Indian Journal of Geo Marine Sciences
Vol. 48 (01), January 2019, pp. 169-172

Occurrence of algal bloom dominated by *Fragilariopsis oceanica* from the coastal waters of southwest India, off-Kannur

KC Vijayalakshmy*, M Abhijith, MK Megha, AA Mohamed Hatha & AV Saramma
School of Marine Sciences, Cochin University of Science & Technology, Kochi 682016, India
[E.mail: *lakshmichandra86@gmail.com]

Received 28 April 2017; revised 24 July 2017

Malabar area is vulnerable to algal blooms because of increased nutrient inputs from terrigenous sources through river run-off. The appearance of bloom in the winter season and its intensification in the summer season in coastal waters may also be due to the stability of the water column and enhanced light penetration. This area is an active fishing zone, and the appearances of blooms of diatoms like *Fragilariopsis oceanica* are beneficial for the availability of fish like oil sardine.

[Key words: *Fragilariopsis oceanica*; Southwest coast; Spring diatoms; inorganic phosphate]

Introduction

Algal blooms are quite common in Indian waters[1]. West coast of India is highly vulnerable to algal blooms during the monsoon and post monsoon seasons as a result of seasonal upwelling and riverine discharge[2]. Apart from these, a break in monsoon also provides a window for certain phytoplankton species to bloom because of favorable conditions arising out of a let-up in freshwater input into the sea[3]. As part of the HAB monitoring program of the Ministry of Earth Sciences, Government of India, sampling was carried out along the southwest coast of India during 2013 monsoon period. On 14th August, a sub surface mixed diatom bloom was observed from off-Kannur (Off-Puthiyangadi) (Lat.12°00.24' N, Long. 75°13.28' E). No surface water discoloration and foam formation were witnessed.

During Bongo net hauling in the sampling area, filaments of bloomed species were found settled on the bucket portion of the multiple plankton net. Microscopic observation of samples revealed the species as *Fragilariopsis oceanica* (Cleve) Hasle (Fig: 2(A&B)). The genus *Fragilariopsis* is an araphid colonial centric diatom coming under the Class Bacillariophyceae. Bloom of *Fragilariopsis* (earlier known as *Fragilaria*) has already been reported by Devassy, 1974 from Kaikani, Mangalore[4]. In June 2000, Patil and Anil, reported a sub-surface *Fragilariopsis* bloom from Zuari estuary, east coast of India[5]. The present short communication may be the second report of *Fragilariopsis* bloom from the west coast of India. *F. oceanica* bloom can serve as an indicator of huge shoals of oil sardine, *Sardinella longiceps*[6]. The genera *Fragilariopsis* is usually dominant in spring diatoms[7] and they demand high nutritive requirements[8] and the sunshine seems to favor the development of *Fragilariopsis* bloom[9].

Materials and Methods

From the bloom area (Fig. 1), 50 litres of surface water was filtered through phytoplankton net made of bolting silk with a mesh size of 20µm. Another 20 litres of sub-surface water was kept for 20-30 minutes

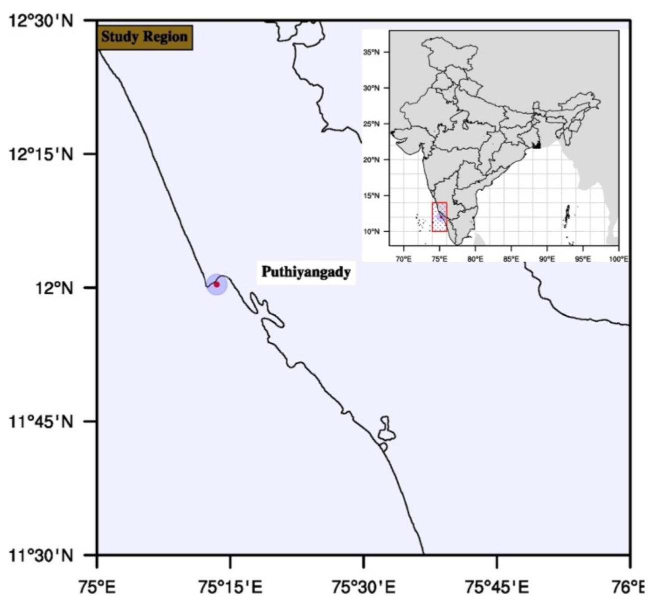

Fig. 1 — Location of *Fragilariopsis oceanica* bloom

to settle down the diatom filaments, the supernatant was siphoned out and the settled cells were transferred into clean polyethylene bottles. Both the samples were preserved in Lugol's iodine solution. Species identification and microphotographs were accquired by Leica DM 2000 Phase contrast microscope. Microalgae were identified by using standard keys[10-11]. Sedgewick-Rafter counting chamber was employed for quantitative analysis. Pigments were extracted using 90% acetone as per method suggested by Strickland and Parsons[12] and quantified.

Temperature was measured using a precision mercury thermometer with an accuracy of ±0.01° C. Salinity was estimated by the method of Mohr[13]. Measurements of pH were made using a portable pH meter (Perkin Elmer, accuracy ±0.01). For the estimation of dissolved oxygen, samples were collected in 50 ml ground stoppered BOD bottles and fixed using Winkler's A&B solutions[14]. Nutrients (nitrite, phosphate and silicate) were estimated using filtered water samples (GF/C filter paper; pore size 1.2 µm) by following the methods of Strickland and Parsons[12]; nitrate was estimated by the method of Fischer and Zhang[15].

Results and Discussion

Altogether 24 microphytoplankton species were recorded, of which 23 were diatoms. The standing crop of the bloom was 10.3×10^6 cellsL^{-1}, in which *Fragilariopsis oceanica* contributed 97% of the total microalgal biomass having a cell density of 10×10^6 cellsL^{-1}. Other diatom species recorded from the bloom station were *Proboscia alata* (Brightwell) Sundström (10,500 cellsL^{-1}), *Coscinodiscus radiatus* Ehrenberg (40,800 cellsL^{-1}), *Trieres mobiliensis* (J.W.Bailey) Ashworth & Theriot (12,300 cellsL^{-1}), *Asterionellopsis glacialis* (Castracane) Round (9,500 cellsL^{-1}), *Thalassionema frauenfeldii* (Grunow) Tempère & Peragallo (4,300 cellsL^{-1}), *Skeletonema costatum* (Greville) Cleve (900 cellsL^{-1}), *Pleurosigma elongatum* W.Smith (2,800 cellsL^{-1}) and potentially toxic diatom *Pseudo-nitzschia* sp (Cleve) H. Peragallo (2,77,500 cellsL^{-1}) along with dinoflagellate, *Pyrophacus horologium* Stein (900 cellsL^{-1}).

The dominance of diatoms in the study region may be due to their euryhaline and eurythermal nature which allows them to grow quickly under eutrophic conditions[16]. According to Patil and Anil, *Fragilariopsis* bloom was recorded in high saline nutrient rich sub-surface water during onset of monsoon and prolonged till the end of the season[5]. Bacillariophytes have been shown to exhibit blooms and could proliferate in freshwater and marine environments. The efficacy in the utilization of nutrients and light availability promote their competence over other phytoplankton species[17].

Even though the surface chlorophyll *a* (12.3µg L^{-1}), *c* (2.6 µgL^{-1}) and carotenoids (6.1 µgL^{-1}) were remarkably low, the sub-surface chlorophyll *a, c* and carotenoids were very high, 92.3µgL^{-1}, 36.6µgL^{-1} and 59.1µgL^{-1} respectively. The high value of pigments (chlorophyll *a, c* and carotenoids) in the samples indicated that the bloom was at its peak. Chlorophyll *c* to *a* ratio during bloom event was less (0.64), high values of chlorophyll *c* and carotenoids substantiated the presence of dead chlorophyll *a* and its derivatives [18]. In the present study chlorophyll *a* was higher than that of chlorophyll *c* and carotenoids.

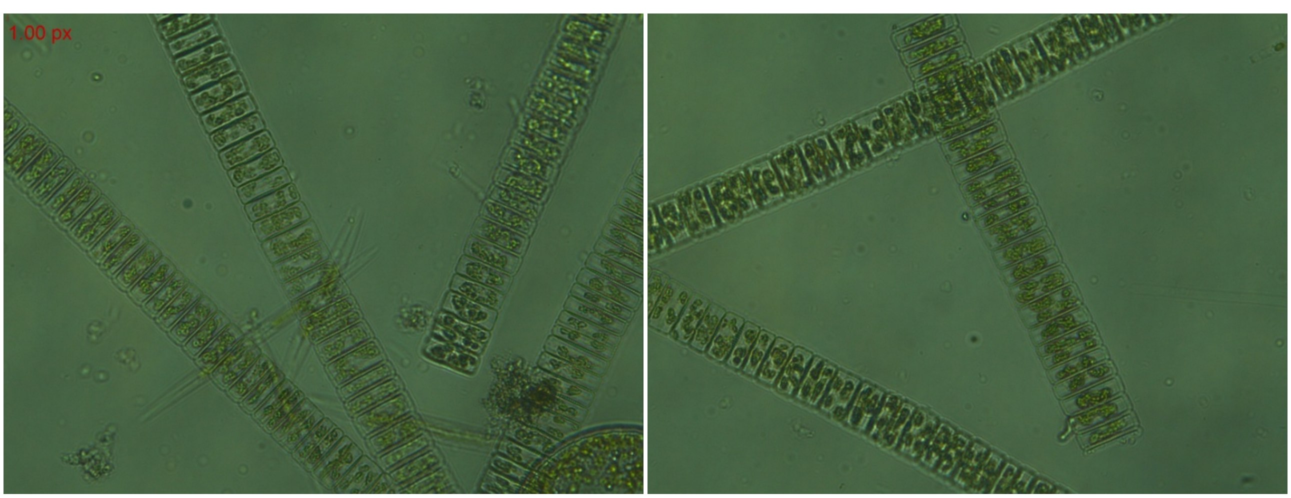

Fig. 2 — (A) & (B) Photomicrographs of *Fragilariopsis oceanica* bloom.

Surface water concentrations of nitrate, nitrite, silicate and phosphate were low (0.23µmL^{-1}, 0.02 µmL^{-1}, 0.56 µmL^{-1} and 0.13 µmL^{-1} respectively). Whilst in the sub-surface layer inorganic phosphate was exceptionally high (3.15µmolL^{-1}), nitrate and silicate were 6.54µmolL^{-1}, and 11.24 µmolL^{-1} respectively. Nitrite was 0.56 µmolL^{-1}. High silicate and nitrate concentration might be due to the land run-off and precipitation during monsoon season. Comparative high silicate value was observed among nutrients. Silicate is one of the important nutrients which regulate the diatom and silicoflagellate distribution in estuaries. The variation of silicate in coastal water is influenced by physical mixing of seawater with freshwater, adsorption into sedimentary particles, chemical interaction with clay minerals, co-precipitation with humic components, and biological removal by phytoplankton, especially by diatoms and silicoflagellates[19].

The water temperature was 24^0C and transparency of water column limited to 95cm. pH was measured as 8.5. Nutrient enrichment alters the hydrogen ion concentration in the coastal environment. Upon the availability of more nutrients the phytoplankton proliferates into bloom condition, which may progressively drive the pH higher[20-21].The salinity was 33psu which is favorable for the formation of the *F. oceanica* bloom[22]. Dissolved oxygen concentration was moderate (6.53mgL^{-1}). High dissolved oxygen value could be due to the photosynthetically produced oxygen by rich phytoplankton biomass as reported by Satpathy et al[19].

Malabar Coast is a hotspot for algal blooms; both harmful and beneficial blooms are reported frequently. Based on the categorization of algal blooms during different seasonal periods, diatoms bloom mainly during May, and August–November. It could be inferred from the present bloom event that, most of the bloom formation are naturally driven by physical forcing such as monsoonal influence, riverine discharge and seasonal upwelling, which in turn results in alteration of temperature, salinity, irradiance, water stability, nutrient enrichment etc. Monsoonal breaking along with high sunshine and strikingly high inorganic phosphate may provide an ample niche for the proliferation of *F. oeanica*, which leads to the bloom formation.

Acknowledgements

The study is supported by Centre for Marine Living Resources & Ecology, Ministry of Earth Sciences, Government of India.

References

1 Naqvi, S.W.A., George, M.D., Narvekar, P.V., Jayakumar, D.A., Shailaja, M.S., Sardesai, S., Sarma, V.V.S.S., Shenoy, D.M., Hema, N., Maheshwaran, P.A., Krishnakumari, K., Rajesh, G., Sudhir, A.K. and Binu, M.S., Severe fish mortality associated with 'red tide' observed in the sea off Cochin, *Curr. Sci.*75 (1998) 543-544.

2 D'Silva, M.S., Anil, A.C. Naik, R.K. and D'Costa,,P.M., Algal blooms: a perspective from the coasts of India, *Nat. Hazards*, 63(2012) 1225–1253.

3 Patil, J.S., *Studies on ecology of diatoms*, PhD Thesis. University of Goa, India, 2003.

4 Devassy,V.P., Observations on the bloom of a diatom *Fragilaria oceanica* Cleve, *Mahasagar,* 7(1974) 101–105.

5 Patil, J. S and Anil, A.C., Temporal variation of diatom benthic propagules in a monsoon influenced tropical estuary, *Cont. Shelf. Res.,* 28(2008) 2404–2416.

6 Nair, R.V. and Subrahmanyan, R., The diatom *Fragilaria oceanica* Cleve, an indicator of abundance of the Indian oil sardine, *Sardinella longiceps* Cuv. Val., *Curr. Sci*., 24(1955) 41-42.

7 Chandler, D.C., Limnological studies on western Lake Erie.I.Plankton and certain physical-chemical data of the Bass Islands region, from September,1938 to November, 1940, *Ohio. J. Sci.,* 40(1940) 291-336.

8 Pearsall,W.H., Plankton in English Lakes II, The composition of phytoplankton in relation to dissolved substances, *J. Ecol.,* 20(2) (1932) 241-62.

9 Rice, C.H., Studies in the phytoplankton of the river Thames (1928-1932). I and II. *Ann. Bot.* New Series, 2(7) (1938) 539-57, 559-81.

10 Subrahmanyan, R., 1946. A systematic account of the marine plankton diatoms of the Madras coast. *Proc. Indian Acad. Sci*. B 24: 165 &168.

11 Tomas C R, *Identifying Marine Phytoplankton,* (Academic Press, USA) 1997, pp. 298-300.

12 Strickland J D H and Parsons T R, *A Practical Handbook of Seawater Analysis*, (Fisheries Research Board, Canada) 1972, pp.311.

13 Mohr, C. F., Neue Massanalytische Bestimmung des Chlors in Verbindungen. Justun Liebig's Annalen der Chimie, *Leipzig*. 97(1856) 335-338.

14 Gaarder, T. and H.H. Gran. 1927. Investigations of the production of plankton in the Oslo Flord.*Rapp. Proc. Verb. Cons. Expl. Mer.* 42: 1–48.

15 Fischer,C.J., and Zhang, J.Z., A simplified resorcinol method for direct spectrophotometric determination of nitrate in sea water, *Mar. Chem*., 99(2006) 220-226.

16 Huang, Y., H. Jiang and Sarnthein, M., 2009. Diatom response to changes in palaeo environments of the northern South China Sea during the last 15000 years, *Mar. Micropaleontol*., 72(2009) 99– 109.

17 Limbu, S. M., and Kyewalyanga, M. S., Spatial and temporal variations in environmental variables in relation to phytoplankton composition and biomass in coral reef areas around Unguja, Zanzibar, Tanzania, *Springer Plus*, 4(646) (2015) 1-18 .

18 Qasim, S., and Reddy, C.V.G., The estimation of plant pigments of Cochin Backwater during the monsoon months, Bull. *Mar. Sci.,* 17(1) (1967) 95-11.

19 Satpathy, K.K., Mohanty, A.K., Natesan, U., Prasad, M.V.R., and Sarkar, S.K., Seasonal variation in physicochemical properties of coastal waters of Kalpakkam, east coast of India with special emphasis on nutrients, *Environ. Monit. Assess*. 164(2009) 153–171.

20 Kenneth, R. H., Effects of pH on coastal marine phytoplankton, *Mar. Ecol. Prog. Ser*., 238(2002) 281–300.

21 Anit, M. T., M.G. Sanilkumar, K.C. Vijayalakshmi, A.A.H. Mohamed and A.V.Saramma. 2014. *Proboscia alata* (Brightwell) Sandström bloom in the coastal waters off Bekal, Southwest India. *Curr. Sci*. 106(12): 1643-1646.

22 Devassy, V.P., and Bhat, S.R., “The killer tides,” *Science Reporter*, 5(1991)16-19.