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39 The fishery, biology and stock assessment of jew fish resources of India

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ABSTRACT

Sciaenids are one of the major component of the demersal trawl. The total catch of this resource during 1990-94 period was 1,50,142 t contributing 8.86% to the demersal catch of India. A number of species are found in different states of India. Of which biological and stock assessment studies were made on eleven important species. Crustaceans and fish appear to be the chief food in juvenile and adult stage respectively. Most of the species have a protracted spawning season. Among all the species studied the largest asymptotic length was estimated for O.ruber from Tuticorin and the smallest for J. sina from Cochin. The highest Z of 7.59 was recorded for K. axillaris from Chennai and the lowest was for O. cuvieri from Mumbai. The average exploitation rate (E) and the Lc/ L∞ was 0.62 and 0.53 respectively. The present yield is 91.222 t and the MSY is 1.42.613 t for all the species taken together. The exploitation rate for almost all the stocks in the states appears to be more than the optimum level.

Introduction

The sciaenids commonly known as croakers, drummers and jew fish contribute 10-12% of the demersal catch of India. They are represented by a dozen genera and about thirty species. Of these, at least fifteen are commercially important. Two of the species *viz Nibea diacanthus* and *Otolithoides brunneus* grow to a large size measuring upto 150 cm. The lesser sciaenids

grow commonly upto a size of 25-30cm and form cheaper source of protein to the poorer section of the people. Landed mainly as a by-catch of shrimp trawlers, the family Sciaenidae has received a good deal of attention from Indian workers. Some of the early workers from Indian waters include Dharmarajan(1936), Gopinath (1942), Mookerjee *et al.* (1946), Chacko (1949), Bal and Pradhan (1945, 1946), Motwani *et al.* (1954), Karamchandani and Motwani (1954), Rajan (1964), Rao (1961, 1966, 1968, 1971), Rao (1964, 1981, 1983, 1985 a,b,c,), Kutty (1967), Devadoss (1969), Jayaprakash (1976), Nair (1977), Murty (1979, 1986a, 1986b), Muthiah (1983), Jayasankar (1989), Chakraborty (1989,1992,1994 a, b), Gulati (1987). In the present communication the biology, age and growth and stock assessment of the following species are reported: *Otolithes cuvieri* and *Johnius glaucus*, from Gujarat; *Johnius macrorhynus*, *Johnieops vogleri* and *O.cuvieri* from Maharashtra; *O. cuvieri*, *Johnieops aneus* from Karnataka; *J. sina* and *O. ruber* from Kerala; *Pennahia macrophthalmus*, *Nibea maculata*, *O. ruber* and *Kathala axillaris* from Tamil Nadu and *Johnius carutta* and *N. maculata* from Andhra Pradesh.

Material and methods

The data on catch and effort, species composition and length frequency were collected once or twice in a week at the major centres in the respective states. The length frequency was raised to day's catch and subsequently to the month's catch following Sekharan (1962). The von Bertallanffy's (1938) growth parameters, the asymptotic length ($L\infty$) and the growth coefficient (K) were estimated using ELEFAN programme developed by Gayanilo *et al.* (1988). This programme does not give an estimate of t_0. The total mortality coefficient (Z) was estimated by length converted catch curve method of Pauly (1982) and the natural mortality coefficient was calculated by Pauly's (1980) emperical formula. The maximum sustainable yield (MSY) was estimated by Corten's (1974) formula and the calculations were done by using ELEFAN II programme. Based on the species composition of sciaenids at vatious centres the catches were raised to the level of the respective states. The catch figures thus arrived were used for the estimation of population parameters.

Fishery

During the period 1990-94 the average all India landings of croakers

was 1,50,142 t contributing nearly 9% to the total fish landing of India. Among the maritime states Gujarat with an average catch of 65,002 t recorded the highest followed by Maharashtra 24,450 t. The other states making substantial contribution to the sciaenid catch were Orissa 15,136 t Kerala 13,336 t and Tamil nadu 12, 475 t respectively. *(Table 1)*

Species composition: The main species landed at Veraval was *O. cuvieri* with a contribution of almost 50% . In Mumbai the catch was dominated by *J.macrorhynus, J. voglerl* and *O. cuvieri*, contributing to nearly 70% of the catch. At Karwar *O. cuvieri* was the dominant species. *J. sina* happens to be the dominant species at Calicut followed by *O. ruber, J. belangerii* and *J.aneus*. At cochin *J. sina* was the dominant species followed by *O. ruber*. At Tuticorin *O. ruber* and *N. maculata* were the dominant species. From Chennai three species contribute substantially to the croaker landing viz. *O. ruber, J. carutta* and *K. axillaris*. At Visakhapatnam *J. carutta, N. maculata and K. axilaris* dominated the catch; whereas at Kakinada the dominant species *were O. ruber* and *J. carutta*.

Length- weight relationship: Some of the published accounts on the length - weight relationships include those of Rao (1983) on *J. carutta* and *P. mactophthalamus* from waltair; Murty (1980, 1984, 1986) on *Atrobucca nibe, J. carutta, P. macrophthalmus* and *J.voglerl*; from Madras on *J. caruta* (Vivekanandan, 1985); from Bombay on *J. voglerl* by Muthiah (1982), *J. macrorhynus, J. voglerl* and *O. cuvieri* by Chakraborty (1988); from Mandapam on *N. maculata* by Jayasankar (1989).

The formulae worked out from different centres for various species are as follows:

Veraval: *O. cuvieri*

Male : Log W = - 1.4623408 + Log L * 2.742264

Female : Log W = -1.9541803 + Log L * 2.987196

J. glaucus

Male : Log W = -,1.4623408 + Log L * 2.642772

Table. 1 State-wise sciaenid fish landings in Tonnes during 1990-94.

Year	WB	OR	AP	T N	PO	KL	KA	GO	MA	GJ	AN	LA	Total
1990	1730	19555	9020	12347	151	4806	10868	586	22803	37119	239	0	119224
1991	5015	11236	7579	13333	142	4724	8816	1101	23035	33174	239	0	108394
1992	2740	11704	8780	11925	146	4641	15603	851	25568	79646	239	0	161843
1993	4738	18888	9694	11155	104	3247	14657	644	23567	70392	1096	0	158182
1994	4360	14299	8579	13614	116	4541	16734	935	27278	104777	1096	0	196329
Total	18583	75692	43652	62374	659	21959	66678	4117	122251	325108	2909	0	743972
Aver-age	3717	15136	8730	12475	132	4392	13336	8223	24450	65022	582	0	148794
Perc-Entage	2.50	10.17	5.87	8.38	0.09	2.95	8.95	0.55	16.43	43.70	0.39	0	100

WB-West Bengal; Or-Orissa; AP-Andhra Pradesh; TN-Tamil Nadu; PO-Pondicherry; KL-Kerala; GO-Goa; MH-Maharashtra; GJ-Gujarat; AN-Andaman and Nicobar; LA-Lakshrdweep.

Table 2. Contd.

Species	L∞	K	Z	M	F	E	Yield	L∞	M/K	Emax	Y/F	MSY
						Mandapam						
P.macroph-thalmus	260	0.98	4.9	1.9	3	0.61	3493	0.5	1.94	0.78	1164	7341
N.maculata	284	0.85	6.18	1.66	1.67	0.73	3742	0.54	2.06	0.93	826	7942
						Tuticorin						
N. maculata	314	0.72	4.3	1.4	2.9	0.67	998	0.62	1.94	1	344	1489
O.ruber	469	0.47	3.53	1	2.53	0.72	1871	0.47	2.12	0.76	739	1975
						Madras						
O.ruber	315	0.65	5.05	1.33	3.72	0.74	3368	0.8	2.04	0.96	905	4369
K.axillaris	220	0.86	7.59	1.84	5.75	0.76	2495	0.65	2.14	1	434	3282
						Visakhapatnam						
J. carutta	281	0.56	3.7	1.11	2.59	0.7	1920	0.56	2	0.91	741	2496
						Kakinada						
N.maculata	315	0.61	2.93	1.26	1.67	0.57	1309	0.6	2.06	0.93	813	2135

Table 2: Growth, mortality and population parameters of the species studied from different localities.

Species	L∞	K	Z	M	F	E	Yield	Lc/L∞	M/K	Emax	Y/F	MSY
						Veraval						
O.cuvieri	382	0.53	1.87	1.08	0.79	0.42	33811	0.47	2.03	0.7	42798	60376
J.glaucus	300	0.87	4.5	1.6	2.9	0.64	7802	0.53	1.84	0.82	2690	9996
						Mumbai						
J.macrorhynus	345	0.7	3.51	1.4	2.11	0.6	6112	0.45	1.87	0.69	2897	7029
J.vogleri	350	0.72	3.79	1.3	2.9	0.66	4890	0.4	1.8	0.63	1963	4667
O.cuvieri	398	0.52	1.83	1	0.83	0.45	4401	0.4	1.92	0.64	5302	6259
						Karwar						
O.cuvieri	385	0.52	5.5	1.02	4.48	0.81	2196	0.5	1.96	0.78	490	2115
						Calicut						
J.aneus	185	0.8	4	1.77	2.3	0.57	1069	0.47	2.21	0.75	465	1406
						Cochin						
J.sina	195	0.91	4.04	1.8	2.4	0.55	9735	0.71	1.98	1	4345	17700
O.ruber	315	0.64	2.7	1.3	1.4	0.52	2004	0.6	2.04	1	1431	3854

Female : Log W = - 1.6013482 + Log L * 2.78699

Cochin : *J. sina*

Male : Log W = - 8.264755 + Log L * 2.418798

Female : Log W = - 4.319050 + Log L * 2.757509

O. ruber

Male : Log W = - 11.54984 = Log L * 3. 02969669

Female : Log W = -10.013137 + Log L * 2. 756875

Food and feeding: At Veraval *Acetes* spp appears to be the chief food item followed by other prawns and young fish. Among prawns *P. stylifera.* and *Solenocera* spp were the dominant food items. *Bregmaceros* spp, *C. dussumieri*, ribbon fish and *N. japonicus* were also observed in the stomachs of *O. curvieri and J. glaucus*. Among molluscs *Loligo* and *Octopus* were observed.

At Mumbai too *Acetes* spp appears to be the chief food item for all the species of sciaenids. Juveniles showed a marked preference for crustaceans while the adults for fish. Among fish polynemids, *Coilia, Trichurus savala* and eels happened to the chief food item. Among crustaceans *Squilla*, crabs, *Acetes* spp, *P. stylifera*, *Solenocera spp*, *M. stridulans* were found. *Loligo duvaucelii* and gastropod shells were also observed in the stomach.

At Calicut prawns appear to be chief food item of *J. sina and O. ruber.*

At Cochin *J. sina* appear to be carnivorous feeding on fishes like *Stolephorus* spp, silverbellies, juveniles of *Saurida*, flat fish and mackerel. Prawns, *Squilla* spp and *Acetes* spp were also found in the stomach of these species. Squid juveniles were also recorded.*O. ruber* feeds on *Johnieops* spp, *Stolephorus*, flat fish, silverbellies, nemipterids, prawns, crabs, *Squilla*, *Acetes* spp, molluscan shells and squids.

At mandapam prelimanry investigations on *P. macrophthalumus* indicate that it feeds on *Coilia*, anchovies, sardines, prawns crabs and squids.

Reports from Chennai shows that fish, prawns, cephalopods, *Palaemon* spp etc happen to be the chief food items.

Length at first maturity: The length at first maturity was found to be 218 mm and 158 mm for *O. cuvieri* and *J. glaucus* respectively from Veraval. From Mumbai for *J. macrorhynus*, *J. vogleri* and *O. cuvieri* the length at first maturity was calculated as 159, 150, and 170 mm respectively. The lengths at first maturity for *J. sina* and *O. ruber* were calculated as 115 mm and 175 mm respectively.

From Mandapam for *N. maculata* the length at first maturity was recorded at 185 mm. From Visakhapatnam and Kakinada the length at first maturity was found to be 155 mm for *J. carutta* and 110 mm for *J. dussumieri*.

Spawning season: At Veraval *J. glaucus* appears to spawn during September- November and *O. cuvieri* from February to May. The spawning seasons of, *macrorhynus* were July-August and November - December ; *O. cuvieri* spawns in July and December, while *J.vogleri* spawns during June- July and October - November along the waters of Mumbai. Off Cochin *J. sina* spawns during January-April and September - October, *N. maculata* at Mandapam spawns during April- August period. *J. carutta* from Madras shows peak spawning period in June-July. At Visakhapatnam January-April appears to be the peak spawning period of *J. carutta*.

Age and growth: Employing ELEFAN programme developed by Gayanilo *et al.* (1988) the asmptotic length (L_∞) and growth coefficient (K) were estimated for 11 species *(Table 2)* Out of this the L_∞ and K value for three species from Maharashtra and one species from Andhra pradesh were taken from Rao *et al* (1992). The growth and mortality parameters for *N. maculata* from Kakinada estimated by Murty(Personal communication). For rest of the species estimates were freshly made using the latest data.

O. ruber is the largest among all the species studied in the present investigation. The largest size of 440 mm for *O. ruber* is recorded from gill net. The L_∞ of this species was estimated as 470 mm. The smallest L_∞ of 180 mm is estimated for *J. aneus* from Calicut. Highest total mortality coefficient of 7.59 was estimated for *K. axillaris* from Chennai. Highest K of 0.98 was estimated for *P.macrophthalmus* from mandapam and lowest K was 0.47 for *O.*

ruber from Tuticorin. The natural morality coefficient of 1.9 was calculated for *P. macrophthalmus* from Mandapam. The average exploitation rate for all the species together was 0.62. The average yield was 5366 t and average Lc/ Loo was 0.53. The average M/K was found to be 1.98, the Emax 0.83 and standing stock 4005 t. The average MSY stood at 8389 t. According to Gulland (1983) the exploitation rate (E) indicates the fishing pressure on a species. If the E is more than 0.5 then the stock is supposed to be under pressure and hence pose the threat of overexploitation. In the present study it is evident that the E is 0.62 which is beyond the E opt 0.5. But for *O. cuvieri* from Veraval and Mumbai, the exploitation rate is higher for all the species. The highest exploitation rate is from Karwar 0.81. The Lc/Loo ratio is also very high. In spite of all these reasons none of the species show any signs of over exploitation like decrease in the catch or CPUE etc. One of the chief reasons for this may be the faster rate of growth associated with abundance of food supply and the second reason may be the protracted rate of spawning period for all the species.

The E_{max} was calculated as 0.84 at which the projected MSY would be 1,42,613 t as against total yield of all the species as 91,222 t. Thus, though apparently it appears that the catch can be increased further, we have already seen that except that of *O. cuvieri* from Gujarat and Maharashtra the exploitation rate is well beyond the optimum. Thus for the overall benefit of the stock it is better that the efforts be maintained at the present level only.

Future research

a) Stock/ recruitment relation is one of the major field where our knowledge is very limited. A detailed plan must be envisaged to carry out the investigation in this direction.

b) One of the lacunae in our study is limited attempts on the study of fecundity of the species. There is an urgent need to study the fecundity of major sciaenids at all the centres.

c) Hither to our knowledge of age and growth is limited to the application of length frequency data only. Hard parts like scales, otoliths and other

bony structures have not been explored. Study on the hard parts may provide us with a new insight on the growth of fish.

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