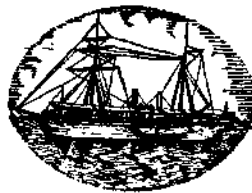


SYMPOSIUM ON CRUSTACEA

PART IV



**MARINE BIOLOGICAL ASSOCIATION OF INDIA
MARINE FISHERIES P.O., MANDAPAM CAMP
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PROCEEDINGS
OF THE
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PART IV



SYMPOSIUM SERIES 2

MARINE BIOLOGICAL ASSOCIATION OF INDIA
MARINE FISHERIES P.O., MANDAPAM CAMP
INDIA

PENAEID PRAWNS IN THE COMMERCIAL SHRIMP FISHERIES OF BOMBAY WITH NOTES ON SPECIES AND SIZE FLUCTUATIONS*

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ABSTRACT

Among the maritime states of India, Maharashtra contributes over 50% of the total marine prawn catches of the country. There are about a dozen species of prawns contributing to the commercial fisheries of this region. Analysis of the data obtained by regular sampling from two centres—Sassoon Dock and Versova—for the years 1957-59 shows the species composition in different months and size frequencies. An attempt is made to find out the nature of recruitment of the various species into the fishery at different seasons. The spawning seasons of these species are determined by observations on the preponderance of ripe individuals in the catches.

DURING the past ten years shrimp industry has developed considerably in India and it now occupies a prominent place among the three major fisheries of the country. Although prawns are landed throughout the coastline of India, majority of the catches come from the west coast, particularly from the Maharashtra coast which accounts for more than half the annual production of shrimps in the country. Earlier accounts on this fishery (Rai, 1933; Chopra, 1943; Panikkar and Menon, 1955, etc.) dealt with general distribution of the resources and the species composition in the landings of the region. Shaikhmahmud and Tembe (1958, 1960) have studied the reproductive organs of *Parapenaeopsis stylifera* and have given a general account of the seasonal abundance of prawns in Bombay based on observations made on the stake net catches landed at Sassoon Dock.

The Central Marine Fisheries Research Institute has initiated a programme of work in early 1957 to study the species succession and detailed size frequencies of commercially important prawns of Bombay as part of the life-history studies. The data collected by this programme which continued till the end of 1959-60 fishing season is analysed and presented here.

MATERIAL AND METHODS

The data were collected from regular weekly samples taken from Versova and Sassoon docks, two important fish landing centres of Bombay City representing the inshore and offshore fishery of the locality. While the catches at Versova came from the stake net fishery operated at 12-15 fathoms depth, those at Sassoon Dock came from the stake net fishery as well as from the trawlers working in deeper waters (15-22 fathoms). The samples for analysis from Sassoon Dock were taken from the trawler landings in order to ensure comparison of the inshore and off-shore catches of prawns. One to two kg. samples were taken at random from the landings and are brought to the laboratory every week. In the laboratory counts and weights of each specific constituent were recorded, and sex ratio and maturity determined before length measurements are taken with the help of a suitably designed measuring board.

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THE FISHERY

Prawn fishery in Maharashtra coast commences by September, soon after the south-west monsoon; bulk of the catch being landed by the stake net fishermen from grounds lying within 15 fathoms depth. The stake net is a 'fixed engine' net used at the sea bottom with the help of two poles taking full advantage of the current prevailing in the area. Prawns as well as fishes are subjected to capture in this net only if they happen to filter through the net while being passively transported by the current or otherwise (Setna, 1949). The trawl net fishery which normally operates in the deeper waters up to 25 fathoms contribute to only a relatively smaller portion of the total production of shrimps, nevertheless, data obtained by their operations provide details regarding the prawn populations of the region. Although the prawn fishery exists throughout the fishing season from September to May the bulk of the landings are taken in the peak season October to January. There is a subsidiary pre-monsoon peak from late March to May. During the monsoon period—July and August—the inshore fishery is practically nonexistent while the trawl fishery continues depending on the weather conditions.

Nearly 30 species of prawns belonging to the section Penaeidea and Caridea (Crustacea, Decapoda) are known to exist in Bombay waters (Kunju, unpublished) but the commercial fishery is supported by nine species of Penaeid prawns and a few species of Caridean prawns. The Penaeid prawns of commercial value are *Penaeus indicus* (Milne Edw.), *P. monodon* Fabricius, *Metapenaeus affinis* (Milne Edw.), *M. monoceros* (Fabr.), *M. brevicornis* (Milne Edw.), *Parapenaeopsis stylifera* (Milne Edw.), *P. sculptilis* (Heller), *P. hardwickii* (Miers) and *Solenocera indicus* Nataraj. Considerable amount of *Acetes indicus* (Milne Edw.) is caught throughout the year along with the other prawns but it seldom appeared in the samples as the fishermen generally sorted it out before landing.

SUCCESSION OF SPECIES IN THE COMMERCIAL CATCHES

The relative magnitude of the fishery of each species and their succession as observed from the sample analysis is brought out in Figs. 1 and 2. The fishery at Versova, which represents the inshore fishery, commences in September with equal representation to *M. affinis* and *P. stylifera*; other prawns being insignificant at this time of the year. The magnitude of the catch of *M. affinis* shows gradual increase till November. As a general trend the catch of this species decline from December onwards till February and thereafter, till the end of the season it remains as the major constituent of the fishery. It is seen that throughout the season this species contributes to the bulk of the prawn catches at Versova. *M. monoceros* forms a minor fishery at Versova and appear in the catches for only a short period in October-November and sometimes in February. *M. brevicornis* seems to be present almost throughout the year in small quantities with relative preponderance in the catches in January and February. The fishery of *P. stylifera* which appear in the beginning of the season maintain more or less the same trend for the next month also but declined from November onwards. A secondary peak of this fishery was seen in January-February during 1958 and 1960. *P. hardwickii* and *P. sculptilis* begin to appear in the catches from November onwards when the catches of *P. stylifera* and *M. affinis* begin to decline. Both these species have their peak occurrence in December and January. In 1957-58 season the continued occurrence of *P. stylifera* till February seems to have reduced the impact of these two species in the catches. *Solenocera indicus* support an important fishery at Versova from November onwards and continue to exist in large quantities till the end of the fishing season. February and March are the peak months of occurrence of this species. The existence of this species as a commercial fishery is of great scientific interest as the species is not known to support any commercial fishery of value in any other part of the world. *Penaeus indicus* and *P. monodon* are seen in the catches of Versova only occasionally and there seems to be no regularity in their occurrence here. Non-penaeids contribute to the fishery only during the beginning and end of the fishing season.

The off-shore catches sampled from Sassoon Dock present yet another picture. While *M. affinis* substantially remains as the major component of the catches, there are other species as well forming

large portions of the landings here. The erratic occurrence of some of the species in large quantities seems to have upset the regularity of succession and sequence observed at Versova, a fishing village hardly fifteen miles from Sassoon Dock. This can only be due to the selectivity of the gear used by the trawlers and also due to their capacity to fish in different grounds widely separated from one another as compared with the fixed stake nets. For the same reason the general sampling of the off-shore catches will not be of significant value unless continued samples are studied from the same grounds.

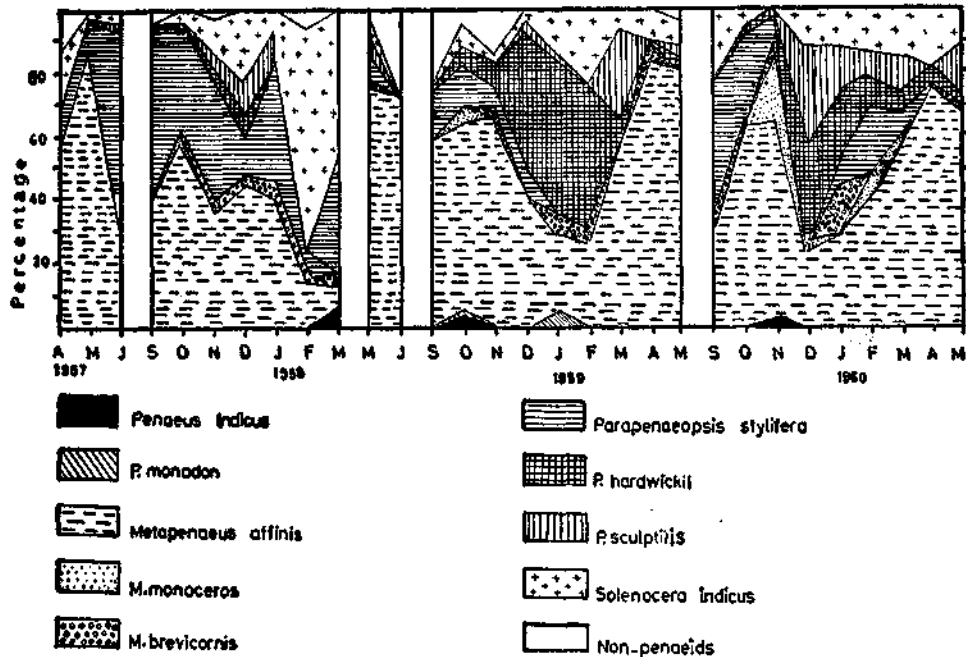


FIG. 1. Magnitude and succession of the different species of prawns in the commercial catches at Versova 1957-58 to 1959-60

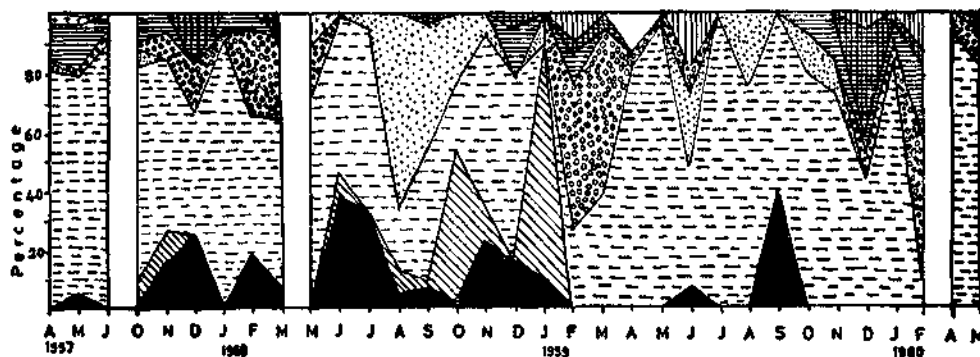


FIG. 2. Magnitude and succession of different species of prawns in the commercial catches at Sassoon Dock 1957-58 to 1959-60

The significant feature noticed from the general picture of distribution of species at Sassoon Dock (Fig. 2) is the occurrence of *P. indicus* and *P. monodon*. Both these species contributed substantially to the catches in certain months, but there appears to be no regularity in their appearance.

M. affinis remained as the major item of the catches throughout with the exception of a few months. If the changes brought out by the occurrence of *P. indicus* and *P. monodon* are not considered the curve of *M. affinis* assumes more or less the same trend as seen at Versova. The preponderance of *M. monoceros* in the catches was greater than what was observed at Versova especially in the last two seasons. The species appears in the catches with the onset of monsoon and remains in the catches till November although the intensity of the catch is reduced by that time. *M. brevicornis* has the same pattern of occurrence as seen in Versova samples. But its relative proportion in the catches is high, indicating a relatively deep water habitat of the species. All the three species of *Parapenaeopsis* appeared in the catches of Sassoon Dock with lesser magnitude; their time of appearance and disappearance in the landings being substantially similar to what was observed at Versova. *S. indicus* appeared in the catches only in the first season and for all practical considerations it need not be considered as forming part of the off-shore catches. The bigger mesh size of trawl nets is probably the reason why the smaller sized prawns such as *P. stylifera*, *P. hardwickii*, *P. sculptilis* and *S. indicus* are poorly represented in the off-shore samples.

BREEDING SEASON

Year round data on percentage preponderance of mature females in the catches is available only in respect of *M. affinis*, *P. stylifera*, *P. hardwickii* and *S. indicus*. For all the other species the data are not sufficient to warrant conclusions. Table I shows the percentage prevalence of mature individuals among females of the species in different months. *M. affinis* seems to be a continuous breeder, but its spawning activity seems to be relatively more intense during the periods December to February and the monsoon period of June to August. In the other three species, while there is no data for the monsoon months there appears to be definite periodicity of breeding showing more or less the same pattern. In these species—*P. stylifera*, *P. hardwickii* and *S. indicus*—the breeding period appears to be protracted extending throughout winter. In *P. stylifera* the period extends from September to February. A few mature individuals were obtained in May also. In *P. hardwickii* the spawning takes place from October to February with maximum intensity in December and January. *S. indicus* seems to breed from December to May; in February, however, no mature females were obtained.

TABLE I
Showing the percentage preponderance of mature individuals among females
(Monthly averages)

	<i>M. affinis</i>	<i>P. stylifera</i>	<i>P. hardwickii</i>	<i>S. indicus</i>
January	37.5	5.0	17.2	8.6
February	26.1	21.4	12.0	Nil
March	10.8	Nil	Nil	7.3*
April	13.4	Nil	Nil	11.0
May	14.2	100.0*	Nil	2.4
June	21.0	..	..	Nil
July	75.0*	..	..	..
August	29.4	..	..	..
September	Nil	2.0	..	..
October	2.1	8.0	7.2	Nil
November	4.7	8.6	6.6	Nil
December	20.9	16.6	30.4	13.1

* Poor sample.

SIZE AND GROWTH

Metapenaeus affinis

The size frequency histograms obtained by plotting samples from Versova and Sassoon Docks are given in Figs. 3 and 4. It is seen that the usual size differences noticed in the growth of other prawns in males and females are observed in this species also. There is a wide range of size, from 45 to 130 mm., at the beginning of the fishing season, viz., September. This is due to the continuous breeding habit of the species and due to the same reason it is seen that there are a number of modes. The earliest mode at this time (September, 1958) is seen at 71–80 mm. for males and 86–90 mm. for females. The progressive shift of these modes in the subsequent months towards the right is clear from the histograms and in January 1959 they could be seen at 121 mm. and 126 mm. for males and females respectively, indicating a growth of 40–45 mm. in four months. Therefore, the monthly growth increment at this stage can be reckoned to be around 10 mm. February onwards new recruits, both young and old, again appear in the fishery though the proportion of the smaller size groups is relatively small. It is therefore clear that the new recruits observed in September are the brood from the December to February spawning and that when they enter the fishery they are in 0-year class having completed 9 to 10 months of life. Their growth during the first year is about

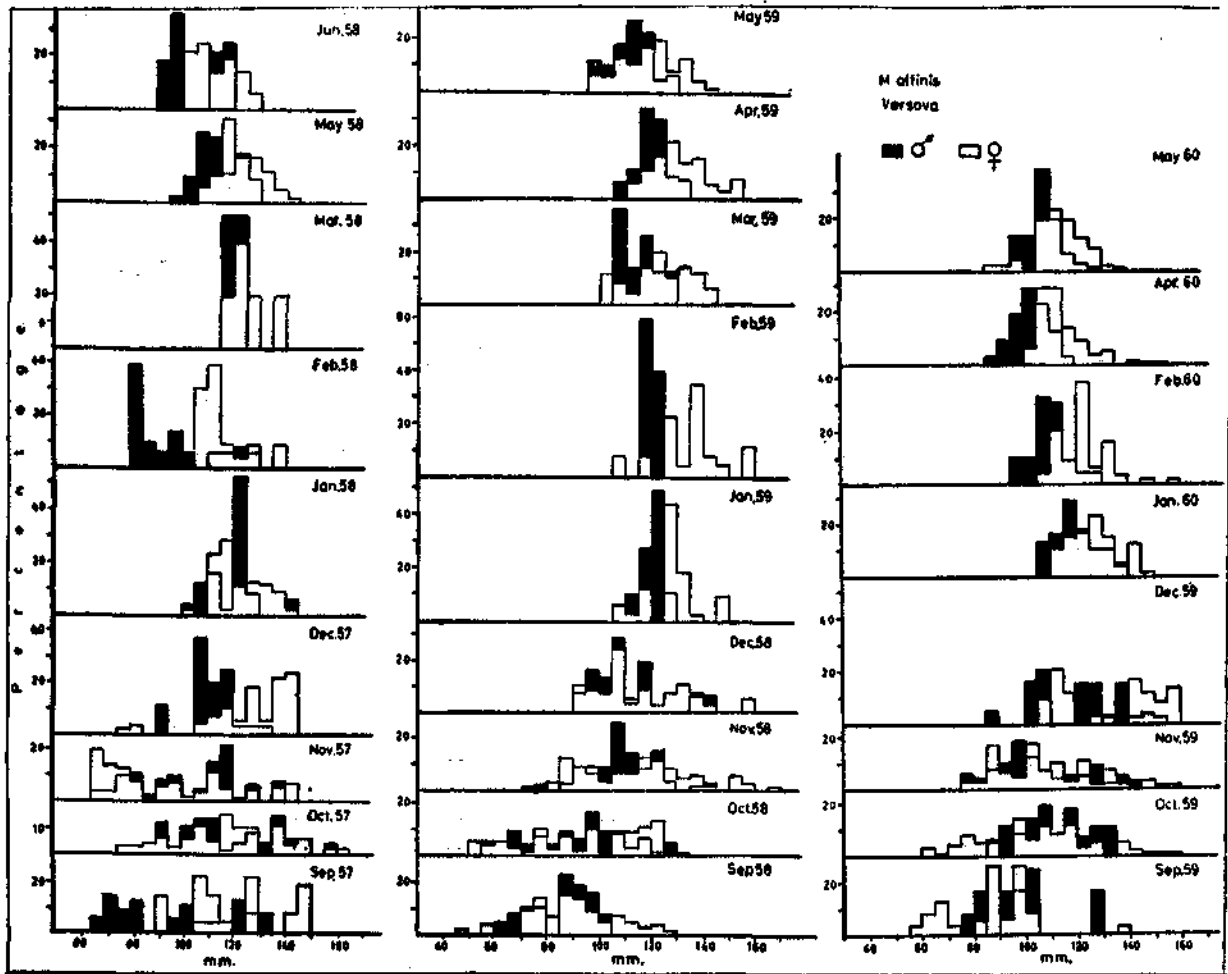


FIG. 3. Size frequency distribution of *M. affinis* in the commercial catches at Versova from 1957-58 to 1959-60

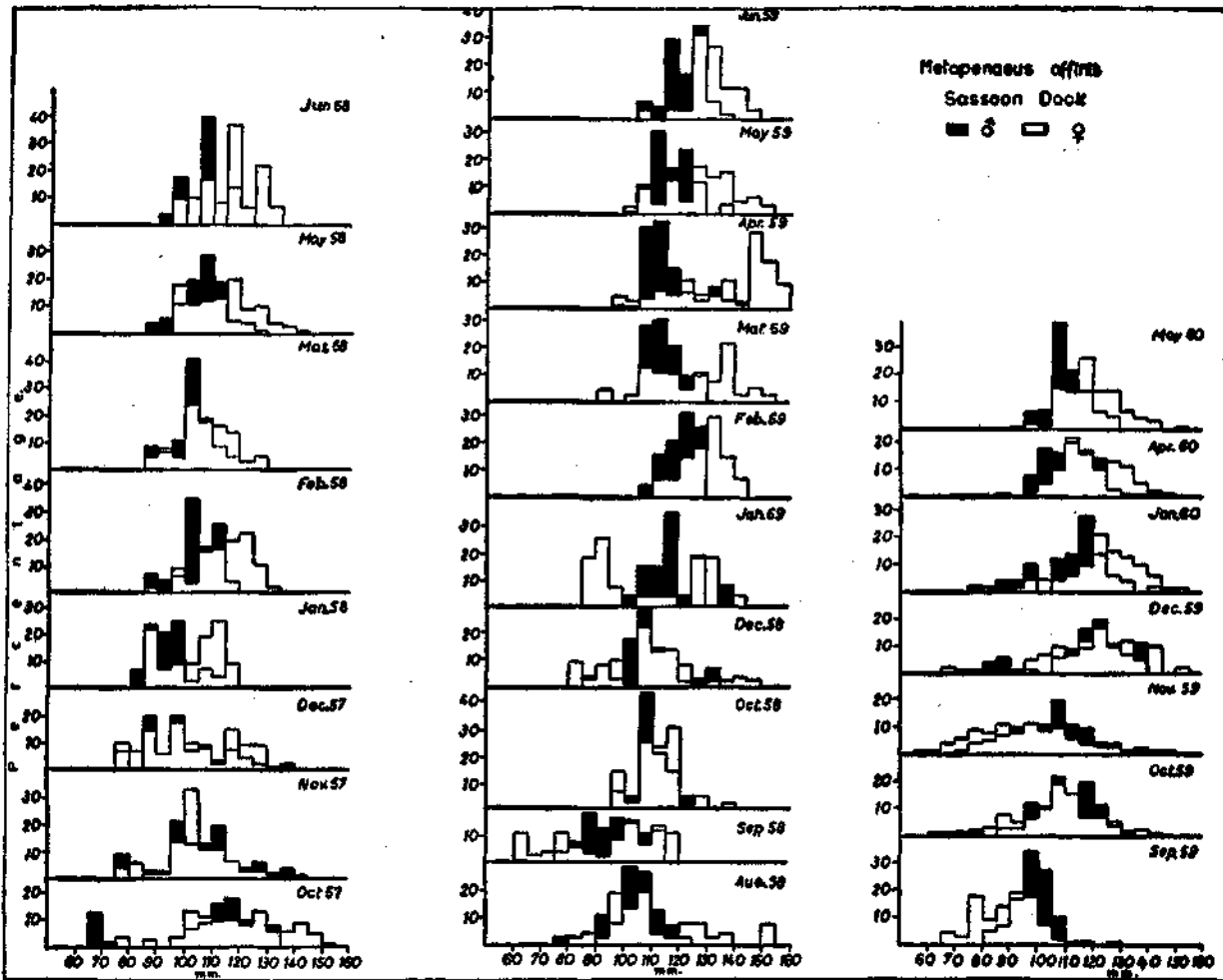


FIG. 4. Size frequency distribution of *M. affinis* in the commercial catches at Sassoon Dock from 1957-58 to 1959-60

120 mm. and all the individuals above this size are in the 1-year class having completed one year of life. The recruitment of the older size groups in February seems to be taking place from outside of the Versova fishing grounds. The histograms from Sassoon Docks also show the same type of distribution of the size groups.

Parapenaeopsis stylifera

The size frequency histograms of the species (Figs. 5 and 6) show the size range from 30 to 140 mm. The younger size group of prawns get recruited to the fishery in September-November period. In November 1957 the modes representing the youngest individuals are seen at 51-55 mm. for males and 61-65 mm. for females. These modes are progressively shifted to the right and are traced at 81-85 mm. and 91-95 mm. in February 1958 thereby showing a growth of about 30 mm. in three months. The monthly growth rate at this stage is therefore about 10 mm. The fresh recruits of younger prawns observed in November must have been born in May or June and they would have completed only 5-6 months of life. It therefore follows that the entire fishery of this species is supported by 0-year class. This observation is not in full agreement with those of Menon

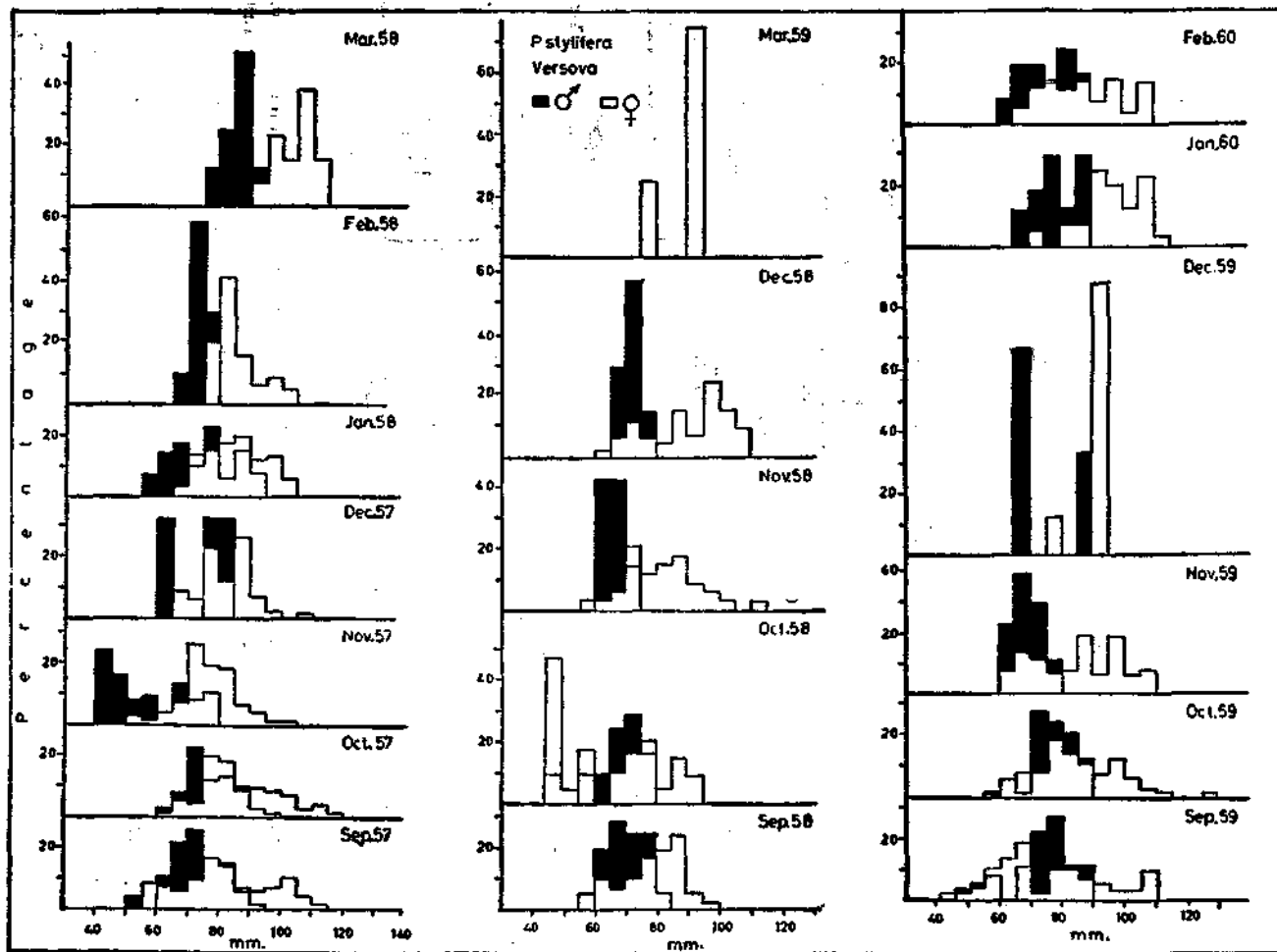


FIG. 5. Size frequency distribution of *P. stylifera* in the commercial catches at Versova from 1957-58 to 1959-60

(1953) and George (1961) who have observed that 0-year and 1-year classes supported the fishery at Kozhikode and Alleppey. The differential growth rate in males and females is observed throughout the period of observation. The larger size range of females seen is probably due to the increased rate of growth of females in the later part of their life as observed by Panikkar and Menon (1955). The breeding season of the species observed at Bombay is more protracted than what was observed by these authors.

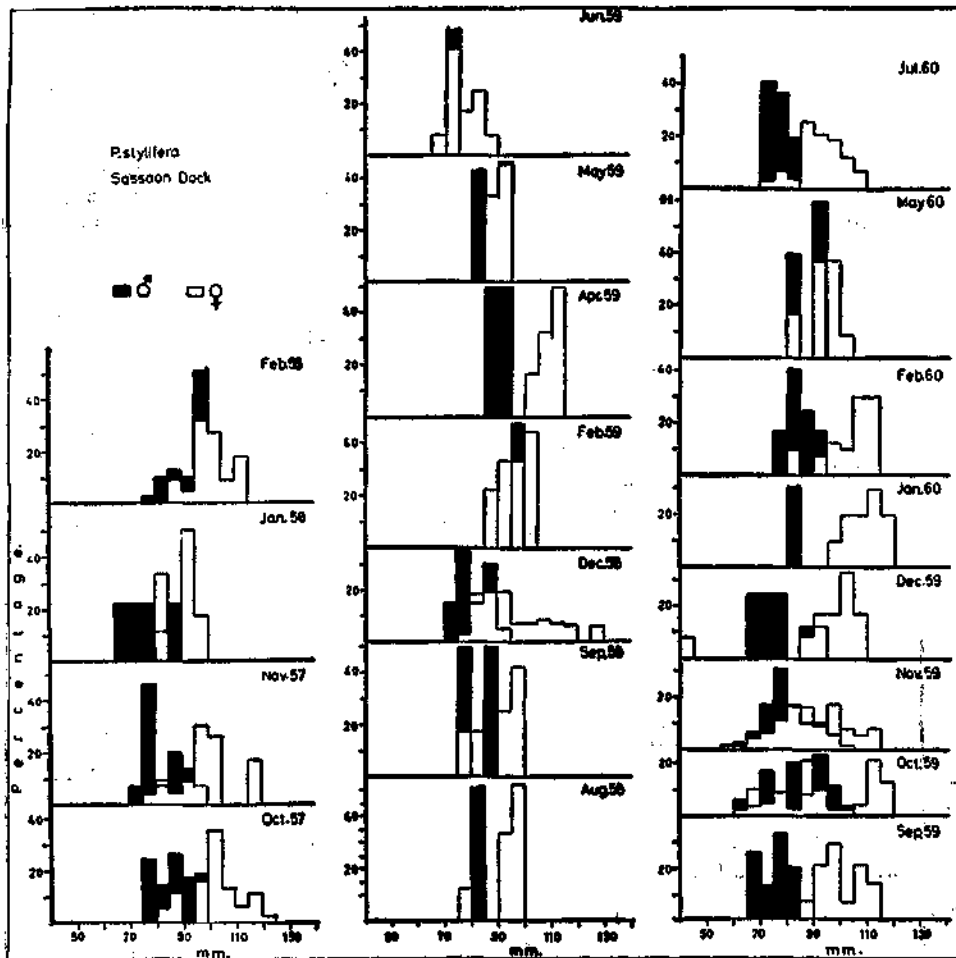


FIG. 6. Size frequency distribution of *P. stylifera* in the commercial catches at Sassoon Dock from 1957-58 to '59-60

Parapenaeopsis hardwickii

The total number of specimens of this species in the samples was very poor in all the months except November, December and January. The size frequency histograms (Fig. 7) obtained from these samples do not present a connected picture for following the growth. However, these polygons brought out another interesting feature of this species. The wide disparity of the sizes of males and females is very striking. The females are recorded up to a size of 125 mm. while the largest size of males seen is only 85 mm. Males are very poorly represented in the catches also. In the distribution of sizes it is seen that the size range of females begin from the point where the size range of males end giving more or less a continuous picture when both the sexes are considered together,

Solenocera indicus

This is a smaller species; the maximum recorded length during this investigation being only 110 mm. The species appeared in the catches of Versova only. The histograms showing the size frequency of the species (Fig. 8) show wide disparity in the sizes of males and females; the largest male observed being less than 90 mm. The youngest size group of this prawn begin to appear in the catches from October-November onwards. The youngest size group in November 1959, being constituted by males, stand at 41-50 mm. In the succeeding months this mode is seen shifting towards right side of the histograms indicating growth. In May 1960 this mode stands at 76-80 mm, showing a growth of about 25 mm. in 6 months. The monthly growth increment, therefore, appears to be around 4-5 mm. In females the mode at 61-70 mm. observed in December is seen shifting to 86-90 mm. in five months showing the same rate of growth. By back-calculating on the basis of this rate of growth it can be seen that the young individuals at 41-50 mm. seen in November are completed nearly 10 months of life having been born in January or December. Fresh young recruits seen in January are probably those born in April. Therefore the mode seen at about 90 mm. in December are due to the 1-year class. This year class is entirely supported by females only. The entire fishery is therefore constituted by 0-year class of males and 1-year class of females.

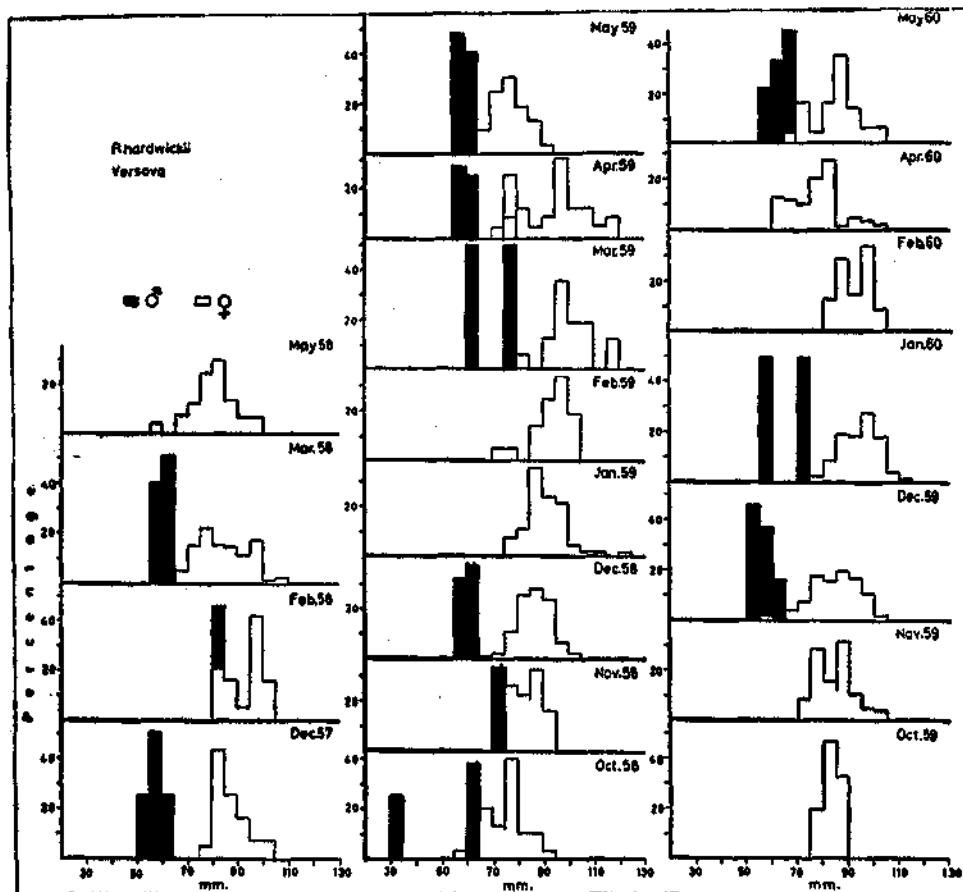


FIG. 7. Size frequency distribution of *P. hardwickii* in the commercial catches at Versova from 1957-58 to '59-60,

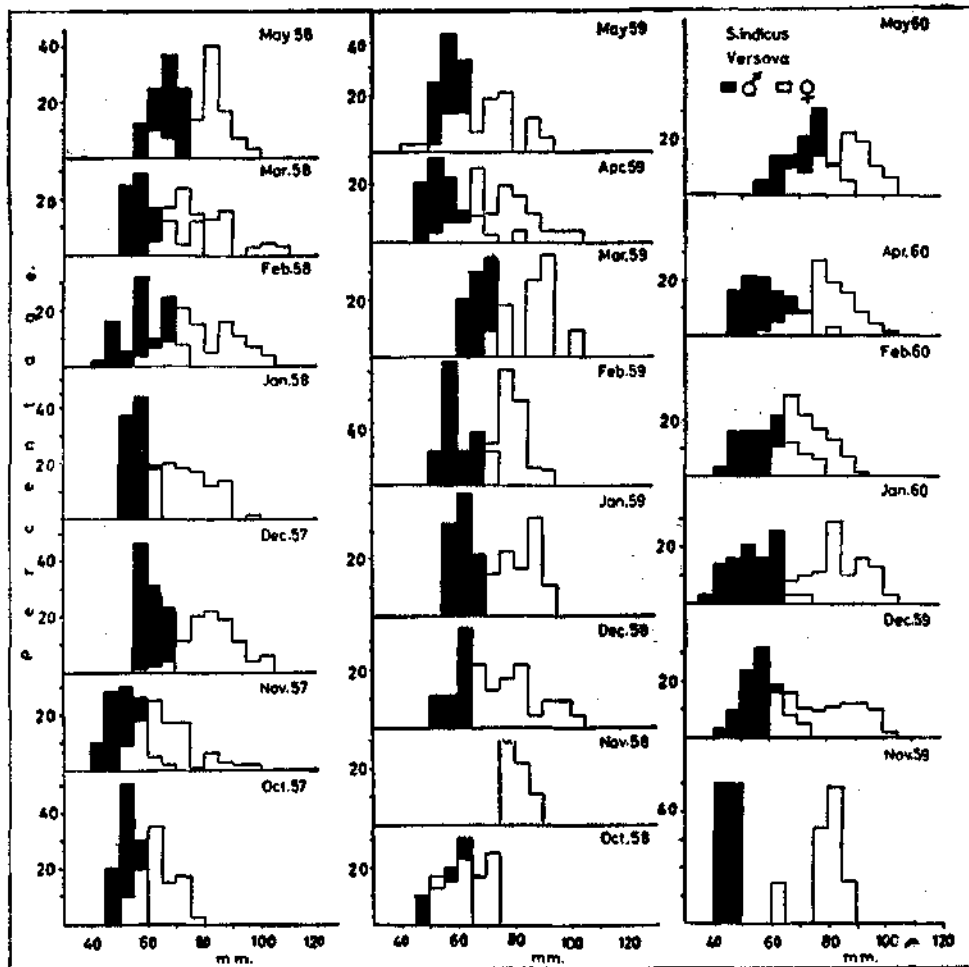


FIG. 8. Size frequency distribution of *S. indicus* in the commercial catches at Versova from 1957-58 to 1959-60

DISCUSSION

The prawn fishery at Bombay is probably unique in having a wide range of species supporting commercial fishery. At least 12 species of prawns among the 30 listed (Kunju, 1967) are being commercially exploited. Some of these species, particularly the caridean prawns, do not exist as a fishery in other parts of the country. The occurrence of *Solenocera indicus* as a fishery adds significance to the region as in no other part of the world this species supports a fishery.

Figures 1 and 2 show the relative preponderance of important penaeid prawns in the catches and their sequence of occurrence. The magnitude of occurrence of different species in inshore and off-shore catches shows some amount of variation which can be due to many reasons. The migratory habit of the prawns, the selectivity of the gear and the capacity of the trawlers to move from one ground to another are the chief reasons for this variation. The regularity of the succession of these species, when fully established, will enable to make short-term predictions which will be of benefit to the industry. Details of the life-history of many of the species remain unexplained and the present observations clearly indicate that some of the species that occur in Bombay waters are only passing through these waters at certain times of the year.

Shaikhmahmud and Tembe (1960) have observed the breeding period of *M. affinis* in April, May and June while the present observations show that the species breeds throughout the year with intensity of breeding during the period December–February and June–August. The same authors have observed the breeding season of *P. stylifera* as February to June whereas from the present observations the breeding of the species seems to take place from September to February and also in May. Their observations on *S. indicus* did not include mature specimens.

The continuous breeding habit of *M. affinis* is seen from the multimodal distribution of sizes in practically all the months. The striking disparity of sizes of males and females seen in *P. hardwickii* and *S. indicus* need further investigation. In *P. hardwickii* males and females are found in distinct and widely separated size groups, males being always smaller. In fact, the size range of females begin from the point where the size range of males end. In *S. indicus* although the size range of males and females overlap to some extent their modes are widely separated. This is probably due to extreme segregation of sexes involving males leaving the fishing ground early in life. As a possible explanation to this phenomenon sex reversal (Protandrous hermaphroditism) in these species should not be completely ruled out. Such conditions are known to exist in the European prawn *Pandalus borealis* (Rasmussen, 1942). *P. borealis* functions as male in earlier part of its life and as female in the later part of life. Only directed and continued research can elucidate this point in respect of the above two species.

REFERENCES

- BANERJI, S. K. 1964. A note on the production trend of marine shrimps in India. *Symposium on prawn fisheries in India, Ernakulam*, October 3rd and 4th, Abstract.
- CARRUTHERS, J. N., S. S. GOGATE, J. R. NAIDU AND J. LAEVASTU 1959. Shorewards upslope of the layer of minimum oxygen off Bombay, its influence on marine biology especially fisheries. *Nature*, 183: 1084–1087.
- CHOPRA, B. N. 1943. Presidential Address to the Section of Zoology and Entomology of the Indian Science Congress.
- GEORGE, M. J. 1959. Notes on the bionomics of the prawn *Metapenaeus monoceros* Fabricius. *Indian J. Fish.*, 6 (2): 268–279.
- KUNJU, M. M. 1967. Observations on the prawn fishery of Maharashtra coast. *Proceedings of the Symposium on Crustacea*, Marine Biological Association of India (1965), Part V: 1382–1397.
- MENON, M. K. 1951. The life-history and bionomics of an Indian Penaeid prawn *Metapenaeus dobsoni* Miers. *Proc Indo-Pacif. Fish. Council.*, 3rd Meeting, 80–93.
- 1955. Notes on the bionomics and fishery of the prawn *Metapenaeus dobsoni* Miers on the South-west coast of India. *Indian J. Fish.*, 2 (1): 41–56.
- PANIKKAR, N. K. AND M. K. MENON 1955. Prawn fisheries of India. *Proc. Indo-Pacific Fish. Council.*, 6 (3): 328–344.
- RAI, H. S. 1933. Shell fisheries of Bombay Presidency. *J. Bombay Nat. Hist. Soc.*, 36 (4): 884–897.
- RAJYALAKSHMI, T. 1961. Observations on the biology and fishery of *Metapenaeus brevicornis* (M.-Edw.) in the Hooghly Estuarine system. *Indian J. Fish.*, 8: 381–402.
- SETNA, S. B. 1949. Bombay Fishermen's ingenuity. *J. Bombay Nat. Hist. Soc.*, 48 (3): 444–453.
- SHAIKMAHAMUD, F. S. AND V. B. TEMBE 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 (1): 69–81.
- 1961. A brief account of the changes in the developing ovary of (Penaeid prawns) *Parapenaeopsis stylifera* (M.-Edw.) in relation to maturation and spawning cycle. *J. Bombay Univ.*, 29 (3 and 5): 62–77.
- 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.
- RASMUSSEN, B. 1942. *Report on Norwegian Fishery and Marine Investigations*, 7 (4): 43.