CHAPTER 6 - LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR

6.1. INTRODUCTION

Length weight relationship as well as the condition factors is useful parameters for assessing the well-being of the individuals and for determining possible differences among different stocks of the same species (King, 2007). The study of length-weight relationship of fish not only helps for estimating the weight from the known length and vice-versa, also to determine the duration of gonadal maturation, increase or decrease in feeding activity, possibly due to modifications in food resources (Bhattacharya and Banik 2012). The study of length weight relationship is also an important factor for conservation and management of fishes in aquatic system (Lawson, 2011). The study of length-weight relationship is useful component in determining the condition factor. In fisheries science, the condition factor is used in order to compare the "condition", "fatness" or well-being of fish. Condition factor is a quantitative parameter for estimating the physical condition of the fish that will determine present and future population success by its influence on growth, reproduction and survival (Hossain *et al.,* 2006).

It has been found that the length-weight relationship does not always obey the cube law which is expressed as $W=aL^3$. The general expectation is that the weight of fishes would vary from the cube of length (Clark, 1928; Allen, 1938; Brody, 1945; Lagler, 1952; Rounsefell and Everhart, 1953; Brown, 1957). So now a days the most

widely accepted formula is $W=aL^b$ (Ricker, 1975), where 'W' and 'L' represent weight and length respectively and 'a' is constants. This is the modified form of cube law equation where '3' is substituted by exponent 'b'. If 'b' is equal to 3 then length and weight increase proportionately which means isometric growth of fish (Santosh *et al*., 2002). But when $b > 3$ then it called positive allometric growth which reveals weight of the fish increase with the length and when $b < 3$ then the body weight will decrease with the increase length that is negative allometric growth (Jones *et al*., 1999).

In view of the importance of length-weight relationship, condition factor of Gourami fish species, considerable attention has been paid by many workers (Awasthi *et al*., 2015, Akter, 2016 and Jafaryan *et al*., 2014) to this aspect of fishery biology but almost no work has been done yet on Nobel Gourami. So understanding the importance of this species, the length weight relationship, frequency distribution and condition factor of *C. nobilis* was studied in the present work to assess the biology of the species.

6.2. MATERIALS AND METHODS

A total of 400 specimens were taken to study of length-weight relationship, frequency distribution and condition factor in which 207 species are male, 118 are female and 75 species are un-identified sex. The study was done during May, 2015 to April, 2016. All data were analysed in SPSS ver. 16 and Microsoft Excel, 2010 software.

6.2.1. Computational formula for length-weight relationship:

The length-weight data were analyzed according to the method given by Le Cren (1951). In the present study, the equation $\mathbf{W=aL^b}$ was used where W represents weight of the fish in gram; L represents the total length in mm; 'a' the constant and 'b' an exponent to which L can be raised. The equation expressed in logarithmic form becomes:

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

In the present study the length-weight data were analysed after classified the fishes in the following major 5 groups:

I) Combined group

II) Ripe male

III) Ripe Female

IV) Different size length

V) Season wise

The equation Log W = Log a + b Log L was calculated separately for each group and a linear relationship between the logarithm length and logarithm weight was found from the examination of scatter diagram. To test the regression coefficient 't' was calculated according to the method given by Gosset, 1908. The statistical comparison was done by the method of analysis of covariance (Zar, 1974). After studying the analysis of covariance, F-test was performed to assess the significance.

6.2.2. Computational formula for condition factor:

The condition index (K) was calculated of ripe males, ripe females and combined group of the fish. Seasonal variation of condition factor were also analysed. Presently, $K = \frac{W}{aL^3}$ is used for the calculation of condition coefficient as stated by Le Cren, 1951. Relative condition factor Kn (Le Cren, 1951) was estimated by using formulae: $K_n = \frac{W}{W1}$. In this formula aL^3 has been replaced by W^1 denotes the calculated weight for the observed length.

6.3. RESULTS

The descriptive statistics of male, female and combined sex of length weight data were presented in **Table 12**. It revealed that the total length and standard length of male fishes are ranges between 38 to 100 mm and 33 to 88 mm respectively whereas in case of female the total length and standard length are ranges between 35 to 100 mm and 25 to 95 mm respectively. The weight ranges between 1.3 to 10.1 g in case of female and 1.7 to 10.6 in case of male.

Table 12. Descriptive statistics of male, female and combined sex of *C. nobilis*

Sex	Analysis	Total Length	Standard Length	Weight
Combined	Min	23	15	0.11
	Max	100	96	10.6
	Mean	56.7669	46.5188	3.8930
	Median	53	45	3.5

	Mode	46	35	2.9
	SE	0.8284	0.7894	0.1184
	STDV	16.5474	15.7689	2.3665
Male	Min	38	33	1.7
	Max	100	88	10.6
	Mean	60.6359	50.1068	4.4471
	Median	58	47	3.8
	Mode	53	44	2.9
	SE	0.9517	0.9199	0.1395
	STDV	13.6599	13.2030	2.0025
Female	Min	35	25	1.3
	Max	100	96	10.1
	Mean	63.0854	52.0085	4.7854
	Median	62	50	4.2
	Mode	46	36	2.8
	SE	1.4259	1.4347	0.2099
	STDV	15.4236	15.5189	2.2707

6.3.1. Total length, standard length and weight relationship of combined group

Table 13. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* (Combined group):

		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.983**	.904**
	Sig. (2-tailed)		.000	.000
	N	400	400	400
LogSL	Pearson Correlation	.983**	1	.882**
	Sig. (2-tailed)	.000		.000
	N	400	400	400

LogWT	Pearson Correlation	.904**	.882**	1
	Sig. (2-tailed)	.000	.000	
	N	400	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

Total length and weight relationship:

Table 14. Regression Model Summary Computed on TL-WT of *C. nobilis* (Combined group):

R	R Square	Adjusted R Square	Std. Error of the Estimate
.904	.818	.817	.154

The independent variable is LogTL.

Table 15. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of total length and weight of *C. nobilis* (Combined group):

	Sum of Squares	df	Mean Square	F	Sig.
Regression	42.047	1	42.047	1783.420	.000
Residual	9.384	398	.024		
Total	51.431	399			

The independent variable is LogTL.

Table 16. Coefficients[a] of regression Equation on TL-WT of *C. nobilis* (Combined group):

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogTL	2.467	.058	.904	42.231	.000
(Constant)	-3.799	.102		-37.392	.000

Standard length and weight relationship:

Table 17. Regression Model Summary Computed on SL-WT of *C. nobilis* (Combined group):

R	R Square	Adjusted R Square	Std. Error of the Estimate
.882	.778	.778	.169

The independent variable is LogSL.

Table 18. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of standard length and weight of *C. nobilis* (Combined group):

	Sum of Squares	df	Mean Square	F	Sig.
Regression	40.022	1	40.022	1396.216	.000
Residual	11.409	398	.029		
Total	51.431	399			

The independent variable is LogSL.

Table 19. Coefficients[a] of regression Equation on SL-WT of *C. nobilis* (Combined group):

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogSL	2.064	.055	.882	37.366	.000
(Constant)	-2.909	.091		-31.941	.000

Total Length and Standard Length relationship:

Table 20. Regression Model Summary Computed on TL-SL of *C. nobilis* (Combined group)

R	R Square	Adjusted R Square	Std. Error of the Estimate
.983	.965	.965	.029

The independent variable is LogTL.

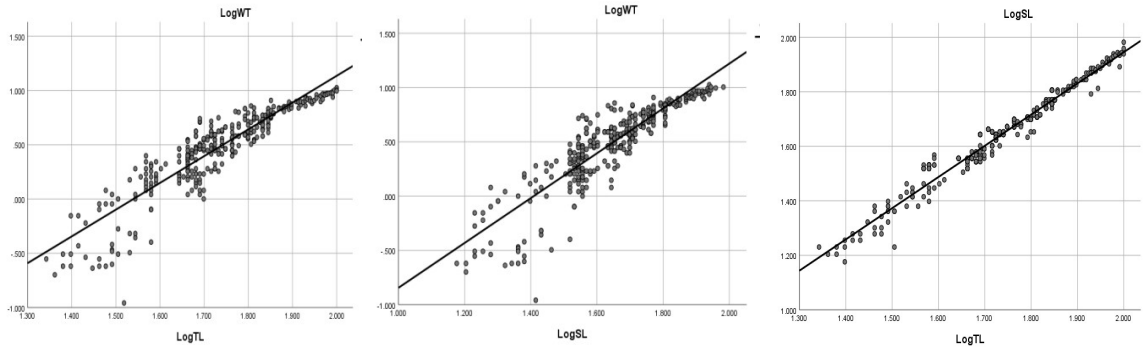
Table 21. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of total length and standard length of *C. nobilis* (Combined group)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	9.066	1	9.066	11104.819	.000
Residual	.325	398	.001		
Total	9.391	399			

The independent variable is LogTL.

Table 22. Coefficients[a] of regression Equation on TL-SL of *C. nobilis* (Combined group):

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogTL	1.145	.011	.983	105.379	.000
(Constant)	-.345	.019		-18.268	.000



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 21 (a-c). Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for combined group

6.3.2. Total length, standard length and weight relationship of Male group

Table 23. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* (Male)

		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.976**	.863**
	Sig. (2-tailed)		.000	.000
	N	207	207	207
LogSL	Pearson Correlation	.976**	1	.839**
	Sig. (2-tailed)	.000		.000
	N	207	207	207
LogWT	Pearson Correlation	.863**	.839**	1
	Sig. (2-tailed)	.000	.000	
	N	207	207	207

**. Correlation is significant at the 0.01 level (2-tailed).

Total Length and Weight relationship:

Table 24. Regression Model Summary Computed on TL-WT of *C. nobilis* (Male)

R	R Square	Adjusted R Square	Std. Error of the Estimate
.863	.745	.744	.094

The independent variable is LogTL.

Table 25. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of total length and weight of *C. nobilis* (Male)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	5.290	1	5.290	598.842	.000
Residual	1.811	205	.009		
Total	7.100	206			

The independent variable is LogTL.

Table 26. Coefficients[a] of regression Equation on TL-WT of *C. nobilis* (Male)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogTL	1.726	.071	.863	24.471	.000
(Constant)	-2.451	.125		-19.588	.000

Standard Length and Weight relationship:

Table 27. Regression Model Summary Computed on SL-WT of *C. nobilis* (Male):

R	R Square	Adjusted R Square	Std. Error of the Estimate
.839	.704	.702	.101

The independent variable is LogSL.

Table 28. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of standard length and weight of *C. nobilis* (Male)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.998	1	4.998	487.229	.000
Residual	2.103	205	.010		
Total	7.100	206			

The independent variable is LogSL.

Table 29. Coefficients[a] of regression Equation on SL-WT of *C. nobilis* (Male)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogSL	1.460	.066	.839	22.073	.000
(Constant)	-1.855	.112		-16.598	.000

Total Length and Standard Length relationship:

Table 30. Regression Model Summary Computed on TL-SL of *C. nobilis* (Male)

R	R Square	Adjusted R Square	Std. Error of the Estimate
.976	.953	.953	.023

The independent variable is LogTL.

Table 31. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of total length and standard length of *C. nobilis* (Male)

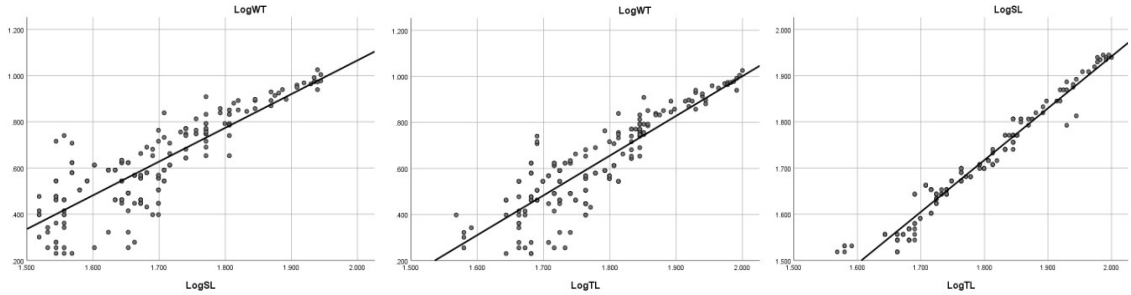
	Sum of Squares	df	Mean Square	F	Sig.
Regression	2.234	1	2.234	4193.290	.000
Residual	.109	205	.001		

Total	2.344	206			

The independent variable is LogTL.

Table 32. Coefficients[a] of regression Equation on TL-SL of *C. nobilis* (Male)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogTL	1.122	.017	.976	64.756	.000
(Constant)	-.302	.031		-9.818	.000



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 22 (a-c). Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for male group

6.3.3. Total length, standard length and weight relationship of Female group

Table 33. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* (Female)

Correlations

		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.984**	.905**
	Sig. (2-tailed)		.000	.000
	N	118	118	118

LogSL	Pearson Correlation	.984**	1	.876**
	Sig. (2-tailed)	.000		.000
	N	118	118	118
LogWT	Pearson Correlation	.905**	.876**	1
	Sig. (2-tailed)	.000	.000	
	N	118	118	118

**. Correlation is significant at the 0.01 level (2-tailed).

Total Length and Weight relationship:

Table 34. Regression Model Summary Computed on TL-WT of *C. nobilis* (Female):

R	R Square	Adjusted R Square	Std. Error of the Estimate
.905	.818	.817	.093

The independent variable is LogTL.

Table 35. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of total length and weight of *C. nobilis* (Female):

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.545	1	4.545	522.813	.000
Residual	1.008	116	.009		
Total	5.554	117			

The independent variable is LogTL.

Table 36. Coefficients[a] of regression Equation on TL-WT of *C. nobilis* (Female):

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogTL	1.876	.082	.905	22.865	.000
(Constant)	-2.724	.147		-18.563	.000

Standard Length and Weight relationship:

Table 37. Regression Model Summary Computed on SL-WT of *C. nobilis* (Female)

R	R Square	Adjusted R Square	Std. Error of the Estimate
.876	.767	.765	.106

The independent variable is Log SL.

Table 38. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of standard length and weight of *C. nobilis* (Female):

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.259	1	4.259	381.696	.000
Residual	1.294	116	.011		
Total	5.554	117			

The independent variable is LogSL.

Table 39. Coefficients[a] of regression Equation on SL-WT of *C. nobilis* (Female)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogSL	1.502	.077	.876	19.537	.000
(Constant)	-1.922	.131		-14.698	.000

Total Length and Standard Length relationship:

Table 40. Regression Model Summary Computed on TL-SL of *C. nobilis* (Female)

R	R Square	Adjusted R Square	Std. Error of the Estimate
.984	.969	.969	.023

The independent variable is LogTL.

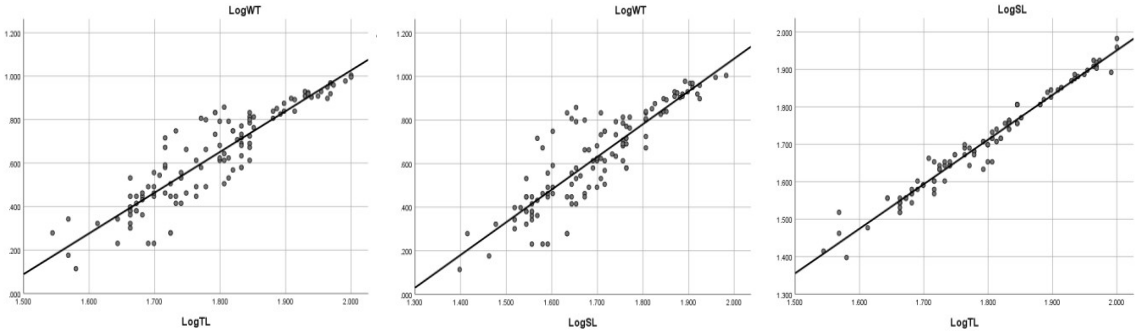
Table 41. Analysis of variance of regression coefficient (ANOVA[b]) for testing regression coefficient of total length and standard length of *C. nobilis* (Female):

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.830	1	1.830	3598.910	.000
Residual	.059	116	.001		
Total	1.889	117			

The independent variable is LogTL.

Table 42. Coefficients[a] of regression Equation on TL-SL of *C. nobilis* (Female)

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LogTL	1.190	.020	.984	59.991	.000
(Constant)	-.429	.035		-12.095	.000



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 23 (a-c). Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for female group

6.3.4. Season wise total length, standard length and weight relationship of the fish

A. Pre-Monsoon (March-May)

Table 43. Descriptive Statistics of Length-Weight Characteristics of *C. nobilis* during pre-monsoon:

	N	Range	Min	Max	Mean		Std. Deviation	Variance
	Stat	Stat	Stat	Stat	Stat	Std. Error	Stat	Stat
TL	133	65	35	100	63.36	1.220	14.072	198.020
SL	133	65	26	91	52.72	1.172	13.517	182.717
WT	133	8.20	1.70	9.90	4.6947	.18825	2.17103	4.713
Valid N (list wise)	133							

Table 44. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* during pre-monsoon

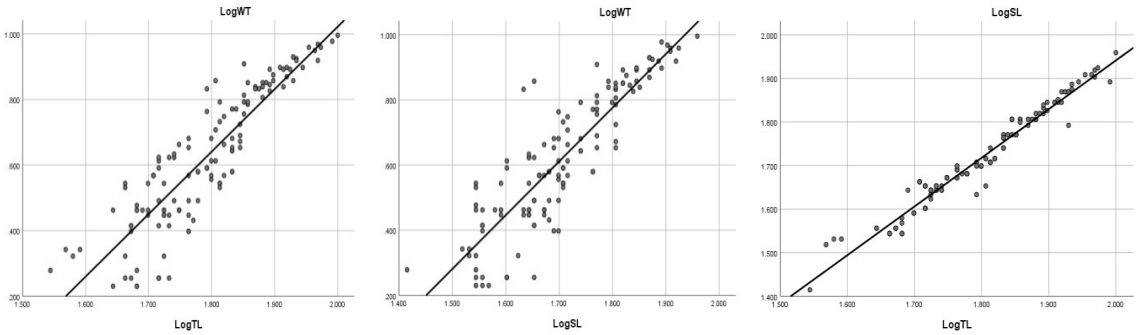
Correlations

		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.976**	.889**
	Sig. (2-tailed)		.000	.000
	N	133	133	133
LogSL	Pearson Correlation	.976**	1	.879**
	Sig. (2-tailed)	.000		.000
	N	133	133	133
LogWT	Pearson Correlation	.889**	.879**	1
	Sig. (2-tailed)	.000	.000	
	N	133	133	133

**. Correlation is significant at the 0.01 level (2-tailed).

Table 45. Regression Model Summary computed on total length, standard length and weight of *C. nobilis* during pre-monsoon:

	R	R Square	Adjusted R Square	Std. Error of the Estimate
TL-WT	.889	.790	.788	.095
SL-WT	.879	.773	.771	.098
TL-SL	.976	.953	.953	.024



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 24 (a-c): Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for pre-monsoon season

B. Monsoon (June-August):

Table 46. Descriptive Statistics of Length-Weight Characteristics of *C. nobilis* during monsoon

Descriptive Statistics

	N	Range	Min	Max	Mean		Std. Deviation	Variance
	Stat	Stat	Stat	Stat	Stat	Std. Error	Stat	Stat
TL	137	56	44	100	62.47	1.302	15.242	232.325
SL	137	63	33	96	51.67	1.308	15.312	234.457
WT	137	8.90	1.70	10.60	4.7387	.18639	2.18165	4.760
Valid N (list wise)	137							

Table 47. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* during monsoon:

Correlations

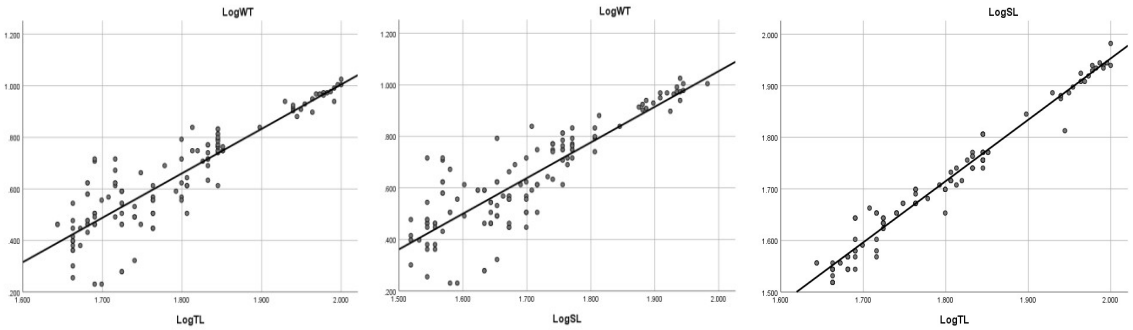
		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.983**	.886**
	Sig. (2-tailed)		.000	.000
	N	137	137	137
LogSL	Pearson Correlation	.983**	1	.860**
	Sig. (2-tailed)	.000		.000
	N	137	137	137
LogWT	Pearson Correlation	.886**	.860**	1
	Sig. (2-tailed)	.000	.000	
	N	137	137	137

**. Correlation is significant at the 0.01 level (2-tailed).

Table 48. Regression Model Summary Computed on total length, standard length and weight of *C. nobilis* during monsoon:

Model Summary

	R	R Square	Adjusted R Square	Std. Error of the Estimate
TL-WT	.886	.786	.784	.089
SL-WT	.860	.740	.738	.098
TL-SL	.983	.967	.966	.022



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 25 (a-c): Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for monsoon season

C. Post-monsoon (September-November):

Table 49. Descriptive Statistics of Length-Weight Characteristics of *C. nobilis* during post-monsoon

Descriptive Statistics

	N	Range	Min	Max	Mean		Std. Deviation	Variance
	Stat	Stat	Stat	Stat	Stat	Std. Error	Stat	Stat
TL	55	48	37	85	53.95	1.390	10.307	106.238
SL	55	49	25	74	43.51	1.269	9.410	88.551
WT	55	6.80	1.30	8.10	3.6927	.20858	1.54690	2.393
Valid N (list wise)	55							

Table 50. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* during post-monsoon

Correlations

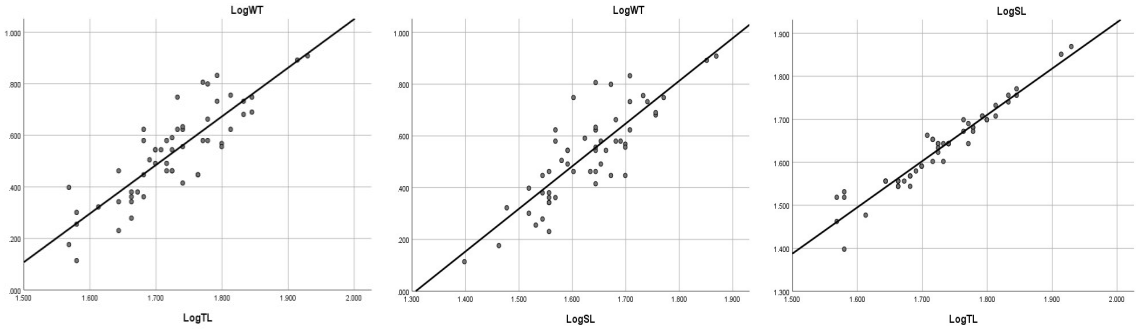
		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.965**	.854**
	Sig. (2-tailed)		.000	.000
	N	55	55	55
LogSL	Pearson Correlation	.965**	1	.832**
	Sig. (2-tailed)	.000		.000
	N	55	55	55
LogWT	Pearson Correlation	.854**	.832**	1
	Sig. (2-tailed)	.000	.000	
	N	55	55	55

**. Correlation is significant at the 0.01 level (2-tailed).

Table 51. Regression Model Summary Computed on total length, standard length and weight of *C. nobilis* during post-monsoon:

Model Summary

	R	R Square	Adjusted R Square	Std. Error of the Estimate
TL-WT	.854	.729	.724	.094
SL-WT	.832	.693	.687	.100
TL-SL	.965	.931	.929	.024



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 26 (a-c): Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for post-monsoon season

D. Winter (December-February):

Table 52. Descriptive Statistics of Length-Weight Characteristics of *C. nobilis* during winter

	N	Range	Min	Max	Mean		Std. Deviation	Variance
	Stat	Stat	Stat	Stat	Stat	Std. Error	Stat	Stat
TL	75	39	44	83	60.84	1.397	12.098	146.379
SL	75	42	32	74	49.89	1.389	12.035	144.853
WT	75	6.7	1.2	7.9	4.134	.24633	2.13335	4.551
Valid N (list wise)	75							

Table 53. Test of significance of Correlations Coefficient between total length, standard length and weight of *C. nobilis* during winter:

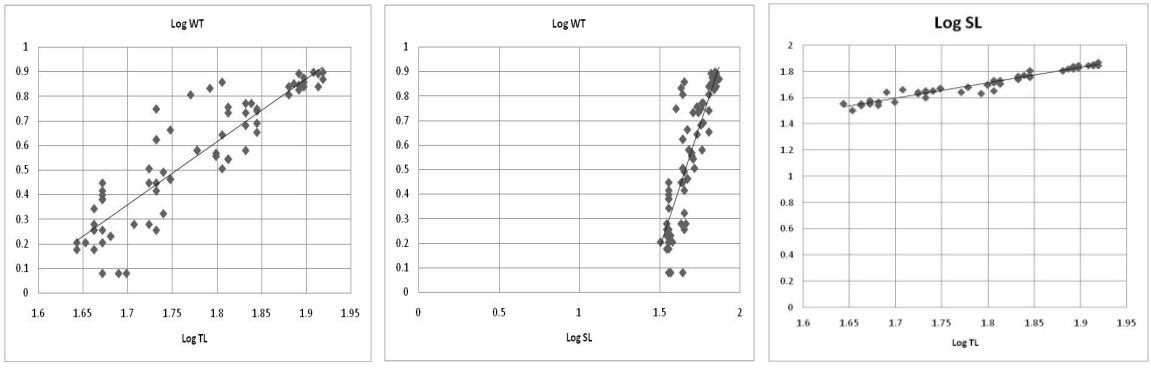
		LogTL	LogSL	LogWT
LogTL	Pearson Correlation	1	.977**	.895**
	Sig. (2-tailed)		.000	.000

	N	75	75	75
LogSL	Pearson Correlation	.977**	1	.843**
	Sig. (2-tailed)	.000		.000
	N	75	75	75
LogWT	Pearson Correlation	.895**	.843**	1
	Sig. (2-tailed)	.000	.000	
	N	75	75	75

**. Correlation is significant at the 0.01 level (2-tailed).

Table 54. Regression Model Summary Computed on total length, standard length and weight of *C. nobilis* during winter

	R	R Square	Adjusted R Square	Std. Error of the Estimate
TL-WT	.895	.802	.799	.109
SL-WT	.843	.711	.707	.132
TL-SL	.977	.956	.955	.022



a) TL-WT **b) SL-WT** **c) TL-SL**

Figure 27 (a-c): Scatter diagram depicting TL-WT, SL-WT and TL-SL relationship of the fish (logarithmic scale) for winter season

6.3.5. **Length-weight relationship on the basis of different size length:**

a) 22-47 mm length:

The study was on 110 specimens in the size range of 22.00 to 47.00 mm and weight range of 0.11 to 2.40g. The regression equation for 22-47mm length was estimated as:

Log W = -5.526 + 3.522 Log L

The correlation coefficient (r) was found to be 0.974 showing a high degree of correlation between the two parameters. The exponential value of 3.522 was tested against '3' and was found to be significantly different (t=44.256) at 1% level. The 'b' value is more than '3' indicates the positive allometric growth.

b) 48-55 mm length:

The study was on 109 specimens in the size range of 48.00 to 55.00 mm and weight range of 2.40 to 3.70 g. The regression equation for 48-55 mm length was estimated as:

Log W = -3.736 + 2.469 Log L

The correlation coefficient (r) was found to be 0.948 showing a high degree of correlation between the two parameters. The exponential value of 2.469 was tested against '3' and was found to be significantly different (t=30.660) at 1% level. The 'b' value is less than '3' indicates the negative allometric growth.

c) 56-69 mm length:

The study was on 95 specimens in the size range of 56.00 to 69.00 mm and weight range of 3.70 to 5.70 g. The regression equation for 56-69 mm length was estimated as:

Log W = -3.151 + 2.120 Log L

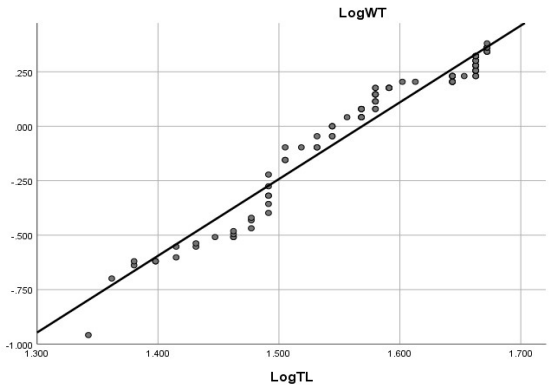
The correlation coefficient (r) was found to be 0.966 showing a high degree of correlation between the two parameters. The exponential value of 2.120 was tested against '3' and was found to be significantly different (t=36.154) at 1% level. The 'b' value is less than '3' indicates the negative allometric growth.

d) 70-100 mm length:

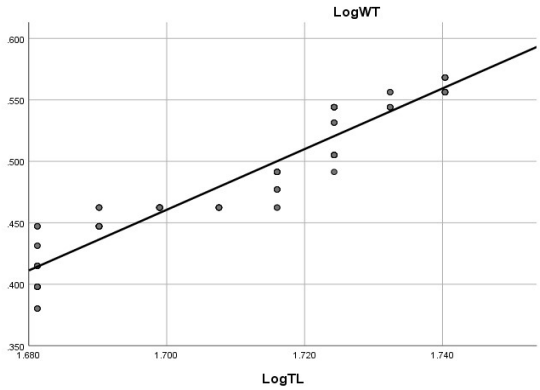
The study was on 86 specimens in the size range of 70.00 to 100.00 mm and weight range of 5.80 to 10.60 g. The regression equation for 70-100 mm length was estimated as:

Log W = -1.657 + 1.328 Log L

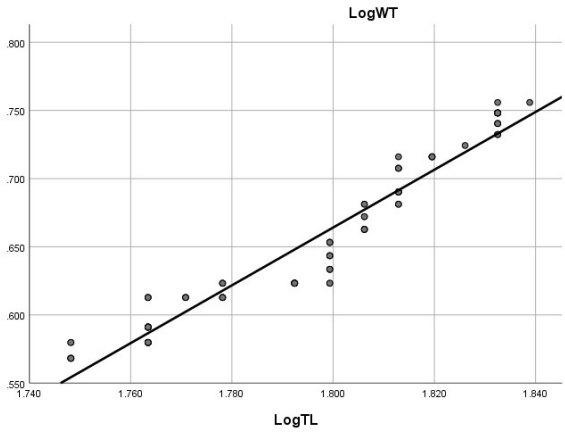
The correlation coefficient (r) was found to be 0.983 showing a high degree of correlation between the two parameters. The exponential value of 1.328 was tested against '3' and was found to be significantly different (t=48.958) at 1% level. The 'b' value is less than '3' indicates the negative allometric growth.



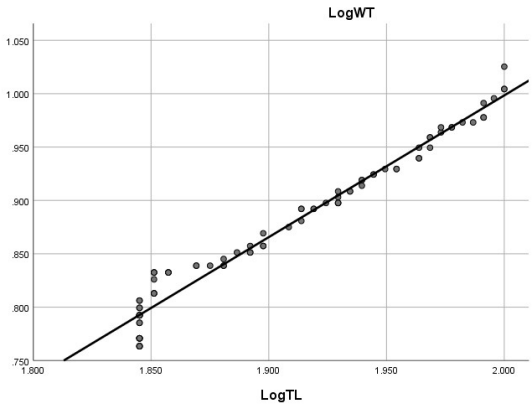
a) 22-47 mm length



b) 48-55 mm length



c) 56-69 mm length



d) 70-100 mm length

Figure 28 (a-d). Scatter diagram depicting TL-WT relationship of *C. nobilis* (logarithmic scale) of different size group

6.3.6. Condition factor of the fish:

The condition factor indicates the good physiological condition of the fish. The condition factor and relative condition factor of male, female and combined sex of *C. nobilis* are tabulated in **table 55**. It is observed that the K value and Kn value of male fish are little better than female fish. The seasonal variations in condition factor are represented in **figure 29**. The result shown that in post monsoon physiological condition of the fish was very good and in winter fish shows poor physiological condition.

Table 55. Condition factor and relative condition factor of Male, female and combined sex of *C. nobilis*

Sex	K value	Kn value
Male	2.08286	1.05568
Female	1.9655	1.1162

Combined sex	2.03	1.07

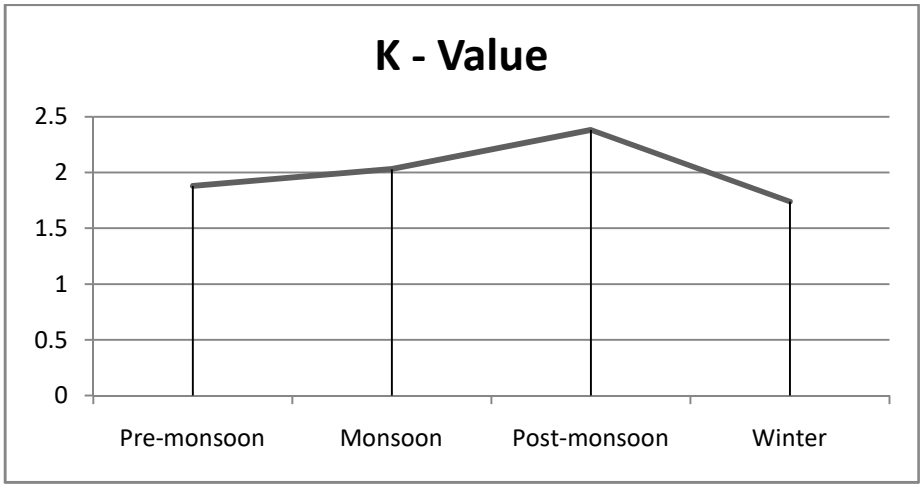


Figure 29. Seasonal variations in Condition factor of *C. nobilis*

6.4. DISCUSSION

Several biological factors like sex (Pal *et al*., 2013), size of fish (Debraj, 1973), physiological condition and gonadal maturity (Reddy and Rao, 1992) and fatness have significant influence over length-weight relationship of fishes. In the present regression analysis study of total length, standard length and weight relationship for male, female and combined sexed *C. nobilis* along with the significance test that the values of 'b' differ from one sex to another. In case of combined sex total length and weight relationship shows positive allometric growth (b= 3.79) which is similar to the observation made by Islam *et al*., 2017 in length-weight relationship of *Trichogaster lalius*. But in case of standard length and weight relationship and total length and standard length relationship shows negative allometric growth (b= 2.90 and 0.34 respectively). Whereas in case of male and female fishes all relationships between total length, standard length and weight

show negative allometric growth. Johal *et al*., 1989 in case of *Colisa fasciata* also observed the negative allometric growth.

In seasonal variation in total length, standard length and weight relationship are discussed in **table 56**. All relationships except total length and weight relationship (b= 4.00) in winter shows negative allometric growth.

Table 56. Seasonal variation in total length, standard length and weight relationship of *C. nobilis*

Season	TL-WT	SL-WT	TL-SL
Pre-monsoon	Log W = -2.78 + 1.90 Log L	Log W = -2.19 + 1.68 Log L	Log W = -0.29 + 1.12 Log L
Monsoon	Log W = -2.42 + 1.72 Log L	Log W = -1.71 + 1.38 Log L	Log W = -0.43 + 1.19 Log L
Post-monsoon	Log W = -2.72 + 1.89 Log L	Log W = -2.15 + 1.65 Log L	Log W = -0.23 + 1.08 Log L
Winter	Log W = -4.00 + 2.57 Log L	Log W = -2.81 + 2.00 Log L	Log W = -0.41 + 1.18Log L

In respect to study with different length group ‘b’ value defers significantly. 22-47 mm length size group shows maximum value (5.52) and 70-100 length size group shows minimu value (1.66). It is revealed from the present study of length-weight relationship do not strictly follow the cube law throughout its life cycle. The ‘b’ values in each of the groups were differs and were always found to be significantly different at 1% level.