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Community structure of phytoplankton in two different areas along Getalsud Dam of Jharkhand state

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ABSTRACT

Blooms including red-tides caused by phytoplankton are of significant value in the aquatic environment as they affect marine economy. Hence, an analysis of phytoplankton becomes essential in any study concerning hydro biological investigations. Present study focusses attention on a thorough investigation of phytoplankton with reference to their species makeup, percentage contribution, population density and community structure. All these are calculated by prescribed formulas. The present study areas (stations 1 and 2) form a typical dumping yard system. Both the stations are present in the Jharkhand state along Getalsud dam basin area. The first collection site was fixed near the northern bank of the dam which was 1 km west of the residential area. The second selected site was fixed near the southern bank of the dam which was 2 km east of the small industrial area. The river water is extensively utilized for agriculture, fisheries, irrigation and navigation purpose. Phytoplankton For two years, samples were taken from the surface waters of the research sites once a month. from October 2022 to September 2023. For convenience's sake and easy interpretation, a calendar year (of study) was divided into four seasons. This kind of grouping viz., postmonsoon (January to March), summer (April to June), premonsoon (July to September) and monsoon (October to December). 0.35 m). These Samples were utilised for qualitative examination after being stored in 5% neutralised formalin. Regarding the quantitative analysis of phytoplankton, the settling technique was used. Plankton numerical analysis was performed using Utermonl's Inverteo-plankton microscope. Analysis of phytoplankton of stations 1 and 2 showed the presence of 187 Diatoms were the most group contributing 71.12% followed by greens and blue greens contributing 9.63% and 8.56% respectively. Dinoflagellates contributed and others contributed only 3.74%. Each group's percentage contribution towards phytoplankton composition in the increasing order was as follows.

Others< Dinoflagellates< Bluegreens < Greens< Diatoms

Key Words - Phytoplankton, population density, Species richness, Blooms, Autotrophs

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INTRODUCTION

Phytoplankton being the autotrophs (primary producers), initiate the aquatic food-chain. Secondary (zooplankton) and tertiary producers (shell fish, finfish and others) depend on them directly or indirectly for food. Phytoplankton also acts as markers of the quality of the water and 'natural regions' which are characterized by typical species or species groups. In addition, phyto plankton clearly have a major part in the global biogeochemical cycling of carbon, nitrogen, phosphorus, silicon and many other elements. Blooms including red- tides caused by phyto `plankton are of significant value in the aquatic environment as they affect marine economy. Hence, an analysis of phytoplankton becomes essential in any study concerning hydrobiological investigations.

Present study focusses attention on a thorough investigation of phytoplankton with reference to their species makeup, percentage contribution, population density and community structure.

MATERIALS & METHODS

The present study areas (stations 1 and 2) form a typical dumping yard system. Both the stations are present in the Jharkhand state along Getalsud dam basin area.

Station 1:

The river Subarnarekha is one of the important rivers of Jharkhand originating from Ranichua place in Piska/Nagri of the state. The famous Getalsud dam is an artificial reservoir situated in Ormanjhi, Ranchi constructed across the Subarnarekha River. The first collection site was fixed near the northern bank of the dam which was 1 km west of the residential area.

Station 2:

The second selected site was fixed near the southern bank of the dam which was 2 km east of the small industrial area. The river water is extensively utilised for agriculture, fisheries, irrigation and navigation purposes. In recent times, its water is put into multifarious use. Innumerable factories, workshops, human inhabitations and new townships have sprung up along its banks.

These add untreated domestic, industrial and other wastes into the river at various points thus introducing many kinds of pollutants. It is also a focus of religious and recreational activity during many festive occasions. There is every possibility for these pollutants to reach the tail end of the southern bank. Quality of the river water till its tail end might be changing with the addition of effluents

Phytoplankton For two years, from October 2022 to September 2023, samples were taken monthly from the surface waters of the study sites. For ease of use and simple understanding, a calendar year (of study) was divided into four seasons. This kind of grouping viz., postmonsoon (January to March), summer (April to June), premonsoon (July to September) and monsoon (October to December). 0.35 m). These samples were utilised for qualitative examination after being stored in 5% neutralised formalin. The Sukhanova (1978) settling method was used for the quantitative analysis of phyto plankton. The inverteo-plankton microscope from Utermonl was used to do numerical plankton analysis.

To identify phytoplankton, Hustedt's classic works (1930-1966) were used (Venkatraman (1939). The collected phytoplankton was categorised into five main groupings for convenience. viz, diatoms, dinoflagellates, blue greens, greens and 'others' and each group's percentage composition was determined. The formula developed by Shannon and Wiener (1949) was used to determine the species diversity index (H').

$$H' = -\sum_{i=1}^{s} Pi \ log2 \ Pi \ldots\ldots$$

where,

Diversity of H' species in individual information bits

P = percentage of the samples that are to the i" species.

Species richness (SR) was calculated as described by Gleason (1922),

$$SR = \frac{S-1}{loge\ N}$$

where,

S= The quantity of species in a specific sample and

N= the total number of individuals of each species in the sample, expressed as a natural logarithm.

Evenness index (J') (equitability) was calculated using the formula of Pielou (1966).

$$J' = \frac{H'}{loge\ S}$$

where,

H' = species diversity in bits of information per individual, and S = number of species.

Dominance index ($) was calculated using the formula of MC Naugton (1967) described by

Ignatiades and Mimicos (1977),

$$\$ = 100 + \frac{(n1+n2)}{N}$$

Where,

N is the average concentration of the total phytoplankton standing crop in the same series of samples, and 8 dominance index is equal to the percentage of the total standing crop contributed by the two most significant species, n and n, the percentage of the total population contributed by the two most abundant species in the sample.

RESULTS

Species Composition

During the current study period, 187 phytoplankton species were identified from both sites (Table 3.1). Of the 187 species, 133 species belonged diatoms (Bacillariophyceae), 13 species to dinoflagellates (Dinophyceae), 16 species to bluegreens (Cyanophyceae), 18 species to greens (Chlorophyceae) and 7 species 16 others' (Silicoflagellates and Euglenophyceae).

A total of 136 species were documented from station 1, including 98 diatom species, 9 dinoflagellate species, 12 bluegreen species, 12 green species, and 5 miscellaneous species. 13 species of dinoflagellates, 13 species of bluegreens, 105 species of diatoms, and 13 species of greens and 4 species belonging to others' constituting a total of 148 species were recorded.

Percentage Composition:

Station 1:

Percentage composition of Diatoms ranged between 0.98 %and 100 %. The summer season (April) had the lowest recorded. Blue greens' percentage composition varied from 0 to 82.5. Many months of the current study period showed no chlorophycean members, however the monsoon season (November) showed a low percentage (5.0%). The premonsoon season (July) saw the highest proportion (82.50%). Others made up between 4.0 and 20.0%, with the lowest (4.0%) occurring in November and January during the monsoon and post-monsoon seasons, and the highest (20.0%) occurring in February during the latter. During several months of the current study period, this group was also completely absent.

Station 2: The diatoms' percentage composition varied from 12.0 to 100.0. The monsoon season (October) saw the lowest percentage (12.0%) and the highest percentage (100%) during the post monsoon (January), summer (June and April) and pre monsoon (July) seasons. Percentage composition of dinoflagellates ranged between 0 and 22.5. No dinophycean member was noted in many of the research period's months, but a low percentage (0.11%) was noted in May, the summer. The maximum percentage (22.5%) was recorded during the post monsoon season (February)

Percentage composition of blue greens ranged between 0 and 65.6. No Cyanophycean member was observed during many months of the present study period but a low (1.0%) percentage was noted across the summer season (March). The monsoon season (October) was when the highest percentage (65.5%) was recorded. Greens' percentage composition varied from 7.0 to 68.0. The summer season (May) saw the lowest percentage (7.0%), while the monsoon season (December) saw the highest (86.0%).

Others' constituted 2.0 to 14.0% with the minimum during the summer season (March) and at its highest point over the monsoon season (October).

Phytoplankton population density:

Station 1. Population phytoplankton density varied from 114 to 36,000 cells 1 Minimum density (114 cells 1-) was noted across the summer season (April) while the highest (36,000 cells 1), during the post-monsoon season (February). In the present investigation, the peak value was observed during the second year of the study period.

Station 2. Population density varied from 50 to 1,04,915 cells 1. Minimum (50 cells 1) was observed during the summer season (June 1990) while the maximum (1.04, 915 cells 1), during the summer season (May).

Species diversity:

Station 1. Diversity index (H') varied between 0.24 and 3.95. The pre-monsoon season (September) saw the lowest value (0.24), while the monsoon season (December) saw the highest value (3.95).

Station 2. With a minimum of 0.94 during the post-monsoon season (March) and a maximum of

4.54 during the monsoon season (December), the diversity index (H) ranged from 0.94 to 4.54.

Species richness:

Station 1. The range of species richness (SR) was 0.18 to 4.24. The pre-monsoon season (September) saw the lowest value (0.18), while the post-monsoon season (February) saw the highest value (4.24).

Station 2. The range of species richness (SR) was 0.62 to 4.11. The post-monsoon season (March) saw the lowest value (0.62), whereas the same season (January) saw the highest value (4.11).

Species Evenness:

Station 1. Evenness index (J) varied between 0.24 and 0.97. The pre-monsoon season (September) saw the lowest value (0.24), while the monsoon season (December) saw the highest value (0.97).

Station 2. Evenness index (J) varied between 0.28 and 0.98. The premonsoon season (July) saw the lowest value (0.28), while the monsoon season (December) saw the highest value (0.98).

Dominance Index

Station 1. Dominance index (8) varied from 16.00 to 99.89 with the minimum during the post-monsoon season (January) and maximum during the premonsoon season (September)

Station 2. Dominance index (5) ranged from 10.0 to 93.0 with the minimum during the post- monsoon season (January) and maximum during the premonsoon season (July)

DISCUSSION

187 diatoms were found in the phytoplankton from stations 1 and 2, according to analysis formed the dominant group contributing 71.12% followed by greens and blue greens contributing 9.63% and 8.56% respectively. Dinoflagellates contributed and others contributed only 3.74%. Each group's percentage contribution towards Phytoplankton composition in the increasing order was as follows.

Others< Dinoflagellates< Bluegreens < Greens< Diatoms

More species were recorded at station 2 than at station 1. Species numbering 97 were common both the stations and 39 species were restricted to station 1 and 51 species, to station 2. Seasonal distribution of phytoplankton species at station 1 indicated that diatoms viz. *Achnanthes brevipes, Amphiprora ornata, Chaetoceros affinis, Concinoda marginatus, Diploneis, bombus, Fragilaria intermedia, Gyrosigma balticum, Navica pastrum Nitzschia closterium, N. longissima, N. sigmoidea, Pleurosigma elongatu Synedra ulra* and *Thallassiothrix longissima; dinoflagellates viz. Protoperidinium oceanicum* and bluegreens viz. *Anabaena macrospora,*

Merismopedia glauca, Oscillatorie limosa and *Trichodesmium erythraeum* were present for the duration of the investigation.

At station 2, diatom species viz. *Asterionella glacialis, Campylodiscus ornata, Chaetoceros diversus, C. lorenzianus, Coscinodiscus marginatus, Cymbella cistula, Fragilaria intermedia, Mastogloia recta, Navicula gracills, Nitzschia filliformis, N. scalpelliformis, N. sigmoidea, Pleurosigma elongatum, Rhizosolenia alata* and *Synedra una*; dinoflagellates viz., *Ceratium fusus, Prorocentram micans* and *Protoperidiniam oceanicum* and bluegreens *Lyngbya martensiana* and *Oscillatoria limosa* were present throughout the study period. Green algae occurred more in number only during the premonsoon and monsoon seasons when the freshwater flow was copious at the study area.

Maximum percentage of diatoms especially of pennates was observed during the post-monsoon (Station 1) and post-monsoon, summer and premonsoon (Station 2) season. It was probably due to the fact that the pennate diatoms thrive better than centric diatoms in shallow marine environs including the present study areas. This is facilitated by their elongated nature instead of cylindrical nature (Character of centric diatoms) with which they can attach themselves better on the other phytobenthos or other floating material.

Dinoflagellate peak was noted during the monsoon season. (station 1) and post-monsoon (station 2) seasons, that of greens, during the premonsoon (station 1) and monsoon (station 2) seasons and that of blue greens, during the summer (station 1) and monsoon (station 2) seasons. Such variations in the seasonal distribution of different groups of phytoplankton are attributable to the ever fluctuating physico-chemical events of the estuary which govern the occurrence of different species of phytoplankton.

Phytoplankton standing crop estimation is important because it gives a simple indication of the amount of food available to the second trophic level organisms of the food-web and eventually to fish and man. Overall, station 2's population density was higher than station 1's. Since it is nearer the Dam's bank, the allochthonous coastal marine species have enriched the population density at this station. It is worth mentioning that *Asterionella glacialis, Bacteriastrum hyalinum, Campylodiscur ornatus, Chaetoceros diversus, C. orientalis, Ditlylum brightwellllii, Eucampia* sp. *Grammatophora angulosa, Licmophora* sp., *Odontella sinensis, Planktoniella* sol *Rhizosolenia* sp., *Stephanophyxis* sp., *Thalassionema nitzschioides* and *Thalassiosira eccentrica* which are the typical marine species were dominant here.

Statistical analysis revealed the fact that temperature, salinity, nutrients and chlorophyll a are associated with the phytoplankton standing crop. Phytoplankton standing crop showed a strong positive association with temperature (r=0.3979, p<.la station 1), salinity (r = 0.4138; p<.1 at station 1;r=0.3833 p<.1 at station 2), nutrients (NO,, r=0.3713; p<.1 at station 2 only NO,, r= 0.4196; p<.1 at station 2) and Chlorophyll a (r = 0.3615; p <.1 at station 1: r = 0.4920; p<.05 at station 2). Such positive correlations between phytoplankton cell number with temperature and salinity have been reported from Waikato River estuary and upper St. Lawrence estuary respectively.

Species diversity and species richness were low during the premonsoon (station 1) and post monsoon (station 2) season, when blooming of diatoms was observed (*Coscinodiscus sublineatus* at station 1: *Campylodiscus ornatus* and *Thalassionema nitzschioides* at station 2). This is because blooming would reduce species diversity as the blooming species could eliminate other phytoplankton species from the environment by causing oxygen depletion and nutrient limitation especially phosphate.

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