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TRENDS IN SECONDARY PRODUCTION IN THE INSHORE WATERS OF THE SEAS AROUND INDIA

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Introduction

The availability of the right forage organisms, their quality and quantity, play a vital role in the sustenance of the living resources of the marine environment. Again, these microscopic organisms which belong to the categories of phyto and zooplankton being a reliable tool for the identification of areas prone to industrial and natural pollution and for understanding its extent and intensity, especially in the inshore areas, the studies on them have added significance. With these in view the Central Marine Fisheries Research Institute has been monitoring the inshore waters at selected centres along the indian coasts, for the seasonal variations in the rate of production at the primary as well as the secondary levels. Such studies help in foretelling any alarming situations developed in the living environment that may affect the commercially important resources adversely.

The following is an account of the pattern of the occurrence and abundance of zooplankton along the Indian coasts from Bombay on the west coast upto Madras on the east coast. Regular weekly or fortnightly samples of zooplankton were collected from fixed stations as surface tows for 10 minutes using a half metre ring net made of nylobolt of 0.4 mm mesh size. The estimates were made as number per 10 minutes haul for all the centres except Vizhinjam where the estimates were made as number per 100 m^3 of water. The samplings were carried out from motor boats at Bombay, Tuticorin, Mandapam and Madras. At Vizhinjam a catamaran was used for making the collections and at other centres country crafts were used for the purpose of plankton collections.

1. Bombay (Fig.1)

In the Bombay waters a study of the annual mean values of zooplankton production during the 3 year period from 1979 to 1982 showed that from a minimum of 3.32 cc per 10 mts. haul in 1979-80 the production of zooplankton rose to 8.43 cc in 1980 - 81 and to 8.08 cc in the subsequent year. Thus it may be stated that the trend in zooplankton production was almost stationery during the latter 2 years. However, the collections could not be made during the southwest monsoon months in the year 1981-82.

The temperature and salinity seemed to have some correlation with the abundance of zooplankton and it was observed that the highest value for plankton was obtained when the salinity was above 35 0/00 in January, 1982. But similar high values of salinity during February and March, 1982 did not coincide with a high yield of plankton. While the temperature showed a gradual decline from October, 1981 to January, 1982, the zooplankton became more abundant and as it went up again the signs of decline in production were noticed. The dissolved oxygen was always on the high rate.

In the plankton samples of the different months the copepods were the highly dominating group and their dominance reached as high as 97.47 per cent in April, 1981. In the other months also their percentage was of the order of 85.52 per cent in March, 1982 and 97.10 per cent in the previous month. The next in abundance was chaetognaths which constituted between 1.58 per cent in February, 1982 and 6.77 per cent in November, 1981 among the other. The decapod larvae contributed from 0.09 per cent in April, 1981 to 3.27 per cent in November, 1981. The above were the three groups whose representatives were present in all the months of sampling. Other zooplankters included medusae, pleurobrachia, lucifer, pteropods, appendicularians and fish eggs and larvae. Most of these groups occurred in the plankton during the period from October to December, 1981.

2. Karwar (Fig.2)

The annual mean values of production at the secondary level showed a declining trend during the 3 year period from 1979. While the mean value for 1979-80 was as much as 9.58 cc per 10 mts. haul it was only 6.78 cc in 1981-82.

The occurrence and abundance of zooplankton in the inshore waters of the Karwar coast were greately influenced by the environmental parameters especially the temperature and the salinity. The density of zooplankton was least during July-August period when the salinity was 6.56 and 5.58 0/00 respectively. Similarly, the lowest temperatures were also noticed during this period, being 26.4 °C and 25.7°C respectively. However, the temperature was

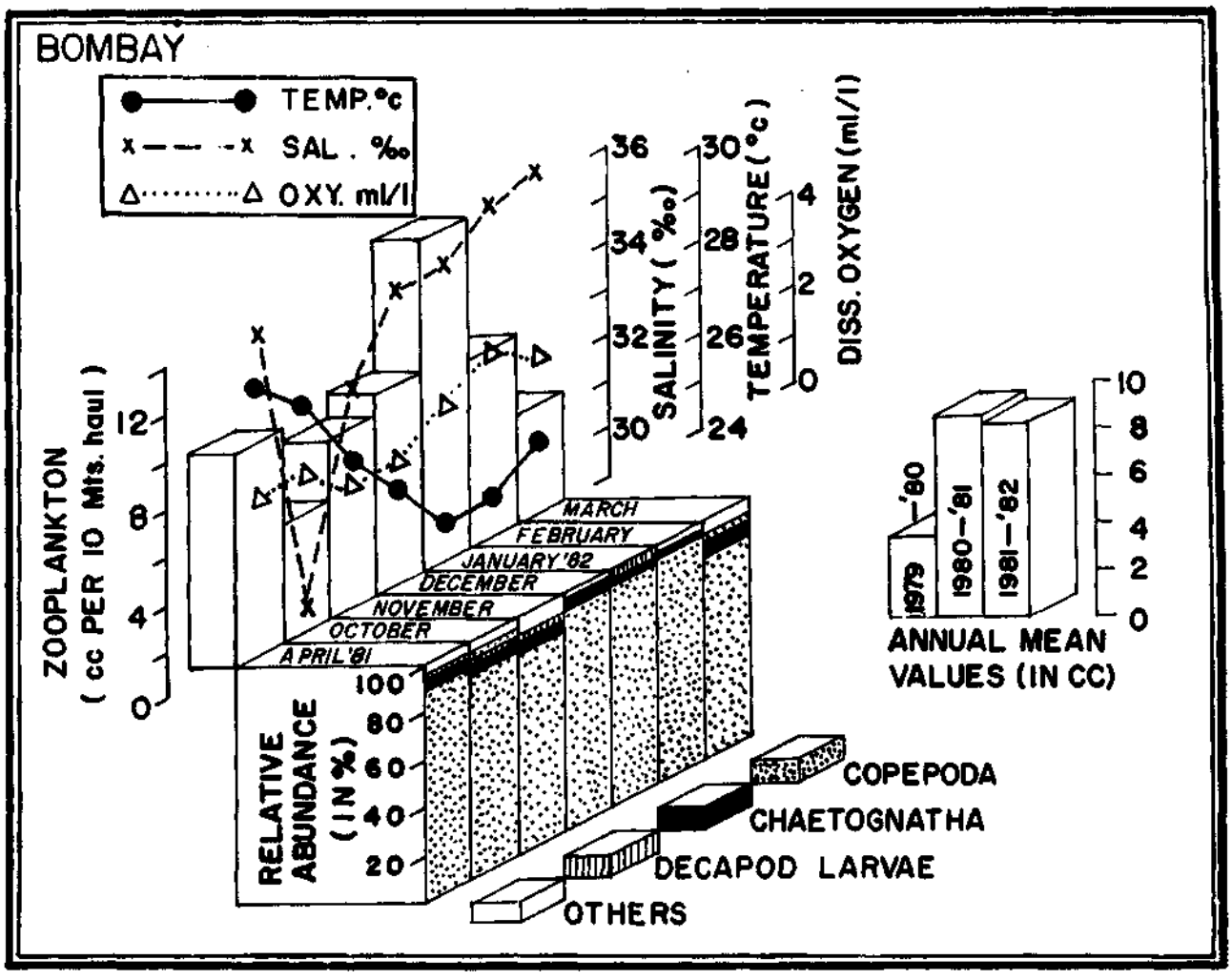

Fig. 1. Trends in secondary production at Bombay

not found to be a limiting factor as the highest value for zooplankton density was obtained in October when the average temperature was 26.6°C. In September eventhough the salinity showed considerable increase, the zooplankton value was low. The dissolved oxygen content of the water was always on the high and therefore it influenced the plankton to the least extent. The premonsoon period from January to April was found to be the most favourable season for the zooplankton in this area. The highest value for zooplankton production observed in October was mainly due to the swarming of the cladocerans.

The monthly variations in the relative abundance among the different groups of zooplankters presented a highly variable picture. The copepods dominated over the others in 8 months. Altogether 12 groups were represented by adults while the larval forms of 9 groups were obtained. The major groups represented in the plankton were copepods, cladocerans and decapod larvae. Eighteen other groups were also represented but in smaller quantities. Occasionally some of these groups swarmed the area and this was particularly observed with the cladocerans and the larvae of cirripede.

The zooplankton groups which were represented by smaller quantities included appendicularians, chaetognaths, lucifer, medusae, siphonophores, salps, doliolids, ctenophores, mysids, amphipods and the larvae of copepods, cirripedes, polychaetes, bryozoans, brachiopods, echinoderms, molluscs and fishes. The fish eggs were present in all months but were relatively more during the postmonsoon period. It was maximum in November when 29.49 per cent of the total zooplankton was constituted by them. The fish larvae were also relatively more in November when 22.41 per cent was present.

3. Calicut (Fig.3)

In the Calicut area the zooplankton collections were made during the premonsoon and the post -

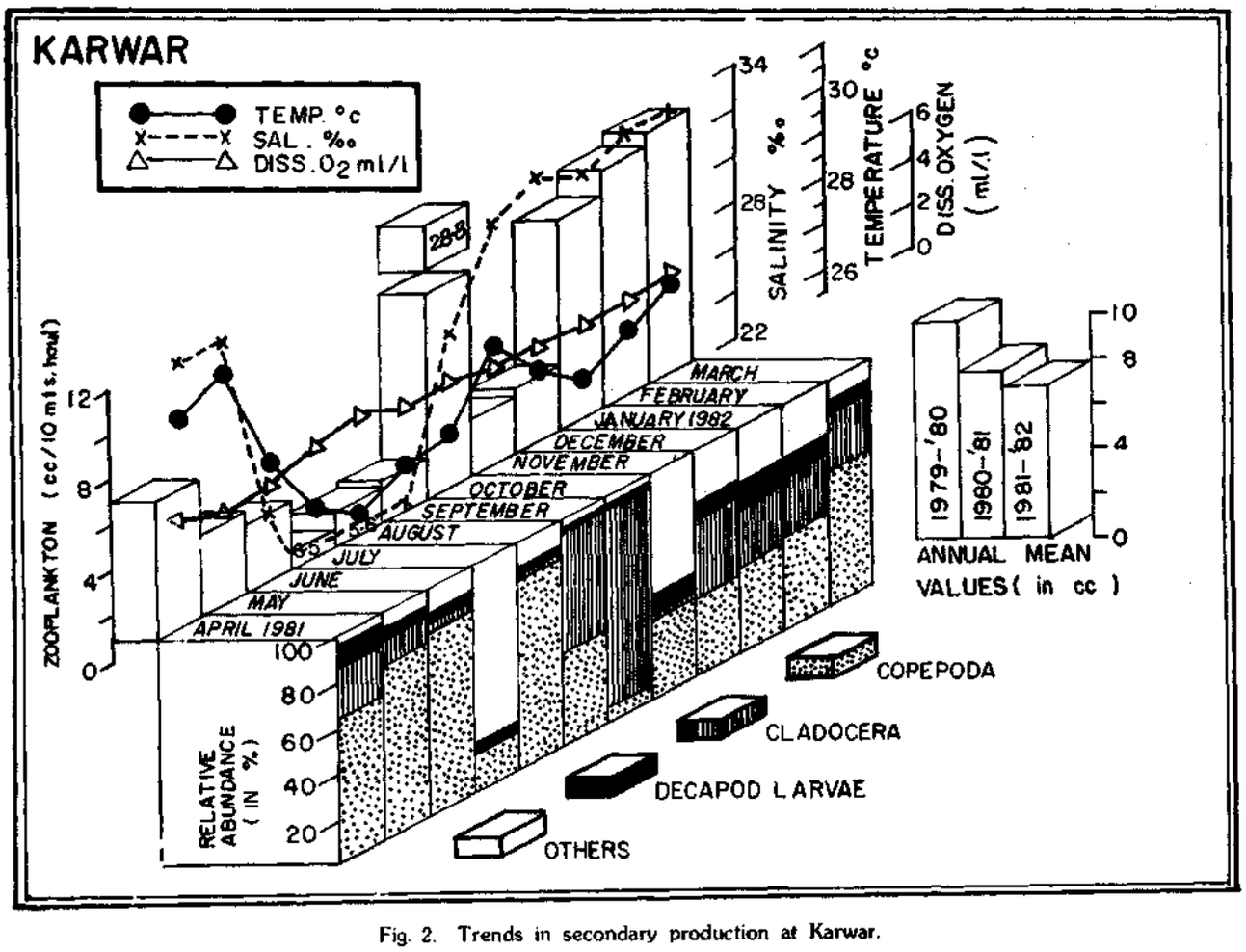

Fig. 2. Trends in secondary production at Karwar.

monsoon months only. As far as the annual fluctuations in the availability of plankton was concerned it came down from a peak of 7.3 cc per 10 mts. haul in 1980 to 3.1 cc in 1981-82. In the previous years of 1977 to 1979 also the density of zooplankton was relatively less.

The monthly variations in the quantitative occurrence of zooplankton were found to be directly correlated with the hydrological parameters, especially the temperature and the salinity. The temperature was found to be a limiting factor on the abundance of zooplankton. It was observed that there was a rhythmic oscillation in the abundance of zooplankton in accordance with the rise and fall of temperature, they being more whenever the temperature registered higher values. The highest quantity of 7.2 per 10 mts. haul was obtained in May, 1981 when the temperature was at the highest (31°C). Similarly, in the case of salinity also its increased values generally favoured a high production of zooplankton in the Calicut area. During the premonsoon months of April and May, 1981 when the salinity was above 35 0/00, the all time increase of zooplankton of the year was noticed. There was noderth of dissolved oxygen in the water in any of the months and therefore it had no role in the fluctuations in the rate of secondary production.

A consideration of the various zooplankton groups which occurred in the different months showed that more groups were present during the summer months of March and April. Cpoepods and chaetognaths were present in all the months of observations. The decapod larvae were absent in January, 1982 only. The other groups which were present in one month or the other were siphonophores, ostracods, appendicularians and eggs of invertebrates and fishes. In all the months the copepods dominated over the others forming 87.68 per cent in April, 1981 to 96.88 per cent in March, 1982. The chaetognaths always ranged between 0.71 per cent in March to 2.95 per cent in January, 1982. The ostracods although were poorly represented constituted 5 per cent of total plankton in November, 1981. Similarly, the decapod larvae also were relatively more in April, 1981 with a share of 6.35 per cent. The other groups of

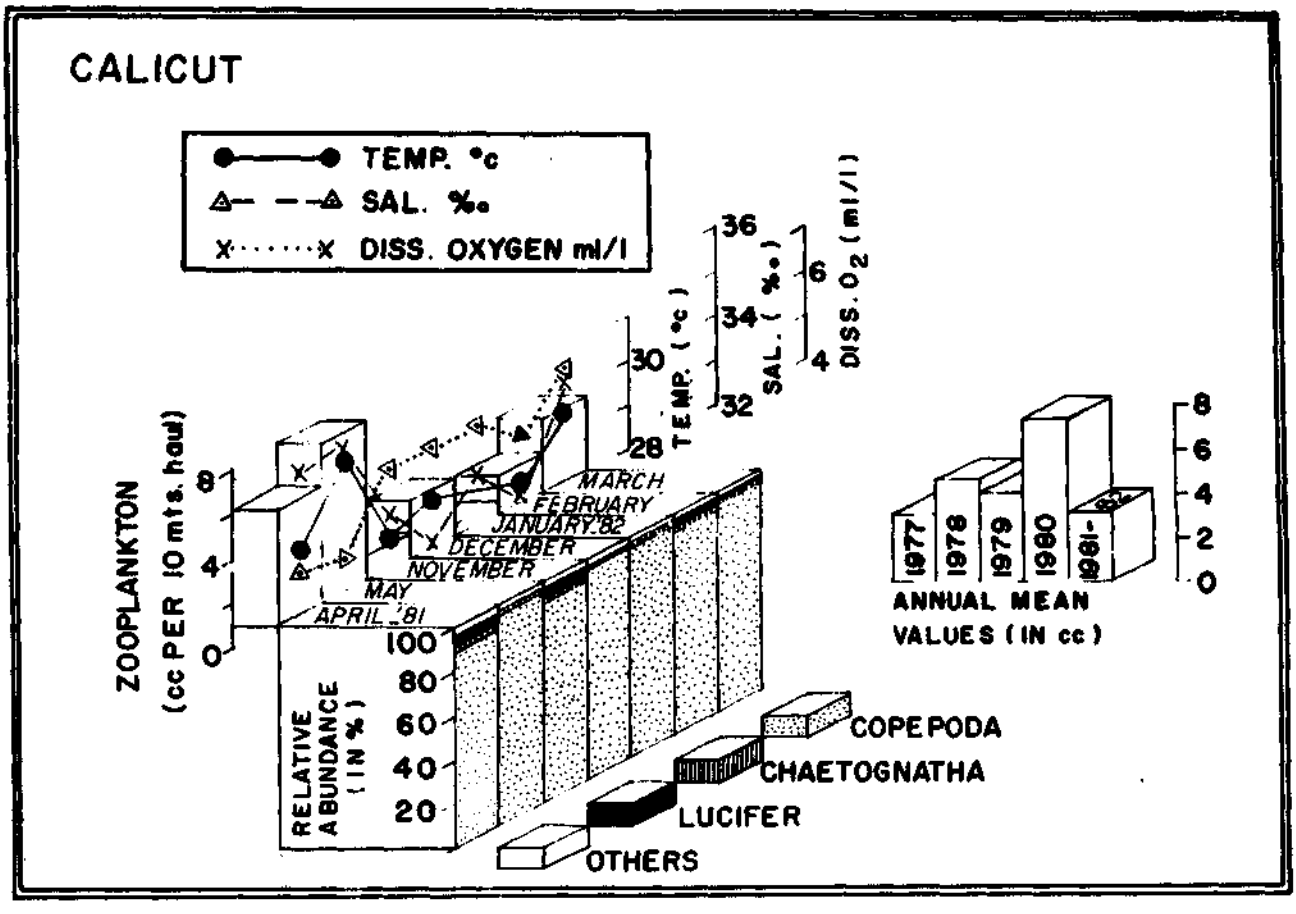

Fig. 3. Trends in secondary production at Calicut.

plankters when present constituted around 1 per cent of the total plankton.

4. Vizhinjam (Fig.4)

At Vizhinjam there was a mixed trend in the rate of production at the secondary level. The highest production was observed in April, 1981 when the average production was 31.05 cc per 100 m^3 of water. A sudden decline in zooplankton production was followed in the next month, when the lowest value of the year, 1981-82 (7.6 cc/10 mts haul) was recorded. From then onwards the alternate rise and fall in density of plankton was experienced at this centre. However, a proper correlation was not found between the plankton abundance and the hydrological features nor did the trend in production follow the changes in the climate. The least values in temperature and salinity were noticed in June, 1981 when the average plankton value was 18.47 cc per 100 m^3 of water. In the other months the temperature and salinity were more or less steady and were centered around 28.5°C and 34.5 0/00 respectively. On the other hand the zooplankton volume fluctuated over a wide margin in every month irrespective of the steady nature of the temperature and salinity values.

As far as the different groups of zooplankton were concerned the copepods dominated which were distantly followed by chaetognaths and decapod larvae. The relative abundance of the copepods among other plankters ranged between 58.71 per cent in June, 1981 and 91.93 per cent in the next month. The other groups were relatively less. The decapod larvae came next in abundance and their maximum of 18.14 per cent among the other zooplankters was observed in March, 1982. They were relatively less in the other months being contributed by 0.47 per cent in September to 5.58 per cent in April. The next in importance was chaetognaths which, however, contributed a small percentage of the total plankton. Thus while their maximum abundance was of the rate of 5.97 per cent in May they were representated in March, 1982 by a mere 0.13 per cent.

5. Tuticorin (Fig. 5)

The annual mean values in secondary production for a period of five years from 1977-82 showed that it maintained a rather steady nature with slight fall in 1978-79 and 1979-80. The 1981-82 value was found to be a little less than that of the previous year.

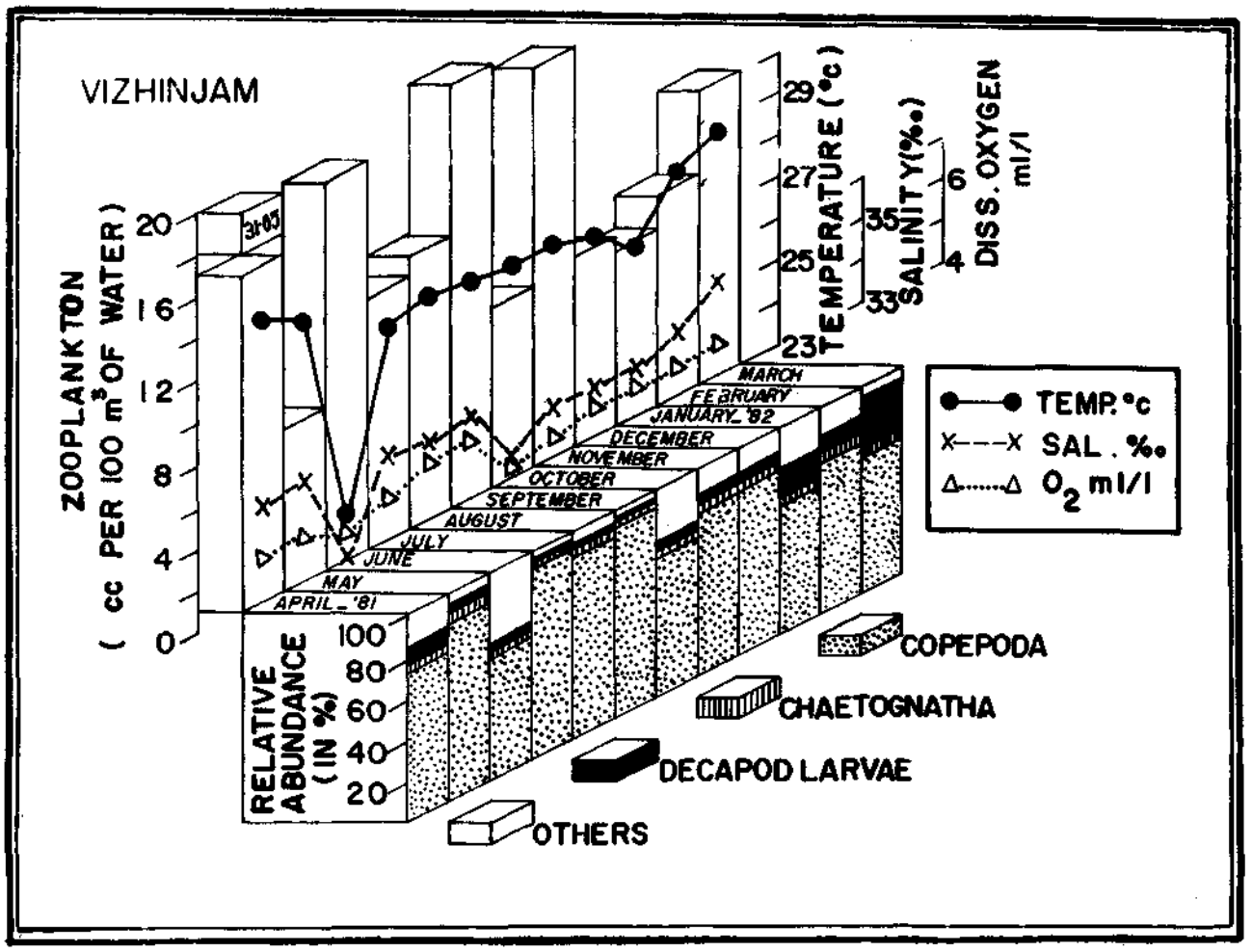

Fig. 4. Trends in secondary production at Vizhinjam.

The temperature ranged from 25.3°C in December, 1981 to 31.6°C in April, 1981. The range in salinity was from 29.93 0/00 in December, 1981 to 34.05 0/00 in March, 1982. The dissolved oxygen content always maintained higher values. The lowering of the temperature and salinity in December due to the northeast monsoon did not affect the overall production of zooplankters adversely. A quantity of 16.0 cc per 10 mts. haul was obtained in this month. However, in the following month when the temperature and salinity remained very low, the quantity of zooplankton came down to as low as 6.2 cc. In general a direct relationship was not noticed between the zooplankton abundance and the hydrological parameters.

One notable feature with regard to the relative abundance of various zooplankton groups in the Tuticorin waters was that the copepods never constituted a major group which was not the case in the other centres. Here their percentage in numerical abundance among the other groups came down as low as 6.0 in November, 1981 and except in May, August and September when they were over 80 per cent, their values were centred around 40 per cent or even less than that. This was mainly due to the sudden swarming of some group of plankters in certain months. Thus for example in November, 1981, 73.5 per cent of the zooplankton was constituted by decapod larvae and such a dominance had reduced the percentage of copepods to 10 per cent. Somewhat similar dominances of larvae of decapods were noticed in July, 1981 and February, 1982 also. A swarm of cladocerans appeared in April, 1981 when 45.7 per cent of the total zooplankton was composed of them. Lucifer was another group which contributed to the bulk of the plankton in July and December, 1981 and January, 1982. Similarly the pteropods dominated over all the other groups in December, 1981. The fish eggs and larvae were relatively more in January-March period.

6. Mandapam (Fig. 6)

The average values of zooplankton production in the Mandapam waters showed a highly declining

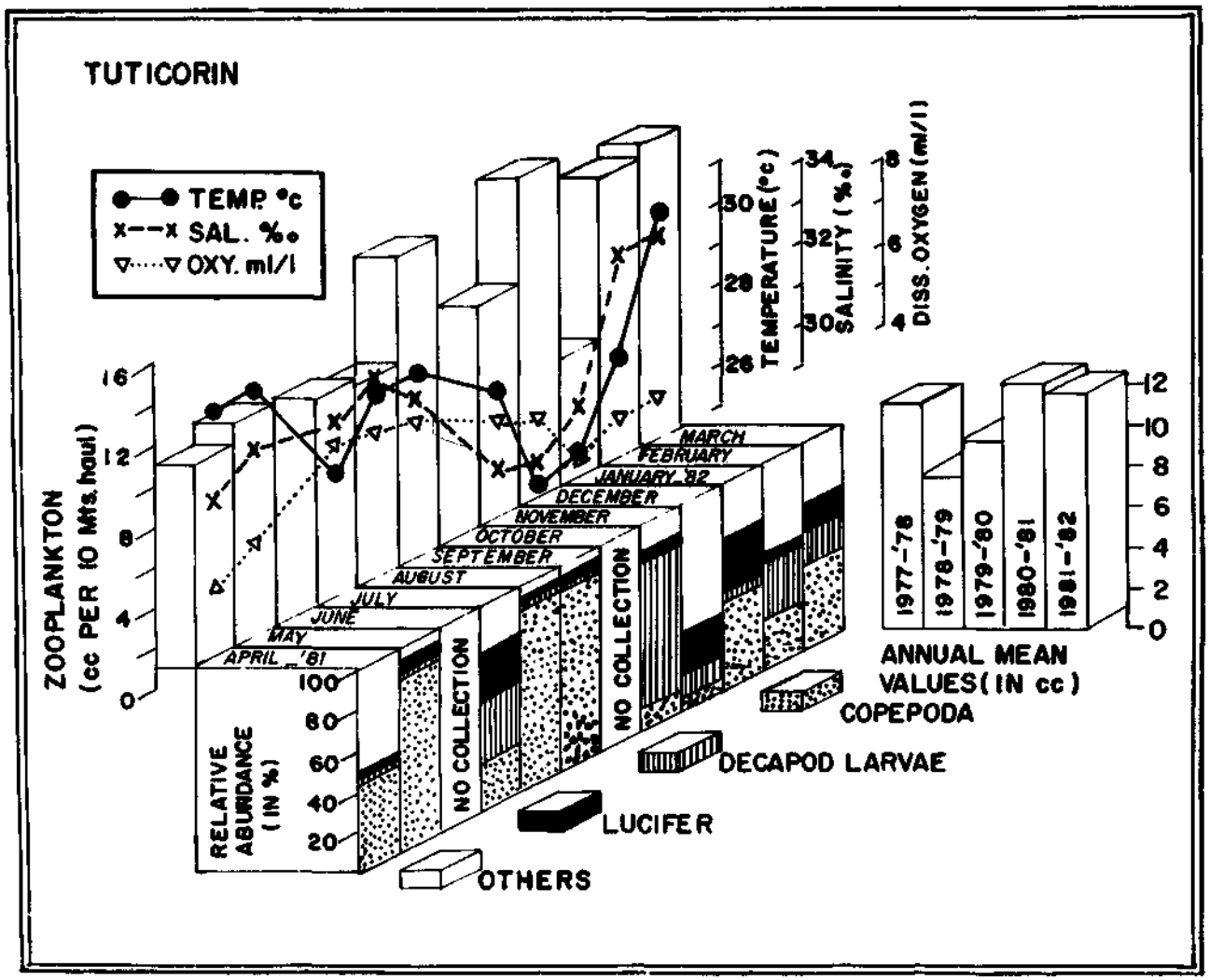

Fig. 5. Trends in secondary production at Tuticorin.

trend from 1979 to 1982. In the 3 years, the rate observed was 18.03 cc, 14.88 cc and 5.46 cc respectively per 10 mts. surface haul.

The monthly mean production of zooplankton during 1981-82 as given in the figure showed a close affinity to the changes in the hydrological features. The general trend was that whenever the temperature and salinity values rose there was a corresponding increase in the quantum of zooplankton. The dissolved oxygen content had no direct relationship with the abundance of zooplankton. Any sudden fluctuation in the quantitative distribution of zooplankton was not noticed in this centre except during November, 1981 and February, 1982 when the displacement volume of plankton was 8.2 cc and 12.3 cc respectively. In the other months it varied between 2.9 and 6.9 cc only with the lowest value in April, 1981.

A groupwise analysis of the major zooplankters for their relative abundance showed that the copepods ranged between 38.8 per cent in March, 1982 and 75.0 per cent in December, 1981 and January, 1982. The fish eggs constituted an important item in the plankton occurring in all the months, and in March, 1982 its number even surpassed that of the copepods. The chaetognaths were also abundant in all the months of observations. Eleven other groups were present in the plankton of the area, the important ones among them being chaetognaths, Lucifer, appendicularians and pteropods. However, these were not regular in their occurrence.

7. Madras (Fig. 7)

In Madras as far as the annual mean production of zooplankton was concerned an alternate pattern of decrease and increase was observed from 1977 onwards, the trend of decreasing or increasing being towards lower values. Therefore in the Madras waters the lowest of the mean production in the last 5 years was experienced in 1981-82 period with a quantity of

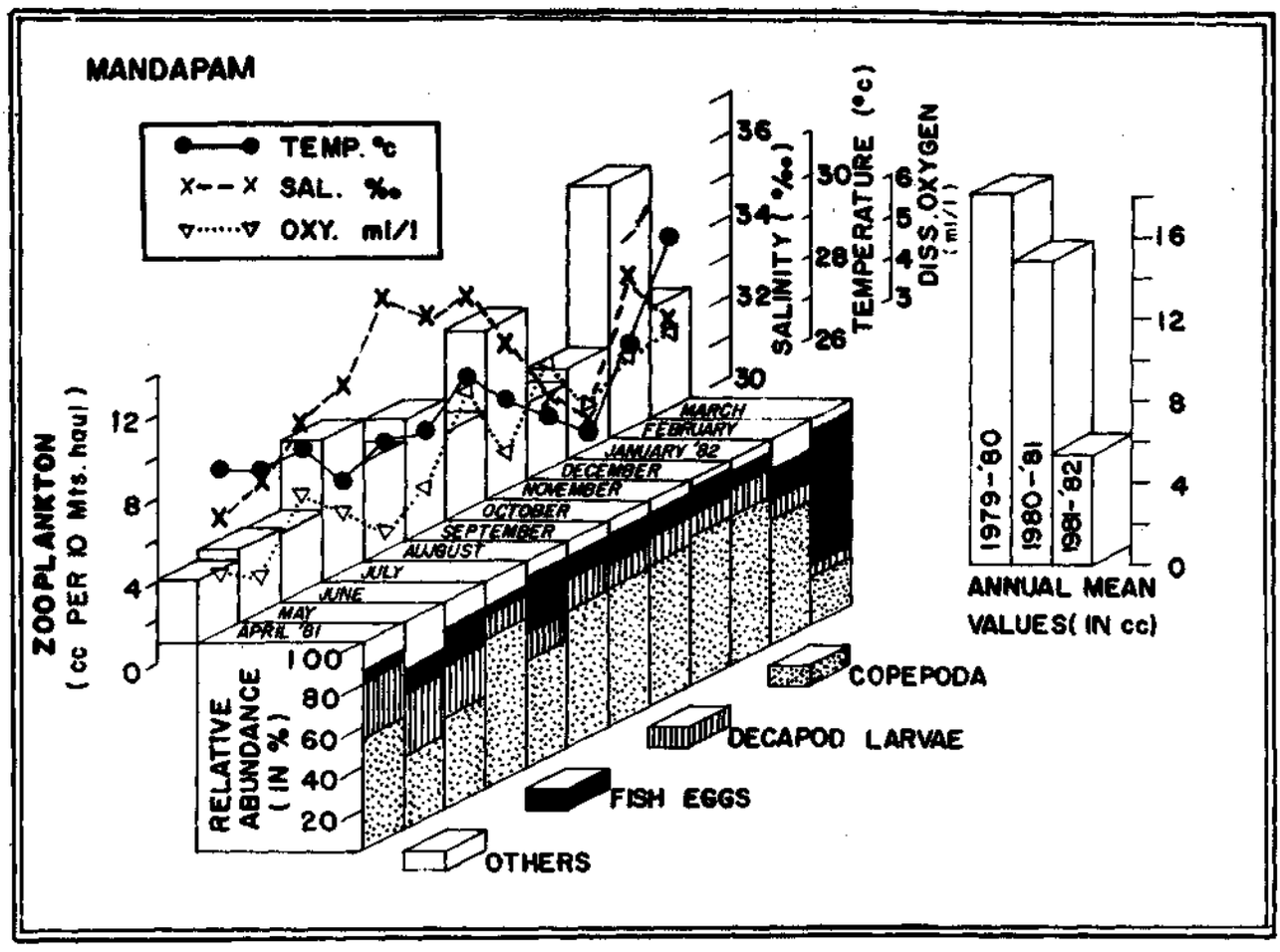

Fig. 6. Trends in secondary production at Mandapam.

5.94 cc per 10 mts. haul. The year of maximum production was 1978 when 13.95 cc of plankton per 10 mts. haul was obtained.

The monthly mean values for the year 1981-82 were found to be always moderate between 2 and 6 cc except in April, 1981 and February, 1982 when higher values at the rate of 16.4 cc and 11.0 cc respectively per 10 mts. haul were obtained. During the northeast monsoon period of November-January the quantum of plankton obtained was low. The environmental parameters such as the temperature, salinity and oxygen were found to have a direct correlation with the plankton abundance. It was generally found that an increase in any of these parameters always favoured an increased availability of the zooplankton.

The percentage composition of the major groups of plankters showed that the copepods formed the main constituent in all the months. Their quantity among others ranged between 43.39 per cent in April, 1981 and 82.13 per cent in October, 1981. Next to copepods the chaetongnaths and decapod larvae dominated the plankton almost equally, but with variations in the different months. While the chaetognaths were absent in the plankton in December, 1981, the decapod larvae were absent in August and October, 1981 and March, 1982. Apart from these, 13 more groups comprised by medusae, siphonophores, Lucifer, amphipods, appendicularians, salps and doliolids, fish eggs etc were also present in the plankton.

Remarks:

In general the rate of secondary production on the west as well as on the east coasts during the 1981-82 period was comparatively lesser than during the previous year. It was more pronounced in Calicut Mandapam and Madras. In Madras, the year 1981-82 was the period of least production in the previous 5 years. Similarly in Mandapam the 1981-82 value was the lowest ever obtained during the previous 3 years time. In Madras in the last 5 year period the year 1978 registered the maximum production. But since then the trend was on the declining side until 1981-82 eventhough a slight increase was noticed in 1980-81

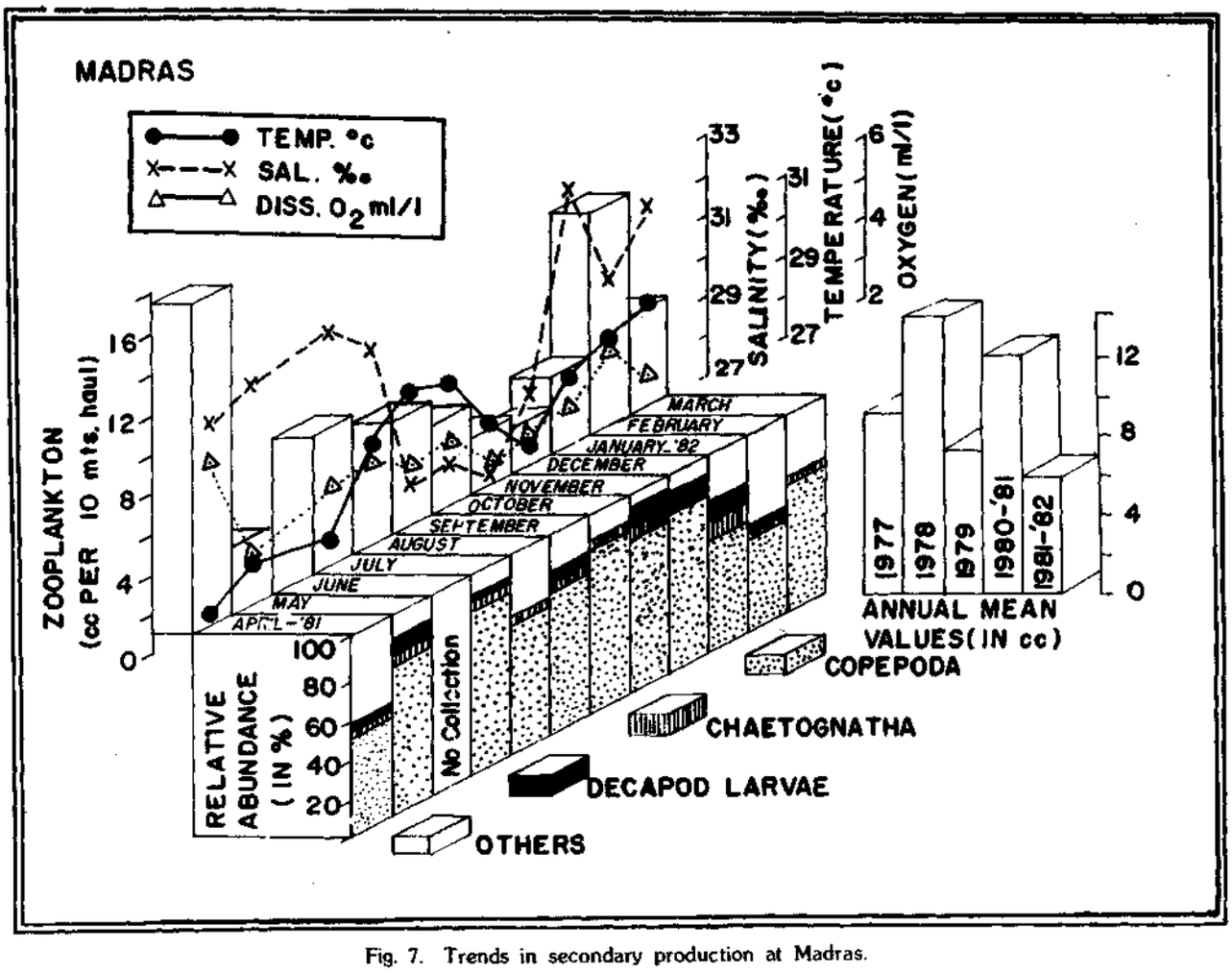

Fig. 7. Trends in secondary production at Madras.

period. In Tuticorin on the other hand the lowest rate of production was observed in 1977-78 from which it gradually improved until 1980-81 only to reduce a little in 1981-82. For the Bombay waters the available data on the annual mean production showed 1979-80 period to be the year of least production. In the ensuring year the quantum of production showed more than a two fold increase which was almost maintained during the 1980-81 period. However, collections were not made during the southwest monsoon months of 1981-82. In Calicut also the zooplankton production rate remained more or less steady during the 1977-82 period with a sudden increase in 1980. During the 5 year period the 1981 - 82 figure was the lowest.