Note

Age, growth and mortality of karut croaker *Johnius carutta* Bloch, 1794 off Visakhapatnam, south-east coast of India

M. SWAMY KUMAR, G. RAJESWARI, K. SREERAMULU* AND B. KISHORE*

Research Centre of Central Institute of Fisheries Technology, Pandurangapuram, Andhra University P. O. Visakhapatnam – 530 003, Andhra Pradesh, India
*Department of Zoology, Andhra University, Visakhapatnam – 530 003, Andhra Pradesh, India
e-mail: swamykumarmoka@yahoo.in

ABSTRACT

Age, growth and mortality parameters of karut croaker *Johnius carutta* were studied using the length data of 3,406 specimens ranging in length from 11 to 24.5 cm, collected from Visakhapatnam coast during January 2008 to December 2009. The von Bertalanffy growth parameters estimated were L_∞ = 26.7 cm, annual K= 0.67 y^{-1}, t_o= -0.1366 and T_{max} (longevity) = 4.3 years. Length attained by the end of the first, second, third and fourth years were estimated as 14.2, 20.3, 23.4 and 25.0 cm respectively. Natural mortality (M) was estimated as 1.10, Total mortality (Z) 2.24 and fishing mortality (F) as 1.14. Exploitation rate (E) was 0.51. The growth performance index (Φ) for *J. carutta* (sexes pooled) was estimated as 2.679. The fishery was largely (91%) supported by first and second year age groups which are within the length groups from 13.5 to 18.9 cm.

Keywords: Age, Asymptotic length, Growth coefficient, *Johnius carutta,* Mortality, Sciaenids, Visakhapatnam

Sciaenids or croakers constituted 4.5% of the total demersal finfish production (25.5%) from Andhra Pradesh during 2000-06 (Rao *et al.,* 2008). The karut croaker *Johnius carutta*, is one of the common commercially important sciaenid landed at Visakhapatnam. This fish is available at affordable price and has good demand in the local markets, particularly among the lower middle income group. Since sciaenids are bottom resources, demersal trawls are the principal gears used for harvesting. During 2000-06, croakers contributed 5.7% of the total demersal trawl catch (29.7%) landed at Visakhapatnam (Rao *et al.,* 2008).

Age, growth and mortality parameters of different species of the family Sciaenidae have been investigated by different authors from east and west coast of India. Review of literature on age, growth and mortality in respect of *J. carutta* reveals that all these aspects have been studied sporadically from different regions along the east coast of India by Vivekanandan (1985) from Madras, Murty (1986) from Kakinada, Rao *et al.* (1992) from Andhra Pradesh as well as Tamilnadu, Chakraborty *et al.* (2000), Rajkumar *et al.* (2004) from Visakhapatnam and Bhuyan *et al.* (2012) from Paradeep. Recently, Swamy Kumar *et al.* (2014) studied the length-weight relationship of *J. carutta* from Visakhapatnam coast. The present study

was conducted using a total number of 3406 samples of *J. carutta* collected weekly from the catches of experimental demersal fishing operations of the departmental research vessel CIFTECH-1 and also from the landings of commercial mechanised trawlers operating from Visakhapatnam Fishing Harbour during the period from January 2008 to December 2009. Fishing operations were mostly within 35-40 m depth off Visakhapatnam between lat. 17˚10ˈ to 18˚10ˈ N and long. 82˚50ˈ to 84˚10ˈ E.

Growth parameters *viz*., asymptotic length (L_∞) and annual growth coefficient (K) were estimated using the ELEFAN I module of FiSAT software and the Powell-Wetherall plot (Gayanilo *et al.,* 1996). The von Bertalanffy's (1938) equation was used to describe the growth. The length based growth performance index (Φ) was calculated as in Pauly and Munro (1984) and the age at zero length was estimated from Pauly's empirical equation (Pauly, 1979). Lifespan (T_{max}) was estimated from Pauly's equation (Pauly, 1983a). Natural mortality (M) was calculated by Pauly's empirical formula (Pauly, 1983b) and total mortality (Z) from length converted catch curve (Pauly, 1983b). Fishing mortality (F) was estimated as: F = Z - M and exploitation rate (E) as: E = F / Z.

The total length of males ranged from 11.0 to 23.6 cm and that of females from 11.6 to 24.5 cm. Monthly length frequency distribution of different size groups of both males and females of *J. carutta* and that of sexes pooled are given in Fig. 1. The fishery of *J. carutta* was largely supported by first and second year age groups which are within the length groups ranging from 13.5 to 18.9 cm with mean length class of 16.52 cm and modal class of 16.0-17.9 cm. Males were supported by the length groups ranging from 13.0 to 18.4 cm with mean length of 16.19 cm and modal classes of 15.0-16.9 cm ; females were supported by 13.5 to 19.9 cm length groups with mean length of 16.86 and modal classes of 16.0-17.9 cm (Fig. 1). The maximum size (24.5 cm) observed in the present study are comparable with the earlier findings reported by Murthy (1986) from Kakinada (25.5 cm) and Vivekanandan (1985) from Madras (25.8 cm), indicating that the fishery has not undergone much change along the east coast, in terms of length distribution.
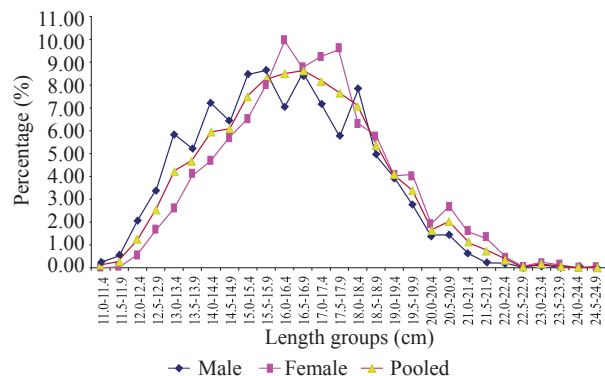

Fig. 1. Percentage frequency distribution of different length groups of male, female and pooled sexes of *J. carutta*

Growth parameters estimated for *J. carutta* in the present study were L_∞= 26.7 cm, K = 0.67 y^{-1} and t_o = -0.1366 years (Fig. 2). Thus, the VBGF for *J. carutta* can be written as: L_t= 26.7 [1- exp $^{-0.67(t+-0.1366)}$]. The growth parameters estimated in the present study and those estimated earlier from Madras, Kakinada, Visakhapatnam, Paradeep, Andhra Pradesh and Tamil Nadu are comparable. Since sex-wise growth parameters were not available for *J. carutta,* pooled parameters are compared with results available from literature. The growth rate (0.67 y^{-1}) estimated in the present study is faster compared to the growth rate estimated by Murthy (1986) from Kakinada (0.32) and slower compared to the growth rate estimated by Bhuyan *et al.* (2012) from Paradeep (0.84).

The longevity (T $_{max}$) of *J. carutta* estimated by Pauly's (1983a) method was 4.3 years. The length attained by the fish at the end of first, second, third and
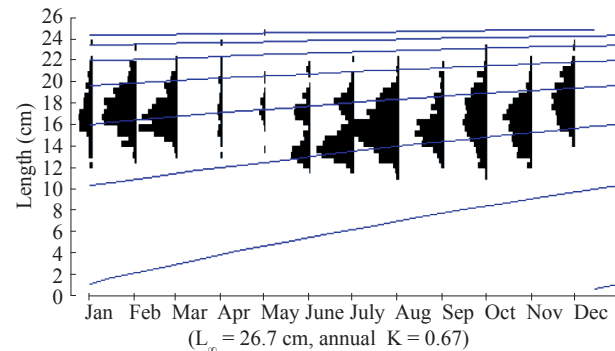

(L_∞ = 26.7 cm, annual K = 0.67)

Fig. 2. von Bertalanffy growth plot of *J. carutta*

fourth year of its life was estimated as 14.2, 20.3, 23.4 and 25.0 cm respectively. *J. carutta* attained sexual maturity in the second year at 17.7 cm, corresponding to 1.5 years (18 months) of age. Growth was rapid during the initial two years and then declined during the remaining two years. The growth performance index (Φ) of *J. carutta* estimated using length frequency data was 2.679. The (Φ) value in the present study is similar to the values of other studies from different regions which ranged from 2.451 to 2.90 (Table 1).

Natural mortality (M) was estimated as 1.10, total mortality (Z) 2.24 and fishing mortality as 1.14 (Fig. 3 and Table 1). The M/K ratio should lie in the range of 1.0-2.5 **(**Beverton and Holt, 1959). The ratio between estimated M (1.10) and K (0.67/year) value of *J. carutta* in the present study was estimated as 1 which falls within this range. The exploitation rate (E) was estimated as 0.51 and exploitation maximum (E_{max}) was 0.648. The E value (0.51) was less than the E_{max} (0.648) indicating a healthy stock condition.

Sciaenids are one of the major demersal resources landed as bycatch of shrimp trawlers (Chakraborty, 2001). Sciaenids being bottom feeders, form an eco-group along with shrimps and are unavoidably under fishing pressure.
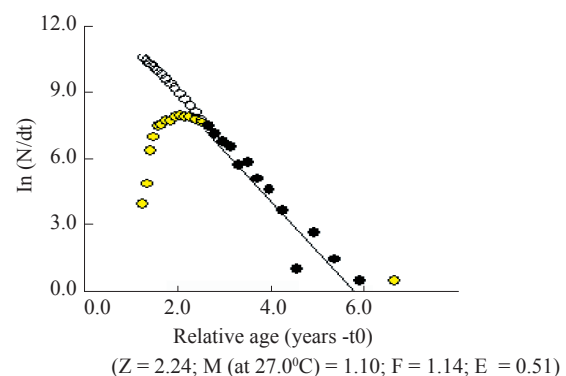

(Z = 2.24; M (at 27.0⁰C) = 1.10; F = 1.14; E = 0.51)

Fig. 3. Length-converted catch curve of *J. carutta*

Table 1. Age, growth and mortality of *J. carutta* from different parts of Indian coast

L∞ (cm)	K (ann.)	t_0	Φ	M	Z	F	E	Length (cm) at the end of				Place/Area	Author
								1st year	2nd year	3rd year	4th year		
25.90	0.73	0.281	2.687	-	-	-	-	10.5	18.5	22.3	-	Madras	Vivekanandan (1985)
33.33	0.44	-0.0002	2.689	1	5.07	4.07	-	11.9	19.5	24.4	27.6	Kakinada	Murty (1986)
29.33	0.51	-	2.642	1.5	2.9342	2.1692	0.7393	12.0	18.9	23.1	-	Tamil Nadu	Rao *et al.*(1992)
29.33	0.51	-	2.642	2	2.8376	1.8173	0.6023	-	-	-	-	Tamil Nadu	Rao *et al.* (1992)
28.10	0.557	-	2.643	1.5	3.7033	2.8678	0.725	12.0	18.9	22.8	-	Andhra Pradesh	Rao *et al.* (1992)
28.10	0.557	-	2.643	2	3.8119	2.7009	0.6641	-	-	-	-	Andhra Pradesh	Rao *et al.* (1992)
28.10	0.557	-	2.643	1.11	3.7	2.59	0.7	-	-	-	-	Visakhapatnam	Chakraborty *et al.* (2000)
29.50	0.40	-	2.542	0.97	3.02	2.05	0.68	97.5	16.3	20.6	-	Visakhapatnam	Rajkumar *et al.* (2004)
29.70	0.32	-	2.451	0.44	2.09	1.65	0.79	-	-	-	-	Visakhapatnam	CMFRI, 2008-09.
30.50	0.84	-	2.9	-	-	-	-	-	-	-	-	Paradeep	Bhuyan *et al.* (2012)
26.70	0.67	-0.1366	2.679	1.1	2.24	1.14	0.51	14.2	20.3	23.4	25.0	Visakhapatnam	Present study

They have become one of the chief components of bycatch landed by commercial shrimp trawl operations from Visakhapatnam (Rajeswari *et al.,* 1998). The present study reveals that the exploitation level of *J. carutta* is at optimum level with some scope for increasing production. However, increasing effort to increase their production must take into account the impact of increased effort on main target species of the gear.

Acknowledgements

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