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Note

Morphometry and length-weight relationship of *Otolithes cuvieri* (Trewavas, 1974) from Ratnagiri waters, Maharashtra, north-west coast of India

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ABSTRACT

Morphometric characters, meristic counts and length-weight relationship of *Otolithes cuvieri* from Ratnagiri waters of Maharashtra along the north-west coast of India was studied from 788 specimens (376 males and 412 females) collected during the period from December 2009 to November 2011. The analysis of morphometric characters revealed that standard length has fastest growth rate when compared to total length while eye diameter has lowest growth rate when compared with head length. The regression equation for the length-weight relationship in males and females revealed no significant difference and a common regression equation is given by Log W = -5.31579 + 3.13609 Log L. The regression co-efficient departs significantly from 3 indicating a positive allometry.

Keywords: Length-weight relationship, Meristic characters, Morphometric characters, *Otolithes cuvieri*, Positive allometry

Sciaenids, commonly known as jewfishes/croakers/grunters are widely distributed in different parts of the world including tropical and sub-tropical waters of Indian Ocean (Druzhinin, 1974) and Atlantic Ocean (Lowe-McConnell, 1962). Fishes of the family Sciaenidae occupy an important position among the demersal fishery resources of India, forming 18% of the total demersal fish landing in the country (CMFRI, 2014).

Morphometric and meristic characters play important role in taxonomic identification of any species and have been commonly used in fishery biology to measure discreteness and relationships among various taxonomic categories (Quilang *et al*., 2007). In fish, morphometric characters represent one of the major keys for determining their systematics, growth variability, ontogenetic trajectories (Kovac and Copp, 1999) and/or various population parameters. Morphometric and meristic studies also have provided useful results for identifying marine fish stocks and describing their spatial distributions (Ihssen *et al*., 1981). Length-weight relationship also has considerable importance in fisheries research especially for the study of fish population dynamics and growth (Mathur and Bhatara, 2007), taxonomic differences, events in life history like metamorphosis and maturity (Le Cren, 1951).

Otolithes cuvieri is the most abundant sciaenid species available in Indian waters. Realising the importance of this resource, detailed study of this species were undertaken by various authors (Chakraborty, 1992; Telvekar *et al*., 2006; Manojkumar, 2007) from Mumbai and Veraval. However, there is not much information available on population characteristics and length-weight relation of *O. cuvieri* along Ratnagiri coast of Maharashtra where this resource contributes significantly to the trawl landings. Hence, the present investigation was undertaken to study the morphometric and meristic characteristics, and to establish the length-weight relationship of *O. cuvieri* along Ratnagiri waters.

Samples of *O. cuvieri* were collected from the trawl landings at Mirkarwada fish landing centre, Ratnagiri, Maharashtra during December 2009 to November 2011. A total of 788 specimens (376 males and 412 females) in the range of 83 to 310 mm total length and 7.6 to 328 g total weight were studied. The total length of fish was measured (nearest 0.01mm) from the tip of the snout to the tail. Each fish was weighed using an electronic balance to an accuracy of 0.01g. Fourteen morphometric characters (Fig. 1) were studied following the methods described by Lowe-McConnell (1971), Dwivedi and Menezes (1974) and Grant and Spain (1977). Meristic characters included in the study were number of rays on dorsal, pectoral,

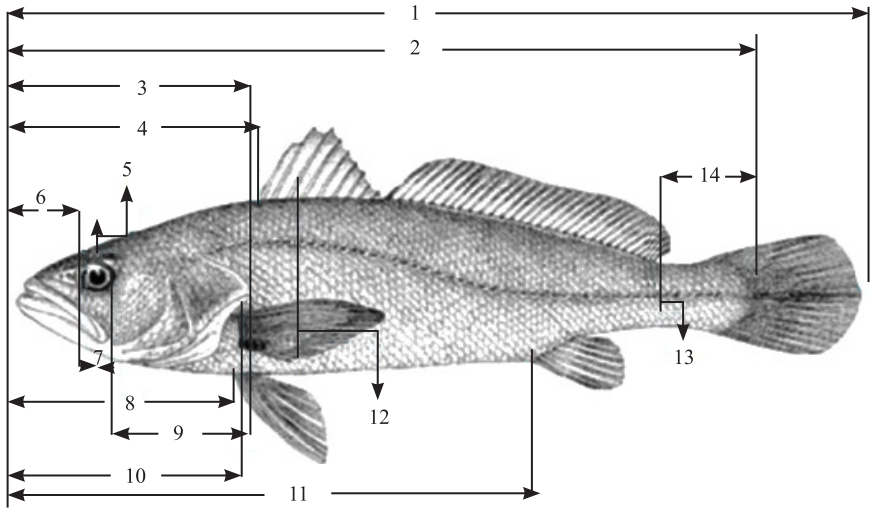

Fig. 1. Morphometric Characters of *Otolithes cuvieri* (Trewavas, 1974). 1. Total length (TL), 2. Standard length (SL), 3. Head length (HL), 4. Pre-dorsal length (PDL), 5. Inter-orbital length (IOL), 6. Snout length (SNL), 7. Eye diameter (ED), 8. Pre-pelvic length (PPL), 9. Post-orbital length (POL), 10. Pre-pectoral length (PPeL), 11. Pre-anal length (PAL), 12. Body depth (BD), 13. Caudal depth (CD), 14. Caudal peduncle length (CPL)

pelvic, anal and caudal fins; number of spines on dorsal, pelvic and anal fins and gill rakers on the lower limb of first gill arch. Statistical estimates like range, mean, standard error, standard deviation, and co-efficient of variation of various morphometric and meristic characters were calculated. Relationships between various body measurements to the total length and head length were calculated and then linear regression equations were fitted following the least square method described by Laevestu (1965) and Snedecor and Cochran (1967). The correlation coefficient (r) was also calculated to know the degree of linear association or interdependence of two variables.

The length-weight relationship was established separately for male and female using the formula: $W = aL^b$. This equation can be expressed logarithmically as suggested by Le Cren (1951) as: Log W = Log a + b Log L, where, W = weight of fish in g, L = length of fish in mm, 'a and 'b' are intercept and regression coefficient respectively. Analysis of covariance (Snedecor and Cochran, 1967) was done to determine variation in the 'b' values between the sexes ($p<0.01$, 0.05). Student's t-test was used to test the pattern of growth.

The descriptive statistics mean, mode, median, range, standard deviation, standard error and coefficient of variation of various morphometric characters are given in Table 1. The study revealed that caudal depth showed a maximum coefficient of variation (27.65%) followed by caudal peduncle length (23.56%). Among the morphometric characters compared against total length (Table 2), the 'b' values indicate highest growth rate for standard length (0.8795) followed by pre-anal length (0.6286), pre-dorsal length (0.2682), and the lowest for caudal depth (0.0872). Similarly, when morphometric characters were compared against their head length, highest growth rate (b) was observed for post-orbital length (0.5598), followed by inter-orbital length (0.2352) and lowest for eye diameter (0.1968). Dobariyal *et al*. (2006) reported that all body parts grow in accordance with total length and similar findings were also reported by Rawat and Agarwal (2003) as dimensions of all the body parts increase simultaneously with total length of fish. Basu (1975) reported high degree of correlation between total length and standard length for *Otolithes argenteus* from Mumbai waters. Chakraborty (1992) also observed high degree of correlation between standard length and total length in *O. cuvieri* and in *Johnius macrorhynus*. Bhuyan (2003) stated that pre-anal length has fastest growth rate in relation to total length, while eye diameter has lowest growth rate in relation to head length for *O. ruber* off Paradeep coast of India. The correlation coefficient (r) between different morphometric characters ranged from 0.9464 to 0.9964 in the present study indicating high degree of positive correlation among various characters compared. Similar results were also reported by Telveker *et al*. (2006) for *O. cuvieri* from Bombay waters.

Examination of meristic characters revealed ten spines in first part of dorsal fin, one on pelvic fin and two on anal fin which were constant in all the specimens. The number of rays on second part of dorsal fin ranged between 27-32, pectoral fin 15-19, pelvic fin 6-8, anal fin 7-8 and caudal fin 16-18. Number of gill rakers on the lower limb of first gill arch of left side varied between 13 and 16 (Table 3). Coefficient of variation recorded for

Table 1. Statistical estimate of various morphometric characters of *O. cuvieri*

Morphometric characters	Range (mm)		Mean (mm)	Standard error	Standard deviation	Coefficient of variation (%)
	Min.	Max.				
Total length	83.00	310.00	194.07	1.51	38.53	19.85
Standard length	62.00	265.00	159.73	1.33	34.01	21.29
Pre-anal length	45.00	190.00	114.63	0.96	24.41	21.29
Pre-dorsal length	22.30	87.00	51.61	0.41	10.50	20.33
Pre-pelvic length	24.20	86.70	49.11	0.38	9.77	19.89
Pre-pectoral length	22.60	78.00	47.65	0.36	9.18	19.27
Head length	23.60	76.00	46.63	0.35	8.80	18.87
Body depth	21.80	74.80	43.89	0.36	9.26	21.09
Caudal peduncle depth	6.90	22.00	13.87	0.32	03.84	27.65
Caudal peduncle length	7.40	39.20	21.80	0.20	5.15	23.56
Snout length	5.50	17.00	10.68	0.082	2.10	19.62
Post-orbital length	11.40	43.80	25.71	0.20	4.99	19.42
Inter orbital length	6.10	19.80	12.13	0.08	2.14	17.60
Eye diameter	6.60	18.10	11.35	0.07	1.83	16.12

Table 2. Linear regression statistics of various morphometric measurements of *O. cuvieri* against total length and head length

Morphometric characters	Y = a+bx	R
Standard length & Total length	Y = -10.9432 + 0.8795	0.9964
Pre-anal length & Total length	Y = -7.3490 + 0.6286	0.9923
Pre-dorsal length & Total length	Y = -0.4379 + 0.2682	0.9847
Pre-pelvic length & Total length	Y = 0.9920 + 0.2480	0.9781
Pre-pectoral length & Total length	Y = 2.0742 + 0.2348	0.9852
Head length & Total length	Y = 2.9376 + 0.2251	0.9859
Body depth & Total length	Y = -0.3449 + 0.2279	0.9487
Caudal peduncle depth & Total length	Y = -3.6187 + 0.0872	0.9631
Caudal peduncle length & Total length	Y = -2.9500 + 0.1278	0.9563
Snout length & Head length	Y = 0.0531 + 0.2302	0.9665
Post orbital length & Head length	Y = 0.3931 + 0.5598	0.9864
Inter orbital length & Head length	Y = 1.1643 + 0.2352	0.9692
Eye diameter & Head length	Y = 2.1718 + 0.1968	0.9464

Table 3. Statistical estimates of various meristic characters of *O. cuvieri*

Statistical estimates	Range	Mean	Mode	Median	Standard error	Standard deviation	Coefficient of variation (%)
Pectoral fin rays	15-19	16.4133	16	16	0.0578	0.7464	3.6998
Dorsal fin rays	27-32	29.8563	30	30	0.0855	1.1046	3.6997
Anal fin rays	7-8	7.6707	8	8	0.0365	0.4714	6.1453
Pelvic fin rays	6-8	6.0960	6	6	0.0244	0.3158	5.1668
Caudal fin rays	16-18	16.9701	17	17	0.0198	0.2557	1.5065
Gill rakers	13-16	14.377	14	14	0.0328	0.4239	2.9985

anal fin rays was the maximum (6.1453) among all meristic characters and minimum in caudal fin rays (1.5065). The values of mean, mode, median, range, standard deviation, standard error and coefficient of variation indicated a high degree of homogeneity within the population. The meristic counts recorded agree well with the range given by various authors for *O. cuvieri* (Table 4).

Length - weight relationship of *O. cuvieri* was estimated as:

Log W = - 5.27343 + 3.11721Log L, (male) (r^2 =0.9725)

Log W = -5.35987 + 3.15567 Log L, (female) (r^2 = 0.9638)

Analysis of covariance indicated that there is no significant difference in the regression coefficients between the sexes ($p<0.01$, 0.05). Hence, the data of males and females were pooled together and a common regression formula was obtained as:

Log W = -5.3158 + 3.1361 Log L (r^2 = 0.9682)

Student's t-test revealed deviation in growth from isometric pattern (b=3) as the estimated value of 't' was found to be significant at $p<0.01$ and 0.05. The weight of the fish increased slightly more than cube of its length as

Table 4. Comparison of meristic characters of *O. cuvieri* with previous reports

Authors	Dorsal fin rays	Pectoral fin rays	Pelvic fin rays	Anal fin rays	Caudal fin rays	Gill rakers
Mohan (1972)	30-31	16-17	---	7	---	13
Trewavas (1977)	29-32	---	---	---	---	12-17
Fisher and Bianch (1984)	29-31	---	---	7-8	---	12-14
Talwar and Kacker (1984)	29-31	---	---	7-8	---	12-14
Chakraborty (1992)	28-32	16-18	7-9	7	16-20	12-16
Present study (2011)	27-32	15-19	6-8	7-8	16-18	13-16

the regression coefficients were found to be more than 3 for males (3.1172), females (3.1556) and combined sexes (3.1360) indicating positive allometry. Chakraborty (1992) estimated the regression coefficient 'b' as 3.0831 for male, 3.0341 for female and (3.1272 for combined sexes of *O. cuvieri* from Bombay waters. Raje (2000) estimated 'b' as 3.1333 for male, 3.1323 for female and 3.1324 for combined sexes of *O. cuvieri* from Veraval and found no significant difference between 'b' value of male and female. Lower values of regression coefficients were observed by Telvekar *et al*. (2006) for *O. cuvieri* from Mumbai waters and calculated the regression coefficient 'b' as 2.8813 for males, 2.7123 for females and 2.7977 for combined sexes. Abdurahiman *et al*. (2004) reported 'b' as 2.897 for males and 2.961 for females from southern coast of Karnataka. The variation of 'b' value in different localities could be attributed to factors such as habitat, season, degree of stomach fullness, gonad maturity, sex, health, preservation techniques and differences in the observed length ranges of the specimens caught (Wootton, 1990). From the above findings it can be concluded that the fish follows a positive allometric growth without any significant difference between both the sexes. Information on morphometric relationships of *O. cuvieri* from the present study will be useful in comparing the same species in different locations and also for stock identification studies. Further, the length-weight relationships can be used for estimating growth rates and age in length based analysis for fish stock assessment and population studies.

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