Length Weight Relationship, Sex ratio and relative condition factor of Moustached Thryssa, *Thryssa mystax* (Bloch & Schneider, 1801) recorded from Maharashtra Coast, India

[1]Tripta Singh*, **[2]Vinodkumar M[#]**, **[3]A. Siva*[4]Ansuman Das***,
[5]Dewanand E. Uikey*,[6]Rajashree U. Pawar*and [7]R. Jeyabaskaran*

[1]Senior Research Fellow (CSIR-NET Awardee),[2]Zonal Director,[3]Sr. Scientific Assistant,
[4]Sr. Fisheries Scientist, [5]Sr. Scientific Assistant, [6]Sr. Scientific Assistant, [7]Director General
*Fishery Survey of India, New Fishing Harbour Jetty, Sassoon Dock, Colaba, Mumbai – 400005, MH, India
#Port Blair Zonal Base of Fishery Survey of India, Phoenix Bay, Port Blair – 744101, India

Abstract: Present study resulted the information on Length-weight relationship (LWR), Sex Ratio and Relative Condition Factor (Kn) of the species Thryssa mystax (Bloch & Schneider, 1801)[1] belongs to Order: Clupeiformes, Family: Engraulidae recorded from Maharashtra coast, India for the period January 2020 to December 2022. A total of 2814 specimens of T. mystax were collected twice a week, from the catches of gill nets, trawl nets and mini purse seine nets were used for the analysis. Overall specimens, the length ranged at 10.0 cm - 24.5 cm and weight at 12.0 gm - 116.0 gm. The regression values derived for females were $r^2=0.9596$, males were $r^2=0.9566$ and pooled specimens were $r^2=0.9667$. Growth type for females, males and pooled specimens was isometric. The Sex Ratio, Chi—square derived for all the specimens was 1.05. The p-value observed was more than 0.05 ($p=>0.05$). The mean relative condition factor values are analysed, where, the highest mean Kn value of the females was 1.01268 (September) and for the males 1.00534 (November). The length-wise mean relative condition factor was 1.04345 in the specimens at minimum length group 10 – 13 cm and 0.96872 for the maximum length group 23-26 cm, it revealed that species are relatively in good condition.

Index Terms: Moustached thryssa, Length-weight relationship, Sex Ratio, Relative Condition Factor

I. INTRODUCTION

The Length-weight relationship studies are to predict the weight from length measurement using the yield assessment (Pauly, 1993)[2]. The Anchovies are closely related to the Family: Clupeidae and belong to the Family: Engraulidae. A total of 16 genera with 139 species were recognised in the Family: Engarulidae (Khan 2004[3], Nelson 1984[4], Grande 1985[5], Grande and Nelson 1984[6] and Whitehead*et. al.,* 1988[7]).

Anchovies are small pelagic fishes which are widely distributed throughout the Indian Ocean including Arabian Sea and the Red Sea (Kuronuma& Abe 1972[8]) and contributing largely to the fishing industry of the Arabian-Gulf Sea (Lamboeuf & Simmonds 1981[9]). About 34 species of anchovies have been reported from Indian waters belonging to five genera, *viz., Stolephorus, Coilia, Setipinna, Thryssa and Encrasicholina* (Gopi and Mishra, 2015)[10]. Most of the anchovies are marine, rarely occurring in freshwater and brackish waters. However, around 17 species are freshwater, occasionally entering brackish waters (Nelson, 2006)[11]. The Arabian Gulf Sea consists mainly of 6 species of anchovies (Relyea, 1981)[12], Of which, *Thryssa hamiltonii* and *Thryssa mystax* are the most common species found in coastal waters (Fig-1). In Indian waters, *Thryssa mystax* commonly known as Moustached thryssa, mainly inhabiting marine, brackish, oceano-pelagic environment and mostly confined to inshore waters and estuaries of India. These species are found to be occurring up to the depth range of 40-70 m and restricted to coastal pelagic waters. Some of the studies revealed that these species are also found in mangroves and adjacent brackish waters (Kende, 2018)[13].

The information on management aspects is scanty or absent from Maharashtra waters particularly for the catches landed in Mumbai Suburban and major fishing harbors. Considering the commercial value of this species, and contribution, in the marine fish production and availability throughout the year, an attempt has been made to study the length-weight relationship, sex ratio and relative condition factor for the specimen collected from the fish landing centers of Mumbai coast.

II. MATERIALS AND METHODS

Fig. 1 Moustached thryssa collected from the Sassoon Dock Fishing harbor

The samples of the species were collected from three major and commercial fish landing centers of Mumbai coast *viz.,* New Ferry Wharf (Dock Yard), Sassoon Dock (Colaba) and Versova (Andheri). A total of 2814 specimens of *Thryssa mystax* (Moustached Thryssa) were collected and analyzed for length-weight relationship, sex ratio and relative condition factor. The study was carried out based on the data collected from the chosen sampling area. The analysis was carried out separately for male, female and pooled samples. The specimens were thoroughly washed and then moisture was removed using blotting paper. The total length of the fish was measured from snout to the tip of the upper caudal fin with Vernier caliper scale to the nearest values to 0.01 cm. Thereafter, the weights of the individual specimens were measured using a digital electronic balance to the nearest gram with accuracy of (0.01).

Among the sampled fishes, the males were 1806 numbers with the size range of 10.0 - 23.5 cm in total length and weight range of 12.0 - 96.0 gm. The females were 1008 numbers with size range of 12.0 - 24.5 cm and weight range of 13.0 - 116.0 gm. Overall the length ranged from 10.0 cm to 24.5 cm and weight ranged from 12.0 gm to 116.0 gm was considered for the study. The Length-Weight relationship analysis attempted using the formula $W = aL^b$ (Le Cren, 1951) [14]   (1)

(Where, 'W' is the weight of the fish, 'L' length and 'a' and 'b' are the two constants. Linear regression was calculated using MS Excel to estimate the value of the coefficients 'a', 'b' and r^2).

The pooled data was fitted in to the logarithmic equation as given below:

$\text{Log } W = \text{Log } a + b \text{Log} L$ (2)

The log value of 'a' and 'b' are determined by the least squares method.

The Length-Weight relationship derived separately for males and females and conducted t-test to verify the regression coefficient and other significance level. The formula used for 't' test adopted by Snedecor and Cochran (1967) [15] was applied in present study, $t = b - 3/S_b$ (3)

(Where 'b' is the observed value, '3' is the expected value and 'S_b' is the Standard error of 'b'). The regression significance assessed using single factor ANOVA.

The sex-ratio for the species is calculated using the female and male data collected from the study area which tends to be obtained at 1:1. Chi-square test $X^2 = \text{sum } (O-E)^2/E$ (4)

(Where 'O' is the observed numbers of female and male, 'E' is expected numbers). The descriptive statistical analysis was carried using MS Excel.

Relative Condition factor (Kn) calculated following the formula derived by Le Cren (1951) [14]. $Kn = W/W*$ (5)

(Where 'W' is observed weight (gm) of the fish, 'W*' is calculated weight of the fish resulted from length-weight relationship).

III.   STUDY AREA

Geographically Maharashtra lies between Lat./Long., 15°58'N to 22°03'N and 72°60'E to 80°90'E with a coastal length of 720 km, continental slope of 387 km and elevation is about 389 km. The geomorphology of Maharashtra is sandy beaches, mud flats, coastal plains, cliffs, spits, estuaries etc. There are 35 districts in Maharashtra, out of which five are coastal districts viz., Mumbai (Suburban), Thane, Raigad, Ratnagiri and Sindhudurg. Mumbai (Lat/Long 19°04'N/72°52'E) is one of the suburban districts with 3 major fish landing centers viz., New Ferry Wharf (Dock Yard), Sassoon Dock (Colaba) and Versova (Andheri), Fig. 2.
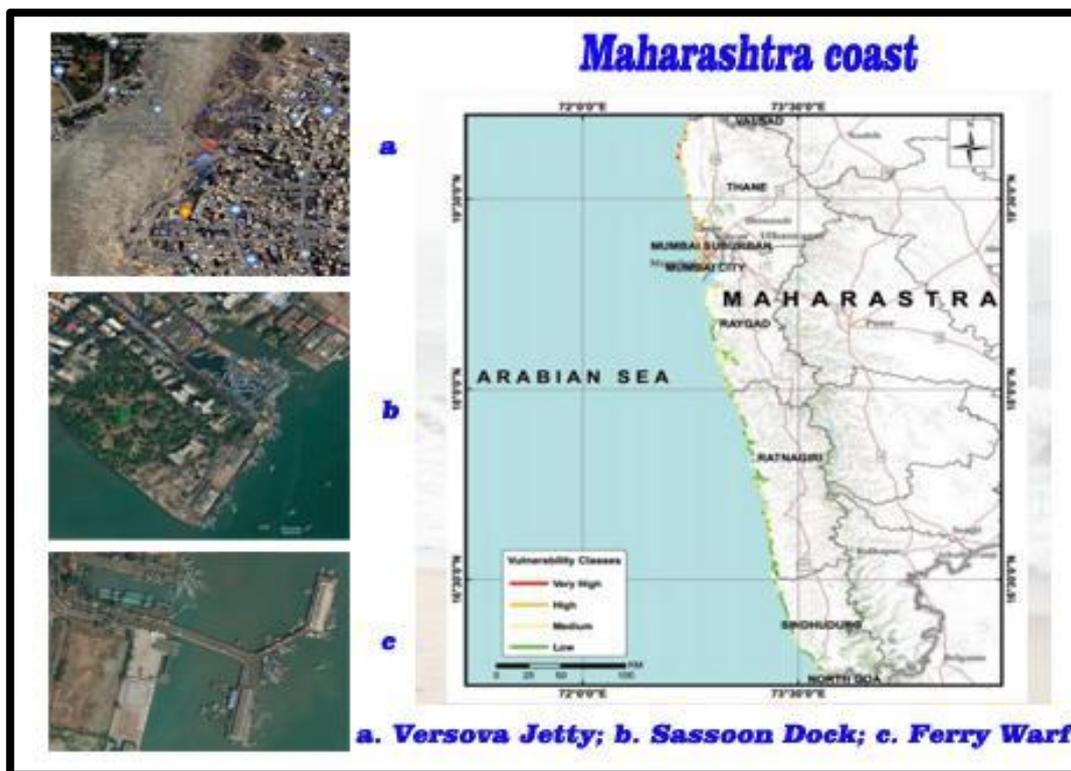

Fig. 2 Study area, Versova jetty, Sassoon Dock & Ferry Warf (source: Google Earth map, 2023)

IV.   RESULTS
Length frequency distribution

For length frequency studies 2814 No. of specimens were analyzed. The highest numbers of 1563 specimens are found in the length range of 16-19 cm, followed by 543 numbers in 19-21 cm, 421 numbers in 13-16 cm, 240 numbers in 21-23 cm, 30 numbers in 10-13 cm, 17 numbers in 23-26 cm (Fig. 3). Month-wise percentage of total female & male, length size & weight range, Mean size and Standard Deviation were also studied (Tab. 1).
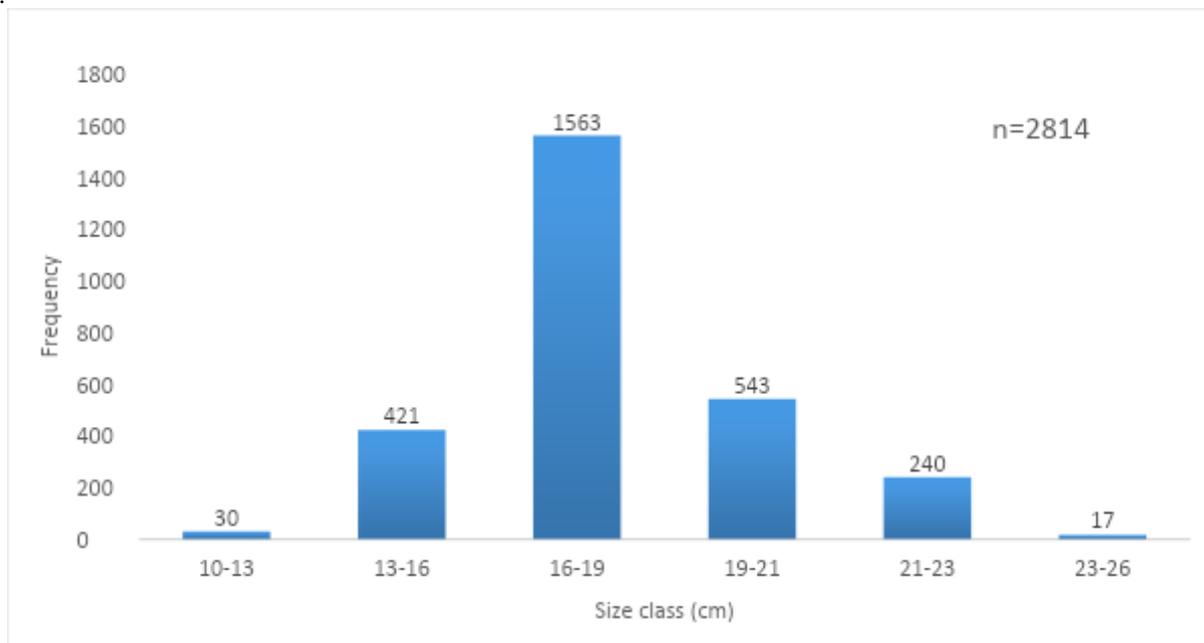

Figure 3 Length frequency distribution of *Thryssa mystax*

Table 1 Month-wise percentage of total female & male, length size & weight range, Mean size and Standard Deviation of *Thryssa mystax*

Month	Female (n=1008)	Size		Mean		Standard Deviation		Male (n=1806)	Size		Mean		Standard Deviation	
	% of total female	Length (cm)	Weight (gm)	Length (cm)	Weight (gm)	Length (cm)	Weight (gm)	% of total Male	Length (cm)	Weight (gm)	Length (cm)	Weight (gm)	Length (cm)	Weight (gm)
Jan	03.2	15.5 - 23.0	25-89	19.5	56.20	2.2	18.7	06.9	14.5 - 21.5	07-65	17.5	40.10	1.4	9.1
Feb	07.0	13.5 - 20.5	18-77	17.5	44.90	1.8	14.2	13.3	13.0 - 20.0	14-55	16.5	34.30	1.6	9.1
Mar	04.3	13.5 - 22.0	18-86	17.5	18.90	2.1	17.1	10.1	14.0 - 22.0	20-60	17.0	37.35	1.2	8.0
Apr	03.6	17.0 - 24.5	38-116	20.5	74.20	1.8	18.5	08.3	15.0 - 20.5	23-65	17.5	39.85	1.1	7.1
May	22.3	17.0 - 23.0	38-105	20.5	67.50	1.2	12.6	21.8	14.5 - 23.5	21-95	18.5	47.75	1.3	11.1
Jun Jul	Samples could not be collected due to Uniform Ban on fishing in West Coast of India from 01st June to 31st July													
Aug	08.4	12.0 - 23.5	12-104	16.5	39.80	2.5	18.9	08.9	07.0 - 23.0	11-70	15.5	29.95	2.2	12.1
Sep	02.6	15.5 - 21.5	25-75	17.5	44.50	1.3	11.5	06.9	12.5 - 21.5	15-80	16.5	37.55	1.2	8.6

Oct	13.9	16.0 - 23.5	31-116	19.5	63.80	1.8	17.8	11.4	15.0 - 23.5	25-90	17.5	42.45	1.2	8.5
Nov	12.4	15.5 - 24.5	26-96	19.5	56.80	2.2	18.8	07.1	13.5 - 21.5	17-70	17.0	35.10	1.7	10.8
Dec	22.3	15.5 - 23.5	30-91	19.5	57.60	1.5	12.9	05.3	15.2 - 23.0	28-80	18.5	45.10	1.3	9.4

Length-weight relationship

The month-wise, Length-weight relationship was derived separately for monthly pooled, female, male and yearly pooled data. The regression values were derived based on length against weights of the specimens (Fig. 4–9). A total of 2814 specimens were considered for length- weight studies. Overall specimen's length range was 10.0 cm - 24.5 cm and weight range was 12.0 gm - 116.0 gm. The derived regression values for females were $W=0.0067L^{3.0451}$ ($r^2=0.9596$), males were $W=0.0080L^{2.9748}$ ($r^2=0.9566$) and pooled samples was $W=0.0064L^{3.0548}$ ($r^2=0.9667$). The growth type for female, male and pooled specimens was isometric. The growth type indicated for female, male and pooled data are given in the Tab. 2 - 4. The month-wise regression analysis revealed that, isometric growth type for the month of January, September, October, and November, whereas, February, March, April, and May indicated positive allometric growth. The negative allometric growth was noticed in August and December. Significant differences between female and male specimens were also studied using t-test (4.277) and p value was $p=<0.05$ (Tab. 3).
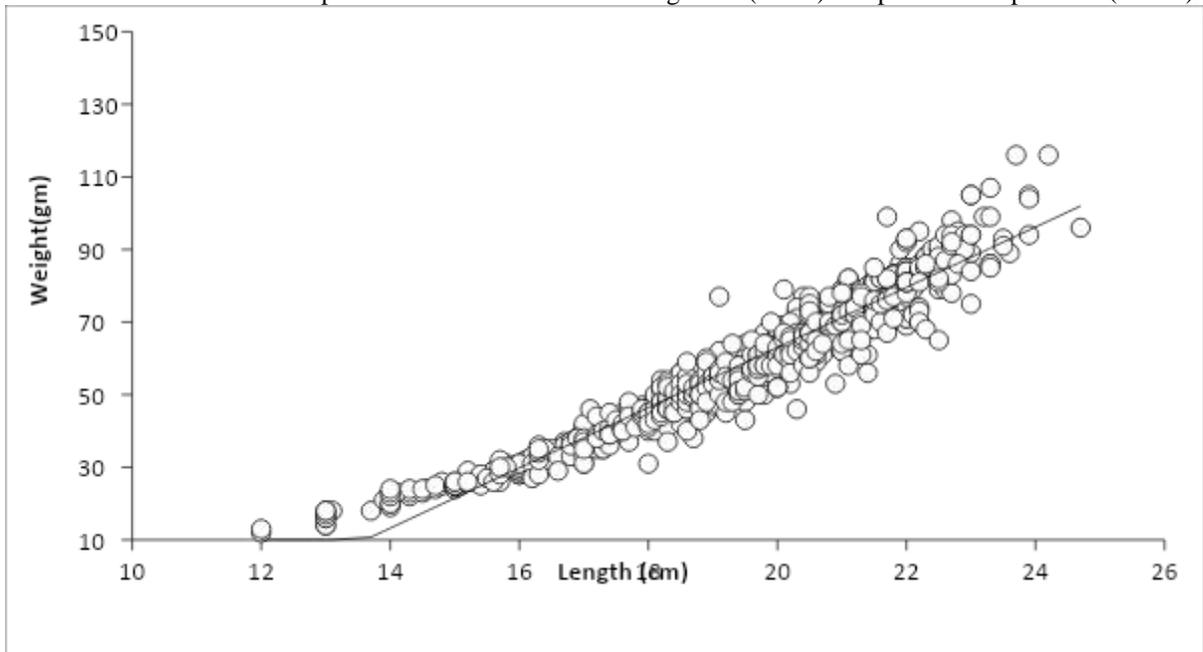

Figure 4 Length-weight relationship in parabolic form of female
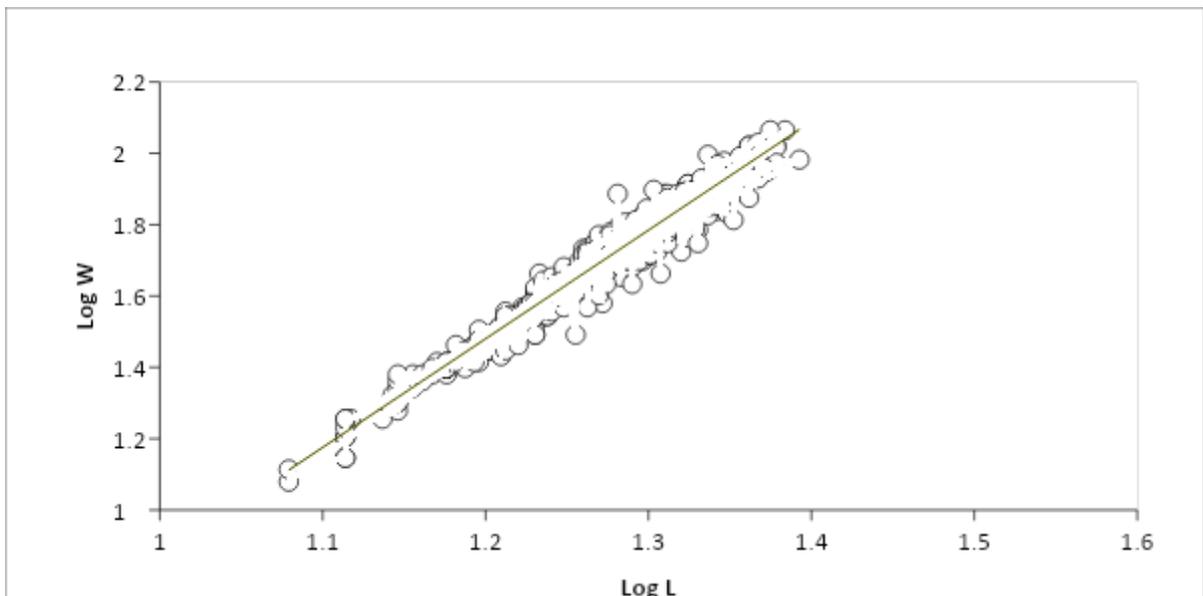

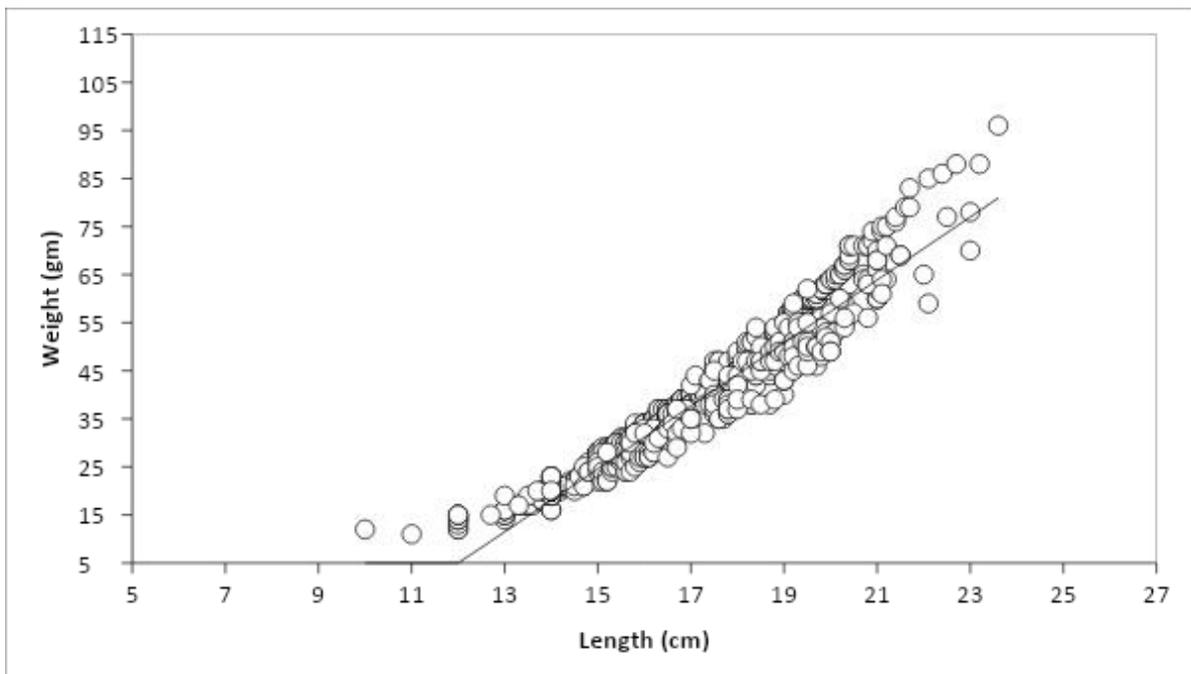Figure 5 Length-weight relationship in logarithmic form of female

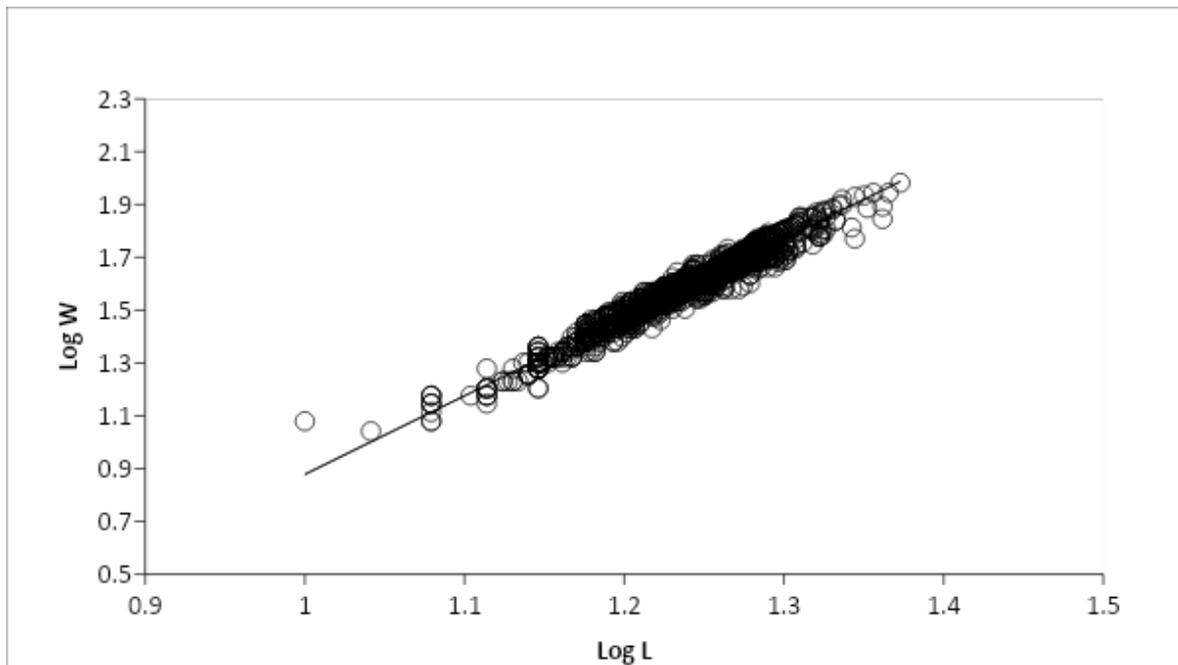Figure 6 Length-weight relationship in parabolic form of male

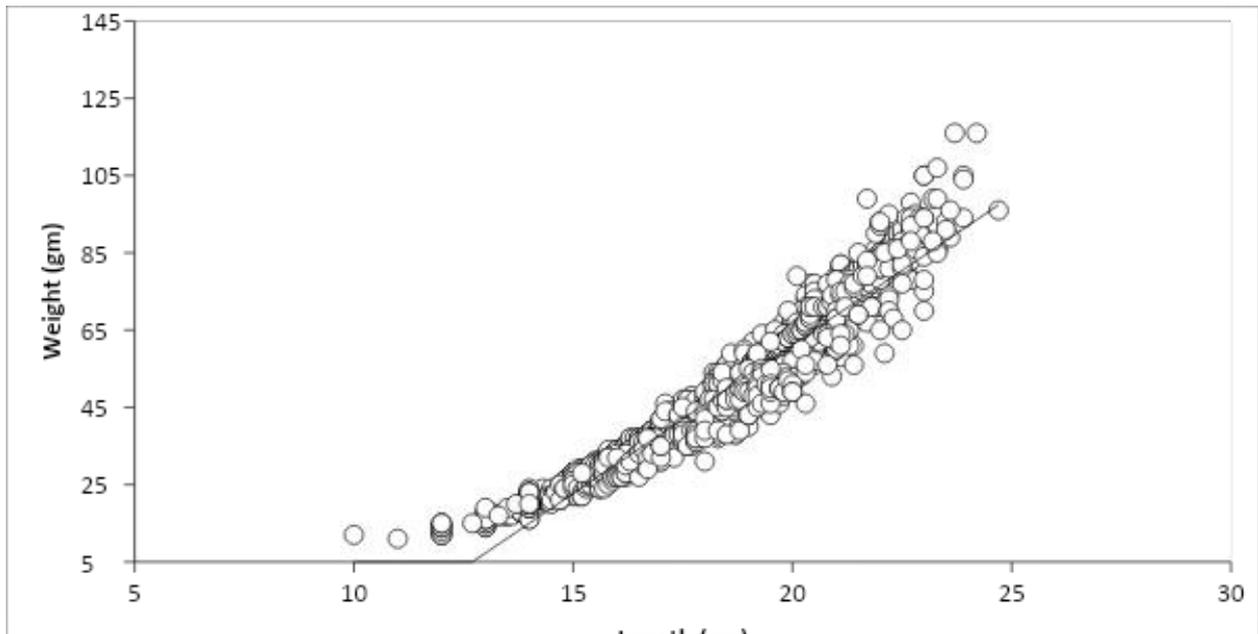Figure 7 Length-weight relationship in logarithmic form of male

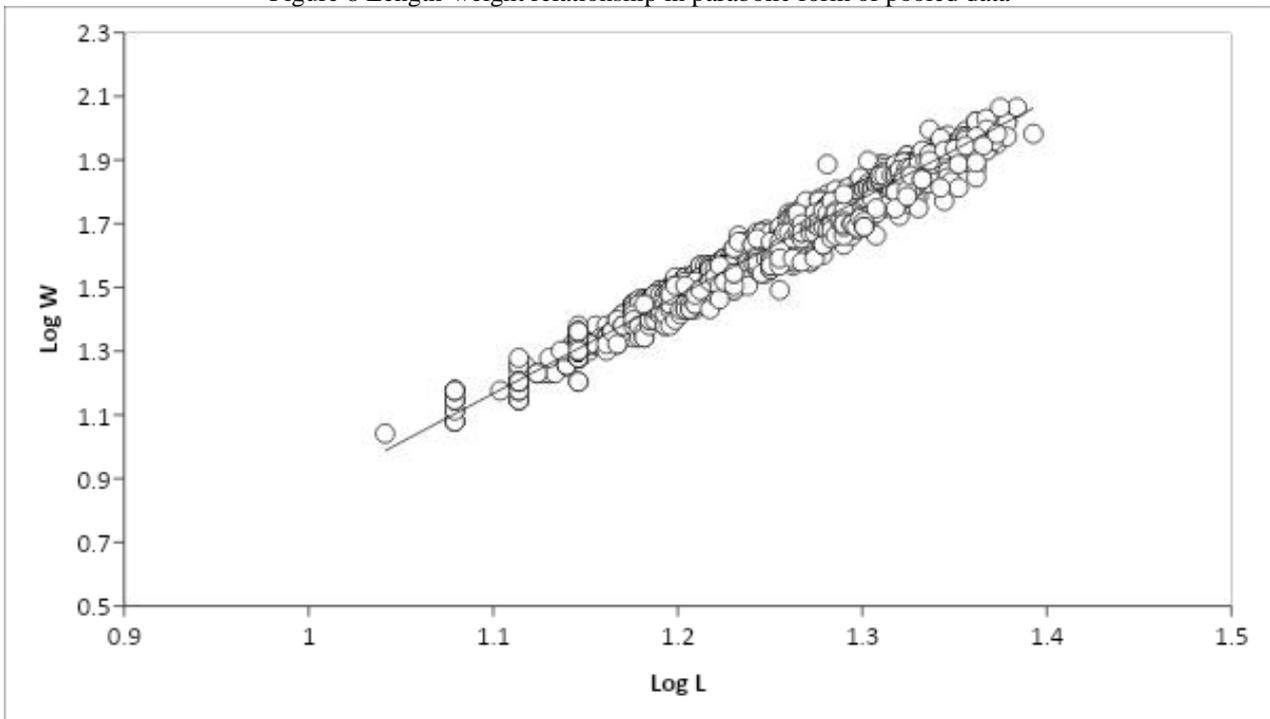Figure 8 Length-weight relationship in parabolic form of pooled data

Figure 9 Length-weight relationships in parabolic form of pooled data

Table 2 Female, Male and Pooled length weight relationship of *Thryssa mystax*

	a value	b value	r²	Growth type
Female	0.0067	3.0451	0.9596	Isometric
Male	0.0080	2.9748	0.9566	Isometric
Pooled	0. 0064	3.0610	0.9667	Isometric

The length-weight relationship, regression coefficients estimated using the least square method for female, male and pooled is furnished in the equation below:

Female: $W=0.0067\ L^{3.0451}\ R^2=0.9596$
    $\text{Log } W = -2.1741 + 3.0451 \log L\ (R^2=0.9596)$
Male: $W=0.0080\ L^{2.9748}\ R^2=0.9566$
    $\text{Log } W = -2.0968 + 2.9748 \log L\ (R^2=0.9566)$
Pooled: $W=0.0064\ L^{3.0610}\ R^2=0.9667$
    $\text{Log } W = -2.2003 + 3.061 \log L\ (R^2=0.9667)$

Table 3 Month-wise regression statistics for length weight of *Thryssa mystax*

Month	a value	b value	r^2	Growth type
January	0.0064	3.0428	0.9084	Isometric
February	0.0046	3.1659	0.9911	Positive Allometric
March	0.0044	3.1874	0.9926	Positive Allometric
April	0.0030	3.3271	0.9916	Positive Allometric
May	0.0044	3.1895	0.9966	Positive Allometric
June	Samples could not be collected due to Uniform Ban on fishing in West			
July	Coast of India from 01st June to 31st July			
August	0.0133	2.7934	0.9471	Negative Allometric
September	0.0065	3.0821	0.9888	Isometric
October	0.0065	3.0564	0.9926	Isometric
November	0.0061	3.0462	0.9593	Isometric
December	0.0140	2.7837	0.8554	Negative Allometric

Table 4 Regression coefficients of male and female of *Thryssa mystax* using t-test

	Degree of freedom (n=-1)	t-test value	p value
Male & Female	2813	4.277	p<0.05

Sex ratio

The month-wise sex ratio for 2814 specimens of male (1806) and female (1008) fishes were studied. The male and female difference in number was 798. Sex ratio was observed to be unequal in most of the months (Table 5). During Month-wise observations, the male specimens recorded higher numbers in May (394), February (240), October (206), March (183), and less in December (95). In the case of females, higher numbers in May and December (225), October (140), November (125) and lesser numbers in September (26). The Chi-square distribution value is an asymmetric value which has minimum distribution values from zero to any maximum numbers. The Chi—square test(X^2) indicated less value (X^2=0.1) in November and higher values in February (X^2=91.8). No significant differences were observed between different sexes (male & female). As the p-value observed to be higher than 0.05 (p=>0.05) and no significance level at 5% (Tab. 5), if the values are to be significant, the values are to be equal to or lesser to the alpha values (0.05), whereas, if the p-value is lower than the said alpha, can reject the null hypothesis as specimens (male & female) have independent significance. The month-wise, observed and expected number of male and females are presented in Fig. 10.

Table 5 Sex ratio in male and female of *Thryssa mystax* and Chi-square values

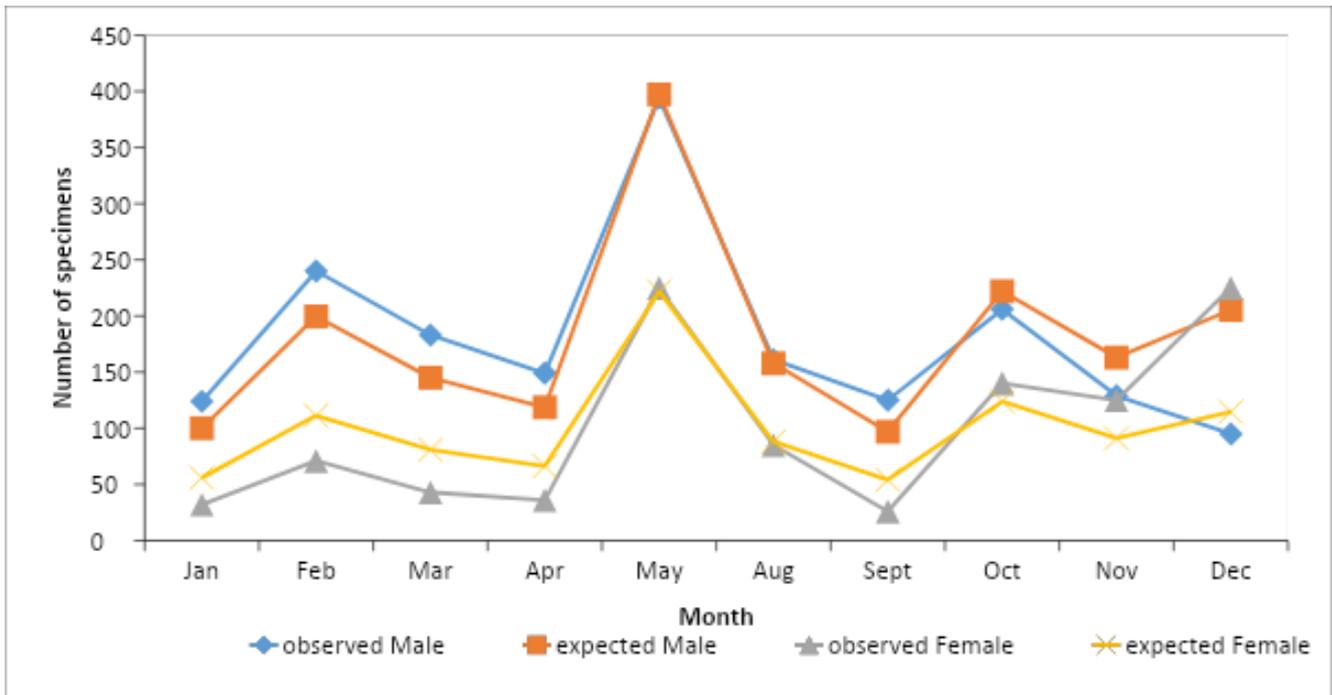| Month	Total observations	Sex & Number		M:F	X^2 value
		Male	*Female*		
Jan	156	124	32	1:0.3	54.3
Feb	311	240	71	1:0.3	91.8
Mar	226	183	43	1:0.2	86.7
Apr	185	149	36	1:0.2	69.0
May	619	394	225	1:0.6	46.1
June	Samples could not be collected due to Uniform Ban on fishing in West Coast of India				
July	from 01st June to 31st July				
Aug	246	161	85	1:0.5	23.5
Sept	151	125	26	1:0.2	64.9
Oct	346	206	140	1:0.7	12.6
Nov	254	129	125	1:1.0	0.1
Dec	320	95	225	1:2.4	52.8
Total	2814	1806	1008	1:0.6	226.3

Figure 10 Month-wise, observed and expected values of female and male of *Thryssa mystax*

Relative Condition Factor (Kn)

A Total of 2814 specimens were analyzed for the relative condition factor analysis. (1008: No. of females and 1806 No. of males). The females were in the length range of 12.0 - 24.5 cm, males length range of 10.0 - 24.5 cm of total length. Considering the higher values, the mean relative condition factor values have been assessed. The highest mean Kn value for females observed was 1.01268 (September) and for the males was 1.00534 (November). The Kn values derived for the different months are given in Fig.   11.
The Kn values near to 1 and above the 1 are to be considered the fish is relatively in good condition. The length-wise mean relative condition factor has shown almost the similar values of 1.04345 in 10 - 13 cm for minimum length and 0.96872 for the maximum length group 23-26 cm (Fig. 12). The Kn values showed variations in different length groups of 19-21 cm followed by 21-23, 16-19,   13-16   and   23-26   cm.
The higher Kn value was noticed in 10-13 cm length groups which are at the juvenile stage.
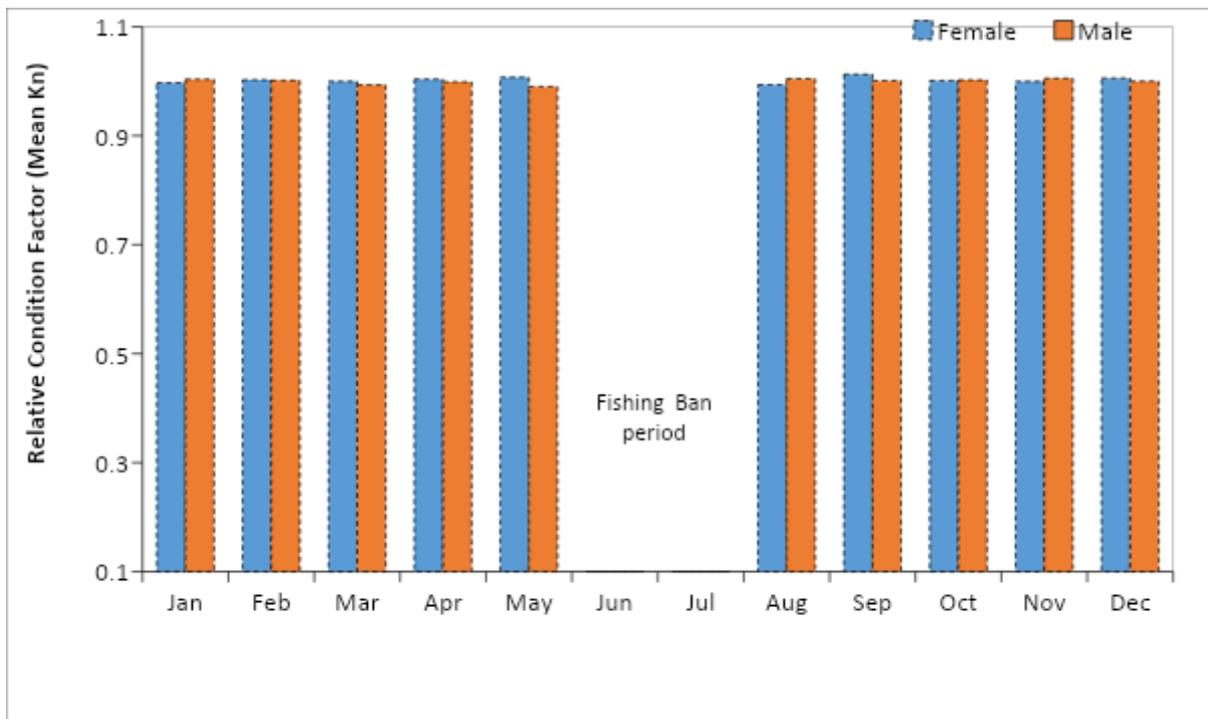

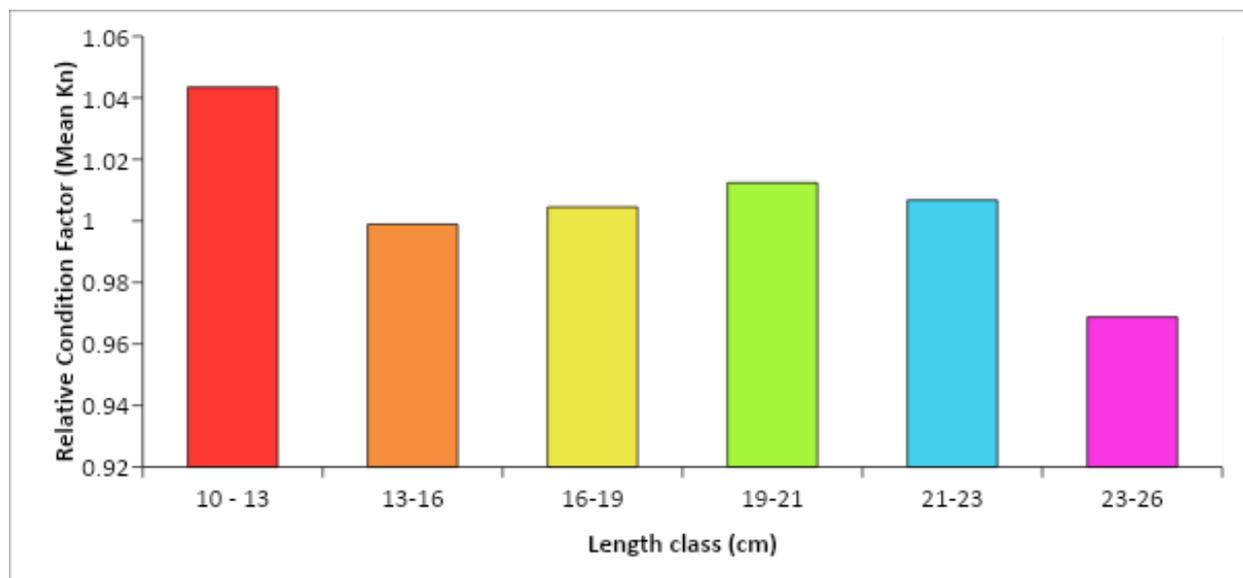Figure 11 Month-wise condition factor (Kn) of pooled specimen

Figure 12 Length class-wise condition factor (Kn) of pooled specimen of *Thryssa mystax*

V.　　DISCUSSION

The present study agrees with the investigations of Kende *et.al.,* (2016[16], 2018[13]) from Ratnagiri coast as almost all the values found to be closer to the values of the specimens collected from major marine fish landing centers in Mumbai. Kende *et. al.,* (2020)[17], studied the biometric analysis of Moustached Thryssa along the Ratnagiri coast of Maharashtra, India. These studies on length-weight relationship for the species found to be isometric growth type in males, females, indeterminate and pooled data ($W=0.0062L^{3.0657}$) and the coefficient (r) values　　　derived was 0.9327, 0.9266, and 0.9379. The probability value found was $p=<0.05$.

Earlier studies for the same species on length-weight have also indicated isometric growth in *Thryssa mystax* by Venkataraman (1956)[18] from Calicut waters ($W=0.00002L^{3.1063}$); Nalluchinnappan and Jeyabaskaran (1991)[19] from Tuticorin coast & Gulf of Mannar, East coast of India ($W=0.00002383L^{3.1043}$). Their studies indicated that, the sex ratio of the species was found to be unequal and males were dominating the females in lesser length class which agrees with the present study. Hoda (1983)[20] reported the allometric growth type from Pakistan waters; Allometric growth was also observed by Hussain & Ali (1987)[21] in North west Arabian Gulf ($W=0.00309L^{3.264}$) Kn=1.120; Bandana *et. al.,* (2017)[22] derived negative allometric growth ($W=0.038L^{2.459}$), K=0.854 from Portonovo coast; Srihari *et.al.,* (2019)[23] studied the length-weight relationship with negative allometric growth from central west coast of India ($W=0.008L^{2.870}$), $r^2=0.98$; Martin *et.al.,* (2016)[24] reported the negative allometric relationship ($LogW=5.000L^{2.600}$), K=0.680 from Southern part of east coast of India; Kamal *et.al.,* (2017)[25] investigated the major fluctuations in proportion of sex ratio in males and females for 1:1 ($p=<0.05$) from Java Province, the results co-relates with the present research. Naik *et. al.,* (2019)[26] studied the Length-weight relationship ($W=0.0056L^{2.9044}$), $r^2=0.998$ for the species from upper east coast of India and Karna (2017)[27] derived the length-weight relationship of *Thryssa mystax* and its group from Chilika Lagoon, India ($W=0.1026L^{3.081}$), $r^2=0.983$. In the present study, even though some of the months have shown slightly positive and negative allometric growth type but the results were within the range of 2.7 to 3.3. Therefore, present investigation in conformity with the results of length-weight relationship, sex ratio and relative condition factor studied by few researchers from various part of India and overseas.

Present study is the first report of the species *Thryssa mystax* collected from the major fish landing centers of Mumbai, Maharashtra coast. Previously, no researchers attempted for Length-weight relationship, sex ratio and relative condition factor (Kn) for the species in the given area. As the Kn values may vary according to the size of the fish, availability of food, habitat, environmental parameters, and reproductive behavior etc., and observed to be nearest to 1 derived for the present study shows the wellbeing of the species distributed in the study area. Therefore, it is concluded that this study has presented an overview about Moustached Thryssa's length-weight relationship, sex ratio, relative condition, and its population health of the region. The work will help these researchers, academia, and end users.

VI.　　ACKNOWLEDGEMENT

REFERENCES

1. Bloch, M.E.; Schneider, J.G., M.E. Blochii, SystemaIchthyologiaeiconibus cx illustratum. Post obitumauctoris opus inchoatumabsolvit, correxit, interpolavit Jo. Gottlob Schneider, *Saxo. Berolini.SumtibusAuctorisImpressumetBibliopolioSanderianoCommissum*. Pp i-lx + 1-584, Pls. 1-110., available online at https://www.biodiversitylibrary.org/bibliography/5750#/summary page(s): 426, Pl. 83, 1801.
2. Pauly D. Linear regressions in fisheries research. Journal of the Fisheries Research Board of Canada.1993; 30:409-434.
3. Khan, K.M., Kasim, H.M., Rohit, P., Thiagarajan,R.,Trends in world anchovy fisheries and India's status, Ocean Life Food and Medicine Expo. 2004, pp. 1–12.
4. Nelson, J.S., Fishes of the World (John Wiley and Sons, New York) 1984, pp 523.

5. Grande, L., Recent and fossil clupeomorph fishes with materials for revision of the subgroups of clupeoids. Bull. Amer. Mus. Natur. Hist., 181(1985) 231–372.
6. Grande, L., Nelson, G.J., Interrelationships of fossil and recent anchovies, (Teleostei: Engraulidea) and description of a new species from the Miocene of Cyprus. Am. Mus. Novit., 2826(1985) 1–16.
7. Whitehead, P.J.P., Nelson, G.J., Wongratana, T., Clupeoid fishes of the World (Suborder Clupeoidei): an annotated and illustrated catalogue of the herrings, sardines, pilchards, sprats, shads, anchovies and wolf herrings. Part 2.Engraulididae.FAO Fish. Symposium, 125(1988) 305–579.
8. Kuronuma, K. and Y. Abe. Fishes of Kuwait. KISR.1972, 123 pp.
9. Lumboef, M. and E. J. Simmonds, Acoustic estimation of the biomass of the stocks of small pelagic species in the Gulf and the Gulf of Oman, in: Pelagic Resources of the Gulf and the Gulf of Oman, edited by FAO, 1981, pp. 29-94.
10. Gopi, K. C., and S. S. Mishra. 2015. Diversity of Marine Fish of India. In: Venkataraman, K., &Sivaperuman, C. (Eds.), Marine Faunal Diversity in India Taxonomy, Ecology and Conservation. Academic Press San Diego, 1981, p. 171-193.
11. Nelson, J. S. Fishes of the World-Fourth Edition. John Wiley & Sons, Inc., Hoboken, New Jersey, 2006: 601.
12. Relyea, K, Inshore Fishes of the Arabian Gulf. The Nat. Hist. Arabian Gulf. 1981, 149 p.
13. Kende, D.R., V.H. Nirmale, Metar, S.Y., and Pawar, R.A., 2018. Studies on growth and mortality of MoustachedThryssa, *Thryssamystax* (Schneider, 1801) along the Ratnagiri coast of Maharashtra, *India. Indian J. of Geo Marine Sciences*, Vol. 47 (05), May 2018. pp. 1065-1068.
14. Le Cren ED. Length-weight relationship and seasonal cycle in gonad weight and condition in the Perch *Perchafluviatilis*, *Journal of Animal Ecology* 1951;20:201-239.
15. Snedecor GW, Cochran WG. Statistical methods. 6th Edition, Ames, Iowa, the Iowa state University 1967.
16. Kende, T. Y. Biological studies on Moustachedthryssa, *Thryssamystax* along the Ratnagiri coast of Maharashtra. M. F. Sc. Thesis, Dr. BalasahebSawant Konkan KrishiVidyapeeth, Dapoli,2016, 59 pp.
17. Kende, D.R., V.H. Nirmale, U.R. Gurjar, U. Qayoom, N. Syed and R.A., Pawar, Biometric analysis of moustachedthryssa, *Thryssamystax* (Block and Schneider, 1801) along the Ratnagiri coast of Maharashtra, India. *Indian J. Fish.,*2020, 67(2):110-113.
18. Venkataraman, G..Studies on some aspects of the Biology of the Common Anchovy, *Thrissocles mystax* (Bloch & Schneider).*Indian J. Fish.*1956*,* 3: 311-333.
19. Nalluchinnappan, I. and Jeyabaskaran, Y. Observation on the biology of *Thryssamystax*off Tuticorin coast, Gulf of Mannar, east coast of India. *J. Mar. Biol. Ass. India*, 1991, 33(1&2): 49-54.
20. Hoda, S. M. S..Some Observation on the Distribution, Maturity stages and Length-Weight Relationship of the anchovy *Thryssa mystax* in the Northern Arabian Sea.*Indian J. Fish.*1983*,* 30(2): 278-286.
21. Hussain, N. A. and T. S. Ali. Some biological aspects of *Thryssa hamiltonii* and *Thryssa mystax* in Khor al-Zubair, north-west Arabian Gulf. *Indian J. Fish.,*1987, 34(2):152-162.
22. Bandana Das, G., Saravana Kumar A, Thangaradjou T, Nagaraja Kumar M, Srinivasa Kumar T and Swagat, G., Length-Weight Relationship for 15 Commercially Important fish species of Portonovo Coast, Tamilnadu, South East of India, *Int. J. Oceanogr. Aquac*, 2017, 1(3): 000116.
23. Sri Hari, M., G.B., Sreekanth, M. Dhanya and A.K. Jaiswar, 2019.Length-weight relationship of 11 fish species from tropical estuarine ecosystem along the central west coast of India, 2019.*J. Mar. Biol. Ass. India.,* 61(1), January-June 2019.
24. Martin, P. Kuppan. A and Kalaichelvi. N, Length Weight relationship of pelagic marine fishes in the east coastal region, Chennai, Tamilnadu, *India. Int. J. Curr. Res. Biol. Med*, (2016), 1(9):1-7.
25. Kamal M. Mohammad Mas Tri Djoko Sunarno (2017), Biological reproductive of estuarine fish comparing between demersal (Long tonque Sole, *Cynoglossus lingua*) and pelagical: (Mutached Thryssa, *Thryssa mystax)* assemblages. *Ind. Fish. Res. J.* Vol.15 No.1 July-2009: 37-42.
26. Naik *et al.* Length-weight relationship of selected commercially important marine fishes from east coast of *India. J. of Entomology and Zoology Studies*; 7(1): 1650-1652, 2019.
27. Karna, S. K. 2017. Length-weight and length- length relationship of *Thryssa purava* (Hamilton, 1822), *Thryssapoly branchialis*Wongratana, 1983 and *Thryssa mystax* (Bloch & Schneider, 1801) from Chilika lagoon, *India. J. Appl. Ichthyol.,* 33: 1284-1286.