J. mar. biol. Ass. India, 1973, 17 (1) : 40 - 55

DISTRIBUTION OF PARTICULATE ORGANIC MATTER IN THE BAY OF BENGAL*

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ABSTRACT

The paper presents an account of the distribution of particulate organic matter (particulate organic carbon, nitrogen and phosphorus) in the inshore waters of Bay of Bengal off the cost of Waltair for a period of two years (1961 to 1962) and also from the different regions of the Bay of Bengal obtained during March-April, 1963 on board R. V. *Anton Bruun* in the International Indian Ocean Expedition.

Variations in the monthly average values of the three fractions of the particulate material in the surface water off the coast of Waltair show an almost similar trend. They reveal high values during the peak period of phytoplankton growth in March-April. (Carbon 13.8 µg. at l, nitrogen 1.25 µg. at l, phosphorus 0.15 µg. at l in 1961 and 14.8 µg. at/l, 1.0 µg. at l, 0.16 µg. at l respectively in 1962). Values obtained during October-November period are of the same magnitude. (Carbon 13.0 µg. at l, nitrogen 1.85 µg. at l, phosphorus 0.1 µg. at l in 1961 and 7.5 µg. at l, 1.2 µg. at/l and 0.1 µg. at l respectively in 1962). The somewhat high values of this period are attributed to a minor bloom of phytoplankton as well as to considerable quantity of detritus from river waters brought down to this coast by the southerly current.

During the period of heavy rains along the Waltair Coast (July and August) there is an indication of an increase in the concentration of organic carbon and nitrogen but not of phosphorus. Average values in the surface water of the different regions of the Bay of Bengal indicate high contents of particulate matter in regions of high productivity for example, off the coast of Burma and the east coast of India during March-April period.

The concentration of particulate organic matter in general is low in the Bay of Bengal when compared to other fertile areas of the Pacific and the Atlantic thus reflecting perhaps, the low productivity of this region.

INTRODUCTION

A STUDY of the cycle of life in the sea indicates that a good amount of living matter occurs as nanno-plankton, which with the more resistant portions of decomposing organisms and detritus constitutes what is termed as 'particulate' organic matter.

The amount of plant material beneath a known area of sea surface at any instant of time is known as the standing crop and can be expressed in several ways. The number of individual plants, their weight or volume are often used. However, these measurements have little significance in terms of potential food value as there

*Presented at the 'Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin from January 12 to 18, 1971.

is an enormous size variation between phytoplankton species. The water content and the amount of inert substances such as silica or lime in the plants are not nearly constant. The most useful measure is the amount of organic carbon in the crop. The phosphorus and nitrogen contents of the crop have considerable significance and we can make a 'proximate' analysis for protein, carbohydrate and fat (Strickland, 1959).

Though the standing crop of phytoplankton does not necessarily tells us much about the rate of production of the food stuff, the standing crop reflects the magnitude of production and a relative idea of the fertility of the different regions may thus be obtained.

We are grateful to Late Dr. N.K. Panikkar, former Director, National Institute of Oceanography, India, for his encouragement and useful suggestions in the preparation of this paper. Thanks are due to Dr. P. N. Ganapati for research facilities at Andhra University, Waltair and to Dr. John H. Rhyther of the Woods Hole Oceanographic Institution, U. S. A. for facilities on R. V. *Anton Bruun* during the International Indian Ocean Expedition.

MATERIALS AND METHODS

Sea water samples for routine work were collected from the surface once in ten days from January 1961 to December 1962 from a station (Fig. 1) located about 5 km off the coast of Visakhapatnam opposite the entrance channel. The depth at this station was about 46 metres.

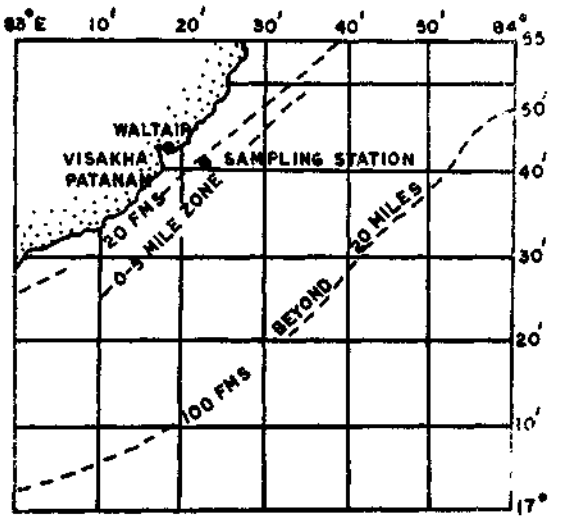

Fig. 1. Location of the sampling station for weekly collections.

A clean polythene bucket was lowered from the boat with the help of a cotton rope. The bucket was rinsed twice with the sea water sample and a bucketful of sample of sea water was collected. The sea water sample was immediately dispensed into a polythene bottle, tightly stoppered and kept in a cool dark place in

the boat. Normally about 2 litres of the sample was first strained through a clean nylon cloth of mesh size 0.3 mm to remove the larger zoo-plankters without losing plant cells or detrital particles. Similar volumes of water were filtered for C and N from the same stock. The sample thus strained was filtered through a millipore AA filter previously treated with a little magnesium carbonate powder to prevent particles adhering to the surface of the membrane. The concentrated particulate matter was rinsed off the membrane filter with a little saline and immediately analysed.

During March-April cruise on *Anton Bruun*, millipore filters were substituted with glass filters (Fig. 2). Surface sea water samples from different regions of the Bay of Bengal were filtered through glass filters spread with magnesium carbonate. The glass filters containing the particulate matter were folded in half, placed in a folded whatman filter paper and covered with an aluminium paper kept intact with a rubber band and stored in a kilner jar containing freshly dehydrated silica gel. The jar was kept in dark in a deep freeze. The samples were analysed later on a unicam Sp. 600 spectrophotometer.

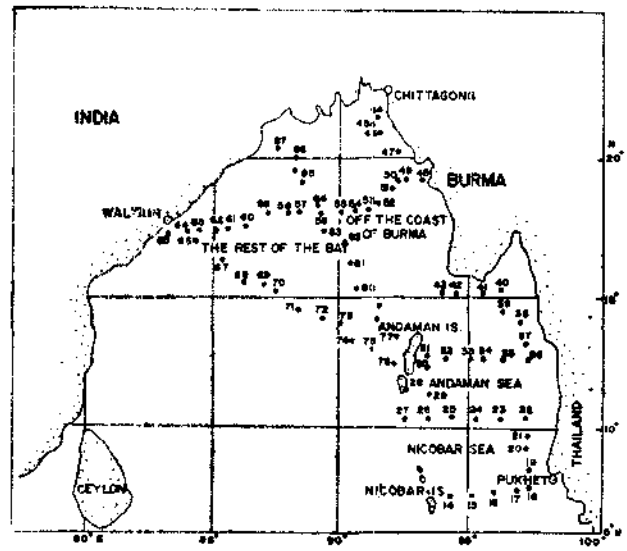

Fig. 2 Location of stations during the first cruise of *Anton Bruun* in the Bay of Bengal.

Particulate carbon was analysed by the procedure given by Johnson (1949) and adopted by Strickland and Parsons (1960) to spectrophotometry.

Particulate phosphorus content was obtained by the difference in the total phosphorus content estimated on two samples of 50 ml each, one filtered through a millipore membrane and the other unfiltered.

Particulate nitrogen was estimated by adaptation of the micro-kjeldahl Nessler procedure given for small amounts of protein by Johnson (1941).

PARTICULATE ORGANIC CARBON

Monthly average values of particulate organic carbon in the surface waters off the coast of Waltair during 1961 and 1962.

Monthly average values of particulate organic carbon in the surface waters during 1961 (Fig. 3a, Table 1) showed an annual variation from 13.75 µg. at/l in April to 3.25 µg. at/l in January, thus showing a range of 10.5 µg. at/l. The average value for this year was 8.6 µg. at/l.

TABLE 1. *Average monthly values of the Particulate organic Carbon, Phosphorus, Nitrogen and other constituents in the surface water off the coast of Waltair during 1961 and 1962*

Month	NO3-N µg. at l	PO4-P µg.at/l	Part P µg.at/l	Part C µg.at/l	Part N µg.at/l	D or N mg/l	Harvey Pigment units/M^3	Salinity ‰
1961								
Jan.	4.6	0.49	0.04	3.3	0.38	0.05	528.2	30.90
Feb.	6.4	0.90	0.06	5.1	0.49	0.035	1100.8	32.68
Mar.	10.4	1.12	0.12	8.8	0.98	0.078	8000.0	33.91
Apr.	6.1	0.71	0.15	13.8	1.25	0.12	10525.0	34.80
May	1.8	0.24	0.07	6.5	0.70	0.28	2800.0	34.80
June	4.2	0.34	0.06	5.5	0.48	0.10	810.0	33.72
July	5.8	0.28	0.04	11.3	0.52	0.08	228.0	33.12
Aug.	7.2	0.71	0.04	12.0	0.82	0.12	651.0	34.08
Sept.	3.6	0.30	0.06	7.6	0.80	0.04	651.0	31.70
Oct.	2.2	0.09	0.11	10.0	1.20	0.18	1653.0	30.81
Nov.	3.4	0.13	0.10	13.0	1.85	0.36	2200.0	24.30
Dec.	4.4	0.23	0.06	8.5	0.62	0.22	185.0	27.44
1962								
Jan.	5.2	0.58	0.03	5.2	0.50	0.18	588.5	31.71
Feb.	3.6	0.64	0.04	5.2	0.62	0.04	1380.0	34.07
Mar.	3.6	0.75	0.08	7.8	0.88	0.06	10000.0	34.51
Apr.	7.8	0.98	0.16	14.8	1.00	0.23	12500.0	34.70
May	1.9	0.32	0.09	9.2	0.50	0.18	4200.0	33.87
June	5.6	0.54	0.06	9.5	0.50	0.06	2300.0	33.16
July	2.8	0.50	0.05	13.2	0.78	0.10	1050.0	33.68
Aug.	6.4	0.79	0.06	11.0	1.00	0.18	422.0	34.55
Sept.	5.0	0.55	0.07	8.0	0.48	0.06	488.0	31.77
Oct.	2.6	0.54	0.09	9.2	0.85	0.28	1328.0	21.55
Nov.	1.8	0.32	0.10	7.5	1.20	0.22	1500.0	22.90
Dec.	2.5	0.44	0.04	6.8	0.55	0.20	26.20	26.98

Particulate carbon value in January was low and the values gradually increased through April to reach the highest value during this month. From April to May, the value showed a considerable fall by about 50% and this trend was seen through June. From June to August an increase in particulate carbon was noticed. Showing a drop in the particulate organic carbon figures in September, the values continued to increase through November. From November to December a slight fall in the value was noticed.

Thus, it may be noticed, that the particulate organic carbon values exhibit three peaks, one in April, the second in August and the third in November.

The trend in variation of the particulate organic carbon values during 1962 is almost identical with the values obtained during 1961. It is interesting to point

out that the annual average value for both the years is equal in magnitude, the

The rest of the Bay

In the surface water of this area the particulate organic carbon values are seen to fluctuate between 2.38 µg. at l and 15.5 µg. at l. thus showing a range of 13.12 µg. at l. The average content is 7.8 µg. at l

The values exhibit under an low concentrations about 4-5 µg. at l (with two exceptions) in the waters of the Northern part of the central Bay. Reference to Fig. 4 shows that the carbon values in the central Bay are less than 5 µg. at l. From this area, the values increase to greater than 5 µg. at l in a Westerly direction towards the Waltair Coast, northeasterly towards the Burma Coast and southeasterly towards the Andamans. The carbon values along the continental shelf of the east coast of India, from the head of the Bay towards the Waltair Coast, are very high. These values are obtained in the last week of April 1963 and during this period the coatal waters have been shown to be enriched with nutrients as a result of the process of upwelling of subsurface waters (vide PO_4-P, NO_3-N and pigment units during March-April 1961 and 1962 off Waltair Coast – Table 1) resulting in high phytoplankton production with chlorophyll 'a' values ranging from 0.37 to 3.03 µg/l in the surface water. The high vegetable organic matter may be responsible for the high organic carbon content in this area.

Thus, it is clear that during the March-April period in the Bay of Bengal, the particulate organic carbon values appear to indicate the magnitude of phytoplankton production in the different regions. For instance, the greater part of the rest of the Bay is indeed barren as is indicated by chlorophyll and primary productivity values. The same is reflected by the particulate organic carbon values as given below:

Stn. No.	Chl. a (µg. l)	Pri. Prod. gC m² day	Part. org. Carbon µg. at. l
60	[illegible]	0.10	7.25
61	[illegible]	0.08	8.70
62	[illegible]	0.10	5.25
71	[illegible]	0.10	2.80
74	[illegible]	0.04	—
78	[illegible]	0.07	5.80

Further the carbon values in the waters along the Burma Coast and on the continental shelf of the east coast of India would indicate high plant production as is revealed by chlorophyll and primary productivity values given below:

Stn. No.	Chl. a (µg. l)	Pri. Prod. gC m² day	Part. org. Carbon µg. at. l.
86	[illegible]	0.27	—
87	[illegible]	0.83	15.00
87C	[illegible]	—	13.64
87G	[illegible]	—	11.00
87I	[illegible]	—	8.80

PARTICULATE ORGANIC NITROGEN

Monthly average values of particulate organic nitrogen in the surface waters off the coast of Waltair during 1961 and 1962.

The monthly average values of particulate organic nitrogen (Fig. 3, Table 1) showed a variation from 1.85 to 0.38 µg. at/1, with a range of 1.47 µg. at/1 during January-December 1961. The average value for the year was 0.83 µg. at/1.

The values were low at 0.38 µg. at/1 in January and increased through April and attained a concentration of 1.25 µg. at/1. Between April and June a fall in the values was observed. From June through November the part-N content was seen to rise gradually touching the maximum concentration for the year in November. A considerable decrease by about 78% in the part-N value was noticed from November to December.

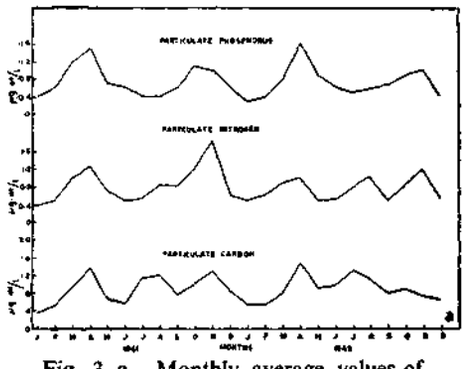

Fig. 3 a. Monthly average values of particulate Carbon, particulate Nitrogen and particulate Phosphorus in surface water off the coast of Waltair during 1961 and 1962.

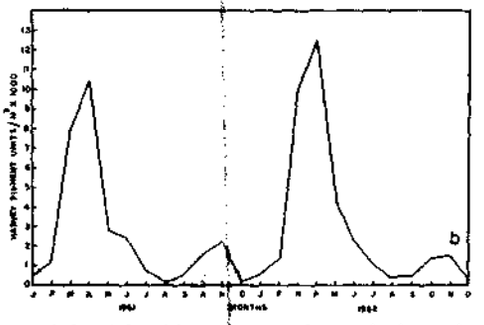

Fig. 3 b. Monthly average values of plant pigments (Harvey Pigment Units) in the surface water off the coast of Waltair during 1961 and 1962.

The trend in variation of the monthly average values of particulate nitrogen during 1962 is almost similar to that of 1961. The values during March-April and October-November periods are high when compared to the other months in both the years. The rise in values from January to April and from September to November in both the years agree fairly well. But the considerable fall in the value between August and September during 1962 has not been noticed during 1961. It is interesting to note that the range in variation of 0.73 µg. at/1 during 1962 is only half of the range observed during 1961. However, the average part-N content in the surface water for the 12 month period does not reveal much difference between the two sets of observations.

The concentration and variations in the distribution of particulate organic nitrogen are generally ascribed to the availability of plankton in the sea water, a part of it being also due to detritus, excreta of organisms, etc. In the surface water of the inshore area of the Waltair Coast seasonal variation of the part-N content has been noticed, the values fluctuating between 1.85 and 0.38 µg. at/1 during the two year period. The low values of part-N during January and February are due to the scarcity of plankton on this coast during these months. With the onset of

the process of upwelling in March and its continuance through April resulting in enrichment of surface water with nutrients, conditions favourable for the development of a phytoplankton blooms are created during this period. In consonance with the occurrence of large numbers of phytoplankton the particulate organic nitrogen values show an upward trend. It may be pointed out that a great proportion of the part-N during this period should have been derived from vegetable organic matter.

The reduction in the particulate nitrogen values from April to May may be due to two factors, *viz.*, (i) the considerable decline in the phytoplankton numbers revealed by the fall in the plant pigment units from April to May (Table 1) and (ii) due to possible conversion of part-N into soluble organic nitrogen. The appreciable rise in the value of dissolved organic nitrogen from 0.12 mg/l in April to 0.28 mg/l in May 1961 (Table 1) is consistent with the above presumption.

During the period June-August, there is a general increase in the values of part-N. When the plant pigment concentration during July-August is so low, 810 and 223 H. P. U. /m³ in 1961 and 1050 and 422 H. P. U. /m³ in 1962 respectively, the rise in the nitrogen values to 0.82 µg. at/l in August 1961 and 1.0 µg. at/l in August 1962 can be explained by considering possible contribution from detritus. In this connection, it may be pointed out, that it is not unlikely that the heavy rainfall on this coast during this period may be responsible to wash out from the land airogenous matter and suspended material which is drained into the Bay through ntnumber of storm water channels. Consequent on this, one would expect that a very high proportion of the particulate organic nitrogen should come during this period from detritus and not from vegetable organic matter.

The highest values of particulate organic nitrogen recorded in November in both the years may be explained thus: During the October-November period a minor phytoplankton bloom appears on this coast, with pigment values ranging from 1500 to 2200 H. P. U. m/³. This constitutes only 25% of the pigment values recorded during March-April period. Yet, it is interesting to observe that the particulate nitrogen during November is higher than the values in March-April. Such a situation would immediately suggest that a great proportion of the part-N comes from sources other than plant material available in the surface water. An important contribution of considerable quantity of detritus during this period may be expected from river water brought down to this coast by the southerly current during November (1961) and October-November (1962).

Horizontal distribution of particulate organic nitrogen in the surface waters of the Bay of Bengal during March-April 1963 (Fig. 5, Table 2)

Nicobar Sea

The values of particulate nitrogen vary from 0.78 to 0.36 µg. at/l. The average value in the surface waters of this area is 0.58 µg. at/l. The values along the Thai Coast are generally 0.8 µg. at/l, but a reduction in the values to < 0.5 has been noticed as one proceeds from the Thai Coast in a westerly direction towards the Andaman Islands.

Andaman Sea

The particulate nitrogen values are seen to fluctuate between 0.78 and 0.42 µg. at/l in this region. The average value is 0.57 µg. at/l and is similar to the

Nicobar Sea. The values in general are greater than 0.5 μg. at/l with slightly lower values at station 32, situated east of Andamans and also in a small area at the southern tip of the Burma Coast.

Off the coast of Burma

The values of particulate nitrogen range between 2.1 and 0.54 μg. at/l showing an average concentration of 9.5 μg. at/l.

The values in this region are comparatively high. At station 40, near the South Burma Coast the part-N value is 1.0 . In this area the values are seen to fall from 1.2 to 0.65 in a westerly direction. The highest value of 2.1 μg. at/l has been recorded at station 44 situated near the Bangladesh Coast (North of Burma). Along the Northern Burma Coast the values are generally high ranging from 2.1 to 0.92 μg. at/l, but they gradually fall in the waters away from the Burma Coast. The high part-N values in this region indicates the high phytoplankton content, the values of which are given under 'Particulate Carbon' in this paper.

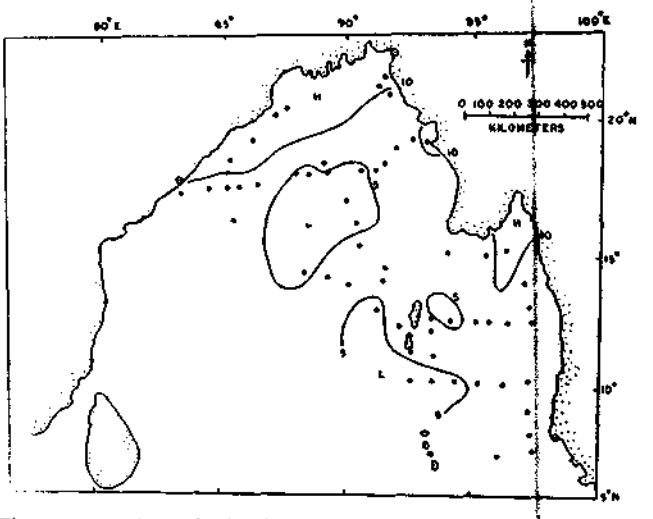

Fig. 4. Horizontal distribution of particulate organic Carbon in μg. at/l in the surface water of the Bay of Bengal.

The rest of the Bay

In this area there are two regions which are sharply divided based on the values of particulate organic matter and chlorophyll in the surface waters. The continental shelf off the east coast of India is characterised by part-N values ranging between 1.77 and 1.12 μg. at/l with an average of 1.46 μg. at/l. This area is also characterised by high phytoplankton production which is reflected in the high values of particulate organic nitrogen. Excluding this narrow strip along the Indian Coast, the remaining part of the central Bay shows values between 0.5 and 1.0 μg. at/l. However, at stations 57 (near the middle of the Bay), 71 and 79 situated towards west and north of Andamans respectively indicate values 0.5 μg. at/l.

Thus, it may be pointed out that the distribution of particulate organic nitrogen in the different regions of the Bay of Bengal reveals the relative fertility of the areas during the March-April period.

TABLE 2. *Particulate organic matter in surface water in the Bay of Bengal during March-April 1963*

Station No.	Volume of water filtered (liters)	Carbon µg. at/l	Nitrogen µg. at/l	Phosphorus µg. at/l
NICOBAR SEA				
16	4	7.87	0.69	0.04
18	4	8.70	0.71	0.04
19	4	8.00	0.78	0.06
20	4	6.00	0.58	0.07
22	4	9.75	0.78	0.08
23	4	6.00	0.58	0.07
24 (0915 hrs)	4	6.87	0.62	0.05
24 (1600) hrs)	4	4.75	0.44	0.05
25	4	4.37	0.51	0.04
26	4	2.50	0.38	0.03
27	4	3.75	0.36	0.03
ANDAMAN SEA				
29	4	8.50	0.78	0.05
30	4	6.00	0.55	0.06
31	4	4.50	0.52	0.05
32	4	3.75	0.42	0.04
33	4	6.80	0.70	0.05
34	4	8.75	0.68	0.06
35	4	6.00	0.58	0.05
36	4	5.50	0.60	0.04
37	4	4.15	0.48	0.05
38	4	6.25	0.45	0.05
OFF THE COAST OF BURMA				
40	2.25	12.50	1.20	0.09
41	4	6.50	0.68	0.05
43 (1200 hrs)	4	6.25	0.65	0.05
43 (1800 hrs)	4	7.37	0.80	0.07
44	2.00	19.82	2.10	0.09
45	3.00	14.23	1.65	0.07
46	3.00	6.25	0.92	0.06
48	4	10.85	1.12	0.09
50	4	6.50	0.54	0.04
51	4	9.50	0.78	0.06
52	4	7.50	0.55	0.04
53	4	6.75	0.58	0.06
54	4	2.95	0.74	0.05
THE REST OF THE BAY				
56	4	4.50	0.51	0.03
57	4	2.38	0.32	0.03
58	4	4.75	0.77	0.06
60	4	7.25	0.77	0.06
61	4	8.70	0.78	0.04
62	4	5.25	0.50	0.03
63	4	6.70	0.82	0.05
65	4	5.80	0.70	0.05
67	4	7.25	0.64	0.06

TABLE 2 Contd.

Station No.	Volume of water filtered (liters)	Carbon µg. at/l	Nitrogen µg. at/l	Phosphorus µg. at/l
71	4	2.80	0.37	0.04
72	4	6.90	0.62	0.06
73	4	10.00	0.95	0.08
75	4	3.50	0.63	0.05
76	3.50	7.00	0.58	0.05
78	3.50	5.80	0.52	0.04
79	3.50	5.75	0.32	0.04
80	3.50	6.75	0.75	0.05
81	3.50	4.40	0.58	0.03
84	3.50	9.65	0.82	0.07
87	2.00	15.00	1.60	0.15
87C	2.00	13.64	1.60	0.12
87G	2.00	11.00	1.20	0.09
87 I	2.00	8.80	0.85	0.07
87M	2.00	15.50	1.77	0.10
87N	2.00	10.30	1.12	0.09

PARTICULATE ORGANIC PHOSPHORUS

Monthly average values of particulate organic phosphorus in surface waters off the coast of Waltair during 1961 and 1962

Monthly average values of particulate organic phosphorus in the surface water off the Waltair Coast (Fig.3a, Table 1) showed a variation from 0.15 to 0.04 µg. at/l thus indicating a range of 0.11 µg. at/l during 1961. The average value for this year was 0.076 µg. at/l.

The values were low in January and showed an increase from January through April in which month the highest concentration for the year was attained. From April to May the concentration of particulate phosphorus had decreased by more than 50%. A fall in the values was noticed through August. Then from August to September and through November the values again increased. From November to December, a slight drop in the values was noticed.

The trend in the variation of particulate organic phosphorus during the year 1962 did not reveal any difference from the values and sequence of change in 1961.

It may be noticed that throughout the year, except in March-April and October-November the particulate organic phosphorus values remain low constituting only 5% on the average of the total phosphorus. Redfield *et al.* (1937) also recorded in the Gulf of Maine low fraction of particulate phosphorus amounting to about 5% of the total.

The high values encountered during the March-April period and October-November period on this coast coincide with the primary and the secondary phytoplankton peaks respectively. It has been pointed out (Gran and Braarud, 1935) that the particulate organic phosphorus occurs in greatest quantity in the upper layers above 40 meters, corresponding to the observed distribution of phytoplankton. Redfield *et al.* (1937) observed that the quantities of particulate organic phosphorus in the upper (0-60 m) layer of the sea are highest in spring and in mid winter the quantity is scarcely distinguished from that of deep water. Ketchum *et al.* (1958)

also pointed out that the particulate phosphorus and chlorophyll content of the water vary in similar ways.

Particulate phosphorus in the water is partly contained in plant cells, partly in organic detritus and partly adsorbed on living and dead organic particles, on silts and clays in suspension in the water. In cultures of *Nitzschia* containing adequate phosphorus Ketchum *et al.* (1958) found that the ratio of phosphorus to chlorophyll was constant and the values ranged from 40 to 80 µg. at P/mg. chlorophyll *a*. But the relationship observed in natural waters, however, appears to be much more complex. Their figures indicate that at high chlorophyll concentrations the ratio lies between 20 and 40 µg. at P/mg chlorophyll *a*. but at low chlorophyll concentrations, the detrital phosphorus becomes important and the ratio becomes very large. For equal amounts of chlorophyll *a* the off-shore waters appear to contain less particulate phosphorus than the inshore waters. They ascribed this condition to the general low inorganic nutrient concentrations offshore and as such less particulate matter of all kinds.

In the present investigation, the particulate organic phosphorus values during the March-April period may be considered to indicate the intensity of phytoplankton production since during this period the waters are comparatively free of detritus and clay and other suspended materials as evidenced by high transparency of the inshore waters (Satyanarayana Rao, 1958). But in the October-November period, the coastal water contains a considerable amount of detritus carried down from the river waters indicated by low transparency of the sea water off this coast and the values of chlorophyll are considerably low (extinction coefficient, k values range from 0.049 to 0.181 during March-April and 0.090 to 0.210 during October-November period). It is presumed that a great proportion of part-P during October-November period seems to have been derived from sources other than phytoplankton organisms in the waters. From a comparison of the particulate carbon, and nitrogen values with those of particulate phosphorus in the inshore waters of this coast, it is apparent that they nearly reflect the magnitude of phytoplankton production during the March-April period when plant production was high.

Horizontal distribution of particulate organic phosphorus in the Bay of Bengal during March-April 1963 (Fig. 6, Table 2)

Nicobar Sea

Particulate organic phosphorus in the surface water of this region varies from 0.04 to 0.08 µg. at/l, thus showing a range of 0.04 µg. at/l. The average value for this area is 0.05 µg. at/l. The values in the southern part of the Nicobar Sea are low. They show an increase in a South to North direction off the Thai Coast. The values indicate a gradual fall from the Thai Coast towards the Andaman Islands.

Andaman Sea

The values of particulate phosphorus in the Andaman Sea are seen to vary from 0.04 to 0.06 µg. at/l, showing a small range of 0.02 µg. at/l. The average value obtained for this area is 0.05 µg. at/l. The values in general are low and show much uniformity in the distribution.

Off the coast of Burma

Particulate organic phosphorus values fluctuated between 0.04 and 0.09 µg.at/l with a range of 0.05 µg. at/l. The average value is 0.067 µg. at/l. The values are

generally high along the coast and show a slight fall away from the coast. It is interesting to note that the maximum concentration of 0.09 µg. at/l, has been recorded at 44 and 48 at which the particulate carbon and nitrogen values are also high. Thus the part-P content in this region may also be taken as an index of the magnitude of phytoplankton production.

The rest of the Bay

In this region of the Bay of Bengal, the particulate phosphorus values are seen to vary from 0.03 to 0.15 µg. at/l thus showing a range of 0.12 µg. at/l. The average value for this area is 0.061 µg. at/l.

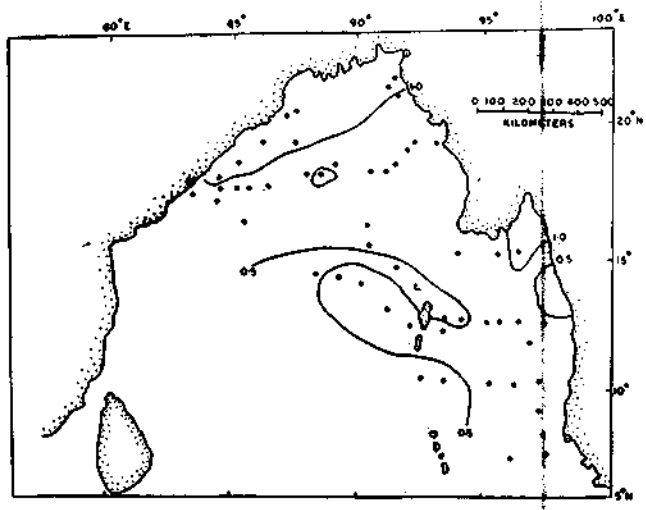

Fig. 5. Horizontal distribution of particulate organic nitrogen in µg. at/l in the surface water of the Bay of Bengal.

The particulate organic phosphorus values in the central Bay are generally low (0.05 µg. at/l). High values between 0.1 and 0.15 µg. at/l are obtained at stations situated along the East Coast from the head of the Bay down to Waltair. There is a good deal of agreement between the particulate phosphorus values and the chlorophyll values of this region. Almost throughout the central Bay there is little chlorophyll (0.05 µg/l) and along the East Coast of India the values are high (1.07-3.03 µg/l). Thus the particulate organic phosphorus values during the March-April period in the Bay of Bengal would help to locate regions of high production.

Vertical distribution of particulate organic phosphorus in the Bay of Bengal during March-April 1963

Nicobar Sea

Particulate organic phosphorus concentration in the surface water is in general low and shows a slight increase at about 100 m level. The values are undetected at depths below 500 m. There are instances of high values in the surface and a gradual fall at subsurface levels, for example at stations 19 and 21.

Andaman Sea

The trend in the vertical distribution of part-P in this area is similar to that of the Nicobar Sea, showing slightly higher values at 100 m and zero values at greater depths.

Off the coast of Burma

Different patterns of distribution with depths of part-P have been noticed in this area. In a shallow station 48 the values are seen to increase from surface to 30 m by almost 50%. At another station (51) the values are uniform in the surface and at 100 m and thereafter decrease with depth. At station 54 the values are high in the surface, show a reduction by more than 50% at 100 m and zero values at 500 and 1000 m.

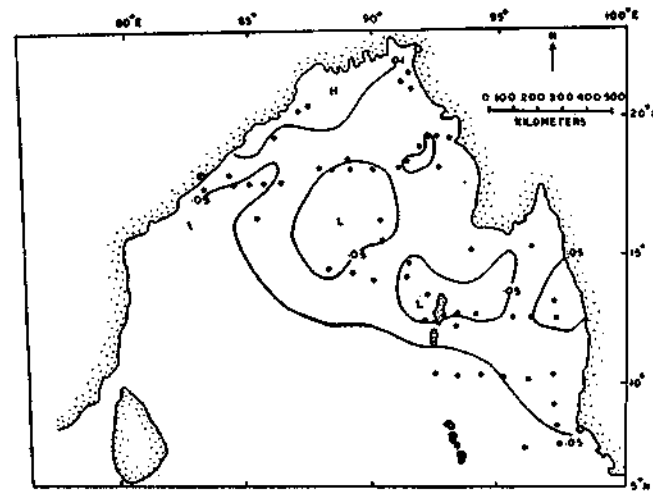

Fig. 6. Horizontal distribution of particulate organic phosphorus in μg. at/l in the surface water of the Bay of Bengal.

The rest of the Bay

The values of particulate phosphorus in general are high in the surface and decrease upto 1000 m, at which depth the phosphorus value is quite often undetectable. Below 1000 m the particulate phophorus is again recorded. At a deep station (71) at 2680 m a value of 0.06 μg. at/l which happens to be higher than the surface value at that station has been obtained.

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