Prawn Resources of the Maharashtra Coast with Special Reference to Penaeids

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Maharashtra with an annual average catch of 66250 t contributes to 49% of the nation's marine prawn production. Non-penaeid prawns constitute the bulk, the State's share being 9090 of the Indian non-penaeid catch. Penaeids accounted for 30% of the prawn fishery of the State and 23% of the penaeid landing of India. Statistical analysis of the annual production of prawns in Maharashtra during 1961–80 revealed an upward trend in penaeid prawns. For non-penaeids, the trend showed increase up to 1977 and thereafter a gradual decline The variations in the annual fishing effort have also been discussed.

In view of the importance of penaeid prawns in the export market, the resources characteristics of this group at New Ferry Wharf, an important trawl landing centre at Bombay were monitored during 1979–81 and the results relating to catch per unit effort, species composition, size and maturity of the commercial species have been presented in this account.

Prawns are of high economic value in the sea-food export trade of India. Maharashtra with a coastline of 720 km occupies an important place in the prawn fishing industry. Among the different maritime states, it stands second in penaeid production with an annual average of 19,500 t and foremost in non-penaeid production with an annual average of 46,700 t.

Earlier accounts on the prawn fishery of Maharashtra (Rai, 1933; Shaikhmahmud & Tembe, 1960; Kagwade, 1967; Kunju, 1967 and Mohamed, 1967) deal with seasonal distribution of the resources, species and size composition. Kunju (1979) and Sukumaran (1979) have made observations on the biology of non-penaeid prawns, namely, *Nematopalemon tenuipes* and *Hippolysmata ensirostris* respectively. Kunju (1968), Raje & Ranade (1972 a, b) and Kagwade (1980) have dealt with some aspects of the biology of penaeid or non-penaeid prawns.

In Maharashtra, mechanisation of craft has made rapid strides during the last three decades particularly from 1955 to 1970 in the case of bag netters and from 1968 to 1977 in the case of trawlers. The catch of prawns had increased from 29,900 t in 1961 to 70,700 t in 1980. In order to elucidate the state of the stock, the data on catch during 1961–80 have been analysed and the results are presented here. Though no continuous data on fishing effort are available during these years, the information available for 1965, 1969, 1972, 1977 and 1980 (census figures) from the Department of Fisheries, Government of Maharashtra is included to highlight the fluctuations on effort and catch per unit effort(C.P.U.E.)

Since 1974, the commercial trawlers belonging to Gujarat fishermen have been landing their catch mainly penaeids at Mazagaon. Resource characteristics of the prawn landings at this centre were studied during 1979–82 and the results relating to C.P.U.E, catch composition, size and maturity of the commercial species are also reported.

Materials and Methods

The prawn production data from 1961 to 1980 for the Maharashtra coast have been taken from the Fishery Resources Assessment Division of CMFRI. To find out the trend, a quadratic equation of the type $y=a+bt+ct^2$ (where y is the annual production in thousand tonnes and t is the year) was fitted to the data by the method of least squares.

The gear employed for catching prawns is *dol* (fixed bag net) and trawl. The former accounts for the bulk of the non-penaeid fishery and the latter for penaeids. Fishing is mostly carried out within 60 m depth, the lean period of activity being during June-September which coincides with the south-west monsoon. The motorised bag netters of the various maritime districts of the State undertake 12–30 h trip expending 8 h of fishing. The non-powered bag netters resort to daily trip of 6 fishing h. The bag netters operate taking advantage of the tide. The trawlers go for three-day trips with fishing ranging from 6 to 55 h in the different districts, the maximum duration being in the Greater Bombay area.

The Gujarat trawlers numbering about 400 at Mazagaon in Greater Bombay fish in the area between Ratnagiri (220 km south of Bombay) and Ankleshwar (250 km north of Bombay). Random samples for biological analyses were collected once in a week at this centre.

Males and females of the commercial species were separated and length from the tip of the rostrum to the trip of the telson was measured. The estimation of prawns in numbers in a particular length group (5 mm intervals) and the C.P.U.E, (catch/h) in weight and numbers on each sampling day and for the month and the mean lengths for the month were determined as was followed by Ramamurthy *et al.* (1975). The condition of gonads and the number of impregnated females were noted and the data for each month were pooled and their percentage calculated.

Results and Discussion

In the Indian production of marine prawns, Maharashtra's share is 48.9%. The State's annual average catch of prawns is 66,250 tonnes forming 34.5% of the total catch, penaeids contributed to only 30% of the prawn fishery, the rest being accounted for by non-penaeids (Table 1).

Fig. 1 shows the trend in the annual production of penaeid prawns in Maharashtra from which it is seen that the catch shows an upward trend throughout. On the other hand, the non-penaeid production (Fig 2) had an increasing trend till 1977 and then declined.

The effort data (fishing hours) showed that the increase in the effort in respect of motorised bag netters was gradual whereas in the case of trawlers it was steep. Non-powered bag netters registered a gradual decline in effort (Table 2). The C.P.U.E. for non-penaeids was calculated with reference to bag netters only since the trawlers landed negligible quantity (less than 10%). The catch as well as the C.P.U.E. showed wide annual fluctuations. The best catch of non–penaeids (84,000 t) and C.P.U.E. (22.7 kg) was obtained in 1972 and the lowest corresponding figures of 31,200 t and 8.2 kg occurred in 1969. The non-penaeid prawn fishery is constituted by *Acetes indicus, Nematopalaemon tenuipes* and *Hippolysmata ensirostris* in the order of abundance (CMFRI Annual Reports 1979 and 1980–81).

Table 1. *Catch of penaeids and non-penaeids (in thousand tonnes)*

	Maharashtra			All India		
Year	Penaeids	Non-penaeids	All fish	Penaeids	Non-penaeids	All fish
1961	8.2	21.7	111.8	39.1	23.7	683.6
1962	8.1	33.7	123.7	48.3	35.0	644.2
1963	5.0	37.5	121.3	41.1	40.5	655.5
1964	14.3	29.3	129.9	63.4	31.5	859.6
1965	9.8	40.4	130.6	38.1	41.4	832.8
1966	9.9	33.3	133.3	56.1	34.8	890.3
1967	8.1	28.4	131.8	61.1	29.1	863.9
1968	11.3	30.3	121.6	68.1	31.6	902.8
1969	14.5	31.2	168.7	72.1	34.0	913.6
1970	28.9	28.4	192.4	89.9	31.8	1085.6
Average	11.8	31.4	136.6	57.8	33.3	833.2
% in all fish	8.6	23.0	—	6.9	4.0	
1971	19.0	74.6	215.3	72.1	76.7	1161.4
1972	20.2	84.0	220.0	78.4	85.5	980.0
1973	16.9	63.5	226.7	136.5	67.0	1220.2
1974	14.7	50.0	185.0	114.9	55.2	1217.8
1975	24.7	69.0	256.6	141.7	79.0	1422.7
1976	40.8	63.7	293.6	114.6	76.8	1352.9
1977	26.7	67.0	264.5	96.5	74.0	1259.8
1978	41.1	44.3	284.2	129.2	50.7	1403.6
1979	45.6	56.2	293.3	113.7	63.9	1388.4
1980	23.4	47.3	231.8	112.0	58.7	1249.8
Average	27.3	62.0	247.1	111.0	68.8	1265.7
% in all fish	11.0	25.1	—	8.8	5.4	
Average for 1961–80	19.5	46.7	191.8	84.4	51.0	1049.5
% in all fish 1961–80	10.2	24.3		8.0	4.9	

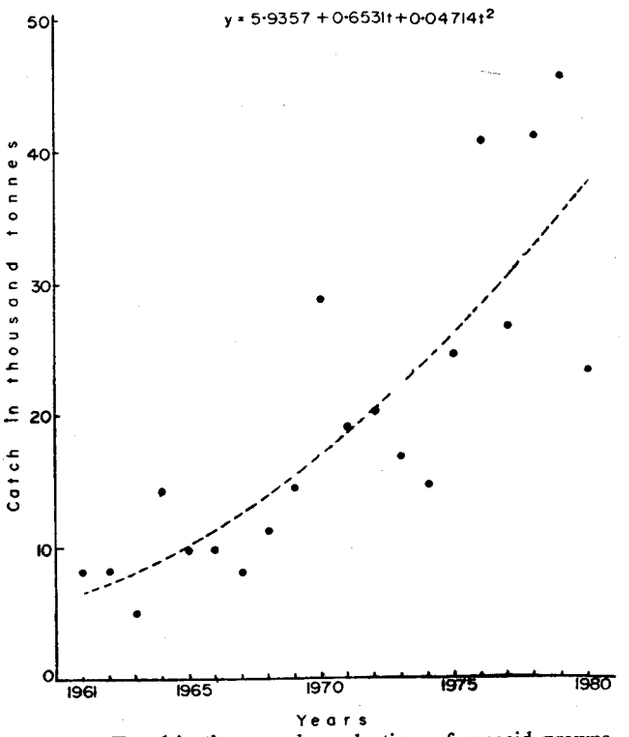

Fig. 1. Trend in the annual production of penaeid prawns in Maharashtra

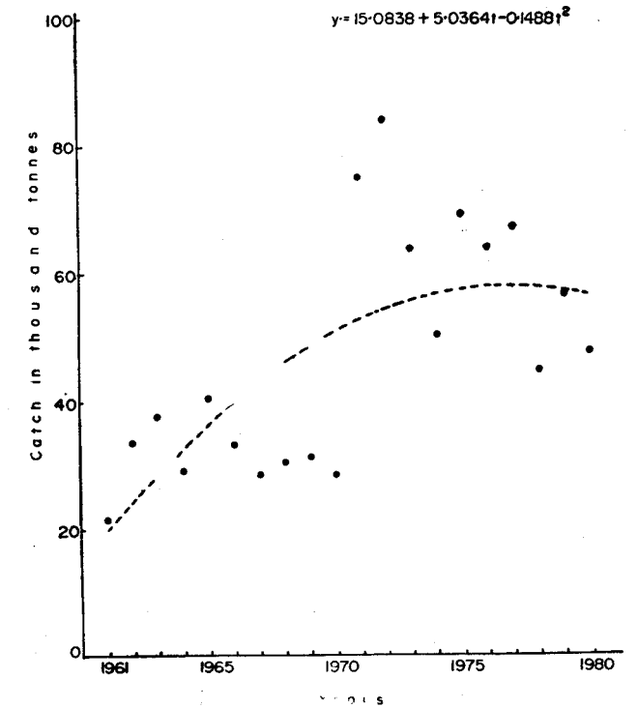

Fig. 2. Trend in the annual production of non-penaeid prawns in Maharashtra

The trawlers initially contributed to only a relatively small portion of total penaeid catch of this region (Mohamed, 1967). With the progressive introduction of trawlers, it was seen that bulk of the penaeid landings (75%) is contributed by this gear. The number of trawlers had increased fivefold during 1969 compared to 1965 and again fivefold during 1980 compared to 1969 (Table 2). The C.P.U.E. for penaeids with reference to trawl was not calculated during 1965 since the trawlers were just then introduced. For the remaining years the C.P.U.E was calculated taking 75% of penaeid landings as the catch by trawlers. While the penaeid prawn catch showed annual fluctuations like the non-penaeids, the C.P.U.E. was found to be on the decline with increasing effort. The best catch of penaeids (26,700 t) was obser ved in 1977 with C.P.U.E. at 9.8 kg whereas the low catch of 14,500 t was recorded in 1969 with C.P.U.E. at 18.4 kg. Thus it could be seen that though the catch rate has been declining in the case of penaeid prawns with increasing fishing effort, the prawn fishery, on the whole, has not shown any sign of adverse effect so far in the biological sense.

At Mazagaon, during 1979–82 the trawlers landed 18662.3 t of penaeid prawns froming 32.7 % of the total catch. The C.P.U.E. was calculated as 5.9. kg. The data collected during these years are presented in Tables 3 to 8 and Figs. 3 to 5.

It was observed that the best catch and catch rate were obtained during 1980–81. The penaeids formed 30.7, 37.8 and 28.7% of the trawl catch respectively during the three years. The catch was generally poor during June–August coinciding with the lean period of fishing activity on account of inclement weather. The peak period of the fishery was correspondingly in December, November and October. The highest C.P.U.E. was however, observed in August in all the years. *Parapenaeopsis stylifera* formed bulk of the penaeid catch, 41.2% on an average, *Solenocera crassicornis, Metapenaeus affinis* and *M. monoceros* formed 24.1, 19.2 and 8.2% respectively. All these species, besides *Penaeus* spp. (2%) occurred throughout. Among penaeids of seasonal occurrence were *P. hardwickii* and *M. brevicornis* (January–April), *Metapenaeopsis stridulans* (October-November and April-May), *M. kutchensis;* (November-February) *Trachypenaeus curvirostris* and *Parapenaeus longipes* (February-April) and *P. sculptilis* (June-July), which occurred in varying quantities.

P. stylifera: This species formed 36.8, 49.0 and 33.7% of the penaeid landings during the three years respectively. The peak period of the fishery was in December during 1979-80 and in November during the other two years. A secondary peak was noticeable in April 1981.

The size composition indicated multi-modal pattern. Recruitment appeared to take place twice in a year–September-October and April-May as indicated by the modal

Table 2. *Effort and C/E in Maharashtra*

Year	Bag netters	Mechanised trawlers	Non-mechanised bag netters	Fishing hours mechanised bag netters	In thousand non-mechanised bag netters	Total	Trawling hours in thousand	Non-penaeid C/h (bag netters), kg.	Penaeids C/h (trawlers), kg.
1965	910	58	1,782	906.5	3,029.4	3,935.9	101.8	10.3	—
1969	1,156	317	1,552	1,187.0	2,638.4	3,825.4	580.8	8.2	18.4
1972	1,229	674	1,432	1,259.2	2,434.4	3,693.6	1,240.1	22.7	12.2
1977	1,481	1,137	1,228	1,530.1	2,087.6	3,617.7	2,041.9	18.5	9.8
1980	1,769	1,559	1,070	1,795.2	1,819.0	3,614.2	2,791.4	13.1	6.3

Table 3. *Catch in tonnes and C/h in Kg.* during* 1979–80 *at New Ferry Wharf (Mazagaon)*

Month	*M. affinis*	*M. monoceros*	*M. brevicornis*	*P. stylifera*	*P. hardwickii*	*S. crassicornis*	*Penaeus* spp	Other Penaeids	Total Penaeids	All fish
July	0.74 (0.8)	1.25 (2.7)	0.19 (0.2)	0.53 (0.6)	0.91 (1.0)	5.98 (7.0)	0.78 (0.9)	—	11.38 (13.2)	52.49
August	7.17 (3.9)	31.27 (16.9)	—	14.16 (7.7)	—	38.20 (20.7)	0.95 (0.5)	0.90 (0.5)	92.65 (50.2)	303.68
September	289.17 (2.6)	96.86 (0.8)	—	188.62 (1.7)	—	207.19 (1.8)	12.63 (0.1)	14.13 (0.1)	808.60 (7.1)	1,636.15
October	539.08 (4.6)	112.68 (0.9)	—	388.70 (3.3)	—	97.51 (0.8)	1.82 —	8.85 (0.1)	1149.63 (9.7)	2,002.43
November	92.57 (0.9)	18.96 (0.2)	1.00	317.59 (2.9)	—	103.45 (0.9)	7.62 (0.1)	9.66 (0.1)	550.85 (5.1)	1,815.88
December	54.56 (0.4)	25.40 (0.2)	7.31 (0.1)	821.38 (6.4)	—	255.71 (2.0)	23.69 (0.2)	—	1188.05 (9.3)	3,267.27
January	18.77 (0.2)	12.23 (0.1)	22.58 (0.2)	128.45 (1.2)	—	92.35 (0.9)	12.07 (0.1)	8.84 (0.1)	295.28 (2.8)	1,675.09
February	15.16 (0.1)	43.58 (0.4)	21.69 (0.2)	85.00 (0.8)	—	77.53 (0.7)	9.40 (0.1)	5.68 —	258.54 (2.3)	1,878.76
March	9.98 (0.1)	50.34 (0.4)	13.39 (0.1)	23.30 (0.2)	98.92 (0.8)	153.48 (1.3)	14.22 (0.1)	1.71 —	365.34 (3.0)	1,759.90
April	37.12 (0.3)	66.42 (0.5)	5.15 —	—	79.07 (0.6)	247.15 (1.9)	20.62 (0.2)	0.12	455.65 (3.5)	1,594.32
May	19.20 (0.2)	6.04 (0.1)	2.28 —	25.37 (0.3)	0.59 —	175.13 (2.3)	6.84 (0.1)	—	235.45 (3.0)	1,525.10
June	2.59 (0.6)	0.94 (0.2)	0.55 (0.1)	0.28 (0.1)	—	7.05 (1.6)	2.90	0.05 —	14.36 (2.6)	144.93
Total	1086.11 (1.0)	466.97 (0.5)	74.14 (0.1)	1993.38 (2.0)	179.49 (0.2)	1460.73 (1.4)	114.54 (0.1)	49.94 —	5425.30 (5.3)	17,656.00

*in parenthesis

Table 4. *Catch in tonnes and C/h* in Kg during* 1979–80 *at New Ferry Wharf (Mazagaon)*

	M.affinis	*M. monoceros*	*M. brevicornis*	*P. stylifera*	*P. hardwickii*	*S. crassicornis*	*Penaeus* spp	Other penaeids	Total	All fish
July	1.26	0.22	0.11	0.15	—	1.35	0.06	0.40	3.54	16.74
	(5.5)	(0.9)	(0.4)	(0.8)		(5.6)	(0.4)	(1.7)	(15.3)	
August	9.36	11.95	0.35	1.16	—	9.95	0.23	0.14	33.14	81.84
	(11.2)	(14.2)	(0.5)	(1.4)		(11.8)	(0.2)	(0.1)	(39.4)	
September	784.04	74.61	—	187.29	—	28.59	12.13	1.34	1088.00	1,977.89
	(7.0)	(0.7)		(1.7)		(0.2)	(0.1)	—	(9.7)	
October	380.31	54.99	—	703.34	—	0.99	15.74	—	1155.37	2,005.73
	(2.9)	(0.4)		(5.3)		—	(0.1)		(8.7)	
November	84.11	18.25	—	1166.19	—	96.94	34.46	—	1399.95	2,379.64
	(0.7)	(0.1)		(9.2)		(0.8)	(0.3)		(11.1)	
December	24.94	23.22	1.06	967.53	—	94.50	11.07	2.17	1124.49	2,256.26
	(0.2)	(0.2)	—	(6.8)		(0.7)	(0.1)	—	(8.0)	
January	13.30	18.66	41.89	333.92	2.09	146.67	8.22	0.05	564.79	2,567.09
	(0.1)	(0.2)	(0.3)	(2.8)		(1.2)	(0.1)	—	(4.7)	
February	9.48	21.48	17.94	86.87	163.63	248.89	3.80	—	552.09	2,122.00
	(0.1)	(0.2)	(0.2)	(0.8)	(1.5)	(2.4)	—		(5.2)	
March	102.80	195.73	71.57	24.60	30.51	234.62	6.42	4.32	670.57	1,995.99
	(1.0)	(1.9)	(0.7)	(0.2)	(0.3)	(2.3)	(0.1)	(0.1)	(6.5)	
April	47.87	113.95	2.76	273.61	14.56	430.80	36.67	—	920.22	3,522.13
	(0.3)	(0.8)	—	(1.9)	(0.1)	(2.9)	(0.3)		(6.3)	
May	34.97	97.96	15.77	147.46	1.88	120.73	3.68	3.72	426.17	1,999.90
	(0.3)	(0.9)	(0.1)	(1.4)	—	(1.1)	—	—	(3.8)	
June	0.31	0.54	0.39	0.60	—	3.46	0.41	0.48	6.19	66.31
	(0.4)	(0.8)	(0.5)	(0.9)		(5.0)	(0.6)	(0.7)	(8.9)	
Total	1492.75	631.56	151.84	3892.72	212.67	1417.49	132.88	12.617)	7944.52	20,991.52
	(1.4)	(0.6)	(0.1)	(3.5)	(0.2)	(1.3)	(0.1)		(7.2)	

*C/h in parenthesis

Table 5. *Catch in tonnes and C/h* in Kg during* 1981–82 *at New Ferry Wharf (Mazagaon).*

	M. affinis	*M. monoceros*	*M. brevicornis*	*P. stylifera*	*P. hardwickii*	*S. crassicornis*	*Penaeus* spp	*Other* Penaeids	Total	All fish
July	0.28	0.38	0.01	0.31	0.08	0.31	0.03	0.47	1.87	16.54
	(1.5)	(2.0)	(0.1)	(1.7)	(0.4)	(1.7)	(0.1)	(2.5)	(10.0)	
August	5.27	15.09	0.39	16.88	—	0.30	5.61	—	43.54	82.86
	(6.5)	(18.7)	(0.5)	(21.0)		(0.4)	(7.0)		(54.1)	
September	261.61	55.31	—	324.87	—	—	20.97	—	662.76	1,117.97
	(3.2)	(0.6)		(3.8)			(0.2)		(7.8)	
October	216.74	109.21	14.08	439.31	—	46.02	7.90	92.62	925.88	2,331.67
	(1.7)	(0.9)	(0.1)	(3.5)		(0.4)	—	(0.7)	(7.3)	
November	6.55	4.14	0.04	531.65	—	273.40	0.24	0.24	816.26	2,323.47
	—	—	—	(4.5)		(2.3)	—	—	(6.8)	
December	14.84	4.73	4.71	168.30	—	218.11	8.14	1.87	420.70	2,292.52
	(0.1)	—	—	(1.4)		(1.7)	(0.1)		(3.3)	
January	74.67	51.00	5.65	176.87	84.04	229.00	14.35	12.36	647.94	3,041.54
	(0.5)	(0.3)	—	(1.2)	(0.6)	(1.6)	(0.1)	(0.1)	(4.4)	
February	22.24	84.28	3.50	63.81	37.42	225.29	2.43	9.36	448.33	2,142.07
	(0.2)	(0.7)	—	(0.6)	(0.3)	(2.0)	—	(0.1)	(3.9)	
March	130.73	25.11	2.17	—	34.81	368.96	37.92	—	599.70	2,042.82
	(1.2)	(0.2)	—		(0.3)	(3.3)	(0.4)		(5.4)	
April	212.30	9.31	—	42.42	2.70	160.14	70.94	—	497.81	1,950.91
	(1.5)	(0.1)		(0.3)	—	(1.1)	(0.5)		(3.5)	
May	31.25	36.38	1.02	3.45	10.77	60.66	7.69	35.40	186.62	868.80
	(0.4)	(0.5)	—	—	(0.1)	(0.7)	(0.1)	(0.4)	(2.2)	
June	10.07	1.34	0. 33	4.50	—	11.81	2.20	10.97	41.22	252.00
	(6.0)	(0.8)	(0.2)	(2.7)		(7.1)	(1.3)	(6.6)	(24.7)	
Total	986.55	396.28	31.90	1772.37	169.82	1594.00	178.42	163.29	5292.63	18,463.17
	(0.9)	(0.4)	—	(1.7)	(0.2)	(1.5)	(0.2)	(0.1)	(5.0)	

*C/h in parenthesis

Table 6. *Sex distribution (females) and mature females in percentage*

		July	August	September	October	November	December	January	February	March	April	May	June
						P. stylifera							
Sex (F)	1979–80	42.5	69.8	66.4	53.2	64.0	70.9	83.6	99.2	100.0	—	100.0	—
	1980–81	95.5	95.7	62.3	68.1	63.5	68.4	75.1	74.2	82.1	71.1	89.5	64.7
	1981–82	68.8	75.9	66.2	60.4	68.3	59.9	68.4	60.1	—	65.4	—	92.2
Maturity	1979–80	—	—	—	—	2.0	—	0.6	—	—	—	—	—
	1980–81	—	—	—	—	4.3	—	1.5	—	1.7	4.5	—	—
	1981–82	—	—	—	—	—	—	—	—	—	—	—	2.6
						S. crassicornis							
Sex (F)	1979–80	45.5	68.0	70.5	78.6	68.8	83.2	73.3	59.1	74.3	62.2	69.6	75.9
	1980–81	85.7	83.0	58.8	47.6	52.3	53.6	66.1	61.8	67.9	70.4	78.4	55.9
	1981–82	87.3	71.6	—	68.4	65.7	70.2	63.6	50.5	67.7	49.9	46.4	70.7

Table 7. *Sex distribution (females) and impregnated/mature females in percentage*

		July	August	September	October	November	December	January	February	March	April	May	June
						M. affinis							
Sex (F)	1979–80	—	69.4	57.9	55.9	56.2	58.2	27.6	89.3	66.4	54.4	74.1	68.7
	1980–81	74.0	83.0	66.8	77.9	54.6	52.2	60.6	96.9	61.6	60.9	69.6	69.3
	1981–82	71.3	—	68.7	56.1	75.8	67.3	59.3	60.5	54.8	61.0	56.1	96.9
Impregnation													
	1979–80	—	14.6	—	24.4	26.1	3.5	2.2	—	5.6	1.0	2.7	3.5
	1980–81	7.1	3.0	—	5.3	1.7	—	2.7	3.4	4.8	11.4	5.9	—
	1981–82	2.2	—	3.0	15.6	—	—	1.8	—	5.7	0.9	8.2	6.7
Maturity	1979–80	—	—	—	2.2	4.8	13.2	10.0	3.7	2.8	4.0	4.4	3.5
	1980–81	—	1.4	—	4.6	5.1	6.3	2.7	3.4	2.9	3.8	1.0	—
	1981–82	2.2	—	1.5	—	6.1	2.7	3.7	4.2	1.9	1.7	7.0	3.3
						M. monoceros							
Sex (F)	1979–80	48.0	54.4	63.2	55.9	60.5	56.8	62.1	—	59.7	58.9	43.7	—
	1980–81	49.1	49.5	36.0	59.9	54.7	79.0	50.8	51.0	52.3	54.8	68.1	—
	1981–82	66.8	—	52.5	64.0	60.3	71.1	67.4	63.0	58.6	51.7	39.3	47.7
Impregnation													
	1979–80	16.7	3.3	24.2	34.2	9.6	12.0	—	—	1.0	—	—	—
	1980–81	—	13.7	1.2	1.2	—	—	—	—	4.3	12.5	1.5	—
	1981–82	—	—	—	15.7	—	—	1.1	—	2.2	—	2.0	—
Maturity	1979–80	4.2	—	3.3	16.0	—	1.3	—	—	—	0.8	—	—
	1980–81	—	—	—	0.6	—	—	—	—	—	—	—	—
	1981–82	—	—	—	1.6	—	0.9	2.2	—	1.1	—	—	—

Table 8. *Sex distribution (females) and impregnated / mature females in percentage*

		July	August	September	October	November	December	January	February	Match	April	May	June
						M. brevicornis							
Sex (F)	1979–80	96.5	—	—	—	88.9	82.4	26.9	78.9	95.3	—	77.2	85.5
	1980–81	—	—	—	—	—	—	67.7	63.5	86.8	75.4	97.2	84.1
	1981–82	84.9	—	—	—	—	73.3	83.3	72.0	90.8	—	82.5	33.4
Impregnation													
	1979–80	100.0	—	—	—	100.0	100.0	100.0	100.0	100.0	—	100.0	100.0
	1980–81	—	—	—	—	—	—	96.3	100.0	95.5	100.0	100.0	100.0
	1981–82	—	—	—	—	—	100.0	100.0	100.0	100.0	—	100.0	100.0
Maturity	1979–80	14.8	—	—	—	16.7	—	7.7	—	14.3	—	1.3	1.7
	1980–81	—	—	—	—	—	—	16.6	1.6	1.0	1.9	1.6	—
	1981–82	—	—	—	—	—	—	—	2.7	—	—	—	—
						P. hardwickii							
Sex (f)	1979–80	96.8	—	—	—	—	—	—	—	100.0	100.0	—	—
	1980–81	—	—	—	—	—	—	100.0	100.0	96.2	83.3	92.7	—
	1981–82	72.7	—	—	—	—	—	97.2	92.6	98.1	93.5	97.4	—
Maturity	1979–80	—	—	—	—	—	—	—	—	0.9	—	—	—
	1980–81	—	—	—	—	—	—	—	4.0	4.4	—	—	—
	1981–82	—	—	—	—	—	—	—	—	—	—	—	—

size distribution and mean length values. Mohamed (1967) indicated single recruitment during September-Novemebr in the Bombay waters. There was a preponderance of females in the populations as was noticed in the Mangalore area on the west coast (Ramamurthy, 1980). Very high degree of segregation of sexes was observed during January–May of 1979–80 and 1980–81. This coincided with the breeding period March–May as indicated by the recruitment of juveniles as well as by the occurrence of relatively more number of mature females in the catch during this period. Such segregation of sexes associated with breeding movements have been already reported (George & Rao, 1967).

S. crassicornis: It constitituted 26.9, 18.0 and 30.2% of penaeid, catch during the respective three years. The peak occurrence was in April during 1979–80 and 1980–81 and in March during 1981–82. During the first year there were two more periods of abundance, namely, September and December.

The size composition showed uni or bi-modal distribution for males whereas for females it was multimodal. Smaller size groups and low mean length values were recorded mostly during October–November and March–April indicating the intense period of recruitment. Females preponderated almost throughout with a high degree of segregation in December during 1979–80 and 1981–82 and in May during 1980–81. Maximum breeding according to Kunju (1967) is in December and April and the sex segregation noticed during the present study more or less coincided with the breeding period.

M. affinis: The percentage composition among the penaeids was 20.0, 19.0 and 18.5 respectively during the period of study. The fishery had two periods of abundance, namely, September and March–April, the former being the primary one.

The size distribution revealed multiple modes. Younger size groups were seen during September-November and March–April. Though female predominated in the population, the segregation was not pronounced. This is in conformity with the observations made by George & Rao (1967) in the Cochin waters. Percentage of impregnation was high during October–November and March–May and mature females during November–December and April–May. Mohamed (1967) noticed year round intense activity during December–February and June–August in Bombay coast.

M. monoceros: The species composition was 8.6, 7.8 and 7.3% respectively during 1979–80, 1980-81, and 1981–82. The seasonal distribution, size composition and sex proportions were more or less similar to those of *M. affinis.*

Recruitment was noticed during August–October. Percentage of impregnation was high in July, September and October during 1979–80, August and April during 1980–81 and October during 1981–82. Mature

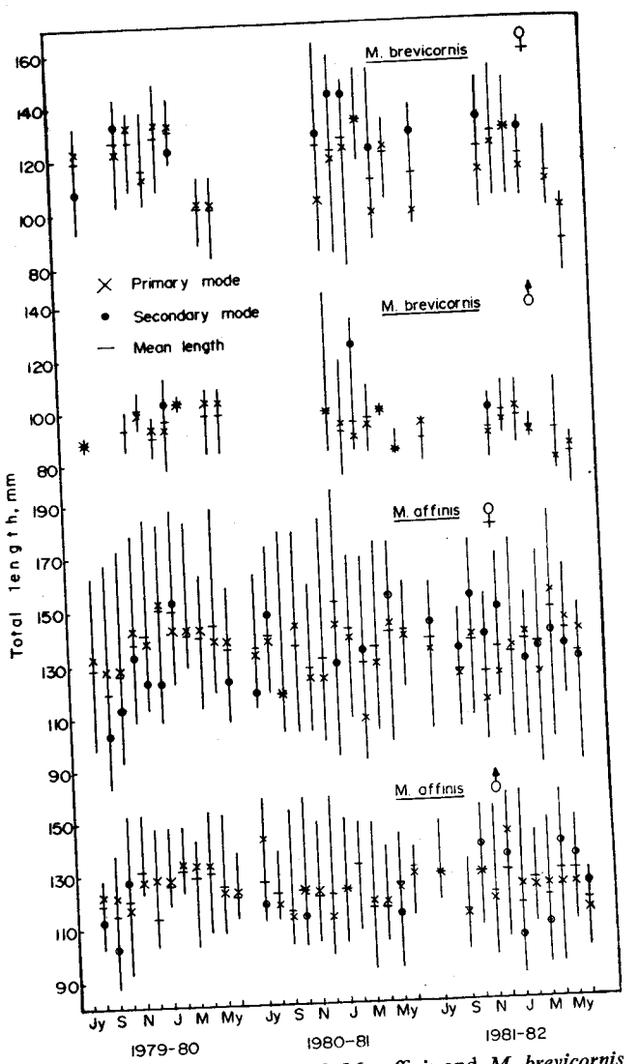

Fig. 3. Size composition of *M. affinis* and *M. brevicornis* at Mazagaon

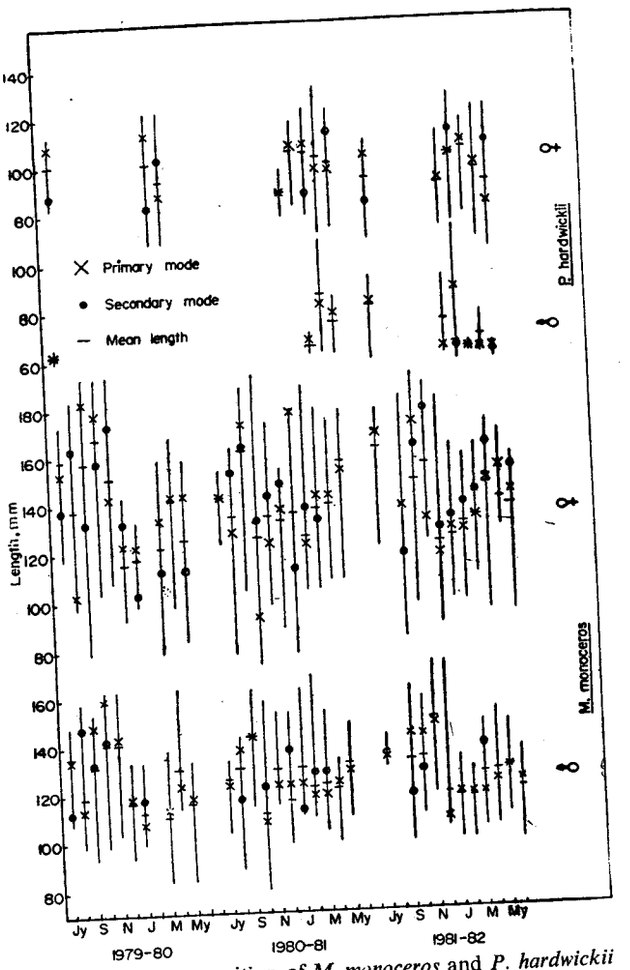

Fig. 4. Size composition of *M. monoceros* and *P. hardwickii* at Mazagaon

females were scarce except in October 1979. This suggests that the breeding grounds are in deeper areas. The intense breeding activity is probably during July–October.

P. hardwickii: This species ranked fifth in abundance and occurred during January–May. Males were scarce in the catches as was observed by Mohamed (1967). Smaller size groups occurred in the catch during April–May. Mature females were poorly represented except during February–March, 1980, indicating that breeding is in the deeper grounds. Mohamed (1967) inferred that the breeding intensity was during December-January.

M. brevicornis: The seasonal distribution of this species was similar to that of *P. hardwickii.* Females predominated except in January 1979. Their proportion was found to increase as the season advanced indicating that they stay longer at the fishing grounds. Recruitment appeared to take place during May–June. Percentage of impregnation was high throughout. Mature females were relatively more during January–March. This species is reported to breed during March–April in the Gulf of Kutch (Ramamurthy, 1967).

Certain salient features emerge from this study. 1. The non-penaeid catch increased from 32,000 t during the early sixties to 56,000 t in late seventies as a result of rapid motorisation of the bag netters. Kunju (1967) observed that *N. tenuipes* was by far the most abundant species followed by *A. indicus* in the bag net catches. The composition of the bag net fishery now reveals that *A. indicus* is the major constituent followed by *N. tenuipes* (CMFRI Annual Reports 1979 and 1980–81). Similarly the trawl net fishery during late fifties brought only relatively small quantities of penaeid prawns mainly dominated by *M. affinis* (Mohamed 1967). The total penaeid landings which were a mere 9000 t during the early sixties (mainly caught by bag-nets) had increased

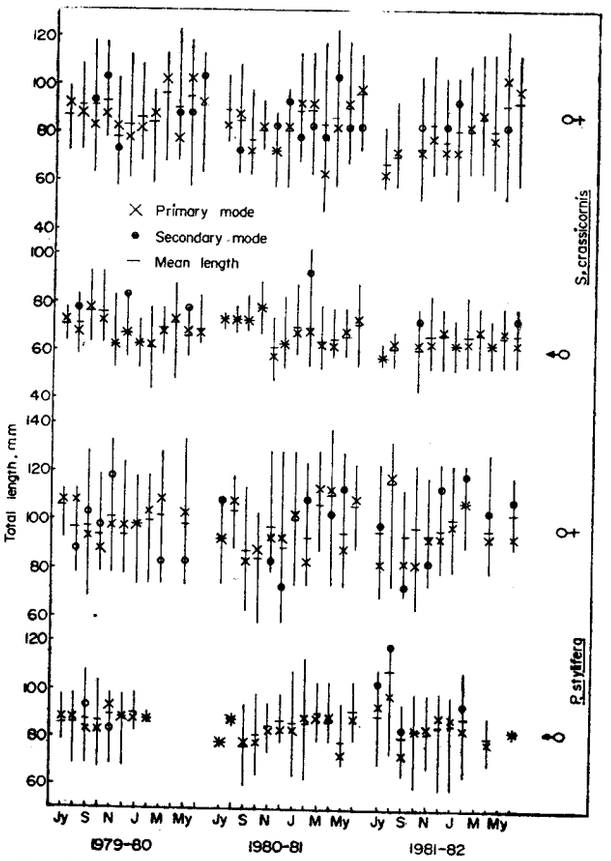

Fig. 5. Size composition of *P. stylifera* and *S. crassicornis* at Mazagaon

four fold during the late seventies as a result of mechanisation. Species-wise, *P. stylifera* and *S. crassicornis* which were originally insignificant in the trawl catch have now established themselves as a fishery and form the major constituents. *M. affinis* has been relegated to a third place. Thus a change in the pattern of the fishery over the years is evident which has been brought about as a result of the operational efficiency of the craft and gear, extending the fishing grounds from 20 to 60 m depth zones, and making day and night fishing possible with fish-hold facilities. 2. The present observations did not indicate any downward trend of the fishery except for a slight decline of non-penaeids from 1978. 3. The penaeid landings at Mazagon reveal that there are two types of inhabitants in the trawling grounds-permanent and seasonal. Among the former category *M. affinis* and *M. monoceros* have the period of maximum occurrence during September–October, *P. stylifera* during November–December and *S. crassicornis* during March–April. The seasonal inhabitants, namely, *P. hardwickii* and *M. brevicornis* are dominant during January–March. 4. It has been observed that sex-wise, females of *P. stylifera, P. hardwickii, S. crassicornis* and *M. brevicornis* were being exploited more. Hence it would be necessary to watch the catch trends of these species with a view to ensure rational exploitation of the resource.

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