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Seasonal variation of length-weight relationship and condition factor of *Amblypharyngodon mola* in Dekar *Haor* under Sunamganj of Bangladesh

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Abstract
The present study investigated the length-weight relationship and condition factor of 2000 *Amblypharyngodon mola* from Dekar *haor*, Sunamganj during January to October 2017 except March and June on seasonal basis. The range of regression coefficient value 'b' varied from 2.798-3.852 for male and 2.603-3.222 for female indicated that both sexes showed allometric pattern of growth. In overall, 'b' value for both sexes was almost similar trend in all the seasons and indicated that both sexes did not follow the cube law (b=3) strictly. The lowest 'r' value (0.884) was recorded in post-monsoon and the highest (0.911) in winter for male, while minimum 'r' value (0.809) was observed in pre-monsoon and maximum (0.898) in monsoon for female. Values of correlation coefficients 'r' showed a significant ($p<0.001$) positive relationship between length and weight of the fish. Condition factor 'K' was the highest (1.302) in pre-monsoon for male and the lowest (0.897) in winter, whereas for female, it fluctuated from 0.931 (winter) to 1.213 (pre-monsoon). Therefore, the results of the present study provides the first baseline information on length-weight relationships of *mola* based on season, which may be useful for sustainable management and conservation of the mother stock of Dekar *haor* ecosystem.

Keywords: length-weight relationship, condition factor, *Amblypharyngodon mola*

1. Introduction
Haor region of Bangladesh is blessed with huge potential of fisheries resources. The *haor* region comprises a wide variety of finfish including 143 indigenous and 12 exotic species along with several species of freshwater prawns [4]. The total contribution of *haor* (floodplain) in national economy is 730210 MT [7]. Dekar *haor* is one of the most important *haor* which covers about 11,514 ha and made up of 36 small, medium and large interconnecting *beels*, canals, rivers and crop lands. There is a great importance of this *haor* in fish production, maintaining biodiversity, meeting local and regional demand and it also serve as the good source of fish seed supply to the adjacent waterbodies [22]. Total 51 indigenous and exotic fish species were recorded from Dekar *haor* [28]. Among them *A. mola* is one of the most abundant small indigenous species, which founds all the year round in Dekar *haor*. *Amblypharyngodon mola* (Ham-Buch), commonly known as 'Indian carplet' or 'pale carplet' belongs to the family Cyprinidae and order Cypriniformes. It has tremendous importance due to its high content of vitamin-A. It is also rich in Fe, Zn and Ca [24]. In different parts of Bangladesh, it is locally known as *mourala, mowa* or *mowka*. Of late, it has also got its entry in ornamental fish trade. *A. mola* is a self-recruiting species and its culture is being encouraged [10].
The study of the length-weight relationship of fishes forms an important base for fish biology. The statistical relationship between two parameters has great significance with regard to their morphology, biology, nutrition, condition and growth rate. Also this relationship is useful in differentiating small taxonomic units, as variations may occur within populations of different localities [19].
Condition factor is an indicator of the variability to attribute growth coefficient. It expresses the condition of a fish such as degree of well-being, relative robustness, plumpness or fatness in numerical terms. The condition of a fish reflects the physical and biological circumstances and fluctuates by interactions among feeding condition, parasitic infections and physical factors [19].

The purpose of choosing *A. mola* as a research species is due to its popularity and high nutrient content than any other Small Indigenous Species (SIS) of Bangladesh. Its nutritional value is totally unknown to local people of Dekar *haor*. Recently this species is considered as a vulnerable species, which needs immediate measures and awareness to protect and conserve for future generations [13]. Very few studies were conducted on length-weight relationship of *mola* on the basis of seasonal variation in Dekar *haor* even in Bangladesh. This study will help researchers, students and teachers to work with new species according to its guidelines. Therefore, the present study aimed to provide information to reduce the probable depletion of their wild stocks in future and their proper management and conservation strategies.

2. Materials and Methods

2.1 Study area and period

The study was conducted in Dekar *haor* of Dakshin Sunamganj, which lies between latitude 24°46´N to 24°57´N and longitude 91°20´E to 91°31´E. Fish sample collection was done for eight months from January 2017 to October 2017 except March and June. These eight months were divided into four seasons namely winter (January-February), pre-monsoon (April-May), monsoon (July-August) and post-monsoon (September-October). Samples were collected twice in a month at 15 days intervals.

2.2 Collection of sample

A total of 2000 samples were collected randomly. After collection, the samples were transported to the laboratory in a large polyethylene bag with 5% formalin. Then washed and transferred to a filter paper to remove excess water from the body surfaces.

2.3 Measurement of length-weight

Total length of fish was measured from tip of the snout to end of the tail using measuring scale (cm) and weight upto 0.1 g using digital weighing balance, respectively.

2.4 Length-weight relationship

The statistical relationship between length and weight was established by the parabolic equation given by Froese [8], $W = aL^b$, Where, W = weight of fish (g), L = length of fish (cm), a = constant and b = a regression coefficient expressing relationship between length-weight. The relationship ($W = aL^b$) was converted into logarithmic form of equation giving a straight line relationship graphically, Log W=Log a + b LogL. The equation is same to Y= a + bX, where, Log W= Dependent variable (Y), Log L= Independent variable (X), b= Regression coefficient or slope, a= Intercept

2.5 Condition factor 'K'

Condition factor 'K' was calculated by Fulton's [9] equation, $K = W \times 100 / L^{3,}$ where, K= Condition Factor, W= Observed body weight (g), L= Observed length of fish (cm).

2.6 Statistical analysis

Data were analyzed using Microsoft Office Excel and SPSS software (Version 20) with $p<0.001$ considered significantly different.

3. Results and Discussion

The highest average total length of male was 6.17±0.50 cm. and that of female was 6.38±0.56 cm in monsoon. The highest average total weight for male and female were 2.90±0.93 and 3.04±0.82 g, respectively in pre-monsoon. The length-weight relationship and condition factor obtained for the males and females of *A. mola* in different seasons have been shown in Table 1 and Figs. 1-8.

Table 1: Length-weight relationship and condition factor of *Amblypharyngodon mola* on the basis of seasonal variation.

Seasons	Sex	Length Mean ± sd	Weight Mean ± sd	b	r	Logarithmic equation	K
Winter	M	5.13±0.61	1.21±0.49	2.87	0.911	y = 2.87x - 1.98	0.897
	F	5.20±0.68	1.31±0.63	2.86	0.858	y = 2.86x - 1.96	0.931
Pre-monsoon	M	6.06±0.44	2.90±0.93	3.85	0.907	y = 3.85x - 2.57	1.302
	F	6.31±0.50	3.04±0.82	2.60	0.809	y = 2.60x - 1.60	1.213
Monsoon	M	6.17±0.50	2.35±0.60	2.79	0.891	y = 2.79x -1.85	0.998
	F	6.38±0.56	2.70±0.76	2.93	0.898	y = 2.93x - 1.94	1.037
Post-monsoon	M	5.34±0.56	1.50±0.62	3.50	0.884	y = 3.50x - 2.40	0.983
	F	6.17±0.53	2.42±072	3.22	0.805	y = 3.22x - 2.17	1.032

sd= Standard deviation, r= Correlation coefficient, b= Regression coefficient, K= Condition factor

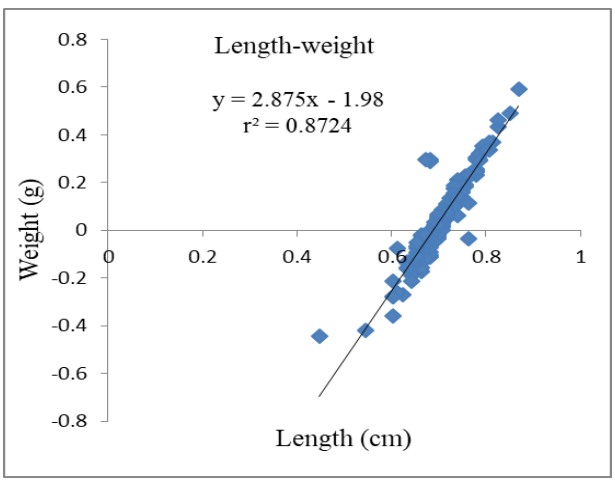

Fig 1: Length-weight relationship of male *A. mola* in winter

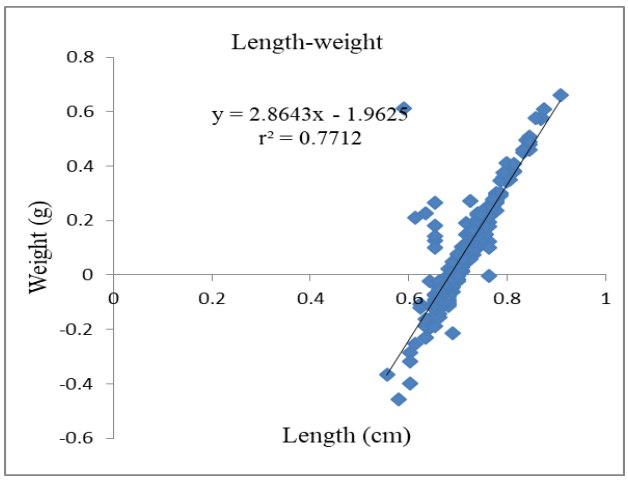

Fig 2: Length-weight relationship of female *A. mola* in winter

3.1 Winter season

3.1.1 Correlation coefficient 'r'

The correlation coefficient value of 'r' for both male and female was recorded 0.911 and 0.858, respectively and showed strongly positive and significant relationship between length and weight (Table 1 and Figs. 1-2). The highest value of 'r' was found for male in winter. The 'r' value of male was 0.83 recorded by Haque and Biswas [11] in case of *Botia dario* is almost similar to the value of the present study, which is indicating strongly positive correlation between the length and weight. According to Sanjay *et al.* [26] the value of 'r' for male *Esomas danricus* was also 0.837, which is nearly close to the present study. The value of 'r' was 0.86 for female recorded by Sanjay *et al.* [26] for *Esomas danricus*, which agrees with the current study. The value of 'r' was obtained 0.90 for female by Haque and Biswas [11] which is almost close to the value of present study. The present investigation reveals that the growth performance of all the experimental fishes exhibits high degree of positive correlation between length-weight relationship of *A. mola*.

3.1.2 Regression coefficient value 'b'

The regression coefficient 'b' is an indicator of isometric or allometric pattern of growth. In the present study, the regression coefficient value of 'b' was 2.87 for male and 2.86 for female, which indicate negative allometric pattern of growth (Table 1 and Figs. 1-2). In winter season, Haque and Biswas [11] found 'b' value 2.02 for male and 2.40 for female, which was negative allometric pattern of growth and agrees with present study. The regression coefficient value of 'b' for both male and female was 1.022 and 1.174, respectively reported by Sanjay *et al.* [26] and also indicates negative allometric pattern of growth.

In all cases the value of regression coefficient 'b' is not found in normal ranges between 2.5 and 4.0 as suggested by Hile [12] and Martin [20]. The present study also indicates that the value of 'b' deviates from 'Cube law' as it remains constant at 3.0 for an ideal fish [2] in a particular environmental condition. The negative allometric growth observed may be due to lower feeding proficiencies or may be the environment or the season of experiment are not suitable for proper growth of fishes.

3.1.3 Condition factor 'K'

The value of condition factor 'K' for both male and female was 0.897 and 0.931, respectively and it is close to the value of 1 indicating nearly good condition of the fishes (Table 1). According to Sanjay *et al.* [26] condition factor was 1.091 for male and 0.894 for female is close to the results of present study. The value of 'K' was also found 1.085 for male and 0.96 for female by Haque and Biswas [11] indicates good condition of fish. It has been observed that females indicate slightly better condition than males.

3.2 Pre-monsoon season

3.2.1 Correlation coefficient 'r'

The study reveals that the growth performance in both male and female are found high since the correlation coefficient 'r' exhibits high degree of correlation between the length-weight relationships. The correlation coefficient 'r' for both male and female was recorded 0.907 and 0.809, respectively, which exhibits strongly positive relationship between length and weight (Table 1 and Figs. 3-4). The value of 'r' was found higher in pre-monsoon for male. The 'r' value of male *Botia dario* was 0.99 recorded by Haque and Biswas [11], which is strongly positively correlated and nearly similar to the value of current study. The value of 'r' for male *Esomas danricus* was also 0.881 by Sanjay *et al.* [26], which is very close to the present investigation. The value of 'r' was 0.910 for female *Esomas danricus* recorded by Sanjay *et al.* [26], is more or less similar with the present study. The value of 'r' was 0.96 for female recorded by Haque and Biswas [11], which also agrees with the present study. All the linear regressions are statistically significant ($p<0.001$).

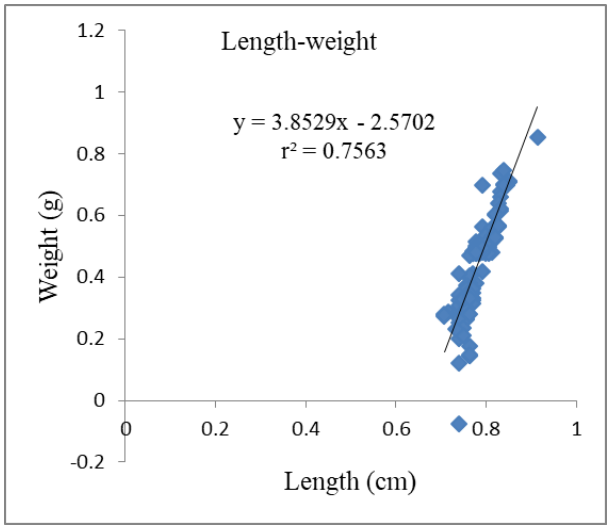

Fig 3: Length-weight relationship of male *A. mola* in pre-monsoon

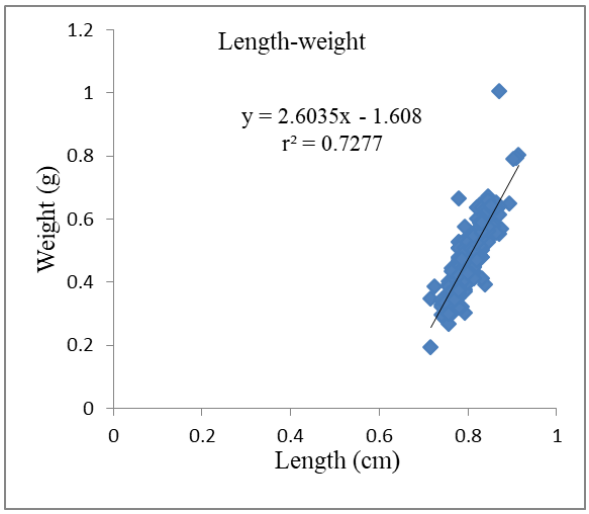

Fig 4: Length-weight relationship of female *A. mola* in pre-monsoon

3.2.2 Regression coefficient value 'b'

In the recent study, the regression coefficient value 'b' was estimated 3.85 for male and 2.60 for female, which indicates positive allometric growth for male and negative allometric growth for female (Table 1 and Figs. 3-4). In pre-monsoon, Haque and Biswas [11] observed 'b' value 3.45 for male, which agrees with the recent study and also 3.17 for female, which differs from recent study indicating positive allometric pattern of growth. Soni and Kathal [27], Kaur [15], Saikia *et al.* [25], Bura Gohain and Goswami [5], Deka and Bura Gohain [6] observed that the higher proficiencies in feeding, availability of food and other associated factors are responsible for positive allometric growth in different fishes. The value of 'b' for both male and female was 1.004 and 1.315 recorded by Sanjay *et al.* [26], respectively indicating negative allometric growth and agrees with the present study. The length-weight

relationship in fishes can be affected by several factors including habitat, area, seasonal effect, degree of stomach fullness, gonad maturity, sex, health, preservation techniques and differences in the observed length ranges of the specimen caught [29] which may be responsible for deviation from the value of 'b'.

3.2.3 Condition factor 'K'

The value of condition factor 'K' for male and female was 1.302 and 1.213, respectively, which is higher than the value of 1 indicating better condition of the fishes (Table 1). The value of condition factor was 1.091 for male and 0.894 for female by Sanjay *et al.* [26] is similar to the findings of the present study. 'K' value was found 1.11 for male and 1.18 for female by Haque and Biswas [11] also indicates good environmental condition and agrees with present study. Condition factor 'K' is an index to monitor feeding intensity and growth rate [21], which expresses the 'Condition', 'fatness' or wellbeing of a fish. Heavier fish for a particular length exhibits better condition [3].

3.3 Monsoon season

3.3.1 Correlation coefficient 'r'

The correlation coefficient 'r' for both male and female was 0.891 and 0.898, respectively showing significant and highly positive relationship between length and weight (Table 1 and Figs. 5-6). Female attained higher value of 'r' than male. The 'r' value of male *Botia dario* was 0.83 recorded by Haque and Biswas [11] is almost similar to the value of present study and indicating strongly positive correlation between length and weight. The value of present study is nearly closed to the 'r' value of Sanjay *et al.* [26] who recorded the 'r' value 0.837 for *Esomas danricus*. In case of female fish, the value of 'r' was 0.86 recorded by Sanjay *et al.* [26] for *Esomas danricus*, which agrees with the current investigation. The value of 'r' was 0.90 [11], which is almost closed to the present study. The present investigation reveals that the growth performance of fishes was found high owing to the correlation coefficient 'r' exhibits high degree of positive correlation between the length-weight relationship of *A. mola*.

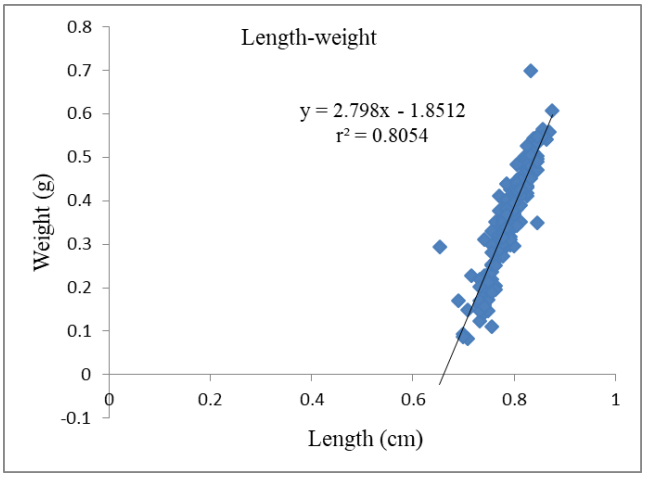

Fig 5: Length-weight relationship of male *A. mola* in monsoon

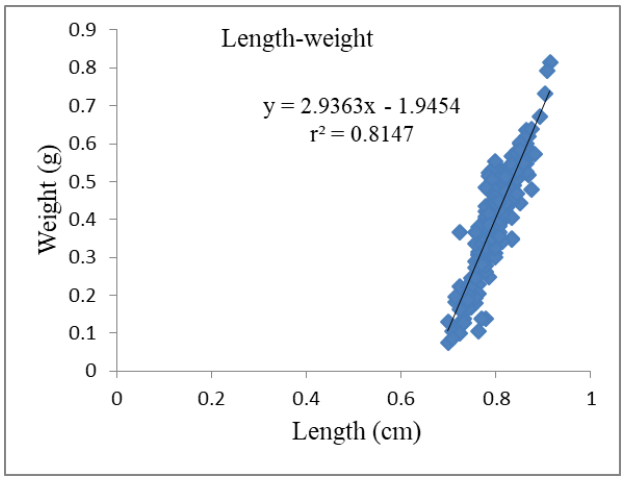

Fig 6: Length-weight relationship of female *A. mola* in monsoon

3.3.2 Regression coefficient value 'b'

In present study, the regression coefficient value 'b' was estimated 2.79 for male and 2.93 for female, which indicates negative allometric pattern of growth (Table 1 and Figs. 5-6). In monsoon season [11] found 'b' value 2.02 for male and 2.4 for female, which was negative allometric pattern of growth and agrees with current findings. According to Sanjay *et al.* [26] the regression coefficient value 'b' for both male and female was estimated 1.022 and 1.174, respectively and also indicates allometric growth of pattern, which is negative. Variations in the regression coefficient value 'b' mostly reflects the change in the body form when the weight of the fish is affected by environmental factors like temperature, food supply, spawning conditions and other factors like life stages, sex, fishing area, fishing time and sample size variations [23, 3, 16].

3.3.3 Condition factor 'K'

The value of condition factor 'K' for both male and female was 0.998 and 1.037, respectively. It is supported to the value of 1 indicating good condition of the fishes (Table 1). In monsoon, Sanjay *et al.* [26] observed the value of condition factor 'K' 1.091 for male and 0.894 for female, which agrees with the result of present study. Secured 'K' value was 1.085 for male and 0.96 for female by Haque and Biswas [11] also indicates good condition of fish. In this season, it was observed that the female fish indicates slightly better condition than the male. Fluctuations in condition factor of many fishes were observed in relation to their reproductive cycle, feeding rhythms, physico-chemical factors of the environment, age, physiological state or some other environmental factors [18, 17, 14, 1].

3.4 Post-monsoon season

3.4.1 Correlation coefficient 'r'

The correlation coefficient 'r' recorder for both male and female were 0.884 and 0.805, respectively expressing strongly positive and significant relationship between length and weight (Table 1 and Figs. 7-8). In post-monsoon, male population gained higher 'r' value than female. The 'r' value of male was 0.83 recorded by Haque and Biswas [11] for *Botia dario* is almost similar to the value of present study indicating strongly positive correlation between length and weight. The value of 'r' for *Esomas danricus* was 0.837 recorded by Sanjay *et al.* [26], which is similar with the present study. In case of female fish, the value of 'r' was 0.86 recorded by Sanjay *et al.* [26] for *Esomas danricus*, which agrees with the present investigation. The 'r' value was reported 0.90 by Haque and Biswas [11] in case of *Botia dario* is consistent with the present work. The present study reveals that the growth performance of the experimental fishes exhibit high degree of positive correlation between length and weight.

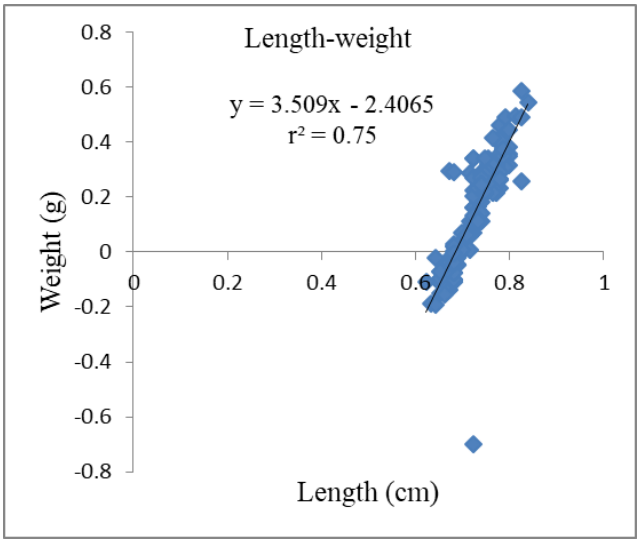

Fig 7: Length-weight relationship of male *A. mola* in post-monsoon

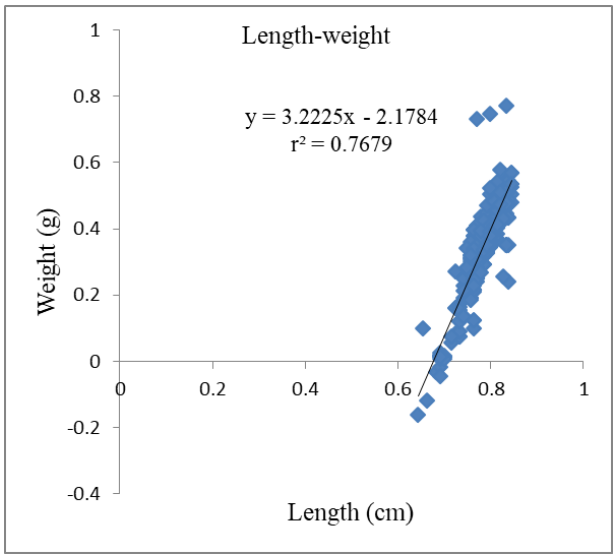

Fig 8: Length-weight relationship of female *A. mola* in post-monsoon

3.4.2 Regression coefficient value 'b'

In the present study, exponential value 'b' was gained 3.50 for male and 3.22 for female, which indicates positive allometric pattern of growth (Table 1 and Figs. 7-8). In post-monsoon, Haque and Biswas [11] obtained 'b' value 2.02 for male and 2.4 for female, which was negative allometric pattern of growth and deviates from recent study. The value of regression coefficient 'b' for both male and female was 1.022 and 1.174 reported by Sanjay *et al.* [26], respectively and also indicates allometric growth of pattern, which was negative and does not agree with the present study. It is interesting to note that the value of regression coefficient 'b' and correlation coefficient 'r' remain higher in male *A. mola* in this season.

3.4.3 Condition factor 'K'

The value of condition factor 'K' for male and female was 0.983 and 1.032, respectively, which is nearest to the value 1 indicating good condition of the fishes (Table 1). The value of condition factor was 1.091 recorded by Sanjay *et al.* [26] for male and 0.894 for female is matched to the result of present study. Observed 'K' value 1.085 for male and 0.96 for female by Haque and Biswas [11] also exhibits nearly good condition of fish. In this season, it is observed that female fish indicates slightly better condition than male. The variation of condition factor 'K' may be due to their reproductive cycle, feeding rhythms, physicochemical factors of the environment, age, physiological state or some other environmental factors.

4. Conclusion

The present study indicates that length-weight relationship of *A. mola* exhibits strongly positive correlation in all seasons and the value of regression coefficient does not follow the cube law strictly, which indicates allometric growth. The length and weight of fishes remains less in winter and pre-monsoon. Highest length, weight and number of females were also found to increase from pre-monsoon to monsoon. Therefore, it can be concluded that the existing hydrobiological conditions of the *haor* is conducive for the feeding and optimum growth of the fish. The outcomes of the present study has also provided new and updated information on the length-weight relationship and condition factor of *A. mola* based on season in Dekar *haor*, Dakshin Sunamganj, Bangladesh. Seasonal variation of length-weight relationship of *mola* is presented for the first time in Dekar *haor* even in Bangladesh. It is assumed that this knowledge will open a new chapter for the new researchers and teachers, who are interested to work on small indigenous species (SIS) of Bangladesh. Information derived from the present investigation will play an important role in management and conservation of this species.

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6. References

1. Alex N, Justin DM, Cyrus R. Length-weight relationship and condition factor of Tilapia species grown in marine and fresh water ponds. Agriculture and Biology Journal of North America. 2012; 3(3):117-124.
2. Allen KR. Some observation on the biology of the Trout (*Salmo trutta*) in Windermere. Journal of Animal Ecology. 1938; 7(2):333-349.
3. Begenal TB, Tesch AT. Conditions and growth pattern in fresh water habitats. Blackwell Scientific Publications, Oxford. 1978, 75-89.
4. BHWDB (Bangladesh *Haor* and Wetland Development Board). Master plan of *haor* area: Summary Report. Ministry of Water Resources, Government of the People's Republic of Bangladesh II. 2012, 249.
5. Bura Gohain A, Goswami MM. A study on length-weight relationship and condition factor in different age groups of *Clarias magur* (Hamilton, 1882) in wetland aqua habitat of Assam, India. Journal of Aquaculture. 2013; 14(1-2):65-70.
6. Deka P, Bura Gohain A. Length-weight relationship and relative condition factor of *Rita rita* (Hamilton, 1822), *Pangasius pangasius* (Hamilton, 1822) and *Chitala chitala* (Hamilton, 1822) of Brahmaputra river system of Assam, India. International Journal of Fisheries and Aquatic Studies. 2015; 3(1):162-164.
7. DoF (Department of Fisheries). National fish week compendium, Department of Fisheries, Ministry of

Fisheries and Livestock, Government of the People's Republic of Bangladesh. 2016, 130-131.
8. Froese R, Cube law, condition factor, and weight-length relationship: History, meta-analysis and recommendations. Journal of Applied Ichthyology. 2006; 22(4):241-253.
9. Fulton TW. The rate of growth of fishes. Twenty-second annual report, part III. Fisheries board of Scotland, Edinburgh, 1904, 141-241.
10. Gupta S, Banerjee S. Indigenous ornamental fish: A new boon in ornamental fish trade of West Bengal. Fishing Chimes. 2012; 32(1):130-134.
11. Haque S, Biswas SP. Length-weight relationship and condition factor of *Botia dario* (Ham-Buch) from Sivasagar district. International Journal of Fisheries and Aquatic Studies. 2014; 2(1):244-247.
12. Hile R. Age and growth of the Cisco, *Leucichthys artedi* (Le Sueur), in the lakes of the north-eastern high lands. Wisconsin. Bulletin US. Bur Fishery. 1936; 48(19):211-317.
13. IUCN (International Union for the Conservation of Nature). Red book of threatened fishes of Bangladesh. (Editorials.). IUCN-the world conservation union, 2000, 116.
14. Kalita N, Jayabalan N. Age and growth of the *Karangid Alepes para* (class: Osteichthyes) from Mangalore coast. Indian Journal of Marine Science 1997; 26:107-108.
15. Kaur S. Studies on Some aspects of the ecology and biology of *Channa gachua* (Ham.) and *Channa stewartii* (Playfair). Ph. D. Dissertation. North Eastern Hill University Shillong, 1981.
16. Kleanthids PK, Sinis AI, Stergion KI. Length-weight relationship of fresh water fishes in Greece. International Journal of Advanced Research in Biological Sciences. 1999; 22(4):37-41.
17. Kurup BM. Population characteristics, bionomics and culture of *Labeo dussumieri* (Val). Final report submitted to Indian Council of Agricultural Research, 1990, 108.
18. Kurup BM, Samuel CT. Length-weight relationship and relative condition factor in *Daysciaena albida* (Cuv.) and *Gerres filamentoses* (Cuv.). Fishery Technology. 1987; 24(2):88-92.
19. Le Cren (Editor). Length-weight relationship and seasonal cycle in gonadal weight and condition in the Perch (*Perca fluviatilis*). Journal of Animal Ecology. 1951; 20:201-219.
20. Martin WR. The mechanics of environmental control of body form in fishes University Toronto Stud. Publications of the Ontario Fisheries Research Laboratory, no. 70. Bibliography. 1949, 67-72.
21. Oni SK, Olayemi JY, Adegboye JD. Comparative physiology of three ecologically distinct freshwater fishes in *Alestes nurse* Riippell, *Synodontis schal* Bloch, *S. schneider* and *Tilapia zill* Gervais. Journal of Fisheries Biology. 1983; 22:105-109.
22. Pandit D, Kunda M, Rashid AHA, Sufian MA, Mazumder SK. Present status of fish biodiversity in Dekhar *Haor*, Bangladesh: A case study. World Journal of Fish and Marine Sciences. 2015; 7(4):278-287.
23. Ricker WE. Linear regression in fishery research. Journal of the Fisheries Research Board of Canada. 1973; 30(3):409-434.
24. Roos N, Wahab MA, Chamnan C, Thilsted H. The role of fish in food-based strategies to combat vitamin A and mineral deficiencies in developing countries. The Journal of Nutrition. 2007; 137(4):1106-1109.
25. Saikia AK, Singh ASK, Das DN, Biswas SP. Length-weight relationship and condition factor of spotted snakehead, *Channa punctatus* (Bloch). Bulletin of Life Science. 2011; XVII:102-108.
26. Sanjay D, Abujam SS, Parthankar C, Prasad BS. Length-weight relationship of *Esomus danricus* (Hamilton) from upper Assam, India. International Journal of Fisheries and Aquatic Studies. 2014; 2(4):125-128.
27. Soni DD, Kathal M. Length-weight relationship in *Cirrhina mrigala* (Val.) and *Cyprinus carpio* (Ham.) Matsya. 1953; 5:67-72.
28. Suravi IN, Islam MS, Begum N, Kasem MA. Fish bio-diversity and livelihood of fishers of Dekar *haor* in Sunamganj of Bangladesh. Journal of Asiatic Society of Bangladesh, Science. 2017; 43(2):233-244.
29. Tesch FW. Age and growth. In: W.E. Ricker (Editor), Methods for assessment of fish production in fresh waters. Blackwell Scientific Publications, Oxford, 1971, 99-130.