ISSN: 0975-833X

Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 5, pp.052-055, June, 2010

RESEARCH ARTICLE

OCCURRENCE OF ALGAL BLOOM *Microcystis aeruginosa* IN THE VELLAR ESTUARY, SOUTHEAST COAST OF INDIA

Santhosh Kumar, C., Ashok Prabu*, V., Sampath Kumar, P. and Anantharaman, P.

Centre of Advanced Study in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai – 608 502. Tamil Nadu, India.

ARTICLE INFO

Article History:
Received 13th April, 2010
Received in revised from
15th May, 2010
Accepted 25th May, 2010
Published online 1st June, 2010

Key words:
Microcystis aeruginosa;
Physico – chemical parameters;
Bloom;
Vellar estuary

ABSTRACT

Parangipettai historically called Porto Novo is situated on the north bank of the mouth of the Vellar estuary (11° 29'50"N and 79° 46'24"E). Algal blooms (Cyanobacteria) were observed during the monsoon season (December) 2009 at Vellar estuary. *Microcystis aeruginosa* was determined as the bloom-forming species. *Microcystis aeruginosa* was counted as 37,600 colony/L and the Chlorophyll-*a* was measured as 18.61 µg/l. In this respect, Nutrient analysis (Nitrite, Nitrate, Phosphate, Silicate and Ammonia) were carried out.

INTRODUCTION

Estuarine ecosystems are environmentally unstable, in opposition to freshwater and marine ecosystems (McLusky and Elliott, 2004). The blooms of toxin-producing cyanobacteria frequently observed in estuary and lagoon environments have been registered in various parts of the world and have caused the intoxication and death of domestic and wild animals (Carmichael, 1992; Lawton, 1991; Odriozola, 1984). Phytoplankton blooms are often predictable features of marine and freshwater habitats. Blooms characteristically follow a suite of hydrobiological changes, including enhanced terrigenous runoff, water column turnover, upwelling, and increased thermal stratification, coupled with temperature and light conditions favoring growth and proliferation of biomass (Fogg 1969). The occurrence of cyanobacterial blooms is a global problem affecting freshwater, saline and marine water bodies. It is particularly problematic in large lakes and aquaculture ponds where it affects not only the aesthetic appearance, but also the fish production (Meybeck *et al.,* 1989; Paerl and Tucker,1995; Chellappa *et al.,* 2004). Under such conditions the productivity of zooplankton, and thereby fish, is reduced. Many studies have demonstrated the effect of Microcystis or its toxins on zooplankton growth and survival. Microcystins either in zooplankton food or dissolved in the water column affect survival and growth rate of copepods, cladocera, and rotifers (Ghadouani *et al.,* 2006; Federico *et al.,* 2007). *Microcystis aeruginosa* (Kutz, 1849) is one of the most cosmopolitan species among the planktonic cynobacteria. Intracellular gas vacuoles cause this species to float under calm conditions, leading to the accumulation of the bulk of the population at the water surface, a phenomenon widely known as 'blooms' or 'scums' (Reynolds and Walsby, 1975). The coloniality of *Microcystis* could be a deterrent to zooplankton such as rotifers or its toxicity to some cladocerans and copepods that can chemically 228 sense the toxic alga and reject it (DeMott and Kerfoot, 1982; DeMott and Moxter, 1991). Some *Microcystis* species produce toxins (Park *et al*., 1998), which have harmful effects not only on domestic animals but also on human (Carmichael, 1992). *M. aeruginosa* occur fresh to moderately brackish water, often forming dense blooms in mid-to late summer and fall to the bottom sediments in autumn (John *et al*., 2002). The growth of *Microcystis* produces bad-smelling and unsightly scum, preventing recreational use of water bodies, hampering the treatment of water for drinking, and clogging irrigation pipe (Yoshinaga *et al*., 2006). The occurrence of harmful algal blooms in eutrophic water bodies is a worldwide problem. The production and release of a range of cyanotoxins is often associated with algal blooms (Codd *et al.,* 1989; Codd, 1995). Microcystis can affect phytoplankton community composition through allelopathy (Legrand *et al.,* 2003). Toxin producing Cyanobacteria in lakes and reservoirs form a threat to humans, bird and fish as well as various other forms of aquatic life. Freshwater systems have become serious water quality problems which also threaten human and animal health (WHO, 2003; Chorus and Bartram, 1999; Carmichael *et al.*, 2001). Microcystins cause fatal poisoning of livestock and human (Sivonen, 1996). A number of publications are available on the occurrence of algae in brackish and marine waters (Thajuddin *et al.,* 2002; Selvakumar & Sundararaman, 2007; Velankar &

***Corresponding Author:** *vprabhu37@gmail.com; san.c175@yahoo.co.in*

Chaugule, 2007; Reginald, 2007). Present study has an aim to attract attention to the first occurrence of *Microcystis aeruginosa* bloom in the Vellar estuary, southeast of India.

MATERIALS AND METHODS

Description of the Study Area

The river Vellar flowing on the southeast coast of India originates in the Shervaroyan Hills of Salem District (Tamil Nadu, South India). After meandering through a distance of 480 kilometers, it forms the estuarine system at Parangipettai (formerly known as Porto Novo), before it joins the Bay of Bengal. The Vellar estuary (11°29'50"N and 79°46'24"E) is always open with the Bay of Bengal and is said to be a "true estuary" as there is no complete closure of the mouth. Average depth of the vellar estuary is 2.5 meter and the maximum depth at high tide is 5.3 meters. An organism collected from here forms a gold mine of scientific investigations, while this estuary forms the earliest physiographic, biological and chemical estuarine investigations in India.

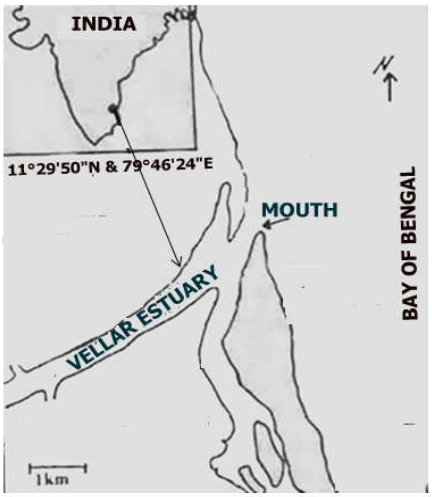

Fig 1: Geographical position of the study area is 11°29'50"N and 79°46'24"E

Fig 2. Algal blooms collected in plastic container

Plankton samples were collected by using plankton net (mesh size, 40µm) at the surface layers. The plankton sample were collected and fixed in 5% formaldehyde solution in field. Temperature was measured using a standard Celsius Thermometer. Salinity was estimated with the help of a hand – held Refractometer (ATAGO) (made in Japan). pH was measured using a ELICO Grip pH meter. Dissolved Oxygen was estimated by the modified Winkler's method and Chlorophyll-*a* (90% acetone method) measurement were carried out spectrophotometrically in the laboratory (Strickland and Parsons, 1972) and is expressed as mg/l. Surface water samples were collected in clean polyethylene bottles for the analysis of nutrients, which were kept immediately in an Ice box, and then transported to the laboratory. The collected water samples were filtered by using a Millipore filtering system and then analyzed for dissolved inorganic nitrate, nitrite, and ammonia, reactive silicate, inorganic phosphate, adopting the standard procedures described by Strickland and Parsons (1972) and are expressed in µg/l. For the identification of species, 1–2 drops of sample were put on a slide, covered with a cover glass and examined under light microscope. Algal bloom forming *Microcystis aeruginosa* was identified by using the monographs on Cyanobacteria (Desikachary, 1959). The eukaryotic phytoplankton cell counts were performed on Sedgewick-Rafter Counting Slide (Guillard, 1978).

RESULTS

Present study *Microcystis aeruginosa*, dominated 80-98% of the total phytoplankton biomass during the bloom. *M. aeruginosa* populations accounted for significant proportions of total phytoplankton biomass in the surface water column (Fig.3).

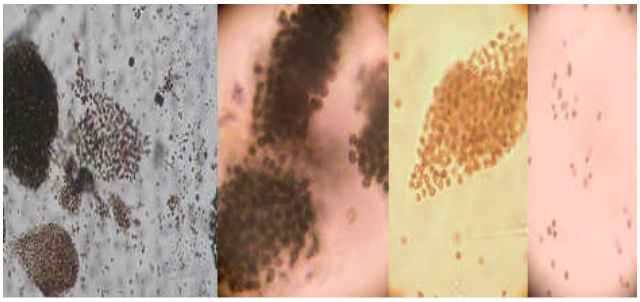

Fig 3. Bloom- forming (Cyanobacteria). *Microcystis aeruginosa* colony form and individual cells

The algal bloom *Microcystis aeruginosa* observed as colonial, which means that the single cells can join together in groups as colonies which tend to float near the water surface. Massive growth of bloom-forming algae found primarily in nutrient enriched waters of vellar estuary. *Microcystis aeruginosa* was determined as the bloom-forming species. *M.aeruginosa* was counted as 37,600 colony/L. *M. aeruginosa* was determined as the bloom-forming species (Fig.4).

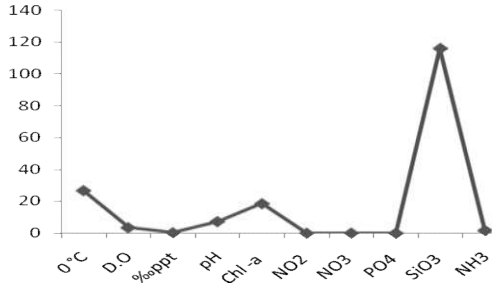

Fig. 4. Physico- chemical parameters measured in the vellar estuary

Phytoplankton species were relatively very low in numbers and zooplankton much lesser in number then that of phytoplankton during the bloom.

The surface water temperature was measured at 26.8°C during the bloom. Lower water salinity due to rainfall at vellar estuary, the salinity varying from 0.3 to 0.4 ppt. Physico-chemical variables measured from surface water during the bloom occurrence are presented (Fig 4). The silica concentrations were presented higher then other nutrients.

DISCUSSION

Microcystis aeruginaosa floated to the surface particularly during winter nights, it utilize the available light from the early morning hours, the similar report was early noted by others (e.g. Tamar Zohary and Richard D.Roberts, 1989; Takamura and Yasuno, 1984; Thomas and Walsby, 1986 ; Ganf, 1974). Usually by the end of November *Microcystis aeruginaosa* was the dominant species, comprising >80% of the phytoplankton volume. The *Microcystis aeruginosa* blooms were dominate during the pre-monsoon (February to March) and northeast monsoon (October to January) of 2005, *M. aeruginosa* flourished at different locations in the Lake (Jithesh Krishnan *et al*., 2008). *Microcystis aeruginaosa* was the dominant species during December at vellar estuary.

Haşim Sömek1 *et al.,* 2008 observed 16,530 colony/L of *M.aeruginosa* in the western shores of Eğirdir Lake during the summer and autumn. Cyanobacteria dominance often occurs when water temperature rises above 20°C this pattern also occurs in subtropical waters, including coastal systems (Murrell and Lores 2004). Salinity has been found to be another important factor influencing the production of cyanotoxins (Blackburn *et al.*, 1996; Hobson *et al.*, 1999), although many species are also capable of growth and bloom over a wide range of salinities (Reed and Stewart, 1988) from freshwater in lakes and rivers, transitional brackish environments, such as estuaries, to oceanic waters and even in hyper saline lakes (Fay, 1983). The large standing crops and dominance of *Microcystis aeruginaosa* were then maintained all autumn and most of the winter (Reynolds *et al.,* 1981).

Various physico-chemical and biological factors may be responsible for the existence of a dominant *Microcystis* species in an environment (Takamura, 1988). Fluctuations of the salinity, Do, pH and nutrients in the estuarine habitats are due to the influx of freshwater from land run off, caused by monsoon or tidal variations (Rajkumar, 2009). *Microcystis aeruginosa* cell abundances and toxin concentrations in the Vellar estuary must be monitored for human and animal health in the future because the vellar estuary waters are used by human for fisheries and tourism activities. Moreover, pollution sources which accelerate to eutrophication process of these regions must be obstructed. The toxic effects and the risks to the population due to the presence of cyanobacteria in water sources are very big and the critical examples are diarrhea, nausea, muscle weakness, cutaneous paleness and liver tumors (Falconer, 1994). This paper documents the first occurrence of a harmful algal bloom of the colonial form of *Microcystis aeruginosa* in Vellar estuary.

Acknowledgement

The authors are grateful to the Director Prof. T. Balasubramanian, Faculty of Marine Science, CAS in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu. India for providing the requisite facilities during the study and the Ministry of Earth Science–ICMAM, providing fellowship during the period.

REFERENCES

Blackburn, S. I., McCausland, M. A., Bolch, C. J. S., Newman, S. J. and Jones, G. J.1996. Effect of salinity on growth and toxin production in cultures of the bloom-forming cyanobacterium *Nodularia spumigera* from Australian waters. *Phycologia,* 36(6): 511-522.

Carmichael, W.W. 1992. Cyanobacterial secondary metabolites—the cyanotoxins. *J. Appl.Bacteriol.,* 72:445–459.

Chellappa, S.l., Marinho, I.R. and Chellappa, N.T. 2004. Freshwater phytoplankton assemblages and the bloom of toxic *Cyanophyceae* of Campo Grande reservoir of Rio Grande do Norte State of Brazil. *Indian Hydrobiology,* **7**: 151-171.

Chorus, I. and Bartram, J. 1999. Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management. E and FN Spon, An imprint of Routledge, London, 416 pp.

Desikachary, I.V., 1959. Cyanophyta. I.C.A.R., New Delhi, pp. 685

DeMott, W.R., and Kerfoot, W.C. 1982. Competition among cladocerans: nature of the interaction between Bosmina and *Daphnia*. *Ecology,* 63: 1949–1966.

DeMott, W.R. and Moxter, F. 1991. Foraging on cyanobacteria by copepods: responses to chemical defenses and resource abundance. *Ecology,* 72: 1820–1834.

Falconer, I.R., Burch, M.D., Steffensen, D.A., Choice, M., and Coverdale, O.R. 1994. Toxicity of The blue-green algal (Cyanobacterium) *Microcystis aeruginosa* in drinking water to growing pigs, as an animal model for human injury and risk assessment. *Environ. Toxicol. and Water Qua.,* 9:131-139.

Fay, P. 1983. *The blue greens*. Studies in Biology Nº160. Edward Arnold, London.

Federico, A., Sarma, S.S.S. and Nandini, S. 2007. Effect of mixed diets (Cyanobacteria and green algae) on the population growth of the cladocerans *Ceriodaphnia dubia* and *Moina macrocopa*. *Aquatic Ecology*, 41: 579–585.

Fogg, G. E., 1969. The physiology ofan algal nuisance. Proc. R. Sot. Lond. Ser. B 173: 175-189.

Ganf, G.G. 1974. Diurnal mixing and vertical distribution of phytoplanktonin ashallow equatorial lake (Lake George, Uganda). *J.Ecol.,* 62, 611-629.

Ghadouani, A., Pinel-Alloul, B.B. and Prepas, E. E. 2006. Could increased cyanobacterial biomass following forest harvesting cause a reduction in zooplankton body size structure? *Canadian Journal of Fisheries and Aquatic Sciences* ,63: 2308–2317.

Guillard, R.R.L., 1978. Counting slides. In: A. Sournia, Editor, *Phytoplankton Manual*, UNESCO, Paris, pp. 182–189.

Haşim Sömek, Mustafa Ruşen, Ustaoğlu and Meral Yağci, 2008. A Case Report: Algal Bloom of *Microcystis*

aeruginosa in a Drinking-Water Body, Eğirdir Lake, Turkey, *Turkish Journal of Fisheries and Aquatic Sciences,* 8: 177-179 .

Hobson, P., Burch, M. and Fallowfield, H. J. 1999. Effect of total dissolved solids and irradiance on growth and toxin production by *Nodularia spumigera*. *J. Appl. Phycol.,* 11: 551-558.

Jithesh Krishnan, R. and Sanilkumar, M.G.2009. *Microcystis aeruginosa* bloom in a high altitude lake inthe Western Ghats of India. *Harmful Algae News,*(40).

John, D.M., Whitton, B.A. and Brook, A.J. 2002. The Freshwater Algal Flora of the British Isles. An Identification Guide to Freshwater and Terrestrial Algae. Cambridge University Pres and Natural History Museum, Cambridge, pp.702

Legrand, C., Rengefors, K., Fistarol, G. O. and Graneli, E. 2003. Allelopathy in phytoplankton: biochemical, ecological and evolutionary aspects. *Phycologia,* 42: 406–419.

Lawton, L.A. and Cood, G.A. 1991.Cyanobacterial (blue-green algal) toxins and their significance in UK and European water. J. IWEN. UK., 460-465.

Meybeck M, Chapman, D. and (eds.), Helmer, R. 1989. Global freshwater quality: a final assessment. Blackwell Reference, Oxford, UK pp.306.

Murrell, M.C and Lores, E.M. 2004. Phytoplankton and zooplankton seasonal dynamics in a subtropical estuary: importance of Cyanobacteria. *Journal of Plankton Research,* 26: 371–382.

McLusky, D S. and Elliott M. 2004. The estuarine ecosystem. Oxford University Press, Oxford.

Odriozola, E., Ballabene, N. and Salamanco, A. 1984. Intoxication en ganado bovino por algas verde-azuladas. Revta**.** Argent**.** Microbiol., Buenos Aires, 4:225-236.

Park, H.D., Iwami, C., Watanabe, M. F. , Harada, K., Okino, T. and Hayashi, H. 1998. Temporal variabilities of the concentration of inter- and extracellular Microcystin and toxic *Microcystis*species in a hypertrophic lake, lake Suwa, Japan.

Paerl HW., and Tucker, C.S. 1995 . Ecology of blue-green algae in aquaculture ponds. *J World Aquaculture Soc*., 26: 109–131.

Rajkumar M, Perumal P, Ashok Prabu V, Vengadesh Perumal N, and Thillai Rajasekar K, 2009. Phytoplankton diversity in Pichavaram mangrove waters from south-east coast of India, *Journal Environmental Biology,* 30 (3): 489-498.

Reed, R. H. and Stewart, W. D. P. 1988. The responses of cyanobacteria to salt stress. In: *Biochemistry of the algae and cyanobacteria*. L. J. Rogers & J. R. Gallon (eds). 12: 217-231. Clarendon Press, Oxford.

Reynolds, C.S. and Walsby, A.E. 1975. Water-blooms. *Biol.Rev.,*50:437-481.

Reynolds , C.S., Jaworski, G.H.M., Cmiech, H.A. and Leedale, G.F. 1981. On the annual cycle of the blue – green algae *Microcystis aeruginaosa* Kutz. Emend. Elenkin. Phil.Trans.R.Soc . Lond .B,293,419 -477.

Reginald, M., 2007. Studies on the importance of micro algae in solar salt production. *Seaweed Res., Util.,* 29, 151-184.

Sivonen, K. 1996. Cyanobacterial toxins and toxin production. *Phycologia,* 35: 12–24.

Takamura, N., 1988. Ecology of water-blooms of blue-green algae, with special reference to Microcystis. Jpn. *J. Phycol.,* 36, 65–79 (in Japanese).

Selvakumar, K. and Sundararaman, M. 2007. Diversity of Cyanobacterial flora in the backwaters of palk bay region. *Seaweed, Res. Util.,* 29: 139-144.

Tamar Zohary, Richard, and Roberts, D. 1989. Diurnal mixed layers and the long-term dominance of *Microcystis aeruginosa. Journal of plankton Research,* 11:(1)25-48.

Takamura,N., Yasuno, M. and Sugahara, K. 1984. Overwintering of *Microcystis aeruginosa* Kutz. in a shallow lake. *J. Plankton Res.,* 6, 1019 -1029.

Thajuddin, N., Nagasathya, A., Chelladevi, R., and Saravanan, I 2002. Biodiversity of cyanobacteria in different salt pans of Pudukkotai District, Tamilnadu. *Seaweed Research and Utilization*, 24: 1 - 11.

Thomas, R.H. and Walsby, A.E. 1986. The effect of temperature on recovery of buoyancy by Microcystis. *J.Gen.Microbial.,* 132,1665-1672.

Velankar, A.D and Chaugule, B.B. 2007. Algae of the salt pans of Nalasopara, Mumbai, *Seaweed. Res. Util.,* 29:273-278.

Yoshinaga, I., Hitomi, T., Miura, A., Shiratani, E. and Miyazaki, T. 2006. Cyanobacterium *Microcystis* Bloom in a Eutrophicated Regulating Reservoir. JARQ, 40(3): 283–289.

****