Status of brackish water phytoplankton during COVID-19 lockdown phase

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Abstract

Phytoplankton act as the energy source for maintaining the aquatic food web. Threats like high suspended particulate matter, oil film, heavy metals, POPs etc. pose a negative effect on this primary producer community which have far reaching adverse impact on aquatic food web. However, during COVID-19 lockdown phase, the major sources of pollution have been cut-off resulting in the restoration of phytoplankton standing stock as evidenced from the data of Diamond Harbour station along the Hooghly estuary during 2018 (219.03×10^5/L), 2019 (226.75 ×10^5/L), and 2020 (430.63 ×10^5/L).

Keywords: Phytoplankton, COVID-19, Diamond Harbour, Hooghly estuary

Introduction

Phytoplankton are free floating, microscopic floral entities that thrive luxuriantly within the photic zone of the ocean, estuaries and different aquatic systems. They are the key players in maintaining the nutrient and energy flow through marine and estuarine food webs. The phytoplankton community encompasses both prokaryotic and eukaryotic species. One of the major challenges for aquatic ecologists is to understand the natural processes and anthropogenic factors, which regulate the standing biomass of phytoplankton in pelagic ecosystems. Understanding these processes would improve our ability to regulate/control nuisance and toxic algal blooms, maintain the aesthetics of surface water bodies, protect drinking water supplies, and improve fisheries production (Vollenweider, 1976; Carpenter *et al*., 1985; McQueen *et al*., 1986; Carmichael, 1994; Pauly and Christensen, 1995; Brett and Goldman, 1996; Brett and Goldman, 1997; Falconer, 1999; Micheli, 1999). Phytoplankton is the foundation of the aquatic food cycle, meaning that they are the primary producers (Vargas *et al*., 2006).

The fish resources of the nation that is directly linked with the economic profile of the country is dependent on the phytoplankton stock as they are primary producers of aquatic system and transfer the energy to members of higher trophic levels like fishes and other commercially important aquatic species by serving as their major food sources. The present paper is, therefore, an attempt to assess their status during the COVID-19 lockdown phase, when all the pollution sources have been cut-off with

upgradation of environmental quality (Mitra *et al*., 2020).

Materials & Methods

Phytoplankton samples were collected during April 2018, 2019 and 2020 through a vertical tow of a plankton net (20 µm effective mesh size) at Diamond Harbour station along the Hooghly estuary. The plankton net was approximately 50 cm long, with a 26 cm diameter mouth and a 10 cm diameter opening at the cod end, which was tied to a 125 ml TARSON collection bottle. The samples collected were preserved by using 1 ml of 37% formaldehyde (~2% final concentration) to identify the phytoplankton species. Phytoplankton cell identifications were based on standard taxonomic keys (Verlencar, 2004; Botes, 2003).

Enumeration of phytoplankton density and diversity

The water samples collected within bucket of a known volume was filtered through the bolting silk cloth and the plankton was concentrated. Centrifugation was carried out to concentrate the sample. The final volume of plankton concentrate was recorded to achieve the result of plankton density in terms of cells/litre or cells/m^3. This step involved the counting of plankton through Sedgwick Rafter. 1 ml of plankton sample obtained from the stock through the pipette was transferred to the Sedgwick Rafter counting cell. The sample for counting in this chamber was spread evenly in the form of a thin layer and this was done by placing a cover slip diagonally across the counting cell and the sample was then introduced at one of its corner. The total number of plankton (standing stock) present in a litre of water sample was calculated using the formula:

N= nv/V

Where,

N= total number plankton cells per litre of water filtered.

n = average number of plankton cells in 1ml of plankton sample.

v = volume of plankton concentrate (ml)

V= volume of total water filtered (l)

The units of standing crop are N/l or $N\times10^3$ /m^3

Results

The analytical results show that the standing stock of phytoplankton in the selected station is highest in April, 2020 compared to the April, 2019 and April, 2020 as highlighted in Fig. 1.

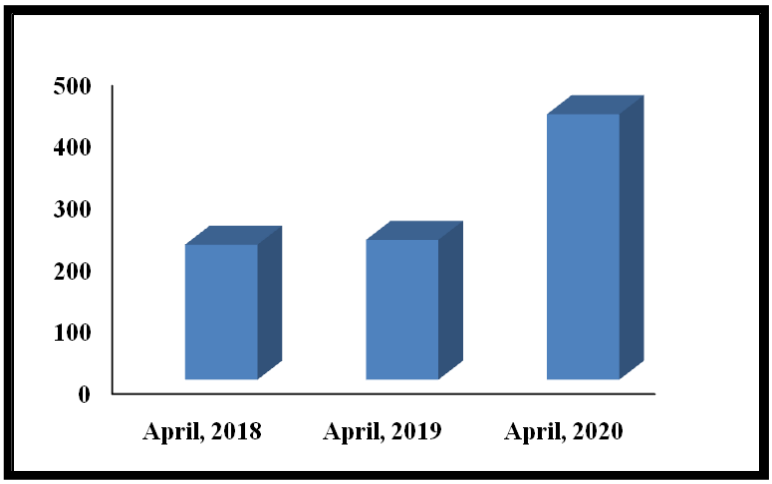

Fig. 1 Standing stock of phytoplankton in Diamond Harbour along the Hooghly estuary

Discussion

The phytoplankton at the base of aquatic food pyramid are exposed to threats of various categories arising from industrial and domestic discharges. The suspended particulate matter and oil film associated with aquatic ecosystem inhibits the solar energy to penetrate the water column thereby posing a negative impact on phytoplankton. This type of stress is common in the estuarine water of Indian Sundarbans due to continuous movement of passenger's vessels, fishing trawlers, ships, oil tankers along the navigation route. In addition to this, the industries situated along the Hooghly estuary also add substantial amount of suspended particles in the water body thus retarding the growth of the tiny producer community (Mitra, 2013; Mitra and Zaman, 2014; Mitra and Zaman, 2015; Mitra and Zaman, 2016; Mitra, 2019). The COVID-19 phase, however, turned the picture of the environment (Mitra *et al*., 2020). Due to lockdown imposed by the Central and State Government, the discharges from industries, tourism units have been cut-off. In addition, the water transport system has also ceased due to which the stress on this tiny producer community has been withdrawn. This is reflected through higher standing stock of phytoplankton during April, 2020 (430.63 $\times 10^5$/L), compared to April, 2019 (226.75 $\times 10^5$/L) and April, 2018 (219.03 $\times 10^5$/L) as shown in Fig. 1 This increase in standing stock has high probability to accelerate the estuarine fish resources in the years to come.

In conclusion it can be advocated that COVID-19 lockdown phase has accelerated the growth of phytoplankton species in the brackish water system along the Hooghly estuary, probably due to complete removal of stress from posed by pollution from point and non-point sources. Thus the COVID-19 lockdown process, in other way, has exposed the biodiversity face of the aquatic ecosystem in a positive direction.

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