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Morphometric measurement, food and feeding habits and condition factor of fresh water fish *Hypophthalmichthys nobilis*

Chhaya Khillare and Smita Sonawane

Abstract
The present study describes the condition factor, feeding habit and length- length relationship in fresh water fish *Hypophthalmicthys nobilis.* The gut content analysis was carried out with frequency of occurrence method (Dewen and Shah (1979) where monthly variation was found. Length- length relationships were estimated by regression equation method. The results indicated that length- length relationship (LLR) was highly co-related, r2>o.56: p<0.001. The values of condition factor vary from 0.87 to 1.31. The results of the present study could be useful to help in conservation and sustainable fisheries management.

Keywords: Feeding habits, condition factor, length-length relationship *Hypophthalmicthys nobilis*

Introduction
Fish is one of most important source of animal protein to maintains of healthy body. Studies on the food and feeding habits indicate the species niche in ecosystem, their feeding preference and food spectrum overlap (Padmakumar *et al*. 2009). Scientific knowledge of food and feeding habits of fish as an important condition factor increasing of fish production. Food and feeding habits of the fish vary from with the time of day, with the season of the year, with the environmental condition and with different food substance present in water body (Isa M.M. *et al* 2012).
Condition factor compares the wellbeing of a fish and is based on the hypothesis that heavier fish of a given length are in better condition (Bagenal and Tesch, 1978) [6]. Condition factor has been used as an index of growth and feeding intensity (Fagade, 1979) [11].Condition factors of different species of cichlid fishes have been reported by Fagade (1978, 1979, 1983) [11], Arawomo (1992) and Oni *et al.* (1983) [18].
A variety of morphological, physiological, behavioral and biochemical characteristics are used to identify and classify the fishes. In practices though, it is more common to use morphometric measurements (i.e. body length, body depth, head length, eye diameter, jaw length) and meristic (i.e. fin ray, scale, teeth, gill raker, and lateral line pore counts). These morphometric measurements are usually presented as a proportion of standard, fork and total length. (Howe, 2002). Morphometric measurements and statistical relationships of fishes are imperative for both fishery biology (Sparre *et al* 1989; Mustafa & Brooks 2008) and taxonomy studies (Tandon *et al* 1993; Simon *et al* 2010a). It is very important especially in comparative studies which little information seems to be available for fish species (Froese and Pauly, 2005).
The aim of present study was to determine length length relationship, food and feeding habits and condition factor of *H. nobilis* in Aurangabad region.

Material and method
A total 320 fishes of (*Hypophthalmicthys nobilis)* of different size were collected randomly from local fish market during the period *of* January 2015 to December 2015. Specimens were properly cleaned and total length (measured form anterior tip of the longest jaw to the posterior part of the tail) and total weight of fish were recorded. Specimens were dissected and their stomach removed and the length and weight of stomach were recorded and preserved in 10% formalin for further analysis.
Analysis of food was done by frequency occurrence method followed by Dewen and Shah (1979)

Frequency of occurrence (Fi)= ni/NT
Where, ni= No. of samples containing type of prey (i)
NT=Total no. of stomach with food in sample
The relative length of gut was estimated by method:

For length-length relation

Total length was measured from the anterior tip of the longest jaw to the most posterior part of the tail, standard length was measured from anterior tip of the upper jaw to the tip of hypural bone (urostyle), fork length was measured from the anterior tip of upper jaw to the median point of the caudal fin, head length was measured from anterior tip of upper jaw to posterior region of head, dorsal length was measured from upper anterior tip of upper jaw to the end of dorsal fin (Laevastu, 1965).
The relationship between total length, standard length, fork length, head length and dorsal length were calculated by linear regression. (Hossain *et al*., 2006).

The condition factor

K was estimated from the relationship:
K=100W/L3,
Where W= weight of fish in grams, L= total length of fish in centimeters.

Results

Gut content analysis

Gut content analysis of fish shows *Hypophthalmicthys nobilis,* content most of plant type of food materiel which content algae, aquatic plant material, sand particles but it shows sometime the fish feed on animal food material but in small amount.
In the present investigation, it was observed that percentage of frequency of occurrence of algae as a food in *Hypophthalmichthys nobilis* was highest 29.289 in month of April 2015 while lowest 20.873 in month of January 2015. (Table no. 1)
It was observed that percentage of frequency of occurrence of crustaceans as a food in *Hypophthalmichthys nobilis* was highest 10.5 in month March 2015 while lowest 5.224in January 2015. (Table no. 1)
The percentage of frequency of occurrence of aquatic plants as a food in *Hypophthalmichthys nobilis* was highest 27. 294 and lowest 20.015 in month of October 2015. (Table no. 1)
In the present investigation, it was observed that percentage of frequency of occurrence of sand and mud particles as a food in *Hypophthalmichthys nobilis* was highest 25.30 in month of September 2015 and lowest 19.31 in month of March 2015. (Table no. 1)
The percentage of frequency of occurrence of unidentified phytoplankton and zooplankton was highest 11.111 in month of August and lowest 6.082 in month of January 2015. (Table no. 1)
The percentage of frequency of occurrence of diatoms was highest 7.777 in month of June 2015 while lowest 4.341 in month of December 2015. (Table no. 1)
The percentage of frequency of occurrence of rotifers was highest 8.318 in month of May 2015 while lowest 5.656 in month of April 2015. (Table no. 1)

Table 1: Frequency of occurance (Fc%) of prey found in *Hypophthalmicthys nobilis,* during months January 2015 to December 2015

Month &Year Prey(i)		Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	June 2015	July 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015
Algae	ni	24	24	15	24	14	18	19	16	21	18	23	19
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.827	0.8	0.882	0.857	0.777	0.782	0.904	0.64	0.806	0.782	0.851	0.673
	Fc%	20.873	24.76	26.32	29.289	23.333	23.392	28.900	25.396	25.305	23.37	28.75	23.680
Crustacean	ni	6	6	6	6	4	5	6	5	7	7	7	6
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.206	0.2	0.352	0.214	0.222	0.217	0.28	0.2	0.269	0.304	0.259	0.212
	Fc%	5.224	6.190	10.50	7.313	6.66	6.491	8.951	7.936	6.459	9.088	8.75	7.459
Aquatic plants and debris	ni	23	23	14	19	13	20	15	16	22	21	19	20
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.793	0.766	0.823	0.678	0.722	0.869	0.714	0.64	0.846	0.913	0.703	0.714
	Fc%	20.015	23.70	24.56	23.171	21.68	25.99	23.68	25.396	26.528	27.294	23.75	25.123
Sand and mud particles	ni	23	24	11	20	13	18	14	12	21	17	17	20
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.793	0.8	0.647	0.714	0.722	0.782	0.666	0.48	0.807	0.739	0.629	0.714
	Fc%	20.015	24.76	19.31	24.401	21.68	23.392	21.291	19.047	25.30	22.092	21.25	25.123
Other miscellaneous	ni	7	10	5	6	6	6	6	7	5	7	5	7
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.241	0.333	0.294	0.214	0.333	0.260	0.28	0.28	0.192	0.304	0.185	0.25
	Fc%	6.082	10.37	8.776	7.313	10	7.777	8.951	11.111	6.020	9.088	6.25	8.796
Diatoms	ni	5	5	3	4	5	6	3	3	4	4	5	4
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.172	0.166	0.176	0.142	0.277	0.260	0.142	0.12	0.153	0.173	0.185	0.142
	Fc%	4.341	5.137	5.253	4.853	8.318	7.777	4.539	4.761	4.797	5.171	6.25	4.996
Rotifers	ni	3	5	3	3	5	4	3	4	3	3	4	4
	NT	29	30	17	28	18	23	21	25	26	23	27	28
	Fi	0.103	0.166	0.176	0.107	0.277	0.173	0.142	0.16	0.115	0.130	0.148	0.142
	Fc%	2.599	5.137	5.253	3.656	8.318	5.175	4.539	6.349	3.606	3.886	5	4.996

Where, 'ni' = No, of stomach containing a type of prey 'i' and NT= is No. of not empty stomach examined; Fi= ni/NT and Fc%= Fi/$\sum$Fi ^{x} 100

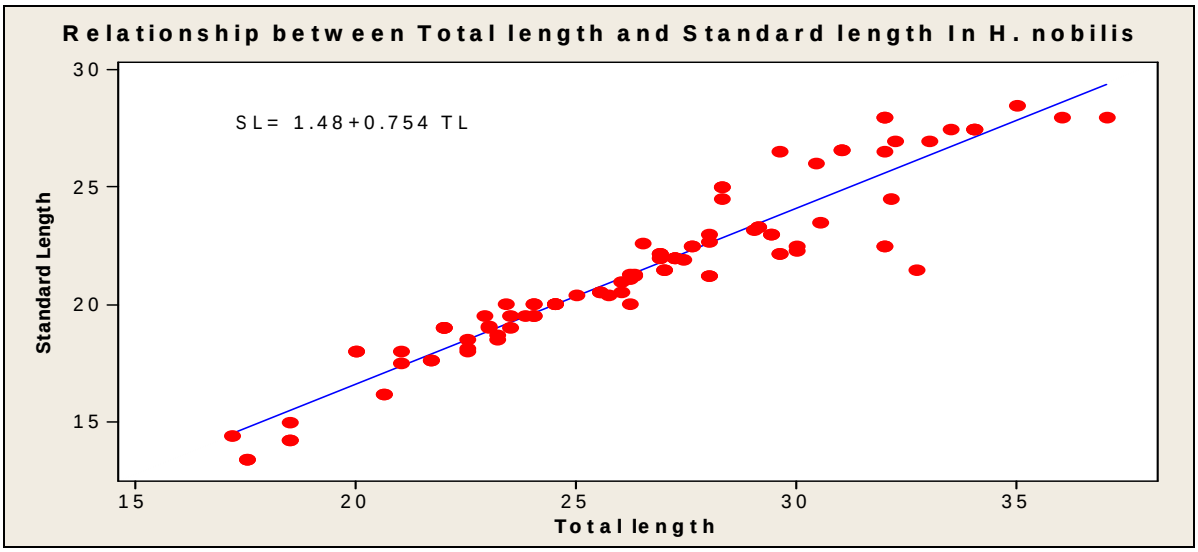
Length-length relationship:

Table no. 2 conversion among length-length measurements i.e. relationship between total length (TL), Fork length (FL), standard length (SL), Dorsal length (DL) and Head length of 100 fish specimens, along with the estimated parameters of the length- length relationship and coefficient determination (r2) are in table 2. Length-length (relationship between total length to standard length, standard length to fork length, fork length to total length, dorsal length to head length, total length to dorsal length, total length to head length, standard length to dorsal length, standard length t head length, fork length to dorsal length and fork length to head length) relationship was highly significant. (p<0.01), with the most of the coefficient determination value being greater than 0.70

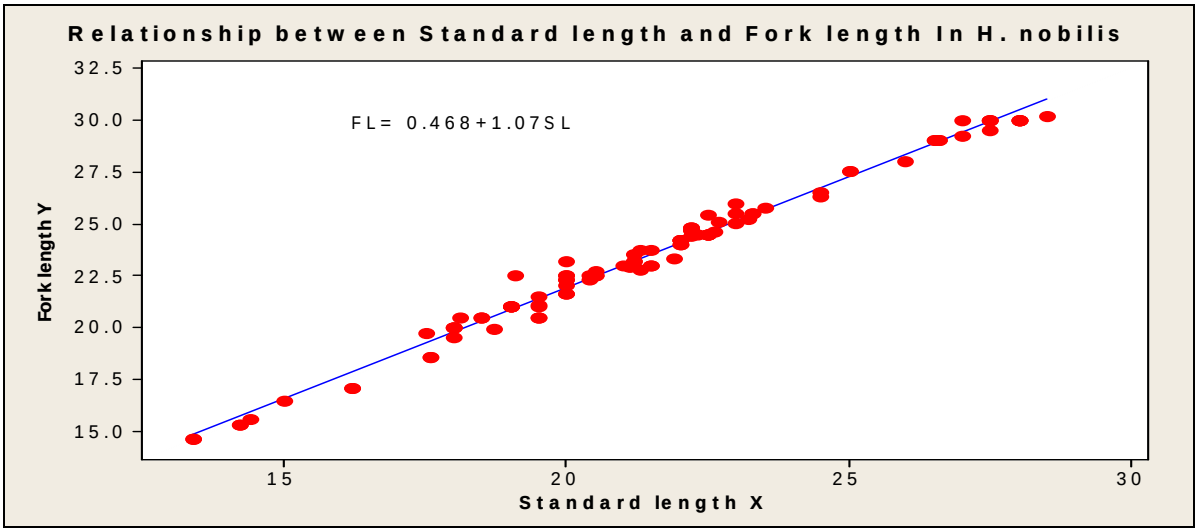
Table 2: Estimated parameters of length-length relationship

Fish name	Type of conversion	Slope (a)	Intercept (b)	R2	Regression equation Y=a+bX
Hypophthalmicthys molitrix	TLV SL	1.48	0.754	0.895	SL=a+bTL
	FL V SL	0.468	1.07	0.98	FL=-a+bSL
	FL V TL	0.795	1.10	0.88	TL=a+bFL
	DL V HL	0.538	0.415	0.60	HL=a+bDL
	TL v DL	-0.529	0.427	0.85	DL=a+bTL
	TL v HL	-0.546	0.210	0.72	HL=a+bTL
	SL v DL	-0.473	0.524	0.81	DL=a+bSL
	SL v HL	-0.649	0.265	0.73	HL=a+bSL
	FK v DL	-0.582	0.484	0.81	DL=a+bFL
	FK v HL	-0.749	0.246	0.73	HL=a=bFL

a, intercept: b, slope:: r2 coefficient of determination: TL, total length, SL standard length, FL fork length, DL dorsal length, HL head length



Graph 1



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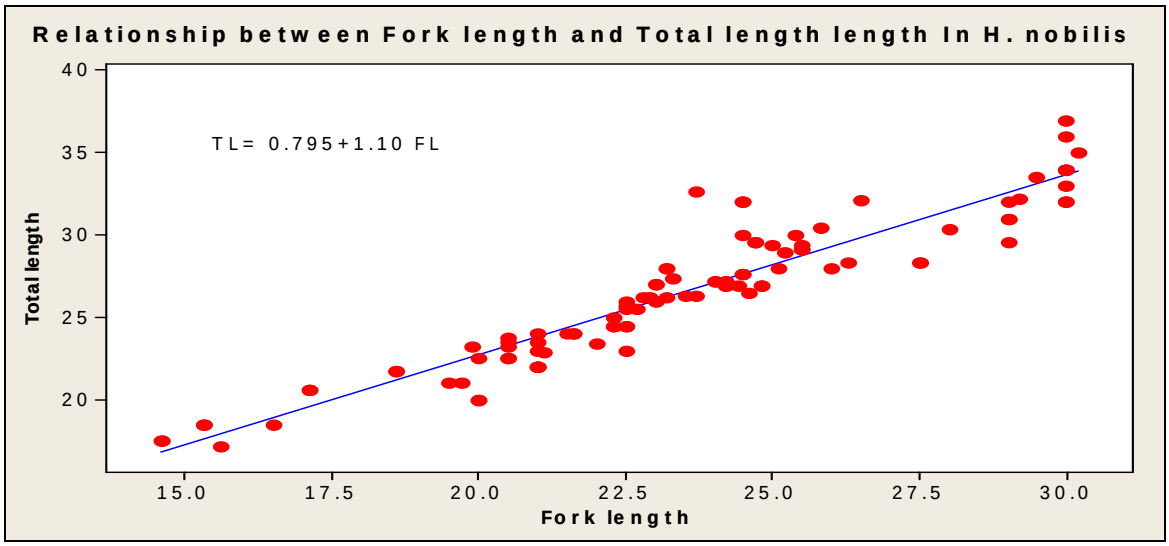

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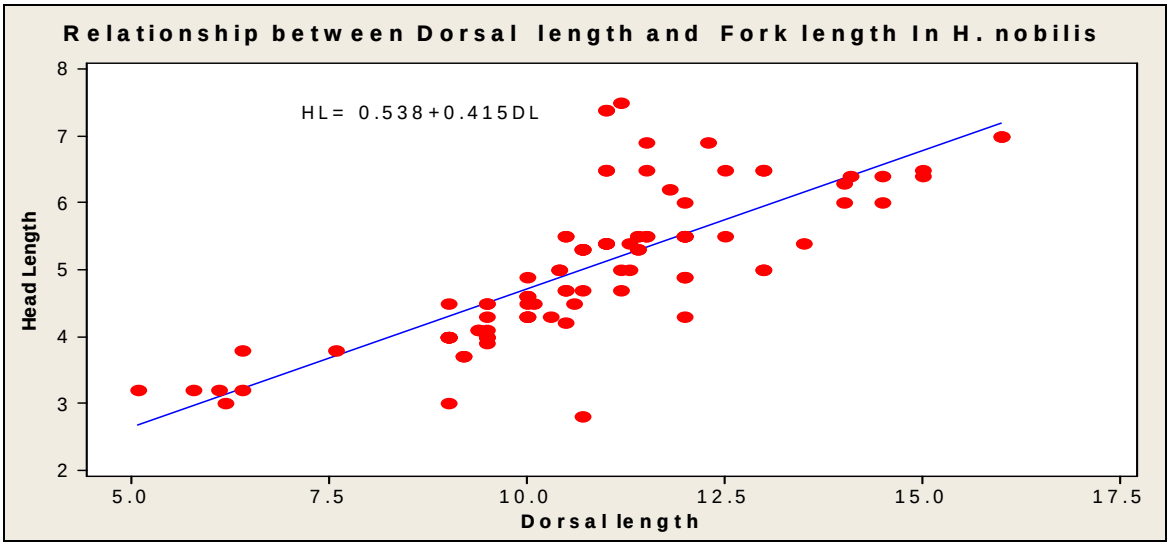

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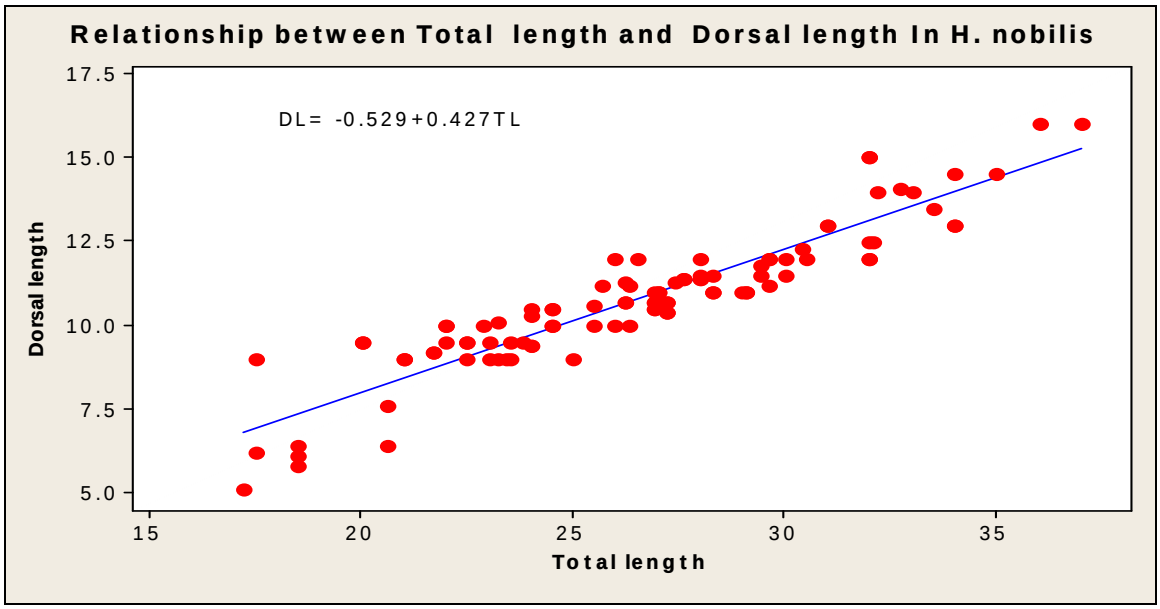

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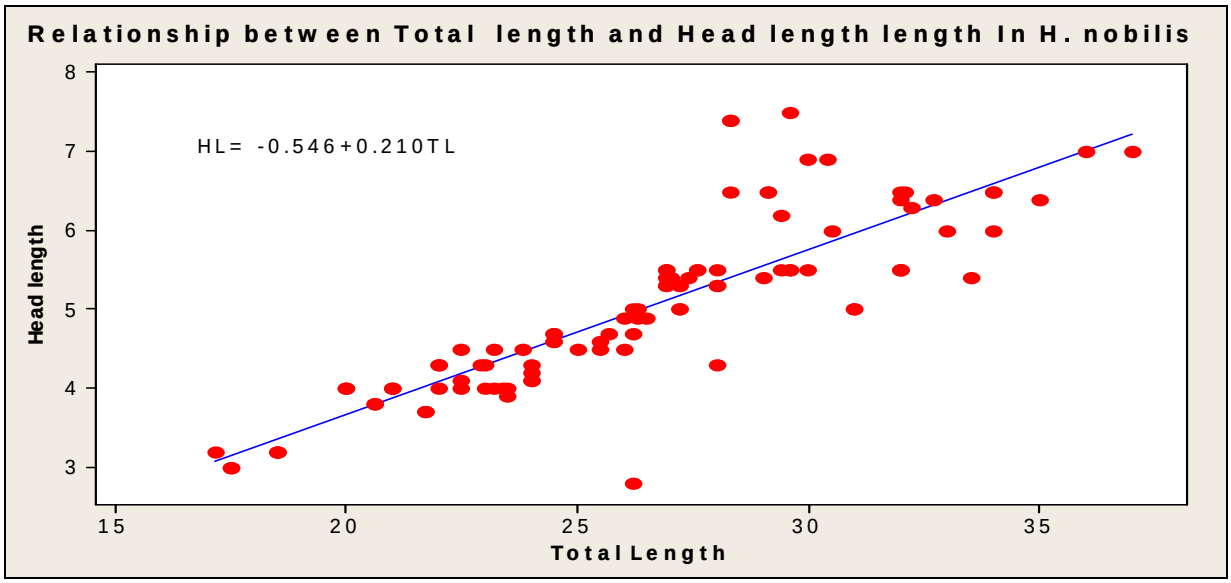

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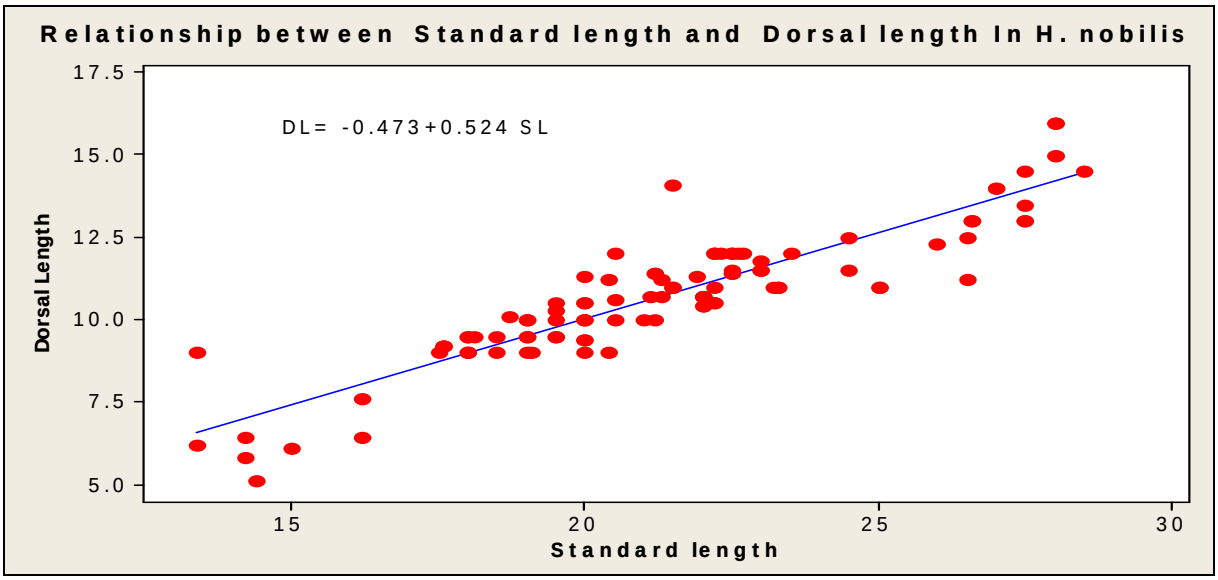

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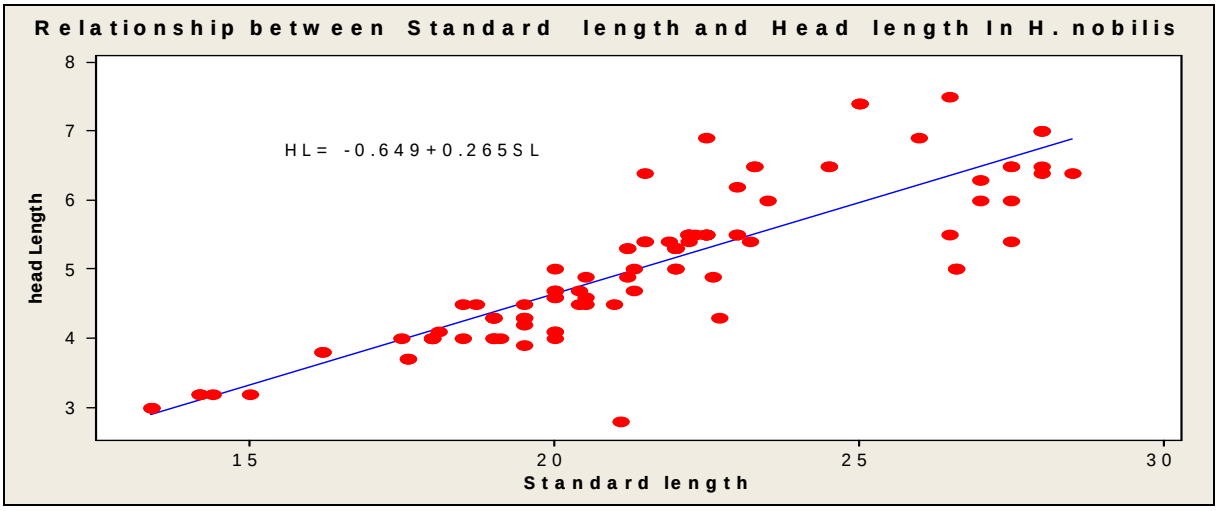
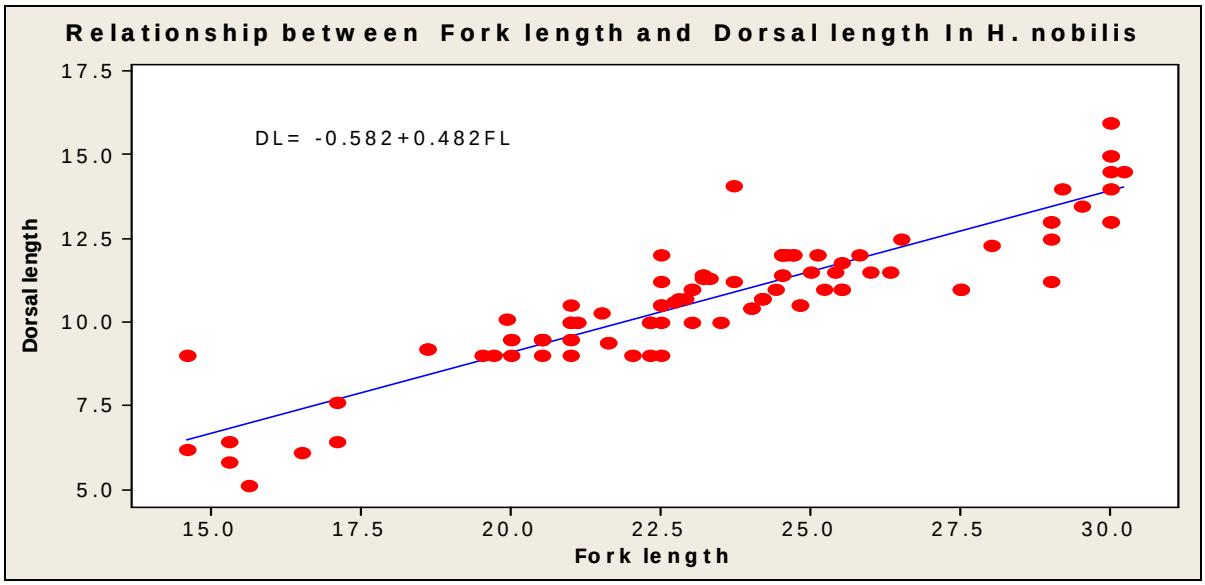
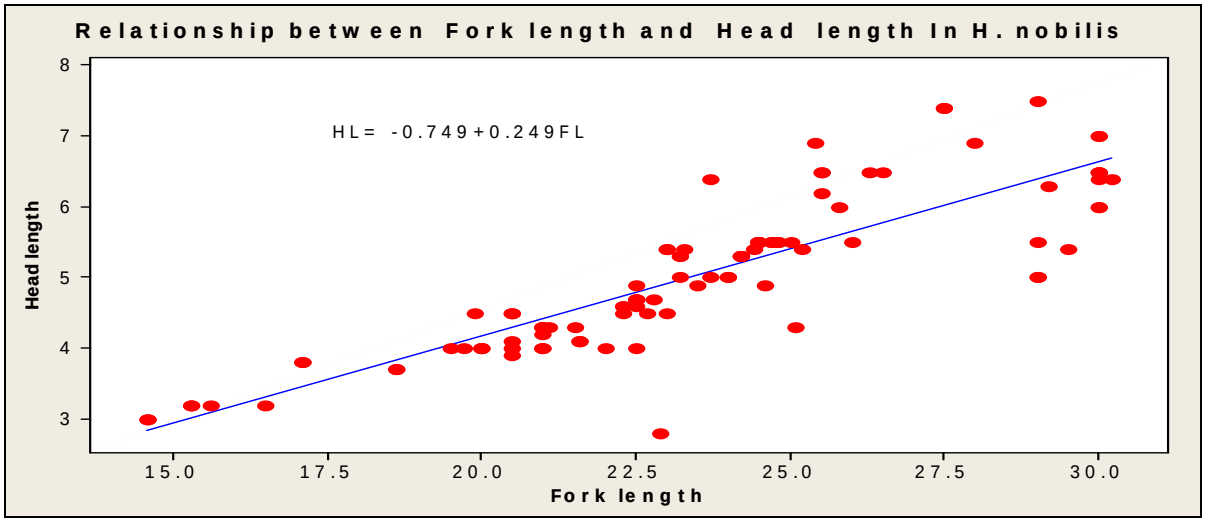


Graph 8



Graph 9



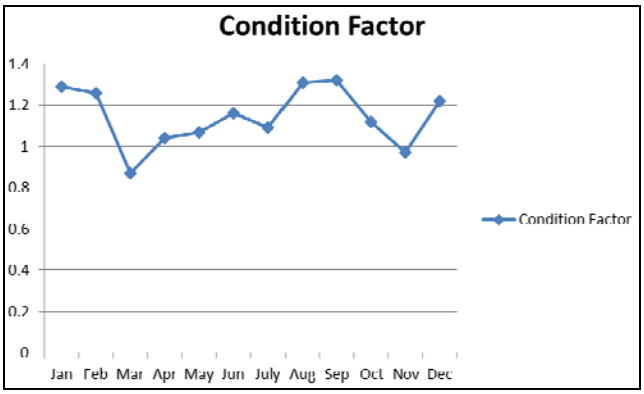
Graph 10

Condition Factor

Graph no. 11 shows the monthly condition factor for species *H. nobilis.* from January 2015 to December 2015. Following table shows that condition factor was highly found in month of August 1.31 and minimum 0.87 in month of March.

Table 1: Monthly data for condition factor

Month	Condition Factor
Jan	1.29
Feb	1.26
Mar	**0.87**
Apr	1.04
May	1.07
Jun	1.16
July	1.09
Aug	1.31
Sep	**1.32**
Oct	1.12
Nov	0.97
Dec	1.22



Graph 11

Discussion

The gut content analysis of H. nobilis was done by percentage of frequency of occurrence method. According to the diet fisher are categorized into three parts.

1. Herbivorous: the fishes feed most of the plant material.
2. Carnivorous: the fishes feed most of animal material.

3. Omnivorous: the fishes which feeds both plant as well as animal material.

On the above observation of gut content of *H. nobilis* it can be concluded that fish belongs in herbivorous category because it content most of the plant material although it may content animal food but it's in minimum quantity.

The condition factor of fishes has been reported to be influenced by a number of factors such as the onset of maturity (Hoda, 1987), Spawning (De-Silva and Silva, 1979; Al-Dham and Wahab, 1991) [9, 2], sex and maturity (Gowda *et al.,* 1987; Doddamani and Shanbouge 2001) [13, 10] and Pollution (Bakhoum, 1999 and Devi *et al.,* 2008) [7]. During the present study also the monthly fluctuations in condition factor in all the six species seemed to be influenced by gonadal development, availability of food and gastral activity. Analysis of condition factor *H. nobilis* showed that majority of fish was in good condition with the mean of condition factor well above 1.00. This is indication that the environmental conditions of water body are at optimum level, giving fish a good condition of growth and development (Courtney J. *et al*. 2012). Condition factor is an index reflecting between biotic and a biotic factor in the physiological conditions of fishes (Ahmad Dar *et al*.)

The high values of r2 in length-length relationships indicate that the length relationships are linear over the observed range of values. A number of factors might affect the proportion total length, standard length, fork length, dorsal length, head length including growth phase, food availability and quality of food, size ranges, health, general fish condition and preservation technique (Gaygusuz *et al*., 2006). However, these factors were not considered in the present study.

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