Indian Journal of Geo Marine Sciences
Vol. 47 (05), May 2018, pp. 1065-1068

Studies on growth and mortality of Moustached Thryssa, *Thryssa mystax* (Schneider, 1801) along the Ratnagiri coast of Maharashtra, India

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Received 01 June 2016; revised 09 December 2016

Growth and mortality parameters of Moustached Thryssa, *Thryssa mystax* were estimated on the basis of length frequency data collected during March 2015 to February 2016. The asymptotic length ($L\infty$) and growth coefficient (K) were estimated to be 224 mm and 1.0 per year respectively by ELEFAN and 243 mm and 1.0 per year respectively by scattergram. t_0 by von Bertalanffy plot was estimated to be - 0.0036 year. This species attains a size of 83, 142, 174 and 194 mm at the end of six, twelve, eighteen and twenty four months respectively. Mortality parameters *Z*, *M* and *F* were estimated at 5.58, 1.03 and 4.55 respectively. Length at first capture for *T. mystax* was found to be 147.5 mm. The present exploitation ratio was determined to be 0.81. Relative yield per recruit analysis showed E_{max} at 0.852.

[Keywords: Moustached thryssa, *Thryssa mystax*, Mortality parameter, Age and Growth, VBGF Plot]

Introduction

Anchovies are widely distributed throughout the Indian Ocean, the Arabian Sea and the Red sea[1]. They contribute largely to the fishing industry of the Arabian-Gulf Sea[2]. Of the six species of anchovies recorded from the Arabian Gulf [3], *Thryssa hamiltonii* and *T. mystax* are among the common species caught in the coastal waters. The Moustached thryssa (*Thryssa mystax*) belonging to the family Engraulidae inhabit marine, brackish, and pelagic oceanic environment. They are distributed in the depth range of 1-50 m in the Indo-west Pacific region and are found in coastal pelagic waters, often observed as entering mangroves and adjacent brackish waters.

The production of anchovies stood 18836 tonnes in Maharashtra while total production of the country stood 114332 tonnes in the year 2013[4]. Though these fishes are caught by combination of different craft & gear, the maximum production is reported by small trawlers and mini purse seiners as bycatch from depths upto 50m. Even though anchovies have less demand in fresh condition, considerable market for dry fish and also as material for preparation of fishmeal exists. *Thryssa mystax* contributes significantly to the landings of anchovies in the country.

As very few studies are reported on growth and mortality of major species of anchovies along the west coast of India and there are no specific studies pertaining to the *T. mystax* from Ratnagiri coast, the present study was undertaken to study the growth and mortality of *Thryssa mystax* a major species of anchovy landed as trawl bycatch along the Ratnagiri coast of Maharashtra.

Material and Methods

Catch and effort data was collected weekly from the Mirkarwada landing centre (16.98^0 N, 73.30^0 E) of Ratnagiri from March 2015 to February 2016. Commercial trawl catches were sampled for the purpose. A total of 3912 specimens were measured for length frequency analysis. The total length was measured to the nearest millimeter. The length frequency data were grouped into 5 mm class interval, then raised and pooled month wise[5]. The asymptotic length L_∞ and growth coefficients K were estimated by FiSAT (FAO-ICLARM Stock Assessment Tools) computer software package[6]. Similarly L_∞ and K were also estimated by scattergram method[7].

Age at length zero t_0 and length at age data was estimated by employing VBGF[8].

$$-\ln (1- Lt/ L_\infty) = - K* t_0 + K * t$$

$$t = t_0- (1/K) * \ln (1-Lt/L\infty)$$

The total instantaneous mortality rate (Z) was calculated by Jones and van Zalinge method[9]. Natural mortality coefficient was estimated by pauly[10] given as:-

$$\ln(M) = -0.0152 - 0.279 \ln(L_\infty) + 0.6543 \ln(K) + 0.463 \ln(T)$$

Fishing mortality (F) was determined by the relationship,

$F = Z\text{-}M$.

The relative yield/recruit was estimated from the relative yield/recruit model represented by the equation[11].

$$Y/R' = E^* U^{M/K} * 1\text{-}\{(3U/(1+ m)) + (3U^2/(1 + 2m)) - (U^3/(1 + 3m))\}$$

where, E = F/Z the exploitation ratio or fraction of deaths caused by fishing.

m = K/M

U = (1 – Lc)/L_∞ the fraction of growth to be completed after entry into the exploited phase. Y/R'is considered a function of U and E and the only parameter is M/K.

Results and Discussion

Employing FiSAT, the growth parameters, $L\infty$ and K were estimated to be 224 mm and 1.0 per year respectively for*T. mystax* by ELEFAN-I. While $L\infty$ and K were estimated to be 243 mm and 1.0 per year by scattergram method (Fig. 1). The growth parameter estimated by ELEFAN - I were considered for further calculation.The t_o estimated by VBGF plot was found to be - 0.0036 year.

$L\infty$ varied from 228 to 285 mm and the K from 0.52 to 0.77 per year for *Thryssa vitrirostris* along Mozambique waters[12]. Growth parameters for three species of *Thryssa* from Cleveland and Bowling Green Bays, North Queensland were studied[13]. $L\infty$ and K for *Thryssa aestuaria* was estimated to be 118 mm and 1.6 per year; while for *T. setirostris* $L\infty$ and K were reported to be 200 mm and 1.4 per year respectively. Growth parameters were estimated separately for males and females in *Thryssa hamiltonii*. $L\infty$ and K for males of *Thryssa hamiltonii* were estimated to be 215 mm and 0.9 per year and for females of *T. hamiltonii* $L\infty$ and K were found to be 235 mm and 1.34 per year respectively.

$L\infty$ and K for *Thryssa baelama* were reported to be 146 mm and 0.4 per year respectively along the Apui coast, Central Maluku[14]. The growth parameters $L\infty$ and K of *T. vitirirostris* along coast of the Safala Bank, Western Indian Ocean were stated to be 190 mm and 0.66 per year respectively[15]. The asymptotic length from various species of *Thryssa* reported by different workers ranged from 146 - 285 mm from different regions. While K varied from 0.4 to 1.6 per year for different species. Growth parameters $L\infty$ and K have not been reported earlier for *Thryssa mystax.* From the above findings it is evident that this group of pelagic fish has a shorter life span and faster rate of growth. Normally a species having a short life span would have low $L\infty$ and high K which has also been found in the present investigation.

t_o is present study was found to be -0.0036 year. t_o for *Thryssa hamiltonii* was reported to be -1.34 year for female and -1.2 year for male from Cleveland and Bowling Green Bays, North Queensland[13]. t_o usually has got a small negative value which indicate that the juvenile fish have got a faster growth rate than adults.

Mean lengths estimated by ELEFAN using von Bertalanffy Growth Function (VBGF). It was noted that *T. mystax* attains a length of 83 mm, 142 mm, 174 mm and 194 mm at the end of six, twelve, Eighteen and twenty two months respectively. The maximum size recorded during the study period was 215 mm, at an estimated age of 2.14 years (Fig. 2).

Earlier study has reported that *T. mystax* attains an average length of 95 mm in 8-9 months. Fish grew

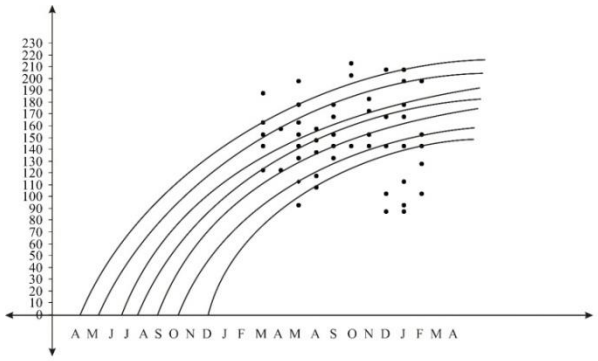

Fig. 1 — Modal progression analysis of length frequencies observed in *Thryssa mystax* by scatterergram technique

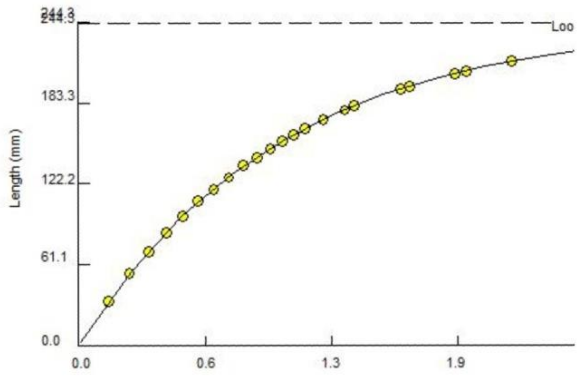

Fig. 2 — Growth curve (Length at age of *T. mystax*)

upto 155 mm after the completion of one year. While in second year of life, fish grows upto 185 mm. The growth rate in second year was comparatively very slow than 1st year of its life[16]. *T. mystax* grew at an average rate of 12 mm per month upto the first year[17]. After attaining 130-140 mm size, its growth decreases to 5 mm per month during second year of its life[17].

T. aestuaria attains a length 100 to 115 mm at the end of one year. *T. aesturia* longevity was reported between 1 to 2 years. While *T. setirostris* grow upto 175 to 195 mm in one year[13]. The growth of *Thryssa mystax* in present study almost conform to the findings reported[16]and highlight the fact that the juvenile stages of *Thryssa mystax* grow at a faster rate and the growth slows down with increasing age which is very normal way of growth in fish.

The total mortality coefficient *Z* was estimated to be 5.58 per year by Jones and van Zalinge method (Fig. 3). The natural mortality coefficient *M* was estimated to be 1.03 per year by Pauly's empirical formula. The annual fishing mortality coefficient (*F*) was estimated by subtracting natural mortality (*M*) from total mortality coefficient (*Z*). Thus, *F* was estimated to be 4.55 per year.

Mortality parameters of *Thryssa baelama*were reported along the coast of Apui, Central Maluku[14]. Total mortality (Z) were reported to be 1.36 per year. The total mortality coefficient (Z) was reported to be 2.3 per year for *Thryssa vitrirostris* from Sofala Bank, Western Indian Ocean[15]. The estimated value of Z in present study is found to be high in relation to the values of Z reported for *Thryssa baelama* and *Thryssa vitrirostris.* This may be due to intense fishing pressure in the area under study.

Natural mortality (M) was reported to be 0.94 per year[14]. Natural mortality (M) for *T. vitrirostris*was reported to be 1.5 per year along Sofala Bank, western Indian Ocean[15]. Although no estimates on natural mortality for *T. mystax* are reported earlier the M estimated in present study is almost similar to that reported for *T. baelama* by[14] but less than 1.5 reported for *T. vitrirostris.*

Mortality parameters of *Thryssa baelama*were reported along the coast of Apui, Central Maluku. Fishing mortality (F) were reported to be 0.40 per year[14]. The fishing mortality for *T. vitrirostris* was to be 0.8 per year along Sofala Bank, western Indian Ocean[15]. *Thryssa mystax* is landed mainly as bycatch from trawlers operating along the Ratnagiri coast. The higher value of fishing mortality more than that of natural mortality point to the increased exploitation of the species by the trawlers using cod end of smaller mesh sizes.

The length at which 50% of the species became vulnerable to the gear was found to 147.5 mm (Fig. 4).

Length at first capture is a function of gear selectivity. Cod end mesh size influences the selectivity of trawl. In present study the length at which 50% of the species became vulnerable to the gear was found to be 147.5 mm. No studies on size at first capture for *Thryssa mystax* have been earlier reported. The length at first capture

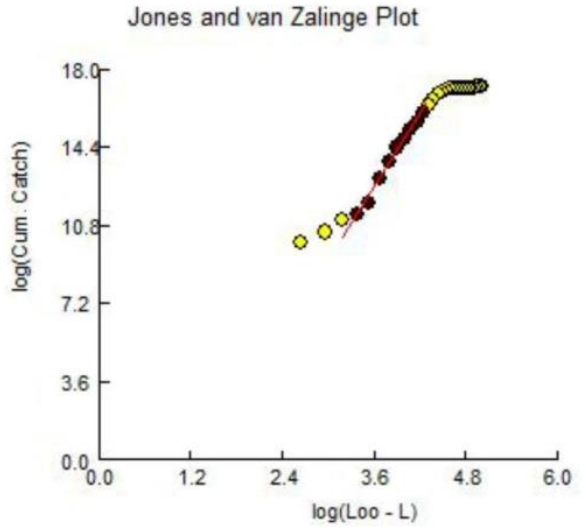

Fig. 3 — Total mortality coefficient by Jones and von Zalinge plot curve

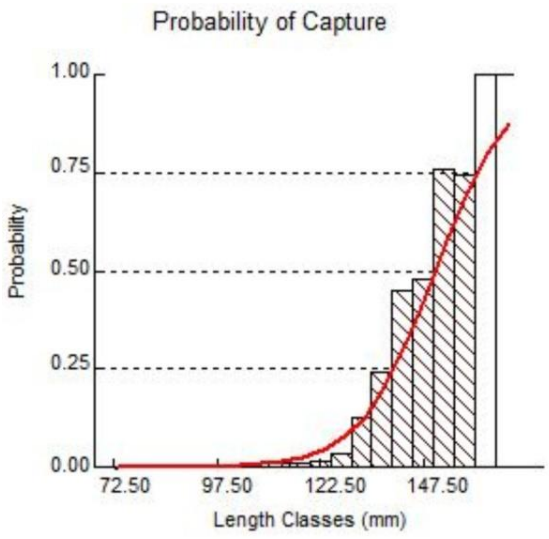

Fig. 4 — Length at first capture

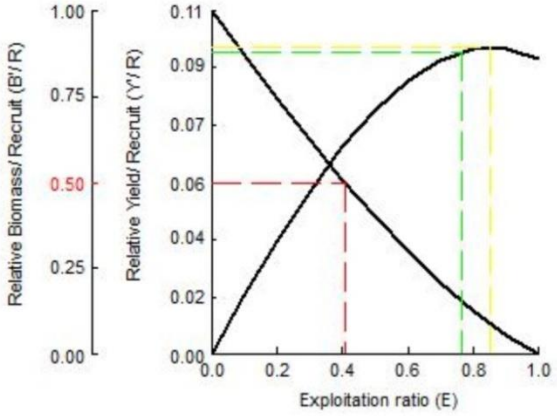

Fig. 5 — Relative yield and biomass per recruit

of *Thryssa dussumieri* is reported to be 88.4 mm from Veraval, Gujarat[18]. Care should be taken not to decrease the mesh size of cod end further so that length at first capture will approach length at first maturity.

Exploitation ratio (*E*) was estimated to be 0.81 for *T. mystax*. Beverton and Holt relative yield per recruit curve is shown in Fig. 5. The Beverton and Holt relative yield per recruit curve was found to be maximum for an exploitation ratio (E_{max}) of 0.852. The values of $L_c/L\infty$ and *M*/*K* taken for estimation of Y/R are as 0.6585 and 1.03 respectively.

The exploitation ratio (*E*) is estimated to be 0.81 for *T. mystax* in the present study which is very much on the higher side. The relative yield per recruit curve is maximum for an exploitation ratio (E_{max}) of 0.85. There is no scope to considerably increase exploitation from the current level to E_{max} level to achieve the higher sustainable landings. In fact, based on the exploitation ratio, it is better to reduce the effort or allow some of the juveniles to escape the net by increasing the mesh size.

Acknowledgement

Authors are grateful to the Associate Dean, College of Fisheries, Ratnagiri and Authorities of Dr.B.S.Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (Maharashtra) for providing facilities to carry out this work.

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