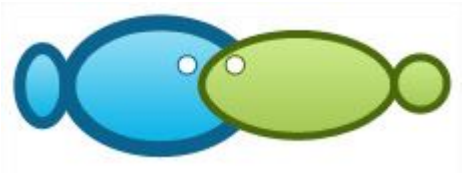

Length-weight, length-length, and condition factors of critically endangered riverine catfish *Rita rita* (Hamilton, 1822) from Surma River, Bangladesh

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Abstract. The study was conducted to investigate the length-weight, length-length, Fulton and relative condition of critically endangered riverine catfish *Rita rita*. A total of 151 specimens of both sexes were collected during July 2018 to June 2019 from Surma River, Bangladesh. Each specimen was weighted (g) and measured (cm) and length-weight relationship (LWRs), length-length relationship (LLRs) and condition factors were analyzed. The mean total length, fork length, standard length, and body weight were 15.74±3.40, 14.04±2.95, 12.82±2.72 cm and 56.22±37.70 g respectively. Overall, the allometric coefficient *b* of the LWRs suggested negative allometric growth for male (*b* = 2.804), female (*b* = 2.734) and also for combined sexes (*b* = 2.761). The results further indicated that the LLRs were highly correlated ($r^2 > 0.929$, $p < 0.001$). The mean Fulton condition factor (*K*) for male, female and combined sexes were 1.34±0.15, 1.23±0.28, and 1.34±0.74 respectively while the relative condition factor (K_n) values were 1.06±0.82, 1.01±0.21, and 1.02±0.52 for male, female and combined sexes respectively. This study presents for the first time results on the length-weight, length-length relationships and condition factors of this critically endangered catfish from the Surma River and indicates the good environment for growth, survival, and reproduction. Results of the study could be useful to help in conservation and sustainable fisheries management of this critically endangered species.
Key Words: *Rita rita*, Surma River, Fulton condition factor, relative condition factor, catfish.

Introduction. *Rita rita* (Hamilton, 1822), an indigenous catfish of Bangladesh, Afganistan, India, Pakistan, Nepal and Myanmar belongs to the family Bagridae of the order Siluriformes (Amin et al 2014). This species is listed as critically endangered fish species (IUCN 2014). Despite its greater economic value this species did not receive sufficient attention in aquaculture. Meager occurrence of live samples in nature, lack of awareness, loss of habitat and poor survival of the larvae are major constrains of the observations (Banik & Malla 2011). Due to rich lipoprotein content and soft bony structure this fish species is considered delicious and nutritious to the people of Bangladesh, Afghanistan, Pakistan, India, Nepal, and Myanmar (Pillay 2000). But over the last few decades its wild population is declining rapidly (> 50%) (Amin et al 2014). Lack of definite information on the biological aspects of the endangered and critically endangered fish species has hampered the species-specific conservation and management strategies implementation.

Fisheries management and research often require the use of biometric relationships in order to transform data collected in the field into appropriate indices. Quantitative aspects of fish such as length-weight relationship (LWRs), length-length relationships (LLRs), condition factors, sex ratio, growth, recruitment, and mortality are important tools for studying fish biology (Simon et al 2013; Gogoi & Goswami 2014).

Length and weight measurements can give information on the stock composition, life span, mortality, growth and production (Kumar et al 2014; Mazumder et al 2016a).

The LWRs and LLRs of fishes are important for fisheries biology and fish stock assessments in all water bodies (Ayoade & Ikulala 2007; Alam et al 2018). Based on the LWRs and LLRs, the average weight of the fish of a given length group can be easily estimated by establishing a mathematical relation between the two (Beyer 1987). The LWRs and LLRs applications are significant when estimating the standing stock biomass and comparing the ontogeny of fish population from different regions (Anderson & Gutreuter 1983). Data obtained from morphometric relationships often shows indication of gonad development of fish and are useful for regional comparisons and histories of specific species (Sarkar et al 2013) and can also provide important clues on climate and environmental changes and change in human subsistence (Bolarinwa & Popoola 2013; Sarkar et al 2013; Alam et al 2015, 2016).

Fulton's and relative condition factor (*K* & *K*n) are common factors for indication of the condition of fish (Daliri et al 2012; De et al 2016). It reflects information on the physiological state of the fish in relation to its welfare (Ighwela et al 2011). Condition factors also give information when comparing two populations living in different feeding, density, climate, and other conditions; when determining the period of gonadal maturation; and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source (Bhattacharya & Banik 2012). The study of the condition factor is thus important for understanding the life cycle of fish and contributes to adequate management of the fish and, therefore, to the maintenance of equilibrium in the ecosystem (Ayoade & Ikulala 2007). Relative fish condition compares the wellbeing of a fish and assumes that heavier fish of a given length are in better condition. The condition of a fish population is affected by interactions among food availability, physical factors, parasitic infections, and the physiology of the fish (Abowei 2010). A fish that is heavier for a given length (higher condition index) is generally considered to be healthier because extra weight means extra energy reserves. Lighter fish lack energy reserves and tend to be more susceptible to environmental stressors. A low body condition may also suggest muscle wasting (proteolysis) indicating a starvation response (Bortone 2003). Because of differences in environmental conditions, between systems, different fish populations display different levels of condition according to exploitation pressure such as quality and type of fishing gears, level of fishing efforts, food availability or catchment characteristics (Boys et al 2012; Sayeed et al 2015a). Detailed studies on the LWRs, LLRs and condition factors of this species are evidently lacking in Bangladesh. Taking all these issues in consideration the study was conducted. Thus, the aims of this study were to describe the LWRs, LLRs, Fulton's and relative condition factor of *R. rita* wild populations from different geographical regions of Surma River, Bangladesh over a one-year study period. This information will enhance management, conservation and culture of this species. It will also allow for future comparisons between populations of the same species.

Material and Method

Sample collection. Specimens of *R. rita* were collected monthly from July 2018 to June 2019 from three different geographical locations as Tuker Bazar, Kanishail Ghat and Kushi Ghat of Surma River, Bangladesh (Figure 1). These three sites were selected because these places are three major fish landing sites of Surma River in Sylhet. A total of 175 fish samples were collected on board of a local fishing vessel using traditional fishing gears like three-layered trammel net, cast net, scoop net, and trap. The mesh sizes (stretched length) of the trammel nets (three layered) were 4.2 cm, 6.5 cm and 7.5 cm and of casts nets were 2 cm. Mesh size of the scoop net was 1.5 cm. The length of the nets were 20 m for trammel nets, 250 cm for the cast nets, while the scoop net diameter was 40 cm. Samples were collected at various locations throughout the study areas. Specimens were preserved in 10% buffered formalin, packed in wooden boxes and transported to the laboratory. After hauling, the catch was removed, washed well, and confirmed to the species level and then tagged (Mazumder et al 2015).

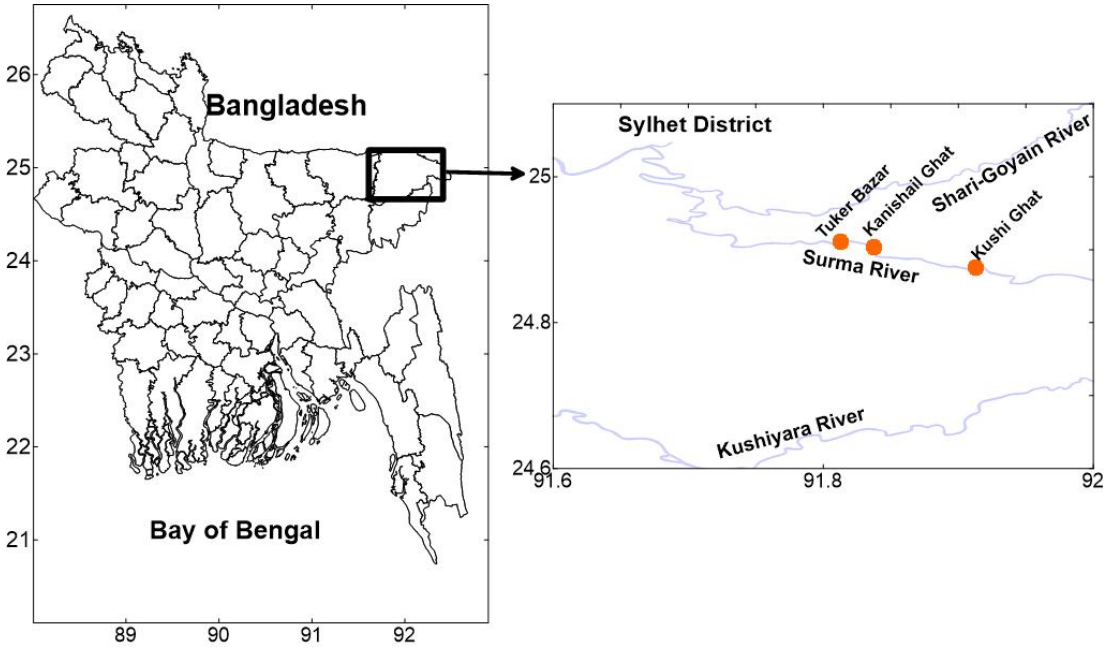

Figure 1. Map depicting the study area.

Morphometrics. All specimens were sexed by gonad observation under a binocular microscope. Total length (TL) was measured from the tip of the snout (mouth closed) to the extended tip of the caudal fin. Standard length (SL) was measured from the tip of the snout to the caudal peduncle. Fork length (FL) was measured from the tip of the snout to the end of the middle caudal fin rays. The lengths were taken with measuring board (BIOTECH fish scale reader) to the nearest 0.1 cm. Body weight (BW) of individual fish was measured to the nearest 0.1 g with an electric balance (Docbel BRAUN) after removing the adhered water and other particles from the surface of body (Mazumder et al 2016b).

Relationship between W and L was described with the nonlinear regression model (Pauly 1983):

$$BW = aTL^b$$

Where, *W* is the body weight in g, and *TL* is the total length in cm. The coefficient *a* is the intercept in the y-axis, and the allometric or regression coefficient *b* is an exponent indicating isometric growth when equal to 3. The measurement of model fit (goodness of fit of calculated *L* and *W*) was evaluated by the coefficient of determination (r^2).

Length-length relationships were estimated by the equation TL = a + b*SL*, TL = a + b*FL*, FL = a + b*SL*, by a linear regression model based on the least-square method (Zar 1996).

To compare conditions of populations among water systems and for the generation of predictive models of fish condition, Fulton's (*K*) and relative condition factors (*K*n) of *R. rita*, were calculated. The Fulton's condition factor *K* was calculated for each individual fish according to Fulton (1904):

$$K = 100\ W/L^3$$

While relative condition factor *K*n was calculated according to Le Cren (1951):

$$Kn = W\ (aLb)^{-1}$$

Where, *W* is the observed individual fish weight (BW), *L* is the observed individual fish total length (TL), *a* is the intercept, *b* is the slope, and 100 is a factor to bring the value of *K* near unity. The value of *a* and *b* from the length-weight relationship (Mazumder et al 2016b), were employed in calculating the relative condition factor (*K*n).

Statistical analysis. Student's t-tests (Zar 1996) were performed to test whether the computed value of *b* was significantly different from three, indicating the type of growth (Spiegel 1991; Das et al 2014): when *b* is equal to three (3), isometric pattern of growth occurs but when *b* is not equal to 3, allometric pattern of growth occurs, which may be

positive if > 3 or negative if < 3, and to compare the regression coefficients *b* for possible significant differences among the months (Seiyaboh et al 2016). Analysis of variance was carried out to test the effect of monthly variation of condition factors (*K*, *K*n). Tukey's *post hoc* tests were used to compare the significant differences ($p < 0.05$) in mean monthly condition factors of *R. rita*. All statistical analyses were performed using MINITAB (version 14), and Microcal Origin TM (version 8) software.

Results and Discussion

Length-weight and length-length relationships. Length-weight relationship was derived from 57 male and 94 female *R. rita* samples. The *R. rita* samples ranged from 9.1 to 26.5 cm in total length and 9.59 to 265.89 g in total body weight for combined sexes whereas, male *R. rita* samples ranged from 9.1 to 23.90 cm in total length and 9.59 to 165.38 g in body weight, and for females ranged from 10.2-26.5 cm in total length and 13.15 to 265.89 g in body weight (Table 1). The intercept *a* for male *R. rita* was 0.022±0.013 and for female was 0.027±0.008 and correlation coefficient r^2 for male was 0.759 and for female was 0.886 (Figures 2a-2b, Table 1). Intercept *a* for combined sexes of *R. rita* was 0.025±0.006, and correlation coefficient r^2 was 0.855 (Figure 2c, Table 1). The values of the slope or exponent *b* for males (2.804±0.202), females (2.734±0.093), and combined sexes (2.761±0.086) were within the expected ranges ($2.0 < b < 4.0$) (Bagenal & Tesch 1978).

However, the b values for male, female and combined sexes were significantly ($p < 0.05$) lower than 3, exhibiting a negative allometric growth ($b < 3$) for *R. rita* indicating that the fish became lighter with increasing size. Nevertheless, the regression models fitting in different months of *R. rita* were highly correlated ($r^2 = 0.759$-0.886).

The relationships between TL, SL and FL of *R. rita* fish in all sexes including 151 specimens along with the estimated parameters of the length-length relationship and the coefficient of determination r^2 are presented in Figure 3 to Figure 5 and Table 2. All LLRs were highly significant ($p < 0.01$), with most of the coefficient of determination values being > 0.928.

The morphometric relationship between length and weight of fishes is a suitable index to enable a conversion of one variable to the other, which is of vital importance in fisheries management (Xie 2015). The parameter b in the LWR was expected to be in the range of 2.0-4.0 (Froese 2006; Simon et al 2009). In the present study, the b-values of species did fall within this range. The b value of *R. rita* is somewhat higher than for other catfishes (Qi et al 2008; Zhang et al 2010; Sayeed et al 2015b). Many factors such as gonad maturity, stomach fullness, and local nutrition conditions, can contribute to these differences (Froese 2006). Abundant food conditions in the reservoir and the reproductive season may play important roles in the higher b value of *R. rita* from Surma River. There is no LWRs and LLRs data available in FishBase (Froese & Pauly 2013). The basic information will be helpful in understanding the population dynamics for fisheries management in the Surma River.

Table 1

Descriptive statistics and estimated parameters of length-weight relationships of *Rita rita*, Surma River, Bangladesh

Sex	n	Total length (cm)			Body weight (g)			Regression parameters			
		min	max	mean±SD	min	max	mean±SD	a	b	95% CL of b	r^2
Male	57	9.1	23.9	14.69±3.35	9.59	165.38	46.28±32.68	0.022	2.804	6.443-9.483	0.759
Female	94	10.2	26.5	16.38±3.27	13.15	265.89	62.26±39.24	0.027	2.734	9.905-11.95	0.886
Combined	151	9.1	26.5	15.74±3.40	9.59	265.89	56.22±37.70	0.025	2.761	8.905-10.61	0.855

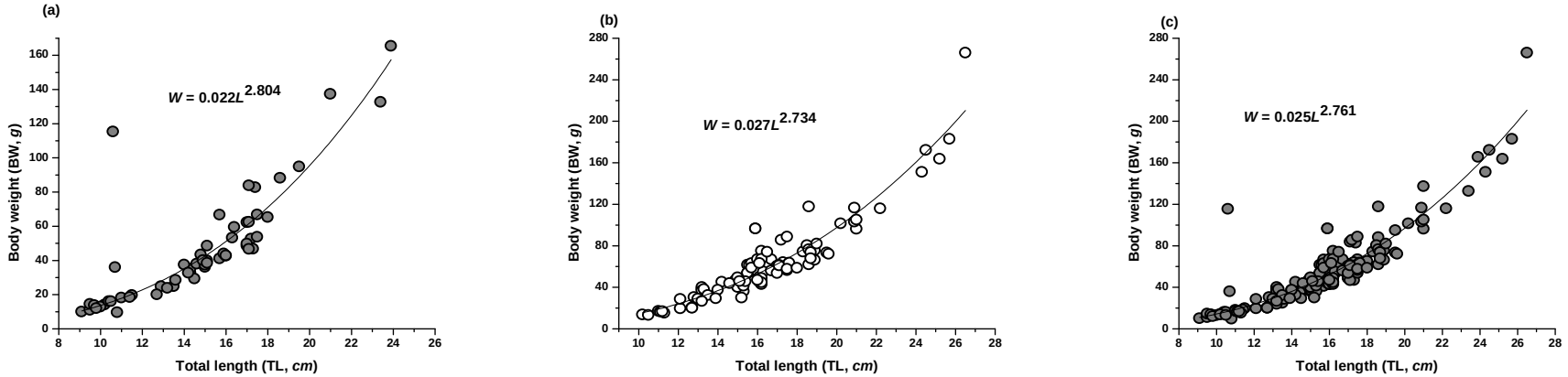

Figure 2. Length-weight relationship of *R. rita* (a) male (b) female (c) combined. Line represents nonlinear fit whereas circles represent individual fish samples.

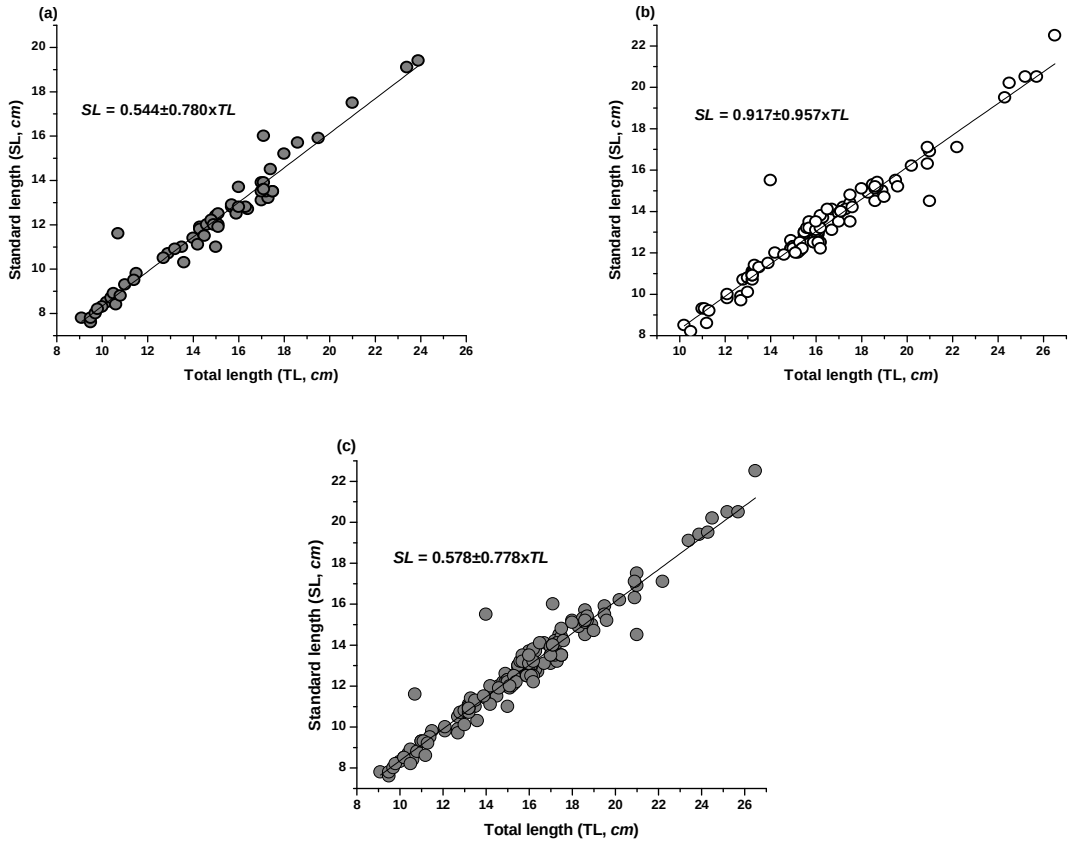

Figure 3. Total length-standard length relationship of *R. rita* (a) male (b) female (c) combined. Line represents linear fit whereas circles represent individual fish samples.

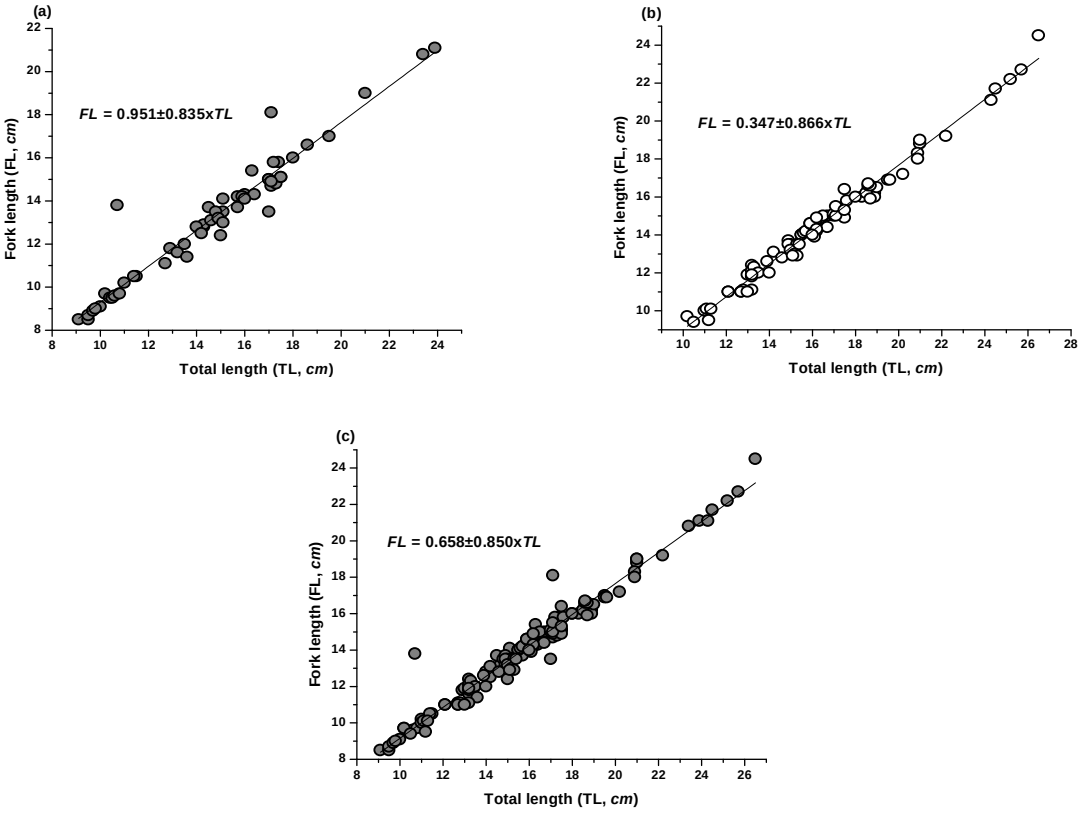

Figure 4. Total length-fork length relationship of *R. rita* (a) male (b) female (c) combined. Line represents linear fit whereas circles represent individual fish samples.

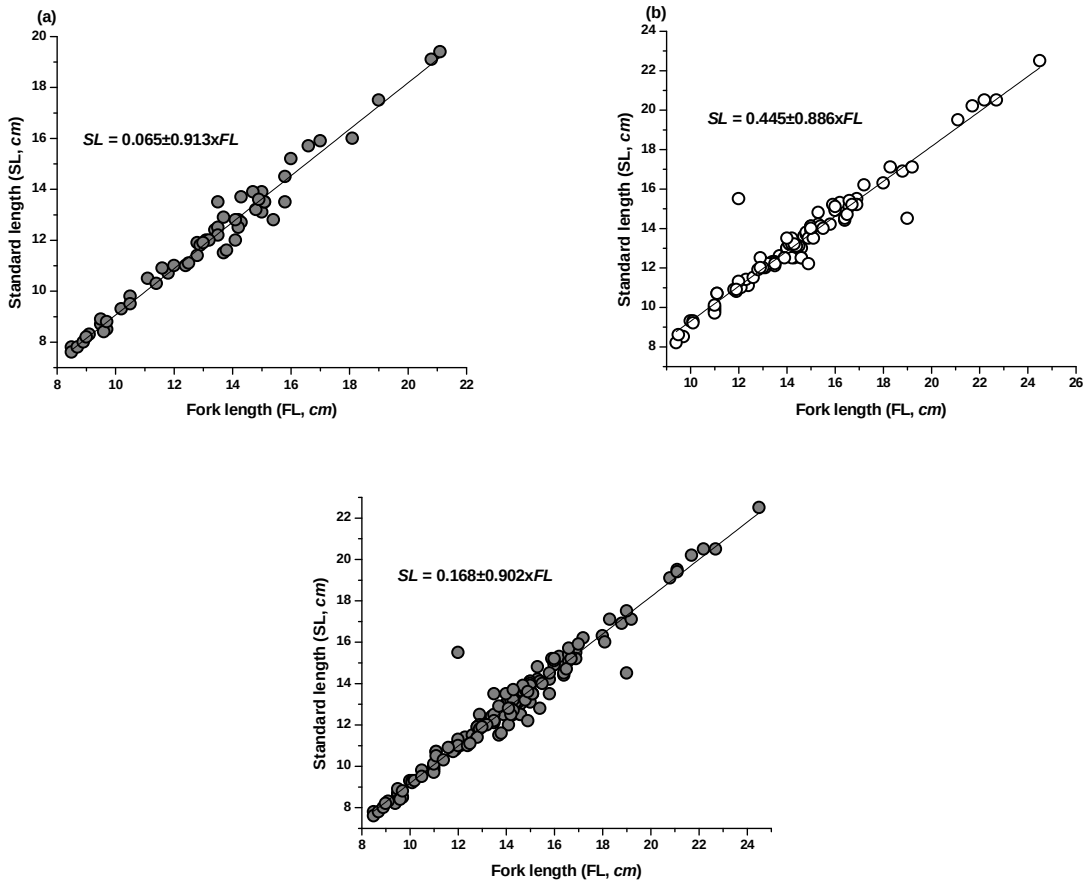

Figure 5. Fork length-standard length relationship of *R. rita* (a) male (b) female (c) combined. Line represents linear fit whereas circles represent individual fish samples.

Table 2

Descriptive statistics and estimated parameters of length-length relationships of *Rita rita*, Surma River, Bangladesh

Sex	*Equation*	*n*	*Mean length (cm)*		*a*	*b*	*95% CL of b*	r^2
			SL	*FL*				
Male	TL=a+b*SL*	57	1199 ±2.68	13.21 ±2.90	0.544±0.366	0.780±0.024	0.730-0.828	0.948
	TL=a+b*FL*				0.951±0.464	0.835±0.031	0.773-0.897	0.929
	FL=a+b*SL*				0.065±0.027	0.913±0.020	0.873-0.952	0.974
Female	TL=a+b*SL*	94	13.33 ±3.02	14.54 ±2.91	0.917±0.63	0.957±0.024	0.736-0.816	0.941
	TL=a+b*FL*				0.347±0.196	0.866±0.012	0.843-0.890	0.983
	FL=a+b*SL*				0.445±0.353	0.886±0.024	0.839-0.933	0.937
Combined	TL=a+b*SL*	151	12.82 ±2.72	14.04 ±2.95	0.578±0.241	0.957±0.024	0.748-0.808	0.948
	TL=a+b*FL*				0.658±0.217	0.850±0.014	0.823-0.877	0.964
	FL=a+b*SL*				0.168±0.023	0.902±0.016	0.867-0.934	0.954

Condition factors. The mean condition factors (*K* and *K*n) for the twelve months of *R. rita* are presented in Figure 6.

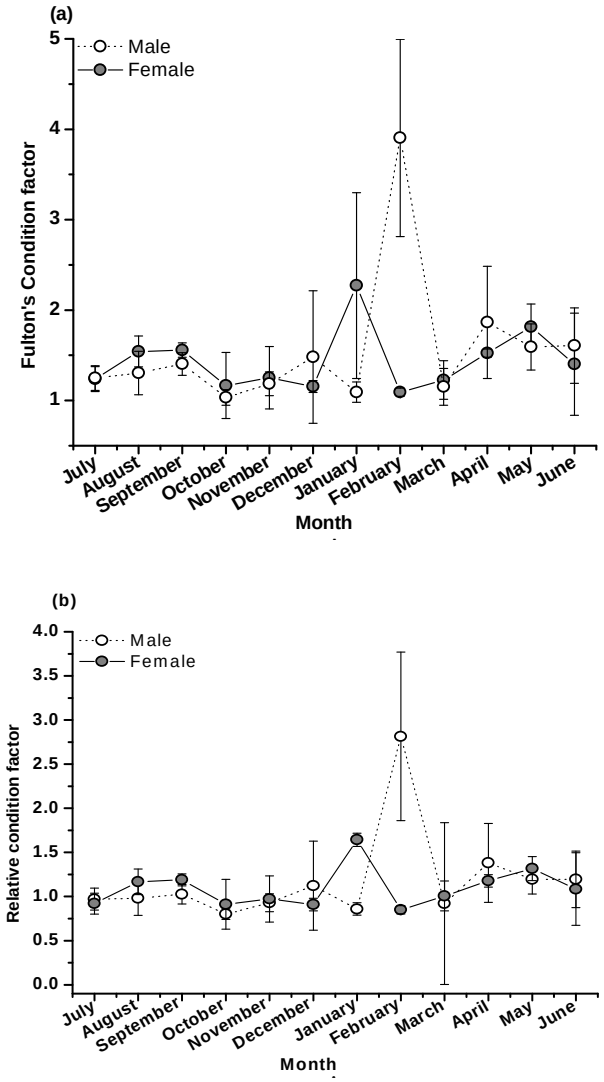

Figure 6. Monthly changes in the mean value (circle) and range (vertical bars) of (a) Fulton's condition factor (*K*) and (b) relative condition factor (*K*n) for both sexes of *R. rita*.

The Fulton's condition factor (*K*) ranged from 0.761 to 2.400 in males (n = 72) and from 0.756 to 2.939 in females (n = 110). There was no significant difference in *K* between months ($p > 0.05$) except in February for male and January for female ($p < 0.05$). Nevertheless, there was no significant difference observed in average *K* in males (1.405±1.044) and females (1.385±0.849) ($p > 0.05$). In males, the lowest mean *K* was found in February (1.091±0.046) and the highest in January (2.271±1.027) while, in females, the lowest mean *K* was found in October (1.034±0.086) and was highest in February (3.904±0.047) (Figure 6a). On the other hand, the relative condition factor (*K*n) ranged from 0.552 to 1.856 in males and from 0.531 to 2.126 in females. Similar to *K*, there was no significant difference in *K*n between months ($p > 0.05$) except in February for male and January for female ($p < 0.05$). However, there was no significant difference observed in average *K*n in males (1.067±0.747) and females (1.063±0.586) ($p > 0.05$). In males, the lowest and highest mean *K*n were found in October (0.800±0.060) and in February (2.815±0.955) respectively while, in females, the lowest and highest mean *K*n were observed in February (0.850±0.047) and in January (1.643±0.076) (Figure 6b). The values were comparable with those documented by Xie (2015) and Amin et al (2014), This suggested that the condition of the Surma River, Bangladesh in comparison with other freshwater bodies might be favorable for species *R. rita*.

Conclusions. Despite the association with wetland ecosystems since the Devonian period, biology and ecology of *R. rita* have not yet been studied comprehensively. The present study provides a preliminary report on the length-weight, length-length relationships and condition factors of *R. rita* from wetland ecosystems in Surma River, Bangladesh and results varied according to season; that is, they are influenced by environmental conditions. The *R. rita* (male, female, and combined sexes) exhibited negative allometric growth pattern (species become slenderer as their length increases) by the exponent *b* values derived from the allometric length-weight relationship. Seasonal variation did not influence the Fulton's condition factor and relative condition factor of the fish (except in February and January respectively) of all the fishes in Surma River. Further studies are needed to obtain more information about the reproductive biology of this fascinating fish. Our findings will be useful for ecological modeling for a better representation of the trophic flows associated with large, medium, and small pelagic fishes in Surma River and nearby areas of Bangladesh.

Acknowledgements. Thanks to Universiti Kebangsaan Malaysia for the publication fee of this article using the grant GP-2019-K019059.

References

Abowei J. F., 2010 The condition factor, length-weight relationship and abundance of *Ilisha africana* (Block, 1795) from Nkoro River Niger Delta, Nigeria. Advance Journal of Food Science and Technology 2(1):6-11.

Alam M. T., Hussain M. A., Sultana S., Hasan M. T., Haque M. Z., Das S. K., Mazumder S. K., 2015 Water quality parameters and their correlation matrix: a case study in two important wetland beels of Bangladesh. Ciência e Técnica Vitivinícol 30(3):463-489.

Alam M. T., Hussain M. A., Sultana S., Hasan M. T., Das S. K., Ghaffar M. A., Mazumder S. K., 2016 Impact of agrochemicals on fish production in two important beels of Bangladesh. AACL Bioflux 9(4):877-888.

Alam M. T., Hussain M. A., Sultana S., Hasan M. T., Mazlan A. G., Simon K., Mazumder S. K., 2018 Population growth and reproductive potential of five important fishes from the freshwater bodies of Bangladesh. Iranian Journal of Fisheries Sciences 17(4):657-674.

Amin M. R., Mollah M. F., Taslima K., Muhammadullah, 2014 Morphological observation and length-weight relationship of critically endangered riverine catfish *Rita rita* (Hamilton). Pakistan Journal of Biological Sciences 17(2):234-240.

Anderson R. O., Gutreuter S. S., 1983 Length, weight and associated structural indices. In: Fisheries techniques. Nielsen I., Johnson D. (eds), American Fisheries Society, Bethesda, pp. 283-300.

Ayoade A. A., Ikulala A. O. O., 2007 Length weight relationship, condition factor and stomach contents of *Hemichromis bimaculatus*, *Sarotherodon melanotheron* and *Chromidotilapia guentheri* (Perciformes: Cichlidae) in Eleiyele Lake, Southwestern Nigeria. International Journal of Tropical Biology 55(3-4):969-977.

Bagenal T., Tesch F. W., 1978 Age and growth. In: Methods for assessment of fish production in fresh water. Bagenal T. (ed), IBP handbook 8;3, Blackwell Scientific, pp. 101-136.

Banik S., Malla S., 2011 Habitat mapping for *Ompok pabda* (Bloch) in Gomoti River of Tripura. The 10th Agricultural Science Congress at National Bureau of Fish Genetic Resources (ICAR), Lucknow, U.P., India 10-12 February, 2011, pp. 388.

Beyer J. E., 1987 On length-weight relationships. Part I: Computing the mean weights of the fish in a given length class. Fishbyte 5:11-13.

Bhattacharya P., Banik S., 2012 Length-weight relationship and condition factor of the pabo catfish *Ompok pabo* (Hamilton, 1822) from Tripura, India. Indian Journal of Fisheries 59(4):141-146.

Bolarinwa J. B., Popoola Q., 2013 Length-weight relationships of some economic fishes of Ibeshe Waterside, Lagos Lagoon, Nigeria. Journal of Aquaculture Research and Development 5(1):4 pp.

Bortone S. A., 2003 Spotted sea trout as a potential indicator of estuarine conditions. In: Biology of the spotted seatrout. Volume 2. Bortone S. A. (ed), CRC Press, Boca Raton, Florida, pp. 297-300.
Boys C. A., Rowland S. J., Gabor M., Gabor L., Marsh I. B., Hum S., Callinan R. B., 2012 Emergence of epizootic ulcerative syndrome in native fish of the Murray-Darling river system, Australia: hosts, distribution and possible vectors. PLoS ONE 7(4):e35568.
Daliri M., Paighambari S. Y., Shabani M. J., Pouladi M., Davoodi R., 2012 Length-weight and length-girth relationships, relative weight and relative condition factor of four commercial fish species of Northern Persian Gulf. Annual Review and Research in Biology 2(1):15-26.
Das S. K., De M., Ghaffar M. A., 2014 Length-weight relationship and trophic level of hard-tail scad *Megalaspis cordyla*. ScienceAsia 40:317-322.
De M., Ghaffar M. A., Bakar Y., Cob Z. C., Das S. K., 2016 Optimum temperature for the growth form of tiger grouper (*Epinephelus fuscoguttatus* ♀) × giant grouper (*E. lanceolatus* ♂) hybrid. Sains Malaysiana 45(4):541-549.
Froese R., 2006 Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. Journal of Applied Ichthyology 22:241-253.
Froese R., Pauly D., 2013 FishBase. World wide web electronic publication. http://www.fishbase.org, version (accessed on 10/2013).
Fulton T. W., 1904 The rate of growth of fishes. 22nd Annual Report of the Fishery Board of Scotland 3:141-241.
Gogoi R., Goswami U. C., 2014 Length-weight relationship and sex ratio of fresh water fish *Amblypharyngodon mola* (HAM-BUCH) from Assam. International Journal of Fisheries and Aquatic Studies 1(4):68-71.
Ighwela A., Ahmed B., Abol-Munafi B., 2011 Condition factor as an indicator of growth and feeding intensity of Nile Tilapia fingerlings (*Oreochromis niloticus*) fed on different levels of maltose. American-Eurasian Journal of Agriculture and Environmental Sciences 11(4):559-563.
IUCN, 2014 IUCN red list of threatened species. Version 2014.2. <www.iucnredlist.org>. Downloaded on 28 May 2014.
Kumar D. B., Singh N. R., Binku D., Devashish K., 2014 Length-weight relationship of *Labeo rohita* and *Labeo gonius* (Hamilton-Buchanan) from Sone beel, the biggest wetland of Assam, India. Journal of Environmental Research and Development 8(3A):587-593.
Le Cren E. D., 1951 The length weight relationship and seasonal cycle in gonad weight and condition in the Perch (*Perca fluviatilis*). Journal of Animal Ecology 20(2):201-219.
Mazumder S. K., De M., Ghaffar M. A., Cob Z. C., Rahim S. M., Das S. K., 2015 Impact of global climate change on fish growth, digestion and physiological status: developing a hypothesis for cause and effect relationships. Journal of Water and Climate Change 6(2):200-226.
Mazumder S. K., Das S. K., Bakar Y., Ghaffar M. A., 2016a Effects of temperature and diet on length-weight relationship and condition factor of the juvenile Malabar blood snapper (*Lutjanus malabaricus* Bloch & Schneider, 1801). Journal of Zhejiang University-SCIENCE B 17(8):580-590.
Mazumder S. K., Das S. K., Ghaffar M. A., Rahman M. H., Majumder M. K., Basak L. R., 2016b Role of co-management in wetland productivity: a case study from Hail haor in Bangladesh. AACL Bioflux 9(3):466-482.
Pauly D., 1993 Fishbyte section. Editorial. Naga, The ICLARM Quaterly 16:26-27.
Pillay N., 2000 Female mate preference and reproductive isolation in populations of the striped mouse *Rhabdomys pumilio*. Behaviour 137:1431-1441.
Qi W. H., Guo Y. S., Wang H., He M., Chen Y. L., Yu T. L., 2008 Study on biology of *Triplophysa scleroptera* in Xiaman Nature Reserve, Sichuan. Sichuan Journal of Zoology 27:1157-1162.
Sarkar U. K., Khan G. E., Dabas A., Pathak A. K., Mir J. I., Rebello S. C., Pal A., Singh S. P., 2013 Length weight relationship and condition factor of selected freshwater fish species found in river Ganga, Gomti and Rapti, India. Journal of Environmental Biology 34(5):951-956.

Sayeed M. A., Hossain M. A. R., Wahab M. A., Hasan M. T., Ghaffar M. A., Das S. K., Mazumder S. K., 2015a Chemical and pesticides uses status in the Chalan beel, Bangladesh and present status of fish biodiversity. American Journal of Experimental Agriculture 6(5):267-289.
Sayeed M. A., Hossain M. A. R., Wahab M. A., Hasan M. T., Das S. K., Mazumder S. K., 2015b Water and sediment quality parameters in the Chalan beel, the largest wetland of Bangladesh. Chinese Journal of Oceanology and Limnology 33(4):895-904.
Seiyaboh E. I., Harry G. A., Izah S. C., 2016 Length-weight relationship and condition factor of five fish species from river Brass, Niger Delta. Biotechnological Research 2(4):187-192.
Simon K. D., Bakar Y., Samat A., Zaidi C. C., Aziz A., Mazlan A. G., 2009 Population growth, trophic level and some aspects of reproductive biology of two congeneric archer fishes (*Toxotes chatareus*, Hamilton 1822 and *Toxotes jaculatrix*, 1767) inhabiting Malaysian coastal waters. Journal of Zhejiang University Science B 10(12):902-911.
Simon K. D., Mazlan A. G., Cob Z. C., 2013 Condition factors of two archer fish species collected from Johor coastal waters, Malaysia. Sains Malaysiana 42(8):1115-1119.
Spiegel M. R., 1991 Theorie et applications de la statistique. McGraw-Hill, Paris, 358 pp. [in French]
Xie J. Y., 2015 Length-weight and length-length relationships of four endemic fish species from the upper Yellow River in the Tibetan Plateau, China. Journal of Applied Ichthyology 31(5):958-960.
Zar J. H., 1996 Biostatistical analysis. 3rd edition, Prentice Hall, 662 pp.
Zhang X. F., He C. L., Song Z. B., 2010 Age and growth of *Triplophysa markehenensis* from the Markehe River in upper reaches of the Dadu River. Chinese Journal of Zoology 45:11-20.

Received: 31 December 2019. Accepted: 28 February 2020. Published online: 24 April 2020.
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How to cite this article:
Mazumder S. K., Kubra J., Das S. K., Nishad N., Sultana T., Kunda M., 2020 Length-weight, length-length, and condition factors of critically endangered riverine catfish *Rita rita* (Hamilton, 1822) from Surma River, Bangladesh. AACL Bioflux 13(2):963-973.