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Morphometrics, Length-Weight Relationship and Condition Factor of *Coilia dussumieri* Valenciennes, 1848 from North-East Coast of India

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Abstract

The Gold spotted grenadier anchovy, *Coilia dussumieri* Val. forms an important component of dolnet (Bag net) and trawl fishery. For morphometric analysis 63 specimens were examined and the total length was ranged between 9.2 and 16.2 cm (mean 13.34± 1.56). A total of 477 specimens (416 males and 61 females) were used for the study. The overall ratio of males to females in the population was 1: 0.15. Length-weight relationship of *C. dussumieri* indicates negative allometric growth and found to be significantly different at 1% level. The fish follow the cube law. The relationship between L-W of the species were fitted as $\text{Log } W = - 1.85006 + 2.4090 \text{ Log } L$, $R^2 = 0.78$ (combined); $\text{Log } W = - 2.23497 + 2.74196 \text{ Log } L$, $R^2 = 0.86$ (male) and $\text{Log } W = - 0.71091 + 1.40273 \text{ Log } L$, $R^2 = 0.41$ (female). A size group 12.3 to 13.9 cm. was found to be predominant (38.16%) followed by 13.9 to 15.5 cm. (36.48%) and can be optimally exploited.

Keywords: *Coilia dussumieri*, Morphometry, Length-weight relationship, Relative condition factor, North-East Coast.

Introduction

Coilia dussumieri Valenciennes, 1848^[34] is popularly known as Gold spotted grenadier anchovy in England, as mandeli in Bombay and Gujarat and “oluua maach” in coastal districts of Bangladesh^[23, 29]. In West Bengal it is known as “Amude maach” or “Ruli maach”. Anchovies are belonging to the Family: Engraulidae^[10] commonly found in the shallow coastal water and estuaries, occurring in fully saline water, but also able to tolerate lowered salinities, perhaps almost fresh water. The Gold spotted grenadier anchovy is widely distributed in the Indian Ocean: India from Bombay to Calcutta, probably also Myanmar, Thailand and Malaysia. Western Central Pacific: Thailand to Java, presumably also Kalimantan. It has a significant catch of the marine fish landed along the North-East coast of India viz. West Bengal & Orissa. The Gold spotted grenadier anchovy, does not form the commercially important marine fish landing, it is caught along with another species of *Coilia* (*C. ramcarati*)^[21] and with a variety of other fishes by indigenous bag nets, dol nets and trawls^[16, 20, 28]. It ranks third in the marine fish landings in the vicinity of West Bengal coast in the year 2013-14^[9]. In Bangladesh it is caught mainly with beach seines, purse seines, bamboo-stack traps and incidentally with bottom trawlers^[23].

In West Bengal the annual catch of this during 1985 was 490 t and 4349 t in 1992 indicating rising trend. However, in the last few years the catch has stabilised to 4000 t. In CMFRI Annual Report it was recorded that among the pelagic fin fish landings, the annual landing of the fish was 30518 t (2009), 31994 t (2010), 37329 t (2011), 26788 t (2012) and 30767 t (2013). The total production by trawlers during 2013 along the north east coast of India was 4.28 lakh t. The catch rate was 39.49 kg/h. Trawl landings in west Bengal was 0.83 lakh t forming 58.6% and 0.067 lakh t forming 31.4% of the total marine landings during 2012 and 2013 respectively, among them golden anchovy is contributing 5.9% and 5.6% of total trawl fishery catch^[8, 9]. The catch of clupeids was 10,358t during 2012-13 in which dominated *C. dussumieri* 35.4%. Fishery Biologists in past have studied some aspects of *C. dussumieri* on skeletal system^[18, 19], maturity stages^[25], general account of biology^[3], length-weight relationship and relative condition factor^[29], eggs and early development^[11], post larval stages^[17] and food and feeding habit at different growth stages^[4]. From North- Western Coast of

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India stock assessment & dynamics of *C. dussumieri* from the Exclusive Economic Zone [12, 14] and reproductive biology of the gold spotted grenadier anchovy were studied [13]. In Bangladesh the age, growth and virtual population analysis of *C. dussumieri* were studied [23]

However dearth of pertinent literature on morphometric aspects of fish from coastal waters of West Bengal was not done. Although *C. dussumieri* is an economically important fish and has a gradually increasing demand in fresh and dry condition at home and abroad but there is no published report on biology, age and growth, length-weight study of this species in North-east coast of India, especially in West Bengal coast. So an attempt was made to study the biology and Length-Weight relationship of *C. dussumieri* from West Bengal coastal waters. Length-weight relationship is important in fisheries science, notably to raise length frequency samples to total catch, or to estimate biomass from underwater length observations [24] from the known weight and vice-versa, duration of gonadal maturation, increase or decrease in feeding activity, possibly due to modifications in food resources and it is an useful tool in fish biology, physiology, ecology and stock assessment.

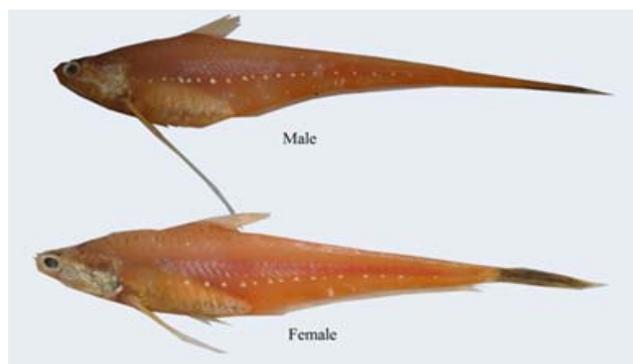


Fig 1: Gold spotted grenadier anchovy, *C. dussumieri*

Materials and Methods

Samples were collected once a month over a period of one year from March 2014 to February 2015 from different commercial landing centres of West Bengal coast like Frazergunge, Raichaowk, Raidighi, Digha Mohona and Sankarpur. Altogether 477 specimens were examined for estimating the distribution of different size group and the study of Length-weight relationship. A total of 63 specimens were examined for morphometric analysis. In the laboratory, a total of 8 morphometric measurements were recorded for each fish. Measurements were followed as mention by earlier worker [2, 27]. Morphometric measurements were taken from the left lateral aspect, and measured to the nearest 0.01 cm using a digital caliper (absolute digimatic digital calipers, Mitutoyo, Japan).

The length, weight, sex data were recorded for each specimen in the sample. Total length was measured with the help of digital caliper and weight was taken by electronic balance of 0.0001 g accuracy. The total length and weight relationship was determined by the equation $W = aL^3$, where W = Weight of fish in gram (g), L = Total length of fish in centimetre (cm) a = Regression constant or intercept, b = Regression coefficient or slope [22]. The equation was linearized by a logarithmic transformation into:

Log Weight = log a + b log Length was computed using Microsoft Excel to estimate “a” and “b” values. The condition

factor was calculated using the means of the total length and weight of fish as provided [26] with the equation: $K = 100w/L^3$, where K = condition factor, W = Mean body weight in grammes (g), L = Mean total length in centimeters (cm). The linear relationship between the length and weight was also estimated by calculating the correlation coefficient (R^2). The sex of the fish was determined by visual observation on the tail fin in which female bearing more elongated hairy fin than male (Fig.1). Sex ratio was determined by counting numbers of males and females specimens throughout the study period.

Result and Discussion

Morphometric Analysis

Various parameters of the morphometric characters of the Gold spotted grenadier anchovy, *C. dussumieri* are presented in Table 1. The total length recorded in the present study was ranged between 9.2 and 16.2 cm (mean 13.34 ± 1.56) whereas the head length ranged from 1.2 to 2.5 cm. with mean of 2.02 ± 0.267 cm. The percentage of morphometric characteristics with respect to total length (TL) is shown in Table 2. The head length of *C. dussumieri* is 15.14% of total body length.

Table 1: Details of morphometric characteristics of *C. dussumieri*

Morphometric Characteristics (cm)	No. analysed	Range	Mean \pm SD
TL	63	9.2-16.2	13.34 ± 1.56
HL	63	1.2-2.5	2.02 ± 0.267
BD	63	1.5-3.4	2.56 ± 0.40
ED	63	0.3-0.7	0.47 ± 0.06
PDL	63	2.2-4.0	3.25 ± 0.39
PAL	63	3.0-5.4	4.48 ± 0.53
PPL	63	1.2-2.4	1.93 ± 0.25
PVL	63	1.8-3.7	3.03 ± 0.40

Table 2: Percentage of morphometric characteristics with respect to total length (TL)

Morphometric Characteristics Percentage of Total length (TL)	Average (%)
HL (% TL)	15.14
BD (% TL)	19.19
ED (% TL)	3.52
PDL (% TL)	24.36
PAL (% TL)	35.58
PPL (% TL)	14.47
PVL (% TL)	22.71

Sex ratio

Out of 477 fish sexed, 416 were males and 61 were females, indicating a sex ratio 1 male to 0.15 female; this deviates significantly from the 50:50 ratio.

Length-weight relationship

The length-weight relationship for *C. dussumieri* ranging in size from 9.2 cm to 17.1 cm (Male) and 9.1 cm to 14.7 cm (Female) was estimated during the study period. Total length varied between 9.1 cm and 17.1 cm and body weight varied between 2.22 g and 15.54 g during the year. From the results it is observed that weight of *C. dussumieri* bears a linear relationship with the length on logarithmic transformation (Fig. 2, 3 & 4). The length and weight measurements of the fish are related to each other with a high degree of correlation coefficient males, $R^2=0.86$ & combined, $R^2=0.78$ and female shows low degree of correlation coefficient $R^2=0.41$ (Table 3). If the value of ‘R’ is found to be higher than 0.5 the length-

weight relationship is positively correlated [5]. Hence the 'R' values of male and combined shows a positive correlation. The regression equation for both the sexes and combined of *C. dussumieri* are, Males: $\text{Log W} = -2.23497 + 2.74196 \text{ Log L}$; Females: $\text{Log W} = -0.71091 + 1.40273 \text{ Log L}$ and combined: $\text{Log W} = -1.85006 + 2.40901 \text{ Log L}$. Equation $W = a + bL^3$ was found to be the best fit to the length-weight data. The value of exponent ('b') for males was 2.74, for females was 1.40 and for combined was 2.41 (Table 4) and the exponent value was tested against '3' and was found to be significantly different at 1% level. The theoretical value of 'b' in length-weight relationship is reported as 3 (Cube's law), when body form of fish remains constant at different lengths i.e. the growth in fish is isometric [1, 32, 31, 33]. When $b < 3$ it can be said to have a negative allometric growth and is defined hypoallometry; instead when $b > 3$ it showed a positive allometric growth and is defined hyperallometry [30]. In the present study lower regression coefficient ($b < 3$) were recorded for both the sexes and combined sex and it was an indication

of negative allometric growth. The fish does not follow the cube law ($b=3$) strictly. The comparable result from neretic waters off the Mumbai coast and from Bangladesh in *C. dussumieri* also showing negative allometric growth [29, 23]. The relative condition factor measures all variations associated with food supply, sexual maturity etc. The study indicates a seasonal variation by change of weight in relation to length of fish (Table 4). The higher K value in males ($K = 0.82$) is indicative of increased deposition of fat as a result of adaptability and high feeding activity in male over female. Whereas calculated K value in females ($K = 0.51$) indicating extremely poor and thin body condition.

Table 3: Regression Statistics

Sex	Observations	Multiple R	R ²	Adjusted R ²	Std. Error
Male	416	0.93	0.86	0.86	0.05
Female	61	0.64	0.41	0.40	0.08
Combined	477	0.88	0.78	0.78	0.06

Table 4: Length-weight relationship equation and "K" value of *C. dussumieri*

Sex	Regression Equation	Exponent ("b" value)	"K" value
Male	$\text{Log W} = -2.23497 + 2.74196 \text{ Log L}$	2.74	0.82
Female	$\text{Log W} = -0.71091 + 1.40273 \text{ Log L}$	1.40	0.51
Combined	$\text{Log W} = -1.85006 + 2.40901 \text{ Log L}$	2.41	0.77

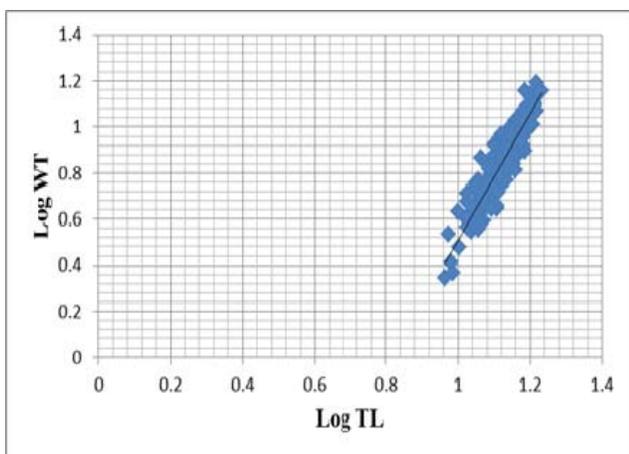


Fig 2: Relationship between Log Total Length (TL) and that of body Weight (WT) in *C. dussumieri* (Male)

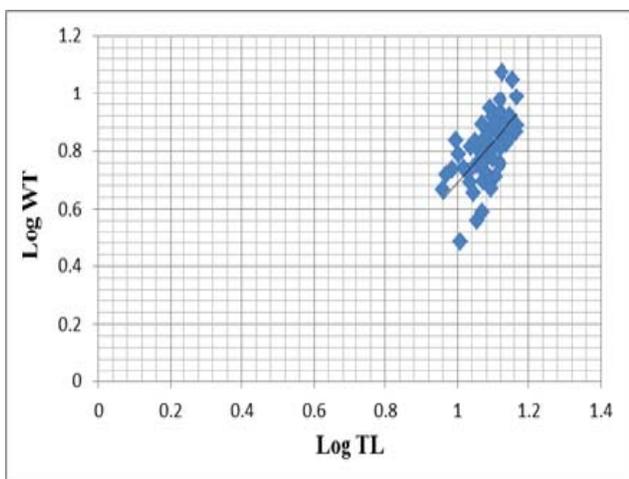


Fig 3: Relationship between Log Total Length (TL) and that of body Weight (WT) in *C. dussumieri* (Female)

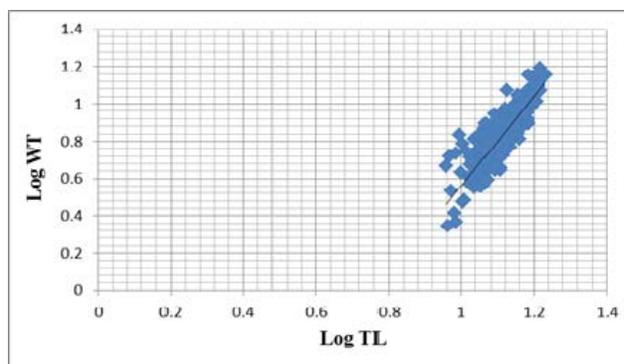


Fig 4: Relationship between Log Total Length (TL) and that of body Weight (WT) in *C. dussumieri* (Combined)

Length frequency distribution

The variation in the number of fishes of *C. dussumieri* recorded in different size groups are presented in Table 5 after grouping at intervals of 1.6 cm. Maximum number of fishes were found distributed in 12.3 to 13.9 cm. size group (38.16%) followed by 13.9 to 15.5 cm. size group (36.48%). The distribution gives an indication that the size group of 12.3 to 13.9 cm is predominant in the natural habitat during most part of the year. The remaining fish are distributed from 9.1 to 10.7 cm. (3.98%), 10.7 to 12.3 cm. (14.68%), and 15.5 to 17.1 cm. (6.71%) Fig. 5 & 6.

Table 5: Frequency distribution of different size groups of *C. dussumieri* during the study period

Size Groups (cm)	Frequency	Relative Frequency	% Frequency
9.1-10.7	19	0.039832285	3.98%
10.7-12.3	70	0.146750524	14.68%
12.3-13.9	182	0.381551363	38.16%
13.9-15.5	174	0.364779874	36.48%
15.5-17.1	32	0.067085954	6.71%
Total	477	1	100.00%

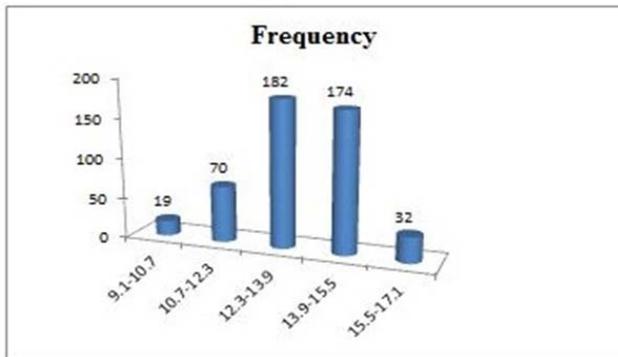


Fig 5: Length-Frequency distribution of different size groups of *C. dussumieri*

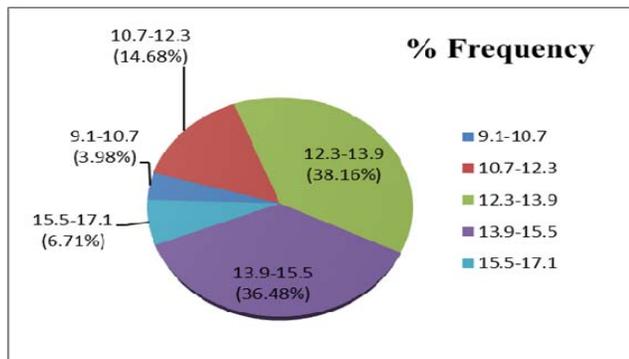


Fig 6: Percentage of Length-Frequency distribution of different size groups of *C. dussumieri*

Conclusion

This is the first report on the morphometric and length-weight analysis of *Coilia dussumieri* from North-Eastern coast of India (West Bengal Coast). Present studies indicated negative allometric and poor growth of the fish. The result of the study will be useful to the researchers and policy planners. This study also helpful for the fishery managers to implement adequate adaptation-centric regulation for sustainable fisheries management of Gold spotted grenadier anchovy.

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