Indian Journal of Marine Sciences
Vol. 26, March 1997, pp. 53-56

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

Sushant K. Chakraborty, Vinay D. Deshmukh, Mohammad Zafar Khan, Kuber Vidyasagar & Sadashiv G Raje
Bombay Research Centre of CMFRI, Army & Navy Building, 148, M.G.Road, Mumbai-400 001,India

Received 16 April 1996; revised 2 September 1996

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 62,926 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 center. 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 manyfold 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 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 macrophthalamus* 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

Table 1—Growth, mortality and population parameters of the species studied

Species	Linf	Lmax	K	Z	M	F	E
Scoliodon laticaudus (female)	726	700	0.48	3.0	0.9	2.1	0.7
Scoliodon laticaudus (male)	740	640	0.63	3.0	0.9	2.1	0.7
Otolithes cuvieri	398	359	0.52	1.2	0.86	0.34	0.28
Johnieops vogleri	345	326	0.72	3.2	1.1	2.1	0.65
Johnius macrorhynus	350	331	0.75	4.1	1.2	2.9	0.7
Johnieops sina	240	210	0.8	6.56	1.6	4.96	0.75
Pennahia macrophthalamus	245	229	0.64	2.0	1.3	0.7	0.35
Nemipterus joponicus	335	321	0.65	2.8	1.1	1.7	0.6
Nemipterus mesoprion	286	265	0.71	3.44	1.4	2.04	0.65
Epinephelus diacanthus	502	459	0.61	1.5	1.12	0.4	0.26
Priacanthus hamrur	345.5	328	0.66	2.5	1.1	1.4	0.56
Saurida tumbil	600	570	0.51	2.8	1.0	1.8	0.64
Saurida undosquamis	421	420	0.51	2.52	1.1	1.42	0.56
Harpodon nehereus	413	410	0.73	3.1	1.53	1.57	0.51
Arius caelatus	521	450	0.68	3.5	1.1	2.4	0.68
Arius thalassinus	850	640	0.28	1.5	0.52	0.97	0.65
Osteogeneiosus militaris	600	480	0.65	5.0	1.1	3.9	0.78
Coilia dussumieri	230	205	1.2	7.05	3.0	4.0	0.57
Trichiurus lepturus	1480	1257	0.4	2.62	0.75	1.87	0.71
Loligo duvaucelii	343	270	0.49	2.09	1.1	0.99	0.47
Sepia aculeata	297	275	0.56	3.4	1.1	2.3	0.67
Parapenaeopsis stylifera (female)	140.8	136	2.15	7.6	3.6	4.0	0.53
Parapenaeopsis stylifera (male)	119.2	109	1.45	10.78	2.96	7.82	0.73
Metapenaeus monoceros (female)	219.2	212	1.4	3.82	2.4	1.42	0.37
Metapenaeus monoceros (male)	180.5	178	1.35	4.5	2.5	2.0	0.44
Metapenaeus affinis (female)	188.8	181	1.47	6.78	2.58	4.2	0.62
Metapenaeus affinis (male)	151.5	149	1.5	4.6	2.78	1.12	0.4
Solenocera crassicornis (female)	139	127	2.0	10.36	3.44	6.92	0.67
Solenocera crassicornis (male)	92	82	1.5	6.0	3.2	3.6	0.53

Linf = asymptotic length, Lmax = the largest record of the fish in the catch, K = growth coefficient, Z , M & F = the instantaneous rates of total, natural and fishing mortalities respectively, E= exploitation ratio.

Table 2—Yield and stock paramrters of fish prawns and cephalopods

Species	Yield	Lc/L∞	M/K	E	Emax	F	Y/F	MSY
Scoliodon laticaudus (female)	2349	0.77	1.87	0.70	1.0	2.10	1119	3356
Scoliodon laticaudus (male)	2150	0.46	1.42	0.70	0.66	2.10	1024	2024
Otolithes cuvieri	6063	0.40	1.65	0.28	0.61	0.34	17832	13209
Johnieops vogleri	6126	0.40	1.52	0.65	0.67	2.10	2917	6314
Johnius macrorhynus	4958	0.45	1.60	0.70	0.66	2.90	1709	4674
Johnieops sina	2118	0.60	2.00	0.75	1.0	4.96	427	2824
Pennahia macrophthalamus	1038	0.44	2.03	0.35	0.7	0.70	1483	2076
Nemipterus joponicus	1242	0.48	1.69	0.60	0.71	1.70	731	1470
Nemipterus mesoprion	962	0.49	1.97	0.65	0.75	2.04	472	1110
Epinephelus diacanthus	280	0.46	1.83	0.26	0.71	0.40	701	761
Priacanthus hamrur	283	0.56	1.66	0.56	0.83	1.40	202	606
Saurida tumbil	3193	0.43	1.97	0.64	0.68	1.80	1774	3388
Saurida undosquamis	171	0.47	2.15	0.56	0.77	1.42	120	236
Harpodon nehereus	37270	0.40	2.09	0.51	0.65	1.57	23739	47650
Arius caelatus	453	0.71	1.61	0.68	1.00	2.40	189	666
Arius thalassinus	1990	0.28	2.16	0.65	0.52	0.97	6156	1588
Osteogeneiosus militaris	2948	0.53	1.69	0.78	0.79	3.90	2268	3004
Coilia dussumieri	4793	0.64	2.22	0.57	1.0	4.0	2397	8715
Trichiurus lepturus	23965	0.44	1.87	0.71	0.68	1.87	12815	22986
Loligo duvaucelii	6125	0.29	2.26	0.47	0.53	0.99	6187	6895
Sepia aculeata	5248	0.30	1.96	0.67	0.53	2.30	2281	4143
Parapenaeopsis stylifera (female)	12320	0.64	1.67	0.53	1.0	4.00	3080	23245
Parapenaeopsis stylifera (male)	5646	0.72	2.04	0.73	1.0	7.82	722	7734
Metapenaeus monoceros (female)	4563	0.59	1.71	0.37	1.0	1.42	3213	12332
Metapenaeus monoceros (male)	1709	0.61	1.85	0.44	0.91	2.0	855	3519
Metapenaeus affinis (female)	6227	0.72	1.75	0.62	1.0	4.20	1483	10044
Metapenaeus affinis (male)	2876	0.79	1.85	0.40	1.0	1.12	1580	7190
Solenocera crassicornis (female)	4401	0.68	1.72	0.67	1.0	6.92	636	6569
Solenocera crassicornis (male)	662	0.71	2.13	0.53	1.0	3.60	184	1249

Lc = length at first capture, Emax = maximum exploitation rate, Y/F = standing stock, MSY = maximum sustainable yield in tons

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 macrophthalamus,Epinephelus diacanthus, Priacanthus hamrur Scoliodon laticaudus* (female) and *Arius caelatus*.

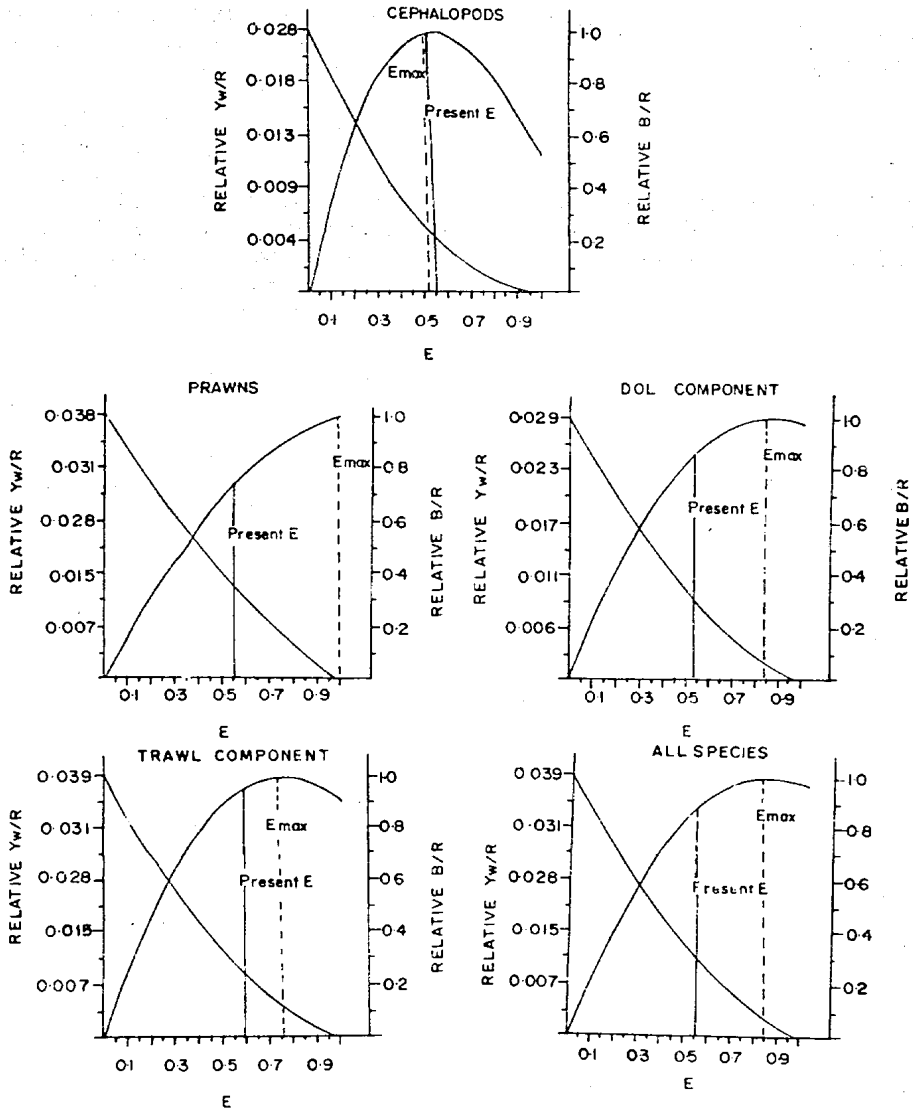

Fig. 1—Gear wise estimates of relative yield per recruit and biomass per recruit for various resources

Among the dol communities stock of *Harpodon 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 2.6×10^5 tons by Jones & Banerji[5]. Kalawar[6] 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 Lc/L∞ for all the species taken together is 0.53 and the estimated exploitation ratio (E) is 0.573 whereas the Emax 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.

Acknowledgement

The authors are grateful to Dr.P.S.B.R.James, Director C.M.F.R.I. for encouragement during the course of investigation. They are also thankful to M/s J.D. Sarang, B.B. Chavan, A.D. Sawant, A.Y.

Mestry and Thakurdas for the assistance provided in the field and laboratory.

References

1 Srinath M, Jacob Varughese, Kanakkan A, Mani P T & Karbhari J P, in *An appraisal of the marine fisheries in Maharashtra. CMFRI Spl.Publ,* 37 (1987) p. 46

2 Chakraborty S K, Deshmukh V D, Kuber Vidyasagar & Ramamurthy S, *Mar Fish Infor Ser Tech & Extn,* 55 (1983) 7.

3 Gulland J A, *Fish stock assessment :A manual of basic methods* Vol.1,.(FAO/ Wiley) 1983, pp. 223.

4 Gayanilo F C Jr,Soriano M & Pauly D,in *Draft guide to COMPLEAT ELEFAN,*.ICLARM Software Project 2, (ICLARM, Manila) 1988, p. 65.

5 Jones S & Banerji S K , in *Proc.Symp.Living Resources of the sea around India,*(CMFRI,Cochin) 1973, 1.

6 Kalawar A G, *Bull.Cent. Mar. Fish. Res Inst,* 30B (1981) 4