

Full Length Research Paper

Age and growth of *Gerres filamentosus* (Cuvier, 1829) from Kodungallur, Azhikode Estuary, Kerala

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The age and growth, length – weight relationship and relative condition factor of *Gerres filamentosus* (Cuvier, 1829) from Kodungallur, Azhikode Estuary were studied by examination of 396 specimens collected between May 2008 to October 2008. Here, length frequency method was used to study age and growth in fishes. L_{∞} , K and t_0 obtained from seasonal and non - seasonal growth curves. *Gerres filamentosus* showed a low mortality rate (Z) $3.702 y^{-1}$. *G. filamentosus* has moderately low K value and long life span. The relation between the total length and weight of *G. filamentosus* was described as $\text{Log } W = 1.321 + 2.5868 \log L$ for males, $\text{Log } W = 1.467 + 2.7227 \log L$ for females and $\text{Log } W = 1.481 + 2.7316 \log L$ for sexes combined. The mean relative condition factor (K_n) values ranged from 0.9 to 1.14 for males, 0.89 to 1.11 for females and 0.73 to 1.08 for sexes combined. The length weight relationship and relative condition factor showed that the wellbeing of *G. filamentosus* were good. The morphometric measurements of various body parts were recorded. The morphometric measurements were found to be nonlinear and there is no significant difference observed between the two sexes.

Key words: Age and growth, length weight relationship, condition factor, morphometry, *Gerres filamentosus*.

INTRODUCTION

Studies on age and growth are important in fisheries research. Most of the methods employed for assessing the state of exploited fish stocks rely on the availability of age composition data (Ricker, 1975). Information on growth rate, natural and fishing mortality, age at maturity and spawning, age composition of the exploited populations etc. can be generated from age data of fish populations. Length – weight relationship studies of any fish species is a pre requisite for the study of its population (Le Cren, 1951). The ponderal index or condition factor or the 'fatness' (K) was worked out to assess the well-being of the population with the assumption that the growth of fish in ideal conditions maintain an equilibrium in length and weight (Hile, 1936).

The data on length – weight relationship and the associated condition factor also enables to compare the population of the same species from different environments. The study of morphometric characters in fishes is important because they can be used for the differentiation of taxonomic units. The present study provides comprehensive information on the age and growth, length weight relationship, relative condition factor and morphometry of *Gerres filamentosus* (Cuvier, 1829) from Kodungallur, Azhikode Estuary, Kerala.

G. filamentosus is an economically important food fish species, also known as silver – biddies of the family Gerreidae. The importance of the species of the genus *Gerres* as food and ornamental fish is significant in the

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context of its sustainable use of the resource and conservation of the endemic fish germplasm. The study on the biology of food and feeding habits of *Gerres oblongus* (Abeyrami and Sivashanthini, 2008), *Gerres macracanthus* (Badrudeen and Mahadevan, 1996) and population dynamics of *Gerres abbreviatus* (Kuganathan, 2006) and *Gerres setifer* (Sivashanthini et al., 2004) were the works done on *Gerres*. A survey on the literature of *Gerres* sp.; showed that, there was very little information available on the age and growth of *G. filamentosus* from this sub continent. It was in view of this, that the age and growth of *G. filamentosus* from a wetland system in Kerala is presented in this study.

MATERIALS AND METHODS

Fresh fish samples were collected weekly during May 2008 to October 2008 from the fishermen of the Anappuzha region, Azhikode estuary, Kodungallur (Latitude 10° 11'53" N and Longitude 76°12'13" E). The backwater is known for fishing activities. A total of 396 specimens of *G. filamentosus* ranging in size from 6.8 to 24.2 cm in total length (TL) were used for the age and growth, length- weight analysis and various morphometric measurements. The relationship between various parameters was determined by the method of least square.

Length of fish was measured to the nearest mm and weight up to 0.1 g. The fishes were then sexed by observing the gonads after dissecting the abdomen. The total length was measured from the tip of snout to tip of upper caudal lobe to the nearest mm and weight to 0.5 accuracy. The growth parameters were estimated using Von Bertalanffy's (1938) equation based on the length data on weekly modal progression. The data on males, females and both combined were subjected to analysis using the length frequency data analysis (LFDA) version 5.0 (Kirkwood and Hoggarth, 2006). The total mortality rate (Z) was estimated following Beverton and Holt (1956) method. The Von Bertalanffy growth function of the length frequency data was estimated base on the following:

1. Shepherd's length composition analysis (SLCA, Shepherd, 1987).
2. The projection matrix method (PROJMAT, Rosenberg et al., 1986).
3. ELEFAN method (Pauly, 1987).

The Von Bertalanffy growth function (VBGF) was used to describe the growth the simplest version of VBGF has the form

$$L_t = L_\infty (1 - e^{-k(t-t_0)})$$

Where, L_t is the length of fish at age t , L_∞ is the average maximum length, K is a measure of the growth rate (the rate at which L_∞ is approached) and t_0 is the time (age) at which length is zero. The length – weight relationship of the form $W = aL^b$ was calculated for male, female and pooled, which was transformed in logarithmic form as $\text{Log } W = \text{Log } a + b \text{ Log } L$. Ponderal index (K_n) was observed separately for males and females of different length groups. It was calculated for each 3 cm length interval. The smoothed mean weights W , for each length group have been computed from this Log formula. LeCren's (1951) modified formula, $K_n = W/aL^3$ was used for calculation of the relative condition factor. Nineteen morphometric characters were studied following the standard procedures described by Appa (1966) and Dwivedi and

Menezes (1974).

RESULTS

Age and growth

In practice, it has been found that the SLCA method does not perform well when estimating seasonal growth parameters, and so LFDA allows only the PROJMAT and ELEFAN methods to be used for fitting seasonal growth curves (Tables 2 and 3). Total mortality was estimated by using the methods of Beverton and Holt (1956). Z was calculated from the mean length derived from the Von Bertalanffy parameters. All three of the mortality estimators available in LFDA are based on non-seasonal von Bertalanffy growth curves. The von – Bertalanffy growth equations for the different sets of parameters can be written as: From nonseasonal growth curves,

$$L_t = 335.00(1 - e^{-1(t+0.47)}) \text{ for combined and male}$$

$$L_t = 335.00(1 - e^{-1(t+0.53)}) \text{ for female (Table 1)}$$

Here the values obtained by SLCA method. By this method values of K , L_∞ and t_0 were same (Table 1). From Hoing seasonal growth curves both pooled and males the same values were obtained from PROJMAT and ELEFAN method. And they can be written as:

$$L_t = 467.79(1 - e^{-0.30(t+0.16)}) \text{ pooled (ELEFAN METHOD)}$$

$$L_t = 414.96 (1 - e^{-0.87(t + 0.41)}) \text{ pooled (PROJMAT METHOD)}$$

$$L_t = 639.9 (1 - e^{-0.47(t + 0.47)}) \text{ male (ELEFAN METHOD)}$$

$$L_t = 414.9(1 - e^{-0.41(t + 0.86)}) \text{ male (PROJMAT METHOD)}$$

$$L_t = 412.3(1 - e^{-0.99(t + 0.39)}) \text{ female (PROJMAT METHOD)}$$

$$L_t = 399.9(1 - e^{-0.60(t + 0.80)}) \text{ female (ELEFAN METHOD) (Table 2)}$$

From Pauly seasonal growth curves different values were obtained for male, female and pooled.

$$L_t = 374.73(1 - e^{-0.96(t+0.09)}) \text{ pooled (PROJMAT)}$$

$$L_t = 299.33(1 - e^{-1(t+0.58)}) \text{ pooled (ELEFAN)}$$

$$L_t = 693.66(1 - e^{-0.25(t+0.78)}) \text{ male (ELEFAN)}$$

$$L_t = 515(1 - e^{-0.39(t+0.75)}) \text{ male (PROJMAT)}$$

$$L_t = 391.35(1 - e^{-0.86(t-0.54)}) \text{ female (ELEFAN)}$$

Table 1. The different growth parameters using non seasonal von Bertalanffy growth model in *G. filamentosus*.

Sex	Method	K	L [∞]	T0
Combined	SLCA	1	335	-0.47
Male	ELEFAN	1	335	-0.47
Female	SLCA	1	335	-0.53

Table 2. The different growth parameters using Hoenic seasonal von Bertalanffy growth model in *G. filamentosus*.

Sex	Method	K	L [∞]	T0	Ts	C
Combined	PROJMAT	0.87	414.96	-0.41	0.07	0.54
Combined	ELEFAN	0.30	467.79	-0.16	-0.4	0.44
Male	PROJMAT	0.86	414.9	-0.41	0.07	0.58
Male	ELEFAN	0.47	639.9	-0.47	-0.4	0.48
Female	PROJMAT	0.99	412.3	-0.39	0.13	0.87
Female	ELEFAN	0.60	399.9	-0.80	0.07	1.30

Table 3. The different growth parameters using Pauly seasonal Von Bertalanffy growth model in *G. filamentosus*

Sex	Method	K	L [∞]	T0	Ts	NGT
Combined	PROJMAT	0.96	374.73	-0.09	-0.78	0.86
Combined	ELEFAN	1	299.33	-0.58	-0.48	0.01
Male	PROJMAT	0.39	515	-0.75	-0.26	0.67
Male	ELEFAN	0.25	693.66	-0.78	-0.47	0.68
Female	PROJMAT	0.93	408.48	-0.12	-0.16	0.61
Female	ELEFAN	0.86	391.35	-0.54	-0.38	0.67

$L_t = 408.48(1 - e^{-0.93(t-0.12)})$ female (PROJMAT) (Table 3 and Figures 1, 2, 3).

The L[∞] values obtained were found to range from 374.73 to 693.66 mm from seasonal growth curves (Tables 2 and 3) and 335 mm in non seasonal growth curves (Table 1). The range of estimated K value was 0.25 to 1 from seasonal growth curves and 1 from non seasonal growth curves. According to, von Bertalanffy plot was created to estimate the growth coefficient K. The K was determined from non seasonal curves as 1 and t zero as -0.47 years. The total mortality rates (Z) obtained from a length converted catch curve is 3.702y⁻¹.

Length-weight relationship

Length – weight equations were calculated separately for males, females and sexes combined. The fish samples were divided into 3 cm length groups (Table 4 and

Figures 4, 5, 6). When empirical values of lengths were plotted against their respective weight on an arithmetic scale, smooth curves were obtained. The regression coefficients were calculated using the methods of least squares for male and female, *G. filamentosus* in the size range 6.8 to 24.2 cm gave the following equations:

$$\begin{aligned} \text{Male} \quad W &= 0.0478 L^{2.5868} \\ \text{Log } W &= 1.321 + 2.5868 \log L \end{aligned}$$

$$\begin{aligned} \text{Female} \quad W &= 0.0341 L^{3.7227} \\ \text{Log } W &= 1.467 + 2.7227 \log L \end{aligned}$$

$$\begin{aligned} \text{Pooled} \quad W &= 0.0330 L^{2.7316} \\ \text{Log } W &= 1.481 + 2.7316 \log L \end{aligned}$$

As may be seen from the equations, the exponential values for males, females and sexes combined were practically identical.

Growth Curve = Pauty Seasonal. Linf = 408.48. K = 0.93. Tzero = -0.12. Ts = 0.16. NGT = 0.64

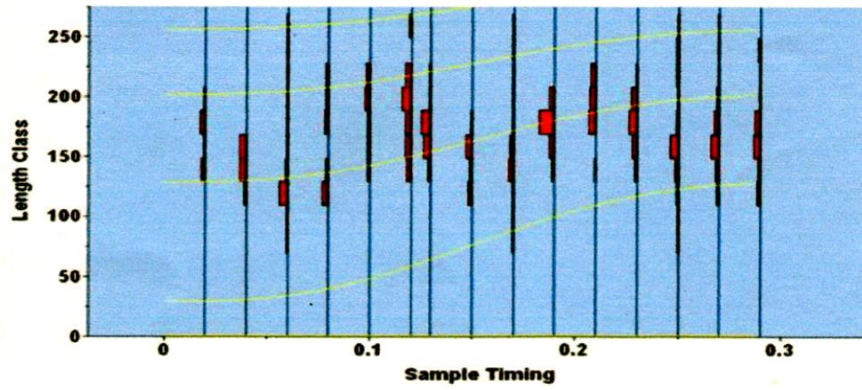


Figure 1. Growth curve (Pauty seasonal), combined sex.

Growth Curve = Pauty Seasonal. Linf = 408.48. K = 0.93. Tzero = -0.12. Ts = 0.16. NGT = 0.64

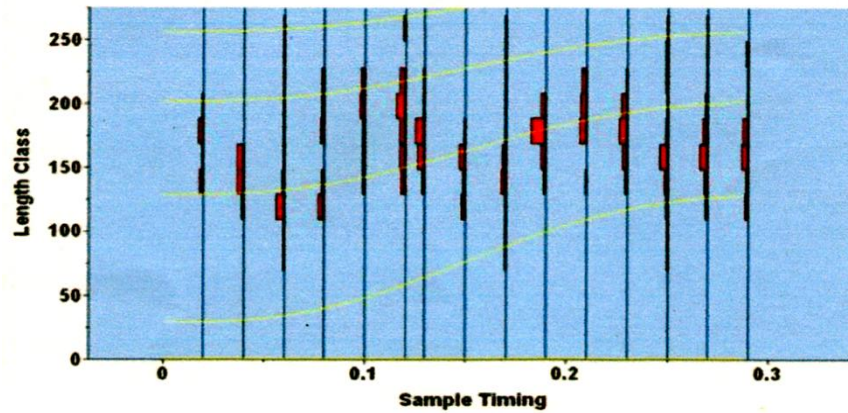


Figure 2. Growth curve (Pauty seasonal), female.

Growth Curve = Pauty Seasonal. Linf = 374.73. K = 0.96. Tzero = -0.09. Ts = -0.78. NGT = 0.86

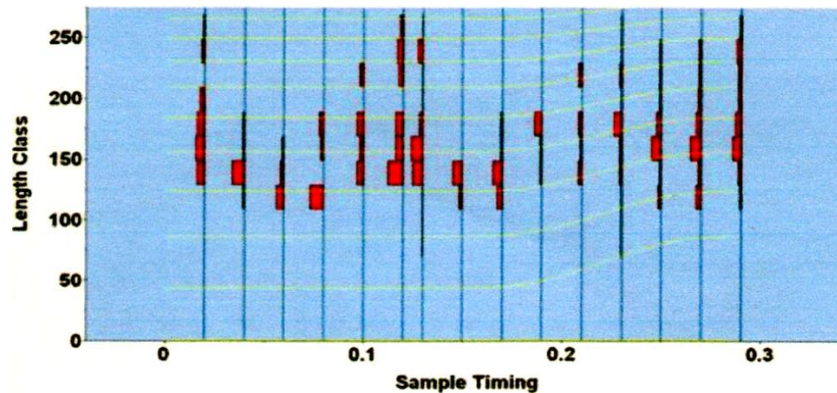
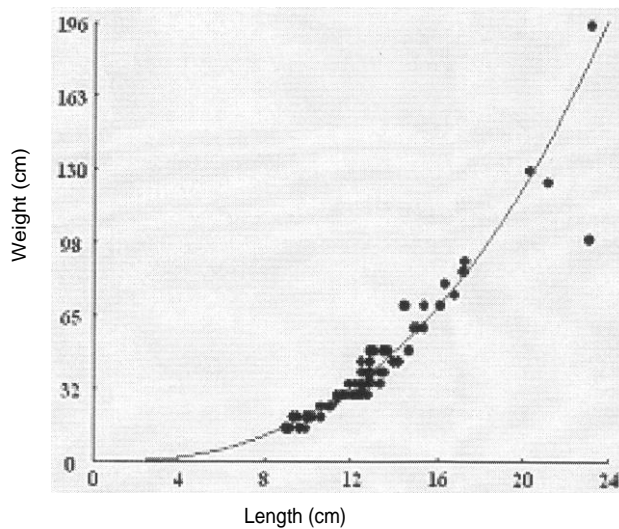
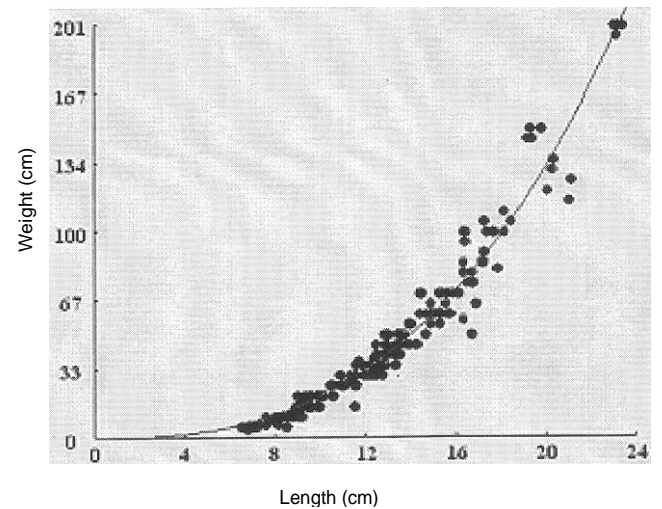
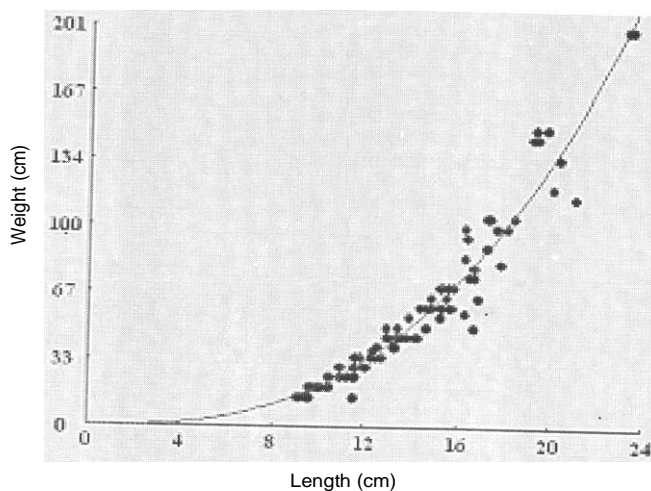


Figure 3. Growth curve (Pauty seasonal), male.

Table 4. Data on length and weight of *G. filamentosus* from Anappuzha.

Length group (cm)	No of fishes combined	Mean length (cm)	Mean weight (g)	No of male	Mean length (cm)	Mean weight (g)	No of female	Mean length (cm)	Mean weight (g)
6-9	37	8.86	9.22	0	0	0	0	0	0
9-12	61	10.21	18.72	28	9.92	21.71	18	10.69	20
12-15	111	13.64	41.11	65	13.22	38.97	46	13.61	42.83
15-18	123	16.53	70.21	46	16.58	69.37	77	16.51	68.87
18-21	48	19.21	111.16	6	19.2	114.66	42	19.67	110.79
21-24	17	21.84	130	10	22	134.5	7	21.6	123.57
24-27	3	24.23	198.33	1	24.1	195	2	24.3	200

**Figure 4.** Length weight relationship of *Gerres filamentosus* in Azhikode estuary (male).**Figure 6.** Length weight relationship of *Gerres filamentosus* in Azhikode estuary (combined).**Figure 5.** Length weight relationship of *Gerres filamentosus* in Azhikode estuary (Female).

Relative condition factor

The relative condition factor (K_n) can be computed using the formula:

$$K_n = W / a L^n \text{ (Le Cren, 1951)}$$

This can be expressed as $K_n = W/W'$; Where W is observed weight and W' the calculated weight as determined from the length – weight equations. The relative condition factor (K_n) for all fish samples were determined from the average lengths and weights of 3 cm interval of total length (Table 5). The values of K_n showed fluctuation in all size groups of both males females and sexes combined. The weekly K_n values were calculated for various length groups. Values of K_n for different size groups ranged from 0.9 to 1.14 in males, 0.89 to 1.11 in females and from 0.73 to 1.08 in sexes combined (Tables 5 and 6).

Table 5. Relative condition factor (Kn) values of *G. filamentosus* from Anappuzha.

Length group (cm)	Male			Female			Combined		
	Observed Wt (g)	Calculated Wt (g)	Kn	Observed Wt (g)	Calculated Wt (g)	Kn	Observed Wt (g)	Calculated Wt (g)	Kn
6 - 9	0	0	0	0	0	0	9.22	12.63	0.73
9 - 12	21.71	19.04	1.14	20	19.76	1.01	18.7	18.54	1.01
12 - 15	38.92	39.97	0.973	42.82	38.61	1.11	41.11	40.60	1.01
15 - 18	69.38	71.72	0.97	68.87	65.97	1.04	70.21	68.28	1.03
18 - 21	114.6	104.85	1.09	110.79	107.23	1.03	11.16	102.53	1.08
21 - 24	134.5	148.85	0.90	123.57	139.01	0.89	130	145.08	0.89
24 - 27	195	188.35	1.04	200	192.71	1.04	198.3	192.14	1.03

Table 6. K and Kn values of *G. filamentosus* for different length groups.

Male			Female			Combined		
Length (cm)	K	Kn	Length (cm)	K	Kn	Length (cm)	K	Kn
0	0	0	0	0	0	8.286	1.62	0.73
9.917	2.23	1.14	10.69	1.64	1.01	10.209	1.76	1.01
13.22	1.69	0.97	13.61	1.69	1.11	13.635	1.62	1.01
16.58	1.52	0.97	16.514	1.53	1.04	16.529	1.55	1.03
19.2	1.62	1.09	19.67	1.46	1.03	19.206	1.57	1.08
22	1.26	0.9	21.6	1.23	0.89	21.835	1.25	0.89
24.1	1.39	1.04	24.3	1.39	1.04	24.233	1.39	1.03

Morphometric characters

Morphometric measurements of various parts of the body and their percentage ratio in relation to TL for males and females of 75 fishes (36 males and 39 females) ranging from 7.2 to 22.3 cm, TL are given in Table 7. As may be seen from the tables, fork length, standard length, body depth, pre anal length, pre dorsal, pre pectoral, base of dorsal, base of pelvic, length of pectoral, length of pelvic, length of anal, length of caudal, least width of caudal peduncle, head length, snout length, post orbital length, inter orbital length and gape width are highly correlated with TL and the relationship between body measurements are found to be non linear.

DISCUSSION

Quantification of age and growth is a vital component for understanding the ecology and life history of any fish species (Thomas et al., 2006). Age and growth of fishes can be estimated by indirect methods such as length frequency analysis and rings appearing on the scales. In the present study L_{∞} was estimated by non seasonal and seasonal growth curves. In non seasonal methods L_{∞} and K obtained in male, female and sexes combined are equal. In seasonal growth curves L_{∞} obtained are higher

in males than females (Tables 1, 2 and 3).

In the present study the K value range from 0.25 to 1. Pauly (1984) reported that species having shorter life have high K value and reach their L_{∞} within one or two years. Similar observations were seen in the study on *P. hamrur*, where K value was 0.69 and their L_{∞} 360 mm (Yassar et al., 2009). On the other hand, those having flat growth rates have lower K values and take many years to reach their L_{∞} . Most of the fish species have a growth rate, K of between 0.1 and 1.0 per year. With a K of 0.1 per year fish grow 9.5% closer to L_{∞} each year. With a K of 1 per year, they grow 63% closer to L_{∞} each year. The parameter t zero is the theoretical age (t) at which the fish would have had zero length if growth had followed the VBGF from birth. *G. filamentosus* has moderately low K value and long life span. All three of the mortality estimators available in LFDA are based on non-seasonal von Bertalanffy growth curves, so it cannot be used to estimate mortality for a stock displaying strongly seasonal growth. *G. filamentosus* showed a low mortality rate (Z) $3.702y^{-1}$. Low mortality rates showed by catfish like *Pylodictis divaris* (Das, 1994).

It is universal that growth of fishes or any other animal increases with the increase in body length. Thus, it can be said that length and growth are interrelated. Length weight relationship is expressed by the cube formula $W = aL^3$ by earlier workers (Brody, 1945; Largler, 1952;

Table 7. Regression values for various morphometric characteristics as function of total length.

Parameter	a	b	R	R ²	Y = b X + a
Fork length	5.488	11.880	0.924	0.854	11.880TL + 5.488
Standard length	7.173	15.527	0.870	0.756	15.527TL + 7.173
Body depth	2.556	5.534	0.916	0.839	5.534TL + 2.556
Pre anal length	2.631	5.695	0.710	0.505	5.695TL + 2.631
Pre dorsal length	1.669	3.614	0.904	0.818	3.614TL + 1.669
Pre pectoral length	1.227	2.657	0.941	0.885	2.657TL + 1.227
Pre pelvic length	1.449	3.138	0.925	0.855	3.138TL + 1.449
Base of dorsal	1.948	4.218	0.949	0.901	4.218TL + 1.948
Base of pelvic	0.431	0.933	0.695	0.484	0.933TL + 0.431
Length of dorsal	2.606	5.642	0.943	0.888	5.642TL + 2.606
Length of pectoral	2.030	4.395	0.871	0.758	4.395TL + 2.030
Length of pelvic	1.533	3.378	0.914	0.836	3.378TL + 1.533
Length of anal	1.732	3.750	0.761	0.580	3.750TL + 1.732
Pre orbital length	0.789	1.707	0.700	0.490	0.789TL + 0.789
Inter orbital width	0.520	1.126	0.710	0.505	1.126TL + 0.520

Brown, 1957). In the present study the value of 'b' in *G. filamentosus* was found to range between 2.5860 to 2.7316. The highest 'b' value was arrived in females followed by males. The exponential value of 2.7227 implies that the female gain weight at a faster rate in relation to the length than male (2.5868). Le Cren (1951) reported that females are heavier than the males of the same length probably because of the difference in fatness and gonadal development. All the earlier reports (Hile, 1936; Tesch, 1968; Narejo et al., 2000) are in compliance with the present findings on the length-weight relationship in *G. filamentosus* in which the 'b' values were very close to the isometric value of 3. This indicated that *G. filamentosus* in the present study showed an isometric growth.

In the present study, sex - wise analysis of Kn values in males (1.14) was higher than that of females (0.927) (Tables 2 and 3 and Figure 4). In sexes combined, the mean value was 1.03. According to Le Cren (1951), Kn values greater than 1 indicates good general condition of the fish whereas values less than 1 denotes the reverse condition. High Kn values were recorded in *Labeo rohita* (1.0129) and *Catla catla* (0.9967) by Pandey and Sharma (1998) from Uttar Pradesh. In the present study also males showed the highest value (1.14) when compared to females. This indicates that males are in better condition when compared to females. The values of K showed significant fluctuation in both males and females which may be due to difference in the weight of food contents in the stomach. This result supports the results of Kader and Rahman (1978); Umesh et al. (1996) and Das et al. (1997). In males, Kn values remained high in size group up to 9 to 12 cm and then gradually declined by 12 – 15 and 15 – 18 values showing major fluctuations

which may be due to several factors like spawning activity, feeding condition, maturation cycle and several other unknown factors of the species. In females Kn value remained almost equal in size group up to 12 to 15 cm followed by 15 to 18 cm indicating attainment of maturity in this size group.

Thus from the study, it is observed that, the body parameters grew symmetrically when observed in different length groups. Similar observations were reported in *Mahseer* spp by Mann (1976), Talwar and Jhingran (1992) and Muhammad et al. (2002). The morphometric measurements were found to be linear and there is no significant difference observed between the two sexes. From the regression results of morphometric characters, the coefficient of determination (r^2) was noted to varying strength relationships between the total length against other measurements. As such the relative growth of the morphometric characters in relation to the total length was noted to be the least in the base of pelvic ($b=0.933$) and the highest in the standard length ($b=15.527$). Thus from the present investigation on age and growth of *G. filamentosus* indicated that the wellbeing of the species studied were good and showed a long life span.

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