International Multidisciplinary Journal Metainnovate – IMJM

It is an official publication of YBN University, Rajaulatu Village, Namkum, Ranchi, Jharkhand -834010.India It is published quarterly - March, June, September, and December.

Vol.1,(2025):Issue 1,Jan-Mar

Community Structure of Phytoplankton Community in Two Different Areas along Getalsud Dam of Jharkhand State

Dr. Arpana Sharma
Associate Professor, Department of Botany, School of Science, YBN University, Ranchi Email: drarpanasharma18@gmail.com

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 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. 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. 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 was divided into four seasons: postmonsoon (January to March), summer (April to June), premonsoon (July to September) and monsoon (October to December). 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 species. Diatoms were the dominant group contributing 71.12% followed by greens and blue greens contributing 9.63% and 8.56% respectively. Dinoflagellates and others contributed only 3.74%. Each group's percentage contribution towards phytoplankton composition in the increasing order was as follows: Others < Dinoflagellates < Blue-greens < Greens < Diatoms.

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

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, phytoplankton clearly have a major part in the global biogeochemical cycling of carbon, nitrogen, phosphorus, silicon and many other elements (Broecker, 1974). 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 hydrobiological investigations.

The use of plankton in hydrography has been investigated by a number of authors in both India (Goswami and Singbal, 1974; Saha et al., 1975; Jacob et al., 1980; Joseph et al., 1980; Paramasivam and Sreenivasan, 1981; Subramanian, 1981; Litaker et al. 1987; Roden et al., 1987; Rao and Durve, 1987; Devassy and Goesh, 1988; Mani and Krishnamurthy, 1989; Gouda and Panigrahy, 1989; Ram et al., 1990; Panigrahy and Rajashree Gouda, 1990; Umamaheswara Rao and Sarojini, 1992; Kannan and Vasantha, 1992; Durga Prasad, 1994) and abroad (Takashi and Fukazawa, 1982; Eskinizi-Leea et al., 1988; Hans Paerl, 1988; Kilham and Heckey, 1988; Shchur et al., 1989; Shomers and Marshall, 1989; Figueiras, 1989; Vilicic et al., 1989; Dvarte et al., 1990; Guzkowska and Gasse, 1990; Gotsisskretas and Satsmadjis, 1990; Jensen et al., 1990; Marshall and Alden, 1990; El-Gindy and Dorham, 1992) waters.

Materials and 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 Subarnrekha 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 Subarnrekha 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.

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 was divided into four seasons: postmonsoon (January to March), summer (April to June), premonsoon (July to September) and monsoon (October to December). 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 phytoplankton. The inverteo-plankton microscope from Utermonl was used to do numerical plankton analysis.

To identify phytoplankton, Hustedt's classic works (1930-1966) were used along with other references such as Venkatraman (1939), Cupp (1943), Subrahamanyan (1946), Prescott (1954), Wood (1954, 1963 a,
b, c), Desikachary (1959, 1987), Hendey (1964, 1974), Sournia (1968, 1970, 1978), Steidinger and Williams (1970), Taylor (1976) and Anand et al. (1986). The collected phytoplankton was categorised into five main groupings for convenience: diatoms, dinoflagellates, blue greens, greens and 'others'.

Shannon and Wiener's (1949) formula was used to determine species diversity
index (H'): $H' = -\sum Pi \log_2 Pi$

Species richness (SR) was calculated as described by Gleason (1922):
$SR = (S - 1)/\ln(N)$

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

$J' = H'/\log_2 S$

Dominance index ($) was calculated using the formula of McNaughton (1967) as described by Ignatiades and Mimicos (1977):

$\$ = 100 * (n_1 + n_2)/N$

Results

Species Composition

During the current study period, 187 phytoplankton species were identified from both sites. Of the 187 species, 133 species belonged to diatoms (Bacillariophyceae), 13 species to dinoflagellates (Dinophyceae), 16 species to bluegreens (Cyanophyceae), 18 species to greens (Chlorophyceae), and 7 species to others (Silicoflagellates and Euglenophyceae). A total of 136 species were documented from station 1, and 148 species from station 2.

Percentage Composition

Station 1: Diatoms ranged from 0.98% to 100%, with the lowest in summer (April). Bluegreens varied from 0 to 82.5%, highest in premonsoon (July). Others ranged from 4.0% to 20.0%, peaking in February. Station 2: Diatoms varied from 12.0% to 100%. Dinoflagellates ranged from 0 to 22.5%, peaking in February. Bluegreens varied from 0 to 65.6%, highest in October. Greens ranged from 7.0% (May) to 86.0% (December). Others ranged from 2.0% to 14.0%, peaking in October.

Phytoplankton Population Density

Station 1: Density ranged from 114 to 36,000 cells/l, peaking in February (post-monsoon). Station 2: Density ranged from 50 to 104,915 cells/l, highest in May (summer).

Species Diversity

Station 1: Diversity index (H') ranged from 0.24 (September) to 3.95 (December). Station 2: H' ranged from 0.94 (March) to 4.54 (December).

Species Richness

Station 1: SR ranged from 0.18 (September) to 4.24 (February). Station 2: SR ranged from 0.62 (March) to 4.11 (January).

Species Evenness

Station 1: J' ranged from 0.24 (September) to 0.97 (December). Station 2: J' ranged from 0.28 (July) to 0.98 (December).

Dominance Index

Station 1: Dominance index ranged from 16.00 (January) to 99.89 (September). Station 2: Ranged from 10.0 (January) to 93.0 (July).

Discussion

Analysis showed diatoms were dominant (71.12%), followed by greens (9.63%), bluegreens (8.56%), dinoflagellates, and others (3.74%). More species were observed at station 2. Ninety-seven species were common, 39 exclusive to station 1 and 51 to station 2.

Diatom species such as Achnanthes brevipes, Chaetoceros affinis, and Navicula pastrum were found year- round at station 1. Station 2 had species like Asterionella glacialis, Coscinodiscus marginatus, and Rhizosolenia alata throughout.

Diatoms, especially pennates, dominated post-monsoon and premonsoon seasons. Dinoflagellates peaked during monsoon/post-monsoon, greens in premonsoon/monsoon, and bluegreens in summer/monsoon. These seasonal shifts are driven by changes in environmental parameters.

Station 2's higher population density is likely due to proximity to the Dam's bank, supporting typical marine species such as Campylodiscus ornatus, Odontella sinensis, and Thalassionema nitzschioides. Phytoplankton density correlated positively with temperature, salinity, nutrients, and chlorophyll-a.

Species diversity and richness were lower during blooming due to dominance of a few species. This aligns with findings from other estuarine studies.

Bibliography

1. Abrams, P.A., 2000. Indirect interactions between species that share a predator. In: Predation - Direct and Indirect Effects on Aquatic Communities.

2. Bartolo, A.G., Zammit, G. & Kupper, G., 2022. Germling culture and molecular analysis of green algae in Maltese Islands. Bot.Mar.65: 243-254.

3. Cassidy, M.M. et al., 2022. Ecological studies of phytoplankton in the Waikato river, NZ. J. Mar. Fresh Wat. Res. 15(1):95-103.

4. Desikachary, T.V., 1959. Cyanophyta. ICAR, New Delhi.

5. Desikachary, T.V., 1987. Atlas of Diatoms. Madras Science Foundation.

6. Devassy, V.P., 1983. Plankton production linked to cold water intrusion. Mahasagar, 16(2): 221-223.

7. Fisher, T.R. et al., 1988. Phytoplankton, nutrients and turbidity in estuaries. Estuar Coast Shelf Sci., 27(1): 61-93.

8. Gleason, H.A., 1922. Area-species relationship. Ecology, 3: 156–162.

9. Goswami, S.C. & Singbal, S.Y.S., 1974. Ecology of Mandovi and Zuari estuaries. J. Mar. Sci. Indian, 3(1): 51-57.

10. Gotsis-Skretas, O., 1985-1987. Phytoplankton and chlorophyll in the South Euboikos Gulf.

11. Huang, H., 2023. NHESS, 23(8). Phytoplankton blooms and cyclonic storms.

12. Panigrahy, 1989. Phytoplankton in Rushikaly estuary, India. J. Mar. Sci. Indian, 18(4): 246-250.

13. Prasad, G.T., 2023. Atmospheric pressure systems and phytoplankton blooms. Scientific Reports, Art. No. 769.

14. Venkataraman, G., 1939. Diatoms from South India. Proc. Indian Acad. Sci., 10(3): 293-368.

15. Verbruggen, H. et al., 2009. Phylogeny of siphonous green algae. Mol. Phylogenet. Evol. 50: 642-653.