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LENGTH-WEIGHT RELATIONSHIP AND POPULATION DYNAMICS STUDY OF THE GIANT CATFISH (*Arius thalassinus*) IN THE BAY OF BENGAL COAST OF BANGLADESH

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The present study investigated the length-weight relationship, population parameters and the instantaneous natural mortality rate of *Arius thalassinus* from two major landing center of Bangladesh using the FAO-ICLARM Stock Assessment Tools (*FiSAT II*). A total of 1789 specimens were collected between January 2016 and December 2017. The estimated values of the exponent "*b*" was ranged from 3.019 (pre-monsoon) to *3.293* (monsoon), indicating an isometric growth pattern of the species with high correlation coefficients (*0.904* to *0.927*). The equation of length–weight relationship was: $W=0.005L^{3.181}$. Model parameters of the von Bertalanffy growth equation were: $L_\infty = 97.60$ *cm* and $K = 0.33^{-1}$ *year*. The estimated growth performance index (*Ø*) was *3.497*. The instantaneous natural mortality rate (*M*) was 0.62^{-1} *year* and a high exploitation rate (*E*) *0.62* (>0.50) showed that this fish is over-exploited in the Bay of Bengal coast of Bangladesh.

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INTRODUCTION

Arius thalassinus, commonly known as giant catfish under the family Ariidae (Pisces, Siluriformes) is an economically important marine fish species for commercial fishing activities in the Bay of Bengal coast of Bangladesh. Though considerable amount of landing of the species has been reported from the landing centers over the years (DoF 2016), therefore, its sustainability needs to be ensured by effective management. Unfortunately, knowledge on the stock structure of this species in the Bay of Bengal coast of Bangladesh, needed for management, is unknown. Information on basic biological parameters, i.e., age, growth and mortality of the exploited stocks is the primary requisite for the assessment and sustainable management of the stock (Heupel *et al*. 2010), but there are no such data available on the population parameters of *Arius thalassinus* in this region. Hence, the aim of this study was to establish the key population parameters of *Arius thalassinus* by presenting the Length-Weight Relationship, estimating the growth parameters ($L\infty$, K & to) and calculating the instantaneous natural mortality rate. This information will be the baseline for the development of species-specific management policies in the coast of Bangladesh.

MATERIALS AND METHODS

A total of 1791 samples of *Arius thalassinus* was collected from the commercial catches landed at two major landing centers in Bangladesh i.e. BFDC ghat, Cox's Bazar (*21⁰ 27' 4.04" N* and *91⁰ 58' 16.62" E*) and Fishery Ghat, Chittagong (*22⁰ 19' 38.33" N* and *91⁰ 50' 50.15" E*) between January 2016 and December 2017. Length-frequency data were obtained at the landing sites. Fishes were randomly selected and measured the total length (±0. 1 cm) and weighed (±0. 01 g) using a metric scale. The LWRs for different seasons were calculated by applying the exponential regression given by Le Cren (1951):

$$W = aL^b;$$

Where, W is body weight (g), L is the total length (cm), a is a coefficient related to body form, and b is an exponent indicating the isometric growth of fish when b = 3 (Beverton and Holt 1996; Froese 2006). The length-frequency data was grouped into 5 cm class intervals for the estimation of growth parameters. The two years data were pooled for one year by using FAO-ICLARM Stock Assessment Tools (*FiSAT II*) (Pauly & David 1981). The *ELEFAN I* procedure in *FiSAT II* was employed to estimate growth parameters ($L\infty$ and K) of the von Bertalanffy growth function (VBGF):

$$Lt = L\infty\ [1 - exp^{-K(t-t0)}],$$

Where, Lt is the length at age t, $L\infty$ is asymptotic length, K is the growth coefficient, and t_0 is the theoretical age of fish at zero length t_0 was estimated from the "*Analysis of Length-at-Age data*" routines. The growth performance index ($\O$) for *Arius thalassinus* was calculated according to the following formula (Pauly and Munro 1984):

$$\acute{\O} = \log K + 2 \log L\infty$$

The total instantaneous mortality (Z) was estimated by length converted catch curve method (Pauly 1983). Estimation of natural mortality rate (M) was carried out using the following empirical equation proposed by Pauly (1980):

$$Log\ M = -0.0066 – 0.279 \log L\infty + 0.6543 \log K + 0.4634 \log T$$

Where, M is natural mortality and T is the mean annual sea surface temperature, which was taken as 28.2^{0}C during the sampling period. Annual instantaneous fishing mortality (F) was calculated by subtracting the natural mortality rate (M) from the total mortality (Z) (F = Z-M). Present exploitation rate (E) was analyzed as the proportion of the fishing mortality (F) relative to total mortality ($E = F/Z$) (Gulland 1971).

RESULTS AND DISCUSSION

The estimated exponent "*b*" of the LWRs were ranging from *3.019* (pre-monsoon) to *3.293* (monsoon), indicated the isometric form of growth in *Arius thalassinus* throughout the year (Table 1). For the length-weight relationship analysis, 1789 individuals were grouped according to length and corresponding weights.The values of length-weight relationship for the *A. thalassinus* were estimated as: a=0.005, b= 3.181 and r^2 = 0.914 (Figure 1). Swant and Raje (2009) also reported similar kind of estimates of "*b*" exponent (*3.029* for male and *3.046* for female) for the giant catfish from the Veraval coast of India. Furthermore, higher r^2 values (*0.904* to *0.927*) also proved the strong relationship between length and weight of the species. There was no significant different between the "*b*" values and the isometric value (*b*=3) and isometric growth model was determined for the giant catfish in the study area ($P > 0.05$). The regression constant "*a*" is a scaling coefficient for the weight at length of the fish and when "*b*" is within the range of *2.5* to *3.5*, then it can be regarded as condition factor (Froese 2006; Tzeek-Tuz et al. 2012) which shows the condition of a fish at temporal and spatial level. The values "*a*" showed significant variation between the seasons and it was higher in pre-monsoon and monsoon season (Table 1).

Table 1. Seasonal estimated LWRs of Arius thalassinus from Bay of Bengal coast of Bangladesh

Season	Number	Total Length		Total Weight		Length-Weight Relationships	r^2
		Min	Max	Min	Max		
Winter	497	15	72	70	4682	$W=0.008L^{3.057}$	0.904
Pre-monsoon	408	18	76	64	7309	$W=0.010L^{3.019}$	0.927
Monsoon	589	20	95	98	11805	$W=0.004L^{3.293}$	0.923
Post-monsoon	295	19	67	95	4732	$W=0.005L^{3.216}$	0.905
Combined	1789	15	95	64	11805	$W=0.005L^{3.181}$	0.914

The von Bertalanffy growth parameters were estimated as: L_∞ = 97.60, K = 0.33 $year^{-1}$ (Figure 2) and the growth performance index (Ǿ) were *3.497*. The estimated VBGF equation was $Lt = 97.60* (1\text{-}exp^{-0.33\ (t\ +\ 0)})$. The estimates of growth parameters of *Arius thalassinue* reported by Dmitrenko (1975) from India and Bawazeer (1987) from Kuwait showed a little difference with the results of the present study (Table 2). This is common when fishes are collected from different ecosystem since the productivity of the ecosystem has a strong influence on fish growth. Sometimes, this could also be due to the difference in genetic structure (Pauly 1994), sampling error, and variation in fishing intensity (Taghavi Motlagh et al. 2010) and uncertainty in the estimation of growth rate (*K*) from the length-frequency data (Tzeek-Tuz et al. 2012). The growth performance index (Ǿ) obtained in this study was almost similar to the values of other studies (Table 2) that established the reliability of the growth parameter estimation for *Arius thalassinus* in this study from the length frequency data.

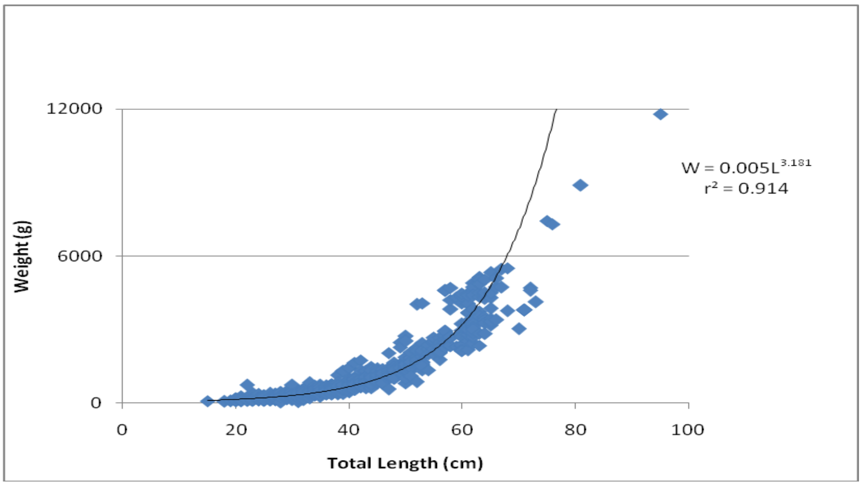

Figure 1. Total Length (cm) and Weight (g) relationship *A. thalassinus*

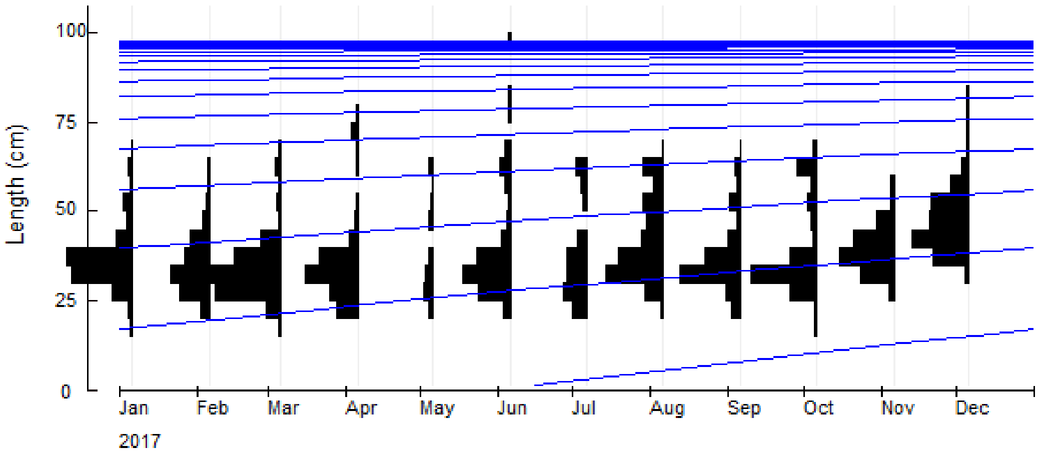

Figure 2. Length-frequency distribution data and growth curves estimated using ELEFAN method for *A. thalassinus*

The total instantaneous mortality rate (*Z*) was *1.63* $year^{-1}$ (Figure 3) and the instantaneous natural mortality (*M*) rate was *0.62* in relation to the average water temperature of the sampling period (27^0C). The calculation of fishing mortality gave $F = 1.02\ year^{-1}$. With the values of *M* and *F* available, the exploitation ratio was then computed as *E = 0.62*. The estimated fishing mortality rate was about two times greater than the natural mortality rate (*M*) and together with the current exploitation rate, it indicated a very high fishing pressure on the stock of *Arius thalassinu*s in the Bay of Bengal coast of Bangladesh. For the sustainable management of this fishery, a strong fishing regulatory tool and management policy should be employed immediately to stop the over fishing of this species.

Table 2. Growth parameters (L∞, K and t0) and growth performance index (Ǿ) for *Arius thalassinus*

Region	L∞ (cm)	K year^{-1}	Ǿ	Sources
Bangladesh	97.60	0.33	3.497	Present study
India	92.23	0.10	2.925	Dmitrenko (1975)
Kuwait	106.40	0.06	2.860	Bawazeer (1987)

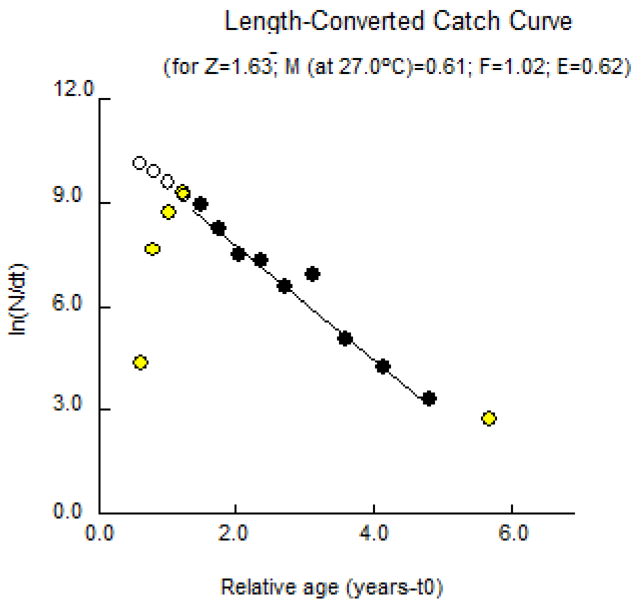

Figure 3. Estimation of 'Z' by length converted catch curve method for *A. thalassinus*

Finally, this was the first report on the growth parameters of the species in the Bay of Bengal coast of Bangladesh which provides basic biological information that will be useful for the assessment and management of *Arius thalassinus* fishery in this region.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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