RESEARCH ARTICLE

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Allometry and Condition factor of Whipfin Silverbiddy, *Gerres filamentosus* from Mangalore Coast, Karnataka, India

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ABSTRACT

Background: Gerrids under family Gerridae are important in contributing rich source of protein. *Gerres* species are economically important food in India. They take a good role in development and economic of Indian estuaries. In fish biology, knowledge of the length-weight data and condition factor (Kn) is an important tool. *Gerres filamentosus* is one of the economically important groups of fishes inhabiting Karnataka coast. It was selected as a candidate for the present study since the knowledge on length-weight data and condition factor will be helpful in mass culture and production of this species in Karnataka.

Methods: The length-weight relationships and condition factor of 2020 specimens of fish, *G. filamentosus* from Mangalore, Karnataka, south west coast of India, were studied from July 2009 to June 2011. The length-weight relationship was found using parabolic equation. Analysis of co-variance was used to test the significant difference in estimates of "b" between sexes. The condition factor for individual fish was calculated using the formula Kn = Wo/Wc.

Result: The relation between the total length (L) and total weight (TW) was described as LogTW = -1.7716 + 2.9511 Log L for females, Log TW = -1.7526 + 2.9364 LogL for males and LogTW = -1.8343 + 2.9720 LogL for indeterminate fishes. The highest and lowest condition factor (Kn) values in females was in December 2010 (1.1186) and September 2010 (0.8871), respectively. Similarly, the highest and lowest Kn values in male was in March 2011 (1.0630) and September 2010 (0.6977), respectively. The result of length-weight relationships could be used for fishery to approve appropriate regulations for sustainable fishery management. The present findings could also be useful for ecosystem modeling. In the present study, changes in Kn value may be in relation to some other reasons than reproductive cycle and feeding intensity.

Key words: Condition factor, *b* values, Length-weight relationship, Mangalore coast, The Arabian sea.

INTRODUCTION

Gerres filamentosus Cuvier, 1829 (Family Gerreidae) commonly known as whipfin mojarras or lined silver biddy is an important fish inthe inshore waters of Karnataka. Members of family Gerreidae are characterized by having a highly protrusible mouth which can be extended as a tube into the substrate during feeding and a sheath of scales along the bases of their median fins. In India, the silver biddies constitute animportant fishery in the Chilkalake, Vembanad Lake, Pulicat Lake, Palk Bay, Gulf of Mannar and in the estuaries of the Uttar Kannada and Dakshina Kannada districts of Karnataka. They are tropical/subtropical euryhaline fishes while some species are even adapted to a total freshwater habitat (Austin, 1971). They are abundant in the estuaries and coastal inshore waters with sandy bottom.

Marine fishes like gerrids are highly important in contributing rich source of protein. In the Indo-Pacific region, *Gerres* species are economically important food under family Gerreidae. Importantly, it is functioning in development and economic of Indian estuaries. In the study of fish biology, knowledge of the length-weight data and condition factor (Kn) or ponderal index is an important tool. In fisheries, length-weight relationship is one of the most common uses in analyzing data, notably to raise length-frequency samples or to allow the conversion of growth in length equations for growth in weight, for use in stock assessment models (Mendes *et al.,* 2004).

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G. filamentosus is one of the economically important groups of fishes inhabiting Karnataka coast. The ratio of the length to the weight of fish is known to be a useful index of the condition of fish. The study of the length-weight relationship and condition factor of *G. filamentosus* was conducted from Sharavathi estuary (south west coast of India) and (south east coast of India) (Sivashanthini, 2008; Renuka and Bhat, 2011). The knowledge of allometric relationship like length-weight relationship has a vital role in the fishery. This study presents information on the length-weight relationship parameters and condition factor of *G. filamentosus* from

Mangalore coast. Perhaps, this species is one of the most abundant edible fishes with high consumer demand. It was selected as a candidate for the present study since the knowledge on length-weight relationship parameters will be helpful in mass culture of this species in Karnataka.

MATERIALS AND METHODS

Study area

Netravati-Gurupur river mouth area (estuarine), a stretch along the Mangalore coast from Talapady in the south and Tannirbhavi beach in the north, along the west coast of India is the study area (12°51′01.9"N,74°49′43.8"E) (Fig 1). Netravati and Gurupur rivers originate in the Western Ghats, flows westward, take almost 90° turn near the coast and then flows parallel to the coast before joining the Arabian Sea at Mangalore by Dwarakish (2001). Bengre at North and Ullal at South are two active submerged sand spits attached to mainland developing in front of the confluence of river mouth. The landing centre, Bengre (Mangalore) was visited once a month for two years. *Gerres filamentosus* were collected from the commercial cast nets, gill nets and drift nets in Mangalore coastal waters from July 2009 to June 2011.

Laboratory work

The fish samples were brought to the laboratory and cleaned using tap water. The samples of *G. filamentosus* were subjected for recording morphometric measurements and to study the length-weight relationship and condition factor. Total length from the tip of the snout to the tip of the caudal fin, were measured to the nearest one millimetre using a graduated measuring board.

Measurement of samples

Female and male individuals were identified by examining the gonads and cutting the body cavity. The present study is based on the observation of a total of 2020 individuals of *G. filamentosus* ranging in size from 52 to 300.0 mm (TL) based on the numbers of females, males and unsexed fish. Fishes were measured to the nearest millimetre and weighed to 0.001 g for *G. filamentosus* using an electronic balance.

Length-weight relationship

The parabolic equation $W = aL^b$ (Le Cren, 1951) was linearized to the form Y = a + bX, where Y = log W, X = log L, a and b are constants. Based on this equation, constants a and b were estimated for each month using least squares method. The data for the sexes were treated separately in order to examine differences between sexes. Analysis of co-variance (Snedecor and Cochran, 1967) was used to test the significant difference in the estimates of "b" between sexes. In order to observe the pattern of growth, whether isometric or allometric, *i.e.,* whether the value of "b" is significantly different from 3, the following equation was used to compute the t-statistic value (Snedecor and Cochran, 1967).

The t-statistic was calculated as follows:
The hypothesis given is,
H_o: Growth is isometric *i.e.* H_o: b = 3
H_1: Growth is not isometric *i.e.* H_1: $b \neq 3$

$$t = \frac{b - \beta}{S_b}$$

Where
b = regression coefficient of the sample, β = 3, S_b = standard error of estimate regression coefficient.

Condition factor

The condition factor, Kn (Le Cren, 1951) for individual fish was calculated using the formula Kn = Wo/Wc, where Wo = observed weight and Wc = calculated weight. Monthly mean values of Kn were calculated for both sexes separately to find out the relation, if any between spawning season and condition factor. The weighted average of the condition factor was also calculated for the study period (July 2009 to June 2011) for female and male separately.

RESULTS AND DISCUSSION

Size range

A total of 2020 specimens (1043 females, 708 males and 269 indeterminate/unsexed) of *G. filamentosus* were analyzed. The size (TL) of *G. filamentosus* ranged from 52 to 300 mm (mean ± SD = 147.8 ± 38.0 mm). The TL of females ranged from 70 to 300 mm (mean ± SD = 155.6 ± 35.6 mm), males from 60 to 275 mm TL (mean ± SD = 153.7 ± 33.4 mm) and indeterminate *G. filamentosus* ranged from 52 to 180 mm TL (mean ± SD = 102.2 ± 23.5 mm).In the present study, the weight range was from 4.53-393.0 g for females, 2.80-310.88 g for males and 2.50-92.93 g for indeterminate fish. Therefore, for the pooled fish the weight ranged from 2.50 to 393.0 g in the study area.

Length-weight relationship

The estimates of the regression parameters for females, males, indeterminate and pooled data of *G. filamentosus* obtained by regression analysis are given in Table 1.

The b values 2.9511 (r = 0.9759), 2.9364 (r = 0.9699), 2.9720 (r = 0.9526) and 3.0165 (r = 0.9789) were obtained for females, males, indeterminate and pooled. *G. filamentosus* respectively. Correlation coefficients (r) for females, males, indeterminate and pooled sample were found to be significant (p<0.001) in all instances indicating good correlation between length and weight of *G. filamentosus*.

The length-weight relationships of *G. filamentosus* from July 2009 to June 2011 are as follows.

For female,
Log TW = -1.7716 + 2.9511 Log L (logarithmic equation)
$TW = 0.01692\ L^{2.9511}$ (parabolic equation)
For male,
Log TW = -1.7526 + 2.9364 Log L (logarithmic equation)
$TW = 0.01768\ L^{2.9364}$ (parabolic equation)

For indeterminate,

Log TW = -1.8343 + 2.9720 Log L (logarithmic equation)

TW = 0.01465 $L^{2.9720}$ (parabolic equation)

For pooled,

Log TW = -1.8521+ 3.0165 Log L (logarithmic equation)

TW = 0.01406 $L^{3.0165}$ (parabolic equation)

Analysis of covariance (Table 1) indicated that there is no significant difference in the length-weight relationship between the two sexes. But from the F - ratio, it is evident that there is significant difference in the length-weight relationship between the females and juveniles and males and juveniles (Table 2-4). Two tailed 't' test was applied to see whether the 'b" values arrived at for females, males and indeterminate fish were significantly different from the hypothesis value, 3 (Table 5). The results of the t-test applying the formula, $t = |b-\beta|/sb$, to test the significance of variation in the estimate of 'b' from the ideal fish were, Females = 11.62, Males = 12.85 and Indeterminate = 3.03.

Condition factor

The monthly mean values ofcondition factors for males and females *G. filamentosus* are presented in Table 7. In females, the Kn values higher than the average weight (1.0044) for a two-years period (July 2009-June2011) were in July 2009, August-November 2009, January-February 2010, April 2010, July 2010, December 2010, January 2011, March 2011 and May-June 2011 (Table 7). The Kn values lower than the average weight were in December 2009, March 2010, May-June 2010, August-November 2010, February 2011 and April 2011. The higher Kn value in female was in December 2010 (1.1186) and lowest in September 2010 (0.8871).

In males, the Kn values higher than the average weight (0.9905) was in July 2009-July 2011 and November 2010-June 2011. The Kn values lower than the average weight were in August 2010-October 2010, December 2010 and April 2011. The highest Kn value was in March 2011 (1.0630) and lowest in September 2010 (0.6977).

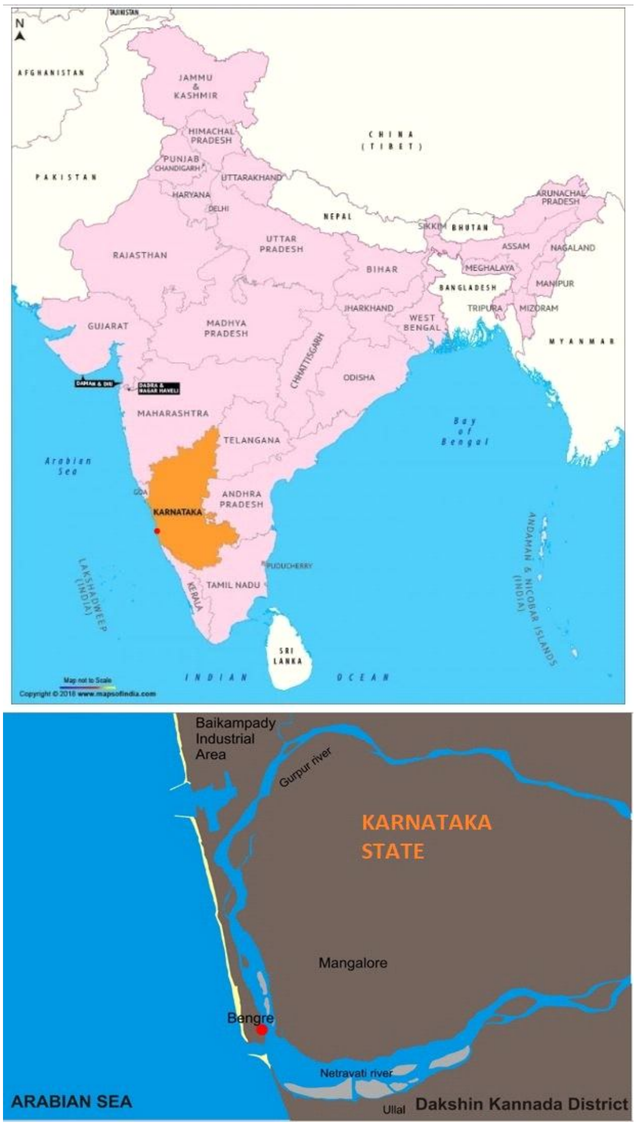

Fig 1: Location of sampling site, Bengre, Karnataka. Red circle: study area.

Table 1: Various parameters in the length-weight relationship of *G. filamentosus* males, females, indeterminate and pooled).

Group	N	Length (mm)	Weight (g)	a	b	r
Females	1043	70-300	4.53-393.0	-1.7716	2.9511	0.9759
Males	708	60-275	2.80-310.88	-1.7526	2.9364	0.9699
Indeterminate	269	52-180	2.50-92.93	-1.8343	2.9720	0.9526
Pooled	2020	52-300	2.50-393.0	-1.8521	3.0165	0.9789

Table 2: Analysis of covariance for comparison of length-weight relationship of male and female *G. filamentosus.*

Source of variation	df	Regression coefficient	Deviation from regression			F-ratio
			df	SS	MSS	
Males	707	2.9364	706	3.4951	0.0050	
Females	1042	2.9511	1041	4.3821	0.0042	
Deviation from the individual regression within sex			1747	7.8772	0.0045	
Pooled	1749	2.9452	1748	7.8791	0.0045	
Difference between slopes			1	0.0019	0.0019	0.42

Table 3: Analysis of covariance for comparison of length-weight relationship of female and juvenile *G. filamentosus.*

Source of variation	df	Regression coefficient	Deviation from regression			F-ratio
			df	SS	MSS	
Females	1042	2.9511	1041	4.3821	0.0042	
Juveniles	268	2.9720	267	2.4693	0.0092	
Deviation from the individual regression within sex			1308	6.8514,	0.0052	
Pooled	1310	3.0361	1309	7.0830	0.0054	
Difference between slopes			1	0.2316,	0.2316	*42.89

*Significant at 5% level

Table 4: Analysis of covariance for comparison of length-weight relationship of male and juvenile *G. filamentosus.*

Source of variation	df	Regression coefficient	Deviation from regression			F-ratio
			df	SS	MSS	
Males	707	2.9364	706	3.4951	0.0050	
Juveniles	268	2.9720	267	2.4693	0.0092	
Deviation from the individual regression within sex			973	5.9644	0.0061	
Pooled	975	3.0472	974	6.1944	0.0064	
Difference between slopes			1	0.2300	0.2300	*35.94

*Significant at 5% level.

Table 5: Results of t-test to analyze the significance of variation in the estimates of 'b' for *G. filamentosus.*

Group	df	b	S_b	t =|b-3|/s_b	Allometric type
Females	1042	2.9511	0.00420	11.64**	negative
Males	707	2.9364	0.00495	12.85**	negative
Indeterminate	268	2.9720	0.00925	3.03**	negative

**Exponent b differed significantly from 3.

The length-weight relationship gives an idea about the mathematical relationship between length and weight of the fish. It also depicts variation in the observed weight of the individual fish from those expected. According to Le Cren (1951), this variation indicates the fatness, general wellbeing or gonadal development of the fish. The length-weight relationship of a fish can be described by the hypothetical cube law, $W = aL^3$, where *W* represents weight of fish, *L* represents length of fish and *are* presents a constant. In this context, the cube law represents a condition of an ideal fish where in the fish maintains a constant shape n = 3 (Allen, 1938). If there is a change in density and form as a result of growth, there will be significant departure from the isometric growth pattern. Hence, the formula $W = aL^b$ will be more useful in describing the length-weight relationship. The value of the exponent "n" in the parabolic equation usually lies between 2.5 and 4.00 (Hile, 1936; Martin, 1949). The parameters of length-weight relationship of gerreids estimated by various authors from different parts of the world are tabulated in Table 6. The range (2.14-3.72) of b values of the length-total weight relationship reported for *Gerres filamentosus* from several regions of India is between 2.5 and 4.00.

The length-weight relationship of *G. filamentosus* in the present study showed that curvilinear pattern in sexes, indeterminate fish and pooled fish. During July 2009-June 2010, the b value was found to be 2.9540 for female, 2.9241 for male and 2.7472 for indeterminate fish. Whereas, the b values of the fish were found to be 2.9856, 2.9499 and 3.0961 (during July 2010-June 2011) for female, male and indeterminate fish, respectively. For the pooled year, the b value was found to be 2.9511 for female, 2.9364 for male, 2.9720 for indeterminate fish and 3.0165 for pooled fish. From the F-ratio, it is evident that there is no significant difference between male and female for the length-weight relationship. But there is significant between males and juveniles and females and juveniles for the length-weight relationship. From the't' test (Table 5), it was confirmed that female, male and indeterminate fish followed non-isometric growth. Further, from this table, it is shown a negatively allometric pattern (b<3) in female, male and indeterminate fish which indicates that the rate of increase in body length is not proportional to the rate of increase in body weight. Since, the difference between the slopes of the regression of male and female was significant (P<0.05), it reflects a divergence in growth pattern in both the sexes. This change may be due to a number of factors including gonadal maturity, habitat, season, sex, stomach fullness, diet, preservation techniques, health and locality (Bagenal and Tesch, 1978; Froese, 2006). Such differences in values 'b' can be ascribed to one or a combination of most of the

Table 6: Values of *a* and *b* of *Gerres* species reported from different geographical locations.

Species	Sex	a	b	Relationship	Region	Source
*Gerres filamentosus**	Female	-1.7716	2.9511	TL - TW	India, Arabian sea	Present study
	Male	-1.7526	2.9364			
	Indeterminates	-1.8343	2.9720			
	Pooled	-1.8521	3.0165			
*G. filamentosus**	Female	-1.2874	2.8381	HP - TW	India, Arabian Sea	Kurup and Samuel (1987)
	Male	-l.32244	2.8740			
	Indeterminates	-0.8167	2.2558			
*G. filamentosus**	Female	-4.8405	3.0017	TL - TW	India, Arabian Sea	Golikatte (2002)
	Male	-5.1929	3.1657			
	Indeterminates	-4.5945	2.8220			
	Pooled	-5.2209	3.1675			
	Pooled	0.3979	0.7757	TL - SL		
		1.1279	0.2350	TL - HL		
		0.9399	0.0574	TL - Sn.L		
		0.9110	0.0526	TL - Pt.OL		
		0.8820	0.0432	TL - ED		
		1.0968	0.2519	TL - Pr.Pec. L		
		1.0878	0.2748	TL - Pr.Pv. L		
		1.1134	0.2502	TL - Pr. DL		
		1.0295	0.3492	TL - Pr.AL		
		1.0368	0.3371	TL - DL		
		0.9094	0.0533	TL - IO		
		1.0703	0.2959	TL - B		
G. filamentosus	Female	0.007	3.247	TL - TW	India, Bay of Bengal	Sivashanthini (2008)
	Male	0.007	3.264			
	Unsexed	0.008	3.203			
	Pooled	0.006	3.285			
G. filamentosus	Female	0.00006926	3.0017	TL - TW	India, Arabian sea	Renuka and Bhat (2011)
	Male	0.00000156	3.1657			
	Indeterminates	0.00003931	2.8220			
G. filamentosus	Female	0.0341	3.7227	TL - TW	India, Arabian Sea	Aziz *et al.* (2013)
	Male	0.0478	2.5868			
	Pooled	0.0330	2.7316			
G. filamentosus	Unsexed	0.0050	3.130	TL - TW	India, Bay of Bengal	Krishna *et al.* (2015)
G. filamentosus	Unsexed	0.001	2.14	TL - TW	India, Bay of Bengal	Martin *et al.* (2016)
G. filamentosus	Pooled	-0.09115	0.805925	TL - FL	Egypt, Red Sea	Abu El-Nasr (2016)
		0.0775028	0.719603	TL - SL		
		-0.54244	0.280646	TL - HL		
		0.386537	0.223684	TL - HD		
		0.305667	0.315312	TL - Pr.DL		
		0.438857	0.245933	TL - Pr.Pec.L		
		0.485321	0.290824	TL - Pr.Pv.L		
		0.253349	0.542515	TL - Pr.AL		
		-0.10677	0.302764	TL - BD		
		0.500502	0.362091	TL - DFL		
		0.175233	0.181678	TL - 2nd DS		
		-0.58463	0.305837	TL - Pec.FL		
		0.101155	0.140019	TL - Pv.FL		
		-0.10503	0.132039	TL - AFL		
		-0.57855	0.293656	TL - CFL		
		-0.15709	0.058979	TL - ED		

Table 6 Continue...

Table 6 Continue...

		-0.01751	0.072187	TL - Sn.L		
		0.011708	0.091639	TL - M		
		0.875498	0.788453	HL - HD		
		0.574323	0.640092	HL - 2nd DS		
		0.143061	0.254027	HL - Sn.L		
		0.37544	0.247174	HL - Pr.OL		
		-0.00949	0.205063	HL - ED		
		0.345889	0.323134	HL - Pt.O.L		
		0.219033	0.321954	HL - M		
	Female	0.014845	2.9528	TL - TW		
	Male	0.014649	2.9498	TL - TW		
	Pooled	0.015045	2.9475	TL - TW		
*G. filamentosus**	Unsexed	-1.849	2.989	TL - TW	Pakistan, Arabian Sea	Hussain *et al.* (2010)
	Female	-1.728	2.883			
G. filamentosus	Unsexed	0.0086	3.2441	TL - TW	Peninsular Malaysia, Malacca Strait	Isa *et al.* (2012)
G. filamentosus	Unsexed	0.0088	3.21	TL - TW	Iran, Oman Sea	Hashemi *et al.* (2012)
G. filamentosus	Unsexed	5204 x 10^{-8}	2.9367	BL - TW	Vietnam, Quang Binh province	Thiep *et al.* (2014)
G. filamentosus	Female	0.0146	2.9543	TL - TW	Egypt, Hurghada Red Sea	Abu El-Nasr (2017)
	Male	0.0143	2.9564			
	Pooled	0.0144	2.9597			
G. filamentosus	Unsexed	0.007	3.245	TL - TW	Indonesia, Java Sea	Putranto *et al.* (2019)
G. filamentosus	Unsexed	0.0240	3.011	FL - TW	New Caledonia, Coral Sea	Kulbicki *et al.* (2005)
Gerres spp.	Unsexed	0.0194	3.070			
G. ovatus	Unsexed	0.0229	3.005			
G. oyena	Unsexed	0.0095	3.337			
Gerres sp.	Female	3.26 × 10^{-5}	2.97	SL - TW	Japan, East China Sea	Kanak and Tachihara (2006)
	Male	3.13 × 10^{-5}	2.98			
*G. limbatus**	Unsexed	-1.830	2.992	TL - TW	Pakistan, Arabian Sea	Hussain *et al.* (2010)
G. setifer	Female	0.017698	2.9022	TL - TW	India, Bay of Bengal	Sivashanthini and Ajmal Khan (2004)
	Male	0.018498	2.8690			
G. longirostris	Unsexed	0.0087	3.18	FL - TW	Iran, Oman Sea	Hashemi *et al.* (2012)
G. cinereus	Female	0.704	1.012	TL - SL	Mexico, North Pacific Ocean	Espino-Barr *et al.* (2014)
	Male	0.702	1.010			
	Pooled	0.699	1.013			
	Female	0.310	1.009	TL - H		
	Male	0.353	0.964			
	Pooled	0.324	0.993			
	Female	0.006	3.208	TL - TW		
	Male	0.007	3.172			
	Pooled	0.006	3.193			
	Female	0.006	3.167	TL - EW		
	Male	0.005	3.253			
	Pooled	0.005	3.203			
G. abbreviatus	Female	0.010	3.119	TL - TW	India, Bay of Bengal	Sivashanthini (2008)

Table 6 Continue...

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	Male	0.011	3.095			
	Unsexed	0.012	3.037			
	Pooled	0.009	3.178			
G. oblongus	Female	0.015319	3.126119	TL - TW	Sri Lanka, Palk Bay	Sivashanthini and Adeyrami (2003)
	Male	0.01127	2.958295			
	Pooled	0.01135	3.095936			
G. acinaces	Unsexed	0.0826	2.59	SL - TW	Guam, Philippine Sea	Kamikawa *et al.* (2015)

* indicates "*a*" value is obtained from logarithmic equation for the length-weight relationship. Total length (TL), fork length (FL), standard length (SL), body depth (BD), head depth (HD), head length (HL), snout length (Sn.L), anterior point of snout to first dorsal spine-pre-dorsal Length (Pr. DL), pre-pectoral length (Pr.Pec. L), pre-pelvic length (Pr.Pv. L), pre-anal length (Pr.AL), 2nd dorsal spine-when found (2nd DS), eye diameter (ED), pre-orbital length (Pr.OL), post-orbital length (Pt.OL), mouth width (M), dorsal fin length (DFL), caudal fin length (CFL), Dorsal to anal (DL), Interorbital (IO), pectoral fin length (Pec. FL), pelvic fin length (Pv. FL), anal fin length (AFL), height (H), total weight (TW), breadth (B), hypural plate (HP), eviscerated weight (EW).

Table 7: Kn values for females and males in the present study.

Month	Female	Male
Jul-09	1.0131	1.0240
Aug	1.0050	1.0084
Sep	1.0107	1.0192
Oct	1.0109	1.0100
Nov	1.0269	1.0215
Dec	1.0020	1.0008
Jan-10	1.0119	1.0065
Feb	1.0058	1.0093
Mar	1.0014	1.0082
Apr	1.0066	1.0126
May	0.9931	0.9987
Jun	0.9995	1.0015
Jul	1.0247	0.9962
Aug	0.9442	0.9355
Sep	0.8871	0.6977
Oct	0.9388	0.9477
Nov	0.9722	1.0455
Dec	1.1186	0.9788
Jan-11	1.0481	1.0511
Feb	0.9760	0.9981
Mar	1.0355	1.0630
Apr	0.9701	0.9890
May	1.0224	1.0606
Jun	1.0816	1.0040
	Average = 1.0044	Average = 0.9953

factors including differences in the number of specimens examined, area/season effects and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well (Moutopoulos and Stergiou, 2002). According to Jhingran (1968) and Frosta *et al.* (2004), the slope 'b' shows that the rate of weight gains relative to growth in length and varies among different populations of the same species or within the same species. The correlation coefficients (r) indicate the degree of association between length and weight of the fish. The high values of correlation coefficients in both sexes revealed that there is a perfect relationship between the length and total weight in *G. filamentosus.* Negative allometric growth for females, males and indeterminate fish, exhibited that they tend to become thinner as they grow larger. Similarly, the negative allometric pattern for all groups (females, males and indeterminate) has also been observed in same species, *G. filamentosus* from Vembanad, India (Kurup and Samuel, 1987).

Golikatte (2002) found that on the basis of Gonado-Somatic Index (GSI), it was found convenient to divide the annual cycle of reproduction of *G. filamentosus* into three phases along Karnataka coast, the pre-spawning period (March to June) characterised by high GSI values, spawning period (July to September) characterised by sharp decrease in weight of the gonads and post spawning period (October to February) characterised by progressive growth in weight of the gonads. They stated that the pattern of fluctuation of relative condition factor during different months of the year seemed identical in males and females of *G. filamentosus.* The fluctuation in condition factor of both the sexes could be attributed to reproductive cycle or feeding intensity in the present study. The present study on the seasonal variation in the condition of males and females showed that the Kn values were more or less similar in both the sexes, thus indicating almost equal metabolic activity. The lowest values of females (0.8871) and males (0.6977) were noted in September 2010 which may be related to spawning of the fish. It is in agreement with the decrease in weight of the gonads in this month (spawning period) of *G. filamentosus* from Sharavati estuary, Karnataka (Golikatte, 2002). But in September 2009, the Kn value was higher in both females (1.0107) and males (1.0192). There seems to be some relation in environmental factors and feeding habits in both the sexes.

Hart (1946) correlated fluctuations in the ponderal index with the attainment of maturity and spawning. Feeding intensity is not the probable cause for variation in 'Kn' value noticed during different months in male and female, since the feeding intensity was observed to be low in some months when the 'Kn' values were high. Hart (1946) observed that apart from seasonal variation there could be a secondary variation related to the length of the fish. However, with increase in age there could be a lower level of condition through the seasonal cycle consequent to the increased metabolic strain or spawning. Hence, it may be concluded that in *G. filamentosus* from Mangalore region the changes in 'Kn' value may be in relation to some other reasons than reproductive cycle and feeding intensity.

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