Growth, mortality and stock assessment of two perches moontail bull's eye *Priacanthus hamrur* (Perciformes/Pricanthidae) and thornycheek grouper *Epinephelus diacanthus* (Perciformes/Serranidae) from Bombay waters

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Based on the data collected from 1989-92 the growth, mortality and stock assessment of *P. hamrur* and *E. diacanthus* were calculated. The von Bertalanffy's growth functions worked out for *P. hamrur* were as follows L_∞=360 mm, K=0.64 per year and that of *E. diacanthus* were L_∞=494 mm and K=0.59 per year. Based on these calculations the growth of *P. hamrur* at the end of I-IV years works out to be as 171, 260, 308 and 334 mm. The length attained by *E. diacanthus* at the end of I-IV years of its life works out to 223, 345, 414 and 451 mm respectively. The mortality coefficients - Z, M and F were worked out 2.24, 1.13 and 1.11 for *P. hamrur*. The same for *E. diacanthus* was calculated as 1.74, 1.1 and 0.64 respectively. Stock assessment study shows that there is no decline in the catch at the present rate of exploitation. However, even if the efforts are trebled, the increase in the catch will not be proportionate and returns are not remunerative.

Along the southwest coast of India, perches are the important fishery resource. Various gears are employed for catching them but most of the catch comes as by-catch of shrimp trawl. The average annual catch of perch at all India level during 1985-92 period was around 800 tons contributing 5% to the total fish catch. Maharashtra's catch during this period was 320 tons contributing 2% to the all India catch.

Priacanthus hamrur (Forsskal) and *Epinephelus diacanthus* (Valencinnes) are two important species of perch which are available almost throughout the year. Work on the fishes belonging to the family Priacanthidae and Serranidae has been carried out from various localities of world[1–10]. Based on the data collected from Greater Bombay during the period 1989-92, the growth, mortality and stock parameters of *P. hamrur* and *E. diacanthus* are reported in the present communication.

Materials and Methods

Weekly length measurements were collected at New Ferry Wharf and Sassoon Docks landing centres of Greater Bombay. A total of 5889 specimens of *P. hamrur* in the length range of 100-346 mm and 5043 specimens of *E. diacanthus* in the length range of 120-476 mm were measured. The data on catch were raised for the days' and subsequently to the months' catch following Sekharan[11]. Growth was studied using Bhattacharya[12] and Gulland & Holt[13] plot. The total mortality was estimated by length cohort[14] and natural mortality by Cushing's[15] methods. The length-weight relationship was calculated by the formula $W=a * L^b$, where weight is in g and length in cm and 'a' and 'b' are constants.

For basic data for the length-cohort[14] analysis 29 months data for *P. hamrur* and 26 months data for *E. diacanthus* were pooled. The yield at various levels of fishing mortality was calculated by Thompson & Bell[16] model. Both these analyses were carried out using LFSA package developed by Sparre *et al.*[17] employing "MIX FISH" programme[18].

Results and Discussion

The $L\infty$ of *P. hamrur* was calculated as 360 mm and K as 0.64 per year. Based on this the length

attained by this species at the end of I-IV years of its life works out to be 171, 260, 308 and 334 mm.

The VBGF parameters of this species could be written as

$$Lt=360\ [1-e^{-0.64\,(t-t_o)}]$$

For *E. diacanthus* the asymptotic length (L∞) was estimated as 494 mm and growth coefficient (K) as 0.59/year (Fig. 1). Based on this the length attained by this species at the end of I-IV years of its life works out to be 223, 345, 441 and 451 mm. The von Bertalanffy's growth formula for this species could thus be written as

$$Lt = 494\ [1 - e^{-0.59\,(t-t_0)}]$$

The natural mortality coefficient for *P. hamrur* and *E. diacanthus* based on Cushing's[15] formula was calculated as 1.13 and 1.10 respectively. The total mortality coefficient Z was estimated as 2.24 for *P. hamrur* and 1.74 for *E. diacanthus*. The Z estimated by length-converted catch curve[19] and Jones & van Zalinge's[20] method for *P. hamrur* was 2.06 and 2.14 respectively. The 'Z' for *E. diacanthus* by those two methods were estimated as 1.59 and 1.57 respectively. The length-weight formula obtained for both the species are presented below:

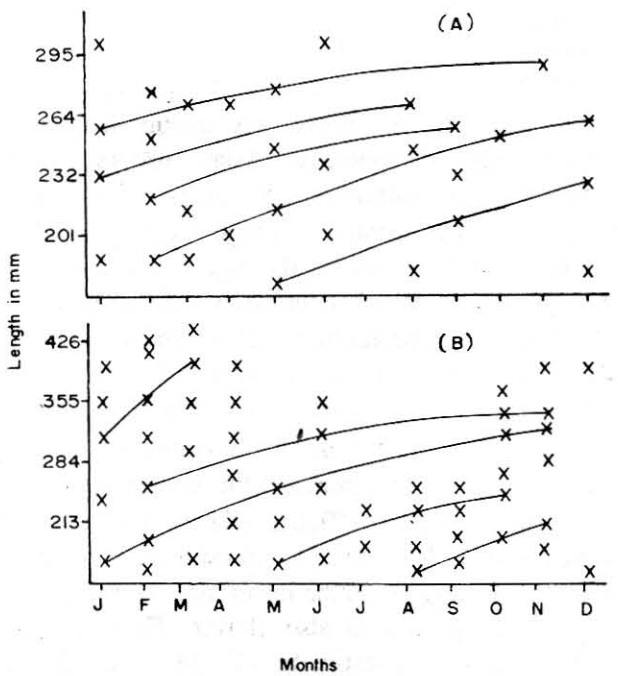

Fig. 1—Mean length of assumed cohorts connected for estimation of growth by Bhattacharya method: (A) *P. hamrur*, (B) *E. diacanthus*.

P. hamrur $W=1.59598 \cdot L^{2.7715}$ ($r^2=0.905492$)

E. diacanthus $W=1.318256 \cdot L^{2.39299}$ ($r^2=0.923638$)

The input parameters used for the length cohort analyses[14] and Thomson & Bell[16] are presented in (Table 1). The length cohort and Thompson & Bell[16] analyses show that for *P. hamrur* at the present level of fishing (X=1) there is no decline in the catch. But even by increasing the efforts three times the catches can go up only by 47 tons. For *E. diacanthus* also there is no decline in the catch at the present level of fishing. But for this species also even by increasing the efforts three times catches can go up only by 53 tons (Figs 2-4). Using "MIXFISH" of LFSA programme taking both the species together the total catch at the present level of fishing is 736.9 tons which could be increased to 843.9 tons by trebling the efforts (Fig. 5).

Work on *P. hamrur* from Bombay waters has been done by Birader[8] and Chakraborty[9]. Though the L∞ estimated by Chakraborty[9] was same as that estimated in the present study, the growth

Table 1—Input parameters used for the length cohort analyses

Parameters	*P. hamrur*	*E. diacanthus*
Asymptotic length (cm)	36.00	49.4
Growth coefficient/year	0.61	0.59
Natural mortality (M)	1.13	1.10
Terminal F/Z	0.50	0.50
Constant "a" (g, cm)	0.025	0.12
Constant "b" (g, cm)	2.7715	2.392

F/Z=Exploitation rate; constant "a" and "b" are from the length-weight relationship.

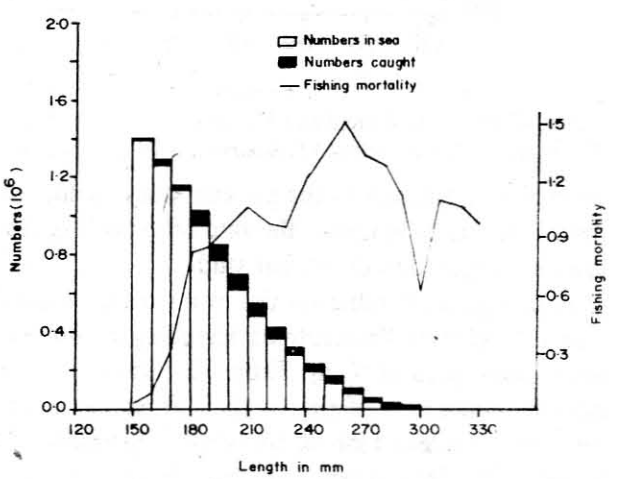

Fig. 2—Length cohort analysis for *P. hamrur*

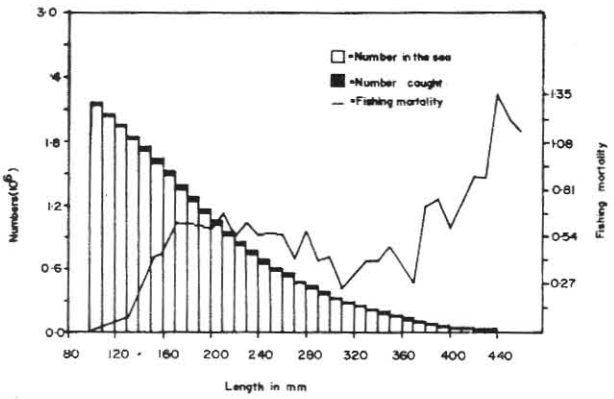

Fig. 3—Length cohort analysis for *E. diacanthus*

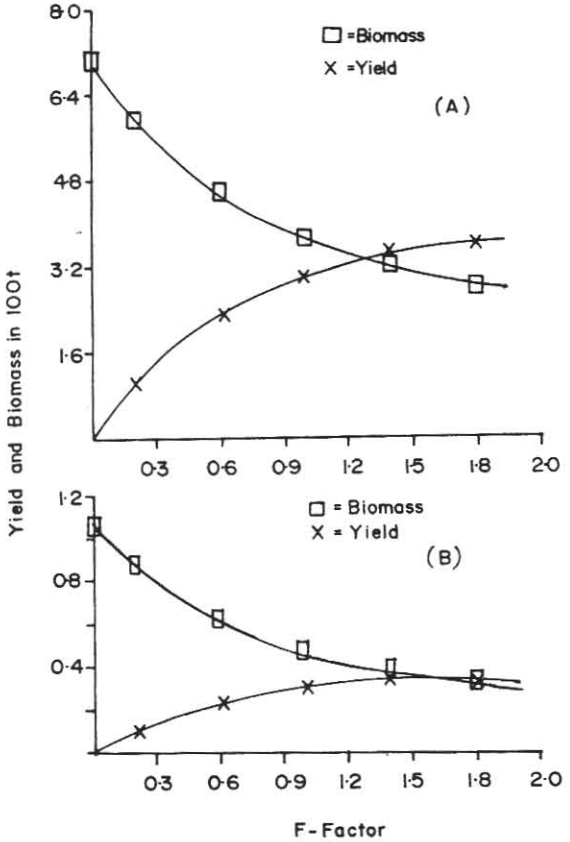

Fig. 4—Estimation of yield and biomass by length based on Thompson & Bell model: (A) *P. hamrur*, (B) *E. diacanthus*.

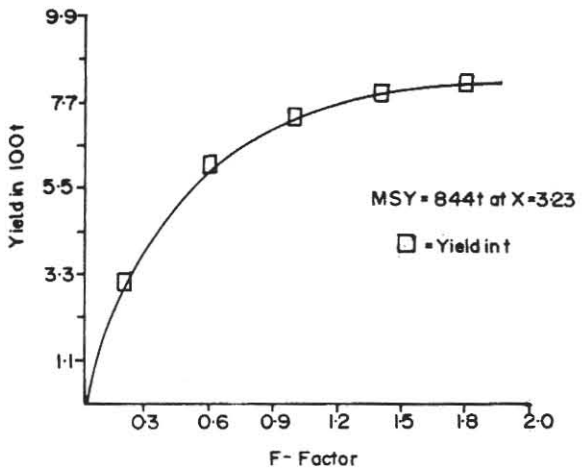

Fig. 5—Estimation of yield and biomass by length based on Thompson & Bell model, taking both the species together.

Table 2—Estimation of natural mortality rates for Priacanthids from various localities of the world

Species	Location	M
P. tayensis[1]	Gulf of Thailand	2.13
P. tayensis[4]	Samar Sea	8.09
P. macracanthus[5]	Java Sea	3.45
P tayensis[6]	Java Sea	2.13
Priacanthids[7] (in general)	Indian coast	1.7-1.9
P. hamrur[8]	Bombay	1.0
P. hamrur[9]	Bombay	1.52
P. hamrur (Present study)	Bombay	1.13

coefficient estimated in the present study is slightly lower. As the K is lower, the rate of growth is also low as compared to the earlier study.

A comparative table on the estimates of natural mortality (M) of Priacanthids including *P. hamrur* have been presented in Table 2. Based on the growth parameters of priacanthids from the south-east Asian waters John & Sudarsan[7] calculated the M as 1.75. This appears on the higher side. The reason for this higher estimate of natural mortality is because of the lower asymptotic length of priacanthids of southeast Asian waters. From Bombay the estimates of natural mortality coefficient of *P. hamrur*[7-9] ranges from 1 to 1.52. Of these 1.52 appears on the high considering that with a strong dorsal spine and wide body depth chances of this species being much predated upon is less. Thus the natural mortality of 1.0 (ref. 8) and 1.13 (present study) appears to be reasonable.

For *E. diacanthus*, Chakraborty[10] using ELEFAN technique estimated the asymptotic length (L∞) and growth coefficient (K) as 502 mm and 0.61 per year. Thus, the present estimate of 494 mm and 0.59 is slightly on the lower side. Consequently the rate of growth is also slower. There is little difference in the estimate of 'M' and 'Z' as compared to the earlier study. The only other comparison could be done is with *E. guttatus*[3] from Jamaican reef where the estimate of asymptotic

length ($L\infty$) is 520 mm, and growth coefficient (K) is 0.24 and natural mortality is 0.68. While the $L\infty$ of 520 mm is comparable, K appears to be very low. Length cohort study indicates that though there is no decline in the catch at the present level of fishing and the efforts can be increased up to three times, the decline in the biomass may adversely affect the stock.

Using "MIX FISH" of LFSA programme it is evident that for both the species taken together by trebling the efforts the catch can go up by 107 tons. But here too decline in the biomass is too drastic to necessiate such a step. Thus for the benefit of the stock it is better if the efforts are confined at the present level only.

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