

Distribution of Phytoplankton & Chlorophyll *a* around Little Andaman Island

V P DEVASSY & P M A BHATTATHIRI

National Institute of Oceanography, Dona Paula, Goa 403 004

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Surface chl *a* and phaeopigments of the whole phytoplankton varied from 0.02 to 0.085 mg/m³ (av. 0.043) and 0.017 to 0.068 mg/m³ (av. 0.039) respectively; chl *a* of the nanoplankton fluctuated from 0.013 to 0.085 mg/m³ (av. 0.034) and phaeopigments from 0.014 to 0.064 (av. 0.029). Depthwise distribution of phytoplankton, chl *a* and phaeopigments showed an increasing trend up to 1% light depth in the 2 coral banks. Phytoplankton population ranged from 1400 to 4900 cells/litre. Dinoflagellates formed an important constituent unlike those of the Arabian Sea and coastal waters of Bay of Bengal. Comparison of environmental data from these shallow coral banks with those from similar locations in the Arabian Sea was made.

Compared to other regions of the Arabian Sea and Bay of Bengal, the biological characteristics of the Andaman Sea remain least explored. *R V Gaveshani* undertook 2 cruises (51 and 52) during Feb. 1979 to gather information on oceanographic parameters. This communication presents data on the distribution of surface phytoplankton, chlorophyll *a* and phaeopigments of whole phytoplankton and nanoplankton at 18 closely spaced stations around Little Andaman Island in a radiating fashion. At 2 of the stations (1200 c and 1201 c) apart from the depthwise distribution (5 depths) of the above factors, primary productivity (pp) and particulate organic carbon (POC) also have been studied. Data from these 2 shallow coral banks have been compared with results obtained in the earlier cruises in the Arabian Sea (sts 235 & 236) and Gaveshani Bank¹.

estimation of nanoplankton chlorophyll samples were screened through 20 µm nybolt silk and filtered on a GF/D filter. Estimations of chl *a* were made by fluorometry. Primary productivity was measured by ¹⁴C method; POC was estimated by wet acid digestion and spectrophotometry.

Results and Discussion

Table 1 shows the surface distribution of chl *a* and phaeopigments from whole phytoplankton and nanoplankton at 18 stations. The highest chl *a* concentration was obtained at st 1200 c. Nanoplankton chl *a* also showed equally high

Materials and Methods

Location of stations is given in Fig. 1. Chlorophyll extractions were made in 90% acetone. For the

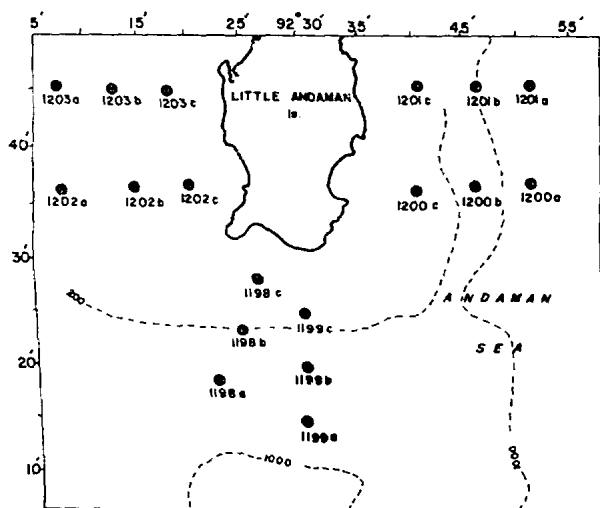


Fig. 1—Station position (200 and 1000 m depth contours are shown)

Table 1— Distribution of Surface Chlorophyll *a*, Phaeophytin, Nannochlorophyll *a* and Phaeophytin around Little Andaman Island during Feb. 1979

St	[Values are in mg/m ³]			
	Whole phytoplankton		Nannoplankton	
	Chl <i>a</i>	Phaeophytin	Chl <i>a</i>	Phaeophytin
1198 a	0.052	0.064	0.013	0.064
1199 a	0.068	0.068	0.031	0.060
1200 a	0.029	0.021	0.025	0.014
1201 a	0.033	0.020	0.023	0.015
1202 a	0.042	0.025	0.034	0.020
1203 a	0.033	0.017	0.019	0.015
1198 b	0.041	0.034	0.028	0.026
1199 b	0.045	0.043	0.045	0.023
1200 b	0.040	0.053	0.040	0.022
1201 b	0.020	0.021	0.014	0.020
1202 b	0.028	0.033	0.020	0.021
1203 b	0.037	0.024	0.028	0.023
1198 c	0.042	0.035	0.042	0.019
1199 c	0.050	0.052	0.034	0.020
1200 c	0.034	0.034	0.024	0.029
1201 c	0.047	0.052	0.047	0.052
1202 c	0.085	0.053	0.085	0.053
1203 c	0.035	0.044	0.035	0.029
Av.	0.043	0.039	0.034	0.029
SD	0.015	0.015	0.016	0.016

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concentration at this location. This may be due to the abundance of flagellates at this station (Table 2). Though in general nanno chl *a* was less than the whole chl *a* values, at 6 stations (sts 1199b, 1200b, 1198c, 1201c, 1202c and 1203c) the former equalled that of the latter. At most of the stations phaeopigment values were lower than those of the corresponding chl *a* and nanno chl *a* concentrations. However, at few locations phaeopigments were higher than those of the chl *a* concentrations.

Surface phytoplankton distribution is shown in Table 2. Total phytoplankton ranged from 1200 to 4000 cells/litre. Flagellates occurred at all the stations in appreciable quantities, followed by diatoms, dinoflagellates and blue green algae. In diatoms *Navicula* spp were most abundant followed by *Coscinodiscus* spp and *Denticula* sp. Other diatoms

(Table 2) occurred in very negligible quantities. Bulk of the blue green algal population was composed of *Trichodesmium thiebautii* and *T. erythraeum*, the former being present at all the stations.

At the sts 1200 c and 1201 c parameters such as whole chl *a*, nanno chl *a*, phaeopigments, primary productivity and particulate organic carbon were studied from 5 light depths (Table 3). These are shallow banks with live corals and calcareous algae². At the first station whole chl *a* showed a progressive increase from surface to 50 m (1% light depth). Phaeopigments showed the same trend. Nanno chl *a* and phaeopigments also followed an increasing trend up to 50 m layer. In shallow coral reef regions most of the organic matter production is by corals and seaweeds occurring near the bottom and hence the increasing trend in chlorophyll values is found towards the subsurface

Table 2—Distribution of Surface Phytoplankton around Little Andaman Island during Feb. 1979

[Values are cell count or filaments/litre]

St Numbers

	1198			1199			1200			1201			1202			1203		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
Diatoms																		
<i>Amphora</i> sp.						100									200			
<i>Coscinodiscus</i> spp	300		100		400	100		200	300	100		100	100					100
<i>Denticula</i> sp.	100	100				100		300	100			100						
<i>Diploneis</i> sp.	100				100													
<i>Eucampia</i> sp.															200			
<i>Fragilaria oceanica</i>														400				400
<i>Licmophora</i> sp.													100					
<i>Navicula</i> sp.	700	600	200		1300	100	600	100		500	400		700	500	100	100	400	300
<i>Nitzschia closterium</i>			100															
<i>Pleurosigma</i> sp.		100								100								
<i>Rhizosolenia</i> sp.										100								
Total	1200	800	400	100	1700	400	600	600	400	700	500	100	1000	1100	300	200	800	300
Green algae																		
Flagellates	1500	900	1000	700	1600	2100	700	1400	2200	900	1700	700	800	1400	2900	600	1800	1200
Blue green algae																		
<i>Merismopedia</i> sp.						400		400										200
<i>Synechocystis</i> sp.							200					200						200
<i>Trichodesmium erythraeum</i>		200	200			200				500			400					
<i>T. thiebautii</i>	500	700	500	400	500	400	100	200	300	600	300	200	800	900	100	200	200	600
Total	500	900	700	400	500	1000	300	600	300	1100	300	400	1200	900	100	200	600	600
Dinoflagellates																		
<i>Ceratium</i> spp		100				100			100		100							
<i>Peridinium</i> spp	700	200	200	200	100	100	200	100	400	200	400	200	200	100	100	100	100	100
<i>Prorocentrum</i> sp.		100						100	100			400						100
Total	700	400	200	300	100	200	300	100	600	200	500	600	200	100	100	100	200	100
Unidentified																		
Total phytoplankton	3900	3200	2300	1600	4000	3700	1900	2700	3600	3000	3000	1800	3200	3500	3400	1100	3200	2200

a, b, c indicate the radial transect of each station as shown in Fig. 1.

Table 3—Depthwise Distribution of Chlorophyll *a*, Phaeopigment, Primary Productivity (PP) and Particulate Organic Carbon (POC)

Depth (m)	St 1200 c						St 1201 c					
	Phytoplankton pigment mg/m ³		Nannoplankton pigment mg/m ³		PP mgC/m ³ / d	POC mg/m ³	Phytoplankton pigment mg/m ³		Nannoplankton pigment mg/m ³		PP mgC/m ³ / d	POC mg/m ³
	Chl <i>a</i>	Phaeo	Chl <i>a</i>	Phaeo			Chl <i>a</i>	Phaeo	Chl <i>a</i>	Phaeo		
0	0.034	0.034	0.024	0.029	3.6	120	0.047	0.052	0.047	0.052	5.4	120
5	0.036	0.031	0.020	0.014	5.7	60	0.039	0.026	0.032	0.030	9.6	120
10	0.050	0.023	0.025	0.011	4.5	60	0.040	0.017	0.040	0.031	4.1	30
20	0.089	0.058	0.029	0.043	8.0	30	0.139	0.067	0.110	0.058	4.2	137
50*	0.189	0.174	0.111	0.117	5.2	60	0.140	0.098	0.113	0.026	1.2	180
Column	5.26 ^a	4.18 ^a	2.59 ^a	2.84 ^a	309 ^b	2.595 ^a	2.71 ^a	1.55 ^a	2.25 ^a	1.22 ^a	140.0 ^b	3.325 ^c

* 30m in case of st 1201 c

Column values: a = mg/m²; b = mgC/m²/d; c = g/m²

levels. However, the highest values of primary productivity and POC were observed at 20 m and surface respectively (Table 3). Conditions were very similar at station 1201c also. Highest values of whole chl *a*, nanno chl *a*, phaeopigments and POC were observed at 1% light level (30m), though production was highest at 60% light level (5m).

Table 4 shows the depthwise distribution of phytoplankton at the above 2 stations, which ranged from 1400 to 4900 cells/litre. Flagellates occurred at various depths of both the stations, maximum being at 1% light level. Similarly, diatoms and dinoflagellates were also maximum at this depth. Distributional trend of diatom population was similar to that at the surface. The qualitative distribution of phytoplankton was not very different from surface to 1% light depth. Most abundant diatom was *Navicula* spp followed by *Denticula* sp. and *Coscinodiscus* spp. Other diatoms such as *Nitzschia* spp, *Amphora* sp. and *Cyclotella* sp. were also present in negligible quantities. The blue green *Trichodesmium thiebautii* occurred at various depths, followed by *T. erythraeum*, which was less abundant and found mainly at the surface. Qasim³ recorded a *Trichodesmium* bloom from the Malacca Strait during April 1979. During premonsoon the occurrence of these algae is widespread on the west coast of India. At the beginning of a *Trichodesmium* bloom, *T. thiebautii* also occurs in abundance along with *T. erythraeum* though later the latter takes over completely⁴. Moreover, *T. thiebautii* seems to be more widely distributed in the open ocean as evidenced by the observations from Laccadive Sea⁵ and the present studies from Little Andaman Sea. Dinoflagellates were as abundant as diatoms at st 1201 c. *Peridinium* spp was the most predominant form present at various depths of both the locations. This was followed by *Prorocentrum* spp, *Ceratium* spp and *Gonyaulax* sp. in

the order of abundance. Movachan⁶ has recorded that throughout the entire Andaman Sea dinoflagellates were rich during and after northeast monsoon. Many of the photosynthetic dinoflagellates are able to tolerate low inorganic nutrient levels and this may be the reason why dinoflagellates successfully thrive in the oligotrophic tropical waters⁷. Bhattathiri and Devassy⁵ found appreciable quantities of dinoflagellates in the Laccadive Sea also. In general, the phytoplankton population of Little Andaman Sea is quantitatively comparable with that of the Laccadive Sea.

Data collected during the earlier cruises are shown in Table 5 for comparison with the data from Little Andaman coral bank. Most of the features observed from the latter environment were comparable with those of the former 3 stations (Nos 235, 236 and 882). At the Sesostris Bank, chl *a*, phaeopigments and primary productivity progressively increased from surface to 1% light level (35 m). Bassas de Pedro also exhibited similar features. Highest concentrations of chl *a*, phaeopigments and primary productivity were observed at 1% light level (50 m). A comparison of these stations with that of the Gaveshani Bank was also interesting since the latter is also a shallow bank with live corals and calcareous algae¹. Values of chl *a*, phaeopigments, primary productivity and particulate organic carbon are also given in Table 5. The depthwise increasing trend of primary productivity and POC remain similar, though not chl *a*.

An assessment of the phytoplankton population of the Little Andaman Sea during Feb. 1979 shows the importance of dinoflagellates as primary producers since they are able to thrive successfully in oligotrophic tropical waters unlike the diatoms. The coastal waters, where nutrient levels are naturally higher can sustain a richer diatom population.

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Table 4—Depthwise Distribution of Phytoplankton at St 1200 c and 1201 c around Little Andaman Island during Feb. 1979

	[Values are cell count or filaments/litre]									
	St 1200 c					St 1201 c				
	0 m	5 m	10 m	20 m	50 m	0 m	5 m	10 m	20 m	30 m
Diatoms										
<i>Amphora</i> sp.			100		200					
<i>Coscinodiscus</i> sp.	300				100	100		200		100
<i>Cyclotella</i> sp.				100	100					
<i>Denticula</i> sp.	100	300					100	400	200	100
<i>Diploneis</i> sp.										100
<i>Grammatophora</i> sp.										200
<i>Licmophora</i> sp.										100
<i>Navicula</i> sp.		200	300	400	400		200	400	100	700
<i>Nitzschia</i> sp.								200		300
<i>Pleurosigma</i> sp.										200
<i>Rhizosolenia</i> sp.								200		
<i>Surirella fluminensis</i>										100
<i>Thalassiothrix frauenfeldii</i>										100
<i>Triceratium favus</i>					100					
Total	400	500	400	500	900	100	300	1400	300	2000
Green algae										
Flagellates	1200	700	600	600	1600	700	900	1600	800	1400
Blue green algae										
<i>Synechocystis</i> sp.						200				
<i>Trichodesmium thiebautii</i>	300	400	300	400	100	200	100	600	100	100
Total	300	400	300	400	100	400	100	600	200	100
Dinoflagellates										
<i>Ceratium</i> sp.	100				100		300			
<i>Peridinium</i> sp.	300	100	100	200	400	200	1000	200	600	900
<i>Prorocentrum</i> spp	100	100		200	300	400				300
<i>Gonyaulax</i> spp					200					200
Total	500	200	100	400	1000	600	1300	200	600	1400
Silicoflagellates										
<i>Dictyocha</i> sp.	100	100					100	100		
Total Phytoplankton	2500	1900	1400	1900	3600	1800	2700	3900	1900	4900

 Table 5—Depthwise Distribution of Various Parameters Collected during Earlier Cruises of *RV Gaveshani*

Depth (m)	Chl <i>a</i> (mg/m ³)	Phaeopigment (mg/m ³)	PP (mgC/m ³ /d)	POC (mg/m ³)	Nutrients IMC µg at/l		
					PO ₄ -P	NO ₃ -N	NO ₂ -N
St. 235 (Sesostris Bank ⁵ ; 13°08'N 71°54'E)							
0	0.075	0.063	0.67	75	0.068	0.52	not detected
15	0.142	0.063	1.14	—	—	—	—
35	0.404	0.286	1.97	37	—	—	—
Column	7.08 ^a	4.38 ^a	44.63 ^b	1.97 ^c			
St. 236 (Bassas de Pedro Bank ⁵ ; 13°06'N 72°2'E)							
0	0.113	0.062	4.65	50	0.71	0.6	0.004
20	0.069	0.096	9.69				
50	0.289	0.432	21.33	50			
Column	7.19 ^a	9.49 ^a	608.0 ^b				
St. 882 (Gaveshani Bank ¹ ; 13°24'N 73°45'E)							
0	0.14	0.016	0.26	12.0			
30	0.03	0.016	0.41	15.4			
Column	2.5 ^a	0.48 ^a	9.70 ^b	0.41 ^c			

Column values: a = mg/m²; b = mgC/m²/d; c = g/m² 1 MC = Integral mean concentration.

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References

- 1 Qasim S Z, *Indian J mar Sci*, 8 (1979) 242.
- 2 Parulekar A H & Ansari Z A, Personal communicaiton.
- 3 Qasim S Z, *Mahasagar—Bull natn Inst Oceanogr*, 12 (1979) 191.
- 4 Devassy V P, Bhattathiri P M A & Qasim S Z, *Indian J mar Sci*, 7 (1978) 168.
- 5 Bhattathiri P M A & Devassy V P, *Indian J mar Sci*, 8 (1979) 222.
- 6 Movachan O A, *Soviet fisheries investigations in the Indian Ocean* edited by A S Bogdanov (translated from Russian Israel Program for Scientific Translation, Jerusalem) 1973, 62.
- 7 Taylor F J R, in *The biology of the Indian Ocean* edited by B Zeitzschel (Chapman and Hall Ltd., London) 1973, 155.