OBSERVATIONS ON THE MARINE PRAWN FISHERY BY SHORE SEINE AT KAKINADA

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ABSTRACT

The estimated annual prawn landings by shore-seines at Kakinada varied from 13.9 to 57.3 tonnes during 1967-1971. July-September was found to be the peak season of the fishery. The catch was composed of *Metapenaeus brevicornis* which formed about 60% of the landings. Other penaeid prawns occasionally landed in commercial quantities were *M. monoceros*, *M. affinis*, *M. dobsoni*, *Penaeus monodon* and *P. indicus*. The landings of many of these species dropped gradually from 1967 to 1971 indicating a decline in the fishery. The size-frequency distribution for *M. brevicornis* indicated that females of 60-130 mm and males of 60-80 mm in total length dominated the fishery in most of the years. It was inferred that females grow at a rate varying from 8.7 mm to 11.2 mm per month. Males showed unimodal size distribution. The distribution of sexes in different size groups indcated a preponderance of males up to 80 mm and females thereafter. Length at first maturity for females of *M. brevicornis* was at 86 mm. Ripe prawns were found to be rare in the inshore waters indicating spawning migration to offshore waters. Spent females were observed allthrough the season with a peak during July-October.

INTRODUCTION

Prawns are fished all along the Andhra coast throughout the year in appreciable quantities. With annual landings estimated at 10,675 tonnes, (CMFRI 1976) prawns form an important fishery and contribute to about 7% of the marine fish production of the state. Despite their commercial importance as an export commodity, practically nothing is known about the fishery and biology of the component species of the region which is a prerequisite for a rational exploitation of the resources. The present account deals with the data collected during May 1966 to December 1971 at Kakinada, an important fishing centre of the Andhra coast and attempts to describe briefly the prawn fishery by the shore-seines in the inshore waters with notes on some aspects of the biology of a few commercially important species.

MATERIAL AND METHODS

Among the indigenous gears employed for prawn fishing the shore-seines locally known as *alivivala* is the most commonly used at Kakinada. The landings

by boat seines (*Iragavala*) and the drag nets (*Konlivala*) are sporadic and hence are not considered here. The *alivivala* is a wall net operated from a *Kakinada nava* and hauled by 12 to 30 men at each end. The construction and mode of operation are described in detail by Ramamurthy and Muthu (1969). The operation of shore-seines starts in the early hours of the morning. One to three hauls, each of 2-4 h duration are made on a fishing day. A haul is taken as a unit of effort (E).

The data relating to prawn landings, effort and species composition were collected once in a week. On each observation day, data were obtained from 10-30% of the shore seines operated. The day's catch was calculated from the average value obtained from observed units. Monthly estimates were made from these data depending on the number of fishing days in a month, which was ascertained by enquiry from the fishermen.

Random samples were brought to the laboratory, weighed and analysed for species composition, total length (sex-wise), sex ratio and maturity condition for all the species of commercially important penaeid prawns. For biological studies, the data collected during July 1966 to December 1970 were taken into consideration. To have some knowledge on the biology of *M. brevicornis* samples from Uppada, a nearby landing centre, were also considered where samples were not available at Kakinada. Total length of prawns referred to in this report is the distance between the tip of rostrum to the tip of telson. Ovarian stages were classified as suggested by King (1948).

Catch and effort

Prawn landings by shore-seines at Kakinada from 1967-1971 are presented in Table 1. The fishery during 1967 yielded an estimated catch of 57.4 tonnes which formed 8.5% of the total shore-seine landings. The maximum catch was landed in April. However, the percentage of prawns in the catches was high during July-September which accounted for over 40% of the annual prawn catch. Catch per unit of effort (C/E) exceeding 20 kg was recorded during March-April and August-September.

Despite a sharp decline in the effort, prawn fishery during 1968 was of the same magnitude as that of the previous year. The bulk of the landings (about 93%) was during July-September. Average annual C/E was exceptionally high (39.3 kg) during this year. There was a steep fall (to less than 1/3 of the previous year) in the prawn catch during 1969. A major portion of the catch was landed during July-October. The magnitude of the fishery during 1970 was comparable to that of 1969 though the effort expended was only 2/3 of the previous year. Maximum landings were recorded in December. 1971 witnessed the poorest catch of the period which was also reflected by the lowest value for C/E (8.7 kg).

TABLE 1. *Prawn landings (in kg) by shore-seines (Alivivala) at Kakinada during* 1967-1971

	Jan	*Feb*	*March*	*April*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*	*No. of units*	*Per-centage*	C/E *in kg*
1967	—	—	3960	24552	2880	480	7080	9792	6270	312	2048	—	57374	3061	8.5	18.7
1968	—	—	455	1153	122	1554	20755	20930	11935	400	—	660	57964	1474	17.7	39.3
1969	63	—	—	1430	270	—	7072	955	1344	4653	—	522	16309	1299	8.2	12.6
1970	—	240	—	——	3300	—	1400	1016	3260	450	—	4728	14394	861	8.3	16.7
1971	—	—	3102	——	260	9310	488	175	550	—	—	—	13885	1603	8.4	8.7
Ave-rage	13	48	1503	5427	1366	2269	7359	6574	4672	1163	410	1182	31986	1660	10.4	19.3

It could thus be seen that the peak landings were observed during July-September coinciding with the monsoon. A deviation from this trend was observed in April 1967 and December 1970 when unusually heavy catches of *Metapenaeus monoceros* and *M. dobsoni* respectively contributed to the bulk of the fishery. The highest catch and C/E were recorded in 1968 whereas the lowest catch and C/E were in 1971. The maximum effort was in 1967. Since then, there had been a decline in the effort except in 1971. There had also been a sharp fall in the catch from 1969 onwards. It would therefore appear that the level of abundance of prawns has registered a fall during the latter half of the period under investigation.

Species composition and biological notes

The important species contributing to the prawn fishery are *M. brevicornis M. monoceros, M. affinis, Penaeus monodon* and *M. dobsoni* (Table 2). Other species occasionally observed in the landings are *P. indicus, P. merguiensis P. semisulcatus, P. japonicus, M. lyssianassa, Parapenaeopsis stylifera, P. hardwickii, P. nana, P. maxillipedo, Hippolysmata ensirostris* and *Palaemon tenuipes.*

M. brevicornis: This was a major component of the shore-seine prawn fishery at Kakinada contributing to about 60% of the prawn landings. The success or failure of this species greatly influences the prawn fishery at this landing cenre. Maximum landings of this species were usually observed during June-September.

The monthwise size-frequency distribution for females is represented in Fig. 1. Although females ranging in total length between 40-150 mm were represented in the fishery, specimens of less than 60 mm and more than 130 mm

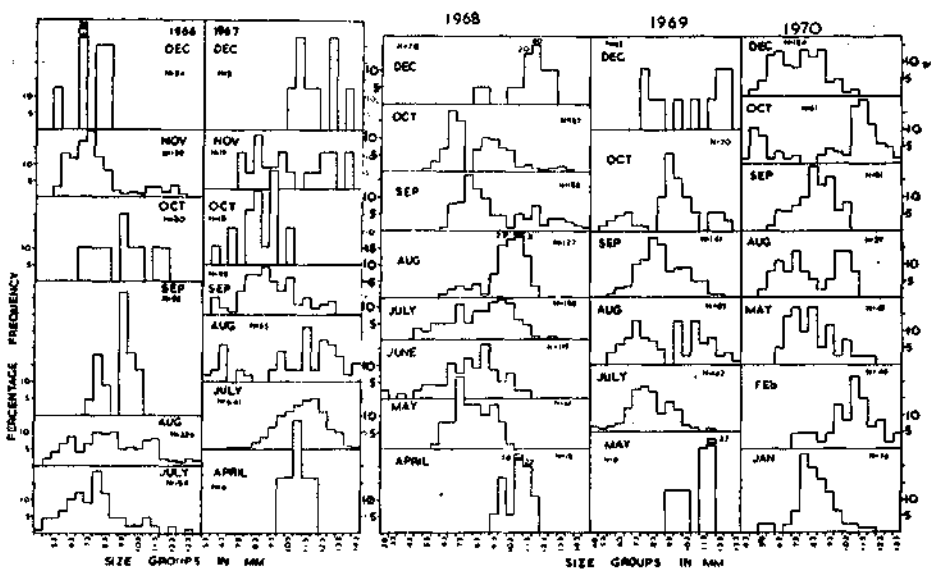

FIG. 1. Size frequency distribution of females of *M. brevicornis* during 1966-70.

TABLE 2. *Species composition of shore-seine prawn landings at Kakinada (Pooled average for the years 1967-1971)*

	Jan	*Feb*	*March*	*April*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*
No. of shore-seines (E)	115	130	178	224	118	71	170	162	118	83	194	97	1660
Prawn catch in kg (C)	13	48	1503	5427	1366	2269	7359	6574	4672	1163	410	1182	31986
Percentage of prawns	0.1	0.3	3.1	7.5	4.9	28.3	38.8	32.5	23.4	5.7	1.8	8.2	10.4
C/E for prawn catch in kg	0.1	0.4	8.4	24.2	11.6	32.0	43.3	40.6	39.6	14.0	2.1	12.2	19.3
Species composition by weight in kg													
Metapenaeus brevicornis	—	21	275	319	634	2126	6034	4905	3728	276	170	545	19033
%		43.7	18.3	5.9	46.4	93.7	82.0	74.6	79.8	23.7	41.7	46.1	59.5
M. dobsoni	13	—	120	288	160	—	20	19	30	—	—	422	1072
%	100.0		8.0	5.3	11.7		0.5	0.3	0.6			35.7	3.4
M. monoceros	—	3	87	3773	130	27	10	19	12	25	—	2	4088
%		6.2	5.8	69.5	9.5	1.2	0.1	0.3	0.3	2.1		0.2	12.8
M. affinis	—	3	86	248	8	39	42	228	33	181	2	11	881
%		6.2	5.7	4.6	0.6	1.7	0.6	3.5	0.7	15.6	0.5	0.9	2.8
Penaeus monodon	—	10	665	156	220	16	—	7	143	155	—	83	1455
%		20.8	44.2	2.9	16.1	0.7		0.1	3.1	13.3		7.0	4.5
P. indicus	—	6	47	38	24	18	236	343	43	59	192	7	1013
%		12.4	3.1	0.7	1.8	0.8	3.2	5.2	0.9	5.1	46.8	0.6	3.2
P. merguiensis	—	—	7	—	169	—	433	35	16	82	14	—	756
%			0.5		12.4		5.9	0.5	0.3	7.1	3.4		2.4
Other species	—	5	216	605	21	43	584	1018	667	385	32	112	3688
%		10.4	14.3	11.1	1.5	1.9	7.9	15.5	14.3	33.1	7.8	9.5	11.5

were rather scarce in the landings. In most of the years a wide range of size groups (73-128 mm) contributed to the fishery.

From the size-frequency distribution of females a number of modes could be traced although for short duration. It may be seen that within the size range of 60-120 mm, the females grow at a rate varying from 8.7 mm to 11.2 mm per month during their stay in the inshore waters. The histograms also show that recruitment to the inshore fishery starts at 41 mm and at 81 mm much of the population is recruited into the inshore waters. This is consistant with the author's earlier observation that juveniles of 45-80 mm length are the mainstay of the fishery of this species in the Kakinada backwaters (Rao 1975).

Males of 41-100 mm were represented in the samples with a unimodal distribution in many of the months (Fig. 2). In the slack season (January-April) bigger males of 71-95 mm were found more. A deviation from this trend was observed in January-February 1970, when a wide range of size groups (41-95 mm) was observed in the catches. When the species started appearing in May males of 61-75 mm dominated the fishery. In the active fishing season (June-September) a wide range of size groups were represented in the samples. How-

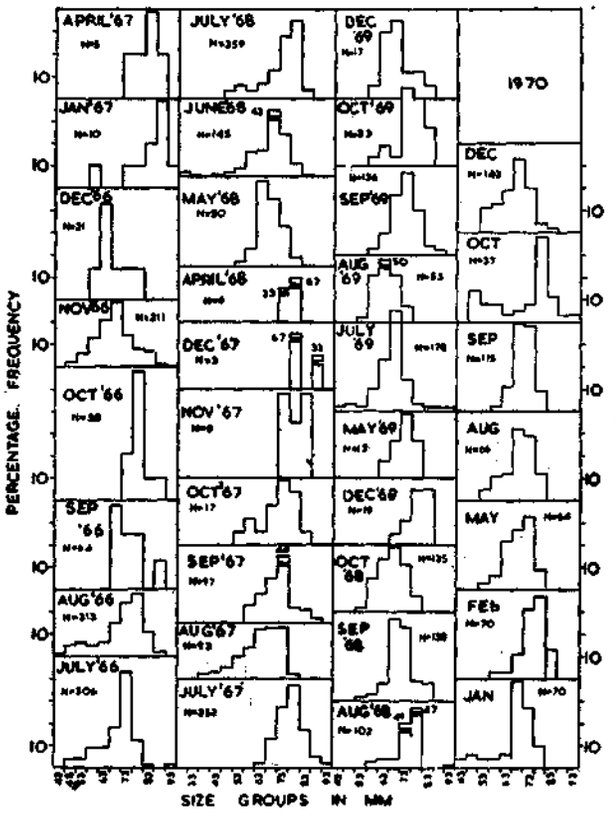

FIG. 2. Size frequency distribution of Males of *M. brevicornis* during 1966-70.

TABLE 3. *Sex ratio of* M. brevicornis *in various months during* 1966-1970.

		Jan	*Feb*	*March*	*April*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total/ Average*
1966	Males	—	—	—	—	—	—	306	318	64	38	211	21	958
	Females	—	—	—	—	—	—	184	226	88	20	139	24	681
	% of females	—	—	—	—	—	—	37.6	41.5	57.9	34.5	39.7	53.3	41.5
1967	Males	10	—	—	5	—	—	352	93	97	17	8	3	585
	Females	4	—	—	6	—	—	641	55	98	18	19	8	849
	% of females	28.6	—	—	54.5	—	—	64.6	37.2	50.3	51.4	70.4	72.7	59.2
1968	Males	—	—	—	6	50	145	359	102	138	135	—	19	954
	Females	—	—	11	18	61	119	188	127	188	187	—	20	919
	% of females	—	—	100.0	75.0	55.0	45.1	34.4	55.5	57.7	58.1	—	51.3	49.1
1969	Males	—	—	—	—	12	—	178	53	136	11	—	17	407
	Females	—					—	142	85	142	70	—	11	458
	% of females	—	—	—	—	40.0	—	44.4	61.6	51.1	86.4	—	39.3	52.9
1970	Males	70	70	—	—	64	—	—	66	115	37	37	143	602
	Females	76	46	—	—	41	—	—	37	81	87	61	184	613
	% of females	52.1	39.7	—	—	39.0	—	—	35.9	41.4	70.2	62.2	56.3	50.5

ever males of 66-80 mm dominated the fishery during this period. During the waning period of the fishery (October-December) also a wide range of size groups was represented but the fishery was supported by males of 56-80 mm. Growth calculation was not attempted as the progression of the modes was not clear.

The proportion of males and females during the different months of the year is shown in Table 3 In 1966 females were more during September and December whereas in 1967 they were more in all the months except January and August. In 1969 females predominated the samples during August-October and males in the other months. Males were found more in February-September 1970. It appears from the above analysis that the distribution of sexes in the inshore catches is of random nature. This may be partly related to the spawning migration of the females to more deeper areas. The dstribution of sexes in relation to size groups indicates a preponderance of males up to 80 mm in all the years (Table 4). This may be due to differential growth in sexes. It may also be that males migrate to the inshore fishing grounds at a relatively lesser length.

TABLE 4. *Sex ratio of* M. brevicornis *in different size groups during* 1968-70

Size groups in mm	1968		1969		1970	
	Number observed	*% of females*	*Number observed*	*% of females*	*Number observed*	*% of females*
41-60	150	28.7	26	46.2	179	48.6
61-80	1085	26.0	510	25.1	703	30.3
81-100	350	88.9	218	89.4	218	91.3
101-120	233	100.0	105	100.0	92	100.0
121-140	33	100.0	18	100.0	19	100.0

The percentage of females in various stages of maturity is given in Table 5. Both ripe and spent females were found at and beyond the 91-95 mm size group. The smallest female with ripe ovary measured 93 mm. Many of the specimens at 86 mm and beyond were either mature or maturing.

Maturity of males was analysed based on the fusion of petasmal endopodities and on the visibility of spermatophores on the coxae. The smallest male with completely fused petasma measured 57 mm. Above the length of 64 mm all the males had fused petasma (Table 6). The smallest male with spematophores on the coxae measured 59 mm. All the males above 67 mm had spermatophore on the coxae. Thus the development of gonads in this species coincides with the development of petasma.

TABLE 5. *Stages of maturity among the various size groups of females of* M. brevicornis *during* 1968 *and* 1969 *(pooled), in percentage*

Length groups in mm	*Immature*	*Maturing*	*Mature*	*Ripe*	*Spent*	*Number of prawns examined*
66-70	100.0	—	—	—	—	81
71-75	98.9	1.1	—	—	—	95
76-80	68.8	31.2	—	—	—	112
81-85	43.1	55.0	1.9	—	—	109
86-90	22.2	75.2	0.9	—	1.7	117
91-95	7.9	72.2	5.9	1.0	12.8	101
96-100	——	66.7	6.0	2.6	24.7	117
101-105	——	62.4	9.2	4.6	23.9	109
106-110	——	48.7	11.5	14.2	25.7	113
111-115	——	44.3	21.3	11.5	23.0	61
116-120	——	17.9	15.4	20.5	46.2	39
121-125	——	21.4	7.1	42.9	28.6	14
126-130	——	11.1	11.1	27.8	50.0	18
131-135	——	50.0	10.0	—	40.0	10
136-140	——	20.0	—	20.0	60.0	5
141-145	——	—	—	—	100.0	3
146-150	——	—	100.0	—	—	1

TABLE 6. *Percentage of males of* M. brevicornis *with fused petasma and spermatophores at various lengths.*

Total length *in mm*	*No. of males observed*	*% Males with fused petasma*	*No. of males observed*	*% Males with spermatophores*
56	7	nil	—	—
57	9	44.5	—	—
58	7	42.9	16	nil
59	13	61.5	15	6.3
60	14	64.3	13	18.8
61	15	66.7	15	21.1
62	13	84.6	20	28.6
63	14	84.7	17	58.7
64	13	92.3	23	78.3
65	17	100.0	18	83.3
66	—	—	20	90.0
67	—	—	17	100.0

TABLE 7. *Monthly maturity distribution (percentages) of females of* M. brevicornis *during* 1966-1969.

	Immature	*Maturing*	*Mature*	*Ripe*	*Spent*	*No. of females examined*
July 1966	50.0	33.7	——	——	16.3	184
Aug. 1966	61.1	3.9	——	——	35.0	180
Sep. 1966	31.8	——	——	4.5	63.6	22
Oct. 1966	22.2	22.2	——	22.2	33.3	9
Nov. 1966	86.0	——	——	——	14.0	143
July 1967	48.6	34.2	7.5	2.7	7.0	187
Aug. 1967	23.6	29.1	10.9	7.3	29.1	55
Sep. 1967	18.0	67.0	3.0	2.0	10.0	100
Oct. 1967	88.9	5.5	——	5.5	——	18
Nov. 1967	15.8	42.1	10.5	21.1	10.5	19
May 1968	55.6	36.5	——	——	7.9	63
June 1968	44.7	43.8	8.8	——	2.6	114
July 1968	48.7	13.2	2.1	——	36.0	189
Aug. 1968	6.3	80.3	10.2	0.8	2.4	127
Sep. 1968	58.0	5.3	3.2	6.9	26.6	188
Oct. 1968	80.7	15.0	3.7	0.5	——	187
July 1969	44.0	51.0	2.1	2.8	——	141
Aug. 1969	——	83.9	5.5	——	11.0	93
Sep. 1969	19.7	68.3	9.9	——	2.1	142
Oct. 1969	——	71.0	1.4	——	27.5	69
Dec. 1969	18.2	9.1	9.1	63.6	——	11
Average	45.2	34.0	4.0	2.0	14.8	—

It may be noticed from Table 7 that there is considerable variation in the percentage occurrence of females of various stages of maturity from month to month in different years. The populations supporting the shore-seine fishery were mainly composed of prawns in immature and maturing stages, Whereas ripe females formed only 2.0%. This indicates that ripe prawns migrate away from the fishing grounds, probably to deeper waters to spawn there, and return to coastal waters after breeding. Spent females occured in considerable numbers throughout in all the years indicating continuous spawning. However a peak of spawning was observed during July-October.

M. monoceros: The average annual landings were estimated at 4 tonnes forming about 13% of the prawn landings. Most of the catch was landed during April.

P. monodon: With average annual landings estimated at 1.5 tonnes this species formed the third important component of the prawn catches. This formed about 4.5% of the inshore prawn landings. The landings were considerable only during March-May and September-October.

P. indicus: Forming about 3.2% of the prawn catches, the annual landings of this species were estimated at 1 tonne. The fishery was good during July-August and November.

M. dobsoni: The average annual landings of this species were estimated at 1.1 tonnes forming about 3.4% of the prawn catches. The landings were good only during March-May and December. Females of 40-110 mm and males of 35-95 mm were observed in the landings (Fig. 3). Although a wide range of size

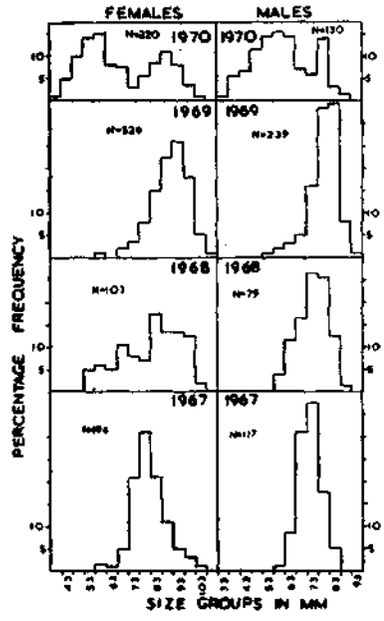

FIG. 3. Size frequency distribution of *M. dobsoni* during 1967-70.

groups was observed only females of 75-90 mm and males of 65-80 mm supported the fishery.

M. affinis: Annual landings estimated at 0.9 tonnes this formed about 2.8% of the prawn catches. The fishery for this species was good during April, August and October. Annual size-frequency distribution for females and males is separately shown in Fig. 4. Though females of 40-150 mm and males of 40-140 mm were observed in the catches, the fishery was mainly supported by juveniles of 50-90 mm size range. The adults were rarely found to frequent the inshore waters.

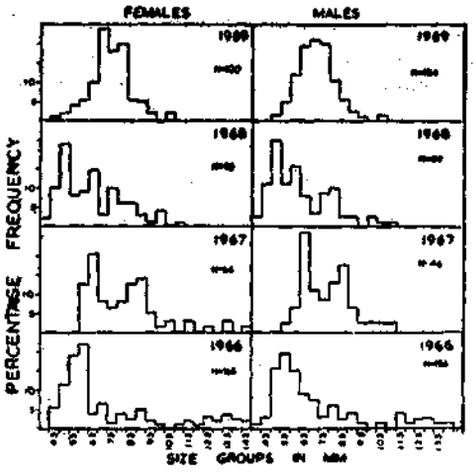

FIG. 4. Size frequency distribution of *M. affinis* during 1966-69.

DISCUSSION

The indigenous prawn fishery at Kakinada exhibited a declining trend during the period of study. The fishing effort had also suffered an overall decline which could mainly be attributed to the increased activity of the trawlers as well as the cargo vessels' movements in the vicinity of the harbour which had restricted the operational range of the shore-seines. However, it remains to be seen whether the annual fluctuations noticed in the fishery are dtermined by natural causes or otherwise, keeping in view the large number of trawlers combing for prawns in this area.

The species composition of the inshore prawn fishery is interesting in so far as *M. brevicornis* constitutes the dominant one. This is in contrast to the adjacent creeks and backwaters where *M. monoceros, P. monodon, P. indicus* and *M. dobsoni* are important in that order and *M. brevicornis* contributes only 5.3% to the catches (Rao 1975). Ramamurthy (1967) reported that commercial catches of this species are taken only from the sea and that it does not occur in any significant numbers in the creeks. On the other hand, Rajyalakshmi (1961) found that this species is abundant only at the mouths of the Hooghly estuary.

The growth rate of *M. brevicornis* was found to be relatively high in the Kakinada waters, being 8.7 to 11.2 mm per month when compared to 3.0 and 3.3 mm per month reported by Rajyalakshmi (1961) and Ramamurthy (1967) in the Hooghly estuary and Gulf of Kutch respectively. Similarly differences in the spawning periodicity have been noticed. A pronounced peak in July-October has been observed during the present investigations. In the Hooghly estuary, Rajyalakshmi (1961) reported two spawning peaks during March-April and July-August whereas in the Gulf of Kutch a single pronounced spawning peak

during March-April has been noticed by Ramamurthy (1967). It is likely that these differences in the biological characteristics are related to the different hydrological conditions prevailing at these regions associated with the latitudinal variations.

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