ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2016; 4(2): 131-136

www.fisheriesjournal.com
Received: 27-01-2016
Accepted: 29-02-2016

Muddasir Jan
Fish Nutrition Research Laboratory Department of Zoology, University of Kashmir, Hazratbal, Srinagar

Imtiaz Ahmed
Fish Nutrition Research Laboratory Department of Zoology, University of Kashmir, Hazratbal, Srinagar

Correspondence
Imtiaz Ahmed
Fish Nutrition Research Laboratory Department of Zoology, University of Kashmir, Hazratbal, Srinagar

Length weight relationship and condition factor of snow trout, *Schizothorax plagiostomus* (Heckel, 1838) from Lidder River, Kashmir

Muddasir Jan, Imtiaz Ahmed

Abstract
Length–weight relationships of fish *Schizothorax plagiostomus* were originally used to provide information on the condition of fish and to determine whether somatic growth was isometric or allometric. The study was carried out to study length-weight relationship and condition factor of snow trout, *Schizothorax plagiostomus* in river Lidder originating from Kashmir Himalaya of District Anantnag and the sampling duration was from July, 2013 to June, 2014. The length-weight relationship of *Schizothorax plagiostomus* were calculated for males, females and combined ones. The relationship was analysed using the formula $W = a L^b$ which was further transformed into Log W =a +b log L. A total of 500 specimens comprising 250 males, 250 females with different size groups were studied. The equation obtained for males was; logW = 1.590+2.726 logL; for females; logW= 1.664+2.775 log L and for combined ones: logW = 1.626+2.750log L. Females show 'b'value more than males in Lidder River. Length-Weight relationship and condition factor showed that the growth of *Schizothorax plagiostomus* is quite satisfactory in river Lidder. The regression coefficient between males and females did not show any significant difference while significant difference could be noticed between males and between females (p<0.01). Studies on condition factor revealed that the fluctuations in K values can be attributed to the spawning cycle as well as feeding intensity.

Keywords: Length-weight relationship, condition factor, *Schizothorax plagiostomus.*

1. Introduction
The indigenous cyprinids, Schizothoracines or snow trouts are locally known as Kashmiri gad, snow barbles and mountain barbles. In Kashmir valley each species is identified by its own name. Snowtrouts are highly preferred to the local masses because of its nutritional value and taste that fetches high price market (Sing and Paul, 2010) [35]. *Schizothorax plagiostomus* locally known as 'khont'. Its Colour is usually dark grey on dorsal side and lighter on sides, underside whitish. The fish is typically lotic water species being distributed in fast flowing streams of Kashmir (Kullander *et al*., 1999) [20]. The Lidder as a whole as well as its tributaries and distributaries harbour a number of fish species such as exotic trout and indigenous spps. *Schizothorax plagiostomus*, *S. labiatus, S. esocinus, Crossocheilus diplochilus, Glyptosternon reticulum* and *Triplophysa kashmirensis.* Among *Schizothorax* species, *S. plagiostomus* is one of the most dominant fish followed by *S. labiatus* and *S. esocinus*.
Length-weight relation are very useful for fisheries research because they allow the conversion of growth-in-length equations to growth-in-weight, for use in stock assessment models, biomass estimation, and condition of the fish and differences of life histories of fish species (Froese and Pauly, 1998., Petrakis and Stergious, 1995., wooton, 1990) [17, 30, 38]. The length-weight relationship and condition factor of fish has got significant importance in fishery management. These relationships can be used in estimating the average weight at a given length groups (Beyer, 1987) [5] and in estimating the health status of the fish population (Bolger and connoly, 1989) [10]. The length-weight data has two main purposes; it helps to express the relationship between length and weight, so that one of them can be converted into another. It helps to measure the variation of fish condition from the observed weight in relation to the length of the individual fish. These variations are mostly related to changes in the fat content of the fish, its robustness, or generally wellbeing and gonad development. Since the length of fish is rapidly and accurately measured than weight, especially in the field, it is thus very convenient to find a relationship, by which weight can be determined if only length is known.

Our study estimates LWR of *Schizothorax plagiostomus* from River Lidder. To the best of our knowledge, no previous reports on monthly variation in length-weight and condition factor of a highly demanded fish *Schizothorax plagiostomus* in River Lidder was available. Therefore, this study provides baseline information on this fish species, which may serve as a tool for management and conservation practices. Fulton's condition factor (K) is widely used in fisheries and fish biology studies. This factor is calculated from the relationship between the weight of a fish and its length, with the intention of describing the condition of that individual fish (Fulton, 1904) [18].

2. Materials and methods

2.1 Length-Weight Relationship

Live specimens were captured directly from the selected sampling station with the help of local fisherman by using cast nets. The fishes used for the study were collected during July, 2013 to June, 2014 from River Lidder, which lies to the North of Anantnag district (Jammu and Kashmir, India) in the central Himalayan mountain range with the geographical coordinates of 33°4′–34°15′ N latitude and 75°05′–75°32′ E longitude. The randomly selected samples were shifted to laboratory for further biological measurement. Total length (TL)) was measured to the nearest 0.01 cm and the length of the fish was taken from the tip of snout (mouth closed) to the tip of the caudal fin and the weight was taken on digital balance (Shimadzu UX320G) with 0.01g accuracy for each individual. Identification of species was made based on (Day 1878., Kullander *et al*., 1999) [13, 20]. The length frequency data of male and female fishes were collected from the four different sites of river Lidder on monthly basis.

The relation between length and weight of fishes was analysed by measuring length and weight of fish specimens collected from study area. The statistical relationship between these parameters of fishes was established by using the parabolic equation by (Froese, 2006) [16]

$$W = a L^{b}$$

Where, W = weight of fish (g)

L = total length of fish
a = constant.
b = an exponential expressing relation between length and weight.

The relationship ($W=aL^b$) when converted into the logarithmic form gives a straight line relationship graphically.

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

Where b represents the slope of the line, Log a is a constant.

2.2 Condition factor (K)

The condition factor is used for comparing the condition, fatness, or wellbeing (Mir *et al*.; 2012) [27] of fish, based on the assumption that heavier fish of a given length are in better condition. Difference in the condition factor have been interpreted as a measure of histological events such as fat reservation, adaptation to the environment and gonadal development. (Le Cren, 1951) [21]. The coefficient of condition, K was calculated using (Fulton, 1904) [18].

$$K = W/L^3 x100$$

Where, W = weight in grams, L = length in cm, and 100 is a factor to bring the value of K near unity (Froese, 2006) [16].

3. Results

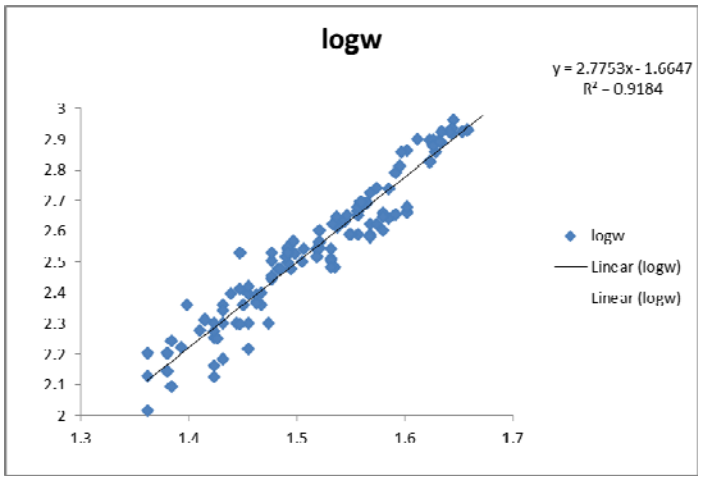
3.1 Length -weight relationship

The length ranges of the fish, weight ranges, coefficient of determination (r^2), growth coefficient b, are given in Table 1 and Table 2 respectively. During the present study length weight relationship and condition factor of *S. plagiostomus* showed some variation throughout the year. The value of b in case of females showed some deviation from cube law throughout the year except August, April and December were b was observed to be greater than 3, this can be attributed to the fact that during these three months the fishes were collected only from the lower reaches of the Lidder, were the water current was less and the food was present in abundance as compared to the upper reaches where the current is too fast. This has led to almost ideal growth pattern of the fish. The coefficient of determination r^2 ranged from 0.393 in October to 0.972 in Aug. In case of males the value of b showed deviation from cube law throughout the year as negative allometric growth was observed throughout the year i.e. $b< 3$. The growth co-efficient was minimum in August (2.208) and maximum in November (2.970). The coefficient of determination r^2 ranged from 0.72 in October to 0.963 in May. The Fulton's condition factor K and the coefficients a, r^2 and b differs due to variations in the length classes and number of measurements available. Length- weight relationship of Females and males of *Schizothorax plagiostomus* can be expressed as follows:

Females : logW = 1.664+2.775 logL
Males : logW = 1.590+2.726 logL
Combined LogW = 1.626+2.750 logL

Table 1: Monthly descriptive statistics and estimated parameters of length-weight relationships of *S. plagiostomus* (Females) in River Lidder from Kashmir Himalaya (India) from July, 2013 to June 2014.

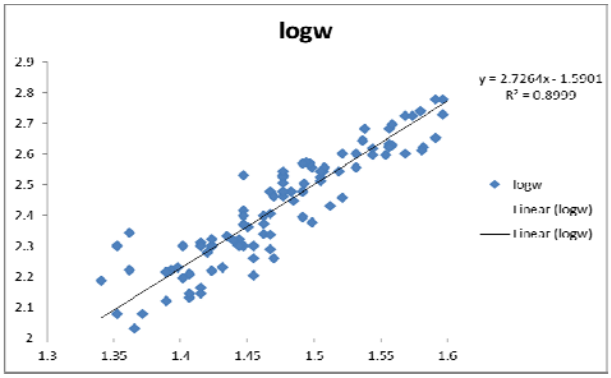
Months	N	Total Length (cm)		Total Weight (gms)		Regression Parameters $W= aL^b$		r^2
		Min	Max	Min	Max	a	b	
July	7	26	38.1	140	410	1.581	2.695	0.891
August	10	23	44.2	104	915.7	2.85	3.538	0.972
September	11	29.8	45	200	840	1.772	2.821	0.888
October	12	29	44	230	830	1.687	2.789	0.393
November	10	33	42	305	672	1.399	2.563	0.798
December	10	33	47	305	1030	2.705	3.402	0.909
January	12	23	44.2	160	915.7	1.633	2.776	0.972
February	10	28	44	316	860	1.112	2.535	0.873
March	10	28	44	166.4	840.4	1.227	2.464	0.925
April	12	24.7	43.8	166.4	840.4	1.533	3.089	1.533
May	15	24.5	43	164	800	2.114	2.84	0.963
June	11	29.3	42.9	252	700	1.802	2.834	0.898



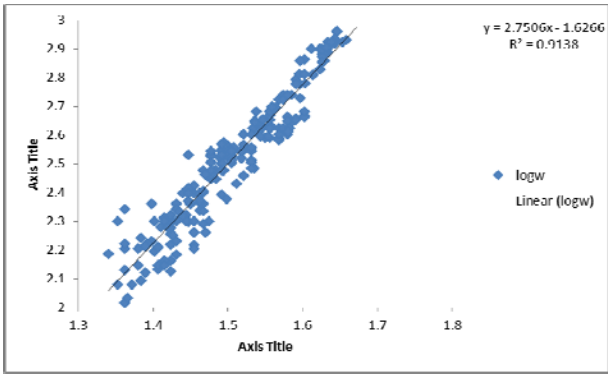
Length-Weight Relationship of *S. plagiostomus*-Females.

Table 2: Monthly descriptive statistics and estimated parameters of length-weight relationships of *S. plagiostomus* (Males) in River Lidder from Kashmir Himalaya (India) from July, 2013 to June, 2014.

Months	N	Total Length (cm)		Total Weight (gms)		Regression Parameters $W = aL^b$		r^2
		Min	Max	Min	Max	a	b	
July	9	22.5	42.3	104	760.3	1.612	2.73	0.95
August	10	21.9	40	154	650	0.799	2.208	0.942
September	10	22.5	34.5	120	480	1.673	2.746	0.816
October	8	24.7	34.4	157.2	440	1.471	2.622	0.72
November	8	24.7	41.1	157	646.2	1.96	2.970	0.944
December	10	24.7	43.8	166.4	840.4	1.677	2.784	0.956
January	8	23.2	38.2	108	420	1.839	2.874	0.906
February	7	26	38.1	140	410	1.581	2.695	0.891
March	12	23	43.5	166.4	840.4	1.310	2.576	0.956
April	13	23.5	39.5	120	535.2	1.866	2.908	0.892
May	12	24.2	43	124	840.4	2.114	2.840	0.963
June	14	26	42.8	42.8	182	1.794	2.868	0.91



Length-Weight Relationship of *S. plagiostomus*-Males.



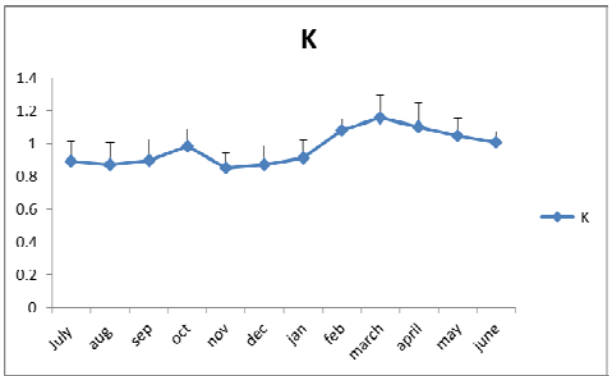
Length-Weight Relationship of *S. plagiostomus*-Combined

3.2 Condition factor

The condition factor of *S. plagiostomus* was calculated month-wise**,** it ranged from (0.855±0.085) to (1.157±0.140). K was highest in March followed by April, February, May and June, October, July, January, September, December, August and November and it was lowest in November (0.855±0.085) in case of females Table 3. In case of males, it ranged from (0.86±0.31) to (1.14±0.40). K was highest in March followed by April, May, June, December, November, August, January, October, February, September, and July Table 4.

Table 3: Month wise condition factor K-value of Females of *S. plagiostomus* for different months.

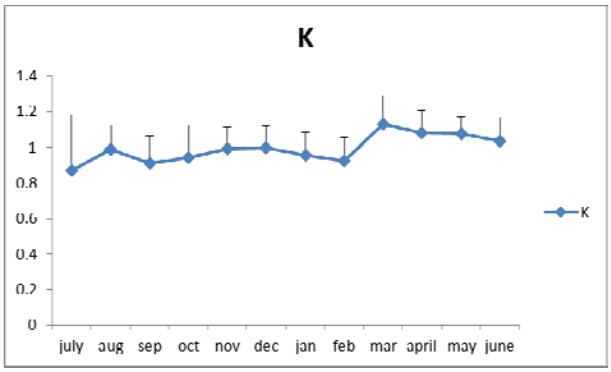
Months	K	S D
July	0.926	±0.125
Aug	0.872	±0.134
Sep	0.898	±0.128
Oct	0.983	±0.108
Nov	0.855	±0.085
Dec	0.872	±0.114
Jan	0.914	±0.109
Feb	1.082	±0.068
March	1.157	±0.140
April	1.105	±0.148
May	1.074	±0.098
June	1.010	±0.064



Month-wise variation in condition factor of *S. plagiostomus* collected from River Lidder-Females.

Table 4: Month wise condition factor K-value of Males of *S. plagiostomus* for different months.

Months	K	S D
July	0.86	±0.31
Aug	0.87	±0.13
Sep	0.910	±0.15
Oct	0.941	±0.178
Nov	0.993	±0.121
Dec	0.999	±0.18
Jan	0.955	±0.126
Feb	0.926	±0.125
March	1.14	±0.40
April	1.08	±0.126
May	1.046	±0.117
June	1.034	±0.133



Month-wise variation in condition factor of *S. plagiostomus* collected from River Lidder, Males.

4. Discussion

It is universal fact that growth of fishes or any other animal increases with increase in body length. Thus it can be concluded that growth and length are inter related. The length-weight relationship can be obtained from length and weight measurement of the same fishes throughout their lives or from a sample of fish taken at a particular time (Wootton, 1990) [38]. Fisheries management and research often requires the use of biometric relationships in order to transform data collecting in the field into appropriate indices (Patiyal, *et al.*, 2010) [29]. Studies on the length-weight relation of fishes constitutes an important tool in fishery biology and helps to understand whether variations from the expected weight for the known groups are the indicators of fatness, well-being and gonadal development in relation to the environment (Le Cren, 1951; Bagenal, 1978; Yousuf *et al*., 2003) [21, 3, 39]. The parameters of fish LWR are affected by a series of factors including, season, habitat, gonad maturity, sex, diet, stomach fullness, health and preservation techniques (Tesch, 1971, Bagenal and Tesch, 1978) [37, 4]. The LWRs obtained monthly throughout a complete annual cycle in the present study, gives more appropriate parameters. All allometric coefficients (b) estimated in this studies were within the expected range of 2.208–2.970, in case of males, and in case of females it ranges from 2.535-3.538, but they can vary between 2 and 4 (Bagenal and Tesch, 1978) [4]. In the present study, the b value was found higher in females as compared to males. The highest 'b' value in females of *S plagiostomus* implies that the females gain weight at a faster rate in relation to its length. The b value of males indicates negative allometry, which indicates that, the increase in length is not in accordance with increase in weight. Similar results were observed by Dar *et al.* (2012) [12] in *Schizopyge esocinus*. Le Cren (1951) [21] had reported that females are heavier than males of the same length probably because of difference in fatness and gonadal development. The slope value of regression line less than'3' has been reported in *Tor tor* (Malhotra, 1982) [23], *Labeo dero* (Malhotra and Chauhan, 1984) [24], *Labeo dyocheilus* (Malhotra, 1985) [22], and *Cyprinus carpio communis* and *Ctenopharyngodon idella* (Dhanze and Dhanze, 1997) [4] and *Rasbora daniconius* (Sunil, 2000) [36]. These reports corroborate with the present findings on the length-weight relationship in *S. plagiostomus* in which significant departure of 'b value from the isometric value of 3 was noticed in respect of both sexes. (Bhat, 2003) [9] had reported that Lidder water is relatively low polluted water and the environmental stress on this species seems to be very low. This has led to the almost ideal growth pattern of fishes in the river. Khan and Sabah (2013) [19] have reported values of b for *S. esocinus, S. labiatus,* and *S. curvifrons* in the Jhelum River of Kashmir. Bhagat and Sunder (1984) [7] have reported the value of b parameter for *S. esocinus* as 3.0034. The value of b reported by Bhat *et al.* (2010) [8] for *S. labiatus* differs from the present study, which is possibly due to several factors such as habitat, number of specimens examined and length ranges and length types used. Qadri and Mir (1980) [31] reported the value of b as 2.4487 for *S. plagiostomus* from the peripheral water bodies of Dal Lake, while as Bhagat and Sunder (1983) [6] have reported it to be 2.9288 for the same fish from Jammu water bodies. Our results are in conformity with the earlier reports of Bhagat and Sunder (1983) [6], Qadri and Mir (1980) [31] Bhat (2010) [8]. Values of b for these snow trout species were within the normal range of 2.5–3.5, as suggested by Froese (2006) [16]. The b values observed in this study (Table 1 and Table 2) were significantly below 3 which mean that the *S. plagiostomus* in River Lidder exhibited negative allometric growth pattern except few months in case of females. In other words, the fishes became thinner as they grew longer. These observations are in agreement with those of Midhat *et al.*, (2012) [26] who observed the b values of 2.2749, 2.2915 and 2.2863 for *S. schall* females, males and combined sexes in River Nile at Gizza. According to Ruiz campos, (2010) [34], the b value ranged from a minimum of 2.863 for reef fin spot (*Paraclinus integripinnis*) to 3.404 for the fluffy sculpin (*Oligocottus snyderi*). All the earlier reports are in compliance with the present study in which the b value was very close to isometric value of 3 and this indicates that *S. plagiostomus* in the present study showed an isometric growth. Also it is well known that the functional regression b value represents the body form, and is directly related to the weight affected by ecological factors such as temperature, food supply, spawning conditions and other factors such as sex, age, fishing time and area (Ricker,

1973) [33]. Allen, (1938) [1] have reported that the cube law is applicable only for those species which maintain the form and specific gravity throughout their life, but the shape and the form of fish may change with time, so the length-weight relationship of most of fish species may deviate the cube law.

Condition indices have been widely used as indicators of relative health (Brown and Murphy, 1991) [11]. The condition factor reflects the well-being of the fish. In the present study the condition factor of *S. plagiostomus* showed variation in different months, it was noticed that value of K for females was highest i.e. 1.157 in March which shows that the fish has entered into the maturation phase, for rest of the months K showed slightly lower values. Similarly in case of males the highest value of K was 1.14±0.40 in the month of March. Le-Cren, (1951) [21] had reported that environmental factors, food supply and parasitism have great influence on the health of the fish. The differences in condition factors seasonally could be attributed to low feeding intensity and degeneration of ovaries during winter and high feeding intensity and full development of gonads during summer months. Comparatively higher values of K during winters could be attributed to high deposition of fats as preparation for the coming breeding season. The present study is the first attempt to provide information about the growth condition of *S. plagiostomus* from wild habitat. This study will enlighten biologists about the status and growth condition of this fish in natural waters and will be useful for the fishery biologists and conservation agencies, for successful development. From a reproductive point of view, the highest K value are reached in the species, if the fish is fully mature and having higher reproductive potentiality (Angelescu *et al*., 1958) [2]. From a nutritional point of view, increase in K value indicates the accumulation of fat and sometimes gonadal development Maguire and Mace, (1993) [25]. Figueiredo-Garutin (1991) [15] had stated that the lowest K value occurs in the beginning of the reproductive period and the highest at its end.

5. Acknowledgements

The authors are grateful to the Head, Department of Zoology, University of Kashmir, Hazratbal, Srinagar, India for providing necessary laboratory facilities and also gratefully acknowledge the Department of Science and Technology (DST), Govt of India, New Delhi for providing the financial support for the establishment of Fish Nutrition Research and Feed Technology Laboratory (Wet-Lab.) in the Department of Zoology.

6. References

1. Allen KR. Some observation on the biology of the trout (Salmotruta) in Windermere. J of Anim Ecol. 1938; 7:333-349.
2. Angelescu V, Gneri FS, Nani A. Argentine sea hake (biology and taxonomy). Secr. Mar. Serv. Hydrogenation. Nav. Public, 1958; H1004:1-224.
3. Bagenal TB. Aspects of Fish Fecundity in: Gerking, S. D. (Ed.), Ecology of Freshwater Fish Production. Blackwell Scientific Publications, Oxford, UK 1978; 75:101.
4. Bagenal TB, Tesch FW. Age and growth. In T.B. Bagenal. (ed.). Methods for assessment of fish production in fresh waters. Blackwell Science Publications. Oxford 1978, 101-136.
5. Beyer JE. On length-weight relationship: Part11. Computing means weights from length statistics. Fish byte 1987; 9:50-54.
6. Bhagath MJ, Sunder S. A preliminary notes on Length weight relationship and condition factor *S.* plagiostomus (Heckel, 1883) from Jammu region. J Inland Fish Soc India. 1983; 15:73-74.
7. Bhagath MJ, Sunder S. Some biological aspects of Schizothoracicthy sesocinus (Heckel) from Kashmir waters with a note on its utility in culture. J Inland Fish Soc India. 1984; 16:42-47.
8. Bhat FA, Yousuf AR, Balkhi MH, Mahdi MD, Shah FA. Length-weight relationship and morphometric characteristics of Schizothorax spp. in the River Lidder of Kashmir. Indian J Fish. 2010; 57:73-76.
9. Bhat FA. Ecology of Schizothorax (Heckel) in Lidder river, Kashmir. M. Phil Dissertation, University of Kashmir, 2003.
10. Bolger T, Connolly PL. The selection of suitable indices for the measurement and analysis of fish condition. J Fish Biol. 1989; 34:171-189.
11. Brown ML, Murphy BR. Standard weight (W_s) development for striped bass, white bass and hybrid bass, N. Am. J Fish Manag. 1991; 11:451-467.
12. Dar SA, Najar AM, Balkhi MH, Rather MA, Sharma R. Length weight relationship and relative condition factor of Schizopygeesocinus (Heckel, 1838) from Jhelum River, Kashmir. International J Aqua Sci. 2012; 3:29-36.
13. Day F. The Fishes of India, being a Natural History of the Fishes known to inhabit the seas and fresh waters of India, Burma and Cylone. Reproduced in1958. London; Willaim Dowen and sons. 1878, 1778.
14. Dhanze R, Dhanze JR. Biology of scale and grass carp, length-weight relationship and growth performance under the Agro Climate Zone of Himachal Pradesh. Indian J of Fish. 1997; 44:255-263.
15. Figueiredo-Garuti ML, Garuti V. Total condition factor and somatic condition factor for females Astyanaxbi maculatus *(*Pisces, Characidae),coming from the northwest region of Sao Paulo Parana River Basin. IX Brazilian Meeting of Ichthyology, 1991, 6.
16. Froese R. Cube law, condition factor and weight- length relationship: history, meta-analysis and recommendations. J Appl Ichthyol. 2006; 22:241-253.
17. Froese R, Pauly D. Fish base concepts, design and data sources (http:\\www.fishbase.org\manual\content.htm) ICLARM, Manila. 1998, 293.
18. Fulton TW. The rate of growth of fishes. Twenty-second Annual Report Part III. Fisheries Board of Scotland, Edinburgh, 1904, 141-241.
19. Khan MA. Sabah. Length –weight and Length – length relationships for five fish species from Kashmir valley. J Appl Ichthyol. 2013; 29:283-284.
20. Kullander SO, Fang F, Delling B, Ahlander E. The fishes of the kashmir valley. In: river Jhelum, kashmir valley (ed. by Nyman, L), 1999, 99-162. Swedmar, The international consultancy group of the National Board of Fisheries, Goteborgs, Lanstryckeri AB., Swedmar.
21. Le-cren ED. The length weight relationship and seasonal cycle in gonadal weight in gonad weight and condition in the pearch (Percafluviatilis). J Anim Ecol. 1951; 20:201-219.
22. Malhotra SK. Bionomics of the Hill stream Cyprinids 1. Food Parasites and Length-weight Relationship Labeo dyochilus. Proc. Ind. Aca. Sci, 1985; 94:377-381.
23. Malhotra SL. Bionomics of Hill stream Cyprinids III Food, Parasites and Length-Weight Relationship of

Garwhal mahaseer, Tor tor (Ham.). Pro. Ind. Aca. Sci 1982; 91:479-485.
24. Malhotra SK, Chauhan RS. (Bionomics of Hill-Stream Cyprinids IV. Length-Weight Relationship of Labeodero (Ham.) from India. Pro. Ind. Aca. Sci 1984; 93:411-417.
25. Maguire JJ, Mace PM. Biological refrence points for Canadian Atlantic gadoid stocks. In Smith SJ, JJ Hunt, D Rivard (Eds.), risk evaluation and biological refrence points for fisheries management. Can. Spec. Publ Fish. Aqua. Sci.
26. Midhat AEK, Mohammed MNA, Seham AI. Environmental studies on Synodontis schall (Bloch and Schneider, 1801), (Pisces: Mochokidae) in The River Nile at Gizza Sector, Egypt: Biological aspects of Population Dynamics. J Fish Aqua Sci. 2012; 7:104-133.
27. Mir JI, Sarkar UK, Dwivedi AK, Gusain OP, Pal A, Jena JK. Pattern of intrabasin variation in condition factor, relative condition factor and form factor of an Indian Major Carp, Labeorohita (Hamilton-Buchanan, 1822) in the Ganges Basin, India. Eur. J Biol Sci. 2012; 4:126-135.
28. Mir JI, Shabir R, Mir FA. Length-weight relationship and condition factor of Schizopyge curvifrons (Heckel, 1838) from River Jhelum, Kashmir, India. World J Fish and Mar Sci. 2012; 4:325-329.
29. Patiyal RS, Sharma RC, Punia Gowswami PM, Lakra, WS. Length-Weight relationship of Tor Putitora (Hamilton, 1822) from the Ladhiya River, Uttarakhand, India. J Appl Icthyol. 2010; 26:472-473.
30. Petrakis G, Stergious KI. Weight length relationship for 33 fish species in Greek waters. Fish Res 1995; 21:465-469.
31. Qadri MY, Mir S. Length weight relationship of Orienus plagiostomus (McCl). Geobios, 1980; 7:158-159.
32. Ricker WE. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can 1975; 191:1-382.
33. Ricker WE. Linear regressions in fishery research. Fish. Res. Board Can 1973; 30:409-439.
34. Ruiz-Campos G, Ramirez-Valdez A, Gonzalez-Guzman S, Gonzalez-Acosta AF, Acosta Zamorano D. Length-weight and length-length relationships for nine rocky tidal pool fishes along the Pacific coast of the Baja California Peninsula, Mexico. J App Ichthyol. 2010; 26:118-119.
35. Singh NO, Paul AK. Fitting of allometric model with expected-value parameters for different species of snow trout from Jhelum River, Kashmir. The Indian J Anim Sci. 2010; 80:85-88.
36. Sunil MS. Length-weight Relationship in *Rasbora daniconius* (Ham.) from Achenkoli River, Pathanamthitta. Kerala, India. Indian J Fish. 2000; 47:271-274.
37. Tesch FW. Age and growth, In: W. E. Ricker (Ed.) Fish Production in Fresh waters. Blackwell, Oxford. 1971, 98-130.
38. Wooten RJ. Ecology of teleost fish. Chapman and Hall, London, 1990.
39. Yousuf AR, Bhat FA, Mahdi D, Ali S, Ahangar MA. Food and feeding habits of Glyptosternon reticulatum McClelland and Griffth in Torrential streams of Kashmir Himalayas. J Res Dev. 2003; 3:124-133.