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# Biometric Analysis and Length Weight Relationship of *Carassius Carassius* (Linneaus 1758) in Dal Lake, Kashmir

**Syed Nadima, F.A. Bhat*, M.H. Balkhi, T.H. Shah and B.A. Bhat**

*Faculty of Fisheries, Rangil, Ganderbal, SKUAST-K, J&K-190 006, India*
**E-mail: fabhat_fb@yahoo.com*

***Abstract***: This study was aimed to describe the morphometrics, meristic and length weight relationship of *C. carassius* in Dal Lake, Kashmir based on 180 specimens for a period of six months. The total length ranged from 88.62 mm to 177.45 mm with the corresponding weight of 8 gm and 86.5 gm respectively. Thirteen morphometric measurements were observed and the coefficient of determination ($R^2$) value was highest between total length and standard length (0.946) and least between head length and snout length (0.503) indicating high degree of relationship between the characters compared. The fin formula of the fish was D(I/18-19); A(I/7); $P_1$(11-13); $P_2$(8-9); C(19-22); LL(30-33): LLP(13-20). The coefficient of determination ($R^2$) for length-weight relationship was 0.872 for females, 0.855 for males and 0.868. The value of "b" for male fish was 3.016 and for females was 3.002. The 'b' for pooled data was 3.054 that showed almost isometric growth in the fish.

***Keywords***: Biometric analysis, *Carassius carassius,* Length-weight relationship, Dal Lake

*Carassius carassius* Linneaus (crucian carp) is a medium sized fish belonging to family Cyprinidae. Its habitat includes lakes, ponds, and slow-moving rivers and is native to England. They are deep bodied and laterally compressed fish with terminal and strongly curved mouth and thick lips having no barbels. Color is grey on back, lighter on sides with whitish underside and dusky fins, with 31-33 Scales in a lateral series, lateral line scales tubed only on anterior 12-25 scales, branched dorsal fin rays 18-20, branched anal fin rays 6-7, gill rakers about 26-27 and the third dorsal and anal fin rays are strong and posteriorly serrated. These are broadly described as having a body of golden-green shining color, young fish are golden – bronze but darken with maturity until they gain a dark green back, deep bronze upper flanks, and gold on the lower flanks and belly and reddish or orange fins (Lintermans 2023), *C. carassius* in Kashmir is known as "Crucian carp" and was introduced in Kashmir during 1956-1958 in Dal lake (Shafi 2012). It is among one of the common cyprinids found in Dal lake Kashmir and is well adapted to wide range of habitats to enable tolerance with varied environmental factors. It spawns in dense submerged vegetation (Kottelat and Freyhof 2007). Maqbool (2017) reported *C. carassius* contributes 32.09% in catch composition and 20.5% by biomass in Dal Lake. This study aimed to understand the changes in morphometric and meristic characters in *C. carassius* which can be an important aspect of adaptation and evolution happening in the region and can provide a basis for population differentiation.

## MATERIAL AND METHODS

A total of 180 specimens of *Carassius carassius* were observed for a period of six months (December to May). Thirteen morphometric measurements were studied using the standard procedures described by earlier researchers (Lagler et al., 1962, Laevastu 1965, Appa Rao 1966, Dwivedi and Menezes 1974, Grant and Spain 1977).Meristic characters have definite number and count, they were analyzed following the conventional method as described by Hubbs and Lagler (1958). During the present study, seven meristic characters were counted. Relationships between the various body measurements to the total length and head length were calculated. Range, mean, median, standard deviations and correlation of coefficient were estimated for the characters under study.

Morphometric characters were plotted using Scattergram. The relationship between the various morphometric measurements was determined by linear regression formula: Y = a + b X Where, 'Y' is the dependent variable, 'X' is the independent variable, 'a' is a constant (intercept) and 'b' the regression coefficient (slope). The length-weight relationship was estimated from the allometric separately for both sexes and significant differences, if any, in the slopes of the regression lines for males and females were ascertained (Le-Cren 1951).

$W = aL^b$ or $\text{Log } W = \log a + b \log L$

Where, W is the total body weight in grams, L is the total length in mm, a and b are the coefficients of the functional regression between W and L.

## RESULTS AND DISCUSSION

The total length ranged from 88.62 (January) to 177.45 mm (April) with the corresponding weight of 13.5 and 86.5

gm respectively. The standard length was maximum in April (142.75 mm) and minimum in January (71.03 mm). Total length showed a maximum coefficient of variation (0.40%) while standard length, pre-orbital length, and post orbital length showed minimum variation (0.12%) (Table 1). The coefficient of determination ($R^2$) was highest between total length and standard length (0.946) that was followed by total length and pre-anal and pre-pelvic length. The least was between head length and snout length (0.503) followed by head length and eye diameter (0.544) indicating high degree of relationship between the characters compared (Fig. 1, 2). Variety of morphological, physiological, behavioral and biochemical characteristics are used in the identification of fishes. The 'b' values obtained among various morphometric characters showed highest correlation (0.834) between total length and standard length, while as lowest 'b' value (0.083) was between total length and post orbital length. Bhat et al. (2010) studied the morphometric characteristics of *Schizothorax* species in the River Lidder of Kashmir and reported maximum growth in standard length (0.9080) and least in maximum body depth (0.1730) with respect to the total length of the fish. Shah et al. (2011) in farmed rainbow trout in Kashmir reported high level of interdependence between the fourteen morphometric characters. Qadri et al. (2017) also reported high relation in total length and standard length and lowest between total length and head length of S. curvifrons in River Jhelum, Kashmir. Similar inferences as

**Table 1.** Weight (gms) and various morphometric characters (mm) of *Carrassius carassius* Linneaus

| Statistical estimates | Range (mm) | | Mean (mm) | Coefficient of variation (%) |
|---|---|---|---|---|
| | Min | Max | | |
| Total length | 88.62 | 177.4 | 129.55 | 0.40 |
| Weight(gm) | 8.0 | 86.5 | 37.73 | 0.40 |
| Standard length | 71.03 | 142.75 | 105.52 | 0.12 |
| Pre-dorsal length | 34.71 | 75.25 | 52.97 | 0.13 |
| Pre-pectoral length | 16.59 | 46.19 | 31.15 | 0.15 |
| Pre- pelvic length | 33.05 | 76.01 | 54.09 | 0.13 |
| Body depth | 20.58 | 54.9 | 40.15 | 0.14 |
| Pre-anal length | 53.14 | 111.28 | 81.26 | 0.13 |
| Head length | 15.03 | 33.45 | 25.54 | 0.18 |
| Snout length | 4.45 | 12.85 | 8.75 | 0.20 |
| Eye diameter | 4.32 | 9.56 | 7.08 | 0.13 |
| Caudal fin length | 18.46 | 35.03 | 27.14 | 0.13 |
| Pre-orbital length | 6.16 | 13.87 | 10.22 | 0.12 |
| Post-orbital length | 9.04 | 16.97 | 13.30 | 0.12 |

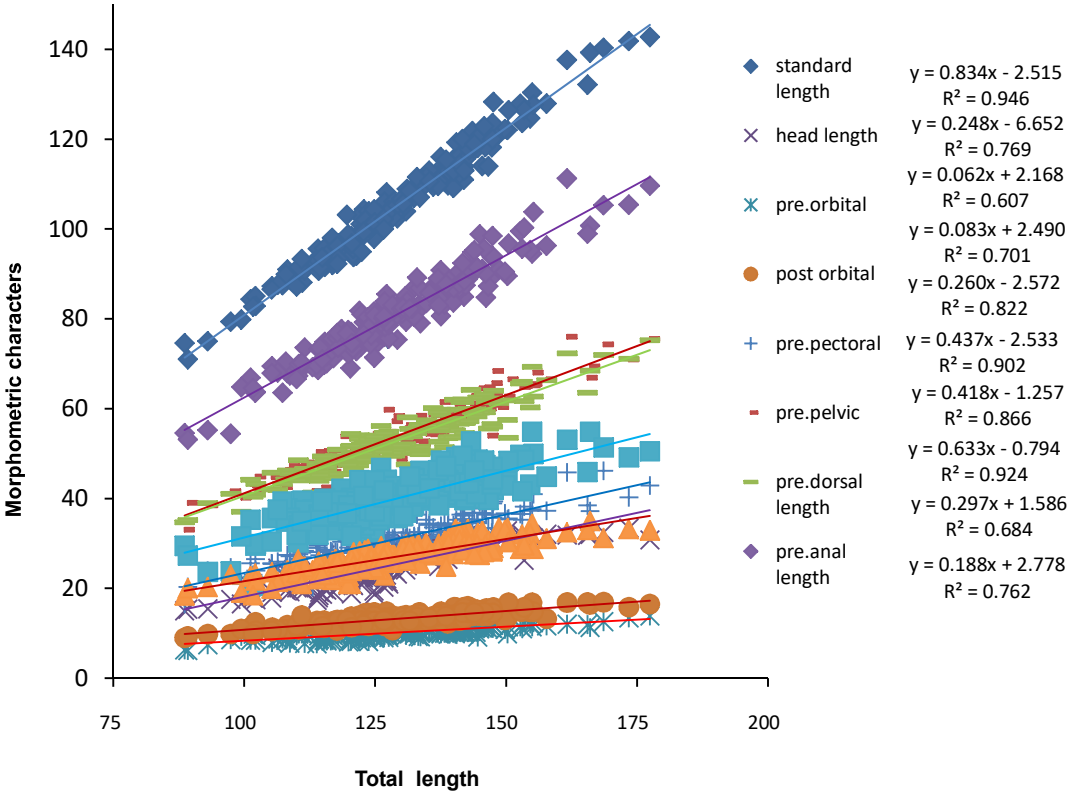


**Fig. 1.** Logarithmic relationship of different morphometric characters with total length of *Carassius carassius* Linneaus

well as high positive correlation among morphometric characters were reported in earlier studies (Balai et al., 2017, Arafat and Bakhtiyar 2020, Sidiq et al., 2021, Khan et al., 2022, Zakiya et al., 2024).

**Meristic characters:** Meristic characters have definite number and are countable, repetitive structures that help in fish classification; sometimes they vary and fall under some specific range. (Langer et al., 2013, Jan and Ahmed 2020) Seven meristic characters i.e., number of lateral line scales, dorsal fin rays, pectoral fin rays, pelvic or ventral fin rays, caudal fin rays, anal fin rays and lateral line pores of *C. carassius* were recorded in current study, out of which lateral line scales ranged from 30-33, dorsal fin, 18-1, 19, pectoral fin 11-13, pelvic fin 8-9, caudal fin 19-22, anal fin 1, 7 and lateral line pores ranged from 13-20 in length groups. The number of spines measured in dorsal fin and anal fin was one spine in all length groups (Table 2). Findings show that some counts of *C. carassius* showed similarities, while some counts showed variation in all length groups. Fin formula was:

D (I/18-19); A (I/7); $P_1$ (11-13); $P_2$ (8-9); C (19-22); LL (30-33); LLP (13-20)

Kottelat and Freyhof (2007) and Froese and Pauly (2011) reported Dorsal spines: 3 - 4; Dorsal soft rays: 13-22; Anal spines: 2 - 3; Anal soft rays: 5 - 7; V; lateral line with 31-36 scales; Caudal fin with 18-20 rays and no barbells in *C. carassius.* FAO (2017) reported 27-30 scales in lateral line, dorsal fin ray: 3, 15-19; pectoral fin ray: 1, 16-17; ventral fin ray: 1, 8; anal fin ray: 3, 5 in *C. carassius* showing certain variations from present study. Variations in meristic characters were reported in many fishes such as *Nematalosa nasus* (Al Hassan 1987), *Pterophyllum scalare* (Bibi et al., 2008) and *Crossochelius latius* (Brraich and Akhter (2015). During present study, meristic counts are dependent of body size and there is change in meristic counts with increase in body length. The lateral line counts observed during the present study varied from the earlier studies, the difference indicates that different locations and environment have considerable impact on meristic characters. The differences can be due to geography, ecology and human activities (Lawson 2010) and considerable impact of abiotic factors and biotic factors like depth, turbidity, and temperature of water population size, fish growth (Ezeafulukwe et al., 2015, Hasan et al., 2021).

**Length-weight relationship:** The length range of 88.62 mm to 177.45 mm and weight range of 8g to 86.5 g comprising of 91 males and 89 females were analyzed for length weight relationship. The relationships for males, females and combined were established as, Log W = -4.830 + 3.016 Log L; Log W = -4.778 + 3.002 Log L and Log W = -4.889 + 3.054 Log L respectively (Fig. 3, 4 and 5).The coefficient of determination ($R^2$) for length-weight relationship was 0.872 for females, 0.855 for males and 0.868 for pooled data. The value of “b” for male fish was 3.016 and for females it was found to be 3.002. The 'b' (3.054) for pooled data showed isometric growth in the fish which show fish grows with equal proportions in all dimensions. Zargar *et al*. (2012) recorded length weight relationship of *C. carassius* in three water bodies from Kashmir that included Anchar Lake, Dal Lake and Manasbal Lake and reported different values of 'b' showing inter Lake Variation. The fish showed positive allometric growth b>3.0; heavy group in Manasbal Lake and Anchar Lake and isometric growth of equal increment of both parameters of length and weight in the Dal Lake showing similarity with the results from the present study. Bhat et al. (2010) reported the value of 'b' between 2.9467 to 3.0997 in *Schizothorax* species showing almost ideal growth pattern of the three species. Shafi and Yousuf (2012) observed exponential value (b) indicating the isometric growth for the fish of *Schizothorax niger* from Dal Lake. Farooq et al. (2017) and Qadri et al. (2017) observed negative allometric growth in *S. labiatus* and *S.curvifrons.* Shah et al. (2013) and Wali et al. (2019) reported isometric growth for rainbow trout from Kashmir indicating fish growth with equal proportions in all dimensions. Zakiya et al. (2024) reported b value of 3.152, which indicated positive allometric growth in *S. progastus* in Ladakh region.

**Table 2.** Meristic characters of *C. carassius* Linneaus in different length groups

| Meristic characters | Length groups (mm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 85-95 | 96-105 | 106-115 | 116-125 | 126-135 | 136-145 | 146-155 | 156-165 | 166-175 | 176-185 |
| Lateral line scales | 30 | 31 | 31 | 31 | 31 | 32 | 32 | 32 | 33 | 33 |
| Dorsal fin | 1,18 | 1,19 | 1,19 | 1,19 | 1,19 | 1,19 | 1,19 | 1,19 | 1,19 | 1,19 |
| Pectoral fin | 11 | 11 | 12 | 12 | 12 | 12 | 12 | 13 | 13 | 13 |
| Pelvic fin | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 |
| Caudal fin | 19 | 19 | 20 | 20 | 20 | 20 | 21 | 21 | 21 | 22 |
| Anal fin | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 |
| Lateral line pores | 13 | 13 | 14 | 14 | 14 | 16 | 17 | 18 | 20 | 20 |

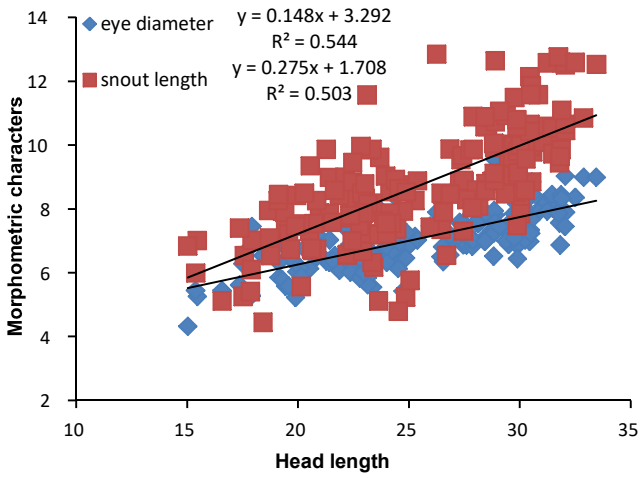


**Fig. 2.** Logarithmic relationship of different snout length and eye diameter with head length of *Carassius carassius* Linneaus

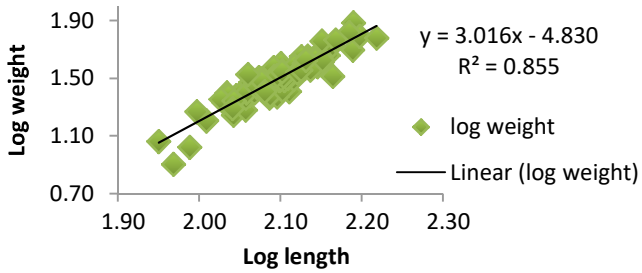


**Fig. 3.** Logarithmic relationship between length and weight in *Carassius Carassius* Linneaus (Male)

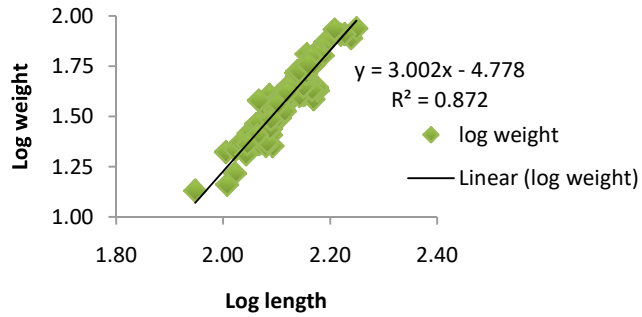


**Fig. 4.** Logarithmic relationship between length and weight in *Carassius Carassius* Linneaus (Female)

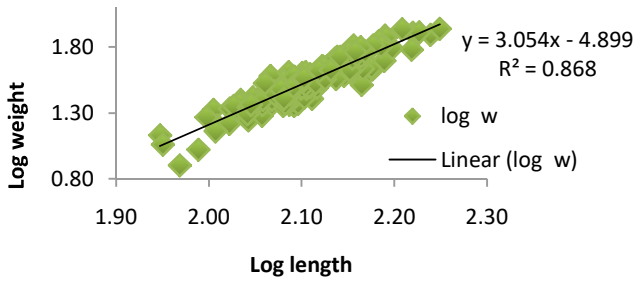


**Fig. 5.** Logarithmic relationship between length and weight in *Carassius carassius* Linneaus (Combined)

## CONCLUSION

This study provides the valuable data on the biometric analysis and length-weight relationship and different morphometric measurements and meristic counts can also be used to differentiate the external changes, ontogenic associations and recognition, stock structure of the species and explain the effect of various environmental factors on growth in fish. *Carassius carassius* showed an isometric growth that is relatively suitable for the growth of this species in this region and making the data valuable for further biological studies. Moreover, comprehensive studies are required for a better understanding of the population dynamics of the species and the status of fish population in different habitats.

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