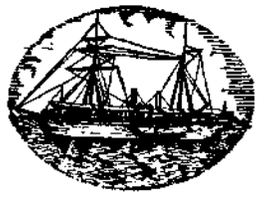
SYMPOSIUM ON CRUSTACEA

PART IV



MARINE BIOLOGICAL ASSOCIATION OF INDIA

MARINE FISHERIES P.O., MANDAPAM CAMP

INDIA

PROCEEDINGS

OF THE

SYMPOSIUM ON CRUSTACEA

HELD AT

ERNAKULAM

FROM JANUARY 12 TO 15, 1965

PART IV

SYMPOSIUM SERIES 2

MARINE BIOLOGICAL ASSOCIATION OF INDIA

MARINE FISHERIES P.O., MANDAPAM CAMP

INDIA

STUDIES ON THE PRAWN FISHERY OF KUTCH*

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ABSTRACT

This paper deals with the observations on the prawn fishery and bionomics of the commercial species during May 1959 to April 1962. The principal landings consisted of *Metapenaeus kutchensis* and *M. brevicornis* and the fishery for these occurred during the monsoon period (August–October) and winter (November–February) respectively.

Both the species appear to live for four years. In the case of *M. kutchensis* all the year classes are represented in the coastal waters and a length of 81–85 mm., 106–110 mm., 131–135 mm. and 146–150 mm. is reached by the respective year class. From the length frequency curves for this species that occurred in the creeks the monthly growth rate is estimated to be 5–7 mm. in the '0' year class. The monsoon fishery was constituted by the '0' year group. No marked disparity in the sex ratio was noted. Breeding takes place only in the sea and it extends from February to September with the peak during March–May.

The commercial catches of *M. brevicornis* in the inshore waters were constituted by the 2 year class (86–90 mm.). Towards the end of the season the 3rd year class (106–110 mm.) appeared in the fishery and a marked disparity in the sex proportion was also noticed then. From the length frequency curves for this species occurring in the lower reaches of the creek, the monthly growth rate has been estimated to be 3 mm. in the 1 year group. In the second year group it is 2·7 mm.

Evidence is presented to show that this species breeds during March–April which synchronises with the disappearance of the fishery from the coastal waters. It is, therefore, probable that it migrates into the deeper waters for breeding. The differential growth rates and survival rates in the two sexes of both the species are discussed.

INTRODUCTION

PRAWNS constitute nearly 60% of the total marine fish catch of Kutch. The present paper is the result of investigations carried out during May 1959 to April 1962 and deals with the study of commercially important species of prawns caught in the Kutch coast of the Gulf of Kutch, from the point of view of the size groups entering the fishery at different seasons and the relationship of the fishery to surface temperature, salinity and rainfall.

With the exception of the work done by Srivatsa (1953) who made a general survey of the prawn fisheries with particular reference to the Saurashtra coast and that of the author (Ramamurthy, 1963) whose account deals with the distribution of the different species of prawns in the Kutch coast, no information is available on the prawn fisheries of this region.

MATERIAL AND METHOD

Material for this investigation was collected fortnightly by random sampling of the commercial catches at Cherowari, and Takara (Text-Fig. 1). Cherowari is connected to the open sea by both Kandla and Hansthal creeks. Weekly samples were analysed from Kandla situated in the lower reaches of the Kandla creek. Apart from this, samples collected once a month from the departmental catches of *gunja* at Cherowari during May 1960 to October 1961 and during February to

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April 1962 and those collected fortnightly at Luni and Modhwa from August 1960 are also included in this study.

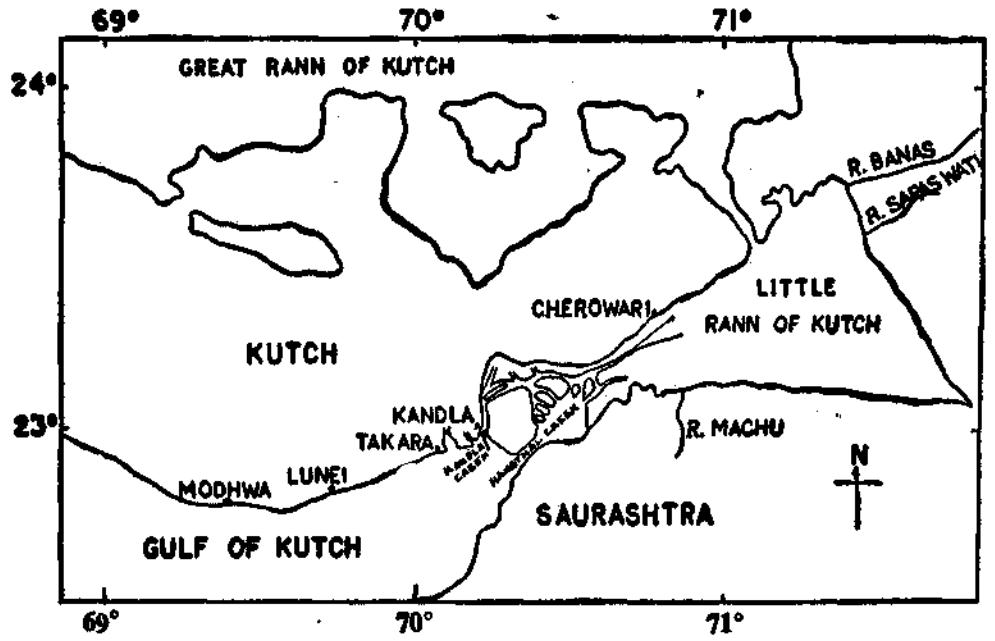

FIG. 1. Showing the location of fishing centres of observation in Kutch.

The type of net used at these centres was *gunja* (conical bag net) tied to stakes. The *gunja* used in creek-fishing is 15′ long, 9′ in diameter with a mesh size of 1¾″ near mouth to ¼″ at cod end and that used in the inshore waters of the Gulf is 72′ long, 18′ in diameter with a mesh range of 4½″ to ½″. At Luni, *Patti* (rectangular shore net) 40′ × 4′ with a mesh size of 1″ to ⅛″ is operated. Fishing by these types of nets is done taking advantage of the strong tidal flow, between depths of 2–12 m. The tidal range at Kandla is about 6 m. While collecting the samples no distinction was made between the catches of the different types of nets. The data gathered from the open gulf centres are pooled.

In analysing the samples, the percentage values of the different species by weight were determined. For length frequency studies, total length (from tip of the rostrum to the end of the telson) was taken after separating the sexes. The maturity condition was also noted.

Salinity was determined by Mohr's method of the titration of the chlorides and the temperature was recorded by the centigrade thermometer.

FISHERY AND CATCH COMPOSITION

Since the fishing is done depending on the tidal flow, the catches were generally scanty from the 7th to 11th day and from 22nd to 26th day of the lunar month.

There are two prawn fishing seasons in Kutch. The monsoon fishery occurs in the upper reaches of the creeks during August to September, sometimes extending to October and this period coincides with the rainy season (June to October) of this region. The fishery is constituted almost entirely by *Metapenaeus kutchensis*. This species contributes to the bulk of the prawn fishery of

Kutch which is however, erratic. The fishery was a total failure during 1960–61. The total landings of prawns during 1959–60 and 1961–62 were estimated as 880 and 700 m. tons respectively. The winter fishery occurs during November to February and it was observed to be more or less regular unlike the monsoon fishery. The average annual production during the three years was 180 m. tons. The bulk of this fishery (60%) is constituted by *Metapenaeus brevicornis*. The other important species found in the catches are *M. kutchensis* (20%), *Penaeus indicus* (11%) and *Parapenaeopsis sculptilis* (7%). Occasionlaly *M. stebbingi*, *Parapenaeopsis stylifera*, *Penaeus canaliculatus*, *Acetes* sp., *Leander* spp. and *Hippolysmata ensirostris* also are present in the catches. The fishery and bionomics in respect of the two commercial species *M. kutchensis* and *M. brevicornis* are dealt with below.

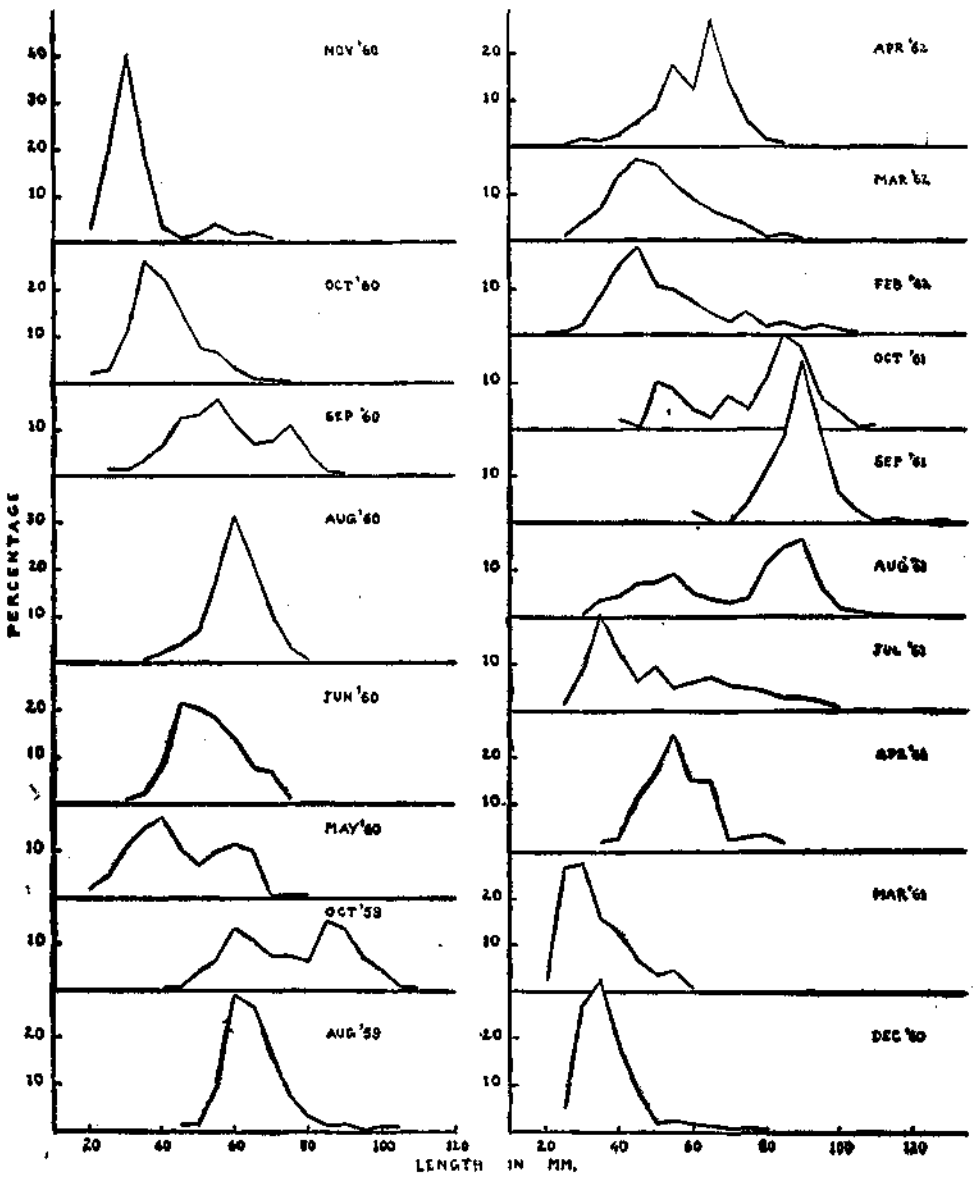

FIG. 2. Length frequencies of *M. kutchensis* at Cherowari.

I. Metapenaeus kutchensis

The bulk of the catch is netted in the inner creeks of the Gulf during the south-west monsoon period (August to September) when the flood waters of the rivers Banas, Saraswati and Machu (Text-Fig. 1) get discharged into the creek. Outside, in the coastal waters of the open Gulf, this species is caught along with *M. brevicornis* in winter.

GROWTH

The commercial fishery is restricted to a very brief period every year. In order to get a picture of the occurrence of this species at other times of the year departmental *gunja* was operated once a month at Cherowari. These operations, necessarily limited in frequency due to the inaccessibility of the place, could not be planned so as to have any reference to the phases of the moon. The monthly frequency curves based on the data collected thus, together with the frequency curves for the commercial fishery are represented in Text-Fig. 2. It can be seen that during 1959–60 the length of the modal group in the commercial catches was 56–60 mm. in August while in October another group, *viz.*, 81–85 mm., was also represented. The fishery came to a close thereafter. From the month to month frequency curves in 1959–60 the modal length is found to gradually increase from 36–40 mm. in May to 56–60 mm. in August and the monthly growth rate works out as 6·7 mm. During 1960–61 the fishery failed. However, the analysis of the departmental catches revealed that in September and the following months the length of the majority group was less than that in August, reaching a minimum of 26–30 mm. in November 1960. In December the mode shifted to 31–35 mm. But in subsequent months the majority group was varying in length irregularly between 26–30 and 51–55 mm. till July 1961. In August and September 1961, when the fishing operations were on a commercial scale the principal mode was at 86–90 mm. and the 51–60 mm. group was reduced to an insignificant mode unlike the length frequency characteristics of the commercial fishery of 1959–60. It may not be that the 51–55 mm. group noticed in April 1961 could have reached the length of 86–90 mm. in August 1961 as the monthly rate of growth among these size groups is observed to be 5–6 mm. at Kandla (Text-Fig. 3). It is also seen from the length frequency curves in Text-Fig. 2 that during November–July the maximum size of the individuals was always below 100 mm. while during the period of the active fishery, *i.e.*, August–October of 1959–60 and 1961–62 specimens upto a maximum size of 128 mm., comparable to the sizes occurring outside in the sea, were encountered in the fishery. Such comparable sizes do not occur at Cherowari at other times of the year. It can therefore be inferred that *M. kutchensis* migrates into the creeks during the monsoon period and gets caught in the commercial fishery. Such individuals appear to belong to the 0-year group as will be seen later. However, it is fairly clear that specimens measuring over 100 mm. are very rare, the maximum size recorded being 128 mm. Bigger size groups are found to occur only in the sea as will be seen later. In the light of these facts it is also evident that *M. kutchensis* migrates back into the sea.

The length frequency curves for *M. kutchensis* that occur at Kandla are plotted in Text-Fig. 3. Specimens measuring over 110 mm. were very rare. The modal group from month to month does not show any progressive increase in size. During June 1961–April 1962 the majority length group was between 61–75 mm. and each was found to remain unchanged for 3–4 months. However, in the earlier years it was seen that the 56–60 mm. modal size of June 1959 has shifted to 81–85 mm. in March 1961. These indicate a monthly growth rate of 5–6 mm. among these size groups.

Though data on size groups at each of the fishing centres in the open gulf were not continuously available it is attempted here to present a picture of the age groups in fishery by clubbing the entire data of the centres available during 1961–62. The total size frequency plotted for all sexes in the coastal fishery (Text-Fig. 4) shows four modes, *a*, *b*, *c* and *d* at 81–85, 106–110, 131–135 and 146–150 mm. respectively. The sizes attained by this species as well as the rate of growth are comparable

to those of *M. monoceros* (George, 1959) and hence these may be considered to represent the 0, 1, 2 and 3 year classes respectively. However, it will be worthwhile to have more data for a detailed analysis of the age groups with particular reference to the centre of observation.

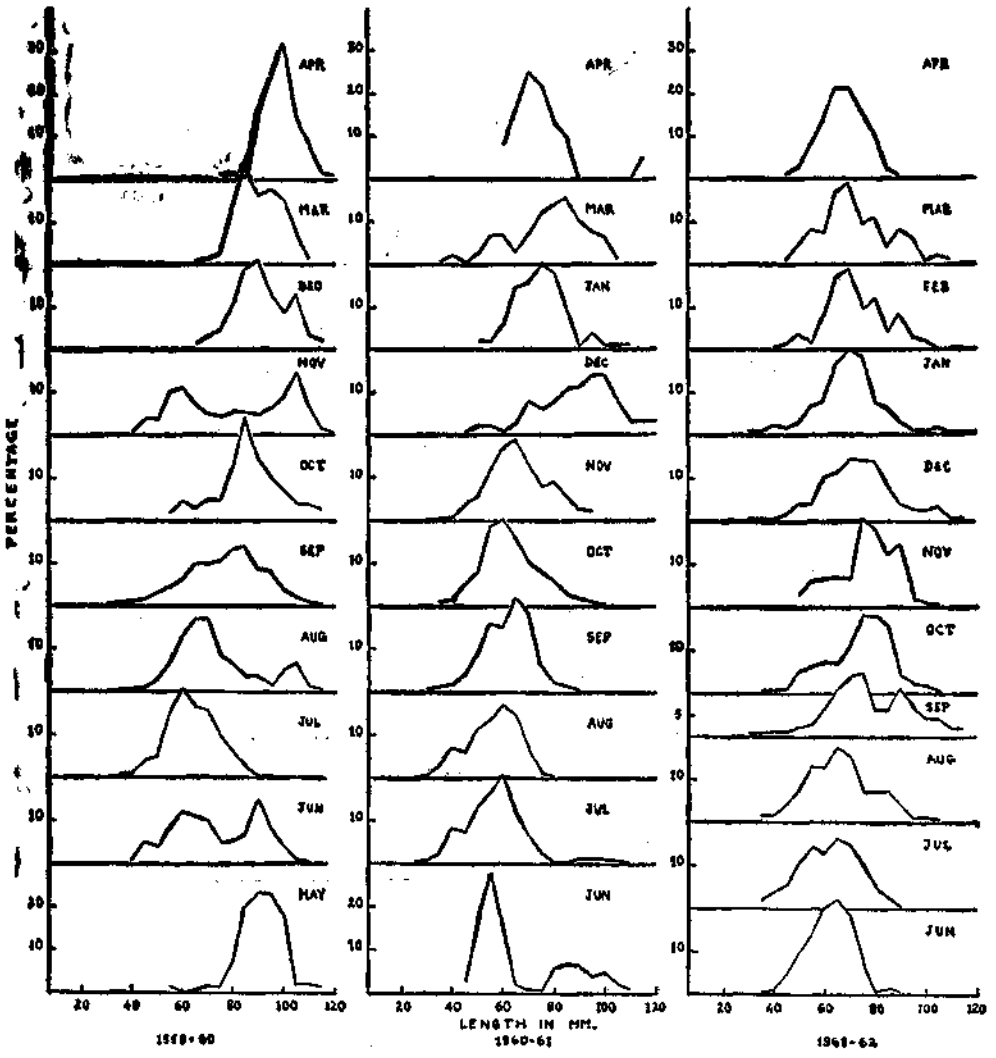

FIG. 3. Length frequencies of *M. kutchensis* at Kandla.

DIFFERENTIAL GROWTH RATE IN SEXES

Length frequencies for the two sexes separately in August and November 1960 and August 1961 at Cherowari and in February 1962 in the coastal fishery are shown in Text-Fig. 5. Females have a higher growth rate as observed in the case of other species of prawns (George, 1961). But it is not quite apparent early in life as the frequencies for August and November 1960 would indicate. The largest female measured 164 mm, while the largest male measured only 148 mm.

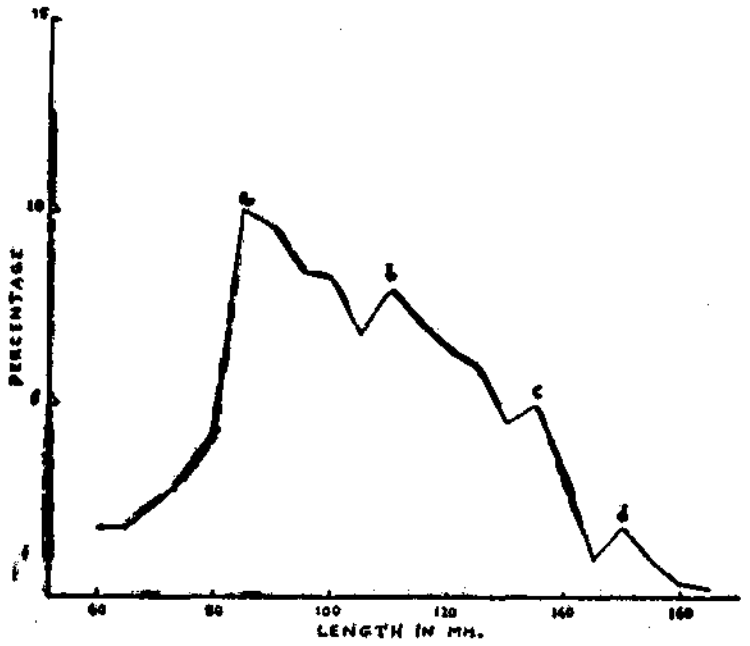

FIG. 4. Total size frequencies of *M. kutchensis* in the coastal fishery during 1961–62.

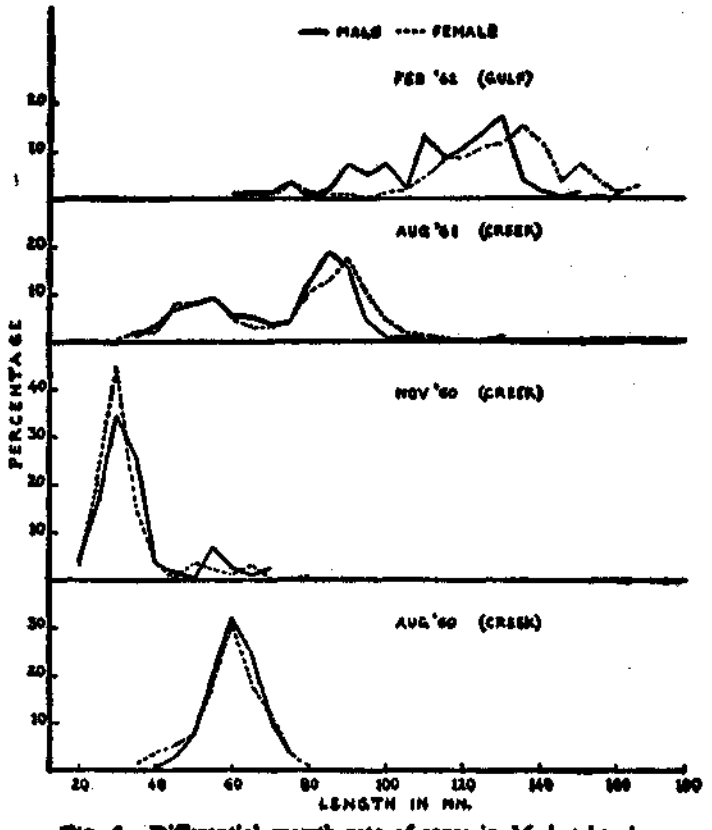

FIG. 5. Differential growth rate of sexes in *M. kutchensis*.

Sex Ratio

The determination of sex-ratio in the commercial fishery during 1959–60 and 1961–62 shows a slightly higher percentage for females in both the years, the respective percentages of males and females being 47·4 and 52·6 and 48·1 and 51·9.

The percentage of males and females in the coastal waters measuring 101–125 mm. and those measuring over 126 mm. in the total number of each sex has been calculated separately for 1961–62 and is shown in Table I.

Table I

Percentage of males and females of M. kutchensis *in specified size groups*

	101–125 mm.	126 mm. and over	Total number measured
	%	%	
Male ..	23·2	4·7	698
Female ..	21·5	13·0	738

The proportion of females of the size 101–125 mm. is more or less equal to that of males while in the next size group of 126 mm. and over, the proportion of females is markedly higher than that of males. Since these sizes (126 mm. and over) would include individuals more than 2 year old, these percentages would indicate that the proportion of prawns, particularly the males, surviving beyond 2 years, is quite small.

Food

The analysis of the stomach content of *M. kutchensis* ranging from 40–130 mm. in size revealed that they feed on the detritus at the bottom and the stomach content therefore usually shows considerable amount of mud. Sand grains were also presant. Among the recognisable remains are the crustacean appendages, molluscan shell remains and foraminiferans. Algal matter was also noticed on several occasions.

Breeding and Migration

Males measuring over 100 mm. are found to carry spermatophores. Mature females were generally rare and they were never recorded from the creeks. The smallest mature female measured 122 mm. The highest percentage of mature females occurred during February to September. Occasionally spent ones were also noticed during March–May which suggest that breeding takes place during this period.

As pointed out earlier, individuals belonging to the '0'-year group appear to migrate into the creeks during the monsoon period. They probably do so in search of low saline waters and migrate back into the sea as a result of the increase in salinity in the creeks as will be seen later. Breeding takes place only in the sea since mature females and spent ones were obtained only from the marine environment.

Factors Influencing the Monsoon Catch

Among the fishermen there is a wide-spread belief that the rainfall exerts a considerable influence on the fishery. In Table II the monsoon prawn catch and rainfall together with the salinity ranges at Kandla separately for the monsoon period and for the rest of the year during May 1958 to September 1962 are presented. Salinity estimations of the water at Cherowari were also carried out during July to October of 1960–61 and 1961–62, the mean monthly range in salinity being respectively 34·21–54·28‰ and 12·43–27·84‰. It is seen from the table that the salinity ranges at Kandla reflect the effect of rainfall to a considerable extent. The fishery completely failed during 1960–61 and the rainfall also was least in that year, consequent on which the salinity remained high. Though no data on rainfall are available for 1961–62, the salinity ranges at Kandla and Cherowari indicate that the monsoon was active in that year as in 1959–60 and the fishery also was good in both these years.

Table II

Landings of M. kutchensis *in relation to rainfall and salinity*

Year	Prawn landing in m. tons	Rainfall in cm.	Salinity range in ‰ at Kandla	
			July–October	Rest of the year
1958–59 ..	862	31·1	No data	No data
1959–60 ..	880	82·4	15·56–24·70	29·90–37·21
1960–61 ..	No landings	13·3	36·51–38·78	36·44–41·88
1961–62 ..	700	No data	25·40–26·71	32·63–41·35

II. Metapenaeus brevicornis

The commercial catches of this species are taken only from the sea. This species is never caught in significant quantities at any time at Kandla. It is however interesting to note that the size groups occurring in the creeks were entirely different from those of the coastal waters of Kutch and hence the month to month fluctuations in the sizes occurring in the creeks were followed.

Growth

The size range of the species together with the modal sizes in each month at Kandla during 1961–62 are shown in Table III. During February–May it was not represented at all in the catches. The smallest modal size 26–30 mm. occurred during September. At other times the majority group varied in length between 36–40 and 51–55 mm. Individuals measuring over 65 mm. were very rare. The majority length group of 41–45 mm. in October appears to have grown to 51–55 mm. in January 1962 which indicates a monthly growth rate of 3·3 mm.

The coastal fishery during the first year could be kept under observation only till December 1959 while in the subsequent years it was followed throughout. Table IV represents the monthly average percentage values of the species by weight in the catches of the coastal waters. *M. brevicornis* appears in the inshore catches from August when they were caught in small quantities. After the period of the active fishery (November–February), when the catches comprised chiefly of this species, it was continued to be caught in small quantities till March–April.

TABLE III

Size range and modal size of M. brevicornis *at Kandla during* 1961–62

Month	Modal size in mm.	Size range in mm.
May ..	Specimens absent in the catch	
June ..	36–40	34–52
July ..	46–55	36–65
August ..	36–40	29–61
September ..	26–30	21–53
October ..	41–45	31–56
November ..	46–50	47–66
December ..	51–55	36–55
January ..	51–55	34–75
February ..	Specimens absent in the catch	
March ..	Specimens absent in the catch	
April ..	Specimens absent in the catch	

TABLE IV

Monthly average percentage values for M. brevicornis *in the marine catches*

	August	September	October	November	December	January	February	March	April
1960–61 ..	11·0	25·0	30·0	27·0	41·0	..	82·0	28·0	1·0
1961–62 ..	14·0	21·1	24·0	42·7	57·9	47·0	55·1	32·5	29·0

The size groups of *M. brevicornis* occurring in the sea are shown in Text-Fig. 6. When this species started appearing in August the dominant size was at 66–70 mm. in all the three years. A progression of this mode to 81–85 mm. in December 1959, 86–90 mm. in March 1961 and April 1962 is clearly noticeable. The lengthy of the majority group in the commercial catches was 86–90 mm. and the age when this length is attained could not be ascertained since no other earlier size groups are available in commercial quantities. However, according to the findings of Rajyalakshmi (1961) this may represent the two-year old group. The monthly rate of growth in this group appears to be 2·7 mm. Larger size groups enter the fishery towards the end and the modal size of 106–110 mm. noticed during February–March would seem to represent individuals in the fourth year of life (3rd year class). The rate of growth is found to be diminishing with the ageing of individuals. The largest size group 126–135 mm. has been recorded only during February to April 1962 and they were entirely females. They however form only a small part of the entire population as can be judged from the catches of the three years. It is not possible from the available data to determine whether they are older than four years. Under the circumstances it can only be stated that the species lives for four years.

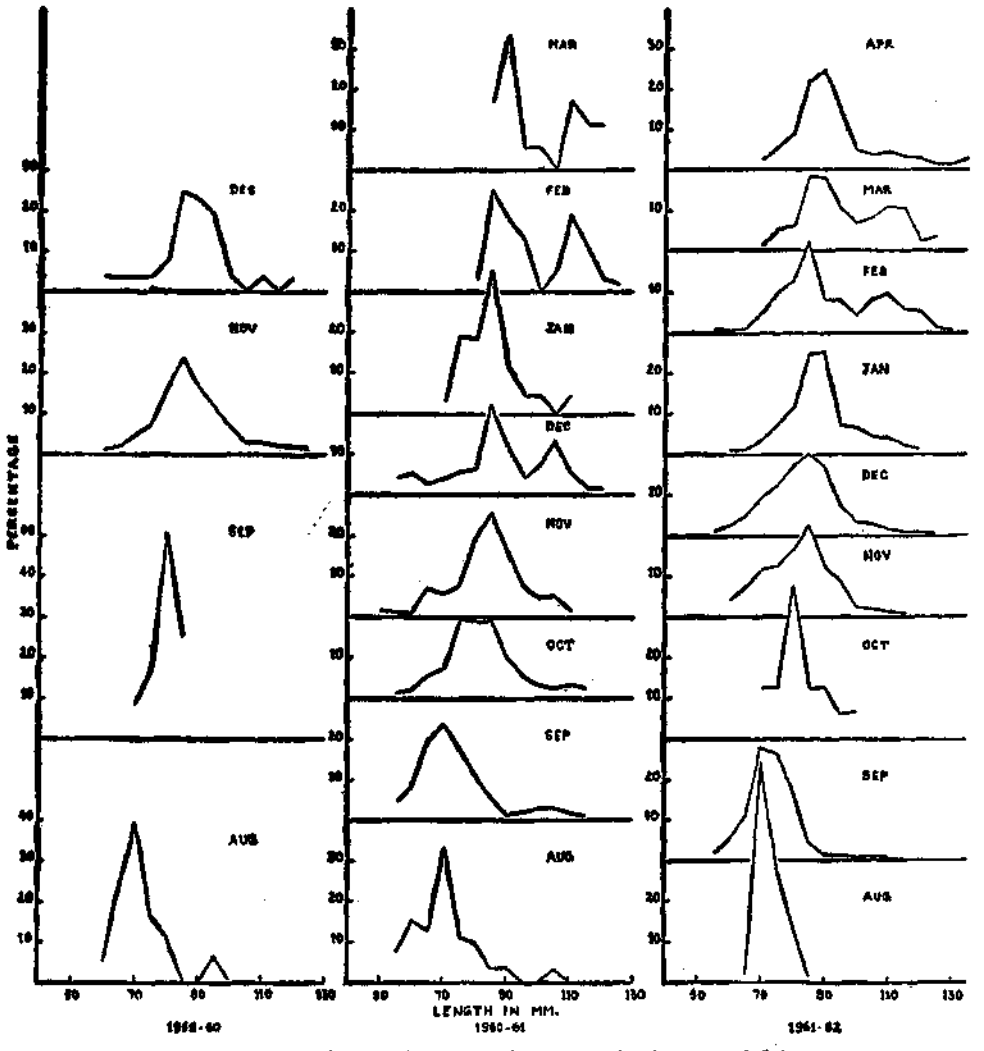

FIG. 6. Length frequencies of *M. brevicornis* in the coastal fishery.

DIFFERENTIAL GROWTH RATE IN SEXES

The study of the length frequency curves of the two sexes separately (Text-Fig. 7) shows that there is a differential growth in the sexes, females having a higher growth rate as in the case of *M. kutchensis*. The largest male and female measured 103 and 135 mm. respectively. Quite early in life such a differential growth is not apparent as the frequencies of both the sexes in the creek were noticed to be the same at Kandla. Such characteristics in the growth rate of sexes have also been observed by Rajyalakshmi (1961).

SEX RATIO

The monthwise sex ratio in the catches during the three years is shown in Table V. The disparity in the proportion was not generally great during the active period of the fishery (November–January). Towards the fag end of the season the proportion of females was much higher.

TABLE V

Percentage of males and females of M. brevicornis *in the commercial catches*

Year	Sex	August	September	October	November	December	January	February	March	April
1960–61	Male	44·4	27·0	40·0	45·5	49·3	53·8	20·0	25·0	..
	Female	55·6	71·0	60·0	54·5	50·7	46·2	80·0	75·0	..
1961–62	Male	38·6	36·1	33·3	42·3	49·3	44·5	31·8	27·5	59·5
	Female	61·4	63·9	66·7	57·7	50·7	55·5	68·2	72·5	40·5

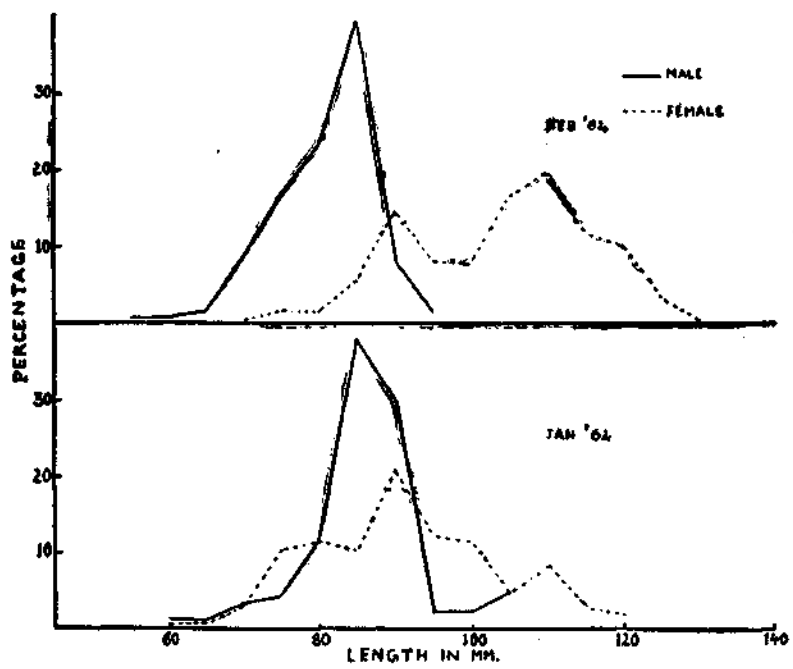

FIG. 7. Differential growth rate of sexes in *M. brevicornis*.

The percentage of males and females measuring 81–100 mm. and 101–120 mm. in the total numbers of each sex has been calculated separately for 1961–62 only and are presented in Table VI.

TABLE VI

Percentage of males and females in specified size groups of M. brevicornis

	81–100 mm.	101–120 mm.	Total number measured
	%	%	
Male ..	50·8	0·6	823
Female ..	42·1	30·9	1,120

The proportion of males in the 80–100 mm. size range is slightly higher than that of females. But in the 101–120 mm. group the proportion of females is markedly higher. Since the sizes chosen

for both the sexes would almost entirely include the 2 and 3 year old groups respectively, it would appear that the proportion of males surviving in the fourth year of life is quite small.

Food

The examination of stomach content of *M. brevicornis* ranging in size from 40–110 mm. showed that the composition of food was similar to that of *M. kutchensis*. But vegetable matter and mud were less common.

Breeding and Migration

Males measuring over 70 mm. were found to have spermatophores. Mature females were very rare in the commercial catches. The smallest mature female that was captured measured 105 mm. This length is reached normally when the prawns are 3 year old. But it is difficult to conclude whether females mature only then, with the available data.

Impregnation was not noticed among individuals below 70 mm. The percentage of impregnation was highest during February–April ranging from 31–69% as against 1–12% during August to January. The majority of impregnated individuals belonged to 101–125 mm. groups. Mature females and spent ones, though rare, were obtained in the inshore catches only during March-April which appears to be the breeding period for this species. The species found in the east coast is reported to breed twice in a year (Rajyalakshmi, 1961).

M. brevicornis starts leaving the inshore waters early in March till they finally disappear in April. There appears to be some relationship between this fishery and the surface temperature of the coastal waters. The mean monthly temperature maximum (29·1–29·3° C.) was in June-July in this coast (Table VII). It was declining subsequently till the minimum was reached in January (16·5–17·7°C.). Coincident with the fall in temperature *M. brevicornis* commenced to appear in the inshore catches and the active period of the fishery was from November–February. When this species starts leaving the inshore waters early in March, the temperature was on the increase. It is therefore probable that the prawns migrate into the deep cooler waters for breeding.

As pointed out earlier *M. brevicornis* of sizes smaller than those in the sea occurs in the creek. It is likely that they are washed up by tidal action into the creeks rather than as a result of active migration since they were never caught in any significant quantities at any time of the year. Under the circumstances it can only be stated that the young ones live in the sea beyond the present fishing limits and that they migrate into the inshore waters when they are probably two year old.

Table VII

Mean monthly temperature (°C.) fluctuations at Kandla

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
1959–60	26·5	29·0	28·3	27·5	27·8	27·7	23·5	21·3	19·0	20·5	23·0	25·7
1960–61	27·8	29·0	29·3	28·9	28·1	27·3	23·4	19·2	17·7	18·9	24·3	25·6
1961–62	28·3	29·1	29·1	28·2	28·6	26·1	22·1	18·8	16·5	18·1	19·2	24·4

SUMMARY

This paper deals with the observations on the prawn fishery and some aspects of the bionomics of the two commercial species—*M. kutchensis* and *M. brevicornis*.

Based on the length frequency studies, the span of life and the lengths attained by the respective year groups have been estimated. The difference in the growth rates of the sexes is also elucidated. The sex ratio in the commercial fishery has been worked out and the percentage of males and females in specified sizes is calculated to show the extent of the survival of the sexes in the different age groups. The breeding and migratory habits are discussed.

The fishery for *M. kutchensis* and *M. brevicornis* is shown to be related to the rainfall and salinity and temperature of the coastal waters respectively.

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