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GROWTH, MORTALITY AND EXPLOITATION OF *PRIACANTHUS HAMRUR* (FORSKAL) FROM THE NORTH EAST COAST OF INDIA

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ABSTRACT

Growth, mortality and exploitation of *Priacanthus hamrur* from the north east coast of India were studied separately for males and females from the exploratory survey data and for both the sexes combined from the commercial landings. The longevity was estimated to be eight years. The natural (M), total mortality (Z), and fishing coefficients (F), exploitation ratio (E) and exploitation rate (U) were studied. The exploitation ratio of commercial data indicated that the stocks are being exploited beyond optimum level.

INTRODUCTION

PRIACANTHUS HAMRUR (family: Priacanthidae) forms an important component of the demersal fishery resources of the shelf beyond 50 m all along the Indian coast. Age, growth and other population parameters of Priacanthid spp. of south east Asian waters were studied by Chomjurai (1970), Chomjurai and Bunnag (1970), Wetchagarun (1971), Senta (1977), Nugroho and Rustam (1983), Ingles and Pauly (1984), Leaster and Watson (1985), Joung and Chen (1992) and Liu *et al.* (1992). However, excepting that of Chakraborty (1994) from Bombay waters, very little attention was paid world-over on *P. hamrur*.

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MATERIAL AND METHODS

Length data of 4147 males and 5334 females of *P. hamrur* collected from the vessels of Fishery Survey of India and Central Institute of Fisheries Nautical Engineering and Training during 1989-93 were used in this study. Besides, the length data of 2045 specimens (both sexes pooled) collected during May 1993 from the commercial catches of small mechanised boats operating from the Visakhapatnam Fishing Harbour were also analysed separately to derive the parameters for the purpose of comparison. Modal Progression analysis was carried out to derive the length-at-age data (Pauly, 1983). Ford-Walford plot and von Bertalanffy plot were used for estimating the VBGF parameters L_∞, K and t as given in Sparre and Venema (1992). Pauly and Munro's (1984) length growth performance index PHI' (ϕ) was computed for different values of K and L_∞ and compared. Total mortality Z was calculated using catch

curve method by plotting In $\frac{N}{ot}$ against relative age, as described by Pauly (1983). Natural mortality 'M' by Pauly's empirical formula (assuming T=27 °C), longevity t_{max}, exploitation ratio E and exploitation rate U were also calculated (Pauly, 1983).

RESULTS AND DISCUSSION

The modes on the scatter diagram for males (Fig. 1) and females (Fig. 2) and repeated length frequency polygen for pooled commercial catch data (Fig. 3) were connected by eyefitted curves to obtain age-at-length data. The values of L_∞ and K obtained from Ford-Walford plot (Fig. 4) for different sets of data, the values of

Thus the VBGF for the males, females and pooled commercial catch be written as:

Male	L_t = 297.0791	$(1-e^{-0.3585}$ (t+0.0206))
Female	L_t = 300.4580	$(1-e^{-0.3826}$ (t+0.0244))
Both sexes	L_t = 283.9278	$(1-e^{-0.3722}$ (t+0.1122))

(Commercial data)

The VBGF corresponding to the weight for the above sets of data derived using the length weight relationship (Philip and Mathew, 1996) were:

Male	W_t = 318.8553	$(1-e^{0.3585\ (t+0.0206)})^3$
Female	W_t = 323.2419	$(1-e^{-0.3826\ (t+0.0244)})^3$
Both sexes	W_t = 274.2867	$(1-e^{-0.3722\ (t+0.1122)})^3$

(Commercial data)

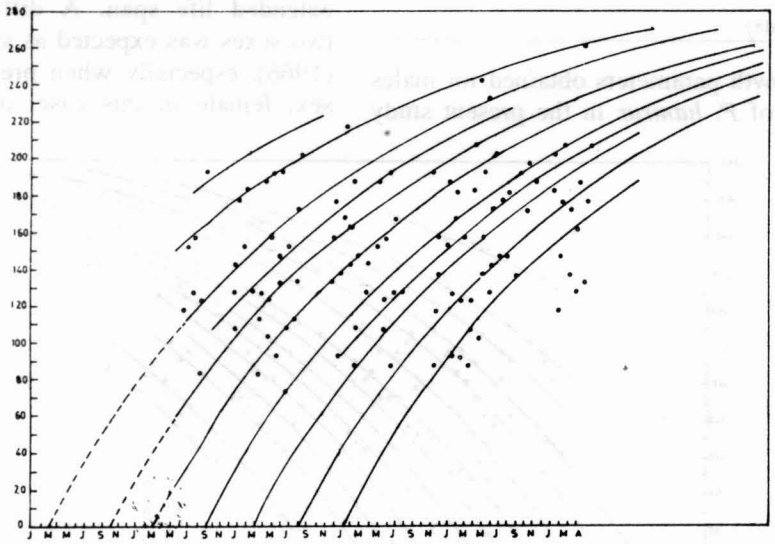

FIG. 1. Growth curves connecting the monthly modes of *Priacanthus hamrur* (male) for integrated modal progression analysis.

t_o obtained from von Bertalanffy plot (Fig. 5) and estimates of L_∞ as per Taylor's (1958) thumb rule using L_{max} were given below:

	L_∞	L_{max}	L_∞ (approx)	K/year	t_o
Male	297.0791	265.00	278.95	0.3585	-0.0206
Female	300.4580	288.00	303.16	0.3826	-0.0244
Both sexes	283.9278	262.00	275.79	0.3722	-0.1122

(Commercial data)

The longevity and Pauly and Munro's ϕ derived from the parameters for the three sets of data were:

	Longevity (t_{max})	ϕ
Male	8.37	2.5002
Female	7.84	2.5501
Both sexes	8.06	2.4772

(Commercial data)

The natural mortality M, the total mortality Z (Fig. 6) and fishing mortality F derived using Z & M were:

	M	Z	F
Male	0.9000	2.4514	1.5514
Female	0.9363	1.7686	0.8323
Both sexes (Commercial data)	0.9341	2.5047	1.5706

The exploitation ratio E and Exploitation rate U were obtained as:

	E	U
Male	0.6329	0.5783
Female	0.4706	0.3903
Both sexes (Commercial data)	0.6271	0.5758

The growth parameters obtained for males and females of *P. hamrur* in the present study showed that males are having a slower growth rate when compared to females. A corresponding difference in the asymptotic length could also be seen. The approximate values of L_∞ obtained applying Taylor's (1958) thumb rule gave values L_∞ much closer to that obtained from Ford-walford plot in the case of females whereas in males, the approximate value was found to be less than that estimated from Ford-Walford plot. However t_o values showed similarity in both males as well as females. The growth parameter computed for the commercial catch showed full agreement with those estimated for males and females from exploratory data. The value of *K* obtained was almost nearer to the average of the same estimated for males and females of exploratory data.

Due to its deeper water inhabitance, *P. hamrur* tends to share some characters of temperate species such as slow growth and extended life span. A differential growth in two sexes was expected as suggested by Qasim (1966), especially when preponderence of one sex, female in this case, over the other was observed in the population. Unlike most of the shallow water demersal species having a longevity of 3-6 years (Murthy, 1981, 1984, Rao, 1966, 1984) t_{max} for *P. hamrur* was computed as about eight years. Using back

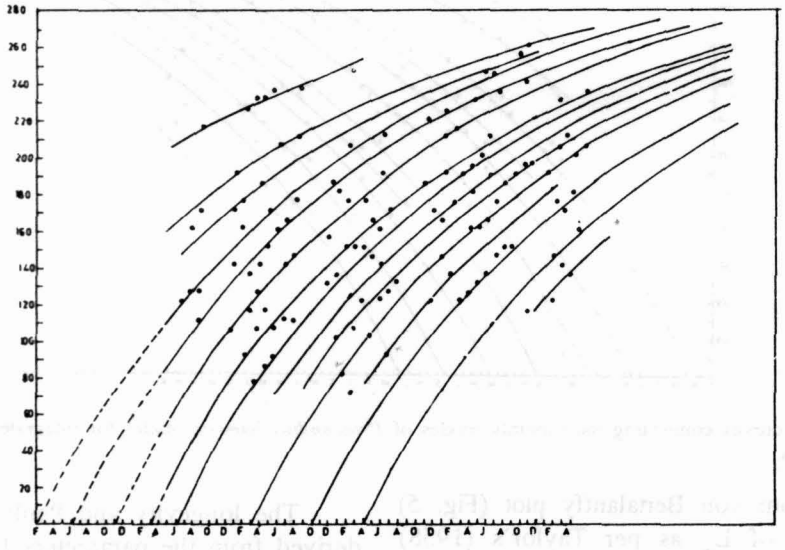

FIG. 2. Growth curves connecting monthly modes of *Priacanthus hamrur* (female) for integrated modal progression analysis.

TABLE 1. Growth parameters of *Priacanthus* spp. arrived at by various workers from different localities

Species	Authors	Locality	Method	Lmax (mm)	L∞ (mm)	K(year^{-1})	to (year^{-1})
P. macracanthus	Nugroho and Rustam (1983)	Northern Java Sea	Length based	260.00 (pooled)	267.00	1.360	—
P. macracanthus	Dwiponggo *et al.* (1986)	Java Sea (Central Java)	Length based	—	237.50	1.300	—
P. macracanthus	Joung and Chen (1992)	Northern Taiwan	Scales	290.00 (female)	620.00 (female)	0.088	-1.050
				272.00 (male)	482.00 (male)	0.113	-1.340
P. macracanthus	Liu *et al.* (1992)	South Western Taiwan	Scales	—	441.07 (female)	0.136	-2.632
					401.68 (male)	0.128	-2.900
P. macracanthus	Lester & Watson (1985)	South of Hong Kong	Length based	—	320.00	0.700	1.000
P. tayenus	Ingles and Pauly (1984)	Samar Sea	Length based	290.00 (pooled)	—	1.250	—
P. tayenus	Lester & Watson (1985)	South of Hong Kong	Length based	—	300.00	0.800	0.600
P. hamrur	Chakraborty (1994)	Bombay waters	Length based	341.00	360.00	0.736	0.009
P. hamrur	Present study	North east coast of India	Length based	265.00 (male)	297.00	0.358	-0.021
				288.00 (female)	300.45	0.382	-0.024

TABLE 2. Lengths attained by *P. hamrur* at different ages computed from growth functions and daily growth rates at different ages

Age (years)	Male (mm)	Daily growth (mm)	Female (mm)	Daily growth (mm)	Both sexes commercial (mm)	Daily growth (mm)
1.	91	0.25	97	0.27	96	0.27
2.	153	0.17	162	0.18	155	0.16
3.	196	0.12	208	0.13	195	0.11
4.	227	0.08	236	0.08	222	0.07
5.	248	0.06	257	0.06	242	0.05
6.	263	0.04	270	0.04	255	0.04
7.	273	0.03	280	0.03	264	0.03
8.	280	0.02	286	0.02	270	0.02

calculated data Joung and Chen (1992) estimated the age at maximum sizes of female (290 mm

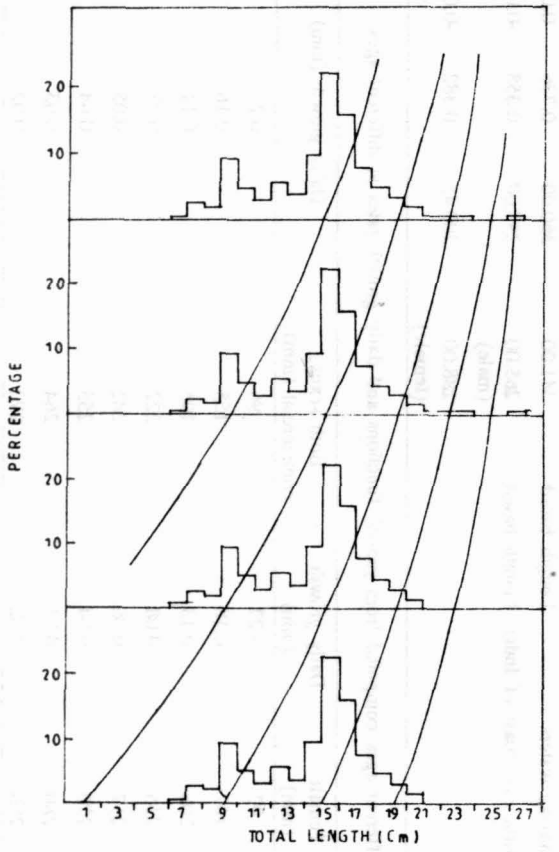

FIG. 3. Curves tracing the modes of frequency distribution of commercial catch of may 1993 iterated for modal progression analysis.

FL) and male (272 mm FL) as 6.12 and 6.03 years respectively for *P. macracanthus* of Taiwan waters. Pauly (1984) has cited estimates of t_{max} as 13 years for *Adioryx spinifer* (Holocentridai), 16 years for *Epinephelus summana* (Serranidae), 18-35 years for *Lutjanus* spp. (Lutjanidae), 12 years for *Pomadasys hasta* (Pomadasyidae) and 14-15 years for *Lethrinus* spp. (Lethrinidae). It would thus appear that the life span of eight years presently assessed for *P. hamrur* falls between those of shallow water demersal species which have a longevity of 3-6 years and larger perches which live for more than 10 years.

The growth parameters worked out by various workers from different regions in respect

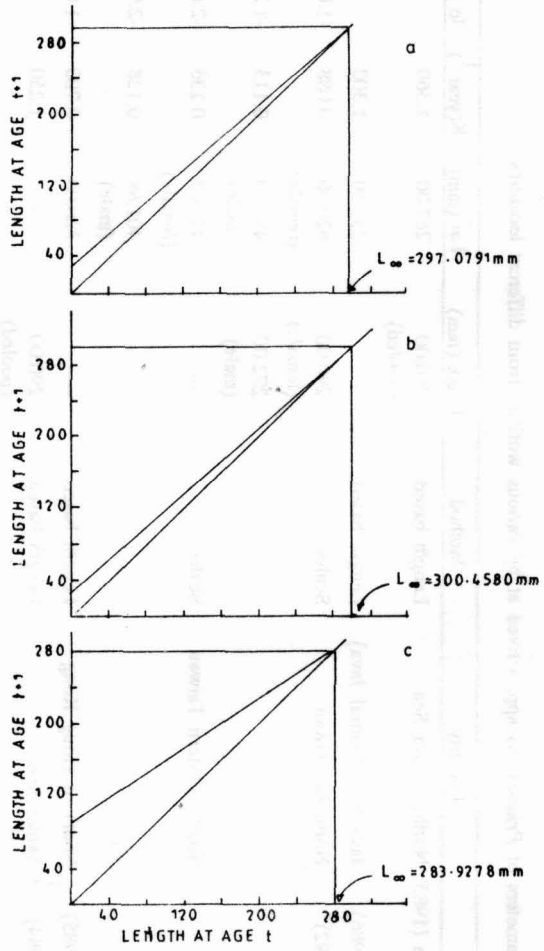

FIG. 4. Ford-Walford plot for estimating L_∞ and K of *Priacanthus hamrur* (a) male (b) female (c) combined commercial catch.

of *Priacanthus* spp. (Table. 1) show great variations. Chakraborty (1994) estimated 193 mm, 90 mm and 40 mm growth during I, II and III years respectively for *P. hamrur* from Bombay waters. This is comparatively faster than the growth rates obtained in the present study. Joung and Chen (1992) estimated the growth rate for male and female *P. macracanthus* as 102 and 112 mm in the first year, 44 and 40 mm in the second year, 40 and

35 mm in the third year and 37 and 32 in the fourth year. Senta (1977) observed that

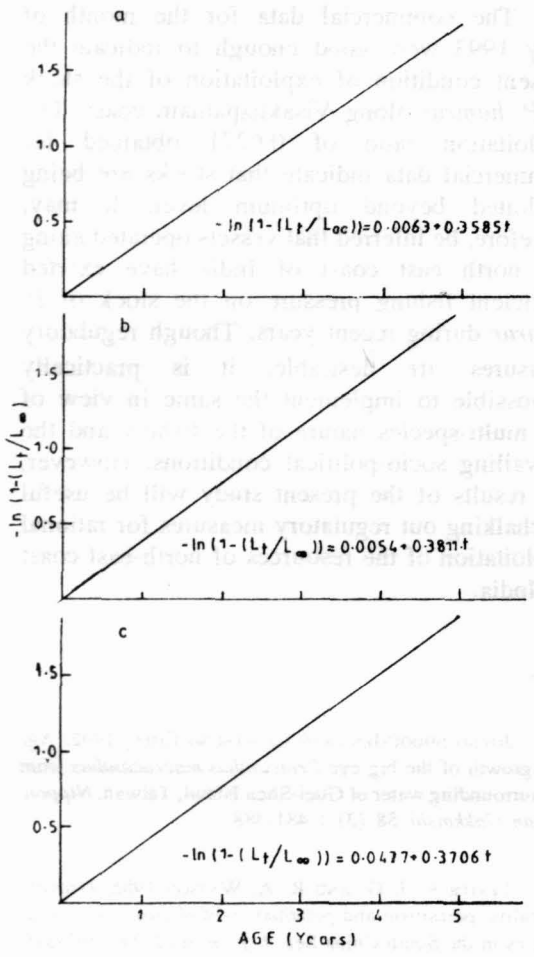

FIG. 5. Von Bertalanffy plot for estimating to (a) male (b) female (c) combined commercial catch.

P. tayenus of Gulf of Thailand grows by 50 mm in the first six months after recruitment and again by 50 mm in one year subsequently. He has worked out daily growth rate of 0.28 mm for the fish from 80 to 130 mm and 0.14 mm from 130 to 180 mm. Based on tagging experiments in Gulf of Thailand, Chomjurai and Bunnag (1970) estimated the daily growth rate of *P. tayenus* as 0.21 mm for fishes of 157-189 mm in fork length and 0.024 for fishes 205-221 mm. Therefore, the results obtained in the present study show that the daily growth rate in *P. hamrur* (Table 2) is more or less

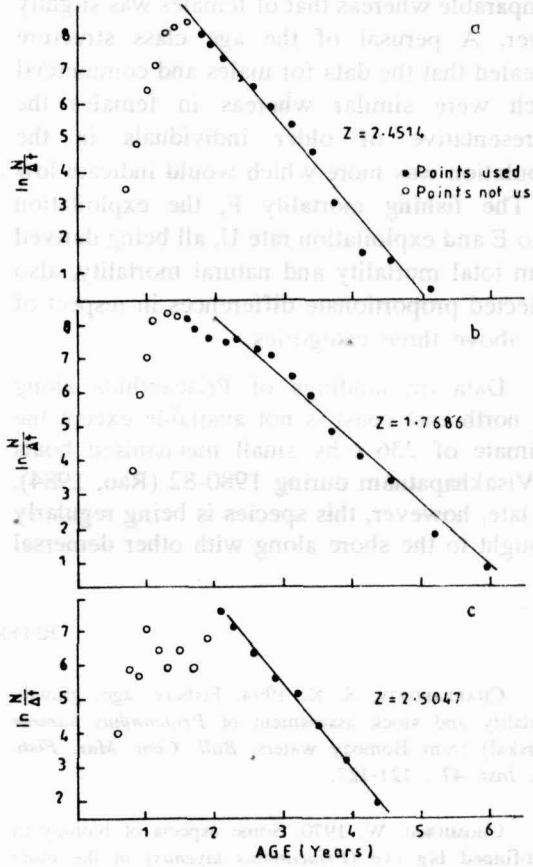

FIG. 6. Estimation of total mortality Z based on catch curve method (a) male (b) female (c) combined commercial catch.

comparable with that of *P. tayenus* and *P. macracanthus* from south east Asian waters.

Unlike the commercial data, the exploratory data may not reflect the reactions of the stock in response to the fishing pressure and therefore it may lead to errors in the estimation of mortality. As the natural mortality coefficients were estimated based on parameters which do not reflect age structure of the catch, the values obtained for male, female and pooled

commercial catch data were more or less comparable. The total mortality Z estimated for males and commercial catch data were comparable whereas that of females was slightly lower. A perusal of the age class structure revealed that the data for males and commercial catch were similar whereas in females the representative of older individuals in the population was more which would indicate low Z. The fishing mortality F, the exploitation ratio E and exploitation rate U, all being derived from total mortality and natural mortality, also reflected proportionate differences in respect of the above three categories.

Data on landings of Priacanthids along the north east coast is not available except the estimate of 236 t by small mechanised boats at Visakhapatnam during 1980-82 (Rao, 1984). Of late, however, this species is being regularly brought to the shore along with other demersal species though a sizeable quantity is being thrown overboard by the shrimp trawlers.

The commercial data for the month of May 1993 were good enough to indicate the present condition of exploitation of the stock of *P. hamrur* along Visakhapatnam coast. The exploitation ratio of 0.6271 obtained for commercial data indicate that stocks are being exploited beyond optimum level. It may, therefore, be inferred that vessels operated along the north east coast of India have exerted sufficient fishing pressure on the stock of *P. hamrur* during recent years. Though regulatory measures are desirable, it is practically impossible to implement the same in view of the multi-species nature of the fishery and the prevailing socio-political conditions. However, the results of the present study will be useful in chalking out regulatory measures for rational exploitation of the resources of north-east coast of India.

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