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# Biometric analysis of moustached thryssa *Thryssa mystax* (Bloch and Schneider, 1801) along the Ratnagiri coast of Maharashtra, India

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## ABSTRACT

The moustached thryssa *Thryssa mystax* (Bloch and Schneider, 1801), is an important bycatch landed by trawl nets and mini purse seines at Ratnagiri in Maharashtra. Morphometric characters and length-weight relationship of the moustached thryssa were studied from 876 specimens comprising of 436 males, 407 females and 33 indeterminates collected from Ratnagiri. The coefficient of correlation of total length against other morphometric characters of *T. mystax* ranged between 0.3967 (against pre-pelvic length) to 0.9966 (against fork length). All morphometric measures had a high and moderate degree of correlation with total length. The length-weight relationship indicated isometric growth. The coefficient of correlation (r) for the length-weight relationship was estimated at 0.9327, 0.9266, 0.9743 and 0.9379 for the males, females, indeterminates and pooled data, respectively.

Keywords: Isometric growth, Morphometry, Ratnagiri, *Thryssa mystax*

Anchovies are widely distributed throughout the Indian Ocean, the Arabian Sea and the Red Sea (Kuronuma and Abe, 1972) and contribute largely to the fishery industry of the Arabian Gulf (Lumboeuf and Simmonds, 1981). The moustached thryssa *Thryssa mystax* (Bloch and Schneider, 1801) belongs to the family Engraulidae and inhabits brackish and pelagic marine environment. It is a small schooling fish distributed in the depth range of 1-50 m in the Indo-west Pacific region. It is found in coastal pelagic waters, often observed as entering the mangrove ecosystem and adjacent brackishwaters (Whitehead, 1988). Of the six species of anchovies recorded from the Arabian Gulf (Relyea, 1981), *Thryssa hamiltonii* and *Thryssa mystax* are the typical ones caught in coastal waters. Along the Indian coastline, *T. mystax* has been mainly found in the Kerala coast, Lawson's Bay (Andhra Pradesh) and the coast of Mumbai (Kapoor *et al.*, 2002). The fish has also been reported in Chilka Lake (Rao, 1995) and Godavari Estuary (MMG-VUB, 2003).

*T. mystax* contributes significantly to the landings of anchovies in the country. The estimated total production of anchovies in India stood at 1,73,744 t in the year 2018 (CMFRI, 2019), while the production from Maharashtra was 18,765 t (DoF, 2019). Though these fishes are caught by a combination of different crafts

and gears, the maximum catch has been landed by small trawlers and mini purse seiners from depths upto 50 m. Morphometric and meristic characters in fishes have provided valuable knowledge for identifying marine fish stocks and describing their spatial distribution (Ihssen *et al.*, 1981). Latest information on the morphometric and length-weight aspects of important species of anchovies along the west coast of India is limited and there are no specific studies on *T. mystax* from Ratnagiri coast. The present study aimed to establish the morphometric and length-weight relationship of *T. mystax*, which would be of use in devising management measures for sustaining the landings of *T. mystax* in the region.

A total number of 876 specimens of *T. mystax* in the length range of 85 to 213 mm were collected from the Mirkarwada Fish Landing Centre (16°59'42"N; 73°16'14"E) of Ratnagiri, Maharashtra at weekly intervals from March 2015 to February 2016. The samples were mainly collected from trawl bycatch, preserved in ice and brought to the laboratory. Collected samples were washed thoroughly with freshwater and morphometric measurements were recorded to an accuracy of 0.5 mm using standard procedures and with the help of a divider (Seshappa, 1970). The specimens were weighed, using an electronic balance, to the nearest accuracy of 0.01 g. Relationships between various body measurements to the

total length were established. Scatter plots of morphometric characters were plotted and the linear regression equation was fitted using the least square method (Snedecor and Cochran, 1967).

Length-weight relationship was determined for males, females, indeterminates and for sexes pooled, using the exponential equation  $W = aL^b$  (Le Cren, 1951), where 'W' = weight (g) of the specimen, 'L' = total length (mm), 'a' = intercept and 'b' = the slope of the linear regression. The equation was linearised to the form  $Y = A + BX$ , where  $Y = \log W$ ;  $A = \log a$ ,  $B = b$  and  $X = \log L$ . Based on this equation, constants A and B were estimated individually for male, female and indeterminate groups separately to examine differences between sexes. The coefficient of correlation "r" was determined to know the relationship between the two variables. Analysis of covariance was done to assess variation in 'b' values among the sexes. To test "b" value against the value of "3", student's t-test was employed to predict any significant deviation. The investigation on the length-weight relationship comprised a total of 876 specimens comprising 436 males in the length range of 87 to 204 mm and weight range of 4.43 to 35.40 g, 407 females in the length range of 112 to 213 mm and weight range of 9.51 to 83.44 g and 33 indeterminates in the length range of 85 to 177 mm and weight range of 4.12 to 31.38 g. Details of the morphometric measurements of all the collected samples during the present investigation

are given in Table 1. Identification of distinct stocks would be useful in devising appropriate management measures based on the biological characteristics of the stock. The correlation coefficient of total length against other morphometric characters of *T. mystax* ranged between 0.3967 (against pre-pelvic length, PVL) to 0.9966 (against fork length, FL), indicating a significant correlation between various morphometric characteristics and total length. Roul *et al.* (2019) also observed the highest correlation between total length (TL), FL and Standard length (SL) for *Ablennes hians* from the south-eastern Arabian Sea. The morphometric characters compared in the present study would prove helpful for comparison with *T. mystax* in other geographical areas and identification of possible distinct stocks. The regression coefficient (b) was found to be highest for standard length (0.8545) and fork length (0.8371), which means the highest growth rate was found in SL and FL as compared to unit growth in TL. Similar findings were observed for white sardine *Escualosa thoracata* along Ratnagiri coast (Gurjar *et al.*, 2017).

For length-weight relationship, the data for all the four groups *viz.*, male, female, indeterminate and pooled individuals were analysed separately (Table 2). The 'a' and 'b' values of the length-weight relationship were -2.1780 and 3.0417 for males, -2.1716 and 3.0377 for females and -2.0514 and 2.8719 for indeterminates. The

Table 1. Relation of various morphometric measurements to total length (TL) in *Thryssa mystax*

Sl.No.	Morphometric characters	Intercept (a)	Slope (b)	Y=a + bx	Correlation (r)
1	TL and SL	0.4002	0.8545	$Y = 0.4002 + 0.8545x$	0.9948
2	TL and FL	-0.2448	0.8371	$Y = -0.2448 + 0.8371x$	0.9966
3	TL and SnL	0.0396	0.0381	$Y = 0.837 + 0.0381x$	0.7976
4	TL and ED	0.0287	0.0422	$Y = 0.0287 + 0.0422x$	0.8566
5	TL and OD	-0.0233	0.0284	$Y = -0.0233 + 0.0284x$	0.7566
6	TL and HL	0.3472	0.1827	$Y = 0.3472 + 0.1827x$	0.9601
7	TL and DBL	0.0393	0.0838	$Y = 0.1827 + 0.0838x$	0.8797
8	TL and ABL	0.5042	0.2111	$Y = 0.5042 + 0.5042x$	0.9149
9	TL and PBL	-0.0763	0.0395	$Y = -0.0763 + 0.0395x$	0.7032
10	TL and PDL	-0.3279	0.4357	$Y = 0.0395 + 0.4357x$	0.9813
11	TL and PAL	-0.3132	0.5154	$Y = -0.3132 + 0.5154x$	0.9005
12	TL and PVL	0.8486	0.2592	$Y = 0.5154 + 0.2592x$	0.3967
13	TL and PPL	0.1768	0.1838	$Y = 0.1768 + 0.1838x$	0.8901
14	TL and h	0.0059	0.2131	$Y = 0.1838 + 0.2131x$	0.8328
15	TL and Ph	0.1316	0.1270	$Y = 0.1316 + 0.1270x$	0.8580
16	TL and Dh	0.2339	0.1246	$Y = 0.2339 + 0.1246x$	0.8759
17	TL and Ah	0.2021	0.0980	$Y = 0.202 + 0.0980x$	0.7928
18	TL and Vh	0.0733	0.0632	$Y = 0.0733 + 0.0632x$	0.7611
19	TL and ML	0.3022	0.2097	$Y = 0.3022 + 0.2097x$	0.9116

TL: Total length, SL: Standard length, FL: Fork length, ED: Eye diameter, SnL: Snout length, OD: Orbital diameter, HL: Head length, DBL: Dorsal base length, ABL: Anal base length, PBL: Pectoral base length, PDL: Pre-dorsal length, PAL: Pre-anal length, PVL: Pre-pelvic length, PPL: Pre-pectoral length, h: Body depth, Ph: Pectoral height, Dh: Dorsal height, Ah: Anal height, Vh: Pelvic height, ML: Maxilla length

Table 2. Length-weight relationship in *T. mystax*

Parameters	N	TL range (mm)	Weight range (g)	a	b	r
Males	436	87-204	4.43-35.40	-2.1780	3.0417	0.9327
Females	407	112-213	9.51-83.44	-2.1716	3.0379	0.9266
Indeterminates	33	85-177	4.12-31.38	-2.0514	2.8719	0.9743
Pooled	876	85-213	4.12-83.44	-2.2075	3.0657	0.9379

estimated 'b' values indicate isometric growth in males, females, indeterminate and pooled samples ( $p < 0.05$ ), which was confirmed with Students' t test. The value of 'r' ranged between 0.9266 to 0.9743. Analysis of covariance indicated no significant difference between the slopes of 3 groups (male, female and indeterminate). Therefore, a common length-weight relationship,  $W = 0.0062L^{3.0657}$ , was deemed to hold good for *T. mystax* from the region (Fig. 1).

Most of the earlier studies on the length-weight relationship in *T. mystax* have indicated isometric growth. The current observations on length-weight relationship confirms a general pattern of isometric growth in *T. mystax*, which is similar to the previous study ( $W = 0.00002382 L^{3.1063}$ ) carried out along the Calicut (Venkataraman, 1956) and Tuticorin (Nalluchinnappan and Jeyabaskaran, 1991) coasts. Venkataraman (1956) determined the length-weight relationship of common anchovy from Calicut coast as  $W = 0.0000003776 L^{2.912}$  and also observed isometric growth in all the individuals across different sexes. However, allometry has been reported from Karachi Fish Harbour, Pakistan (Hoda, 1983) and Khor al-Zubair, North-west Arabian Gulf (Hussain and Ali, 1987). Hoda (1983) studied the length-weight relationship of *T. mystax* along the Karachi Fish Harbour, Pakistan and reported equations for indeterminants, male, female and pooled individuals as  $\log W = -4.5158 + 2.6497 \log L$ ;  $\log W = -5.8867 + 3.3272 \log L$ ;  $\log W = -6.1854 + 3.4606 \log L$  and  $\log W = -5.5780 + 3.1841 \log L$  respectively. The study

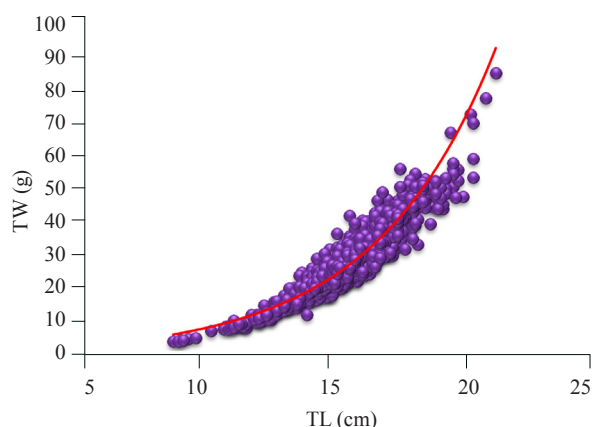


Fig. 1. Length-weight relationship of *T. mystax* along Ratnagiri Coast

revealed that the cube law does not hold for males and females of *T. mystax*. Hussain and Ali (1987) reported the length-weight relationship of *T. hamiltonii* and *T. mystax* as  $W = 0.00275 L^{3.286}$  and  $W = 0.00309 L^{3.264}$ , respectively along the coast of Khor al-Zubair, North-west Arabian Gulf. *Thryssa hamiltonii* was noted to be marginally more robust than *T. mystax* of the same length and both species grew at a rate higher than that of cube TL. The population of *T. mystax* in the present study appears to be different from that of the Pakistan coast and the Arabian Gulf. The cubic relationship reported by Masurekar and Rege (1960) from Bombay waters suggests the presence of distinct fish stock in the region.

The present investigation on morphometric and length-weight relationship provides baseline information on this species, which would help in understanding the stock and further in formulating management strategies along the Ratnagiri coast, Maharashtra.

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