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# PRELIMINARY STUDIES OF PRIMARY PRODUCTION IN THE UBATUBA REGION (Lat. 23°30'S - Long. 45°06'W), Brazil

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SYNOPSIS

Some data and observations of primary production and hydrographic parameters have been made in the region of Ubatuba (Lat. 23°30'S - Long. 45°06'W) during two seasons: summer and winter.

The primary production varied from 1.01 mgC/$m^3$/h to 28.16 mgC/$m^3$/h in summertime and from 0.24 mgC/$m^3$/h to 16.24 mgC/$m^3$/h in wintertime.

The phytoplankton production is believed to be controlled primarily by the quantity of nutrient salts and there is a possibility that relatively nutrient-rich deeper cold waters may increase the fertility of the region.

## INTRODUCTION

The rate of primary production in tropical oceanic waters has been showed to be low, and it has been postulated that seasonal cycles of organic production are probably absent on the open tropical oceans (Ryther & Menzel, 1961). Our researches to present date have been made mostly in mangrove regions, where the values determined for the primary production were characteristically high (Teixeira et al., 1969; Teixeira, 1969; Tundisi, 1969). The present study was undertaken in tropical bay waters, very different from the mangrove region waters. The bay suffers strong influence of coastal water, and sometimes from the open sea.

The purpose of the present investigation is to measure the primary production of organic matter in this region in relationship with some hydrological aspects in order to determine their effect on the primary production. This study can be considered as a pilot experiment, and the results will be information for future investigations.

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## MATERIAL AND METHODS

Sea water and plankton samples were collected from the inner part of the bay to the outer part of the Anchieta Island (Fig. 1), between 08:30 h and 09:30 h during winter (July) and summer (February-March). Samples for all the analysis were taken with a "Van Dorn" and a "Nansen" bottle equipped with a reversing thermometer. The following methods of analysis were employed:

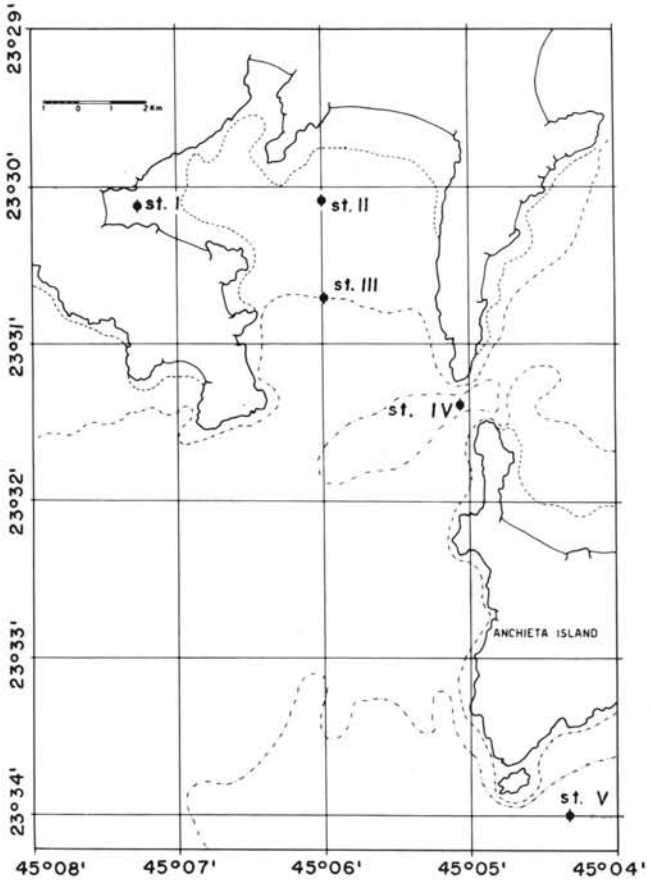


*Fig. 1* - Map of Anchieta Island region showing stations where plankton samples were collected.

PIGMENT ANALYSIS - A litre sample was filtered under reduced pressure and extracted for 24 hours in 10 ml of 90% aqueous acetone. The spectrophotometric determination of pigments was made, using the method described by Richards & Thompson (1952) with the equations of Parsons & Strickland (1963). The re-extraction of samples was made, but it showed that no significant amount was part of the pigment quantity.

PRIMARY PRODUCTION - Measurement of primary production throughout the euphotic zone at three stations (Fig. 1) was based on the carbon-fourteen method as originally described by Steemann-Nielsen (1952) and Doty & Oguri (1959). The determination of radioactivity in ampoules was made by $BaCO_3$ technique described by Calvin et al. (1949), and the values corrected to compare with the biological technique (Steemann-Nielsen, 1965). The measurements were made at the surface (100% of solar radiation) and at the levels of 50%, 25%, 10% and 1%. Water was collected in nontoxic samples, and these were inoculated with $C^{14}$ and then suspended at the depths from which they were collected. The length of incubations was six hours.

HYDROLOGY -

*Submarine daylight:* three different filters (BG12, VG9, RG1) and a hydrophotometer were employed in the measurement of submarine daylight. The photometer was lowered to the surface water and the value obtained considered as a 100% of light reaching the photocell. For determining the vertical attenuation in the photic zone the photometer was submerged. This process was repeated for each different spectral filter.

*Salinity:* chlorinity measurements were obtained by employing the Knudsen method, and the resulting values converted to salinity.

*Temperature:* was measured with standard reversing thermometers, and the necessary corrections were carried out. Nansen bottle spacing was determined based on the optical characteristics and the thermal structure of the water.

*Dissolved oxygen:* measurements were made using the Winkler technique, according to Magliocca (1965).

*Phosphate:* the water samples were filtered and preserved with chloroform. The measurements were made with a Beckman DU Spectrophotometer employing the method of Strickland & Parsons (1968).

*pH:* was determined with a Expandomatic-TM-Beckman, employing glass and calomel electrodes. The values given are only for the depths of primary measurements.

*Suspended matter:* the water samples were collected, preserved with formalin (40 %), and the suspended matter determined according to Teixeira & Kutner (1963).

## RESULTS AND DISCUSSION

PHYSICAL ENVIRONMENT - The circulation pattern of the region is due to the interchange of water between the bay and the adjacent water masses. If conditions in the adjacent water masses were constant, the distribution of conservative properties would be essentially uniform and constant from the surface to the bottom of the basin. The inflow of adjacent sea water with varying properties, and its subsequent mixing, produces the major changes in the conservative properties of the basin water mass.

During heavy rain, some fresh-water inflow produces variations only in the inner part of the region, principally in the transparency of the water. During summertime (February-March), the vertical temperature distribution suggests a two layer system: a surface layer where there is some fluctuation of temperature, and a deep layer with a constant temperature. In summer a characteristic vertical distribution reveals a surface layer of warm water, its boundary marked by a thermocline, and smaller temperatures characterizing the underlying water mass (Tabs IV-V).

During winter (July), the vertical temperature distribution is typically homogeneous (Tabs I-V).

The thermal structure through the summer season may have some effect on the biological production due to the increase of the vertical stability and to prevent a perfect mixing of the waters.

Some values of relatively low salinity were found bordering the inner part of the bay, suggesting some influence of terrigenous water. Excepting these values, salinity is relatively constant (Tabs I-V). The characteristics of the water mass inside the bay can be considered of the same order as those observed off the open coast (Emílsson et al., 1963).

TABLE I - Hydrographic results of station I

| Date | Depth (m) | T (°C) | S (°/oo) | $O_2$ (ml/l) | $PO_4$-P (µgA/l) | pH | Suspended matter (mg/m³) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Dry Weight | Inorganic | Organi |
| 02/12/1970 | 0.0 | 27.60 | 34.29 | 4.52 | 0.84 | 8.10 | 10.7 | 4.1 | 6. |
| | 2.5 | 27.45 | 34.03 | 4.38 | 0.68 | 8.10 | 23.2 | 11.8 | 11.4 |
| | 3.5 | 27.45 | 34.69 | 4.52 | 0.73 | 8.11 | 12.9 | 3.8 | 9.1 |
| 03/05/1970 | 0.0 | 25.20 | 34.81 | 4.52 | 1.47 | 8.10 | 8.3 | 4.2 | 4.1 |
| | 2.0 | 24.50 | 35.05 | 4.52 | 1.68 | 8.09 | 9.5 | 5.3 | 4.2 |
| | 3.0 | 24.50 | 35.05 | 4.49 | 1.59 | 8.12 | 11.8 | 6.5 | 5.3 |
| 07/06/1970 | 0.0 | 21.90 | 34.45 | 4.43 | 0.42 | 8.02 | 7.6 | 3.6 | 4.0 |
| | 2.0 | 21.90 | 34.60 | 4.58 | 0.46 | 8.14 | 12.4 | 6.4 | 6.0 |
| | 3.0 | 21.90 | 34.75 | 4.07 | 0.34 | 8.17 | 13.3 | 7.2 | 6.1 |

TABLE II - Hydrographic results of station II

| Date | Depth (m) | T (°C) | S (°/oo) | $O_2$ (ml/l) | $PO_4$-P (µgA/l) | pH | Suspended matter (mg/m³) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Dry Weight | Inorganic | Organic |
| 02/13/1970 | 0.0 | 27.60 | 34.30 | 4.50 | 0.80 | 8.08 | 9.47 | 4.98 | 4.49 |
| | 2.5 | 27.40 | 34.18 | 4.51 | 0.60 | 8.10 | 10.51 | 5.73 | 4.78 |
| | 5.0 | 26.80 | 34.25 | 4.37 | 1.09 | 8.07 | 17.30 | 9.45 | 7.85 |
| 03/05/1970 | 0.0 | 25.20 | 35.34 | 4.61 | 1.03 | 8.00 | 7.90 | 3.55 | 4.35 |
| | 2.5 | 23.00 | 34.38 | 4.70 | 1.29 | 8.10 | 8.10 | 5.15 | 2.95 |
| | 5.0 | 22.05 | 35.40 | 5.00 | 1.38 | 8.05 | 5.45 | 3.13 | 2.32 |
| 07/07/1970 | 0.0 | 21.90 | 34.60 | 4.45 | 0.39 | 8.00 | 10.30 | 6.45 | 3.85 |
| | 2.5 | 21.80 | 34.55 | 4.44 | 0.27 | 8.10 | 9.45 | 4.15 | 5.30 |
| | 5.0 | 21.80 | 34.80 | 4.46 | 0.31 | 8.12 | 11.05 | 6.41 | 4.64 |

TABLE III - Hydrographic results of station III

| Date | Depth (m) | T (°C) | S (°/oo) | $O_2$ (ml/l) | $PO_4$-P (µgA/l) | pH | Suspended matter (mg/m³) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Dry Weight | Inorganic | Organic |
| 02/14/1970 | 0.0 | 27.50 | 34.42 | 4.55 | 0.84 | 8.07 | 14.8 | 4.3 | 11.5 |
| | 2.5 | 27.00 | 34.59 | 4.55 | 0.89 | 8.09 | 9.5 | 2.5 | 7.0 |
| | 5.0 | 26.70 | 34.20 | 4.55 | - | 8.07 | - | - | - |
| | 7.5 | 25.80 | 34.98 | 4.74 | 1.19 | 8.06 | 17.4 | 5.8 | 11.6 |
| | 10.0 | 24.70 | 35.10 | 4.31 | 1.39 | 8.03 | 19.2 | 6.3 | 12.9 |
| 03/05/1970 | 0.0 | 25.20 | 34.88 | 4.95 | 0.91 | 7.98 | 12.5 | 6.1 | 6.4 |
| | 2.5 | 24.90 | 35.00 | 4.73 | 0.83 | 7.98 | 8.4 | 5.0 | 3.4 |
| | 5.0 | 23.00 | 35.18 | 4.69 | 0.98 | 7.96 | 10.8 | 6.3 | 4.5 |
| | 7.5 | 20.95 | 35.51 | 4.28 | 1.03 | 7.96 | 11.3 | 4.9 | 6.4 |
| | 9.0 | 19.45 | 35.53 | 4.01 | 1.47 | 7.95 | 12.0 | 6.2 | 5.8 |
| 07/07/1970 | 0.0 | 22.20 | 34.65 | 4.80 | 0.52 | 8.01 | 8.6 | 3.6 | 5.0 |
| | 2.5 | 21.70 | 34.70 | 4.71 | 0.52 | 8.00 | 7.3 | 2.2 | 5.1 |
| | 5.0 | 21.60 | 34.75 | 4.64 | 0.52 | 8.01 | 9.4 | 4.1 | 5.3 |
| | 7.5 | 21.60 | 34.90 | 4.07 | 0.52 | 7.98 | 10.1 | 4.8 | 5.3 |
| | 9.0 | 21.60 | 35.08 | 4.10 | 0.50 | 7.98 | - | - | - |

TABLE IV - Hydrographic results of station IV

| Date | Depth (m) | T (°C) | S (°/oo) | $O_2$ (ml/l) | $PO_4$-P (µgA/l) | pH | Suspended matter (mg/m³) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Dry Weight | Inorganic | Organic |
| 02/15/1970 | 0.0 | 27.40 | 34.23 | 4.46 | 0.59 | 7.90 | 9.5 | 2.5 | 7.0 |
| | 2.5 | 27.30 | 34.61 | 4.62 | - | - | - | - | - |
| | 5.0 | 27.20 | 34.22 | 4.55 | 0.55 | 8.00 | 13.5 | 3.5 | 10.0 |
| | 7.5 | 26.50 | 34.91 | 4.54 | 1.29 | 8.00 | 15.0 | 5.0 | 10.0 |
| | 10.0 | 25.30 | 34.42 | 4.20 | 0.79 | 8.00 | 12.3 | 4.1 | 8.2 |
| | 15.0 | 23.90 | 35.10 | 4.00 | 1.15 | 8.10 | - | - | - |
| | 20.0 | 19.40 | 34.92 | 3.32 | 0.94 | 8.80 | 17.0 | 5.0 | 12.0 |
| | 25.0 | 18.90 | 34.91 | 3.26 | - | - | - | - | - |
| | 30.0 | 18.80 | 35.01 | 3.14 | - | - | - | - | - |
| 03/15/1970 | 0.0 | 24.90 | 34.92 | 4.65 | 0.99 | 7.94 | 8.3 | 4.2 | 4.1 |
| | 2.5 | 23.95 | 35.19 | 4.61 | 1.02 | 7.94 | 7.1 | 3.8 | 3.3 |
| | 5.0 | 23.45 | 35.46 | 4.77 | 1.34 | 7.92 | 6.9 | 4.1 | 2.8 |
| | 7.5 | 22.80 | 35.43 | 4.52 | 1.31 | - | 7.0 | 4.1 | 2.9 |
| | 10.0 | 18.60 | 35.50 | 4.38 | 1.29 | - | 5.9 | 3.3 | 2.6 |
| | 15.0 | 17.85 | 35.01 | 3.48 | 1.44 | 7.90 | 8.1 | 4.5 | 3.6 |
| | 20.0 | 17.70 | 35.46 | 3.48 | 0.94 | 7.85 | 7.5 | 3.9 | 3.6 |
| | 25.0 | 17.45 | 35.49 | 3.06 | 1.39 | 7.90 | 9.3 | 5.6 | 3.7 |
| | 30.0 | 17.20 | 35.50 | 2.92 | 1.89 | 7.90 | 9.8 | 5.0 | 4.8 |
| 07/08/1970 | 0.0 | 21.80 | 34.75 | 4.70 | 0.34 | 8.10 | 5.3 | 2.3 | 3.0 |
| | 2.5 | 21.75 | 34.75 | 4.65 | - | 8.10 | 8.5 | 3.1 | 5.4 |
| | 5.0 | 21.75 | 34.80 | 4.66 | 0.40 | 7.99 | 9.3 | 4.0 | 5.3 |
| | 7.5 | 21.75 | 35.00 | 4.64 | - | 8.01 | - | - | - |
| | 10.0 | 21.73 | 35.00 | 4.68 | 0.34 | 7.99 | - | - | - |
| | 15.0 | 21.73 | 35.10 | 4.68 | 0.43 | 8.01 | 8.5 | 3.4 | 5.1 |
| | 20.0 | 21.73 | 35.20 | 4.70 | 0.41 | 8.00 | 9.3 | 4.3 | 5.0 |
| | 25.0 | 21.70 | 35.10 | 4.47 | 0.39 | 8.00 | 7.2 | 2.9 | 4.3 |
| | 30.0 | 21.65 | 35.20 | 4.45 | 0.40 | 8.00 | 10.8 | 4.6 | 6.2 |

TABLE V - Hydrographic results of station V

| Date | Depth (m) | T (°C) | S (°/oo) | $O_2$ (ml/l) | $PO_4$-P (µgA/l) | pH | Suspended matter (mg/m³) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Dry Weight | Inorganic | Organic |
| 02/16/1970 | 0.0 | 26.20 | 35.00 | 4.45 | 0.43 | 7.90 | 6.5 | 3.2 | 3.3 |
| | 5.0 | 26.00 | 35.01 | 4.49 | - | - | - | - | - |
| | 10.0 | 25.10 | 35.10 | 4.37 | 0.29 | 7.90 | 7.4 | 3.8 | 3.6 |
| | 15.0 | 22.60 | 35.08 | 4.41 | 0.53 | 7.90 | 5.3 | 3.4 | 1.9 |
| | 20.0 | 18.10 | 35.15 | 3.30 | 0.37 | 8.00 | 4.9 | 2.8 | 2.1 |
| | 25.0 | 17.30 | 35.25 | 3.20 | - | 8.10 | 5.1 | 3.7 | 1.4 |
| | 30.0 | 17.10 | 35.38 | 3.10 | - | - | 7.2 | 4.1 | 3.1 |
| 03/05/1970 | 0.0 | 23.20 | 35.07 | 4.66 | 0.89 | 7.82 | 5.9 | 3.5 | 2.4 |
| | 5.0 | 18.70 | 35.47 | 4.55 | 0.94 | 7.93 | 6.4 | 3.3 | 3.1 |
| | 10.0 | 17.90 | 35.45 | 4.23 | 0.78 | 7.98 | - | - | - |
| | 15.0 | 17.10 | 35.46 | 3.24 | 1.38 | 8.01 | 5.3 | 2.6 | 2.7 |
| | 20.0 | 16.30 | 35.41 | 2.75 | 1.50 | 7.96 | 4.7 | 2.2 | 2.5 |
| | 25.0 | 15.90 | 35.46 | 2.72 | 1.29 | 7.94 | 5.1 | 2.4 | 2.7 |
| | 30.0 | 15.40 | 35.48 | 2.71 | 1.43 | 8.00 | 5.2 | 3.0 | 2.2 |
| 07/10/1970 | 0.0 | 21.50 | 34.95 | 4.68 | 0.15 | 8.05 | 2.5 | 1.4 | 1.1 |
| | 5.0 | 21.48 | 35.10 | 4.71 | - | 8.00 | 2.3 | 1.3 | 1.0 |
| | 10.0 | 21.48 | 35.27 | 4.59 | 0.09 | 8.00 | 3.4 | 1.4 | 2.0 |
| | 15.0 | 21.48 | 35.30 | 4.63 | - | 8.03 | 2.1 | 1.2 | 0.9 |
| | 20.0 | 21.45 | 35.34 | 4.60 | 0.12 | 8.00 | 4.0 | 1.7 | 2.3 |
| | 25.0 | 21.45 | 35.37 | 4.50 | 0.04 | 8.00 | 1.9 | - | - |
| | 30.0 | 21.45 | 35.32 | 4.43 | 0.05 | 8.00 | 2.1 | 1.4 | 0.7 |

## CHEMICAL ENVIRONMENT

*Nutrient:* in this work, only inorganic phosphate was measured. The lowest value determined was 0.04 µgA/l at station V (Tab. V) and the highest was 1.89 µgA/l at station IV (Tab. IV). These results seem to confirm that the influence of terrigenous water is not of great significance to the fertility of the

whole region. Relatively high levels were found in the summer, principally due to the influx of cold water in the region (Tab. IV), and low levels in the winter.

*pH:* marked seasonal differences were not observed at any station but in the inner part of the bay high levels were found (Tabs I-II).

*Dissolved oxygen:* vertically, the oxygen distribution did not show any systematic variation in the shallow water (Tabs I-III), but during the summer the deep stations were characterized by a distinct two-layered system: a thin surface water layer (0.0 m - 15.0 m) showing high oxygen levels and low temperature waters with relatively low levels of oxygen. This decrease with depth indicates the influx of coastal and oceanic water in the region.

LIGHT CONDITIONS AND SUSPENDED MATTER - The submarine daylight measurements constitute a basic study for marine environments in which productivities studies are being made. The vertical attenuation and changes in the quality of the light penetration may change the depth of the euphotic zone and certainly the primary productivity, the distribution and the composition of the phytoplankton. In the inner part of the region, the spectral distribution resembles that of turbid coastal waters, with a maximum in the green part of the spectrum (Fig. 2). In the other stations some differences were found, with a maximum in

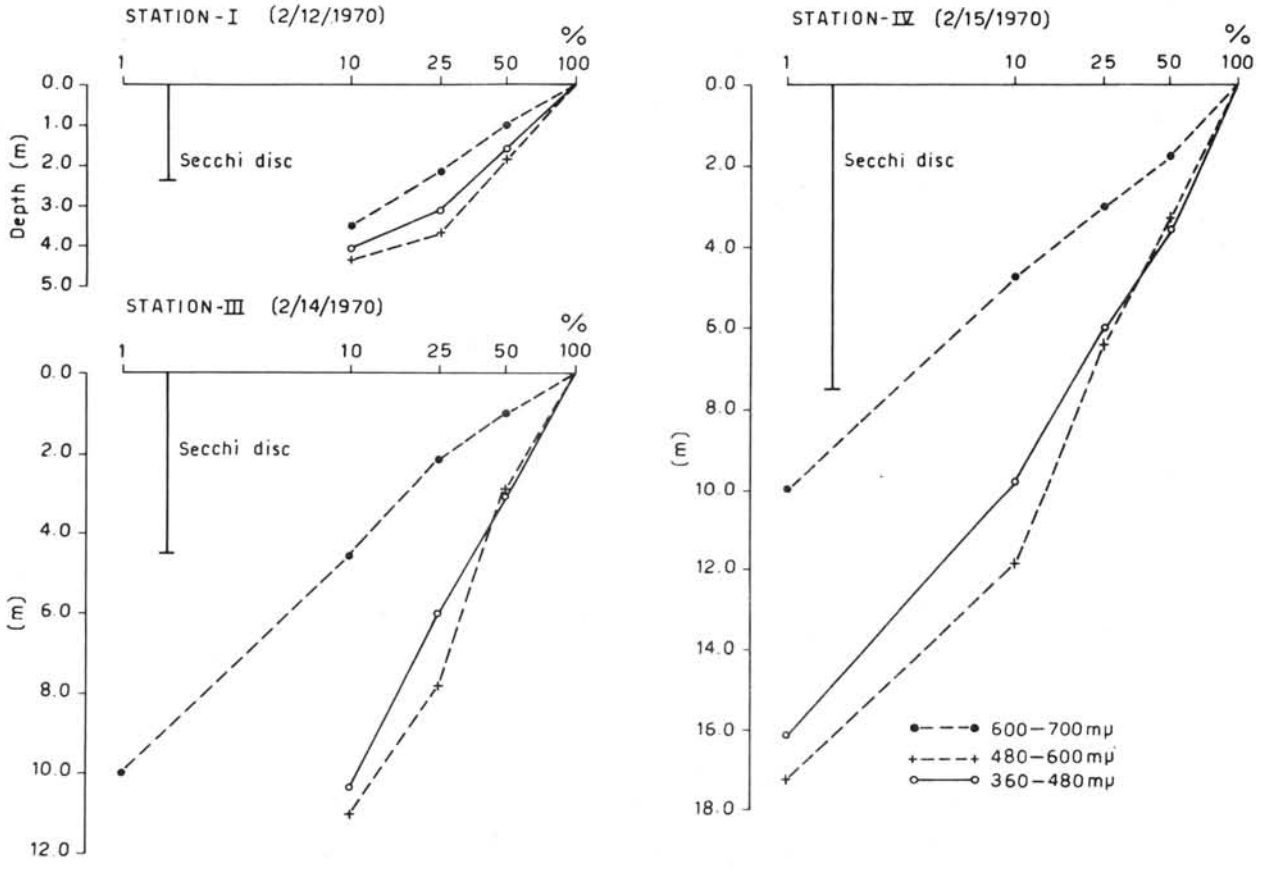


*Fig. 2* - Values of relative light intensities measured at various depths using different spectral filters and Secchi disc readings.

the green or in the blue part of the spectrum (Figs 2-3), showing more influence of coastal and of oceanic water.

*Suspended matter:* vertically, the suspended matter did not show a characteristic pattern, and horizontally the distribution showed a gradual decrease from the inner part of the bay to the open region, principally in summer, probably due to fresh-water admisture: the total suspended matter ranged from 1.90 mg/m$^3$ at station V (Tab. V) to 23.20 mg/m$^3$ at station I (Tab. I).

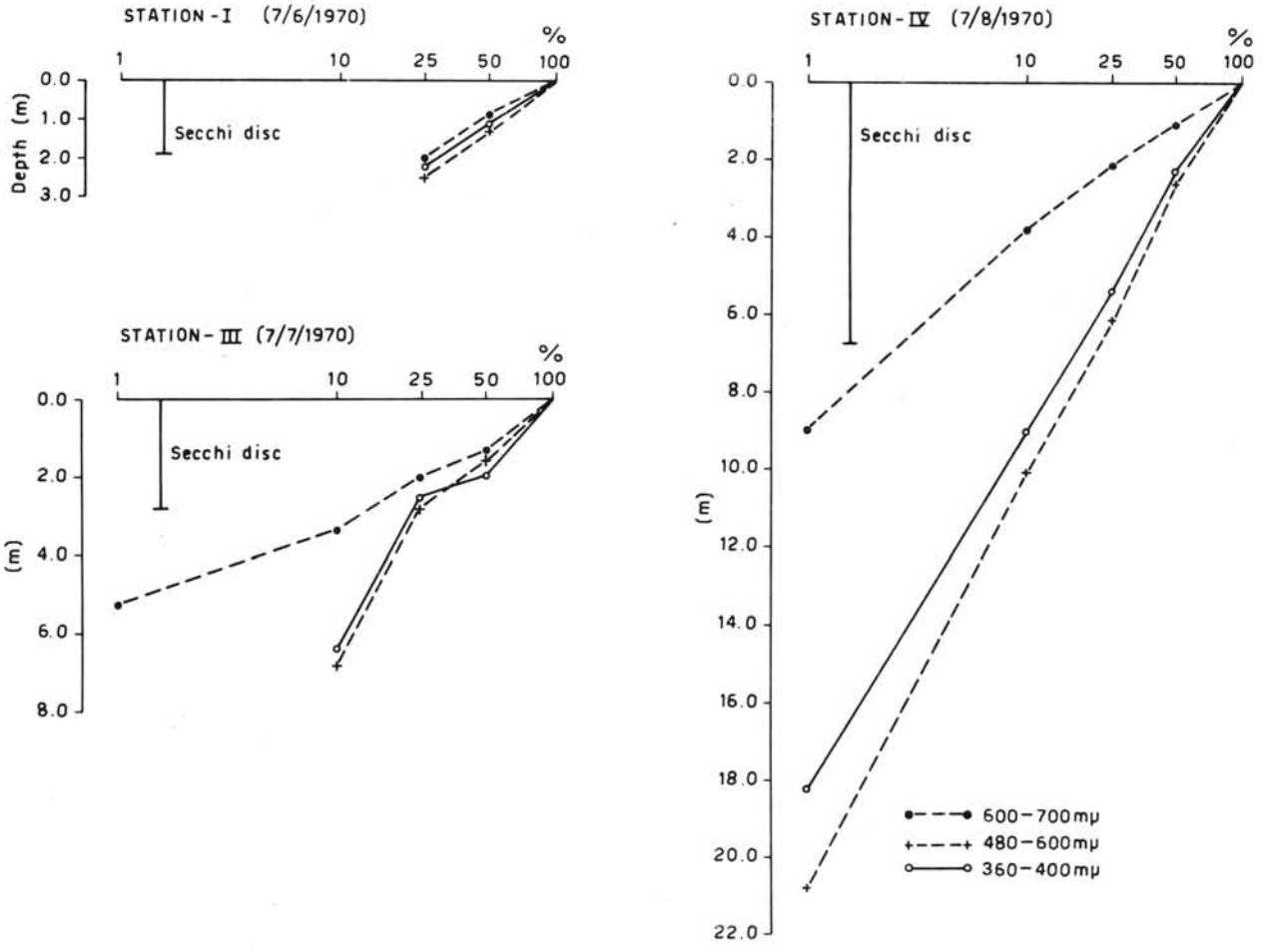


*Fig. 3* - Values of relative light intensities measured at various depths using different spectral filters and Secchi disc readings.

PRIMARY PRODUCTION - One of the problems in productivity research is to determine an accurate measurement of primary production.

The estimate of the rate of carbon fixation in marine environment has been approached in several ways. In this paper, the data were presented based on the measurements of the photosynthetic rate of samples of the natural phytoplankton populations. The method of labeled carbon ($C^{14}$), assumed to be the most accurate, was used to determine the production. However, we must take into account that this methodology only gives an instantaneous measure of the production of a small sample of the population in an artificial environment at a particular time. While ideal conditions were not completely reached in the

present work, the results are considered only as information to pave the way for future research. Usually the *in-situ* incubations were carried out from midday to sunset. The results of the half-day incubations were doubled to obtain an estimate of the production that occurred during the day.

The disadvantage of the $C^{14}$ method is that it does not measure the amount of the respiration, therefore it does not give information on gross production, ecologically very important. The data presented in this work have not been corrected for respiration nor for excretion, although we think that during the hours of high light intensity significant values of excretion may occur. The main factors determining primary production are the size and efficiency of the phytoplankton population, the nutrients available in the euphotic zone, and the radiant energy. The size and efficiency of the phytoplankton population seems to be influenced by variations in the stability of the water column. The variable stability may increase the replenishement nutrient in the euphotic zone. The problem of the nutrient production relationship is very complex, and in this paper only data on phosphate are presented. However, some experimental work carried out (unpubl.) seems to indicate that nitrogen compounds are the principal limiting factor in this region (the addition of $NO_3$-N produced an increase of chlorophyll from 1.62 mg/m$^3$ to 7.56 mg/m$^3$ during 53 hours of incubation).

The radiant energy is sufficient during all seasons and has an inhibitory effect during cloudless days (Fig. 4). Usually relatively high light intensity reaches the bottom (Figs 2-3).

The estimated production of this region is lower than reported from the mangrove region of Cananéia (Lat. 25°00'57.1"S - Long. 47°55'34.6"W), but it is higher than the one we found (Teixeira et al., 1969) in the coastal and oceanic waters in the north of Brazil (Lat. 07°39'N - Long. 42°31'W) (Teixeira & Tundisi, 1967).

The comparison of the values reported from different stations indicates a great difference in the primary production of summer (higher) and winter (lower).

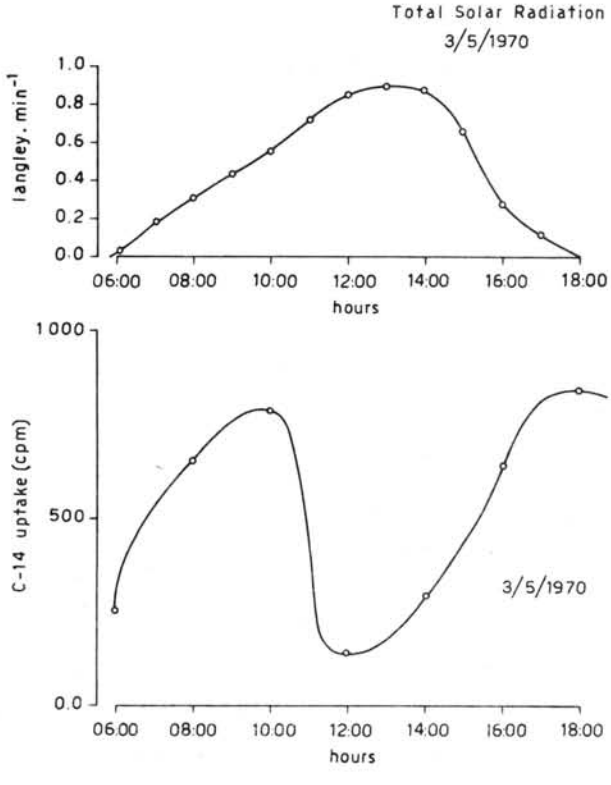


*Fig. 4* - Daily rates of primary production in terms of carbon-14 assimilation and total solar radiation.

The results showed that the material produced within the bay contributes towards the productivity of the coastal region (Tab. VI).

TABLE VI - Data for primary production, chlorophyll-*a* content and submarine daylight

| Date | Station | Submarine Daylight (%) | Depth (m) | Chlorophyll-*a* (mg/m³) | Primary production (*in situ*) | |
|---|---|---|---|---|---|---|
| | | | | | mgC/m³/h | mgC/m³/day |
| 02/12/1970 | I | 100 | 0.0 | 4.211 | 28.16 | 337.92 |
| | | 50 | 1.9 | 3.914 | 12.56 | 150.72 |
| | | 25 | 3.9 | 5.581 | 2.85 | 34.20 |
| 07/06/1970 | I | 100 | 0.0 | 2.971 | 16.24 | 162.40 |
| | | 50 | 1.0 | 2.894 | 5.10 | 51.00 |
| | | 25 | 2.5 | 3.619 | 0.24 | 2.40 |
| 02/14/1970 | III | 100 | 0.0 | 1.168 | 11.27 | 135.24 |
| | | 50 | 2.8 | 1.176 | 7.92 | 95.04 |
| | | 25 | 7.8 | 1.606 | 7.85 | 93.00 |
| | | 10 | 11.0 | 2.284 | 4.44 | 53.28 |
| 07/07/1970 | III | 100 | 0.0 | 2.049 | 10.67 | 106.70 |
| | | 50 | 1.4 | 1.665 | 0.58 | 5.80 |
| | | 25 | 3.4 | 2.037 | 4.76 | 47.60 |
| | | 10 | 7.1 | 2.128 | 3.13 | 31.30 |
| 02/15/1970 | IV | 100 | 0.0 | 1.282 | 9.85 | 118.20 |
| | | 50 | 3.0 | 1.648 | 5.81 | 69.72 |
| | | 25 | 7.4 | 1.906 | 6.09 | 73.08 |
| | | 10 | 10.8 | 2.429 | 3.43 | 41.16 |
| | | 1 | 18.5 | 2.103 | 1.01 | 12.12 |
| 07/08/1970 | IV | 100 | 0.0 | 1.179 | 5.68 | 56.80 |
| | | 50 | 3.0 | 1.250 | 0.24 | 2.40 |
| | | 25 | 5.7 | 1.457 | 0.92 | 9.20 |
| | | 10 | 9.6 | 1.310 | - | - |
| | | 1 | 20.5 | 1.556 | 1.70 | 17.00 |


## RESUMO

Alguns estudos preliminares foram iniciados na região de Ubatuba (Lat. 23°30'S - Long. 45°06'W), tendo em vista a obtenção de dados sobre as características hidrológicas da região. Concomitantemente, foram realizadas medidas sobre a produção primária utilizando-se o método do carbono-14. Como dado complementar, determinamos também o "standing-stock" expresso em mg de clorofila-*a* por m³. As coletas e observações foram realizadas em duas épocas distintas a saber: durante o inverno (julho) e verão (fevereiro-março). Muito embora seja um trabalho preliminar, concluímos que a produção primária é controlada fundamentalmente pela quantidade de nutrientes disponíveis, havendo dois sistemas de fertilização das águas: águas frias (de origem oceânica) e águas terrígenas (provenientes da drenagem devido à precipitação pluviométrica).



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