Estimates of growth, mortality, recruitment pattern and maximum sustainable yield of important fishery resources of Maharashtra coast

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The growth, mortality, recruitment pattern and MSY of important fishery resources of Maharashtra were estimated. The investigation revealed that out of 18 fish resources 11 are optimally exploited. The penaeid prawn resources which are the target species of shrimp trawlers are underexploited. Cephalopods appear to be optimally exploited. The present yield of fishes, prawns and cephalopods are 65083, 38404 and 11373 tons while the estimated MSY are 83025, 72460 and 10475 tons. The study indicates that additional yield of 62926 ton can be obtained by increasing the efforts to the extent of 25% without any adverse effects on the total resources.

The fishing industry in Maharashtra is well organised owing to the large number of ports and creeks and good infrastructure facilities. It contributes about 16% of the total marine fish landed in India. There are about 13 million hectares of productive grounds up to 200 m zone 1. The mechanization of traditional crafts started in early sixties and continued till mid eighties. However, introduction of new vessels has slowed down now. There are three major fish landing centres in Greater Mumbai viz. New Ferry Wharf, Sassoon Docks and Versova. The former two are primarily trawl landing centres while the latter is dol net fishing centre. The craft and gear employed, area of operation of the fishing fleet from New Ferry Wharf and Sassoon Docks have been described 2. But fishermen now venture up to 70 m depth zone than earlier when the fishing was restricted to 40 m. The duration of fishing has also gone up from 3-4 days to 5-6 days. There has been many fold increase in the efforts of "dol" net as a result of phasing out of cotton twine with synthetic material and increase of nets per unit from 3 to 9 in most of the centres.

Target species for commercial trawling in Maharashtra is prawns and all the species of fish and cephalopods are landed as by-catch of shrimp trawl. Groupwise contribution of catch shows that fish forms 56.77%, prawns 33.45% and cephalopods 9.9%. Though by-catch forms quantitatively large constituent, economically it does not fetch good value. But because of the quantum of their landing the value is not altogether negligible. The value of minor species can make all the difference between a profitable and non profitable trip 3.

An attempt was made to study the growth, mortality and estimation of maximum sustainable yield of large number of commercially viable and ecologically associated resources of fish, prawns and cephalopods by using the analytical model.

Materials and Methods
The data was collected during 1987-90 from one of the above mentioned landing centres. ELEFAN package developed by Gayanilo et al. 4 was used for the estimation of age, growth, mortality and maximum sustainable yield (MSY). Data on Priacanthus hamrur, Epinephelus diacanthus and Pennahia macrophthalmus were collected at S. Docks landing centre. Data on Harpodon nehereus and Coilia dussumieri were collected from the dol netters of Versova. For rest of all the species the data has been collected from N. F. Wharf. Estimated total catch of the state of Maharashtra for different resources were taken from the National Data Centre for Living Resources (C.M.F.R.I., Cochin). The same has been used for the calculations of maximum sustainable yield.

Results and Discussion
Various population parameters determined are presented in Table 1. The estimation of MSY, standing stock and the annual average yield are given in Table 2. The total mortality coefficient (Z) of fishes varied from 1.20 to 7.05, for prawns 3.82 to 10.78 and for cephalopods 2.09 to 3.4. The natural
mortality coefficient varied from 0.86 to 3.00 (Table 1).

As evident from the Table 2 out of 18 species of fish studied 11 are optimally exploited and 7 are underexploited. All the species of penaeid prawns which constitute 76% of the penaeid prawns of Maharashtra are underexploited while cephalopods are optimally exploited. The notable underexploited species among fish are Otolithes cuvieri, Pennahia macrophthalumus, Epinephelus diacanthus, Pria-
canthus hamrun Scoliodon laticaudus (female) and Arios caleatus.
Among the dol communities stock of *Harpodont nehereus* is optimally exploited whereas *Coilia dussumieri* is under exploited. Groupwise contribution of catch shows that fish forms 56.77%, prawns 33.4% and cephalopods 9.9%. The estimated MSY of total fish stock is 177785 tons whereas the present yield is 114859 tons. Therefore, there is scope to increase the total catch by 54.78%. The present yield of fish, prawns and cephalopods are 65083, 38404 and 11373 tons while the estimated MSY are 83025, 72460 and 62962 tons.

The potential yield of Maharashtra was estimated as $2.6 \times 10^5$ tons by Jones & Banerji. Kalawar suggested that additional 60000 tons can be expected by increasing the efforts to the extent of 40% of 1984. The number of trawlers in Maharashtra have increased by 18.19% till 1992-93 but there has been no decline in the total fish landing. The present $L_t/L_\infty$ for all the species taken together is 0.53 and the estimated exploitation ratio (E) is 0.573 whereas the $E_{\text{max}}$ is 0.83 (Fig. 1). The study thus indicates that an additional yield of 629262 tons can be obtained by increasing the present fishing effort by 25% without any detrimental effects on the total landings of the resources.

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