Studies on Plankton Production in the Inshore Waters of Tuticorin

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ABSTRACT

The results of hydro-biological investigations, with special reference to plankton production, in the inshore areas off Tuticorin for the period 1976 to 1985 have been presented. The primary production revealed three distinct peaks during the years, 1982-85, the first in January-April, the second in June August and the third October -December. The annual cycle of zooplankton production was dicyclic with slight variations throughout the period of study. Components of zooplankters showed definite seasonal fluctuations. Occurrence of fish eggs and larvae in increased percentages during March, June, July and September-October indicated the spawning seasons in this area. The distribution of bivalve and gastropod larvae exhibits two distinct modes during February-March and October-December, revealing the breeding season of this group. The environmental conditions of the inshore area relating to primary and secondary production are briefly discussed.

INTRODUCTION

In contrast to the considerable amount of knowledge available on the hydrology of the east coast of India in general and the region of Gulf of Mannar in particular (Ganapati and Rao, 1953; Jayaraman, 1954; Prasad, 1954, 1956, 1958; Chacko and Malu Pillay, 1957; Ganapati and Sarma, 1958; Chacko and Rajendran, 1959; Prasad and Nair, 1960, 1963) practically very little information is available on the trends of plankton production in the waters of Tuticorin. Our knowledge about the plankton of this area is restricted to the accounts of Sambandamurty (1962) and Marichamy and Pon Siraimeetan (1979). Marichamy *et al.* (1985) have given an account of the inter-relationship of primary and secondary production in relation to the hydrological conditions of the inshore area. In the present study, an attempt has been made to assess the qualitative and quantitative variations of zooplankters in the inshore waters of Tuticorin with reference to the environmental conditions based on the data collected during 1976-1985 and the primary production measurements for the period 1982-1985.

MATERIAL AND METHODS

Fortnightly collections of plankton and water samples were made on board the research vessels, Cadalmin-IV and M.L. Chippy of the Institute. Although 2 stations in the inshore area were sampled, since the values were similar the data were pooled and average values calculated. Light and dark bottle oxygen technique was employed for measuring the primary production on board the research vessel, using neutral density filters in deck incubators. The hydrological properties studied simultaneously with the primary production and zooplankton abundance were surface temperature and salinity. The surface zooplankton was collected by half-metre bolting nylon net (No. 3, mesh size 0.33 mm) by towing it at uniform speed (1 knot/hr) for 10 minutes. The sample was immediately preserved in 5% formalin. The volume of plankton was measured by displacement method. The entire sample was fractionated by means of a sub-sampler and the total number of organisms in each sample was counted. Fish eggs and larvae were specially determined for the whole sample throughout the period of observation. The fluctuations in productivity and zooplankton abundance in relation to the physical conditions are discussed in terms of monthly averages.

RESULTS AND DISCUSSION

Primary production: The rate of gross primary production estimated by oxygen technique at the surface and bottom waters along with the volume of zooplankton obtained during the period 1982-85 are presented in Fig. 1. Wide range of fluctuations were recorded between the surface and bottom values. In comparison with the dicyclic peak periods of secondary producers, the primary production indicated three seasonal peaks, first during January-April, second during June-August and the third during October-December. However, the magnitude of production was very high during June-August compared to other periods.

Zooplankton: The zooplankton of the inshore area off Tuticorin was rich in quantity and quality, exhibiting regular seasonal variations during the period of study. The displacement volume of zooplankton indicated two peak periods during the annual cycle - the primary one during June-September with high magnitude and the secondary one during January-February with low magnitude. The volume of zooplankton along with primary production and rainfall is presented in Fig. 1. The seasonal occurrence of the dominant groups did not appreciably change;

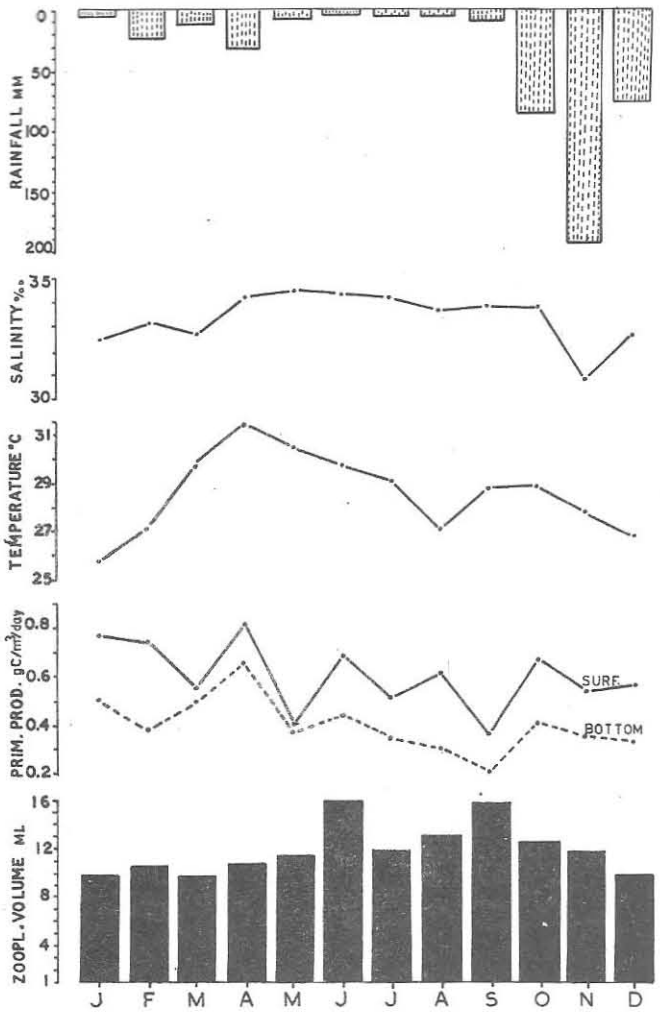

Fig. 1. Monthly average values of primary production, temperature, salinity and volume of zooplankton

however, the magnitude of production was found to vary in some groups. The percentage composition of zooplankters for the 10 year period is presented in Fig.2.

The distribution pattern of plankton and their relative percentage composition in the total volume revealed that copepods formed the major group followed by lucifers, lamellibranchs, decapods and fish eggs and larvae. Copepods were richly present and exibited two peak seasons, during May and August-September. A decline in their occurrence was noticed during December-January and July. The total population and the occurrence of any particular group varied from year to year. The increased occurrence of fish eggs and larvae (10-15%) during February-March, June-July and September-October periods indicated the possible spawning season of various fishes of this area which may be attributed to the increase in surface temperature and salinity during these months.

The distribution of bivalve and gastropod larvae exhibited two distinct peak peridos, the primary one during February-March and the secondary one during October-December with an inter-peak during June, suggesting the breeding season of molluscs. Next to copepods and fish eggs and larvae, lucifers, decapod larvae and chaetognaths indicated distinct seasonal variations. The lucifers were in abundance (11-20%) during April-July and December-February periods. Decapod larvae were recorded in high percentages (11-13%) during June, November and February. The chaetognaths were observed in large numbers during May-July and October-November months. The cladocerans were found to be abundant during March-April and September-December period.

Surface temperature: The general trend of temperature of the surface waters exhibited a bimodal oscillation. Two maxima were noticed, first during the summer months and the second during September-October, corresponding to the two dry seasons and two minima in June-July and December-January. The monthly average values of temperature are presented in Fig. 1.

Salinity: The monthly average values of salinity varied from 30.27 to 35.90 ppt during the entire period of observations (Fig. 1). The surface salinity steadily increased

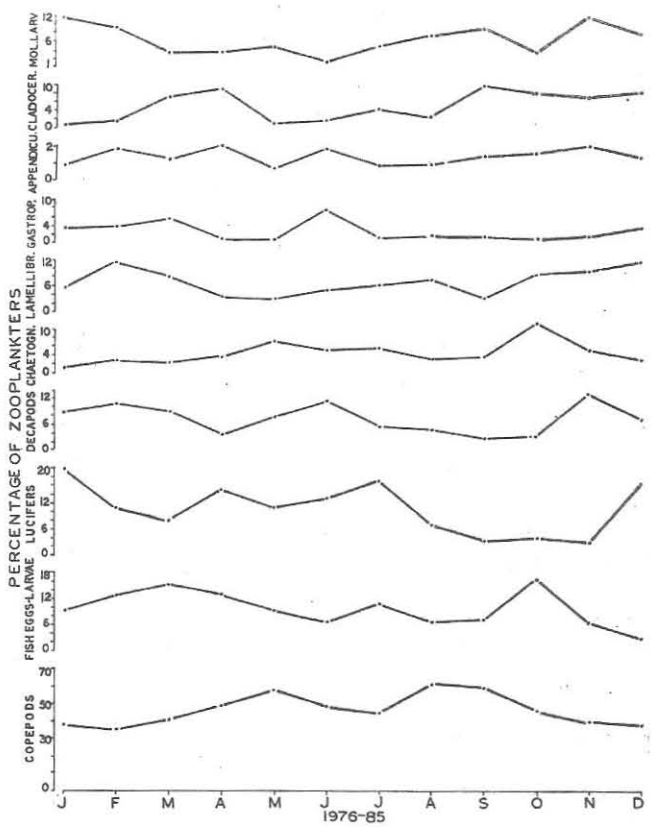

Fig. 2. The percentage composition of various zooplankters in the inshore waters for the period 1976-1985

from January to March, reaching a peak during April-May. The salinity values gradually declined in the following months. The decline continued till July, coinciding with the south-west monsoon. The salinity showed a slight increasing trend during September-October as seen in the case of temperature. With the onset of north-east monsoon, a marked drop was observed during November-January. The monthly average values of salinity was well above 32 ppt during November-December 1984-85 due to the failure of monsoon. However, the earlier observations clearly indicated a bimodal fluctuation in salinity with 2 maxima and two minima, coinciding with the variations in temperature.

Rainfall: The monthly average values of rainfall was very low till August. The average rainfall during the prominent monsoon months of October-November varied from 115 to 230 mm. Stray values of rainfall noted during the summer months of January-March of 1979 and 1985 were unusual in this area. The average rainfall was very poor during 1981 and 1984 due to the failure of north-east monsoon. Maximum rain was recorded in the year 1979.

Surface temperature and salinity exhibited a bimodal cycle of distribution, with two maxima during April May and September October and the two minima during July-August and December-January. Malu Pillay (1962), Freda Chandrasekharan and Sudhakar (1968), Marichamy and Pon Siraimeetan (1979) and Marichamy *et al.* (1985) observed indentical trends from this coast. The high values were due to hot and dry seasons, while current systems may be attributed to the low values. Jayaraman (1954) and Prasad (1954) correlated the influence of coastal currents to the distribution of salinity. The secondary fall recorded during December-January may be associated with the prominent north-east monsoon as well as to the current following from north to south as observed by Sewell (1929).

The three distinct peaks in primary production during 1982-85, concided more or less with the low ranges of temperature and salinity as well as the monsoons. Ganapati and Rao (1953) observed a regular sequence from north to south in the commencement of the primary production on the east coast of India. Prasad and Nair (1963) opined that the inshore waters of Tuticorin, especially at 10 m depth were highly productive and calculated the production per unit area as above 5 gC/m^3/day; the present results showed the values in the range of 4-5 gC/m^3/day. Earlier workers have observed an inverse relationship between the quantities of phytoplankton and zooplankton. Bainbridge (1953) put forward several hypotheses to explain the phenomenon of inverse relationship, involving both migration and grazing. In the present study, high percentages of zooplankters were observed either during or subsequent to the peaks of primary production of this zone, revealing both a direct and inverse relationship in the grazing phenomenon.

An increased composition of larvae of lamellibranchs observed during February-July and November-December and gastropod larvae more or less in the same period indicated the two peak spawning seasons of this molluscan group. Natarajan (1957) recorded the same breeding season for gastropod in Mandapam waters. A direct relationship between the occurrence of molluscan larvae and the hydrological factors is not possible since most bivalves and gastropods breed intermittently, over a prolonged period. However, Rao (1951) observed the influence of salinity and temperature on the intensity of breeding in *Crassostrea madrasensis.*

Bapat (1955) correlated the influence of low temperature and salinity as causative factors for the breeding habits of fishes. In an earlier study, Marichamy and Pon Siraimeetan (1979) observed two peaks in the occurrence of fish larvae during January-February and the secondary one in June-July in Tuticorin waters, corresponding to the low values of temperature and salinity and related these as influencing factors for spawning. But, the present data collected over a period of ten years show a third mode in the occurrence of fish eggs and larvae during September-October, indicating the pre-monsoon spawning habits of certain fishes. As Prasad (1954, 1956, 1958) aptly pointed out, the topographical as well as the morphological features of the region, wind, currents and other factors like reproduction and mortality have an important bearing on plankton production in general.

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