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GROWTH PARAMETERS OF *LEPTURACANTHUS SAVALA* (CUVIER, 1829) FROM MUMBAI WATERS

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ABSTRACT

***Lepturacanthus savala* (Cuvier, 1829) constitutes a minor fishery contributing 23.3% to the total ribbonfish catch in Maharashtra. Based on the length data obtained from shrimp trawlers and the traditionally operated bag nets, age and growth of the species have been investigated from Mumbai waters. Growth was studied by various computer-based methods incorporated in FiSAT Programme. The growth parameters L_∞ and K (on annual basis) by Gulland-Holt plot were 683.3 mm and 0.87, respectively. As the seasonal temperature variations in coastal waters of Mumbai are not pronounced, the seasonally oscillating growth patterns by ELEFAN and Appledoorn's method were not considered. Following the von Bertalanffy growth model, the fish attains 399.8, 567.2 and 637.4 mm at the end of 1, 2 and 3 years, respectively, and the lifespan of the fish is about 3.3 years.**

Key words: *Lepturacanthus savala*, growth parameters, Mumbai waters

INTRODUCTION

Ribbonfishes constitute an important pelagic resource, ranking fifth among the finfishes and seventh in the various groups of marine fish resources landed in India (CMFRI, 2000). In Maharashtra with an annual average production of about 27,000t, the resource is supported by four species, among which *Lepturacanthus savala* (Cuvier, 1829) is an important species contributing 23.3% to the total ribbonfish catch, next to *Trichiurus lepturus*, the commercially dominant species in the state (Rizvi, 2001).

Investigations on age and growth play a very important role in the resource management as the sustaining capacity of a fish stock can be ascertained by understanding age and growth (Gulland, 1983); this is so because the faster growing fish can withstand intensive fishing than the slow growing ones by its ability for faster recuperation. In the absence of annual rings on the hard parts of the fish, several length-based methods wherein basic requirement is the length-frequency data. Several length based methods are available

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for the estimation of widely used von Bertalanffy growth (VBG) parameters of tropical fishes (Sparre and Venema, 1998). These methods (Gulland and Holt, 1959; Faben, 1965; Pauly and David, 1981; Appledoorn, 1987) which have been incorporated in computer programmes for the estimation of VBG parameters, have been attempted in the present investigation on age and growth of *L. savala* in Mumbai waters.

A good number of studies have been made on the age and growth of ribbonfishes from of the Indian waters, particularly on *T. lepturus* from both the east and west coasts of India (Prabhu, 1955; James, 1967; Narasimham, 1976; Somavanshi and Joseph, 1989; Chakraborty, 1990). A review of age and growth of ribbonfishes from Indian waters has been given by James *et al.* (1986). However, excepting for one such study on *L. savala* from the east coast (Gupta, 1967), there is no work reported from India. Present investigation, therefore, relates to the age and growth of *L. savala* from Mumbai waters.

MATERIAL AND METHODS

Length measurements of *L. savala* were taken from the random samples collected weekly from August 1997 to July 1999 from the catch landed by trawlers at New Ferry Wharf and Versova landing centres. In addition, data were also collected from the traditionally operated bag nets at Vasai and Versova centres. For length frequency study, total lengths of fish from the tip of the snout to the end of the tail were measured and the specimens suspected to have broken tail were discarded. The samples were weighed and the length measurements were distributed in 20-mm class intervals. The size-frequencies were raised to the catch of the species landed on the days of observations and subsequently for the monthly catch.

Growth of the species was studied following von Bertalanffy growth model (VBGF) in which the parameters L_∞ and K were estimated employing the following methods, which are incorporated in the FiSAT computer programme developed by Gayanilo *et al.* (1996). However, the parameter t_0 was not estimated; it was considered zero since it has little biological significance (Sparre and Venema, 1998). ELEFAN programme developed by Pauly and David (1981) was used for the studies. Bhattacharya (1967) method was used for resolving multi-modal monthly size distribution into mean sizes and their standard deviations. This method after linking the monthly mean sizes gave preliminary estimates of the VBGF parameters. The same data were subsequently used for the Gulland and Holt (1959) plot, Faben's (1965) method, and Appledoorn's (1987) method to get the VBGF parameters.

RESULTS

During the two-year period, a total of 7352 specimens in the length range 75-650 mm were measured for the length frequency analysis. The length-frequency data were available for all the months excepting July 1998.

ELEFAN

The monthwise length frequency restructured by ELEFAN is presented in Fig. 1. With the starting sample of November 1998 and the starting length of 460.5 mm, the parameters of the growth curve are: $L\infty = 687.6$ mm and $K = 0.83$ per year with the best possible 'Rn' value of 0.122.

The Gulland-Holt Plot

Linking of the mean lengths obtained by the Bhattacharya method is shown in Fig. 2. It is seen that seven curves could be obtained, which gave the following preliminary estimates:

$$L\infty = 683.3 \text{ mm}, K = 0.86\ (r^2 = 0.51)$$

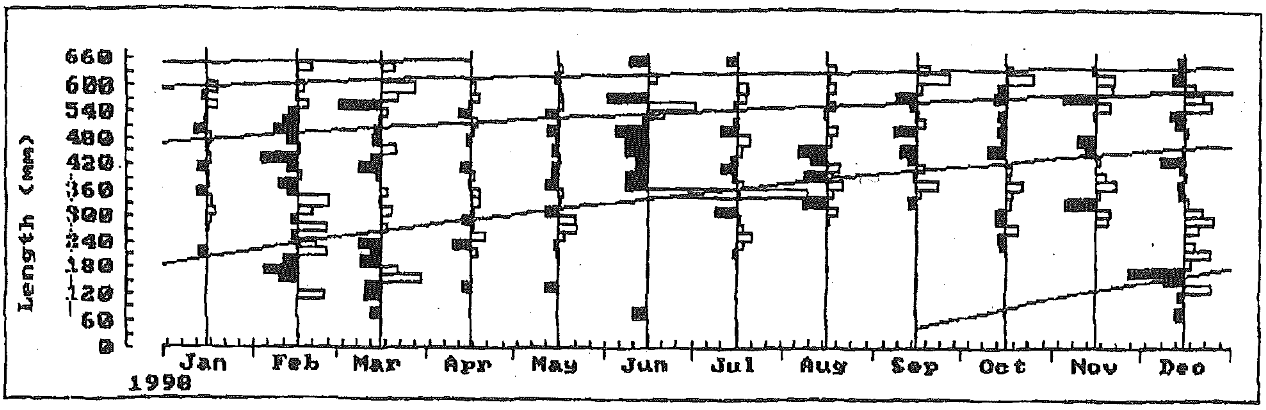

Fig. 1. Restructured length-frequency and growth of Lepturacanthus savala *by ELEFAN*

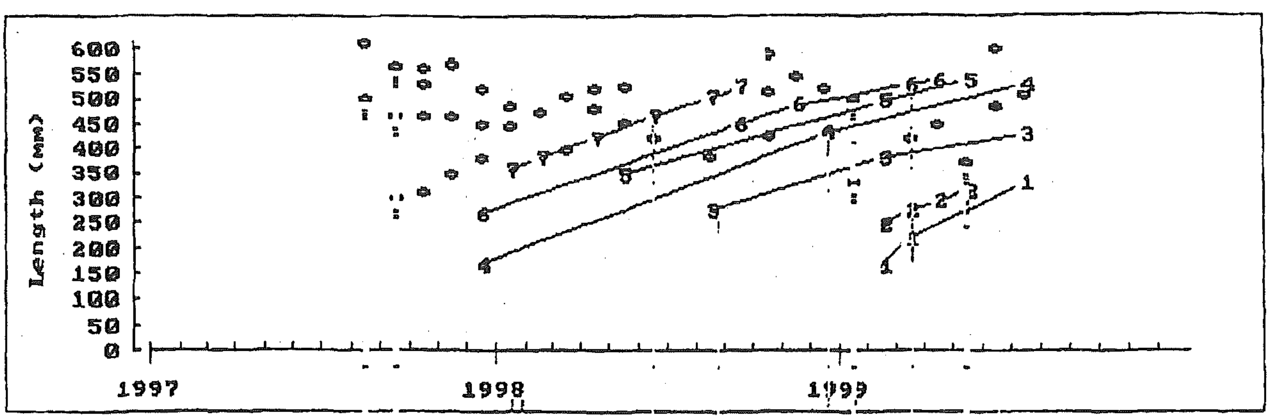

Fig. 2. Linking of monthwise mean sizes obtained by Bhattacharya method and preliminary estimates of growth parameters of Lepturacanthus savala

The linking of mean lengths created a growth increment file that was used further by the following methods to obtain the parameters and their statistic. The regression of mean lengths (L) and the growth increments (dL/dt) formed the basis of the Gulland-Holt plot (Fig. 3). On refinement, the parameters obtained by the plot were: L_∞ = 688.02 mm and annual K = 0.87 (r = 0.71). The method gave the best possible correlation coefficient (r=0.71).

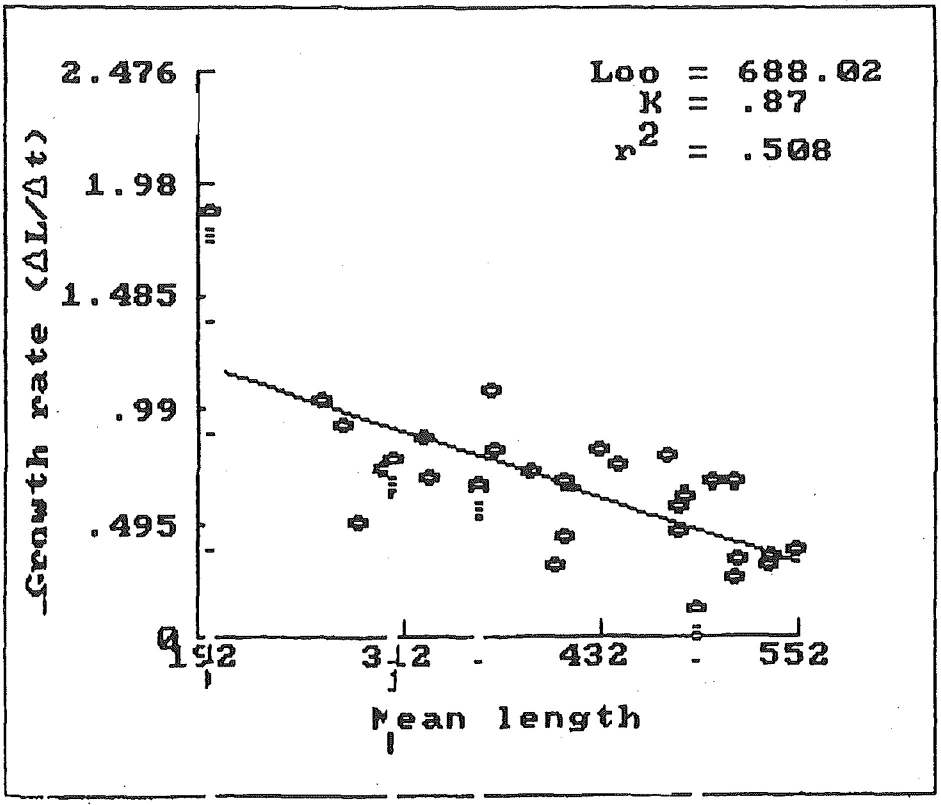

Fig. 3. Gulland-Holt plot of Lepturacanthus savala

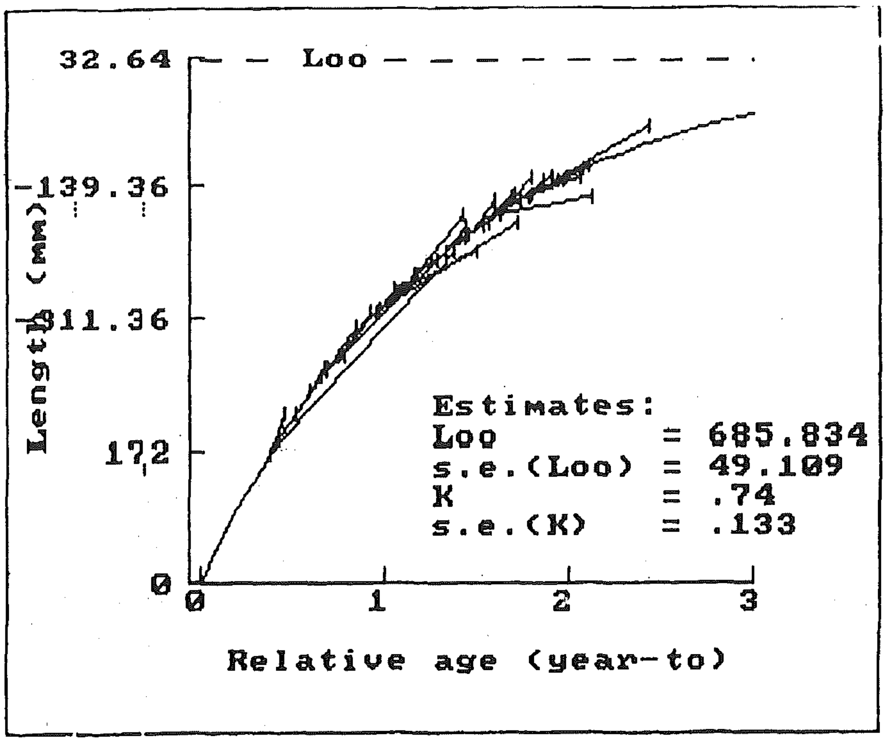

Fig. 4. Growth parameters of Lepturacanthus savala *by Faben's method*

Faben's Method

The growth curve obtained by this method is given in Fig. 4. The method gave the estimates of L_∞ as 685.8 ± 49.11 mm and K as 0.74 ± 0.13 on an annual basis along with their standard errors (s.e.).

Appledoorn's Method

The growth curve obtained by this method is presented in Fig. 5, which in addition to the standard errors of the estimates, gave seasonality parameters such as wintering point (WP) and C as defined and discussed by Longhurst and Pauly (1987). The growth parameters and the associated statistic of the species are as follows:

L_∞ ± s.e. (mm)	: 681.38 ± 40.65
K ± s.e. (annual)	: 0.72 ± 0.11
WP ± s.e.	: 0.11 ± 0.04
C ± s.e.	: 0.45± 0.17

Length at Age

Growth parameters of *L. savala* estimated by different methods are given in Table 1. It is seen that all the four methods yielded length asymptotes (L_∞) in the close range of 683.3-688.02 mm, but the growth coefficient (K) varied from 0.72 by Appledoorn's method to 0.87 by Gulland-Holt plot. Appledoorn's method was not considered as the seasonality parameters were not applicable on account of the more or less uniform temperature regime in Mumbai waters (Bapat *et al.*, 1982). The Gulland-Holt plot showed the best correlation for the mean lengths and the growth increments (correlation coefficient, r = 0.71). Therefore, growth parameters with L_∞ of 688 mm and K of 0.87 were considered for the estimations of age and growth. The VBG expressions of growth by various methods for the species can be given as: $L_t = 688\ [1-e^{-0.87*t}]$

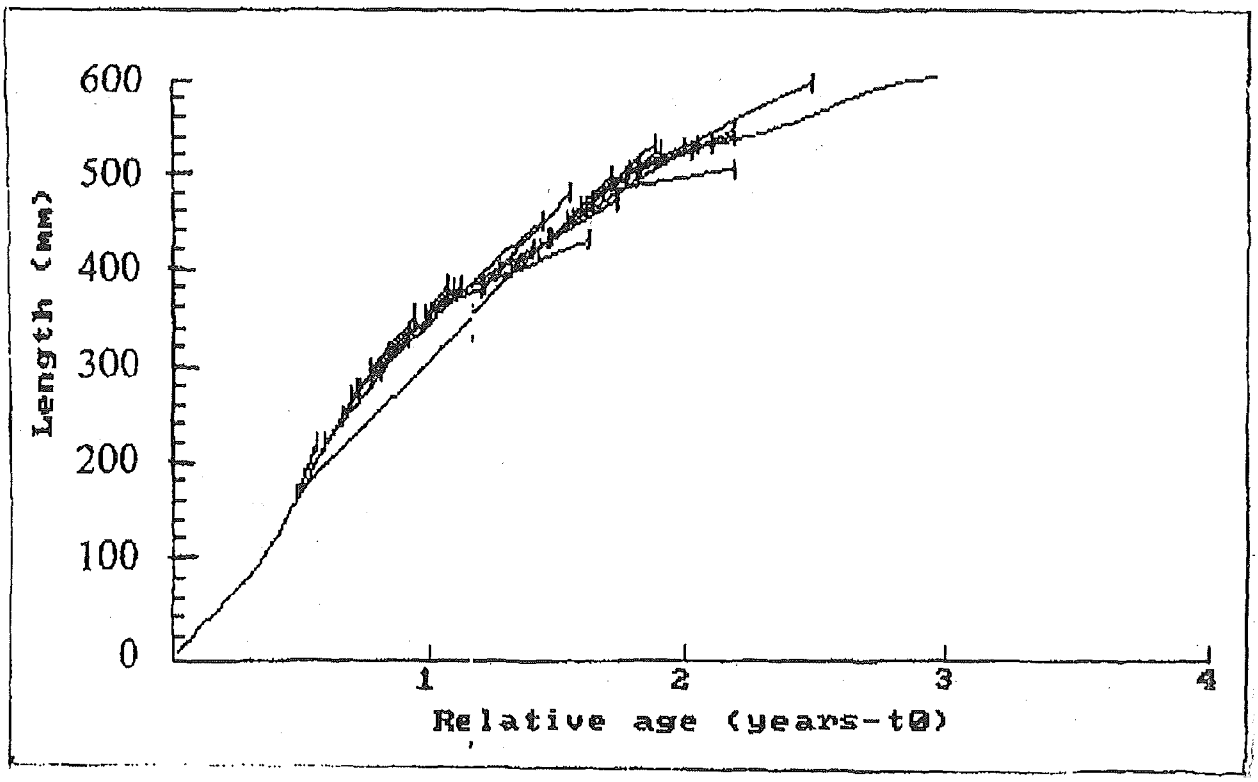

Fig. 5. Growth parameters of Lepturacanthus savala *by Appledoorn's method*

Table 1: Growth parameters of *Lepturacanthus savala* by different methods

Method	L_∞ (mm)	K (annual)	'Rn' or 'r'
ELEFAN	687.6	0.83	0.122
Bhattacharya method and preliminary estimates	683.3	0.86	0.51
Gulland-Holt plot	688.02	0.87	0.71
Faben's method	685.8 ± 49.11	0.74 ± 0.13	—
Appledoorn's method	681.38 ± 40.65 WP = 0.11 ± 0.04	0.72 ± 0.11 C = 0.45 ± 0.17	—

From the VBGF expression, it is found that *L. savala* grows to the size of 399.8, 567.2 and 637.4 mm at the end of 1, 2 and 3 years. During the study, the largest specimen measured 650 mm, so the calculated age for the size is 3.3 years.

DISCUSSION

James *et al.* (1986) commented that the growth of *L. savala* reported by Gupta (1967) was very slow and therefore, called for more information on the age and growth of the species. Gupta (1967) used Cassie's (1954) probability plot method and identified modal sizes as 155.3, 193.6, 250.1, 320.7, 380.1 and 430.9 mm, and assigned them age 1-6 at yearly intervals. Further, by employing the Ford-Walford plot, he estimated growth parameters of the species as L_∞ = 1057.14 mm, K= 0.0887 per annum and t_0= -0.03953 years. However, from the same growth parameters, the total lengths work out to 93.1, 174.9 and 249.8 mm for 1, 2 and 3 years, respectively, which is contradictory to his presumption. It is obvious that the modal sizes might be at half-yearly intervals, rather than annual. Owing to these half-yearly intervals, the growth of *L. savala* estimated by Gupta (1967) appears to be far slower than in the present investigation.

It has been observed that most of the earlier workers followed growth patterns of tropical fishes similar to those exhibited in the temperate water fishes and obtained the VBG parameters, which gave far slower growth. But, Longhurst and Pauly (1987) and several other researchers have commented that tropical fishes grow far more rapidly with much shorter life span than those reported earlier. This is evident in the case of *T. lepturus* for which studies have been reported from different parts of the world. It was seen that the growth coefficient (K) estimated by earlier workers (Misu, 1964; Tsukahara, 1964; Hamada, 1971; Narasimham, 1976) was in the range 0.14 to 0.41, while that reported later on by Ingles and Pauly (1984), Somavanshi and Joseph (1989), and Thiagarajan *et al.* (1992) was in the range of 0.56 to 0.64 per year.

Beverton and Holt (1959) pointed out that two parameters of growth, asymptotic length ($L\infty$) and growth coefficient (K) are inversely related, which implies that fishes with high $L\infty$ had lower K, while those with lower $L\infty$ had higher K. Consequently, those with longer life-span had lower K and *vice versa*. The widely investigated *T. lepturus* is relatively a large-sized ribbonfish growing to more that 1200 mm (Thiagarajan *et al.*, 1992), while *L. savala* grows to about 650 mm. Therefore, the growth coefficient of *L. savala* should be higher than 0.62 reported by Thiagarajan *et al.* (1992) for *T. lepturus*.

James *et al.* (1986) in a review pointed out that *T. lepturus* grows faster than other ribbonfishes, and the largest specimen measuring 115 cm in total length in commercial landings of Kakinada (Narasimham, 1976) was considered to be five years old. Lifespan of *L. savala* estimated from the maximum size (650 mm) observed in the present study worked out to 3.3 years, which is less than that of *T. lepturus*. Therefore, growth coefficient of *L. savala* obtained in the present study as 0.87 per year is more realistic than that reported by Gupta (1967).

James (1967) reported age and growth of a related species, *Eupleugrammus intermedius* from Rameswaram waters, east coast of India. From the otolith and length-frequency studies he found that *E. intermedius* attains 21.1 cm (standard length) at the end of the first year, 33.9 cm at the end of the second year and 42.9 cm at the end of the third year. He further opined that the lifespan of *E. intermedius* is about four years, and presuming the same rate of growth and the maximum size of *L. savala* (standard length 564 mm), he remarked that the two species have lifespan of at least four years, if not more. In the present study, the maximum size of *L. savala* in total length was 650 mm (standard length 542 mm), which is estimated to be 3.3 years old. Thus, the present investigation conforms to the remarks made by James (1967) on the species.

In the present investigation, all the four methods yielded length asymptotes in very close range of 683.3-688.02 mm. But, the growth coefficient (K) differed widely from 0.74-0.87. Bapat *et al.* (1982) reported that surface temperature in Mumbai waters varied from 26 to 29° C, which is not wide enough to bring seasonal changes in the growth of the species. Therefore, Appledoorn's method that yielded growth parameters with high wintering point and oscillating seasonal growth pattern was not considered. The parameters obtained by the Gulland-Holt plot were reasonably good and also within the 95% confidence limits of Faben's method. Thus, parameters obtained by the Gulland-Holt plot are appropriate and therefore, considered for describing the growth of the species.

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