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INCIDENCE OF *NOCTILUCA SCINTILLANS* (MACARTNEY) EHRENB., BLOOMS ALONG PAKISTAN'S SHELF

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Abstract

Noctiluca scintillans (Macartney) Ehrenberg blooms were recorded during the later part of north-east monsoon season. They were strictly surface blooms and occured mostly on the Indus Delta shelf of Pakistan. On three occasions they were observed forming red tides. The cause of their incidence is not known, but it may be related to upwelling and prevailing estuarine conditions.

Introduction

Noctiluca scintillans (Macartney) Ehrenberg (= *N. miliaris*) is a marine cosmopolitan dinoflagellate species, which often occurs in coastal and estuarine areas in such large concentrations that it causes red tide (LeFevre & Grall, 1970; Taylor, 1976, 1987). This rapid increase is probably caused by eutrophication and accummulation of specific growth factors.

N. scintillans is of common occurence in the Arabian Sea where it is associated with frequent displays of bioluminescence (Taylor, 1976; Lynch III, 1978). A number of its blooms causing red tides have been reported from north Arabian Sea, but they were all confined to Indian waters (Devassy *et al.*, 1979: Venugopal *et al.*, 1979). The present report describes the occurence of *N. scintillans* blooms on Pakistan's shelf and surrounding waters.

Material and Methods

During the period January 19, 1977 to June 20, 1977 a number of cruises were made in the N-E Arabian Sea bordering Pakistan on board the vessel "Dr. Fridtjof Nansen". In all 359 stations were sampled repeatedly on 76 fixed positions covering the entire Pakistan's shelf and adjacent waters (Anon., 1978; Chaghtai & Saifullah, 1988). Phytoplankton were collected by vertical (0-50 m) and horizontal surface hauls of 5 minutes duration employing a net of 75 cm diameter and mesh size of 40 um. The samples were fixed immediately with 4% neutral formalin. Biomass was estimated by the settling technique (Newell & Newell, 1977). Temperature and salinity of seawater, depth and wind speed were all recorded at the time of sampling of the blooms, except

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Table 1. List of stations where *Noctiluca scintillans* blooms were observed along with simultaneous hydrographic observations.

Sr. No.	Station No.	Date	Time (GMT)	Depth (m)	Wind speed (Knot)	Temp. (^{o}C)	Salinity ($^{o}/_{oo}$)
1.	104	20.02.77	0400	0018	00	22.20	36.407
2.	105	20.02.77	0800	0048	03	23.42	36.228
3.	106	20.02.77	0000	0076	03	23.62	36.334
4.	107	20.02.77	1400	0083	06	23.20	36.383
5.	X	21.02.77	1100	-	-	-	
6.	126	28.02.77	0500	0013	06	23.00	36.577
7.	Y	01.03.77	0415	-	-	-	-
8.	132	01.03.77	1900	1800	06	24.12	36.602
9.	134	02.03.77	0600	3200	08	23.30	36.527
10.	Z	02.03.77	0800	-	-	-	-
11.	143	04.03.77	0600	3200	08	23.10	36.717
12.	159	10.03.77	1200	0092	02	24.80	36.416
13.	166	11.03.77	1900	0065	08	24.50	36.320
14.	168	11.03.77	2200	0016	03	24.00	35.781
15.	169	13.03.77	0800	1720	08	24.50	36.434
16.	171	13.03.77	1600	0250	10	24.80	36.403
17.	174	13.03.77	2300	0075	08	24.30	36.320
18.	175	14.03.77	0500	0054	08	24.10	36.232
19.	185	17.03.77	1200	0483	02	26.40	36.425

for stations X,Y and Z which were taken off the schedule because red tides were spotted there by the crew (Table 1).

The term "bloom" is applied here to either red discolouration of surface waters or to extreme abundance of *N. scintillans* in net samples (Fig. 2) making them appear red in colour.

Results and Discussion

N. scintillans was recorded invariably at almost all stations during the entire period of study. However, it occured massively in bloom concentrations on as few as 19 stations only on different occasions (Fig. 2, Table 1). The net samples collected from these stations appeared red in colour as a result of its preponderance over other phytoplankton species which were negligible (Fig. 3).

It was observed forming red tides on 3 stations only (St. X,Y,Z in Fig. 1, Table 1) in the shape of red streaks on surface. There was no record of occurrence of any other

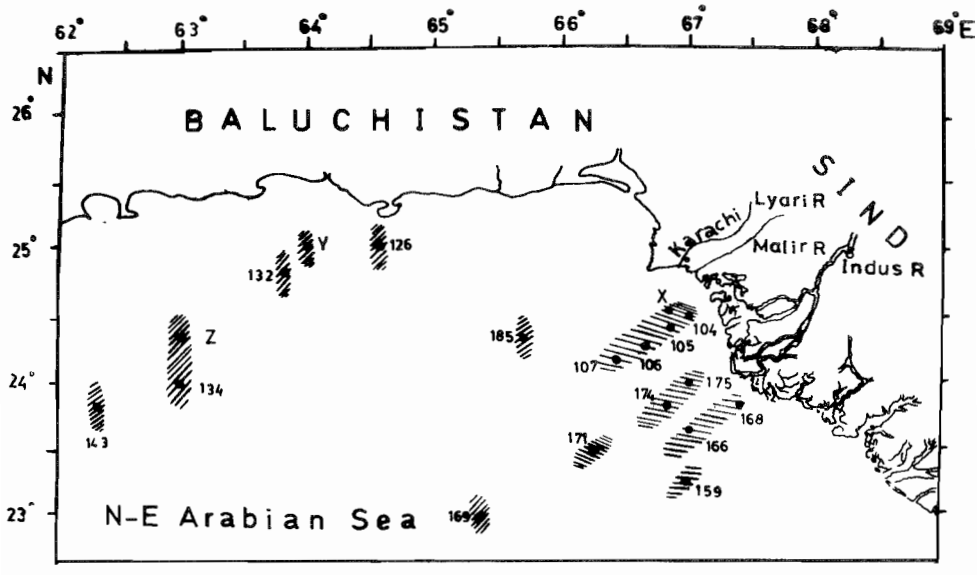

Fig.1. Map showing occurrence of *Noctiluca scintillans* bloom on Pakistan's shelf and vicinity.

red tide on the remaining 16 stations although the species occured in bloom concentrations (Fig. 2) likewise. The reason for this may be that either these stations were sampled at night (Table 1), when colour of the water was not visible or they were not reported duly by the crew.

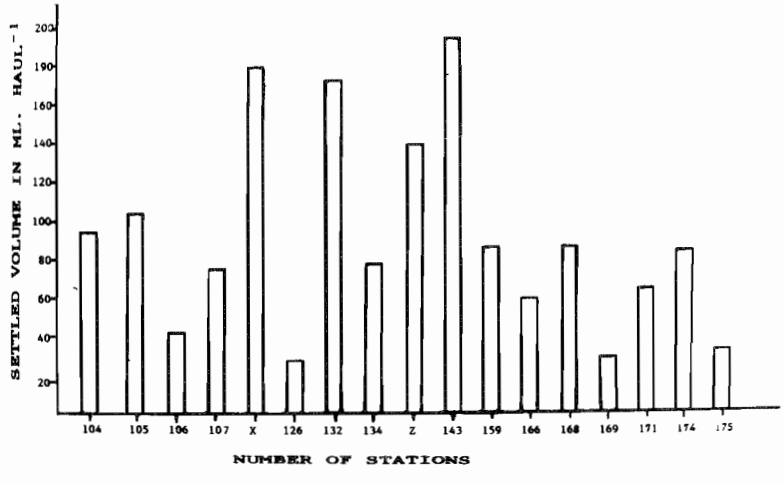

Fig.2. Relative intensities of blooms on different stations.

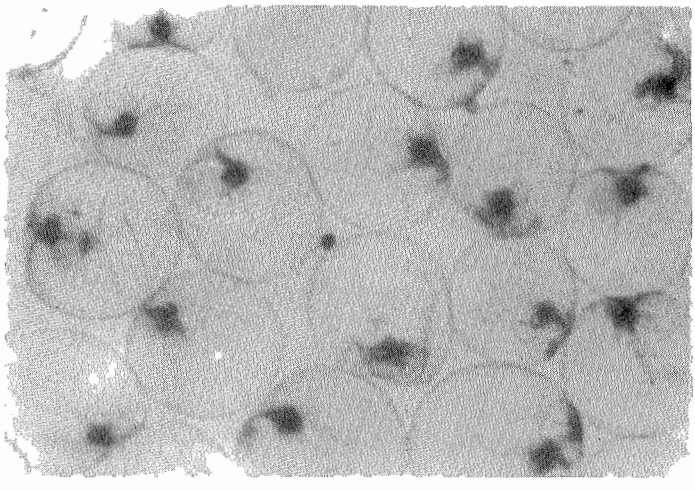

Fig.3. *Noctiluca scintillans* as seen in net samples (x 30).

Noctiluca blooms of similar nature have been recorded frequently and related to mortalities of marine animals in Indian waters (Taylor, 1976; Venugopal *et al.*, 1979; Subrahmanian, 1985) and may be regarded as a permanent feature there (LeFevre & Grall, 1970). Like other parts of the world they too occured predominantly in neritic waters (Morey-Gaines, 1979).

As compared to Baluchistan shelf they occured more frequently on Indus Delta shelf (Fig.1), probably because the later area is wider (about 150 km wide), more heterogeneous and productive than the former (Saifullah, 1979). The large scale domestic sewage and extensive mangrove vegetation also contribute significantly to enrichment of the same area (Khan & Saleem, 1988). The exceptional occurrence of the blooms on 3 stations in deep waters off Baluchistan shelf (St. Z, 134 and 143 in Fig. 1 & Table 1) is indicative of a pocket of high production in the otherwise relatively poor area. Saifullah (1979) has reported high values of chlorophyll 'a' from the same area. Praseno & Adnan (1978) also reported extremely high concentrations of *Noctiluca* in vicinity of delta and correlated it with eutrophication (LeFevre & Grall, 1970).

All the blooms observed were strictly confined to surface waters as simultaneous vertical hauls (0-50 m) from the locations showed poor numbers of the species. Observations by other workers also support the case which may be attributed to the extreme buoyancy of the organisms (Taylor, 1987) and to its capability of maintaining low specific gravity through ionic control of the composition of vacuoles (Boney, 1974).

Simultaneous observations on temperature, salinity and wind speed (Table 1) is indicative that relative calm periods at low temperature may favour formation of the blooms. Such a generalization cannot be made, since observations during the S-W monsoon season are completely lacking.

The most striking feature arising from this study is that the blooms were confined to a short period in the late winter season only (Feb. 20th - March 17th 1977). This may be due to upwelling in the area during the N-E monsoon season in addition to a large scale upwelling during the S-W monsoon season (Banse, 1987). Blooms of phytoplankton in terms of high chlorophyll 'a' values as a result of this additional upwelling have already been recorded from the area during the winter period (Saifullah, 1979; Banse *et al.*, 1988). The large amount of particulate matter both living and non-living arising from these blooms may have augmented growth of *N. scintillans* as it is known to be phagotrophic (Kimor, 1981). LeFevre & Grall (1970), Devasy *et al.*, (1979) and Venugopal *et al.*, (1979) have also earlier correlated its bloom with upwelling.

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