ON THE CHARACTERISTICS OF THE PLANKTON AT KANDLA IN THE GULF OF KUTCH DURING AUGUST 1958—JULY 1960

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INTRODUCTION

The study of plankton and hydrology is of fundamental importance in the marine biological research programmes and our present knowledge on these aspects, which still remains far from satisfactory, is owing to a few contributions (Bal *et al* 1946, Bal and Pradhan 1952 ; Chidambaram and Menon 1945 ; Ganapati and Sarma 1958; George 1953; Jacob and Menon 1947 ; Hornell and Nayudu 1923 ; Menon 1945 ; Prasad 1956 ; Ramamurthy 1953 and Subrahmanyan 1959). Practically no information is available from the Gulf of Kutch on the west coast of India.

The present study, although does not relate to the actual Gulf is based on the collection of water and plankton samples made during August 1958—July 1960 from Kandla Port which is situated in a creek connected to the Gulf, the distance being about 2 miles (Fig. 1) and it attempts to add to our knowledge of the marine biology of the Indian coasts especially of the hitherto neglected area.

A general picture of the plankton fluctuations as indicated by the net plankton volume and the compostion has been given here besides incorporating the data on surface temperature salinity and rainfall.

We are thankful to Dr. S. Jones and Dr. R. R. Prasad for their guidance in the course of this study and to Dr. R. P. Varma for identification of the algae.

PHYSICAL FEATURES AND CLIMATE :

Kandla is situated at 23°·01′N and 70°·13′E in a creek connected to the Gulf of Kutch (Fig. 1). The western side of the Gulf is connected with the Arabian Sea. The tidal variations in the Gulf are known to be very high, the range being about 24 ft. The nature of the bottom of the Gulf is peculiar as it can be demarcated into 2 zones, the portion extending from the mouth of the Gulf (outer western side) up to about Navinar light house being sandy and the inner portion of the Gulf *i.e.* from Navinar to Kandla being of somewhat mixed nature—sandy and muddy. The Gulf extends on the eastern side (inner side) into the little Rann of Kutch through numerous creeks whose bottom is muddy.

The bulk of the rainfall is brought by the south-west monsoon which commences late in June and lasts till the end of September. The north-east monsoon (November-February) follows the south-west monsoon, the amount of rainfall being very negligible. The north-east

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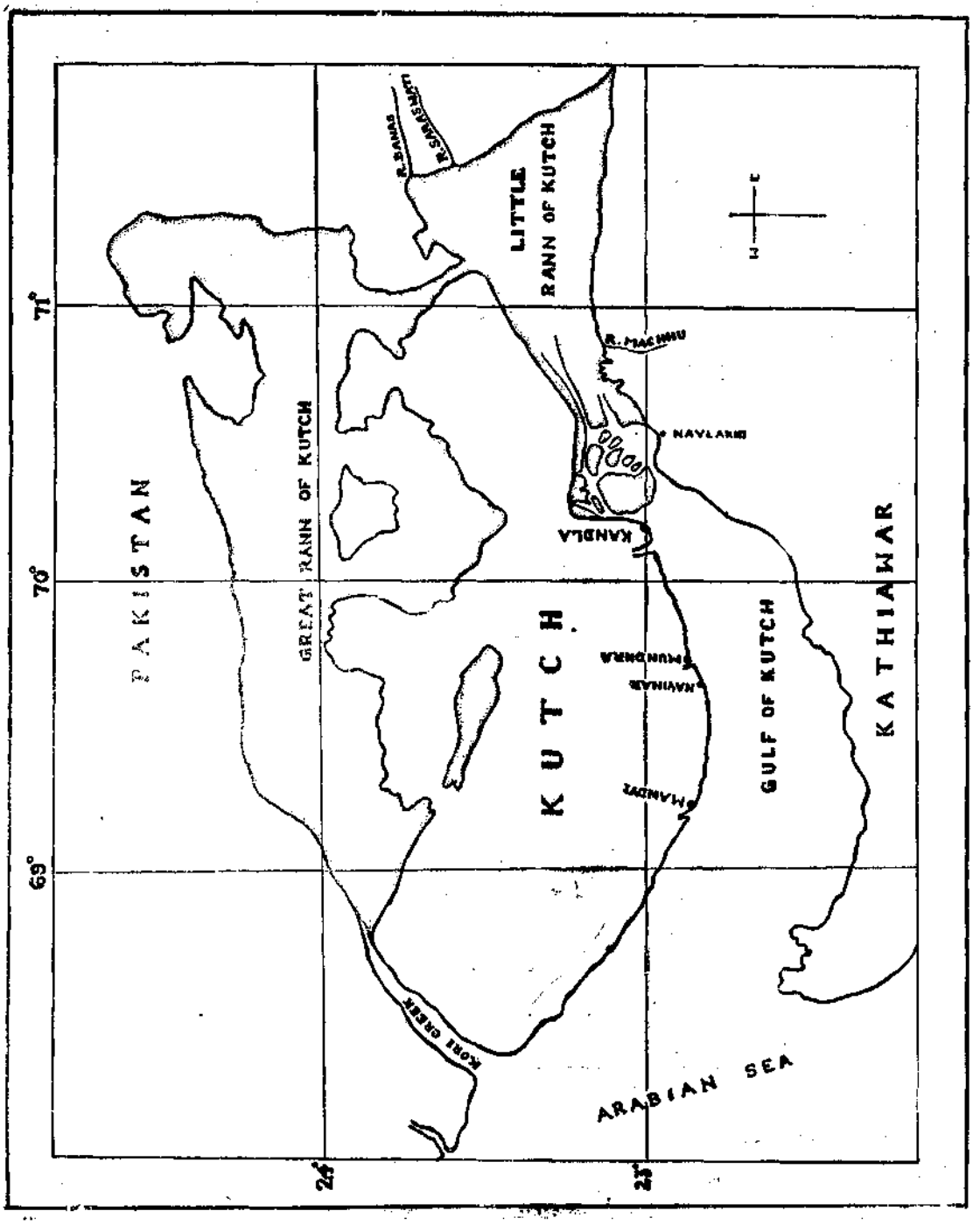

FIG.1. MAP OF KUTCH

monsoon is more or less the winter season also in this area. The rivers Banas and Sarasvati and Machhu establish connection with the Gulf on its inner side through little Rann of Kutch during the south-west monsoon only when they are flooded. The average annual rainfall of Kutch is 25 to 35 cm. but the periods under review had a rainfall of 72 and 47 cm. respectively.

MATERIAL AND METHODS

The present study deals with the observations made during August 1958—July 1960. Temperature was recorded from the site of plankton collection using a centigrade thermometer Samples of sea water from the same area were used for salinity estimation. During the period August 1958 to April 1959, these estimations were carried out at the Kandla Salt Works by means of salinometer and for the subsequent period the Mohr's method of titration of the chlorides was followed. The data on annual rainfall has been collected from the local meteorologicat department.

Horizontal plankton hauls of 15 minutes duration using a half metre organdy cloth net having 36 strands per sq. cm. were made between the Kandla Salt Works jetty and cargo jetty in the central main channel of the Kandla creek, located in an area whose depth is 6 fathoms at low tide. The collections were made between 5 and 6·30 a.m. at low and high tide periods alternatively during each month. In all 82 samples were collected.

Aliquot sample of each haul was examined for a preliminary qualitative estimation immediately after its arrival in the laboratory. Then the samples were fixed in 5% sea water formalin. The volume of the plankton was determined by the displacement method. It was then diluted to a known concentration, (250 cc) from which aliquot portion (1 c.c.) was examined in a plankton counting chamber for enumeration of different organisms. For larger organisms such as chaetognaths etc. 10 c.c. subsamples were taken and their numbers counted. For the study of the seasonal fluctuations of the different plankters the numbers of the zooplankton organism were counted, whereas for phytoplankton the following nomenclature has been used in terms of the number of diatom cells, algal cells/filaments per c.c. of standardized sample.

Rare	Less than 100
Few	101 to 1000
Common	1001 to 5000
Abundant	Over 5000

HYDROLOGICAL CONDITIONS

The temperature of the coastal water showed a more or less unimodal oscillation unlike the other parts of the Indian Coast (Prasad 1957). In both the years the temperature showed a decline from November and reaching the minimum in February and January during the first and second years respectively. Thereafter the temperature increased to reach the maximum in June and July respectively in the two years. The occurrence of the temperature minima and maxima coincided with the winter and summer seasons respectively of this area.

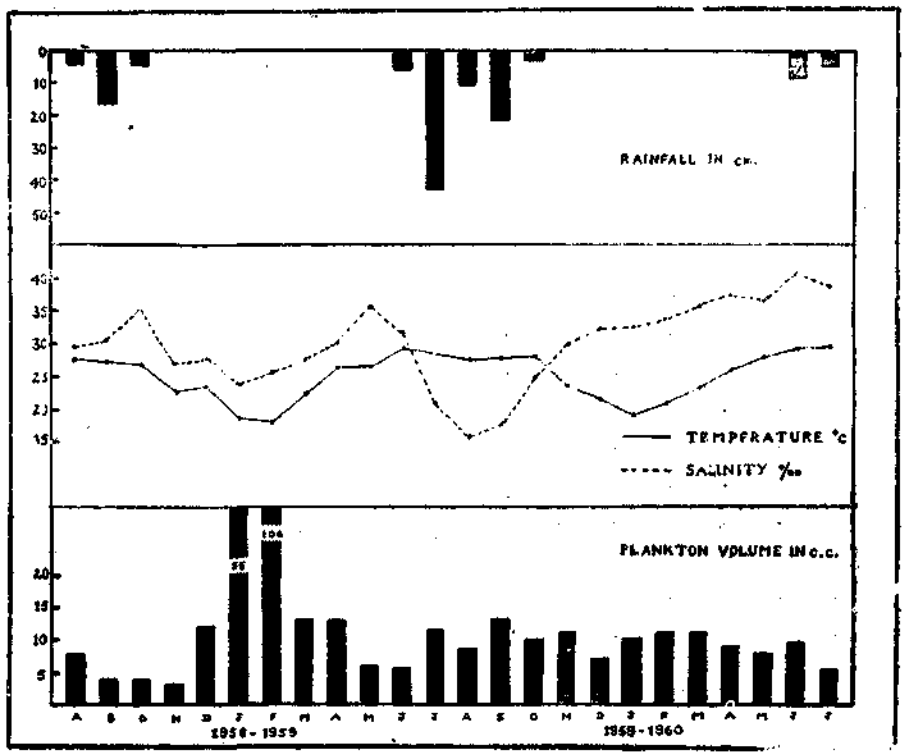

FIG. 2.

Fig. 2 Seasonal variations in the plankton volume, hydrological factors and rainfall.

The salinity ranged during the period of observation from 15·56‰ to 40·57‰ The alinity has been low during July-September in both the years which can be attributed to the discharge of fresh water from the rivers during the south-west monsoon. The peak values for salinity occurred in May and June during the respective two years.

Standing Crop of Plankton (Fig. 2)

Striking differences were observed in the actual values during the two years of the studies. In 1958-59 the standing crop reached the maximum in February and again showed another maximum in July, while in 1959-60 the maximum standing crop was in September with a secondary maximum during February-March. Thus it will be seen that the standing crop was high during the north-east monsoon (January-February) and the south-west monsoon (July-September) periods the former being predominantly due to phytoplankton.

The standing crop noticed during January-February of 1959 was exceptionally high due to the occurrence of swarms of gelatinous ball like structures *Microcystis*—a species of Cyanophyta.

Phytoplankton

Table I shows the trend of variations in phytoplankton.

TABLE I

Month	1958-59	1959-60
August	R	C
September	R	F
October	F	R
November	F	R
December	C	R
January	A	F
February	A	C
March	C	F
April	C	F
May	F	F
June	R	F
July	F	R

There is apparently a single phytoplankton maximum during the first year in January-February, while in the succeeding year two maxima have been noticed—one maximum in August and the other in February. The phytoplankton maxima noticed were constituted chiefly by the blue-green algae *Microcystis* sp. and *Lyngbya* sp.

The diatoms have been rather poor throughout, the chief forms being species of *Coscinodiscus*, *Thalassiothrix*, *Thalassionema*, *Biddulphia*, *Nitzschia* and *Pleurosigma*. The dinoflagellates were never noticed in the collection perhaps due to the coarse nature of the plankton net.

Zooplankton (Fig. 3)

Since the study aims at gaining a knowledge only of the more important zooplankters no attempt has been made to identify all the species represented in the collections. The total zooplankton showed more than one maximum in each year. During the first year, it was in Augst 1958, April and July 1959 and in the second year during September and March.

The tintinnids, foraminiferans, hydromedusae, ctenophores, chaetognaths and amphipods formed the minor zooplankton elements in the collection throughout. The tintinnids were noticed only during January-February; forminiferans were always present being more common during August-September; hydromedusae and ctenophores were met with during December-March and June respectively; chaetognaths were present throughout, represented chiefly by *Sagitta bedotei*, which was more common during March-April; and amphipods were present during February-April.

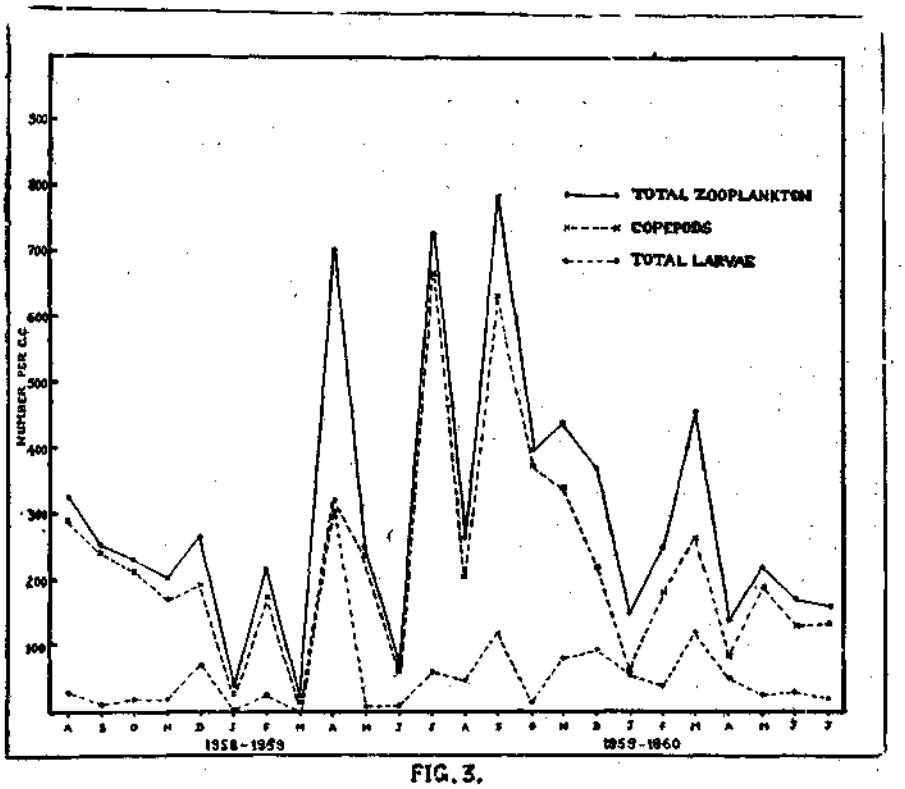

FIG. 3.

Fig. 3 Seasonal variations of zooplankton organisms.

The copepods and the planktonic larvae constituted the more important elements in the zooplankton population. The fluctuations in the mean number of the copepods resemble very closely those of the total zooplankton. The calanids were more important than the cyclopoids and harpacticoids were the least important. Table II shows the important copepods in the order of their abundance together with the period of their maxima.

TABLE II

Copepod	Period
Paracalanus spp.	February and September-December.
Acrocalanus spp.	March-April and September-November.
Centropages spp.	May and August-September.
Oithona spp.	July-September.
Acartia sp.	July-September.
Eucalanus sp.	September.
Pseudodiaptomus sp.	May and September.
Euchaeta sp.	November-December.
Eutcrpina sp.	March and September-October.

Among the larval stages, those of the Decapoda, Copepoda and Mollusca were the most significant quantitatively, the respective periods of their abundance were :

Decapod larvae	March-April and July-December.
Copepod nauplius . . .	April and September.
Molluscan larvae . . .	February-April.

Of the larvae of less importance were those of Polyzoa (November-May) Polychaeta (November-April), cirripedes (April and December) and fishes (July-September).

DISCUSSION

The foregoing results reveal that there is considerable variation in the time of occurrence of the peak periods of the different plankters as well as in the magnitude of the concentration. However, the pattern of events in the plankton cycle remains more or less the same.

The phytoplankton concentration in the present area of investigation is generally poor* compared to that in other parts of the Indian coast particularly the south-west coast of India as noticed by George (1953). It showed a single maximum during the first year of study and two maxima in the succeeding year. However, the occurrence of the phytoplankton maxima during the latter half of the north-east monsoon appears to be regular and this coincides with the prevailing low water temperature and high saline conditions. It is possible that a secondary maximum also occurs regularly during the south-west monsoon period but this will have to be substantiated by further studies.

The zooplankton is comprised mostly of copepods and the planktonic larvae. The copepods show more than one peak during a year and these peaks follow more or less the phytoplankton maxima. The primary peak is noticed during the south-west monsoon season (July-September). Bal and Pradhan (1952) observed 2 or 3 peaks of copepods during May to September in the Bombay waters. The present study indicates that this period is rathe prolonged at Kandla, such peaks occurring between March to September.

The planktonic larvae also show more than one peak during a year. The pronounced one, which is also regular, occurs during March-April following the phytoplankton maxima.

The present study being of a preliminary nature, explanation for the fluctuations in the different plankters is not within the scope. A thorough study of the environmental factor is necessary to elucidate the factors that govern these fluctuations.

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*This might be due to low transparency caused by the muddy nature of the water throughout. Regular observations on the transparency were not attempted, but occasional reading with Secchi disc. showed that visibility may be as low as half a foot.

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