

## ON THE BIOLOGY OF THE PENAEID *PARAPENAEOPSIS SCULPTILIS* (HELLER) IN THE BOMBAY AREA

K. K. SUKUMARAN AND K. N. RAJAN

*Central Marine Fisheries Research Institute Research Centre, Mangalore.*

### ABSTRACT

Male and female *Parapenaeopsis sculptilis* in the fishery registered monthly average growths of 5.88 mm and 8.17 mm, respectively. The young prawns recorded faster rate of growth, about 15 mm per month. In the inshore fishery the smallest female with fully matured ovary measured 88 mm in length, whereas in the Arnala creek the prawns measuring 71 mm and above were found to be mature. Spawning is year-round with two peaks, one during February-March and another during July-November. The chi-square values at 5% probability level showed that the observed proportion of males in different months of the years except 1969 were statistically significant. Sizewise distribution of sex ratio revealed that males were predominant in the sizes within 78-98 mm and females outnumbered males in the rest of the sizes.

The estimated annual catch of *P. sculptilis* varied from 16.9 t to 102.7 t and from 3.6 t to 16.9 t at Sassoon Docks and Versova respectively. The best season of the fishery was during November-March period.

### INTRODUCTION

The penaeid prawn *P. sculptilis* contributes to a minor fishery along the northern regions of west and east coasts of India. Kunju (1967) reported this species to be contributing to 5.9%, 2.2% and 10.4% respectively of the total prawn catches at Sassoon Docks, Versova and Arnala.

Rajyalkashmi (1966) studied the growth, sex ratio and spawning of the species from the Hooghly estuary. Hall (1962) studied the food habits and growth from Malaysian waters, and Kirkegaard and Walker (1970) gave some biological data on this species from Australia. A brief account on the seasonal abundance, maturity and spawning of this prawn is given by Patel and Balapatel (1982) from the Gulf of Khambhat. The present account deals with the age and growth, spawning, sex ratio and size at maturity together with a brief account of the fishery of this prawn based on the studies conducted at Bombay during 1966-76.

## MATERIAL AND METHODS

Samples for biological study were taken from the commercial catches of the 'dol' nets operating in shallow waters (at 10 to 15 m depth) at Sassoon Docks. A few samples were also collected from the catches of smaller stake nets ('bokshi'), operating in depth 2 to 8 m in Arnala creek, about 60 km north of Bombay.

Observations on the fishery were made at Sassoon Docks and Versova, two important landing centres in Bombay, collecting catch statistics. The methods for collecting catch statistics are the same as those followed for the study of *Solenocera crassicornis* (Sukumaran 1978).

## OBSERVATIONS

*Growth*

In order to determine the growth rate and fix the age at different lengths, the length-frequency distribution of males and females for the period 1966 to 1971 is plotted (Figs. 1 & 2) and, to facilitate tracing of modes, year classes

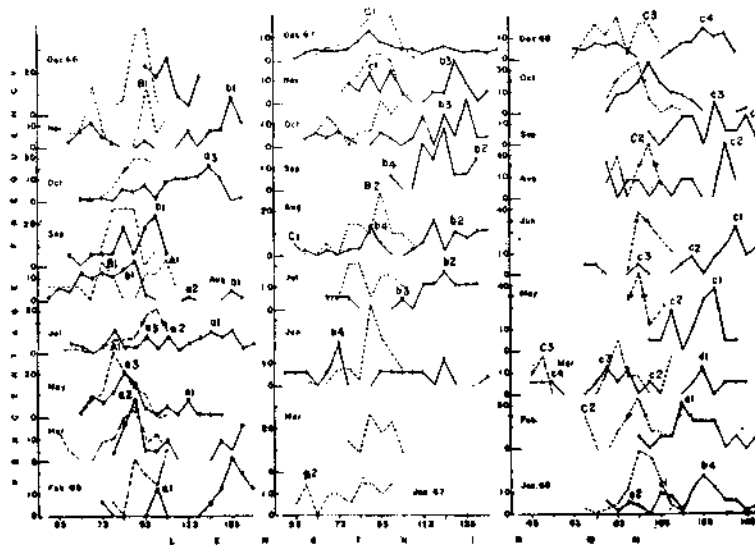


FIG. 1. Length-frequency distribution of *P. sculptilis* during different months for 1966, 1967 and 1968 seasons at Sassoon Docks.

are designated in alphabetical order. Since this species is a perennial spawner, year-round recruitment is expected. From the figures it is seen that young prawns of size 40-60 mm enter the fishery in large numbers, particularly during April-July period. Larger size groups generally dominate in the fishery in August, September and October. Taking all these into consideration, it may be said that,

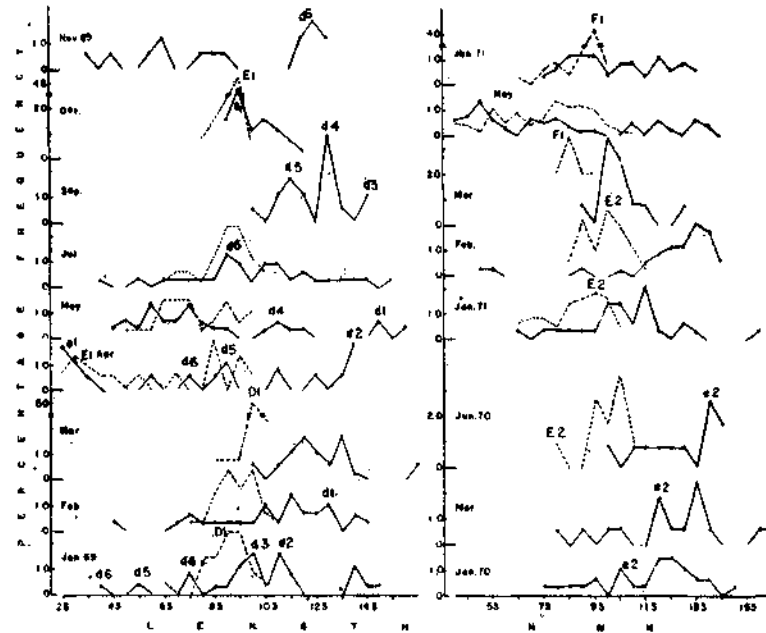


FIG. 2. Length-frequency distribution of *P. sculptilis* during different months for 1969, 1970 and 1971 seasons at Sassoon Docks.

among males, the brood B2 (58 mm) of January 1967, which is the product of the previous year's spawning, grows to 93 mm in August 1967, by the end of first year. The size groups C2 (68 mm) of February 1968, C3 (48 mm) of March 1968 and E2 (78 mm) of June 1970, products of previous years' spawnings, each attains a length of 98 mm, by August 1968, December 1968 and February 1971, respectively, all completing one year. Among females, the broods a2 (88 mm) of March 1966 and d5 (53 mm) of January 1969, which are the products of previous years' spawnings, attain 113 mm respectively in August 1966 and September 1969, also at the end of one year. The progression of the broods such as b1, b2, b3, b4, c1, c2, c3, c4, d1, d2, d3 and d4 follows the same pattern. Therefore, it would appear that males and females of the species grow to a length of 93 mm and 113 mm, respectively, by the end of one year. The growth seems to be slow during the second year, particularly in males. The average monthly growths obtained for males and females were 5.88 mm and 8.17 mm, respectively.

#### Breeding

Five maturity stages are recognized in females, viz., immature, early maturing, late maturing, mature and spent recovering. These maturity stages have been described by the authors while studying the biology of *Parapeneopsis*

*hardwickii* (Sukumaran and Rajan 1981). The monthwise distribution of different maturity stages for the period 1966-71 was studied in order to determine the spawning season. Since the monthwise distribution of maturity stages varied from year to year, the data for the entire period were pooled and the monthwise figure was drawn (Fig. 3) to find out the peak period of spawning. It is evident from this figure that the species spawns year round with peaks during February-March and July-November.

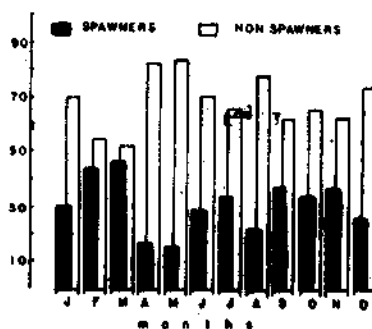


FIG. 3. Percentage distribution of spawners and nonspawners during different months (monthwise pooled) at Sassoon Docks.

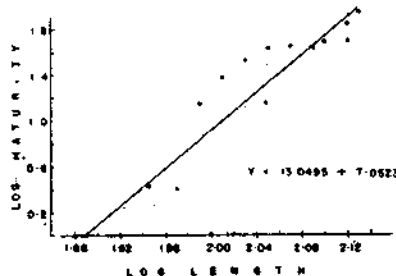


FIG. 4. Percentage distribution of maturing and mature females of *P. sculptilis* against length and a regression line drawn to show the minimum size at maturity.

Although the smallest female with fully matured ovary measured 88 mm in total length, the bulk of the spawners in the fishery are in the size range of 113-143 mm (Table 1) and are one-year olds.

#### Minimum Size at Maturity

In order to find out the minimum size at maturity, the size distributions of late-maturing and mature females were grouped into 5 mm size intervals and percentages found out. Since prawns in various stages of maturity could be noticed at all lengths, a regression line was fitted to the data, using the least square method (Fig. 4). From this, it is seen that the minimum size at maturity was 78 mm, though the smallest prawn with fully matured ovary measured 88 mm at Sassoon Docks. It is interesting to note that prawns measuring 71 mm were also found to be mature at Arnala.

#### Sex Ratio

Considerable variation in the distribution of sexes is noticed among the months (Table 2). In order to ascertain statistically whether there was any significant difference in the proportion of males and females in the monthly

TABLE 1. *Sizewise distribution of late maturing and mature females of P. sculptilis during different months (monthwise pooled) at Sassoon Docks and Arnala.*

Size groups mid-point (mm)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		
73				*1										
83			—	2	*1									
88		1	—	10	—									
93		—	1	2	7	—	*1							
98		—	2	1	4	3	1	—		5				
103	1	1	—	2	4	1	7	1	2	2		6		
108	2	—	2	6	2	1	3	—	1	—	1	9	2	
113	2	3	2	7	1	—	8	2	1	3	1	—	13	3
118	1	3	5	2	2	1	1	—	3	5	—	11	1	5
123	1	1	3	1	3	1	—	5	1	—	12	2	9	
128	4	4	2		2	1	1	4	2	10	1	7	8	
133	3	5	6		1	4	1	5	4	3	4	9	9	
138	8	9	7		2	2	3	4	4	2	2	4	7	
143	2	2	1		—	3		1	4	5	1	1	2	
148	3	1			1	1		1		1			1	
153	—				1			1						
158	1													

\* 'bokshi' net catch from Arnala.

samples during different years, the chi-square test was applied. The chi-square values at 5% probability level during 1966, 1967 and 1968 showed that the observed proportion of males in the different months of the years are statistically significant (Table 3). However, the corresponding value for 1969 is found to be not significant, which may possibly be due to the small size of the monthly samples. Chi-square test of the monthwise pooled data for 1966-69 period showed that the proportion of males is statistically significant. The male : female ratios at various lengths during different years showed that males were considerably more in the size groups between 78 and 98 mm, and females so in the rest of the size groups (Table 4).

TABLE 2. *Monthwise sex ratio of P. sculptilis during different years at Sassoon Docks.*

Months	1966		1967		1968		1969	
	No. of prawns	% of males	No. of prawns	% of males	No. of prawns	% of males	No. of prawns	% of males
January	—	—	27	74.1	126	61.1	45	44.4
February	30	50.0	—	—	28	42.9	52	45.1
March	49	53.1	29	75.9	27	40.7	30	40.0
April	—	—	—	—	—	—	33	45.4
May	192	57.8	—	—	38	44.7	55	49.1
June	—	—	44	65.7	40	45.0	—	—
July	81	54.3	36	52.8	16	43.8	63	52.4
August	88	19.3	57	36.8	26	57.7	—	—
September	27	40.7	19	26.3	19	26.3	23	26.1
October	137	39.4	42	33.3	147	45.6	38	34.2
November	47	29.8	50	60.0	—	—	24	37.5
December	49	55.1	164	51.8	120	38.3	—	—
Annual	700	45.6	468	52.3	587	46.8	363	44.1

TABLE 3 *Test of homogeneity (chi-square) for the proportion of males in the monthly samples during 1966-69 and for the pooled data.*

Year	Degrees of freedom	Chi-square value	Significant at 5%
1966	8	48.6811	S
1967	8	32.7260	S
1968	9	19.0765	S
1969	8	4.7797	NS
Pooled	10	70.2635	S

S — Significant, NS — Not Significant

TABLE 4. *Sizewise sex ratio of P. sculptilis during different years at Sassoon Docks (sex ratio is given as number of females per unit male).*

Size group (mm)	1966	1967	1968	1969	1970	1971
36-40	—	—	—	2.0	—	1.3
41-45	—	—	1.0	3.0	—	3.0
46-50	1.0	*	0.3	2.0	—	11.0
51-55	2.0	1.0	*	1.5	—	1.0
56-60	2.3	1.0	**	3.0	—	0.7
51-65	2.7	2.0	*	0.8	—	0.1
66-70	1.5	0.8	0.6	0.6	**	0.8
71-75	1.0	0.9	0.9	1.3	*	0.6
76-80	0.5	0.4	0.9	0.7	2.0	0.5
81-85	1.0	0.3	0.5	0.3	0.3	0.4
86-90	0.7	0.4	0.5	0.5	1.0	0.3
91-95	0.4	0.3	0.2	0.6	0.4	0.2
96-100	0.4	0.3	0.4	0.4	0.2	0.5
101-105	1.2	0.5	0.9	1.1	1.0	0.2
106-110	14.0	4.5	2.2	17.0	1.0	2.0
111-115	*	4.7	11.0	15.0	*	11.0
116-120	*	*	*	*	*	*
121-125	*	*	*	*	*	*
126-130	*	*	*	*	*	*
131-135	*	*	*	6.0	*	*
136-140	*	*	*	*	*	*
141-145	*	*	*	*	*	*
146-150		*	*	*	*	*
151-155		*	*	*	—	*
156-160				*	—	*
161-165				*	*	

\* Female only

\*\* Male only

— no specimen

*Fishery*

*P. sculptilis* generally began to appear in the fishery in September or October and disappeared in April or May at Versova but continued till August at Sassoon Docks. The species formed 3.4% of the total prawn catch at Sassoon Docks and 0.6% at Versova. The annual catch and catch per unit of effort (c.p.u.e.) ranged from 16.9 t and 1.0 kg to 102.7 t and 6.1 kg during 1966-72 at Sassoon Docks (Table 5), and from 3.6 t and 0.9 kg to 16.9 t and 3.2 kg during 1969-76 at Versova. The best catches were available from November to March at these centres.

TABLE 5. Catch (C) in tonnes, catch per unit of effort (C|E) in kg. and percentage composition *P. sculptilis* at Sassoon Docks and Versova during different fishing seasons.

Fishing seasons	SASSOON DOCKS			VERSOVA		
	C	%	C E	C	%	C E
1966-67	102.7	7.4	6.1	*		
1967-68	53.2	3.0	3.0	*		
1968-69	68.0	3.5	4.0	*		
1969-70	22.0	2.3	1.2	5.1	0.5	1.1
1970-71	39.0	2.4	1.8	8.3	0.4	1.0
1971-72	16.9	1.5	1.0	6.8	0.4	1.2
1972-73	*			9.5	0.6	1.5
1973-74	*			16.9	1.8	3.2
1974-75	*			4.6	0.5	0.9
1975-76	*			3.6	0.4	0.9

\* data not available

**DISCUSSION**

Rajyalakshmi (1966) mentioned that males and females *P. sculptilis* in the Hooghly estuaries attained respectively 45 mm to 59 mm and 50 mm to 65 mm total lengths by the end of first year. In the second year, the male attained a growth increment of 30 mm and females 25.5 mm to 29 mm. The growth increment was 25-29 mm in the case of females during the third year. Based on these conclusions, the species should live for 4 years in the estuary itself,



apart from its remaining life in the marine environment, since the maximum length recorded by the same author was 152 mm (163 mm in the present study). This is quite unlikely since it is well known that most of the penaeid prawns in the tropics have a life span not more than 2-3 years. The present studies indicated that males and females of this species attain a length of 93 mm and 113 mm, respectively, at the end of one year, in the marine environment. The life span of this species may possibly be just over two years, and prawns living beyond this age are relatively rare. Hall (1966), based on the length frequency distribution of *P. sculptilis* obtained from Ambai fishery, Penang, indicated an increase in carapace length from below 0.5 cm to 2.0 cm for males and 2.5 cm for females in four months period, suggesting considerably faster rate of growth in youngones as has been observed by the present authors.

Reviewing the prawn fishery of the Hooghly estuarine system, Bhimachar (1963) had found that males of this prawn attained sexual maturity at 75 mm in length. According to Rajyalakshmi (1966) the size at maturity in female was at 75 mm in length. The present studies showed that the minimum size at maturity was 78 mm.

With regard to spawning season, Rajyalakshmi (1966) opined that the principal season was from December to April-May with peaks in December-January. In Bombay it was found to spawn all through the year with peaks in February-March and July-November.

In the Hooghly estuarine system, Rajyalakshmi (1966) found that females dominated in all sizes above 29 mm, and above 89 mm only females were noticed. But off Bombay, it was seen that males of this species were better represented in the fishery in size groups ranging from 78 mm to 98 mm, and females in the rest of the sizes. Chi-square test on the monthly sex ratios indicated that there was significant departure from the 1 : 1 ratio. The considerable disparity in growth rates in sexes together with the breeding migration of females may have largely contributed to this uneven distribution of sexes in the fishery. The striking disparity in the sizes of males and females may have resulted in the wide difference in the lengthwise distribution of sexes.

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