

Seasonal impact on length-weight relationship and condition factor of *Mystus dibrugarensis*: A focus on gender differences

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Abstract

Length-weight relationships (LWRs) and relative condition factors are of great importance in fisheries management for comparative growth studies since it provides information about the growth of the fish and well being of the species. In the present study LWRs for *Mystus dibrugarensis* collected from the Dihing River were established, and their growth condition was evaluated. The results indicated that almost all captured specimens exhibited a negative allometric growth. The exponential value b was found significantly less than 3 in both sexes that indicates the rate of increase in body length is not proportional to the rate of increase in body weight. LWR was calculated separately for both sexes. From the study, it was observed that the regression coefficient of females is found to be higher than the male. From this trend, it may be presumed that the female of *M. dibrugarensis* gained more weight with an increase in length than the male. This study was also conducted with respect to different seasons. The intercept 'a' of all the seasons and all the length groups was found to be negative for *M. dibrugarensis*, indicating a perfect linear relationship between length and weight. Correlation coefficients (r value) were found to fluctuate in different months in different sexes. Seasonally female showed better correlation than males.

Condition (K) value increased proportionately with the length of the fish. It was observed that the highest K value was found in smaller fishes. Seasonally higher K value during pre-monsoon and monsoon months (spawning months) was mainly due to the maturity of gonads in both sexes. Condition factor in female *M. dibrugarensis* was found to increase during the breeding season, i.e., from March onwards, and reached a peak in June, and again it dropped down in August when spawning activity was over.

Keywords: Length, growth, condition factor

Introduction

Growth may be defined as an increase in size or weight or both with increasing age. It depends on the consumption of food, food assimilation and construction from food in the organism's body (Vasnetsov, 1953) [25]. Moreover, some other external and internal factors that affect the growth are water temperature, dissolved oxygen, intensity of light, pH, growth hormone etc. The study of the mathematical relationship between length-weight of fish is an important prerequisite in fishery management and also provides information on stock condition (Haimovici and Velasco, 2000) [12]. In fisheries research, this relationship helps in the estimation of weights and growth patterns where only length data are available and as an index of the condition factor of gonadal development of the fish (Haimovici & Velasco, 2000) [12]. Length-weight relationships are useful in fishery management for both applied and basic use (Pitcher and Hart, 1982).

In fisheries research, the condition factor (K) is used to compare the 'condition factor' or well-being of fish and it is based on the hypothesis that heavier fish of a given length are in better condition (Bagenal and Tesch, 1978). Condition factor is also a useful index for the monitoring of feeding intensity, age and growth rates in fish as well as index of growth and feeding intensity (Fagade, 1979). This factor depends on various ecological and biological factors such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Mac Gregor, 1959) [18].

Methods and Methodology

Length-weight relationship: The LWR was estimated by using the equation $W = aL^b$ (Biswas, 2002) [4]. The values of constant 'a' and 'b' were estimated from the coefficient of regression equation. The length-weight relationship has been studied with reference to the net weight of the fish. The relationship is calculated for different sexes and for different months and different length groups. Correlation of coefficient (r) has been calculated by using SPSS software.

Condition factor: Individual variations from general length-weight relationship have been studied under the general name condition (Le Cren, 1951) [17]. The condition factor (K) or 'Ponderal index' has been calculated by using the following formula (Wootton, 1992) [28].

$$K = \frac{W \times 10^3}{L^3}$$

Where; K = condition factor, W = Mean weight of the fish (g) and L = Mean length of the fish (mm). The number 10^3 is a factor to bring the Ponderal index (K) to near unity (Carlander, 1970) [5].

Results

Length-weight relationship (LWR) and K factor of *M. dibrugarensis*

Relationship between the length and weight as well as condition factor of the *M. dibrugarensis* at different month of

the year, sexes and length group has been worked out (Table 1A-B) to examine the growth coefficient (b) and correlation coefficient (r) of the studied species.

The coefficient of regression (b) for different seasons in different sexes were recorded within the range of 1.59 to 2.01 for female and from 1.36 to 1.85 for male. From the LWR study the highest coefficient of regression (b) 1.89 was found in 7-9 cm in females and 2.18 in 11-13 cm length group in male. The overall regression coefficient (b value) and

correlation co-efficient (r value) for female, male and combined sex was presented in table 1C. Female showed higher b value that indicates better growth of female during the entire study period. The highest condition factor (K) of *M. dibrugarensis* was observed in pre-monsoon in both the sexes whereas lowest value was recorded during post-monsoon. The coefficient of correlation (r) for different seasons was found between 0.872 and 0.975 for females and from 0.665 to 0.841 in male.

Table 1A: Seasonal length-weight relationship and K factor of *M. dibrugarensis*

Month	Sex	b	Regression equation (Y=a+ bX)	R	K
Winter	Female	1.644	-8.08+1.644X	0.957**	0.97
	Male	1.364	-4.97+1.364X	0.734*	0.92
Pre-monsoon	Female	2.017	-11.2+2.017X	0.901**	1.06
	Male	1.827	-8.03+1.827X	0.665*	0.95
Monsoon	Female	1.855	-9.19+1.855X	0.975**	1.03
	Male	1.853	-7.7+1.853X	0.801**	0.96
Post-monsoon	Female	1.595	-5.06+1.595X	0.872**	0.94
	Male	1.436	-5.43+1.436X	0.841**	0.91

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 1B: LWR and condition factor of *M. dibrugarensis* in different length group

Length group	Sex	B	Regression equation (Y=a+ bX)	R	K
5-7	Female	1.8	Y= -8.6+1.8X	0.746**	1.05
	Male	1.93	Y= -9.53+1.93X	0.534**	1.016
7-9	Female	1.89	Y= -9.5+1.89X	0.733**	1.08
	Male	1.68	Y= -8.12+1.68X	0.667**	1.027
9-11	Female	2.05	Y= -11.7+2.05X	0.654**	0.996
	Male	1.59	Y= -6.12+1.59X	0.394**	0.879
11-13	Female	2.18	Y= -13.8+2.18X	0.581**	0.843
	Male	1.18	Y= -8.46+1.88X	0.329*	0.713

Table 1C: Summary of length-weight relationship in *M. dibrugarensis*

Sex	Regression coefficient (b)	Regression equation	Correlation coefficient (r)
Female	1.786	Y=-8.8+1.786X	0.944
Male	1.749	Y=-8.6+1.749X	0.941
Combined sex	1.764	Y=-8.7+1.764X	0.945

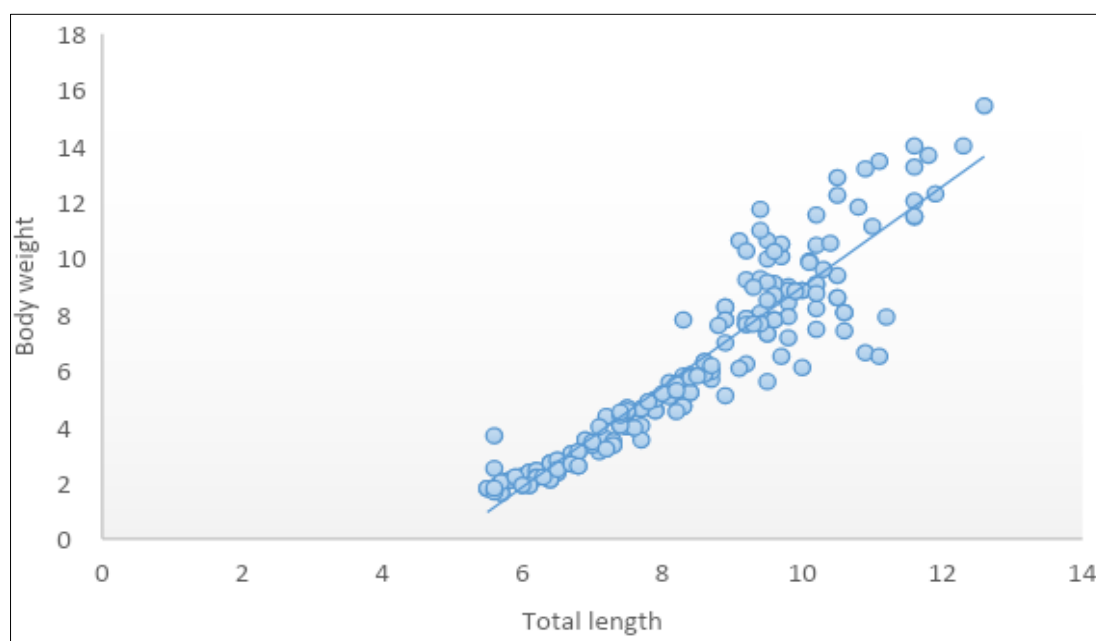


Fig 1: Length-weight relationship of *M. dibrugarensis* (female)

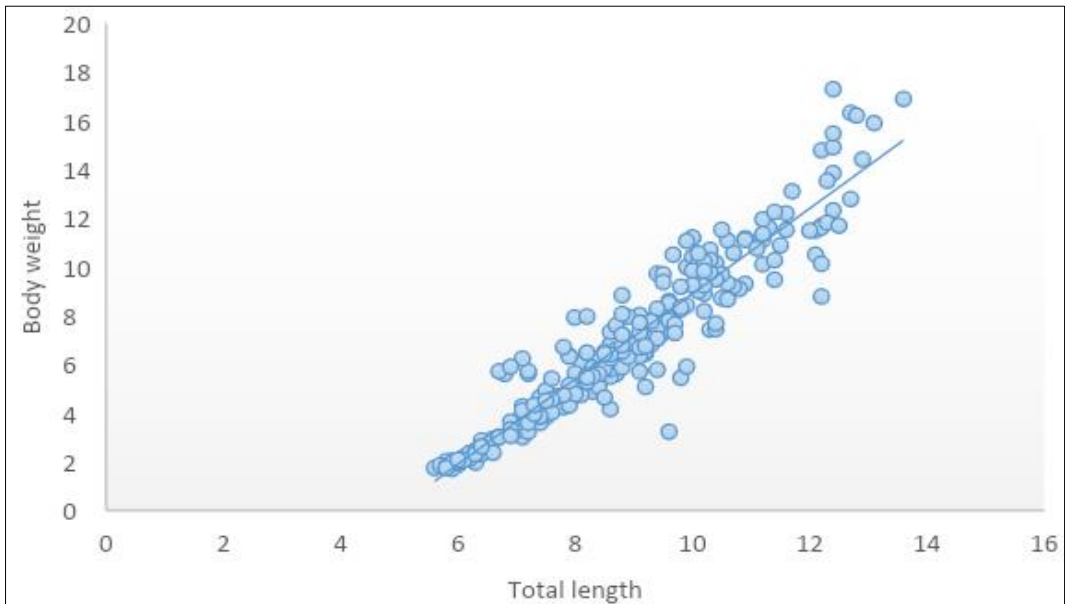


Fig 2: Length-weight relationship of *M. dibrugarensis* (male)

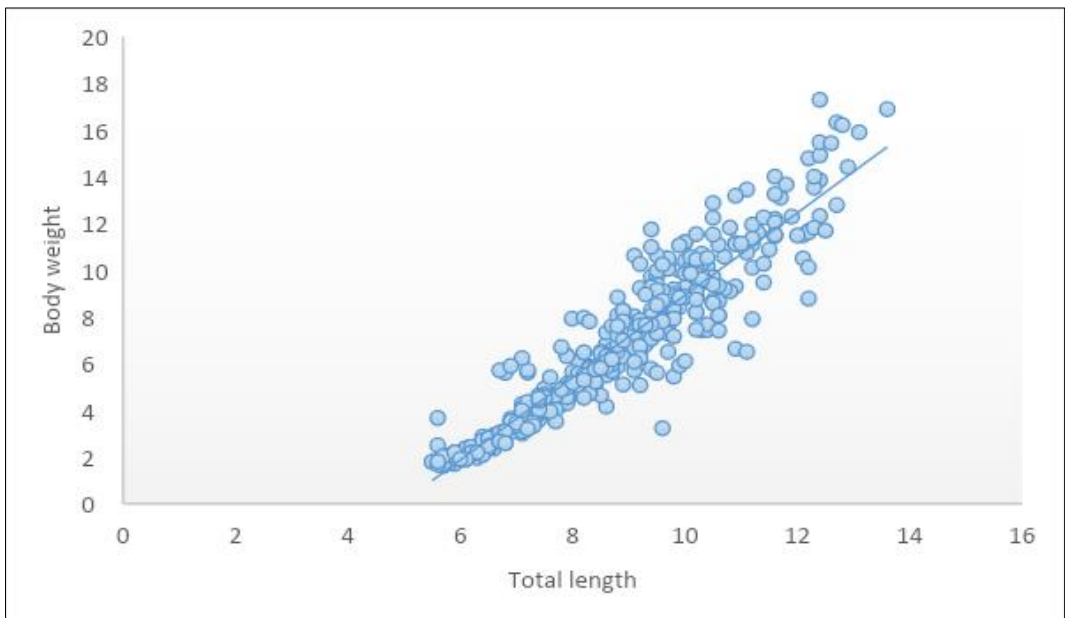


Fig 3: Length-weight relationship of *M. dibrugarensis* (pooled data)

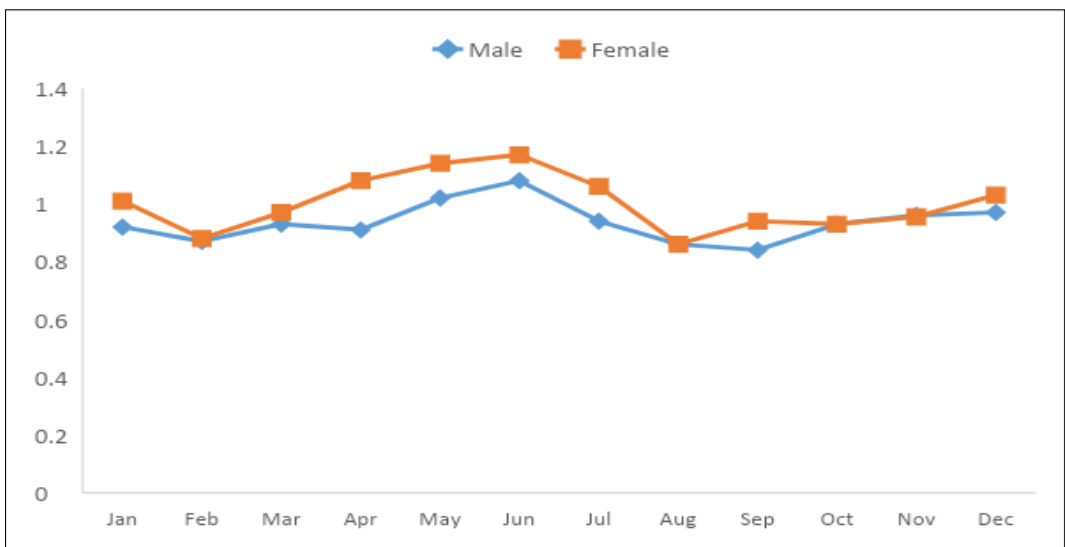


Fig 4: Monthly variation of K value in *M. dibrugarensis*

Discussion

Length weight relationship: The mathematical relationship between length and weight of fishes is a practical index suitable for understanding their survival, growth, maturity, reproduction and general well-being (Le Cren, 1951) [17]. Length weight relationship (LWR) of fishes are important in fisheries biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between the two (Beyer, 1987) [3]. The relationship of length and weight was used to calculate the regression coefficient and slope of the regression line of weight on length.

In the present study, the regression coefficient (b value) for female specimens of *M. dibrugarensis* tends to be higher in pre-monsoon but lower in post-monsoon for females. This result was also observed by Begum *et al.* (2010) [2] in *M. gulio*. While in male highest b value was recorded in pre monsoon and lowest in winter. This result was similar with the findings of Haque (2014) [13] in *Botia dario*.

The length weight relationship (LWR) was calculated separately for males and females during different seasons to observe if there are differences in the relationship due to sex and season. The value of b gives information on the kind of growth of fish. According to Bagenal and Tesch, (1978) if $b = 3$ growth is isometric (no change of body shape as the fish grows), if $b < 3$ then negative allometric growth (fish becomes more slender as it grows) and if $b > 3$ (fish becomes relatively stouter or deeper-bodied as it grows). In the present study, regression coefficient for all specimens of *M. dibrugarensis*, overall female and male specimen was found 1.76, 1.78 and 1.74 respectively. The exponential value b was found significantly less than 3 in both the sexes that means it showed negative allometric growth. That indicates the rate of increase in body length is not in proportional to the rate of increase in body weight. As yet no such information is available on LWR of *M. dibrugarensis* to compare. However, they have been compared with results of the earlier studies on the same aspect in different species of the genus *Mystus*. The result was found similar with the LWR in *M. cavasius* (Venkateshwarlu *et al.*, 2007 and Soomro *et al.*, 2015) [22, 26], *M. gulio* (Begum *et al.*, 2010) [2], *M. bleekeri* (Naeem *et al.*, 2012) [19] and *M. vittatus* (Victor *et al.*, 2014) [27].

Intraspecific variation in regression coefficient was also reported. This may occur due to seasonal changes, that is during and immediately after spawning, gonadal development, seasonal physiological condition of the fish, hydro biological conditions of water at the time of collection and food and feeding habits. Hossain *et al.* (2006) [16] reported positive allometric growth in female and negative growth in males of *M. vittatus*. Srivastava *et al.* (2013) and Heydarnejad (2009) [14, 23] reported the allometric coefficient of the LWR was close to the isometric value ($b = 2.88$) in *M. vittatus* and *M. pelusium* respectively while negative allometric growth in male and positive allometric growth in female of *M. tengara* (Gupta and Banerjee; 2015).

LWR was calculated separately for both the sexes. From the study it was observed that the regression coefficient of females is found to be higher when compared to that of male. From this trend it may be presumed that the female of *M. dibrugarensis* gained more weight with increase in length than male. This result was similar to the results of Hossain *et al.* (2006) and Tripathi *et al.* (2010) [16, 24] in *M. Vittatus*, Venkateshwarlu *et al.* (2007) and Soomro *et al.* (2015) [22, 26] in *M. cavasius*.

Here, LWR was also studied in different length groups and found females showed higher b value than male in all length groups except the 5-7 cm group. The occurrence of variation in fish sizes indicates that fish populations ranged from immature to fully matured ones. Growth of females may be higher in the 11-13 cm group whereas better growth of male occurs during the early age of their life.

The intercept 'a' of all the season and all the length group was found negative for *M. dibrugarensis* indicating a perfect linear relationship between length and weight. This result was supported by Venkateshwarlu *et al.* (2007) and Begum *et al.* (2010) [2, 26] in other *Mystus* species. In this study variability was found between the exponent (b) value and intercept (a). Variation in 'b' value is due to environmental factor, seasonal variation in availability of food, sex, age, and other important physiological factors, even daily and also between habitats (Goncalves *et al.*, 1997) [10].

Correlation coefficients (r value) were found fluctuating in different months in different sexes. Seasonally female showed better correlation than male. Begum *et al.* (2010) [2] reported similar results in *M. gulio*. The variation in 'r' value might be due to differences in sampling areas, physicochemical parameters and availability of food. Correlation coefficient (r) between length and weight of *M. dibrugarensis* during the entire study period was found 0.945, regardless the sex and season, representing strong relationship between length and weight i.e. the increase in weight is significant with per unit increase in length. This was similar with the result of Begum *et al.* (2010) [2] in *M. gulio*.

As far as length-weight of male and female *M. dibrugarensis* was concerned, the regression line derived from the data for both the sexes showed a linear relationship between the two variables. It can be seen from the following figures (Fig 1-3) that points were more or less very close to the regression line and hence it can be assumed that there is a close relationship between length and weight.

Condition factor: Condition factor is also a useful index for the monitoring of feeding intensity, age, and growth rates which is influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005) [1]. The condition factor (K) calculated for different seasons gave an indication about the variations in the condition of the fish during its growth. This variation may occurs because K value is influenced by age of fish, sex, season, stage of maturation, fullness of gut, type of food consumed, amount of fat reserve and degree of muscular development. Condition (K) value increased proportionately with the length of the fish. It was observed that the highest K value was found in smaller fishes. The highest K values (1.027) for males and (1.08) for females were observed in the 7-9 cm length group. These results also indicating the sex specific differences between male and female populations, where female show slightly better condition than male population. Further, the increase and decrease in K values with the increasing length may be due to metabolic strain during maturation or spawning as well as changes in feeding activity. Similar conditions were observed in several species of fish by earlier workers (Dhanze *et al.*, 2005) [8].

Seasonally higher K value during pre-monsoon and monsoon months (spawning months) were mainly due to maturity of gonads in both the sexes. It was again found to be reduced after spawning in August. Seasonal data on condition factor indicate the gonadal cycle of the fish (Chaturvedi and

Saksena, 2016)^[6]. Similar result was observed by (Hossain *et al.* 2013). The condition factor showed fluctuations in relation to the reproductive cycle of fish and this was well documented by (Saliu, 2001 and Narejo *et al.*, 2002). Hossain *et al.* (2006)^[16, 20, 21] reported the condition factor of *M. vittatus* was constant during the pre-spawning period, decreased in the period of spawning and was lowest immediately after spawning. The condition factor is a tool to measure the changes in food reserves, food uptake and the health of fish (Soomro *et al.*, 2015)^[22].

Condition factor in female *M. dibrugarensis* was found to increase during breeding season i.e. from March onwards and reached peak in June and again it dropped down in August when spawning activity was over. From September onwards it slowly increases and becomes steady. In male K value was found to peak in June and later dropped down and reached lowest in September (Fig 4). This type of fluctuation may be due to the onset of maturity (Hoda, 1987 and Gowda *et al.*, 1987)^[11, 15] and spawning, feeding intensity (De-Silva and Silva, 1979^[7]; Al-Daham and Wahab, 1991).

Reference

1. Anene A. Condition factor of four cichlid species of man-made lake in Imo State, Southeastern Nigeria. Turkish Journal of Fisheries and Aquatic Sciences, 2005;5:43-47.
2. Al-Daham NK, Wahab NK. Age, growth and reproduction of the greenback mullet, *Liza subviridis* (Valenciennes), in an estuary in Southern Iraq. Journal of Fish Biology, 1991;38:81-88.
3. Begum M, Pal HK, Islam MA, Alam MJ. Length-weight relationship and growth condition of *Mystus gulio* in different months and sexes. University Journal of Zoology, Rajshahi University, 2010;28:73-75.
4. Beyer JE. On length-weight relationships. Part 1: Computing the mean weight of the fish of a given length class. Fishbyte, 1987;5:11-13.
5. Biswas SP. Fundamentals of Ichthyology. Narendra Publishing House, Delhi, 2002.
6. Carlander DK. Handbook of Freshwater Fishery Biology. The Iowa State University Press, America, 1970.
7. Chaturvedi J, Saksena DN. Condition factor and gonadosomatic index: different variables correlate growth and reproduction. International Journal of Innovative Research and Growth, 2016;2(5):64-71.
8. De-Silva SS, Silva EIL. Biology of young grey mullet, *Mugil cephalus* (Linnaeus). Populations of a coastal lagoon in Sri Lanka. Journal of Fish Biology, 1979;15:9-20.
9. Dhanze R, Sharma I, Dhanze JR. Length-weight relationship of golden Mahseer *Tor putitora* (Ham.) from western Himalayas. Journal of Inland Fisheries Society, India, 2005;37(2):60-62.
10. Fagade SO, Adebisi AA, Atanda AN. The breeding cycle of *Sarotherodon galilaeus* in the I.I.T.A. Lake, Ibadan, Nigeria. Archive Hydrobiologie, 1984;100:493-500.
11. Goncalves JMS, Bente L, Lino PG, Ribeiro J, Canario AVM, Erzini K. Weight-length relationships for selected fish species of the small-scale demersal fisheries of the south and south-west coast of Portugal. Fisheries Research, 1997;30:253-256.
12. Gowda G, Shanbougu SL, Udupa KS. Length-weight relationship and relative condition of Grey mullet, *Valamugil sehli* (Forsk.) from Mangalore waters. Indian Journal of Fisheries, 1987;34:340-342.
13. Haimovici M, Velasco G. Length-weight relationships of marine fishes from southern Brazil. Naga ICLARM Quarterly, 2000;23(1):19-23.
14. Haque S. Some aspects of reproductive biology of *Botia dario* (Hamilton-Buchanan) from Sivasagar district, India. 2014.
15. Heydarnejad MS. Length-weight relationships for six freshwater fish species in Iran. Chinese Journal of Oceanology and Limnology, 2009;27:61.
16. Hoda SSM. Relative growth of body parts and length-weight relationship in *Boleophthalmus dussumieri* and *B. deutatus* of Karachi Coast. Indian Journal of Fisheries, 1987;34:120-127.
17. Hossain MY, Ahmed ZF, Leunda PM, Jasmine S, Oscoz J, Miranda R, *et al.* Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (*Siluriformes: Bagridae*) in the Mathabhangha River, south western Bangladesh. Journal of Applied Ichthyology, 2006;22(4):304-307.
18. Le Cren ED. The length-weight relationship and seasonal cycle in gonad weight and condition in Perch *Perca fluviatilis*. Journal of Animal Ecology, 1951;20(2):201-219.
19. Mac Gregor JS. Relation between fish condition and population size in the sardine (*Sardinops caerulea*). U.S. Fishery Wild Service, Fishery Bulletin, 1959;60:215-230.
20. Naeem M, Zubert A, Hasan Z, Salam A, Khalid M, Khan MJ, *et al.* Length-weight and length-length relationships of freshwater wild catfish *Mystus bleekeri* from Nala Daik, Siakot, Pakistan. African Journal of Biotechnology, 2012;11(50):11168-11172.
21. Narejo NT, Rahmatullah SM, Rashid MM. Studies on the reproductive biology of freshwater spiny eel, *Mastacembelus armatus* reared in the cemented cisterns of BAU, Mymensingh, Bangladesh. Pakistan Journal of Biological Sciences, 2002;5(7):809-811.
22. Saliu JK. Observation on the condition factor of *Brycinus nurse* (Pisces: Cypriniformes, Characidae) from Asa Reservoir, Ilorin, Nigeria. Tropical Freshwater Biology, 2001;10:9-17.
23. Soomro AN, Wazir AB, Zulfiqar AL, Palh ZA, Lashari KH, Mastoi GM, *et al.* Length-weight relationship and condition of *Mystus cavasius* (Hamilton) from lower Indus River at Thatta District, Sindh, Southern Pakistan. International Journal of Emerging Trends in Science and Technology, 2015;2(2):1875-1879.
24. Srivastava PP, Lakra WS, Dayal R, Chowdhary S, Raizada S. Length-weight relationships and condition of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) from non-drainable perennial ponds from Lucknow, UP, India. International Journal of Recent Scientific Research, 2013;4(6):1251-1255.
25. Tripathi PN, Singh NP, Prakash V. Studies on length weight relationship of the freshwater catfish *Mystus vittatus* (Bloch) in Ghaghra belt of Eastern U.P., India. The Scientific Temper, 2010;1:187-192.
26. Vasnetsov VV. Pattern of fish growth. In: Ocherki poobshchim vaprosam biologini. Akademiya Nauk Press, Moscow, 1953.
27. Venkateshwarlu M, Srigowri J, Somashekar DS, Ashashree HM. Length-weight relationship and

- condition factor of freshwater catfish *Mystus cavasius* (Ham-Buch) from Bhadra Reservoir, Karnataka. *Environment and Ecology*,2007:25(1):49-53.
28. Victor RM, Sivakumar R, Mathialagan R. Food and feeding habit and length-weight relationship of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (*Siluriformes: Bagridae*) in the Vadavar River, Lower Anicut, Tamil Nadu. *Indian Journal of Science*,2014:8(20):55-64.
29. Wootton RJ. *Fish Ecology. Tertiary Level Biology.* Blackies, New York, 1992.