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RESEARCH ARTICLE

Some population parameters of Bengal yellowfin seabream, *Acanthopagrus longispinnis* (Val.), from Hatiya Island, Bay of Bengal

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Abstract. Size frequency, length-weight relationships (LWRs), length-length relationships (LLRs), and relative condition factor (K_n) was studied in an estuarine fish the Bengal yellowfin seabream, *Acanthopagrus longispinnis* (Val.), from Hatiya Island in the Meghna River estuary. Specimens were caught with fixed purse nets of two mesh sizes (0.2 to 0.5 inch and 2.0 to 2.5 inch) from January to March 2020. The total body length of *A. longispinnis* ranged between 5.8 and 9.3 cm throughout the sampling period. The length-weight relationships for *A. longispinnis* was highly significant ($p < .001$), and the adjusted r^2 value was 0.921. The calculated growth coefficient (b) for *A. longispinnis* was 3.163, which indicated a hyperallometric growth pattern. The length-length equation TL = 1.1384 SL + 0.4899 for unsexed *A. longispinnis* was highly significant ($p = 0.001$, $r^2 = 0.951$). There were no significant variations in relative condition factors among the specimens of different length classes (5.5-9.5 cm). No information regarding length-weight or length-length relationships for *A. longispinnis* was previously reported in FishBase. Our estimated LWR and LLR parameters for *A. longispinnis* can be useful for management and conservation purposes of this estuarine species.

Keyword: LWR, LLR, Bengal yellowfin seabream, Hatiya Island

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Introduction

The Hatiya Islands are situated in the Meghna River estuary that meets the Indian Ocean in the northern Bay of Bengal (southeastern Bangladesh). The Meghna estuary is an extensive aquatic ecosystem that supports multitudes of fishes and other organisms. The fishery resources of this estuary are greatly diversified because of the influence of the maritime climate, and they support a variety of commercially important fishes (Siddique et al. 2012). Bengal yellowfin seabream, *Acanthopagrus longispinnis* (Val.), is a small fish species of lower economic value. Despite their ecological importance, population parameters for many estuarine fishes have not been studied because of their low economic value (Abu Hena et al. 2017). Although *A. longispinnis* is considered to be a bycatch species, it is available at local fish markets at a low price (100 to 120 BDT per Kg).

A. longispinnis is mainly distributed in two locations in the Bay of Bengal – the lower basins of the Ganges River and the shallow coastal area of Chennai. It is likely to be more widely distributed in the northwestern Bay of Bengal (Iwatsuki 2013). *A. longispinnis* is regarded as a junior synonym of *Acanthopagrus datnia* (Hamilton). *A. longispinnis* is characterized by a relatively slender-shaped body; slightly ctenoid scales the anterior part of which are similar to cycloid scales; a nearly horizontal mouth; thick lips; a firmly pointed snout with two nostrils just in front of the eyes; the anterior nostril is rounded and the posterior one is like a slit; the maxilla extends to below the posterior margin of the pupil; teeth are present in both jaws in three to five rows; six canine teeth are at front of both jaws; the suborbital depth is subequal to the orbit; six (five or six) transverse rows of scales are on the cheeks; the anterodorsal profile ascends gently from just above the eye and is curved; a low scaly sheath on the soft dorsal and anal-fin ray bases; dorsal-fin spines are strong and the fourth longest; the first anal-fin spine is clearly shorter than the orbit diameter; the second anal-fin spine is clearly longer than the longest (fourth) dorsal-fin spine; the third anal-fin spine is shorter than the second anal-fin spine and more prolonged than the snout length; the pectoral-fin is divided into the lectotype and paralectotype; the first pelvic-fin ray is divided in to the lectotype and paralectotype; the pelvic-fin spine is longer than the snout length; three supraneural bones (0/0+0/2); vertebrae 10+14 (Iwatsuki 2013). The head and body are a silvery pale grey with a somewhat greenish reflected hue. The belly is whitish silver with very weak streaks along the longitudinal scale rows, and the dorsal fin color ranges from a translucent greyish to a blackish-grey; the pelvic and anal fins and lower caudal-fin lobe are pale yellow or yellow tinged; the pectoral fins are a translucent yellow without blotches at the origin, or axil, of the pectoral fin (Iwatsuki 2013).

In fisheries science, length-weight relationships (LWR) provide valuable information for calculating the total weight of a fish, based on length observations (Froese 2006, Siddique et al. 2014, 2015). Length-weight data are also used as input parameters when estimating the total biomass of aquatic ecosystems (Froese 1998, Moutopoulos and Stergiou 2002). This parameter is one of the main tools used in assessing and planning the sustainable exploitation and management of a vast spectrum of fish populations as well as for modeling marine ecosystems throughout the world (Anene 2005). Length-weight (LWR) and length-length relationships (LLR) have yet to be recorded for many estuarine fishes. Therefore, this study was conducted to estimate the size-frequency, the LWR, the LLR, and the relative condition factor (K_n) for the estuarine fish species *A. longispinnis* from the Meghna River estuary, Noakhali coast, Bay of Bengal.

Materials and Methods

Study area and sampling

Samples were collected from Hatiya Island, Meghna River estuary, Bay of Bengal. Sampling was conducted from January to March 2020, at three sampling sites where the availability of this species was the highest (Fig. 1). A fixed purse net of two mesh sizes (0.2 to 0.5 inch and 2.0 to 2.5 inch) was operated by a small wooden boat during the day. The fish specimens collected were immediately washed with freshwater, and total body length, standard length, and total body weight were measured in the field. Species identification was made following Froese and Pauly (2020) and Hasan et al. (2020). Total length (TL) was measured to the nearest 0.1 cm using a Vernier caliper, and total wet body weight (W) was determined with a portable electronic balance to the nearest 0.01 g (Siddique et al. 2016).

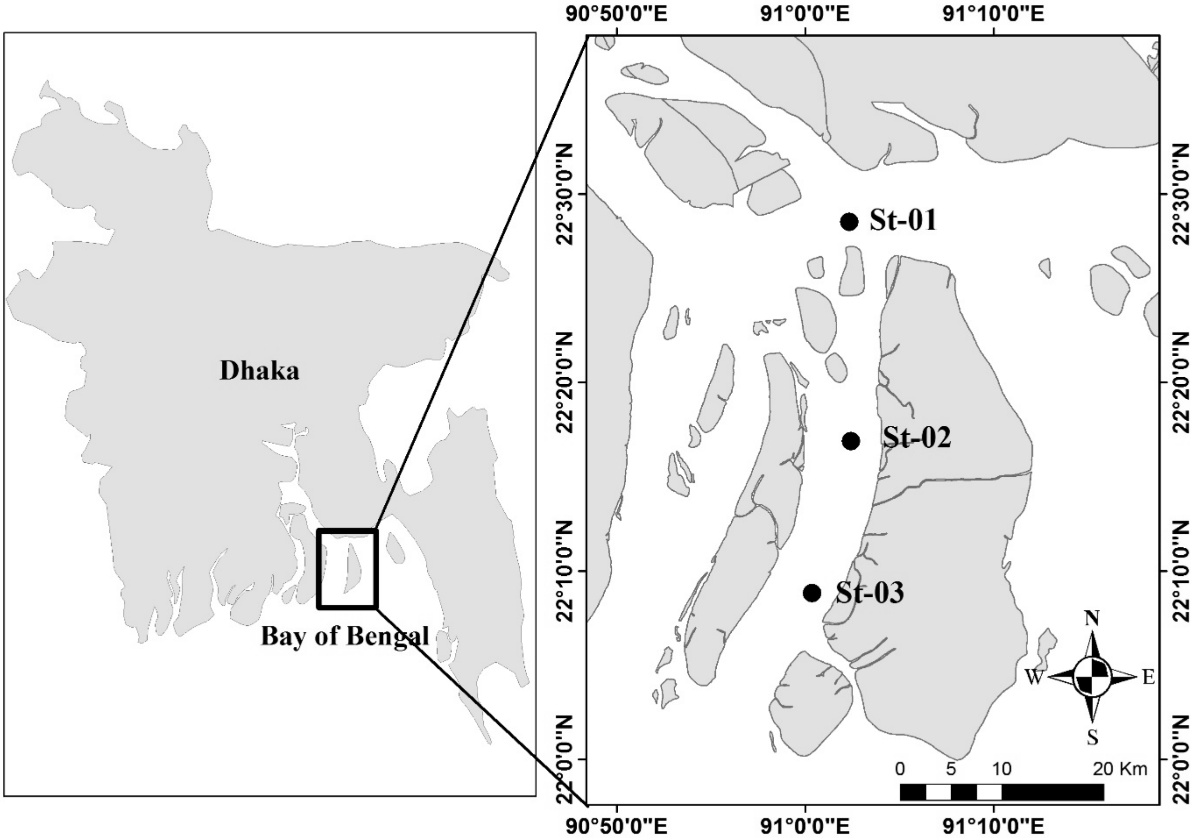

Figure 1. Sampling sites of *A. longispinnis* on the coast of Hatiya Island, Meghna River estuary.

Data analysis

For the LWR and LLR, juveniles were excluded from the study. The LWR of *A. longispinnis* was established using linear regression analysis (least-squares method). The parameters of the LWR were estimated with the equation proposed by Le Cren (1951):

$$W = a \times TL^b$$

After the logarithmic transformation of the length-weight data, this equation was expressed as log W = log a + *b* log TL

Where, W is the weight of the fish in grams, and TL is the total length of the fish in cm, where a is the intercept of the regression curve (coefficient related to body form), and *b* is the regression coefficient (exponent indicating isometric growth). Visual inspection of outliers for logarithmic values of total body length and total wet body weight were performed before the regression analysis to exclude extreme values (Froese 2006).

Total length (TL) and standard length (SL) relationships were established using linear regression analysis of TL = a + *b* SL. The relative condition factor (Kn) was calculated from Le Cren's (1951) equation, Kn =BW/BW', where BW = observed total body weight (g) and BW' = calculated total weight of *A. longispinnis* ($a \times L^b$). All the analyses were performed with the statistical software PAST Version 4.01 (Hammer et al. 2001).

Results

A total of 512 specimens were collected for this study. After excluding juveniles, 334 specimens of *A. longispinnis* were used to estimate the size and weight frequency, LWR, LLR, and relative condition

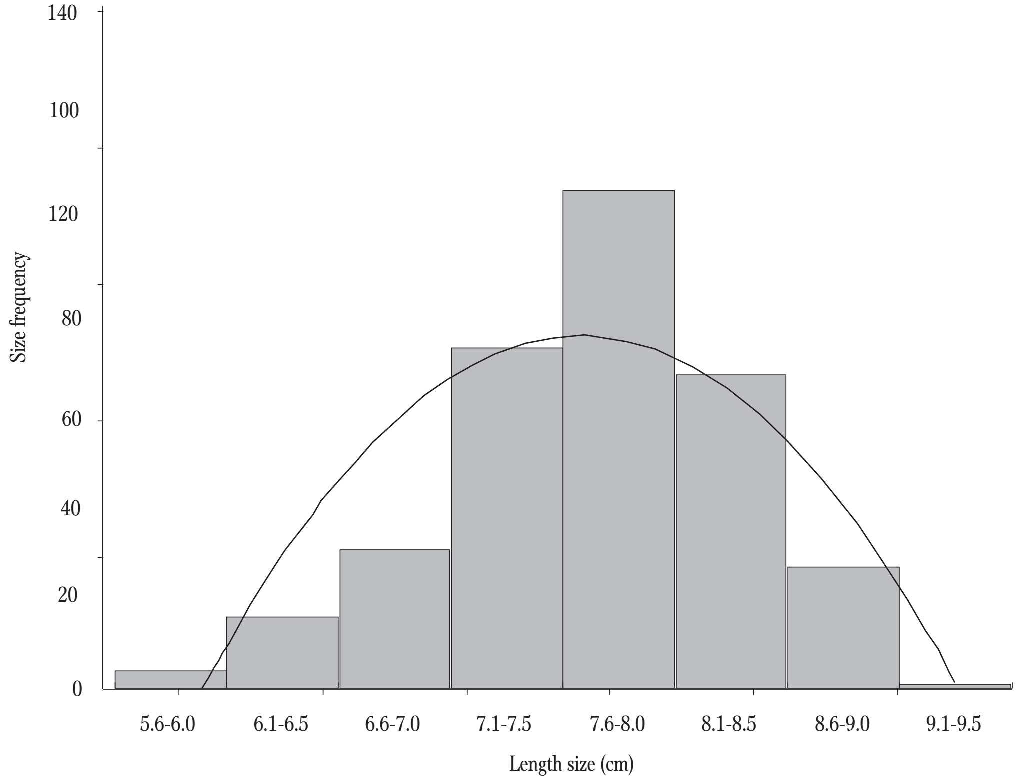

Figure 2. Size frequency of *A. longispinnis* collected from the coastal waters of Hatiya Island, Meghna River estuary.

Table 1

Descriptive statistics and length-weight relationships for *A. longispinnis* from Hatiya Island, Meghna River estuary

		Total body length (cm)		Total body weight (g)		Regression parameters					
Species	N	Min	Max	Min	Max	*a*	95% CL of *a*	*b*	95% CL of ^{b}	SE (b)	r^2
A. longispinnis	334	5.8	9.3	3	13	0.0120	0.0095-0.0150	3.163	3.053-3.275	0.0509	0.921

Note: N – sample size; Min – minimum; Max – maximum; *a* and *b* – parameters of length-weight relationship; CL – confidence limits, SE (*b*) – standard error of slope *b*; r^2 – coefficient of determination

factor (K_n). The mean (±SD) total body length and body weight were 7.70 ± 0.63 cm and 7.81 ± 2.02 g for *A. longispinnis*. The total body lengths of 76.94% of the specimens examined were in the range of 7.1–8.5 cm. The size-frequency distribution is presented in Fig. 2, which shows that the 7.1–8.5 cm length class was numerically dominant.

The descriptive statistics and estimated parameters of LWR for *A. longispinnis* are given in Table 1. The LWR for *A. longispinnis* was highly significant (P < .001), and the adjusted r^2 value was 0.921 (Fig. 3). The calculated growth coefficient (*b*) was 3.163, which shows positive allometric growth. The total length (TL) vs. standard length (SL) relationship for *A. longispinnis* was TL = 1.1384 SL + 0.4899 (N = 316; r^2 = 0.953) (Fig. 4). The relative condition factor (K_n) values were calculated for *A. longispinnis* from the studied area. The mean value of K_n of *A. longispinnis* was recorded as 0.987 ± 0.068. The maximum level of K_n of *A. longispinnis* was observed in the 6.1–6.5 cm size class, and there were no significant variations in relative condition factors among specimens from different length classes (5.5–9.5 cm) (Fig. 5).

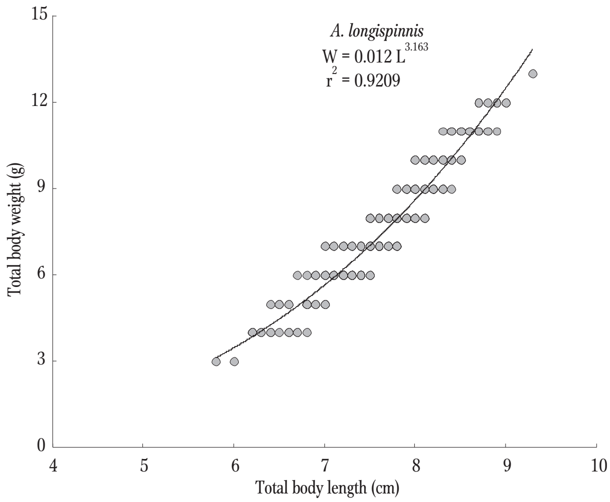

Figure 3. Length–weight relationships of *A. longispinnis* collected from the coastal waters of Hatiya Island, Meghna River estuary on an arithmetic scale.

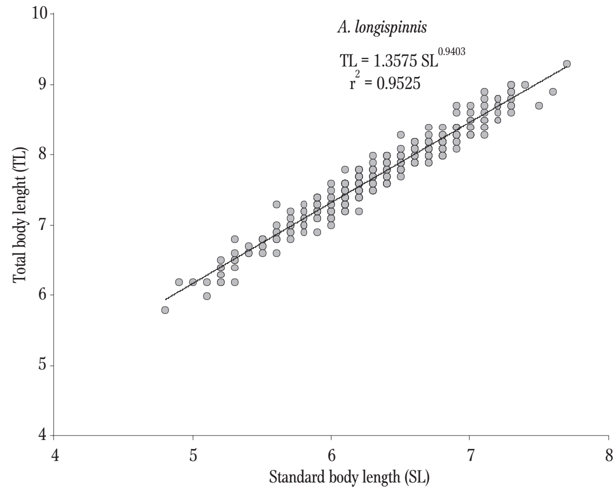

Figure 4. Length–length relationships of *A. longispinnis* collected from the coastal waters of Hatiya Island, Meghna River estuary on an arithmetic scale.

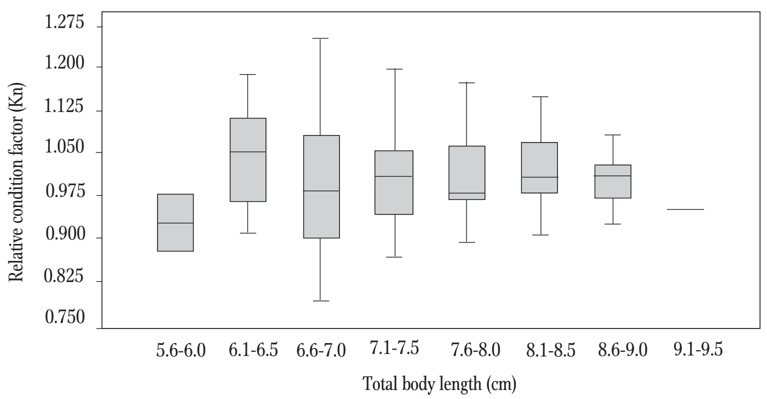

Figure 5. Variation of relative condition factor (Kn) in different size classes of *A. longispinnis* collected from the coastal waters of Hatiya Island, Meghna River estuary.

Discussion

The maximum length and weight of *A. longispinnis* has been reported as 21.3 cm and 313 g, respectively, from the southwestern part of Bangladesh (Chaklader et al. 2018). In the present study, the maximum specimens were within the range of 7.1–8.5 cm length due to our short sampling period. In the present study, the estimated exponent b = 3.163 was higher than the isometric value (b = 3). It was very close to the Bayesian LWR predictions (b = 2.76 – 3.12) for this species with this body shape in FishBase (Froese et al. 2014, Froese and Pauly 2020). Regression parameter b for *A. longispinnis* also fell within the expected range of $2.5 < b < 3.5$ (Froese 2006). The estimated intercept, a = 0.0120 obtained from this study, was also very close to the Bayesian LWR predictions (a = 0.01073 – 0.04890) based on LWR estimates for this (sub)family-body shape.

The condition factor of any fish species reflects interactions between the abiotic and biotic factors of aquatic ecosystems (Liao et al. 1995). Moreover, the condition factor indicates the well-being of any fish population in various stages of their life cycles. The condition factor of a species is not only assumed to reflect biological characteristics such as health, well-being, reproductive state, and growth, but also environmental conditions such as habitat quality, water quality, and food availability (Anderson and Gutreuter 1983, Ney 1993). Heincke (1908) stated that the better the condition of the fish, the higher the value of *K*. Several studies showed that sudden fluctuations in condition indices could be associated with the attainment of sexual maturity (Amin 2001). In general, after the spawning season, the condition factor of all fishes decreases. In the present study, there were no variations of relative condition factors among the different length classes.

We also did not observe any gonads in the specimens in the 8.0–9.5 cm length classes. The results of our study indicated that this species did not attain sexual maturity within the size range of 5.5–9.5 cm. However, further studies are needed to understand the reproductive biology as well as the size and age of these species at first maturity and in the gonad development stages.

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Author contributions. M.A.M.S. and M.G.M. designed the study; M.S.H., M.S.H., and Z.H. performed field sampling; M.A.M.S and J.D. analyzed the data; M.A.M.S., JD., and M.G.M. prepared and reviewed the manuscript.

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