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CONTENTS

Length-weight relationship and condition factor of four fishes of the Family Trichiuridae south west and east coast of India

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ABSTRACT: Cutlass fishes *Trichiurus gangeticus*, Gupta, 1966*, Eupleurogrammus glossodon*, (Bleeker, 1860) *Tentoriceps cristatus* (Kluzinger, 1884) and *Benthodesmus oligoradiatus*, Parin and Becker, 1970 were collected from the landing centers, off southwest, south east and northeast coast of India during 2020-2021. The present study estimated the length-weight relationship parameter b with the coefficient of determination r^2 scores using ordinary least squares regression method. The b values in the relationship $W=aL^b$ varied between 2.6306 to 3.3396 and the r^2 value ranged from 0.8 to 0.93. Also determined the condition factor of all the four fishes and it indicates wellbeing ranging from 1.02 to 1.1. Present study provides valuable inputs to the species management and stock assessment.

Key words: Cutlassfishes, Indian waters, length-weight relationship, Trichiuridae

The length-weight relationship (LWR) is used for estimating the weight of the fish in relation to length and to know the condition of the fish (Froese, 2006; Le Cren, 1951). It is an important parameter used for fisheries management and stock assessment (Froese, 2006; Froese *et al.,* 2011). Condition factor is used for monitoring the feeding intensity, age and growth rate in fishes and determining whether fishes are in good or poor condition (Uddin and Gish, 2021). From the Family Trichiuridae15 species were reported from the Indian coast. However, information on LWR data and condition factor is limited to a few species *viz*., *Trichiurus lepturus, Lepturacanthus savala, Trichiurus auriga* and *Eupleurogrammus muticus* (James, 1967; Narasimham, 1970; Swain, 1993; Rizvi, 2001; Azadi and Ullah, 2008; Chakravarty *et al*., 2012; Rizvi *et al.*, 2012; Pakhmode *et al*., 2013; Kudale *et al*., 2014; Bineesh *et al.,* 2018). Present study aimed to establish LWR details and condition factor of *Trichiurus gangeticus*, Gupta, 1966*, Eupleurogrammus glossodon*, (Bleeker, 1860) *Tentoriceps cristatus* (Kluzinger, 1884) and *Benthodesmus oligoradiatus*, Parin and Becker, 1970, belonging to the Family Trichiuridae. These estimates can be useful for the species management and fisheries stock assessment in the region.

MATERIALS AND METHODS

Present study collected specimens from different landing centres of the southwest and east coast of India, Sakhthikulangara (Kerala), Tuticorin (Tamil Nadu) and Shankarpur (West Bengal) during 2020-2021. The specimens were identified using standard references (Day 1876; Goode and Bean 1895; Alcock 1899; FAO 1984; Smith and Heemstra 1986; Nakamura and Parin, 1993). The length was measured to the nearest 0.1 cm (Total Length, TL) using Digital Vernier caliper and weighed to the nearest 0.1 g (weight, W) using an electronic balance. The length weight was estimated using the regression formula $W=aL^b$, (Le cren, 1951; Froese, 2006) where W is body weight (g), L is the total length (cm), a and b are regression parameters. After converting the measurements into logarithmic values, least square regression of weight and length was derived by excluding the outliers (log W= loga + blogL) (Petrakis and Stergiou, 1995). Coefficient of determination (r^2) and 95% of confidence interval of a and b estimated (Zar, 1984). Students't-test (Zar, 1984) was used to test the statistical significance of the isometric value (b=3). Analysis of Covariance (Zar, 1984) was also performed for comparing regression parameters of male and female. R software (R Core Team, 2021) was used for all statistical analysis.

The co-efficient of condition or the condition factor is an indicator to fish welfare in their habitat (Omogoriola *et a*l., 2011) The Relative condition factor (Le Cren, 1951) was estimated using the formula $Kn = Wo/Wc$
Where, Wo – weight observed and Wc- is weight calculated (aL^b)

RESULTS AND DISCUSSION

The length weight relationship of four fishes of the Family Trichiuridae has been carried out. Scientific name, sample size, length range and weight range and the estimated, regression parameters a and b, Coefficient of determination (r^2), 95% of confidence interval of a and b, are given in the Table1. Results of Student's t-test (Pooled data) showed that b value *B. oligoradiatus*, *E. glossodon* and *T. cristatus* was statistically significant ($p<0.05$) and b value of *T. gangeticus* was not significant. Results of ANCOVA showed that the curvilinear relationship for all the four species (ANCOVA, $p < 0.05$).

The mean condition factor with standard deviation of Fulton's condition factor and Relative condition factor is furnished in the Table 2 and the relative condition factor for the species *T. gangeticus, E. glossodon, T. cristatus, and B. oligoradiatus*is found to be Kn> 1. While the Fulton's condition factor for all the species is K<1.

LWR was established for four ribbonfish species namely, *T. gangeticus*, *E. glossodon*, *T. cristatus*, and *B. oligoradiatus*. The b value of *T. cristatus* ranged from 2.5463- 2.7149 and was statistically significant. From a study of LWR of *Tentoriceps cristatus* in South China Sea, the reported b value was 2.875 (Senta, 1975), which is nearer to the b value estimated by the present study. Hence, it can be inferred that *T. cristatus* follow negative allometric growth. Present study estimated the b value of *Trichiurus gangeticus* as 3.34 (Range 2.7409- 3.9383). Sastry (1980) reported a b value of 2.86 from Kakinada waters. Length range of specimens used by Sastry (1980) was 6.4 cm to 15.7 cm. Length range of specimens used by the present study was 36.9-49.7. This difference in the length class of specimens can be attributed as a reason for the differences in b value. However, statistical tests proved that this value is not significant, hence it can be inferred that *Trichiurus gangeticus* follows isometric growth pattern.

Table 2: Condition factor of four fishes of the Family Trichiuridae from the south west, and east coast of India during 2020-2021

Species	Relative Condition Factor (Kn)
Trichiurus gangeticus Gupta, 1966	1.02±0.16
Benthodesmus oligoradiatus Parin & Becker, 1970	1.102±0.172
Tentoriceps cristatus (Klunzinger, 1884)	1.039±0.256
Eupleurogrammus glossodon (Bleeker, 1860)	1.07±0.069

Present study estimated b value of *E. glossodon* and *B. oligoradiatus* at 3.05 and 3.22 respectively and found significant. Hence, it can be inferred that these species follows allometric growth pattern. Coefficient of determination (r^2) was ranged from 0.8 to 0.9. This showed the strong relationship between the total length and the total weight of all these four ribbonfish species. Additionally, the regression parameters were compared with the Bayesian approach (Froese and Pauly, 2021), but the parameters were not within range. This may due to narrow size range of some species. Sample size, habitat, season, sex, diet, and gonadal maturity of specimens play a major role in LWR (Le cren, 1951, Bagenal and Tesch, 1978, Aneesh *et al.*, 2016). According to Froese (2006), b value of finfishes should be within the range of 2.5 to 3.5. Results of present study (a and b value) of four species were within this limit. Hence, it can be concluded the LWR of four species of ribbonfishes estimated by the present study can be used as input for understanding the stock status and hence for sustainable management of these species.

The Kn values of the present study ranged from 1.02 to 1.1, which shows wellbeing of the species. According to

Table 1: Length-weight relationship parameters of four fishes of the Family Trichiuridae from the south west, and east coast of India during 2020-2021

Species	N	Length range (cm)	Weight range (g)	(a)	(b)	95% CL of a	95% CL of b	r^2
Trichiurus gangeticus Gupta, 1966	34	36.9 - 49.7	11.8 - 34.4	0.000085	3.3396	0.00000901-0.000813	2.7409-3.9383	0.8013
Benthodesmus oligoradiatus Parin & Becker, 1970	66	30.6 - 63.6	8 - 86.5	0.00013	3.2205	0.00006093-0.000314	3.0071-3.4338	0.9342
Tentoriceps cristatus (Klunzinger, 1884)	268	21.9 - 79.8	5.5 - 227.5	0.00176	2.6306	0.001254-0.002486	2.5463-2.7149	0.9341
*Eupleurogrammus glossodon (*Bleeker, 1860)	54	31.2 - 41.8	13.5 - 31.8	0.000405	3.0509	0.000177-0.000931	2.819-3.2829	0.9305

Abbreviations: a, intercept; b, slope; CL, confidence limits; N, total number of samples; r^2, coefficient of determination.

Bennet (1970), Sajeevan and Kurup (2015) and Jisr *et al*. (2018) relative condition factor value above 1 is considered as wellbeing bench mark value of a fish, hence fish with relative condition factor above wellbeing bench mark were considered to be in good condition. Results of the present study indicated that Cutlass fishes *Trichiurus gangeticus, Gupta, 1966, Eupleurogrammus glossodon, (Bleeker, 1860) Tentoriceps cristatus (Kluzinger, 1884) and Benthodesmus oligoradiatus, Parin and Becker, 1970,* occurring along south west, and east coast of India are in good condition throughout the study period.

CONCLUSION

Present study established LWR of four cutlass fishes. Results indicated that *Trichiurus gangeticus*, Gupta, 1966 follows isometric growth pattern. But, *Eupleurogrammus glossodon* (Bleeker, 1860) and *Benthodesmus oligoradiatus*, Parin and Becker, 1970, showed positive allometric growth pattern. *Tentoriceps cristatus* (Kluzinger, 1884) recorded a negative allometric growth pattern. Relative condition factor estimates revealed that all four cutlass fishes under the study are in good condition.

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