

OBSERVATIONS ON THE LARVAE OF PENAEID PRAWNS OF COMMERCIAL IMPORTANCE IN THE COASTAL WATERS OF GOA

M. J. GEORGE AND S. C. GOSWAMI

National Institute of Oceanography Goa - 403 004, India

From the coastal waters of Goa no information is available concerning the larvae of commercially important penaeid prawns. Therefore, five stations in the inshore waters of Goa were sampled to study their distribution and abundance. Among the larvae of five species, namely *Metapenaeus dobsoni* (Miers), *Metapenaeus affinis* (Milne Edwards), *Metapenaeus monoceros* (Fabricius), *Penaeus merguensis* de Man and *Parapenaeopsis stylifera* (Milne Edwards) present in the samples, the larvae of *M. dobsoni* were the most abundant.

In general, stations south of the mouth of the Mandovi and Zuari rivers show lesser numbers of larvae of all the species, indicating that breeding of the species mostly takes place in the northern region. As indicated by the abundance of the larvae the peak breeding periods of the different species in this area would appear to be during the premonsoon season, especially in the months January-February and April-May, varying with the species. The peak breeding period in November-December months noticed in the case of most of the species in the southwest coast is however, not indicated in this area, probably because of the westerly surface current of the region in these months carrying the larvae away from the inshore waters.

INTRODUCTION

Although prawns of the family Penaeidae are of considerable importance in the fishery of the coastal and estuarine waters of India, information on their larval abundance and recruitment to the estuaries is quite negligible except along the southwest coast where considerable work on these aspects has been done (George, 1962, 1968, 1973; Mohamed *et al.*, 1963; Rao, 1973b). Exploitation of penaeid prawns from the waters off Goa coast by mechanised vessels is of recent origin and is increasing every year. Side by side with this increasing exploitation, information on their larval abundance both in space and time and their recruitment into the estuarine waters is quite essential for proper management of the fishery. With this in mind, a few stations in the inshore waters of Goa were sampled regularly to study the larval abundance of penaeid prawns and the results are reported here.

MATERIAL AND METHODS

Penaeid larvae were separated from the surface zooplankton samples collected monthly at five inshore stations off Goa (Fig. 1) during 1974-1976. No sampling has been done during the monsoon months (June to September). Samples were collected by towing a HT net (mouth area, 0.25 m² and mesh

width 0.3 mm) for five minutes and the collected samples were preserved in 5% buffered formaldehyde. Depending upon their abundance, penaeid larvae were sorted out under stereoscopic microscope from 20 to 100% of the sample and their number raised to the total. The larval identifications are based on the descriptions of Menon (1952), Mohamed *et al.* (1968), Raje and Ranade (1972) and Rao (1973a).

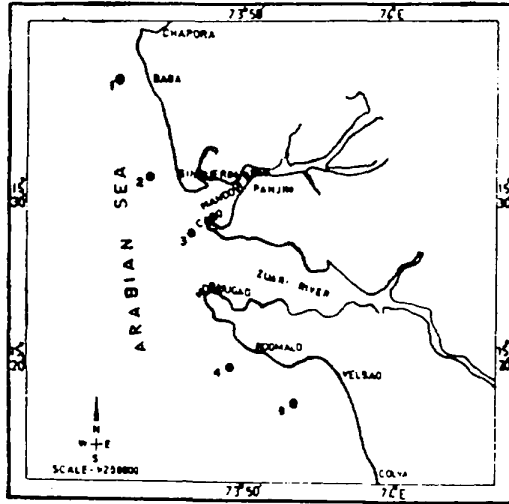


Fig. 1. Showing sampling stations in the inshore waters of Goa

RESULTS

SPECIES AND LARVAL COMPOSITION

Larvae of the following species, *Metapenaeus dobsoni* (Miers), *M. affinis* (H. Milne Edwards), *M. monoceros* (Fabricius), *Penaeus merguensis* de Man and *Parapenaeopsis styliifera* (H. Milne Edwards), were encountered in the samples. Larvae of two other species, namely *Penaeus indicus* and *P. monodon* which are also being caught in the commercial catches of the locality were not found in the samples. Protozoa stages 1 to 3, mysis stages 1 to 3 and early postlarval stages were met with in varying numbers in different samples. Few eggs and nauplii stages of *M. dobsoni* were recorded in certain samples. Their numbers being very low, these are not included in the present study.

Larvae of *Metapenaeus dobsoni* were most abundant in all stations. Larvae of *M. affinis*, *Penaeus merguensis*, *Parapenaeopsis styliifera* and *M. monoceros* came next in order of their abundance. Out of a total of 10154 larvae of all stages, 7602 belonged to *M. dobsoni*, 929 to *M. affinis*, 757 to *P. merguensis*, 675 to *P. styliifera* and 191 to *M. monoceros* (Table 1).

Protozoa 1 and postlarval stages of *M. monoceros* were not represented in the collections. Postlarvae of *P. styliifera* also were not noticed in any of the collections.

Larvae of Penaeid Prawns

TABLE 1. SPECIES-WISE DISTRIBUTION OF LARVAE AT STATIONS IN THE INSHORE WATERS
OFF GOA

Species	Stns.	Proto- zoea I	Proto- zoea II	Proto- zoea III	Mysis I	Mysis II	Mysis III	Post- larvae	All stages
<i>M. dobsoni</i>	1	292	364	156	452	132	148	233	1807
	2	787	706	358	517	226	95	178	2857
	3	428	164	132	147	86	31	21	1009
	4	85	92	86	237	255	202	68	1025
	5	16	28	43	162	165	393	97	904
								Total :	7602
<i>M. monoceros</i>	1	0	50	4	18	31	5	0	180
	2	0	1	8	25	21	8	0	63
	3	0	0	0	1	5	0	0	6
	4	0	0	0	0	1	10	0	11
	5	0	2	0	0	1	0	0	3
								Total :	191
<i>M. affinis</i>	1	75	71	15	116	50	5	0	332
	2	365	25	10	40	13	0	0	453
	3	100	0	20	0	15	0	0	135
	4	0	0	0	0	0	0	0	0
	5	3	4	2	0	0	0	0	9
								Total :	929
<i>P. merguensis</i>	1	0	25	0	30	34	0	28	117
	2	75	53	50	50	85	10	125	348
	3	10	0	15	20	30	0	24	99
	4	40	50	60	0	0	0	27	177
	5	0	0	0	15	0	0	1	16
								Total :	757
<i>P. stylifera</i>	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	502	20	45	21	40	0	0	628
	4	0	0	0	22	10	15	0	47
	5	0	0	0	0	0	0	0	0
								Total :	675

DISTRIBUTION OF THE LARVAE

Arcaicse distribution (Table 1) and *breeding grounds*:

In general, all the species except *P. stylifera* had maximum number of larvae collected in the samples from stns. 1 and 2 north of the Mandovi and Zuari river mouths, off Baga and off Sinkerim respectively, especially from the latter (Table 1). *P. stylifera* alone had the maximum number of larvae collected from stn. 3 off the river mouth opening. Generally, stns. 4 and 5 south of the mouth of the rivers, off Bogmalo and off Velsao respectively showed lesser numbers of larvae of all the species. This would definitely indicate that the main breeding grounds of all these species in this region are either off or towards the north of the Mandovi and Zuari river mouths.

In the case of *M. dobsoni*, maximum numbers of protozoa and early mysis stages were found off Sinkerim in the north. By the occurrence of large numbers of the later mysis stages in stns. 4 and 5 and postlarvae in stn. 1 (Table 1), the dispersal of the larvae may be noticed from the main breeding ground which appears to be off Sinkerim.

M. affinis had maximum number of protozoa stage 1 in samples from stn. 2 off Sinkerim. The later protozoa stages as well as all the mysis stages had their maximum numbers in stn. 1 off Baga, postlarval stages being absent in the samples. Stns. 4 and 5 were almost devoid of these larvae. It is evident that the larvae produced at the breeding grounds off Sinkerim are being dispersed towards the north in the case of this species.

Compared to all other species *M. monoceros* had the least number of larvae represented in the collections. The late protozoa stages and the mysis stages, which only are represented in the samples, were mostly found in samples from stns. 1 and 2 only, thus making it clear that the breeding ground of this species is also north of the river mouth.

As in other species *Penaeus merguensis* also had the maximum numbers of larvae in samples from stn. 2 off Sinkerim. The larvae were very few in the southernmost station and in stns. 1, 3 and 4 they were represented but much less than in stn. 2. Therefore, the main spawning ground for this species also is somewhere off Sinkerim.

Parapenaeopsis stylifera is peculiar in the distribution of the larvae. Protozoa and early mysis stages were found in fairly good numbers in samples from stn. 3 off the river mouths. In stn. 4, just south of this, a few mysis stages have been obtained. No larvae were found in any of the other stations. Hence, it is quite clear that the species is spawning off the Mandovi and Zuari river mouths and not much of dispersal of the larvae from this area is noticed.

Seasonal distribution and breeding season (Fig. 2):

In general, in the samples analysed the maximum number of larvae were found in February. No samples being available during the months June through September, the distribution of the larvae during these months is not known. Hence, a peak breeding period during the premonsoon season is indicated in most of the species.

Larvae of *M. dobsoni* were abundant in February of all the three years, the maximum being in February, 1974. The larvae were represented in fairly good numbers from April to May. Their numbers were very much less in October

Larvae of Penaeid Prawns

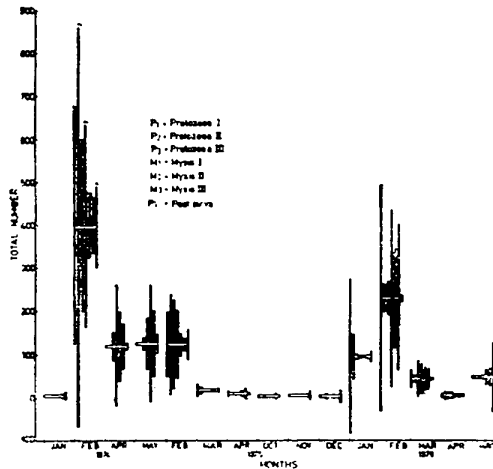


Fig. 2. Monthly distribution of larvae of *Metapenaeus dobsoni*.

to January, especially during October, November and December. This would clearly indicate that the peak spawning season is in February. Another increased spawning activity is indicated in April and May.

Larvae of *M. affinis* were very much less and represented in the collection only in January, February and March of 1973 with the peak in January. 1 or 2 numbers of larvae were (Table 2) found in March and December, 1975. So the peak breeding of this species seems to be in the month of January.

Larvae of *M. monoceros* also were represented in small numbers, mostly in February and in smaller numbers in December, January and April (Table 2). So, January and February seem to be the peak breeding months for this species also. Like in *M. dobsoni*, slightly increased breeding activity is indicated in April.

P. merguensis of the locality share the same characteristic of breeding mostly in February with lesser breeding activity in May by the indirect evidence of the presence of their larvae in these months. Maximum number of larvae were found in February 1974 (Table 2).

February 1976 showed the maximum number of larvae of *P. stylifera* (Table 2). In other months the larvae were not present except very rarely in a few months. Thus, in this species also February seems to be the peak breeding month.

DISCUSSION

In the southwest coast of India Menon (1952, 1953), George (1962), George *et al.* (1968) and Rao (1968) have reported about the spawning of penaeid prawns in close inshore waters, especially the species *M. dobsoni* and *P. stylifera*. The presence of large numbers of larvae in the samples collected from the inshore stations off Goa would definitely indicate that here also these prawns are spawning in these regions. However, it is interesting to note that in all species the breeding takes place mostly either in the area off the mouth of the Mandovi

TABLE 2. MONTHLY DISTRIBUTION OF LARVAE OF DIFFERENT SPECIES (P₁₋₃ PROTOZOA 3 STAGES; M₁₋₃ =MYSIS 3 STAGES AND P1=POSTLARVAE)

Year	Month	<i>Metapenaeus monoceros</i> Larvae						<i>Metapenaeus affinis</i> Larvae						<i>Penaeus merguensis</i> Larvae						<i>Parapenaeopsis stylifera</i> Larvae										
		P ₁	P ₂	P ₃	M ₁	M ₂	M ₃	P1	P ₁	P ₂	P ₃	M ₁	M ₂	M ₃	P1	P ₁	P ₂	P ₃	M ₁	M ₂	M ₃	P1	P ₁	P ₂	P ₃	M ₁	M ₂	M ₃	P1	
1974	January	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
	February	0	50	0	0	25	0	0	0	0	0	0	0	85	75	65	95	115	0	20	0	0	0	0	0	0	0	0	0	0
	April	0	0	4	18	16	10	0	0	0	0	0	0	0	0	0	0	2	0	0	16	0	0	16	0	0	5	0	0	0
	May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0
	February	0	0	0	1	0	0	0	0	0	0	0	0	0	40	50	60	10	0	0	13	0	0	0	0	0	0	0	0	0
1975	March	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	April	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	December	0	1	0	0	1	3	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	January	0	2	8	0	0	0	0	516	27	17	5	8	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0
	February	0	0	0	25	15	10	0	25	0	30	135	60	5	0	0	0	0	0	0	0	0	15	500	20	40	40	50	15	0
	March	0	0	0	0	0	0	0	0	0	0	15	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	April	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	29	10	136	0	0	0	1	0	0	0

Larvae of Penaeid Prawns

-Zuari rivers or areas north of the mouth. In the fishing for these prawns in this region, it is reported that the northern areas between Calangute and Mormugao harbour mouth are more productive (CMFRI, 1975). This may probably be due to a difference in the nature of the substratum between the north and south regions.

Breeding seasons of the different species show slight variations from the observations on the respective species made from other regions of the west coast. In *M. dobsoni*, based on maturity condition of adults, George *et al.* (1968), Rao (1968) and George (1970) reported about the species breeding throughout the year in Cochin waters with peaks in April, June through August and November-December. In Calicut waters, from the presence of eggs and larvae in the plankton, Menon (1952) derived a spawning season for the species from September to April, with a peak from September to December or January. The present study indicates that the breeding, although taking place throughout the year, has peaks in the months of February and April-May, the main peak being in February. The peak during November-December is not noticed here. Because of the absence of sampling during the monsoon months, the peak breeding in the monsoon period could not be ascertained. However, CMFRI (1975) reported peak spawning period for the species in the waters of Goa based on studies on spawning population of adults of the species as February and November. So the absence of samples during the monsoon period does not seem to have missed any peak breeding season.

In Cochin waters, the breeding season of *M. affinis* was reported to be October-March with peak in November and December. The present study in the waters of Goa indicates that the breeding is from January which is the same as that recorded for the species in Calicut waters by Subrahmanyam (1967). By following the occurrence of mature females, March-April and November-December were reported as peak spawning periods for this species in Goa waters (CMFRI, 1975). In this species also there does not seem to be a peak spawning period during the monsoon season, when samples were not available during the present study. However, the November-December peak was not observed in this species also, probably because *M. affinis* is reported to be spawning in slightly deep waters than *M. dobsoni* in the south west coast (Subrahmanyam, 1967; George *et al.*, 1968), which may be the case here also and the existing current pattern of the region may not be bringing in the larvae to close inshore areas.

In the Gulf of Kutch area Srivatsa (1953) reported the spawning period of *M. monoceros* from February to April. More or less the same period is seen to be the peak season in these waters also, the peak spawning month being February. George (1962) found two peaks in this species from Cochin, the first in July-August and the second in November-December, neither of which is noticed here. Perhaps the species is spawning in deeper waters as pointed out by George and George (1964) in Cochin waters and the larvae are not properly represented in the close inshore samples.

The February peak spawning is shared by the species *Penaeus merguensis* also along with the other prawns in this region. In the CMFRI report (1975) the spawning population of the species is reported to be dominant in these waters from October to January. From this, it would appear that only the larvae, spawned towards the end of the peak season, are represented in the present collections as peak. This again is probably brought about by the prevailing currents of the area.

Parapenaeopsis stylifera is reported to have peak spawning season in Bombay waters extending from September to May. (Shaikmahmud and Tembe, 1961; Mohamad, 1967). Along the Malabar coast the peak spawning occurs in October to December (Menon, 1953) and at Cochin, November, January and April are the peak months (George *et al.*, 1968; Rao, 1968). The peak spawning of the species noted in the present study in February falls in the season noticed in the northern waters only.

Although for most of the species studied in other parts of the west coast of India, especially the southwest coast, a peak breeding is reported during November-December months, it is strange that this peak in breeding is not noticed in any of the species during the present study. This may be attributed to the surface current pattern of the central west coast during this period which probably carry away the larvae from the close inshore region which only has been sampled in the present study. According to Varadachari and Sharma (1967) in this area the monsoon current is westerly during the northeast monsoon period. Therefore, this westerly surface current may be transporting the larvae away from the inshore areas and hence they were not represented in large numbers during these months, although there was peak breeding. However, detailed study of the larvae in slightly deeper waters also in relation to the environmental parameters will throw more light on the breeding peaks of these species in these waters, in order to determine the availability of postlarvae for collection for stocking in pond culture.

REFERENCES

- CMFRI. 1975. Studies on marine prawn biology and resources. Report of the All India Co-ordinated Research Project, 1971-74. Mimeo. 1-124.
- GEORGE, M. J. 1962. On the breeding of penaeids and the recruitment of their postlarvae into the backwaters of Cochin. *Indian J. Fish.*, **9**, 110-116.
- GEORGE, M. J. 1968. Postlarval abundance as a possible index of fishing success in the prawn *Metapenaeus dobsoni* (Miers). *Indian J. Fish.*, (1963), **10**, 135-139.
- GEORGE, M. J. 1970. Synopsis of biological data on the penaeid prawn *Metapenaeus dobsoni* (Miers, 1878). *FAO Fish Rep.*, (57), **4**, 1335-1357.
- GEORGE, M. J. 1973. Prawn larvae and assessment of prawn resources. *Mahasagar — Bull. natn. Inst. Oceanogr.*, **6**, 133-139.
- GEORGE, M. J., RAMAN, K. AND KARUNAKARAN NAIR, P. 1968. Observation on the off-shore prawn fishery of Cochin. *Indian J. Fish.*, (1963), **10**, 460-499.
- GEORGE, P. C. AND GEORGE, M. J. 1964. On the location of a possible spawning area for the penaeid prawn *Metapenaeus monoceros* Fabricius off Cochin. *Curr. Sci.*, **33**, 251-252.
- MENON, M. K. 1952. The life history and bionomics of the Indian penaeid prawn *Metapenaeus dobsoni* (Miers). *Proc. Indo-Pacif. Fish Coun.*, **3**, 80-93.
- MENON, M. K. 1953. Notes on the bionomics and fishery of the prawn *Parapenaeopsis stylifera* (M. Edw.) on the Malabar coast. *J. Zool. Soc. India.*, **5**, 153-162.
- MOHAMED, K. H. 1967. Penaeid prawns in the commercial shrimp fisheries of Bombay with notes on species and size fluctuation. *Proc. Symp. on Crustacea*, Mar. biol. Ass. India. Part **4**, 1408-1418.
- MOHAMED, K. H., VEDAVYASA RAO, P. AND GEORGE, M. J. 1968. Postlarvae of penaeid prawns of southwest coast of India with a key to their identification. *FAO Fish. Rep.*, (57), **2**, 487-503.

Larvae of Penaeid Prawns

- RAJE, P. C. AND RANADE, M. R. 1972. Larval developments of Indian penaeid shrimps - *Penaeus merguensis* De Man. *Jour. Indian Fish. Assoc.*, **2**, 1-16.
- RAO, P. VEDAVYASA. 1968. Maturation and spawning of the penaeid prawns of the southwest coast of India. *FAO Fish. Rep.*, (57) **2**, 285-304.
- RAO, P. VEDAVYASA. 1973a. Studies on the larval development of the commercially important penaeid prawns of India. *J. mar. biol. Ass. India*, **15**, 95-124.
- RAO, P. VEDAVYASA. 1973b. Some observations on the larval growth of the commercially important penaeid prawns of southwest coast of India. *Indian J. Fish.*, **20**, 308-317.
- SHAIKMAHSUD, F. S. AND TEMBE, V. B. 1960. Study of Bombay prawns. The seasonal fluctuation and variation in abundance of the commercially important species of Bombay prawns with a brief note on their size, state of maturity and sex ratio. *Indian J. Fish.*, **7**, 69-81.
- SRIVATSA, K. R. 1953. A survey and comparative analysis of the prawn (shrimp) fishery of the Gulf of Kutch in Sourashtra in Western India. Department of Industries and Supplies, Government of Saurashtra, Saurashtra, India. 1-20.
- SUBRAHMANYAM, C. B. 1967. Notes on the bionomics of the penaeid prawn *Metapenaeus affinis* (Milne Edwards) of the Malabar coast. *Indian J. Fish.*, **7**, 69-81.
- VARADACHARI, V. V. R. AND SHARMA, G. S. 1967. Circulation of the surface waters in the north Indian Ocean. *J. Indian Geophy. Union*, **4**, 61-73.