Study on Growth and Mortality of *Thryssa dussumieri* (Valenciennes, 1848) along the Coast of Ratnagiri

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Abstract

The present investigations were carried out on Dussumier's thryssa, *Thryssa dussumieri* with respect to growth and mortality parameters. The growth and mortality parameters were estimated by using length frequency data collected from Mirkarwada landing centre during March, 2016 to February 2017. The growth parameters such as asymptotic length ($L\infty$), growth coefficient (K) and age at length zero (t_0) were estimated to be 176 mm, 1.1 per year and 0.0048 year respectively. *Thryssa dussumieri* was found to attain a size of 74 mm, 117 mm, 156 mm and 165 mm at the end of six months, one year, two years and two and half years respectively. The mortality parameters Z, M and F were estimated at 8.52, 1.7 and 6.82 respectively using FiSAT programme. Exploitation ratio for the species was found to be 0.8.

Keywords: Dussumier's thryssa, *Thryssa dussumieri,* growth parameters, mortality parameters, exploitation ratio.

Introduction

Anchovies belonging to the family Engraulidae include four genera (Whitehead *et al*. 1988), viz. *Engraulis* in which the scutes are lacking before or behind pelvic fin base; *Stolephorus* in which needle-like scutes are present only before pelvic fin base; *Thryssa* in which the scutes are present before and behind pelvic fin base; and *Coilia* in which scutes are present on both the sides of pelvic fin base but body is tapering to a point. About 11 species belonging to the genus *Thryssa* (Fischer and Binachi 1984) are reported from Western Indian Ocean. *T. dussumieri* is mainly characterised by long maxilla, reaching at least halfway along pectoral fin and gillrakers usually 17 to 19 on lower limb of first arch.

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Anchovies are widely distributed throughout the Indian Ocean, the Arabian Sea and the Red sea (Kuronuma and Abe, 1972). They contribute largely to the fishery industry of the Arabian-Gulf Sea (Lamboeuf and Simmonds, 1981). Of the six species of anchovies recorded from the Arabian Gulf (Relyea 1981), *Thryssa hamiltonii, T. dussumieri* and *T. mystax* are the most common species caught in the coastal waters. The Dussumier's Thryssa (*Thryssa dussumieri*) is mainly distributed in the Indian Ocean (Western Coast of India, Pakistan, and Sri Lanka), and Western Pacific (Malaysia, Indonesia and north to Taiwan). They are found in coastal pelagic waters, also in mangroves and adjacent brackish waters (Fischer and Binachi 1984). The production of anchovies in India is reported to be 2,64,891 tonnes with Maharashtra accounting for 10,008 tonnes in year 2015 (CMFRI 2016). The maximum catch of anchovies is taken by small trawlers and mini purse seiners from depths up to 50 m.

Very less recent information is available on the growth and mortality parameters of major species of anchovies exploited along the West Coast of India. No information is available on the growth and mortality parameters of *T. dussumieri* from Ratnagiri coast. Therefore, the present study was undertaken to investigate the growth and mortality parameters of *T. dussumieri* along the coast of Ratnagiri.

Material and methods

The Mirkarwada landing centre (16° 59′ 42" North latitude and 73° 16 ′ 14" East latitude) of Ratnagiri located in Maharashtra along the western coast of India was selected for the present study (Figure 1). The samples were collected from commercial trawl-by catches at weekly intervals from March 2016 to February 2017. The total lengths (TL) of all the individuals in a sample were measured for estimation of length-frequency distribution. Care was taken to record the length measurements of fishes comprising all size groups. A total of 2,565 fish specimens were measured for the present study. The total length was measured to the nearest millimetre. The length frequency data

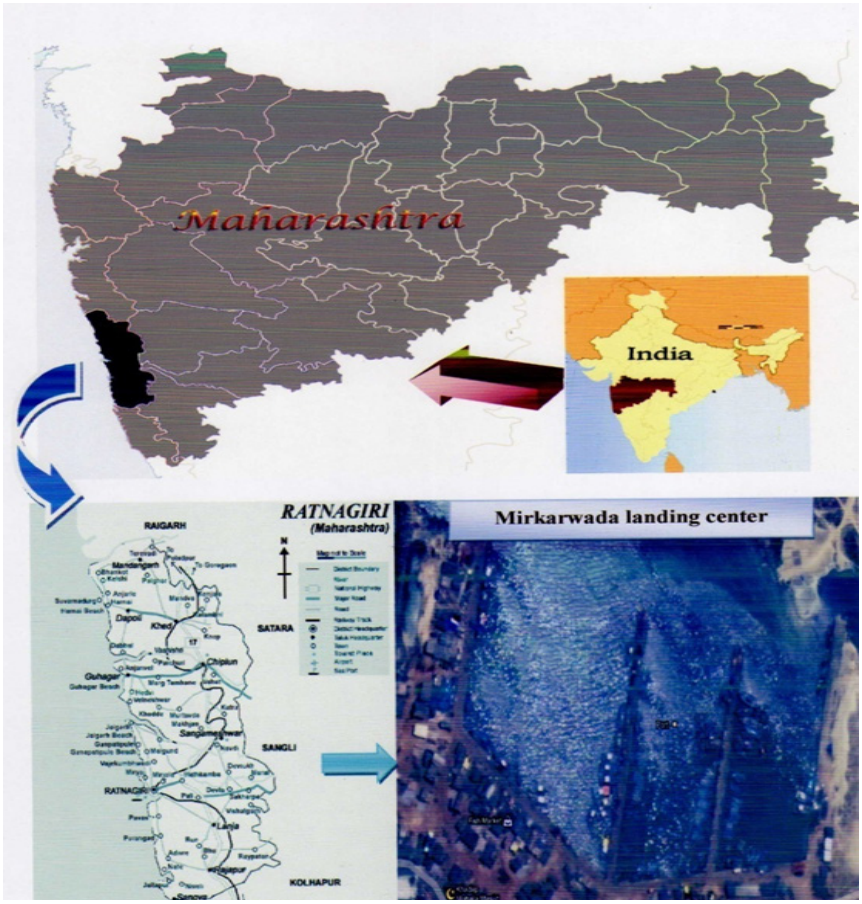

Figure 1. Study area showing sampling location of Mirkarwada, Ratnagiri.

were grouped into 5 mm class interval. The day's catch was divided by sample weight and resultant factor was multiplied by the actual numbers measured and distributed in each group. This way the samples were raised for the day's catch. The length frequency of all the four days of observation in a month was added. Sum of four days of raised numbers was multiplied by monthly raising factor to get the raised number for the month following Sekharan (1962). This formed the basic data for the growth, mortality and population parameters.

The growth parameters were estimated by ELEFAN I employing FiSAT (FAO-ICLARM Stock Assessment Tools) computer software package developed by Gayanilo *et al.* (1996). Similarly the scatter diagram technique of modal progression analysis (Devaraj 1982) was also employed for estimating growth parameters. The age at length zero, t_0 was estimated by von Bertalanffy plot (1938) from length at age data by the equation

$$-\ln\left(1-\frac{L_t}{L_\infty}\right) = -K \times t_0 + K \times t$$

Length at age data was generated by using mean lengths obtained in scattergram technique and employing the following inverse von Bertalanffy Growth formula.

$$t = t_0 - \left(\frac{1}{K}\right) \times \ln\left(1-\frac{L_t}{L_\infty}\right)$$

The total mortality coefficient (Z) was calculated by following the length-converted catch curve (Pauly 1983 and 1984) and by Jones and van Zalinge method (1981) employing FiSAT programme.

The natural mortality coefficient (M) was estimated by using Cushing's method (1968), Pauly's empirical formula (1980) and Rikhter and Efanov's formula (1976). Fishing mortality coefficient (F) was estimated using the relationship, F= Z-M. The exploitation ratio (E) defined as the fraction of year class recruits i.e.,

caught during all the years of its existence (Ricker 1975) was estimated as: E = F/Z.

Results and discussion

Growth parameters

The growth parameters L∞ and K were estimated by ELEFAN - I employing FiSAT programme. The monthly raised length frequency data used for the purpose. The L∞ and K were estimated to be 176 mm and 1.1 per year respectively. The L∞ and K were also estimated to be 185 mm and 1.4 per year respectively by using scattergram technique. The values of growth parameters estimated by ELEFAN-I method appeared to be more reasonable and hence have been considered for further calculations. The L∞, W∞ and K of *T. dussumieri* were reported to be 15.1 cm, 22.12 g and 1.44 per year respectively along Ratnagiri coast of Maharashtra (Mahajan 1983). From Mozambique coast for *Thryssa vitrirostris*, the L∞ varied from 22.8 to 28.5 cm and the K from 0.52 to 0.77 per year (Sousa 1987). Mualeque and Santos (2011) estimated the growth parameters of *T. vitirirostris* along the coast of Safala Bank, Western Indian Ocean. The L∞ and K were stated to be 190 mm and 0.66 per year respectively. Kende (2016) reported the growth parameters of *T. mystax* along Ratnagiri coast. L∞ and K were found to be 243 mm and 1.0 per year respectively by using scattergram technique. He further reported L∞ and K to be 224 mm and 1.0 per year respectively by ELEFAN I. The L∞ reported in present study is higher and K almost close to the estimate, reported by Mahajan (1983). *T. dussumieri* is thus found to grow to a relatively bigger size than reported earlier. Apart from the work of Mahajan (1983) there are no reports on estimates of growth parameters of *T. dussumieri.* The anchovies are group of small pelagic fishes. They have got a short life span and faster growth rate as evidenced from above findings. In present study t_0 was estimated to be 0.0048 year by VBGF plot. Mahajan (1983) reported age at length zero (t_0) to be 0.0185 year for *T. dussumieri* along the Ratnagiri coast of Maharashtra. Kende (2016) reported t_0 for *T. mystax* to be -0.0036 year along the Ratnagiri coast. The t_0 has got smaller positive or usually smaller negative value.

In present study, it was found that *T. dussumieri* attains a length of 74 mm, 117 mm, 156 mm and 165 cm at the end of six months, one year, two years and two and half years respectively (Figure 2). It is seen that growth slows down in *T. dussumieri* with age. The maximum length recorded during the study period was 169 cm at an estimated age of 2.9 years. The growth

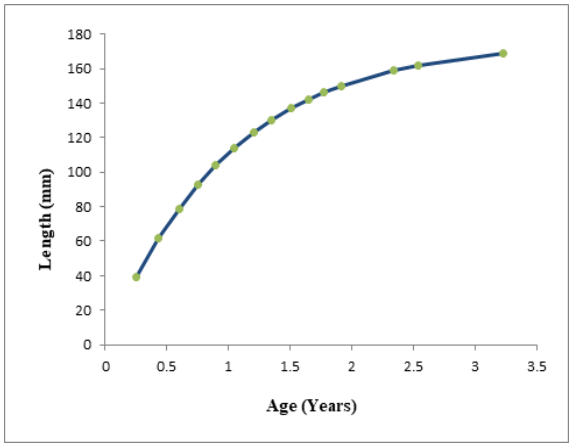

Figure 2. Growth curve (Length at age for *T. dussumieri*).

of *T. dussumieri* has not been previously reported along the Indian coast. Based on the length frequency study of *T. mystax* along Calicut coast, Venkataraman (1956) reported that *T. mystax* grows to a size of 155 mm and 185 mm at the end of first and second year respectively. The growth was relatively very slow during the second year. Along the Ratnagiri coast *T. mystax* attains size of 109 mm, 154 mm, 178 mm and 205 mm at the end of six, twelve, sixteen and twenty months respectively (Kende, 2016). The growth rate and size reached at the end of particular time period depends upon factors such as favourable environment and food availability to name a few. Similarly, growth is also noted to vary between similar species and also within the same species at different regions.

Mortality parameters

The total mortality coefficient (Z) estimated by length converted catch curve is found to be 8.52 per year (Figure 3) and by Jones and van Zalinge to be 8.21 per year (Figure 4) in the present study. For further estimates, the 'Z' obtained by length converted catch curve was considered, as it is one of the most widely used method in tropics. The value of Z estimated for *T. dussumieri* in present study is on higher side as compared to the findings of other workers for different species of Thryssa. The high rate of mortality may perhaps be due to increased annual effort expended on the species during the study period. Mualeque and Santos (2011) estimated the mortality parameters of *T. vitrirostris* along the coast of Safala Bank, Western Indian Ocean. The total mortality coefficient (Z) was estimated by using length-converted catch curve method and found

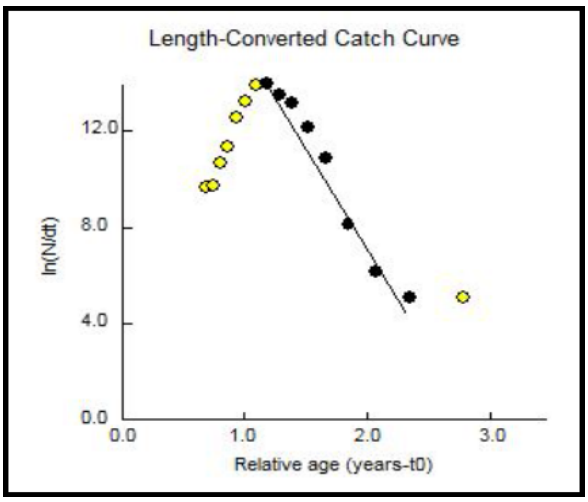

Figure 3. Total mortality coefficient by length converted catch curve.

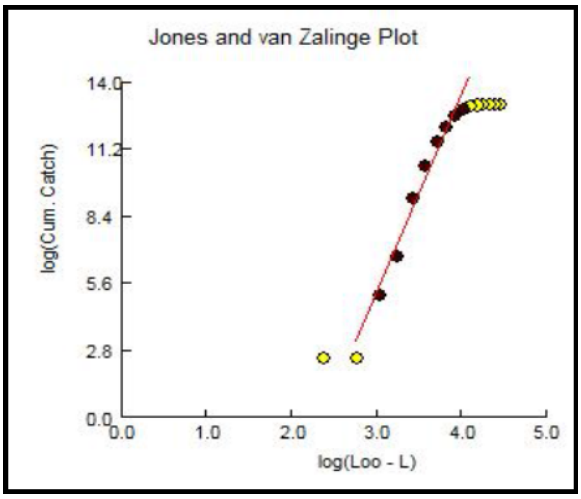

Figure 4. Total mortality coefficient by Jones and van Zalinge plo

to be 2.3 per year. The total mortality coefficient for *T. mystax* was reported to be 5.72 per year and 5.58 per year by length converted catch curve and Jones and van Zalinge method respectively (Kende 2016). Z/K =1 is considered as a thumb rule for a stock to be growth dominated. Whereas, if it is more than 2, it is considered as mortality dominated. Z/K was found to be 7.74 for *T. dussumieri* in the present study indicating the stock of the species as highly mortality dominated.

The natural mortality coefficient (M) is estimated to be 1.7, 2.24 and 1.2 per year by using Cushing's method, Pauly's Empirical Formula and Rikhter and Efanov's formula respectively. The average worked out to be 1.7, which was nearer to the estimate of 'M' by Cushing's method hence the value of 1.7 year^{-1} was used for further calculation. Mualeque and Santos (2011) estimated the natural mortality coefficient (M) for *T. vitrirostris* along the coast of Safala Bank, Western Indian Ocean to be 1.5 per year. As no earlier work on natural mortality of *T. dussumieri* was reported, the present study shows higher value of M than *T. Mystax* (1.03) along the Ratnagiri coast (Kende 2016) and *T. vitrirostris* along the coast of Safala Bank. Estimation of natural mortality coefficient remains to be a problem in tropical multispecies and multigear system as apportioning of effort is difficult. The M/K ratio which should usually fall in the range of 1.0 - 2.5 (Beverton and Holt 1959) often becomes a tool for verifying the accuracy of the estimate of natural mortality. In the present study, natural mortality (M) is estimated to be 1.7 giving M/K ratio of 1.55, which is within the range of 1.0 - 2.5 suggested for fishes.

The fishing mortality coefficient (F) was estimated to be 6.82 year^{-1}. Mualeque and Santos (2011) estimated the fishing mortality coefficient (F) to be 0.8 year^{-1} for *T. vitrirostris*. The fishing mortality for *T. mystax* was estimated to be 4.55 along the Ratnagiri coast (Kende, 2016). The exploitation of *T. dussumieri* along Ratnagiri coast is mainly by trawlers as a by-catch. The value of fishing mortality is greater than natural mortality which indicates the increased exploitation by the trawlers using cod end of smaller mesh sizes. In the present study, exploitation ratio (E) is estimated to be 0.8. As the value of exploitation ratio was greater than 0.5 it can be concluded that over exploitation of the species was observed in Ratnagiri coast. The value of E estimated in the present study is almost similar to 0.81 reported for *T. mystax* by Kende (2016). There is urgent need to reduce the fishing efforts from present level to an optimum level of 0.5. As there is no directed fishery for this stock, implementation of such a suggestion may not be practically possible.

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