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Research Article

CONTINUOUS BLOOMING OF HARMFUL MICROALGAE *MICROCYSTIS AERUGINOSA* KUTZING, 1846 IN MUTTUKADU ESTUARY, TAMILNADU, SOUTHEAST COAST OF INDIA

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ABSTRACT

In this present study we identified a continuous bloom of toxic microalgae *Microcystis aeruginosa* in Muttukadu estuary. The plankton and water samples were collected for four months from January 2014 to April 2014 in three stations (station 1, station 2, and station 3) in Muttukadu estuary. The cell density of *Microcystis aeruginosa* in Station 1, Station 2, and Station 3 was encounter as $3x10^8$, $3x10^7$, $2x10^7$ cells/l respectively. Atmospheric temperature was varied from 35.1 to 28.8ºC and Surface water temperature was varied from 33.9ºC to 26.1ºC in all three stations. The pH was ranged from 7.95 to 6.81. Dissolved oxygen was ranged from 10.57 to 4.87 mg/l. Nutrients silicate and nitrate were presents very high when compare other nutrients. *Microcystis aeruginosa* bloom was very harmful to the fishes, human beings and its lead to high level of fish mortality. So, regular monitoring of algal bloom and physic-chemical parameters in Muttukadu backwaters is needed for to conserve the fishery resources and to protect human health.

Keywords: Muttukadu estuary, Plankton, *Microcystis aeruginosa,* Bloom, Nutrients.

INTRODUCTION

Algal blooms occur naturally with Phytoplankton and microalgae providing food for aquatic organisms. However some algal blooms are harmful. The first reported fatal case of human Poisoning after consuming dinoflagellate toxin contaminated shell fish happened in 1793[1].Phytoplankton bloom are common during February to July when the prevailing hydrological conditions are relatively stable[2,3].The algae bloom problem is the global important problem is mainly affecting the aquatic ecosystem. An algal bloom takes place when species of phytoplankton reproduces at a rapid rate, multiplying quickly in a short time. Sometimes one particular species bloom at the same time. Phytoplankton is the photosynthetic organisms that live suspended just beneath the water surface. They use energy from sunlight and raw materials their own food through photosynthesis. Microalgae and blue green bacteria called cyanobacteria are to group of organisms that belong to the phytoplankton community. High concentration of phytoplankton in the water column can cause water to appear blue-green, green brown or even red depending upon the Pigments found in the species experiencing the bloom[4]. *Microcystis aeruginosa* is one of the most important cosmopolitan species among the planktonic cynobacteria. *Microcystis aeruginosa* is the slow moving of surface water. The most important nutrients for phytoplankton growth are the elements nitrogen and phosphorus. Cyanobacteria (*Microcystis aeruginosa*) are photosynthesizing bacteria, commonly called blue-green algae that are capable of producing toxins (cyanotoxins) that affect the humans, fishes, shellfishes, skin, liver or nervous system. They can also cause water quality deterioration associated with excessive biomass production (such as depleted dissolved oxygen levels, decline in fish population, and detrimental changes in water quality). Muttukadu backwater (lat.12° 46'N and long. 80° 18'E) is located at 36 km south of Chennai city and runs parallel to the east coast, the Bay of Bengal. It is also called as estuary, creek or lagoon. Muttukadu backwater form a complex system of shallow estuarine network spread over an area of 215.36 acres (87.190 hectares) meant for fishing and boating activities. Muttukadu backwaters are highly polluted by the household and industrial discharges. P.Santhanam *et al.,* 2014, reported the first intensive Cyanobacteria Microsystis aeruginosa bloom in Muttukadu backwaters. The growth of *M*. *aeruginosa* produces bad odour and unsightly scum, preventing recreational uses of water bodies, hampering of treatment of water for drinking and clogging irrigation pipe. *M*. *aeruginosa* can affect phytoplankton community. Fresh water systems have become serious water quality problems which also threaten human and animal health[5,6,7]. Toxin producing Cynobacteria in lakes and reservoirs from a threat to humans, birds, fishes as well as various other forms of aquatic life.

MATERIALS AND METHODS

DESCRIPTION OF THE STUDY AREA:

Muttukadu backwater (near south Chennai Tamil Nadu) (Lat. 12^0 49' N; Long. 80^0 15' E) extends for a distance of 20 km from the mouth of the estuary (Fig. 1). The backwater runs at right angle to the coast for a

distance of about 3 km and branches into southern and northern wings. The backwater is connected to the sea by a bar built mouth, the width of which is variable from a few meters to 200 m in different months. The backwater is normally cut off from the monsoon period and rest of the period sand bar is formed due to inundation by the fresh water from the upper reaches, the sand bar gets eroded and the connection with the sea is restored.

Figure 1: Map showing the study area Muttukadu

COLLECTION OF PLANKTON SAMPLES:

Plankton samples will be collected from Muttukadu backwater. The plankton net is made up of bolting silk cloth no 30, mesh size 48 µm and mouth diameter of 0.35 m. During the sampling the net will be submerged in the water and towed horizontally from a mechanized boat with an outboard engine at a speed of 01 – 02 knots for half an hour. Collected plankton sample where fixed with 5% formaldehyde solution and stored in plastic bottles and transported to the laboratory. For the identification of species, one are two drops of sample were put on slide, covered with a cover glass and examined under light microscope. Phytoplankton cell counter were performed on Sedgwick-Rafter counting slide. Phytoplanktons were identified using the standard method by [8,9,10].

COLLECTION OF WATER SAMPLES FOR PHYSICO-CHEMICAL ANALYSIS:

Monthly water sampling will be recorded the physico-chemical. A field data like temperature, salinity, dissolved oxygen and pH will be measured during morning to noon. Atmospheric and surface water temperatures will measure using standard mercury filled centigrade thermometer. Light penetration in the water column will be measured with the help of a Secchi disc and the light extinction coefficient (LEC) will be calculated using the Pool and Atkins (1929) formula. Salinity will be estimated with the help of a hand refractometer (Atago, Japan) and pH will be measured using Elico pH meter (Model LC- 120). Dissolved oxygen will be estimate by the modified Winkler's method. Surface water samples will be collected in clean polyethylene bottles and kept in an ice box and transported immediately to the laboratory.

The water samples will be filtered using a Millipore filtering system (MFS) and analyzed for dissolved inorganic phosphate, nitrate, nitrite, reactive silicate and ammonia by adopting the standard methods described by [12].

RESULT

Microcystis aeruginosa bloom was observed as colonial, which means that the single cell can join together in groups as colonies which tend to float near the water surface (Fig.2). *M. aeruginosa* dominated 80% to92% of the total phytoplankton biomass during the bloom. The cell density of *Microcystis aeruginosa* in Station 1, Station 2, Station 3 was encounter as $3x10^8$, $3x10^7$, $2x10^7$ cells/l respectively. The physico-chemical parameters of the study area during blooming were detailed explained in the figures [Fig:3,4,5].

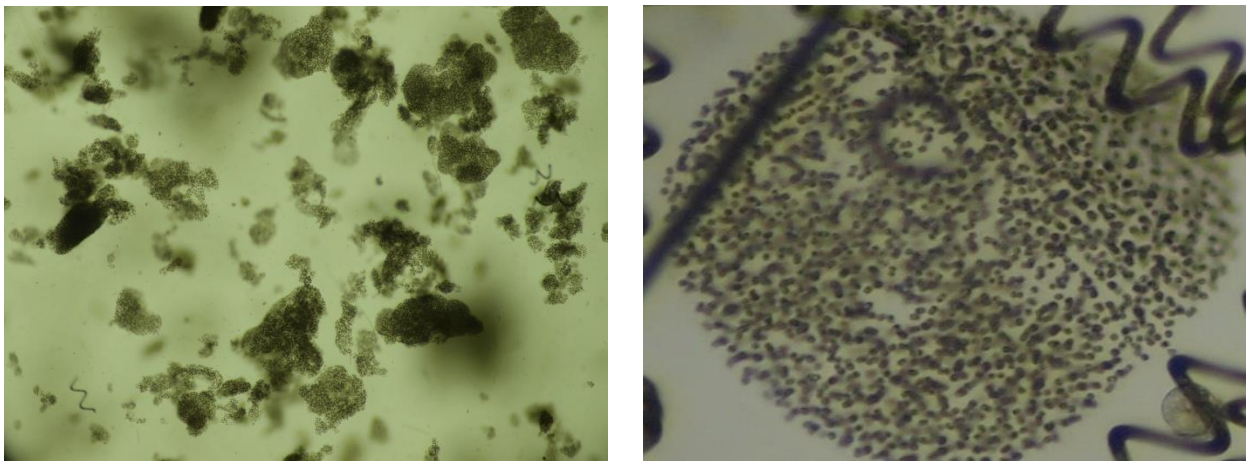

Figure 2: Bloom-Forming Cynobacteria *Microcystis aeruginosa*

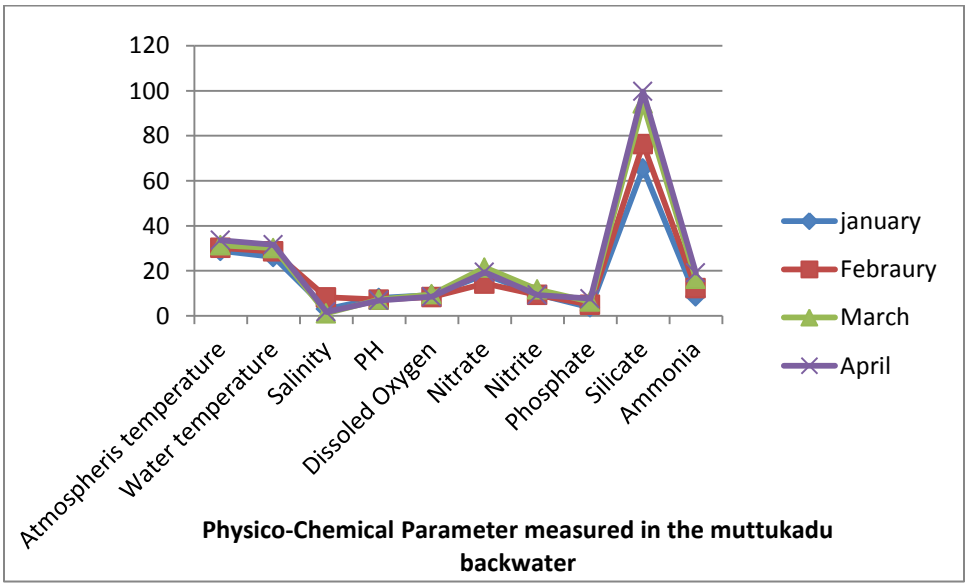

Figure 3: During Study period the Physico-Chemical Parameter in the Muttukadu Backwater in Station-1

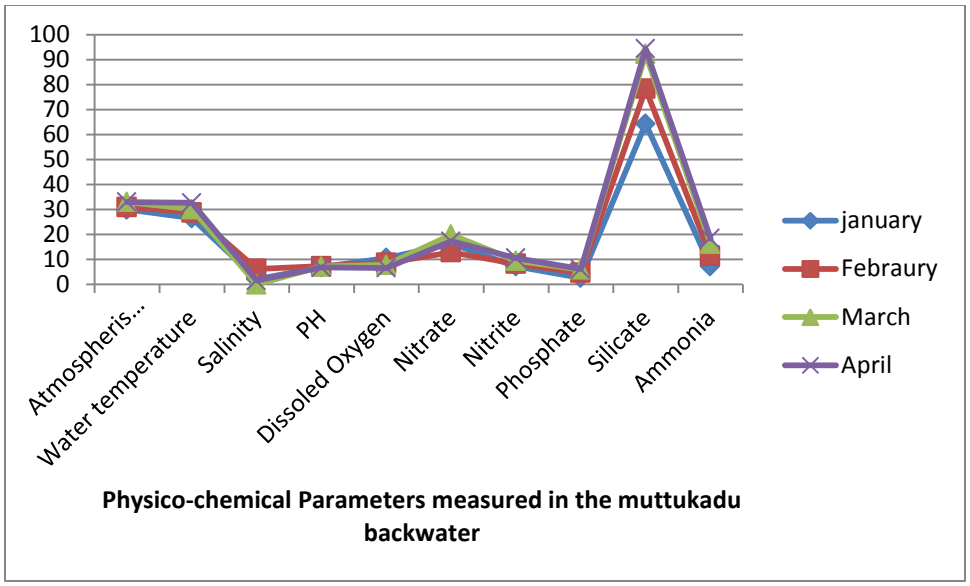

Figure 4: During Study period the Physico-Chemical Parameter in the Muttukadu Backwater in Station-2

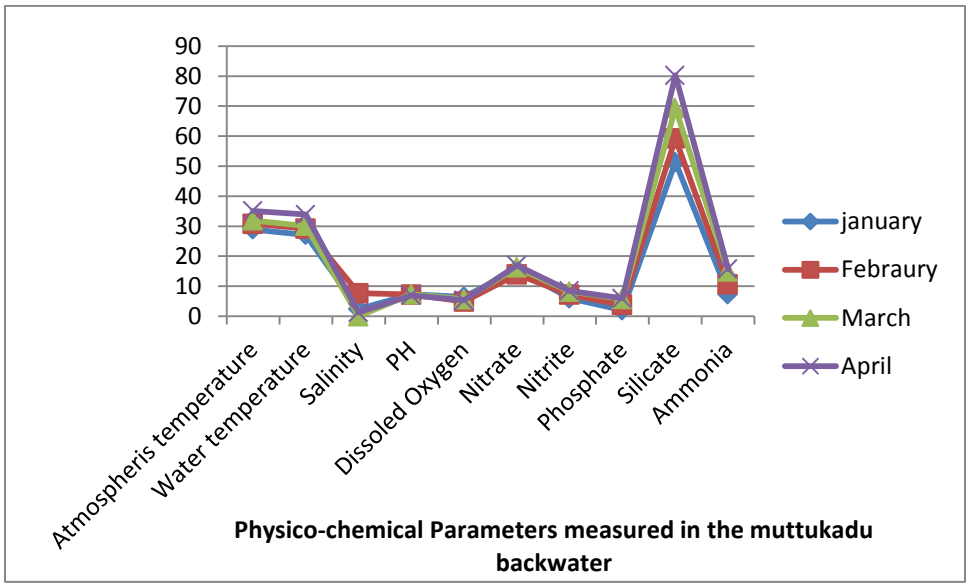

Figure 5: During study period the Physico-Chemical Parameter in the Muttukadu Backwater in Station-3

Temperature:

Atmospheric temperature was varied from 35.1 to 28.8ºC. A minimum (28.8ºC) and maximum (35.1ºC) was recorded in all three stations in January and April respectively. Surface water temperature was varied from 33.9ºC to 26.1ºC. A minimum (26.1ºC) and maximum (33.9ºC) was recorded in station-3 and station 2 in the months of January and March respectively.

Salinity:

Salinity was ranged from 0 to 8.24‰. Maximum (8.24‰) salinity was recorded in the months of

January at station-1. Minimum (0‰) salinity was recorded in the months of February in all three stations.

pH:

PH of the study area has been recorded from 7.95 to 6.81. Maximum 7.95 was observed in station-1 in the months of April. Minimum pH 6.81 was recorded in station-3 in the month of January and February.

Dissolved Oxygen:

Dissolved oxygen between 10.57 and 4.87 mg/l. Maximum 10.57 mg/l was recorded in the month of January at station-1. Minimum 4.87 mg/l was recorded in the month of April at station-2.

Nutrients:

Nitrate- N was varied from 21.45 to 12.87 g/1. Maximum was recorded in station-1(21.45) in the month of March. Minimum was recorded in station-3(12.87) in the month of January. Nitrite- N was recorded from 10.57 to 5.94. Maximum 10.57 was observed in station-1 in the months of February. Minimum 5.94 was recorded in station-3 in the month of January. Phosphate- P was varied from 7.64 to 2.02 g/1. Maximum was recorded in station-1(7.64) in the month of April. Minimum was recorded in station-3(2.02) in the month of February. Silicate was varied from 99.66 to 51.36 g/1. Maximum was recorded in station-1(99.66) in the month of March. Minimum was recorded in station-3(51.36) in the month of March. Ammonia was recorded from 19.15 to7.24 g/l. Maximum was recorded in station-1(19.15) in the month of March. Minimum was recorded at station-3(7.24) in the month of February.

DISCUSSION

Muttukadu was a paradise for anglers since prawns and jelly fish are in abundance here but now due to the urbanization near the backwaters it is getting affected by anthropogenic activities. Most of the biological resources became vanished due to Cyanobacterial Harmful Bloom of this place. Due to the anthropogenic activities, high level of nutrients is carried into the estuary resulting in the formation bloom. The nutrients Nitrogen (N) and Phosphorus (P) are the most important nutrients to enhance the phytoplankton growth and which are found naturally in aquatic environments in various concentrations. Iron, zinc and manganese are also essential, but they are needed only in very small quantities[13]. If any of the necessary nutrients are not available in the right amount for a particular species, growth and reproduction will be limited or non-existent in that species[14]. But, if all conditions are favorable, a bloom will take place. Temperature is the most important factor in the algal bloom. In the suitable temperature, an algal is easily capable to bloom. *Microcystis aeruginosa* reduced water quality transparency through highly dense algal bloom biomass. In organic nutrients, nitrate and nitrite is the limiting factor for plant growth. Phosphate and Silicate concentration was high in the bloom days it may be due to decomposition in the microbial process and the industrial contaminations. Ammonia concentration also high, which is might be due to the high demineralization ability of Cynobacteria to produced ammonia through the process of nitrogen fixation. Due to the presence of high level of ammonia and oxygen deficiency, the *M.aeruginosa* bloom can leads to the

mortality of fish in muttukadu backwater. Various physico-chemical and biological factors may be responsible for the existence of a dominant *Microcystis* species in an environment[15]. Fluctuations of the salinity, Do, pH and nutrients in the back water habitats are due to the influx of freshwater from land run off, caused by monsoon or tidal variations[16]. *Microcystis aeruginosa* cell abundances and toxin concentrations in the muttukadu back water must be monitored for human and animal health in the future because the back waters are used by human for fisheries and tourism activities. Moreover, pollution sources which accelerate to eutrophication process of these regions must be obstructed[17]. The toxic effects and the risks to the population due to the presence of Cynobacteria in water sources are very big and the critical examples are diarrhea, nausea, muscle weakness, cutaneous paleness and liver tumors[18]. Some animals help limit or reduce phytoplankton populations by feeding on them. Filter-feeding oysters, scallops and sponges consume phytoplankton as they circulate seawater through their bodies, while microscopic crustaceans like copepods graze on phytoplankton in the water column.

CONCLUSION

Microcystis aeruginosa bloom affected the water quality of muttukadu backwater, is evidenced by the water transparency, dissolved oxygen and change in the water quality parameters. These bloom forms like a film on the water surface and disturbs the water clarity and oxygen content of the water. This is to turn and affect the fishes, humans, birds and other aquatic organisms. Pollution like domestic and industrial wastes from various sources affects the normal phytoplankton composition of the study area. Present investigation highlights the presence of *Microcystis aeruginosa* bloom and need to regular monitoring of algal bloom and physico chemical parameters in Muttukadu backwaters for to conserve the fishery resources and to protect human health.

CONFLICT OF INTEREST STATEMENT:

We declare that we have no conflict of interest.

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