

PRIMARY PRODUCTIVITY IN THE NEARSHORE WATERS OF VIZHINJAM, TRIVANDRUM

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ABSTRACT

Primary productivity and related aspects in the Vizhinjam Bay and adjacent open sea were investigated from April 1983 to March 1984. The rate of production was estimated by determining O_2 by the light and dark bottle method. The gross production in Vizhinjam Bay ranged from 114 to 672 mg C/m³/day and in the open sea station it varied from 185 to 739 mg C/m³/day. The range in the net production was from 32 to 429 mg C/m³/day in the Bay and from 114 to 411 mg C/m³/day in the open sea station. High values of phosphate were recorded in September and October in the Bay and during August-November in the open sea. The nitrite and nitrate values were low when compared to those reported earlier from Vizhinjam Bay. The monthly variations in surface production were not significantly related to either temperature or salinity. The correlation between primary production and nutrient concentration was discussed.

INTRODUCTION

PRIMARY PRODUCTION, being first link in the food web in the sea, is the main criterion in assessing the relative fertility of waters. Several comprehensive studies on the primary productivity of certain areas of the west coast of India are available (Ramachandran Nair, 1970; Qasim, 1973; Abidi, 1981; Varshney *et al.*, 1983). However, studies over long periods at fixed stations are far and few. There is practically no information on the daily production of organic matter in the inshore waters of Vizhinjam (76°56' E; 8°20' N) which is an important fishing and mariculture centre, although Mathew and Nair (1980) and Dharmaraj *et al.* (1980) have made some observations in respect of the standing crop of phytoplankton and the hydrological features of the Vizhinjam Bay. Hence investigations were undertaken with a view to measuring the magnitude of Primary production, its monthly fluctuations and correlations with hydrobiological parameters *e.g.* temperature, salinity, dissolved oxygen and nutrients.

The authors are grateful to Dr. E. G. Silas Director, C. M. F. R. I., Cochin for his kind

permission to publish this account. Our thanks are due to Dr. K. Radhakrishna and Shri. C. Mukundan for critically reviewing the manuscript.

MATERIAL AND METHODS

The rate of primary production was estimated by the light and dark bottle technique following Strickland and Parsons (1972). Fortnightly observations were made from two stations - Station I (15 m in depth) within the Bay and Station II (30 m in depth) in the open sea. The values were then averaged for monthly means and the data and results for one year (April 1983 to March 1984) are presented in this paper. Besides productivity, data relating to hydrographic variables like salinity, temperature, dissolved oxygen and nutrients were recorded. Correlation analysis as given by Snedcor and Cochran (1967) was done to study the relationships between productivity and the physico-chemical factors.

RESULTS

A. Rate of primary production

In the Vizhinjam Bay two peaks of gross and net production - one in June and another

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TABLE 1. Productivity and environmental data at stations I and II (Monthly average surface values)

	Production (mgC/m ³ /day)		Temperature (°C)	Salinity (‰)	Dissolved Oxygen (ml/l)	Phosphate (µg at/l)	Nitrite (µg at/l)	Nitrate (µg at/l)
	NP	GP						
STATION I								
Apr. '83	96	239	29.90	34.36	4.84	1.34	0.33	3.26
May	32	114	30.35	33.82	4.87	1.60	0.33	2.98
June	429	672	29.40	34.44	4.82	1.57	0.35	3.42
July	179	354	25.50	34.24	4.84	1.79	0.36	2.49
Aug.	172	343	24.50	34.34	4.62	1.50	0.52	2.40
Sept.	143	422	25.30	34.94	4.24	3.54	0.24	0.90
Oct.	193	386	26.00	35.24	4.02	2.63	0.24	3.68
Nov.	257	457	27.40	33.96	4.21	1.90	0.20	4.14
Dec.	118	200	27.15	34.60	5.22	1.39	0.33	1.84
Jan. '84	222	315	27.55	35.07	4.57	1.39	0.28	3.48
Feb.	75	247	27.40	34.62	5.03	1.41	0.12	1.92
Mar.	236	379	27.75	34.42	5.07	0.80	0.28	1.44
STATION II								
Apr. '83	136	336	30.20	34.48	4.95	1.16	0.41	4.02
May	147	185	30.45	34.06	4.86	1.75	0.38	3.40
June	411	568	29.40	34.73	5.06	1.75	0.38	3.69
July	282	450	26.00	34.24	4.89	1.79	0.42	2.89
Aug.	286	461	24.50	35.22	4.74	4.08	0.30	—
Sept.	343	739	27.40	35.68	3.73	3.73	0.28	1.80
Oct.	386	493	27.30	35.41	5.29	3.04	0.22	4.40
Nov.	386	407	27.50	34.70	4.95	3.64	0.11	3.30
Dec.	149	593	28.35	35.12	5.62	1.47	0.32	1.83
Jan. '84	129	214	28.00	35.22	4.74	1.92	0.39	3.93
Feb.	114	197	28.00	34.92	5.18	2.01	0.22	1.20
Mar.	186	325	28.00	34.75	6.15	1.52	0.50	1.44

NP - Net production GP - Gross production

in November were observed. At the station in the open sea gross production showed maximum values in September and June whereas net production recorded the maxima in June and October-December. These monthly variations in the gross and net production in the inshore surface waters of Vizhinjam are given in Table 1.

B. Hydrographical features

The physico-chemical data collected at the two stations are presented in Table 1.

Temperature

The surface temperature was maximum in May and minimum in August at both the Stations. Temperature values from January to March 1984 remained more or less uniform at both the stations.

Salinity

Salinity variations were not wide and ranged between 33.82 ‰ at Station I and between 34.06 ‰ and 35.68 ‰ at Station II. The maximum was at Station I in October while at Station II it was in September. A slight lowering of the salinity values was noticed in May at both the stations.

Dissolved oxygen

Dissolved oxygen values at Stations I and II fluctuated from 4.02 to 5.37 ml/l and 3.73 to 6.15 ml/l respectively. At both the stations the highest values for dissolved oxygen were recorded in March.

Phosphate

The inorganic phosphate concentration at Stations I and II ranged from 0.80 to 3.54 μg at/l and 1.16 to 4.08 μg at/l respectively. At Station I a distinct peak during September-October was exhibited whereas a similar

peak was discernible in August - October period at Station II.

Nitrite

The highest values for nitrite were observed in August at Station I and in July and March at Station II. The range of fluctuation was very narrow at both the Stations.

Nitrate

The values ranged from 0.90 to 4.14 μg at/l and 1.20 to 4.40 μg at/l at Stations I and II respectively. The maximum values for nitrate concentration were recorded in November at Station I and in October in Station II.

Results of the correlation analysis did not show any significant relationship between productivity and physico-chemical parameters at Station I whereas at Station II significant positive correlation between productivity (gross and net) and phosphate and negative correlation between productivity and nitrite were recorded (Table 2).

DISCUSSION

The rate of primary production in the Vizhinjam waters was found to be comparable to those reported in the nearshore areas of the southwest coast of India. The gross productivity in Vizhinjam Bay fluctuated from 114 to 672 $\text{mg C/m}^3/\text{day}$ and in the open sea ranged from 185 to 739 $\text{mg C/m}^3/\text{day}$. In the Mandovi Estuary gross productivity varied from 135 to 550 $\text{mg C/m}^3/\text{day}$ and in the Zuari Estuary the range was from 150 to 580 $\text{mg C/m}^3/\text{day}$ in the surface waters (Qasim, 1979). Likewise the net productivity in Vizhinjam varied from 32 to 429 $\text{mg C/m}^3/\text{day}$ in the Bay and 114 to 411 $\text{mg C/m}^3/\text{day}$ in the open sea. The range in the net productivity at Mandovi was 95 to 274 $\text{mg C/m}^3/\text{day}$ and at Zuari 60 to 245 $\text{mg C/m}^3/\text{day}$. According to Nair *et al.* (1984) the gross productivity in Ashtamudi Estuary varied from

88.68 to 1596.3 mg C/m³/day and the net productivity 22.41 to 1330.25 mg C/m³/day. The highest production recorded in the Cochin Estuary was 245 mg C/m³/day (Pillai *et al.*, 1975). Comparison of the results obtained by Varshney *et al.* (1983) and Qasim *et al.* (1969) in the nearshore waters off Bombay and Cochin respectively cannot be done since the methodology adopted is different. However, these studies show that the recorded production rate of Vizhinjam waters is less than in the Ashtamudi Estuary, but is more than the Goan waters.

Considering the relationship between nutrients and productivity, Qasim *et al.* (1969) have

of Dharmaraj *et al.* (1980) in Vizhinjam Bay and Qasim (1973) in Cochin Backwaters. The nitrite-nitrate values recorded in the present study, however, were low when compared to those recorded by Dharmaraj *et al.* (1980) in Vizhinjam Bay.

Qasim (1973) stated that the temperature of water has no effect on primary production whereas salinity has direct influence on the growth of phytoplankton. Purushothaman and Bhatnagar (1976) noticed a positive correlation of productivity with temperature and salinity in Porto Novo waters. However, in the present study as in the findings of Nair *et al.*

TABLE 2. Correlation coefficient between the environmental parameters and productivity (Gross and Net) in Vizhinjam nearshore waters

Parameters	Station I (Bay)		Station II (Open Sea)	
	GP	NP	GP	NP
Surface temperature	-0.112	0.059	-0.268	-0.195
Salinity	0.115	0.056	0.445	0.326
phosphate	0.195	-0.046	0.456*	0.561*
Nitrite	0.041	-0.091	-0.157	-0.485*
Nitrate	0.169	0.205	-0.132	-0.231

* significant at 5 % level

shown a close correlation between phosphate and productivity. In the present study significant correlation between phosphate and productivity (net and gross) was evident only in the open sea station. Significant negative relationship between net productivity and nitrite was observed only at Station II. Nitrate too did not show any significant relationship with organic production in the present study or in the results of Varshney *et al.* (1983) and Qasim *et al.* (1969).

High values of phosphate during August-November are in agreement with the studies

(1984) no such significant relationship were revealed between primary production and either temperature or salinity. As a consistent relationship between productivity and phosphate or nitrite was not evident at the two stations, it may be concluded that in the Vizhinjam nearshore waters the variations in the surface primary production cannot be attributed to one cause alone, but may be due to the combined effect of the parameters or due to other parameters which have not been considered in the study.

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