

Short Communication

Investigations on the age, growth and mortality parameters of Kawakawa, *Euthynnus affinis* (Cantor, 1849) from the North west coast of India

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Abstract: Kawakawa, *Euthynnus affinis* contributes to the tune of 35,466 tonnes forming 1% to the total marine fish landings of India. Investigations on growth and mortality were of this species carried out based on the length frequency data during 2008-2012. The length-weight relationship for the pooled samples were derived for intercept $a=0.0286$, slope $b=2.857$ and coefficient of determination $r^2=0.917$. The values obtained for growth parameters of L_∞ was 67.86 cm, for growth coefficient (K) 0.70 and for t_0 $-0.26y^{-1}$. The natural, total and fishing mortalities recorded as 0.86, 1.48 and 0.62 y^{-1} , respectively. The exploitation ratio (F/Z) was observed as 0.42. The M/K ratio was estimated at 1.23. The average fork length of 46 cm and weight of 2024 g were estimated in the samples collected. The length at the end of 1st year to 5th year was observed to be 33, 52, 64, 70 and 75 cm, respectively. The fishing mortality derived in this study is more than the optimum and limit value indicated the sign of overexploitation.

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Introduction

Among the neritic tunas occurring along the Indian coastal waters, the Kawakawa, *Euthynnus affinis* is one of the dominant species. Though, this species is reported to be distributed in the Indo-Pacific region (Froese and Pauly, 2007), India's contribution was estimated to the tune of 35,466 tonnes forming 1% to the total marine fish landings of India (CMFRI, 2017). These estimates are almost closer to the revalidated potential estimates of this species which is 38646 tonnes (MOA, 2011). As per FAO (2017), the Kawakawa contribution in the world oceans was 3,68,978 tonnes during 2015.

The parameters of age, growth, and mortality are essential for deriving the strategies for sustainable exploitation. As per the literature, considerable investigations have been carried out by Pauline and Janaka (1991) on the assessment of this species along the west coast of Sri Lanka, Ahmed et al. (2015) on fishery, bionomics, seasonal elemental variations, health risk assessment and conservational

management from Karachi Waters, Ahmed et al. (2016) on the growth parameters along the Pakistan coast of Arabian Sea, Johnson and Tamatamah (2013) from the coastal waters of Tanzania, Al-Zibdah and Odat (2007) from the Gulf of Aqaba, Red Sea, Valeiras et al. (2008) from the Western Mediterranean Sea. In Indian waters, these studies are limited rather scanty in recent years except the works of Kasim and Abdussamad (2003) and Khan and Zafar (2004) from the Maharashtra coast and Rohit et al. (2012) from Indian waters. Further, the studies on population characteristics in the North west coast of India have been found to be inadequate and hence, these investigations are carried out so as to understand and monitor the changes in the population characteristics.

Materials and Methods

The specimens of *E. affinis* were collected from commercial landings at Porbandar in Gujarat, Sassoon Dock and Ferry Wharf, Mumbai in Maharashtra, during 2008-12. The area chosen for collection of

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samples in different landings centres occurring on the Northwest coast of India is shown in Figure 1. A total of 958 specimens with the size ranging 32-64 cm and weight ranging from 0.642-3.70 kg were considered for this study.

The formula $W=aL^b$ was used to calculate the statistical relationship between length and weight. The mathematical model of von Bertalanffy equation $L(t)=L\infty[1-e^{-K(t-t_0)}]$ was applied to derive the growth parameters, where, $L(t)$ is the length of fish at time 't', $L\infty$ is the asymptotic length that the fish will achieve, K is the growth coefficient, t_0 is the time at which the fish had zero length. A popular technique of computer analysis of monthly length frequency distributions. FiSAT-II software programme developed by Gayanilo et al. (2005) was used for estimation of growth parameters. The data was grouped on monthly intervals and used for the estimation of age and growth parameters by adopting Model Progression Analysis (MPA). The total mortality (Z) was estimated using Beverton and Holt model (1956). The growth performance index was drawn through the Phi Prime test (Φ) by applying the equation $\ln K+2*\ln L\infty$ to evaluate the reliability the equation.

Results

Length weight relationships: The mean fork length of 46 cm and weight of 2024 g were observed in the samples collected for the pooled data during 2008-2012. The length weight relationship was estimated as $W=2.860x10^{-2}FL^{2.8577}$ (r^2 : 0.92). The value of 'b' is 2.86 which is close to the value of 3 indicating isometric growth. Slight difference in value of 'b' in the present case could be more related to the absence of younger juvenile specimens. The coefficient of determination ' r^2 ' value is 0.92 which is indicative of high degree of correlation and better fit of length weight relationship. A graphical representation of length-weight relationship of *E. affinis* is given in Figure 2.

Growth parameters and mortality: The growth parameters $L\infty$, K value and t_0 were estimated as 67.86 cm, 0.70 and -0.26, respectively (Fig. 3). The Growth performance index was derived based on

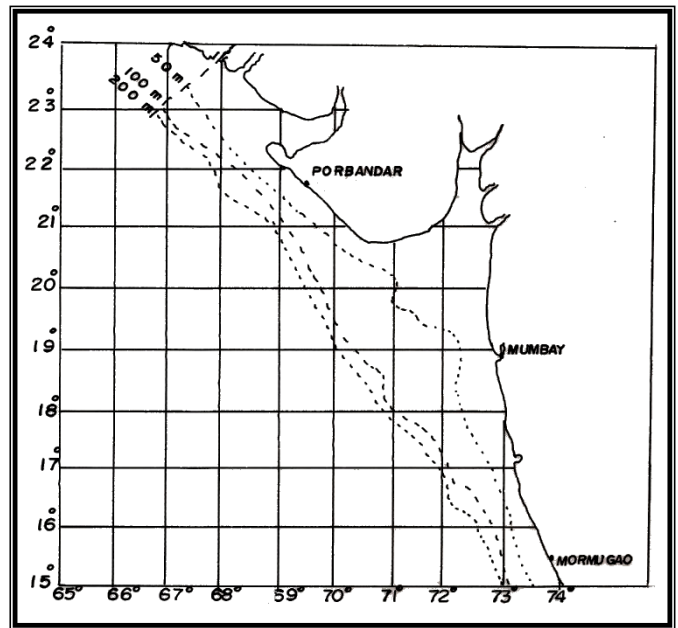


Figure 1. The North-west coast of Indian EEZ.

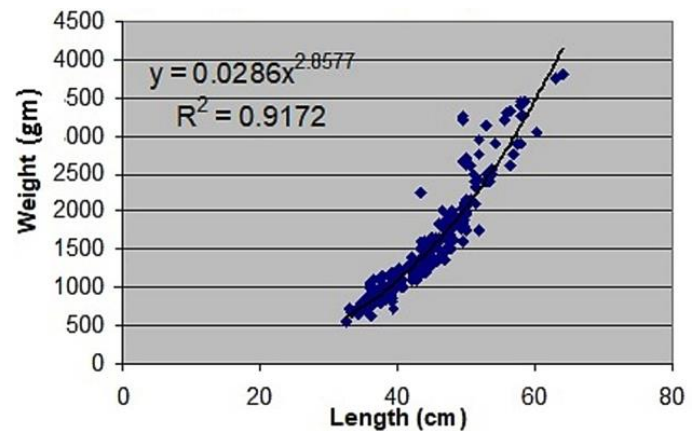


Figure 2. Graphical presentation of Length-weight relationship for *Euthynnus affinis*.

growth parameters in the present study, the Phi Prime Test (Φ) developed by Munro and Pauly (1983) and Pauly and Munro (1984) was applied to understand the reliability, evaluate the growth parameters and compare with earlier studies.

The length at age revealed that, this species attains length at the end of 1st year to 5th year observed to be 33, 52, 64, 70 and 75 cm, respectively. Sustainance of this fishery was observed for 1 to 3 years at the size range of 33-64 cm. The natural mortality (M) was recorded as $0.86\ y^{-1}$, total mortality (Z) was $1.48\ y^{-1}$ and fishing mortality ($F=Z-M$) was $0.62\ y^{-1}$. The exploitation ratio (F/Z) was observed as 0.42. M/K ratio was estimated at 1.23. The maximum yield per

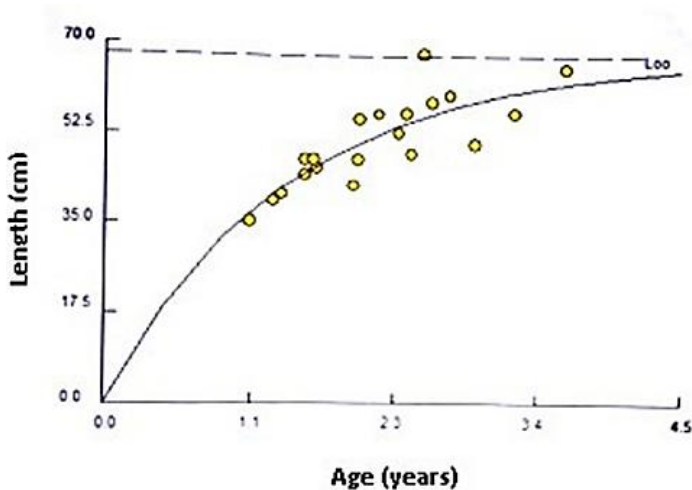


Figure 3. Graphical presentation of length-at-age for *Euthynnus affinis*.

recruit obtained at the exploitation rate of 0.42 y^{-1} at mid class length of 46 cm. The assessment of resource status revealed that the fishing mortality at 0.62 y^{-1} is more than the targeted optimum fishing mortality (F_{opt}) which is 0.42 y^{-1} and limit of fishing mortality ($F_{\text{limit}}=0.58 \text{ y}^{-1}$) as per the biological reference point of view. These results indicating that this species is showing the sign of overexploitation.

Discussion

The investigations on the length-weight relationship would help in understanding the species habitat condition, history of reproductive behaviour, life cycle and health of the fish species (Froes, 2006; Froese et al., 2011). In the present study, the value of 'b' is 2.86 which is very similar to the value obtained by Kaymaram and Darvishi (2012) wherein the value of 'b' derived was 2.87 for the pooled samples from the Northern part of Persian Gulf and Oman and defined that this species is showing isometric growth which is in confirmative with the present study.

The growth parameters L_{∞} (asymptotic length) derived was 67.86 cm; K (Growth coefficient) was 0.70 y^{-1} and t_0 was -0.26 y^{-1} in the present investigation. The results derived by Ahmed et al. (2016) from the offshore waters of Pakistan Coast in the Arabian Sea for L_{∞} was 67.10 cm which is similar to present study. Whereas K (1.049 y^{-1}) and t_0 (-0.84

y^{-1}) values are showing significant difference. Phi Prime value (Φ) derived by Ahmed et al. (2016) was 3.67 from the offshore waters of Pakistan Coast of Arabian Sea, whereas in the present study, the value obtained was 3.52. It is evident that the value does not show any significant difference.

Rohit et al. (2012) from Indian waters derived total mortality (Z) value of 1.68 y^{-1} , fishing mortality (F) 0.75 y^{-1} , natural mortality (M) 0.93 y^{-1} and exploitation ratio 0.36 y^{-1} . The values obtained in the present study are 1.48 y^{-1} , 0.62 y^{-1} , 0.86 y^{-1} and 0.42 y^{-1} , respectively. These values are closer to the values of Rohit et al. (2012). The exploitation rate obtained this study (0.42 y^{-1}) at 46 cm mid class length. These results are almost similar to the results of Johnson and Tamatamah (2013) from coastal waters of Tanzania.

The fishing mortality derived in this study is more than the optimum and limit value indicated the sign of overexploitation. Periodic assessments, monitoring of characteristics of each fishery is essential to evolve strategies for sustainable harvest, conservation and management of the fishery. This study may help planners and policy makers to take appropriate measures required to be addressed to minimise the exploitation levels. Therefore, it is necessary to bring out proper management strategies to sustain this resource in North-west coast of India so as to meet the food requirement for growing human population of the country.

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