Elucidation of Length-Weight Relationship and Condition Factor for Indian Major Carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) in Morvan Dam (Neemuch District), M.P., India

[1]Resham Rajput and [2]Nageshwar Wast

[1]Department of Zoology, Govt. Girls College, Khandwa, M.P., India
[2]PG Department of Zoology, J.P. University, Chapra, Bihar, India

Abstract: A study has been carried out to elucidate the length-weight relationship and condition factor of Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) in Morvan Dam (Neemuch District), during September to November month of the two consecutive years (2018 and 2019) to understand the present status of the fish. The maximum mean value of total lengths were analyzed for *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* as 85.20, 48.30 and 46.00 cm whereas, the maximum mean value of total weight were estimated as 9200, 1350 and 1330 gm respectively during November, 2018. Highest increase in average length were recorded as 39.60% for *Labeo rohita* during 2018 and lowest as 22.86 % during 2019 for *Cirrhinus mrigala* however, the percentage (%) increase in average weight were documented highest for *Catla catla* (49.86%) and lowest for *Cirrhinus mrigala* (12.15%) during 2019. The Condition Factor (K) for *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were noticed in the ranges from 1.4875 to 2.5343, 1.1883 to 2.4142 and 1.3664 to 2.3233, respectively during both the studied years which indicates about the good health condition of fishes in Morvan Dam. The length and weight variables of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* exhibited linear relationships which are illustrated by coefficient correlation (r), exponent values 'b' (indicates positive allometric growth). Results of the current study will provide baseline information which may helps the forthcoming researcher for the better management of Indian major carp fishes in the Morvan Dam.

Key words: Length · Weight Relationship · Condition Factor · Indian Major Carps and Morvan Dam

INTRODUCTION

The length-weight relationship are very important in fishery science as it helps to know about the growth, maturity, reproduction and well being of fish [1]. It can be used for the assessment of biomass and models for stock assessment [2, 3] and; also used to observed inter and intra specific differences based on morphology of fish species found in different habitats or regions [3]. This relationship helps to know about the somatic growth of fishes (either isometric or allometric) in a given water body [1, 4]. Since, besides providing baseline information in fisheries science, it also helps to determine the weight of an individual fish of known length or total weight from length-frequency distribution [5, 6]. Condition factor (K) tells about the sexual maturity, food availability and its utilisation by fish fauna. Furthermore, it may helps to study about age and sex of some species of fishes [7]. Condition factor (K) illustrates about the suitability of a specific water body for the fish growth and an index of species average size [8].It has also been noticed that the condition factor and relative condition factor also help to evaluate the significant changes in body shape of different species of fishes [9].

Previous study reported that the three Indian major carp i.e. *Catla catla* (catla), *Labeo rohita* (rohu) and *Cirrhinus mrigala* (mrigal) contribute about the huge production (over 3.02 million tonnes) of fishes [10]. In view of this, the current study has been focused to elucidate the length-weight relationship and condition factor of Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) in Morvan Dam (Neemuch District), M.P., India to understand the present status of the fish.

Corresponding Author: Nageshwar Wast, PG Department of Zoology, J.P. University, Chapra, Bihar, India.

MATERIALS AND METHODS

Study Area: Morvan dam is located in Morvan village (Neemuch District) of Madhya Pradesh, India (Figure 1). This dam was constructed on Gambhiri sub-river basin of Chambal region. The length and width of dam was measured as 990 and 12 m whereas, its total water holding capacity was observed as 16.46 million m^3. The catchment area of dam was 62.16 km^2 and an average rain fall was recorded as 760 mm. Since, it provides drinking water and irrigation facilities, therefore become valuable for many villages. This dam is also important from aquaculture point of view.

Sample Collection and Data Analysis: Fish samples were collected from the Morvan dam, Neemuch District of Madhya Pradesh in September to November month during the two consecutive years (2018 and 2019). Length-weight relationships of 150 fish samples (50 for each Indian major carps viz; (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) were analyzed by log transformed data, based on length and weight measured every month. The measurement of total length were done from tip of snout to the last end of caudal fin by measuring tape, whereas the body weight of the fishes (after removing water and mucus) was measured with the help of a digital balance.

For statistical relationship between length and weight [11], a parabolic equation [9], were used:

$$W = aL^b$$

The relationship was fitted into straight line with the logarithmic form:

Fig. 1: Google map showing water bodies in Neemuch District (Upper) and Photograph of Morvan Dam (Lower) taken from digital camera

$$Log\ W = log\ a + b\ log\ L$$

where,
W = weight of fish (g), L = length of fish (cm), a = Coefficient and b = Exponent/regression slope

However, the condition factor (K) was calculated by following formula [12]:

$$K = (W \times 100) / L3$$

where, W = Weight of fish (g) and L = Total length of fish (cm)

Statistical Analysis: Regression parameters of Length - Weight relationship were analyzed through SPSS software (Version-16) whereas, S.D. and SEM analysis were done by using Graph Pad prism software (version-7).

RESULT AND DISCUSSION

The length-weight relationships and condition factors were analyzed on 150 fish sample (50 for each Indian major carps viz; *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) during September to November month in two consecutive years (2018 and 2019), has been summarized in Table 1 and 2. Whereas, the percentage (%) increase in average growth rate of each studied Indian major carps has been depicted by Table 3 and 4.

In present investigation, the mean total length of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* varied from 65.23(0.3528±0.6110) - 85.20(0.3055±0.5292), 34.60(0.2646±0.4583) - 48.30(0.1528±0.2646) and 36.70(0.3215±0.5568)-46.00(0.5508±0.9539) cm however, mean weight were measured in the range from 6103.33(64.89±112.40) – 9200(56.86±98.49), 1000(37.86±65.57) - 1350(26.46±45.83) and 1100 (52.92±91.65) - 1330(17.32±30.00) gm respectively during both the consecutive years (2018 and 2019). The mean total lengths of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were documented as 40.734±0.614, 39.285±0.892 and 38.010±0.925 cm whereas, the mean weights were measured as 914.141±46.672, 969.306±93.738 and 635.714±51.129 g respectively in the Vallabhsagar Reservoir, Gujarat [13]. However, the total length and total weight for *L. rohita* were recorded in the range from 38.30 - 62.00 cm and 850.00 -3000.00 g and; for *C. mrigala* these parameters were observed from 36.50 cm. to 48.00 cm and 800.00 g to 1250.00 g respectively [14]. The total length of *Catla catla* were noticed in the ranges from

Table 1: Average growth rate of *Catla catla, Labeo rohita and Cirrhinus mrigala* during three month, September to November (2018)

					Condition	Regression parameters of Length - Weight relationship		
			Length (cm)	Weight (gm)				
S.No.	Fish Species	Month	Mean (SEM±SD)	Mean (SEM±SD)	Factor (K)	'a' Value	'b' Value	R² Value
1	*Catla catla*	September	67.20(0.2082±0.3606)	6500(104.08±180.2)	2.1419	-27100.000	5.000	1.00
		October	70.10(0.4726±0.8185)	8730(41.63±72.11)	2.5343	-40372.388	6.990	0.922
		November	85.20(0.3055±0.5292)	9200(56.86±98.49)	1.4875	-96.763	1.112	0.552
2	*Labeo rohita*	September	34.60(0.2646±0.4583)	1000(37.86±65.57)	2.4142	-5897.433	1.973	0. 956
		October	43.00(0.4359±0.7550)	1230(32.15±55.68)	1.5470	-7074.256	2.129	0.943
		November	48.30(0.1528±0.2646)	1350(26.46±45.83)	1.1883	-7692.987	2.203	0.892
3	*Cirrhinus mrigala*	September	36.70(0.3215±0.5568)	1100(52.92±91.65)	2.2253	-7253.009	2.114	0.900
		October	44.30(0.3786±0.655)	1260(20.82±36.06)	1.4493	-7545.130	2.149	0.896
		November	46.00(0.5508±0.9539)	1330(17.32±30.00)	1.3664	-7780.979	2.171	0.886

Table 2: Percentage (%) increase in average growth rate of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* during three month, September to November (2018)

Fish Species	% increase in length (cm)	% increase in weight (gm)
Catla catla	26.79	41.54
Labeo rohita	39.60	35.00
Cirrhinus mrigala	25.34	16.36

Table 3: Average growth rate of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* during three month, September to November (2019)

					Condition	Regression parameters of Length - Weight relationship		
			Length (cm)	Weight (gm)				
S.No.	Fish Species	Month	Mean (SEM±SD)	Mean (SEM±SD)	Factor (K)	a' Value	'b' Value	R² Value
1	*Catla catla*	September	65.23(0.3528±0.6110)	6103.33(64.89±112.40)	2.1987	-7666.764	2.143	0.900
		October	71.13(0.4702±0.8145)	8786.67(98.21±170.10)	2.4412	-8189.432	2.265	0.918
		November	85.17(0.3180±0.5508)	9146.67(77.96±135.03)	1.5901	-7460.840	2.109	0.924
2	*Labeo rohita*	September	35.47(0.5044±0.8737)	1023.33(43.72±75.72)	2.2938	-7050.896	2.048	0.921
		October	41.07(0.3844±0.6658)	1173.33(38.44±66.58)	1.6942	-7101.443	2.055	0.926
		November	47.20(0.3464±0.6000)	1280(36.06±62.45)	1.2173	-7306.903	2.076	0.919
3	*Cirrhinus mrigala*	September	37.03(0.2906±0.5033)	1180(15.28±26.46)	2.3233	-7082.709	2.043	0.916
		October	42.70(0.4163±0.7211)	1246.67(20.28±35.12)	1.6013	-7153.193	2.052	0.919
		November	45.50(0.2309±0.4000)	1323.33(17.64±30.55)	1.4049	-7265.364	2.064	0.917

Table 4: Percentage (%) increase in average growth rate of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* during three month, September to November (2019)

Fish Species	% increase in length (cm)	% increase in weight (gm)
Catla catla	27.49	49.86
Labeo rohita	33.08	25.08
Cirrhinus mrigala	22.86	12.15

289 to 875 mm and weight was observed from 390 to 11460 g [15].It has been reported that *Rohu* attain the total length from 22 cm to 51.5 cm and weight from 120 g to 1600 g in Barnoo reservoir, Jabalpur, Madhya Pradesh [16].

During present study, the Condition Factor (K) for Indian major carps were noticed in the ranges from 1.1883-2.5343 towards both the years, indicates about the good health condition of carp fishes in Morvan Dam. The 'K' values were recorded as 3.083, 1.695 and 1.714 in *catla*, *rohu* and *mrigal* from pooled data however, these value were fluctuated between 2.788-3.094, 2.011-2.213 and 1.523-1.962 in *catla*, *rohu* and *mrigal* respectively for different length groups [17]. The condition factor was reported in the range from 0.075±0.244 (*C. capoeta*) to 1.021±0.143 (*C. gibelio*) during study of the length-weight and length-length relationships of six cyprinid fish species from Zarrineh River, Iran [18]. The maximum values of 'K' was found to be 1.3932 in *Labeo rohita* (Ham.) in Barnoo reservoir, M.P. [16]. The highest value

of 'K' was observed as 1.120 amongst fishes of size, 260 – 479 mm [19]. However, Condition Factor (K) were analyzed for *L. rohita, C. catla* and *C. mrigala* in the range of 0.917-1.04, 0.903-1.07 and 0.976-1.031 from a sodic soil pond in Uttar Pradesh [20] and 1.03-1.46, 1.04-1.99 and 0.9-1.4 respectively from Raipur Reservoir, Gwalior [21], which exhibits resemblance to the present work. The Condition Factor for males and females of *Garra rufa* were observed to be 1.212 ±0.13 and 1.217 ±0.16 respectively in Cholvar River in Iran [22]. Furthermore, the Condition Factor (K) were estimated as 0.366 ± 0.017 and 1.257 ± 0.058 respectively for total (TL) and standard (SL) lengths respectively of *N. atherinoides* [23]. Previous study reveals that if the values of condition factor greater than one, fish was found to be in good condition [24]. The mean condition factor was analysed as 0.016±0.001 for Caspian Roach, *Rutilus rutilus caspicus* (Jakowlew, 1870) in Southern Caspian Sea, Iran [25]. Approximately, more or less similar patterns of results regarding length-weight relationships of Indian major carps was reported by Naeem *et al.* [26] from Multan, Pakistan; Ujjania *et al.* [17] from selected water bodies of Southern Rajasthan; six drainages of Ganga River system [27]; Pong Reservoir in Himachal Pradesh, India [28], in Harike wetland, Punjab [29], in the sub pond of the Gawala Talab, M.P. [30].

Regression parameters of Length-Weight relationship exhibits that the exponents 'b' values ranges from 1.111-6.990 (Table 1 and 3). It has been previously reported that the condition factor (K) and exponent 'b' value are directly proportional to each other. If the exponent b is equal to 3, the 'K' value will remain constant at 1. However, the value of exponent 'b' are either less than 3 or greater than 3, then the K value is either increase or decrease also [26, 31]. However, the "b" values ranged from 2.845- 3.10 among five freshwater small indigenous fish species from the Pagla river, Bangladesh [8]. Whereas, the parameter 'b' of Length - Weight relationship for four studied fishes *P. macrophtalmus, E. bleekeri, A. joponicum* and *T. lepturus* were noticed in the ranges from 2.68 - 3.07 [32]. The regression coefficient (b) values are also calculated as 2.941, 3.119 and 3.071 for male, female and combined sex of *Mystus tengara* respectively, indicates about negative allometric growth for male but positive allometric growth for female and combined sex [33]. The parameter b found to be in the ranges from 2.75 (*A. microlepis*) - 3.44 (*B. bjoerkna*) with regression coefficients (r2) were 0.87 to 0.99 for the studied fishes from Iranian inland waters viz; Persian Gulf, Caspian Sea, Namak Lake, Dasht-e Kavir, Hari River and Isfahan basins [34]. The straight linear curve between

total length and weight exhibits similarities to *Labeo calbasu* in Rana Partap Sagar, Rajasthan [35] and Indian major carps in river Brahmaputra [36]. Consequently, *L. calbasu* from Jawahar Sagar Dam, Southern Rajasthan [37] and *P. ranga* from Wetland, East Kolkata [38] was not exactly follow the cube law because the regression coefficient (b) value are lower than 3. The growth coefficient values "b" reported in the range from 2.429 (*A. microlpis*) to 3.71 (*C. keyvani*) and Condition factor were found to be in the ranges from 0.544 (*O. bergianus*) to 0.940 (*P. cyrius*) during study of seven fish species of Totkabon River, Iran [39]. The growth parameter "*b*" values were found to be in the range from 2.75 (*R. amarus*) to 3.62 (*C. morar*) and also condition factor was ranged from 0.6 (*R. persus*) to 1.47 (*R. amarus*) during study of ten fish species from Iranian inland waters [40]. However, the growth coefficient values "b" ranged from 2.615 (in *B. cyri*) to 3.001 (in *A. microlepis*) whereas, Condition factor ranged from 0.57 (*C. keyvani*) to 1.11 (in *P. cyrius*) during elucidation of seven fish species from Shahrbijar River, Iran [41] but the coefficient value "b" were reported in the range from 2.53 (Paraschistura turcmenica) to 3.2 (Garra rufa) and condition factor was analyzed as 0.89 (in *P. turcmenica*) and 1.53 (in *G. rossica*) from Iranian inland waters [42]. But, a deviation in the length-weight relationship (based on cube law) was noticed for *Cirrhinus mrigala* from Rihand reservoir, Uttar Pradesh [43]. Furthermore, the allometric coefficient (b) of the LWR was observed as negatively allometric (b<3) throughout the year but it was isometric (b=3) in March, July and October [44]. There are a positive allometry (b>3) of length-weight relationship for *Cyprinion macrostomus* in Dalaki River and negative allometry (b<3) in Shahpur River has been noticed [45]. The coefficient of regression 'b' were recorded more (b=3.16±0.08) and equal (3.013±0.13) in lotic and lentic habitats of freshwater murrel, *Channa punctatus* (Bloch, 1793) respectively to the cube of its length [46]. Moreover, a deviation in the length-weight relationship has been also noticed in present investigation, since 'b' value are lower than 3 in most of the cases and higher than 3 in *Catla catla* during September (5.000) and October (6.990) in 2018, which exhibit conformities to the findings of previous authors.

Previous study exhibits that there are many factors such as age, sex, state of maturity, size and stomach fullness, sample sizes, sampling methods and environmental conditions also influenced the fish condition and different parameter of length-weight relationships in fish fauna [47-50]. Anyway, results of the present analysis provide baseline information which is

very important to know about the health condition of carp fishes and its scientific management in Morvan Dam for further researchers.

REFERENCES

1. LeCren, 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: 201-219.

2. Wooton, J.R., 1990. Ecology of teleost fishes, Chapman and Hall, London, England.

3. Moutopoulos, D.K. and K.I. Stergiou, 2002. Length-weight and length-length relationships of fish species from Aegean Sea (Greece). Journal of Applied Ichthyology, 18(3): 200-203.

4. Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish population. Bulletin of the Fisheries Research Board of Canada, 191: 1-382.

5. Froese, R., 1998. Length-weight relationships for 18 less studied fish species. Journal of Applied Ichthyology, 14: 117-118.

6. Koutrakis, E.T. and A.C. Tsikliras, 2003. Length-weight relationships of fishes from three northern Aegean estuarine systems (Greece). Journal of Applied Ichthyology, 19: 258-260.

7. Anibeze, C.I.P., 2000. Length-weight relationship and relative condition factor of Heterobranchus longifilis (Valencienness) from Idodo River, Nigeria. NAGA, the ICLARM Quarterly, 23(2): 34-35.

8. Alam, M.M., M.T. Rahman and S. Parween, 2014. Morphometric characters and condition factors of five freshwater fishes from Pagla river of Bangladesh. International Journal of Aquatic Biology, 2(1): 14-19.

9. Froese, R., 2006. Cube law, condition factor and weight-length relationships. Journal of Applied Ichthyology, 22: 241-253.

10. FAO (Food and Agriculture Organization), 2006. State of world aquaculture. FAO Fish Tech Pap, 500.

11. Biswas, S.P., 1993. Length-weight relationship and condition factor. In: Manual of methods of fish biology, New Delhi, South Asian Publisher, pp: 60-64.

12. Fulton, T.W., 1904. The rate of growth of fishes. 22nd Annual Report of the Fishery Board of Scotland, 3: 41-241.

13. Soni, N. and N.C. Ujjania, 2017. Length-weight relationship and condition factor of Indian major carps of Vallabhsagar Reservoir, Gujarat, India. Indian Journal of Fisheries, 64(Special Issue): 186-189.

14. Chandrvanshi, R., R. Uraon, N. Sarang and H.K. Vardia, 2019. Studies on length-weight relationship (LWR) and condition factor of *Labeo rohita* and Cirrhinus mrigala in sutiapat reservoir, Kabirdham, Chhattisgarh, India. Journal of Entomology and Zoology Studies, 7(1): 420-424.

15. Singh, B.O. and K. Lakhwinder, 2015. Length-Weight Relationship of *Catla catla* (Hamilton-Buchanan) from Harike wetland (Ramsar Site), Punjab, India. International Research Journal of Biological Sciences, 4(6): 44-47.

16. Ojha, P., 2019. Length – weight relationship and condition factor of *Labeo rohita* (Ham.) fish in Barnoo reservoir, Jabalpur, Madhya Pradesh, India. International Journal of Global Science Research, 6(1): 967-973.

17. Ujjania N.C., M.P.S. Kohli and L.L. Sharma, 2012. Length-weight relationship and condition factor of Indian major carp (*C. catla*, *L. rohita*, *C. mrigala*) in Mahi Bajaj Sagar, India. Research Journal of Biological Sciences, 2(1): 30-36.

18. Radkhah, A. and S. Eagderi, 2015. Length-weight and length-length relationships and condition factor of six cyprinid fish species from Zarrineh River (Urmia Lake basin, Iran). Iranian Journal of Ichthyology, 2(1): 61-64.

19. De, D.K., 1980. Maturity, fecundity and spawning of post-monsoon run of Hilha, Hilha ilisha (Ham.) in the upper stretches of the Hooghly estuarine system. Journal of Inland Fisheries Society of India, 12(1): 54-63.

20. Pandey, A.C. and M.K. Sharma, 1998. Bionomics of the Indian major carps cultivated on sodic soil pond conditions in U. P. India. Indian Journal of Fisheries, 45: 207-210.

21. Saxena, M. and D.N. Saksena, 2013. Growth of Indian major carps and a Chinese carps in extensive culture system in Raipur Reservoir, Gwalior, M. P., India. Journal of Fisheries and Aquaculture, 4(1): 75-81.

22. Gerami, M.H., D. Abdollahi and R. Patimar, 2013. Length-Weight, Length-Length Relationship and Condition Factor of Garra rufa in Cholvar River of Iran. World Journal of Fish and Marine Sciences, 5(4): 358-361.

23. Zannat, L.K., S. Jasmine, S. Hossen, M.Y. Hossain, A. Ghosh, A. Ferdous, N. Saha and S. Hemal, 2020. Length-Weight, Length-Length Relationships and Condition Factor of Schilbid Catfish Neotropius atherinoides (Bloch, 1794) from the Padma River, Rajshahi. World Applied Sciences Journal, 38(4): 278-286.

24. Olurin, K.B. and O.A. Aderibigbe, 2006. Length-Weight Relationship and Condition Factor of Pond Reared Juvenile Oreochromis niloticus. World Journal of Zoology, 1(2): 82-85.

25. Sedaghat, S. and S.A. Hoseini, 2012. Age and Growth of Caspian Roach, Rutilus rutilus caspicus (Jakowlew, 1870) in Southern Caspian Sea, Iran. World Journal of Fish and Marine Sciences, 4(5): 533-535.

26. Naeem, M., A. Salam and M.N. Bhatti, 2000. Morphometric studies of cold water fish rainbow trout Oncorhynchus mykiss in relation to body size. Pakistan Journal of Zoology, 1: 55-62.

27. Mir, J.I., U.K. Sarkar, O.P. Gusain and A. K. Dwivedi, 2014. Length-weight relationship of the Indian major carp, *Labeo rohita* (Cypriniformes; Cyprinidae) from six drainages of Ganga basin, India. Cuadernos de Investigacion UNED, 7(1): 71-77.

28. Parmar, A. and N.P. Bhatia, 2014. Age, growth and length weight relationship of Cirrhinus mrigala from Pong Reservoir, Himanchal Pradesh, India. International Journal of Fauna and Biological Studies, 1(3): 11-17.

29. Brraich, O.S. and L. Kaur, 2015. Length-weight relationship of *Catla catla* (Hamilton-Buchanan), from Harike wetland (Ramsar site), Punjab, India. International Research Journal of Biological Sciences, 4(6): 44-47.

30. Verma, R., 2018. Study of average growth performance and condition factor of fish (Indian Major Carps) in the sub pond of the Gawala Talab, Maheshwar, Khargone (M.P.). International Journal of Zoology Studies, 3(2): 342-346.

31. Naeem M. and A. Salam, 2004. Morphometric studies on Oreochromis nilotica (male) in relation to body size from Islamabad, Pakistan. Punjab University Journal of Zoology, 19: 73-81.

32. Jafari-Patcan, A., S. Eagderi and A. Mouludi-Saleh, 2018. Length-weight relationship for four fish species from the Oman Sea, Iran. International Journal of Aquatic Biology, 6(5): 294-295.

33. Gupta, S. and S. Banerjee, 2015. Length-weight relationship of Mystus tengara (Ham. Buch., 1822), a freshwater catfish of Indian subcontinent. International Journal of Aquatic Biology, 3(2): 114-118.

34. Eagderi, S., A. Mouludi-Saleh and E. Cicek, 2020. Length-weight relationship of ten species of Leuciscinae sub-family (Cyprinidae) from Iranian inland waters. International Aquatic Research, 12: 133-136.

35. Choudhary, C.S., L.L. Sharma, S.K. Sharma and V.P. Saini, 1991.Some aspects of morpho-physiography of Labeo calbasu (Ham.) from Rana Pratap Sagar reservoir, Rajasthan. Indian Journal of Fisheries, 38(4): 207-211.

36. Choudhary M., V. Kolekar and R. Chandra, 1982. Length-weight relationship and relative condition factor of four Indian major carps of river Brahmaputra, Assam. Journal of Inland Fisheries Society of India, 14(2): 42-48.

37. Sarang N. and L.L. Sharma, 2010. Length-weight relationship and harvestable size of Labeo calbasu from Jawahar sagar dam of southern Rajasthan, India. Journal of the Inland Fisheries Society of India, 42(1): 53-58.

38. Mahapatra, B.K., M. Pal, S. Bhattacharjee and W.S. Lakra, 2014. Length-Weight relationship and condition factor of an indigenous ornamental fish, Pseudambassis ranga (Hamilton, 1822) from East Kolkata Wetland. International Journal of Fisheries and Aquatic Studies, 2(2): 173-176.

39. Faradonbeh, M.Z., S. Eagderi and F. Ghojoghi, 2015. Length-weight relationship and condition factor of seven fish species of Totkabon River (southern Caspian Sea basin), Guilan, Iran. International Journal of Aquatic Biology, 3(3): 172-176.

40. Mouludi-Saleh, A. and S. Eagderi, 2019. Length-weight relationship and condition factor of ten fish species (Cyprinidae, Sisoridae, Mugilidae, Cichlidae, Gobiidae and Channidae) from Iranian inland waters. Journal of Wildlife and Biodiversity, 3(4): 12-15.

41. Asadi, H., M. Sattari, Y. Motalebi, M. Zamani-Faradonbeh and A. Gheytasi, 2017. Length-weight relationship and condition factor of seven fish species from Shahrbijar River, Southern Caspian Sea basin, Iran. Iranian Journal of Fisheries Sciences, 16(2): 733-741.

42. Abbasi, K., A. Mouludi-Saleh, S. Eagderi and A. Sarpanah, 2019. Length-weight relationship and condition factor of eight species of the genera Capoeta, Garra, Chondrostoma, Schizothorax and Paraschistura from Iranian inland waters. Iranian Journal of Ichthyology, 6(4): 264-270.

43. Desai, V.R. and N.P. Shrivastava, 1990. Studies on age, growth and gear selectivity of Cirrhinus mrigala (Hamilton) from Rihand reservoir, Uttar Pradesh. Indian Journal of Fisheries, 37(4): 305-311.

44. Mir, J.I., R. Shabir and F.A. Mir, 2012. Length-Weight Relationship and Condition Factor of Schizopyge curvifrons (Heckel, 1838) from River Jhelum, Kashmir, India. World Journal of Fish and Marine Sciences, 4(3): 325-329.

45. Bibak, M., S.A. Hosseini and G.R. Izadpanahi, 2013. Length-Weight Relationship of Cyprinion macrostomus, (Heckel, 1843) in Dalaki River and Shahpur River in South of Iran. World Journal of Fish and Marine Sciences, 5(3): 263-265.

46. Serajuddin, M., L. Prasad and B.C. Pathak, 2013. Comparative Study of Length-Weight Relationship of Freshwater Murrel, Channa punctatus (Bloch, 1793) from Lotic and Lentic Environments. World Journal of Fish and Marine Sciences, 5(2): 233-238.

47. Anene, A., 2005. Condition factors of four cichlid species of a man-made lake in Imo state, Southeastern Nigeria. Turkish Journal of Fisheries and Aquatic Sciences, 5: 43-47.

48. Ama-Abasi, D., 2007. A review of length-weight relationship and its parameters in Aquatic species. In: Proceedings of the 22nd Annual Conference of the Fisheries Society of Nigeria, Kebbi, Kebbi State, Nigeria, 12th–16th November, pp: 240-244.

49. Yem, I.Y., O.A. Sani, M.B. Mshelia and H.U. Onimisi, 2008. The length-weight Relationship and Condition Factor of the Banded Jewel Fish (Hemichromis fasciatus Peters) from Kainji Lake, Nigeria. In: Proceedings of the 22nd Annual Conference of the Fisheries Society of Nigeria (FISON), Kebbi, Kebbi State, Nigeria, 15–18. World Wide Web Electronic Publication. Available at: http://www.fishbase.org. Version 3.

50. Adeyemi, S.O., N.O. Bankole, I.A. Adikwu and P.M. Akombo, 2009. Age, growth and mortality of some commercially important fish species in Gbedikere Lake, kogi state, Nigeria. International Journal of Lakes and Rivers, 2(1): 45-51.