and coefficient of determination r^2 estimated at 95% confidence interval (Froese, 2006).

Results And Discussion

Descriptive statistics and estimated regression parameters a , and b at 95% confidence limits and coefficients of determinations (r^2) are presented in Table 1. The b value of LWRs ranged between 2.35 and 2.70, and the coefficients of determination (r^2) ranged between 0.907 and 0.944. Usually, the value of b is near about 3. The lowest values of regression parameters found for *M. aculeatus* and the highest values for *M. pancalus*.

The sample size was maximum for *M. pancalus* ($n = 1066$) followed by *M. aculeatus* ($n = 823$) and *M. armatus* ($n = 795$). The b values for *M. pancalus* and *M. armatus* in this study were within the expected range of $2.5 \leq b \leq 3.5$ (Froese, 2006) and was found to be significant at 1% significance level ($p \leq 0.001$). The length-weight relationships indicate the negative allometric growth for all the eel species in this study (Figure 1,2,3). Higher values of b (>3) indicate proportionate increase in body weight with increase in total length or positive allometric growth and lower values (< 3) indicates negative allometric growth, means that fish become slimmer as the length increases (Jobling, 2002). The lower b value in this study indicates that these three eel species use more energy in axial growth than biomass (Liu, Ye, & Li, 2016; Vicentin, dos S Costa, & Suárez, 2012). Hossain, Ahmed, Leunda, Islam, Jasmine, et al. (2006) reported the coefficient b of 2.864 for *M. aculeatus* revealing a negative allometric growth pattern from the Mathabhangra River, southwestern Bangladesh which is similar to this study. However, they also reported positive allometric growth in *M. pancalus* from the Mathabhangra River, southwestern Bangladesh, which do not comply with this study, may be due to seasonal variation, number of specimens observed, differences in observed length ranges, habitat and fishing pressure status (Wootton, 1998). Abujam & Biswas (2016) also reported seasonal variation in positive allometric growth ($b > 3$) and negative allometric growth ($b < 3$) of *M. pancalus* from the upper Assam in India.

The actual length-weight relationship varies from species to species based on their genetic characteristics. Reproductive development and the availability of sufficient food also affect the b value throughout the life cycle of fish. Interspecies LWRs also varies according to the condition of individuals within a species (Borah, Bhattacharjya, Saud, Yadav, Debnath, Yengkokpam, Das, Sharma, Singh, & Sarma, 2016). Sarker, Khan, Dabas, Pathak, Mir, Rebello, Pal & Singh (2013) studied the length weight relationship and condition factor of *M. pancalus* and *M. armatus* found in Ganga, Gomti and Rapti Rivers of India and found that the b value ranged between 2.11 to 2.65. Pathak, Zahid & Serajuddin (2013) estimated the length-weight relationship of striped spiny eel, *M. pancalus* and found the b values to be near about 3 that indicates isometric growth of *M. pancalus* and the coefficient of determination were highly significant ($p < 0.001$). Qin, Lin, Li, Wang, Guo & Liu (2017) estimated the length-weight relationship of *M. aculeatus* from a tributary of the Yilou River, China and found that the b value was 3.09.

This is the first report on biological parameters for three indigenous eel species in the northeastern floodplain ecosystems of Bangladesh. The results from this study on the LWRs of three freshwater eels will serve as baseline information for online fish database and accelerate sustainable management and conservation of less studied freshwater fishes in northeastern Bangladesh.

Declarations

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Conflicts of Interest: The author declares no conflict of interest.

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Table

Table 1. Descriptive statistics and estimated regression parameters for LWRs of three freshwater eel species from floodplain ecosystems of northeastern Bangladesh.

Fish Species	IUCN Status	n	TL (cm)		BW (g)		Regression Parameters				
			Min.	Max.	Min.	Max.	<i>a</i>	<i>b</i>	95% CL of <i>a</i>	95% CL of <i>b</i>	<i>r</i> ²
<i>Macrongothus pancalus</i> (Hamilton, 1822)	LC	1066	9.15	24.89	3.52	52.70	0.009	2.70	0.008-0.010	2.66-2.74	0.944
<i>Mastacembelus armatus</i> (Lacepede,1800)	EN	795	12.20	65.88	9.45	415.52	0.012	2.63	0.010-0.014	2.58-2.67	0.941
<i>Macrongothus aculeatus</i> (Bloch, 1786)	NT	823	6.35	30.48	2.15	30.41	0.020	2.35	0.017-0.023	2.30-2.40	0.907

n, sample size; **Min**, minimum; **Max**, maximum; **a & b**, regression parameters of LWR; **CL**, confidence limits; **r²**, coefficient of determination; **LC**, Least Concern; **EN**, Endangered; **NT**, Near Threatened.

Figures

Figure 1

Generalized log-log relationships ($\ln BW = \ln a + b \ln TL$) between body weight (BW) and total length (TL) of *Macrongothus pancalus* from northeastern floodplains of Bangladesh.

Figure 2

Generalized log-log relationships ($\ln BW = \ln a + b \ln TL$) between body weight (BW) and total length (TL) of *Macrongothus armatus* from northeastern floodplains of Bangladesh.

Figure 3

Generalized log-log relationships ($\ln BW = \ln a + b \ln TL$) between body weight (BW) and total length (TL) of *Macragnathus aculeatus* from northeastern floodplains of Bangladesh.