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ASSESSMENT OF PHYTOPLANKTON DIVERSITY OF GHUNGHUTTA DAM SURGUJA DISTRICT (C.G)

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ABSTRACT:
Planktons are an important component of the water ecology and may serve as a marker of altering water quality. Phytoplankton is water ecosystem producer. Most fish larvae and other plankton-eating fishes feed primarily on planktons species. All aquatic ecosystems' dynamics revolve around primary productivity, which sustains various food chains and food webs. The overgrowth of biotic component, pesticides from agricultural runoff, household garbage, sewage sludge, feces near water body, bathing of domestic animals, washing of clothing and utensils, etc. have all put pressure on lotic ecosystems over the past many years. Most plants and animals struggle to survive in polluted environments, but those that can handle the stress of pollution on their own may be able to. These creatures can serve as pollution indicators, or more particularly, as bioindicators of the ecosystem's trophic condition. Present investigative is related with analysis and diversity of phytoplankton of Ghunghutta dam of Surguja District (C.G.) for duration of two year from January 2020 to December 2021. The Ghunghutta dam is located in Surguja district (22^{0}94N latitude & 83^{0}164E Longitude) of northern Chhattisgarh in India. Ghunghutta is a medium irrigation project which was constructed in 2002 across the river Ghunghutta which is a tributary of Rehar Sub basin Sone in the Ganga basin. The Dam is 14km. from the district head quarter Ambikapur. The Dam water use is domestic purposes, irrigation, aquaculture etc. The surrounding area of the dam is semi-urban and partially agricultural .Phytoplankton communities were evaluated at five different study site (A,B,C,D,& E). Several published plankton manuals were used for plankton collection and identification. Phytoplankton were represented by four groups 33 species, viz. Bacilariophyceae 6 species (18.18%), Chlorophyceae 12 species (36.36 %), Cyanophyceae 12 species (36.36 %), and Euglenophyceae 3 species (9.09 %). Diversity study reveals common planktonic forms present at different sampling sites.

KEYWORDS: *Phytoplankton, Diversity, Ghunghutta dam.*

INTRODUCTION:

"The freshwater ecosystem includes rivers, ponds, lakes, puddles, pools, and swamps, as temporary or permanent water bodies. The structural ecosystem is classified into two types of abiotic and biotic components" (Ibrahim S. 2009)."Abiotic components include pH, light, temperature, oxygen levels, etc., and biotic components include plants, animals, and decomposers" (Martins et.al; 2020). "The primary water source controls various environmental factors and associated plants as well as animal life" (Bera et.al; 2014)."Water is used by the community for a variety of purposes, including aquaculture, washing dishes, agriculture, and animals. The rivers provide habitat, food, water, and a breeding ground for a variety of native species, including dragonflies, frogs, birds, and other creatures" (Praveen et.al ; 2013)."The river water body provides a suitable habitat for aquatic plants and animals. Many invertebrates are dependent on these dead and decaying organisms, which eventually become a part of the food chain" (Verma A.K .2020)."Planktons play a significant role in the wetland ecosystem and are a potential indicator of changing water quality. They are susceptible to ecological conditions and react promptly to adjust to the environment" (Kumar et.al. 2012).

Phytoplankton are the primary producers of any aquatic habitat, they float passively in water surface and sometimes, they may extend down to various depths where light is available for photosynthesis. Phytoplankton's, include green algae, blue green algae, diatoms, desmids, euglenoids etc., are important among the aquatic floras. They are ecologically significant as they form the basic link in the food chain of all aquatic animals, and when in large numbers they make the water greenish (Harsha et.al. 2004). Several, physico-chemical factors (Homyra et.al. 2006) and varying influx conditions can markedly influence the aquatic system, and cause changes in the phytoplankton abundance, diversity, and succession. Phytoplankton, a primary producer of the ecosystem, is a major food source for zooplankton. Zooplankton species are the initial prey for most fish larvae and other plankton-eating fishes (Gupta et.al. 2013 & Rajendra Kumar 2023)."In case of blooms or scum, Cyanobacteria pose a series of problems for water quality, fisheries resources, agriculture, and human health. The planktonic algae contribute substantial amount of dissolved oxygen in the aquatic systems" (Harilala (2005). "Micro algae are indeed the biological starting point for energy flow in the food chain in most aquatic ecosystems and gives information relating to the amount of energy available to support bioactivity of the system.

The dynamics of all aquatic ecosystems centre around primary productivity for supports different food chain and food webs. The magnitude and dynamics of primary production has become an essential parameter to assess the state of pollution in aquatic ecosystems. For the last many years, river ecosystem has been under pressure due to overgrowth of macrophytes, pesticides from agricultural runoff, domestic waste, sewage sludge, defecation around rivers, bathing for domestic animals, washing clothes, and utensils, etc." (Majumdar et.al.; 2015 & Gaidhane D.M. 2021). "In polluted environment majority of plants and animals find it difficult to survive but those which could tolerate the stress of pollution alone may survive. These individuals can act as indicator of pollution, more specifically bioindicators of the trophic state of the ecosystem" (Malik et.al. 2012 & Khtri et.al. 2021)

2. MATERIALS AND METHODS

2.1 Collection and Sampling of Phytoplankton:

The study was conducted over a period of 24 months, from January 2020 to December 2021. During this time, water samples were systematically collected every month from just below the surface. To ensure accurate biological analysis, the samples were carefully collected using clean plastic bottles to prevent contamination. Phytoplankton samples were obtained by filtering 50 liters of water through plankton net. The residue, retained in a 50 ml tube attached to the net's lower end, was transferred into labeled vials and transported to the laboratory under dark conditions to avoid light-induced changes. Prior to sampling, all bottles were thoroughly cleaned and rinsed with distilled water. For preservation, 1 ml of Lugol's solution and three drops of 4% formalin were added to each sample (APHA 1998). Quantitative analysis of plankton was carried out using the drop count method with a Neubauer chamber, and the organism count was recorded as the number per milliliter.

Preservation and Identification of Phytoplankton:

The preserved phytoplankton samples were carefully transported to the laboratory in dark conditions to avoid any changes caused by light exposure. Upon arrival, the samples were examined under a microscope, beginning with an initial observation using a 10X ocular lens. For more detailed analysis and species identification, 10X and 40X objective lenses were used. This allowed for precise identification and quantification of the phytoplankton present in the sample. Phytoplankton identification, up to the genus level, was carried out based on well-established references, including works by Ward and Whipple (1959), APHA (1989), and Battish (1992). The relative abundance and frequency of occurrence of each genus were systematically calculated to assess the overall community structure.

Fig.1- Satellite view of study site Ghunghutta Dam

3. RESULTS AND DISCUSSION

An ecosystem is a dynamic relationship between abiotic and biotic parameters. Every parameter has its dependence on each other. Abiotic factors largely control the biotic environment of any ecosystem. Here in this dam water ecological work along with abiotic factor, i.e., the water, biotic factor in the form of biodiversity analysis is carried out. The biotic component is elaborately analyzed for phytoplankton. Phytoplankton are a diverse group of photoautotrophic microorganisms which are the primary producers of any aquatic ecosystem. The phytoplankton populations in diverse habitats are highly responsive to changes in available environmental conditions of the habitat. The nature and distribution of phytoplankton varies considerably with respect to seasons and water quality. Their dominance also leads to qualitative changes to aquatic systems. Information pertaining to the nature, type and distribution of these organisms provides clues regarding the environmental conditions prevailing in their habitat (Sobh et.al. 2005).Phytoplankton populations in lotic& lentic systems like rivers, springs, ponds and dam are highly dynamic in nature with variability in response to changes in seasonal environmental conditions. A variety of ecological processes regulate phytoplankton assemblages and abundances in natural systems (Quinlan et.al. 2007). The phytoplankton community on which the whole aquatic population depends is largely influenced by the interaction of several physico-chemical factors (Thirugnanamoorthy et.al. 2009).

In present investigation phytoplankton were belong to genera of different groups like as Chlorophyceae, Euglenophyceae, Bacillariophyceae and Cyanophyceae. During investigation period 33 genera of phytoplankton genera viz.Bacilariophyceae 6 species (18.18%), Chlorophyceae 12 species (36.36 %), Cyanophyceae 12 species (36.36 %), and Euglenophyceae 3 species (9.09 %). Diversity study reveals common planktonic forms present at different sampling sites population have been identified during the research period and listed in table no. 1 & 2 and Graph no. 1. The species identified in this study and their characteristics are as follows:-

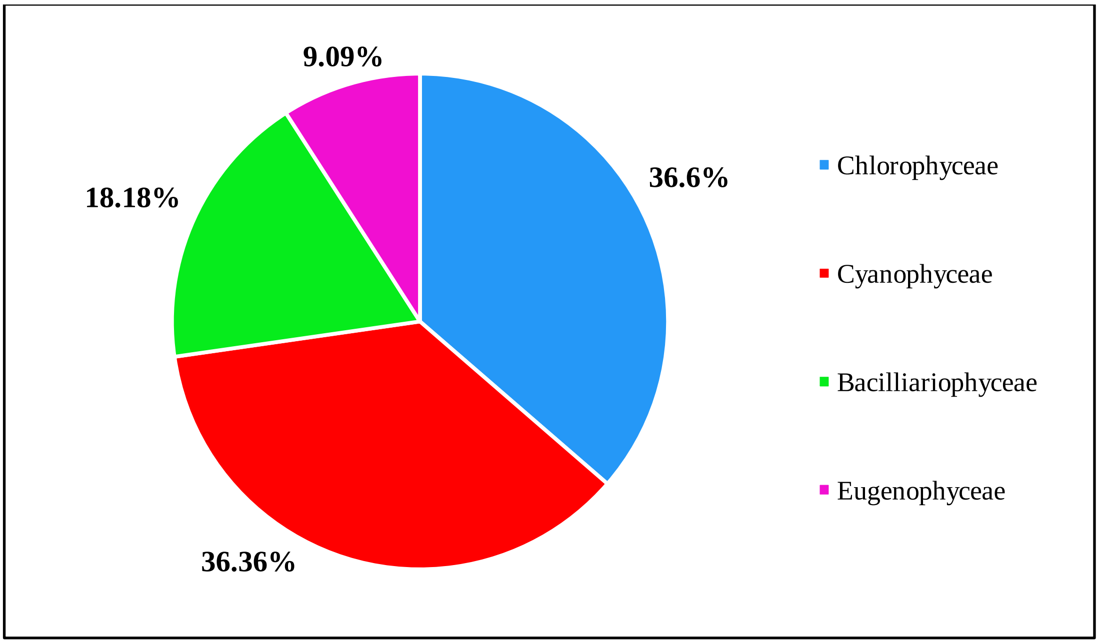
Table 1. Phytoplankton Genera Observed at Five Sampling Stations in Ghunghutta Dam, Surguja (C.G.), January 2020 – December 2021

S.No.	PHYTOPLANKTONS	SAMPLING STATION				
	GROUP- CHLOROPHYCEAE	A	B	C	D	E
1.	*Chlamydomonas reinhardtii*	+	+	+	_	+
2.	*Chlorella vulgaris*	_	+	+	+	+
3.	*Volvox aureus*	+	+	+	+	+
4.	*Pandorinamorum*	_	+	+	_	+
5.	*Oedogonium*	+	_	_	+	+
6.	*Closterium*	+	+	+	+	+
7.	*Spirogyra*	+	+	+	+	+
8.	*Oocystis*	+	+	_	+	+
9.	*Cosmarium*	+	_	+	+	+
10.	*Hydrodictyon*	+	+	+	+	+
11.	*Selenastrum*	+	+	+	+	+
12.	*Microcystisaeruginosa*	+	+	+	+	_
	GROUP-CYANOPHYCEAE					
13.	*Microcystisaeruginosa*	+	+	+	+	+
14.	*Anabaena*	+	+	_	+	+
15.	*Planktothrix*	+	_	+	+	+
16.	*Nostoc*	+	+	+	+	+
17.	*Spirulina*	+	+	+	+	_
18.	*Gloeotrichia*	+	+	_	+	+
19.	*Phormidium*	_	+	+	+	+
20.	*Lyngbya*	+	+	+	+	+
21.	*Calothrix*	+	+	+	-	+
22.	*Synechocysti*	_	+	_	+	+
23.	*Cylindrospermum*	+	+	+	+	+
24.	*Synechococcus*	+	+	+	+	+
	GROUP- BACILLIARIOPHYCEAES					
25.	*Cyclotellameneghiniana*	_	+	+	+	+
26.	*Melosiragranulate*	+	+	_	+	+
27.	*Navicularadiosa*	+	+	+	_	+
28.	*Fragilariacapucina*	+	+	+	+	+
29.	*Synedra ulna*	+	+	+	+	+
30.	*Nitzschiapalea*	_	+	+	+	+
	GROUP –EUGENOPHYCEAE					
31.	*Euglena gracilis*	+	+	+	+	+
32.	*Euglena viridis*	+	+	+	+	+
33.	*Phacus orbicularis*	+	+	_	+	+
	Total	27	30	26	29	31

Table 2. Percentage composition of Phytoplankton species (January 2020 – December 2021)

S.NO.	Group	Number of Species	Percentage
1	Chlorophyceae	12	36.36%
2	Cyanophyceae	12	36.36%
3	Bacilliariophyceae	6	18.18%
4	Eugenophyceae	3	9.09%
	Total	33	100%

Figure 1. Percentage composition of Phytoplankton species (January 2020 – December 2021)



The composition of phytoplankton groups across sampling stations (A, B, C, D, E) varied, with the following findings:

1.Chlorophyceae (Green Algae): This group comprised 12 species, representing 36.36% of the total phytoplankton population. Species such as *Volvox aureus, Closterium*, and *Spirogyra* were observed consistently across all stations, indicating their adaptability to the dam's environmental conditions. The high presence of Chlorophyceae species suggests favorable conditions for green algae growth, including sufficient sunlight and nutrient availability.

2.Cyanophyceae (Blue-Green Algae): Cyanophyceae also had 12 species, accounting for 36.36% of the total phytoplankton. *Microcystis aeruginosa, Nostoc,* and *Lyngbya* were particularly prominent, present at nearly all stations. Cyanophyceae's significant presence indicates that the dam might have periods of nutrient enrichment, as these algae thrive in waters with higher nutrient loads and warmer temperatures.

3.Bacillariophyceae (Diatoms): Six species of Bacillariophyceae were recorded, contributing to 18.18% of the phytoplankton community. Species like *Cyclotella meneghiniana* and *Fragilaria capucina* were more commonly observed, especially at stations with relatively stable water conditions. The prevalence of diatoms suggests that Ghunghutta Dam maintains favorable conditions for primary productivity, as diatoms play a crucial role in oxygen production and form the basis of the aquatic food web.

4.Euglenophyceae (Euglenoids): Three species from the Euglenophyceae group, comprising 9.09% of the total phytoplankton, were observed. Species such as *Euglena gracilis* and *Euglena viridis* were detected across all stations, highlighting their resilience in diverse water conditions. The presence of euglenoids typically indicates organic matter in the water, which might be attributed to runoff from surrounding semi-urban and agricultural areas.

Spatial Variation

The total species count varied slightly across the sampling stations, with Station E recording the highest diversity (31 species) and Station C the lowest (26 species). This spatial variation in species richness may be influenced by factors such as water depth, light penetration, and localized nutrient availability, as well as varying levels of anthropogenic activities around the dam perimeter.

Ecological Implications

The diversity and density of phytoplankton groups in Ghunghutta Dam reveal critical insights into the ecological status of the water body. The co-dominance of Chlorophyceae and Cyanophyceae indicates an ecosystem with a balanced nutrient profile, although Cyanophyceae dominance suggests possible eutrophication phases, which can impact water quality and aquatic life. Bacillariophyceae's significant presence supports the ecological balance by contributing to oxygenation and serving as food for higher trophic levels.

4. CONCLUSION

The world's rivers are the most productive ecosystem in terms of biodiversity because they create an environment that is conducive to the growth of both flora and fauna. Aquatic flora includes phytoplankton, which is a large part of the primary productivity that produces food for aquatic life. They serve as food for a variety of aquatic organisms, particularly fish and large invertebrates, and they are crucial to preserving the right balance between biotic and abiotic components of the aquatic ecosystem. The health of the water quality has been determined by phytoplankton, and these types of research serve as a baseline for future monitoring of a water body and are useful for conservation and management. Our understanding of the health and biodiversity of the aquatic ecosystem is aided by the current study's generation of fundamental data on the diversity of phytoplankton at a different chosen site. Additionally, agro-climatic conditions in each area may have an impact on the presence or absence of genera or populations of plankton.

REFERENCES

1. Adoni A. D. (1985): Work book on limnology, Pratibha Publications, Sagar (M.P.). analysis. Am Nat 146(4): 536-564.
2. APHA (1989) Standard Methods for the Examination of Water and Wastewater, Part 3, Determination of Metals. 17th, American Public Health Association, Washington DC, 164.
3. Bera A, Bhattacharya M, Patra BCH, Sar UK (2014). Phytoplankton density in relation to physico-chemical parameters of Kangsabati reservoir, West Bengal, India, International Journal of Current Research. ;6(6):6989-6996.
4. Bertilsson S, Jones Jr. JB (2003). Supply of dissolved organic matter to aquatic ecosystems: autochthonous sources. In Aquatic ecosystems. Academic Press.;3-24
5. Daniel CB (2005). The importance of terrestrial carbon in plankton food webs; 2005
6. Froneman PW. (2000). Feeding studies on selected zooplankton in a temperate estuary, South Africa. Estuarine, Coastal and Shelf Science ;51(5):543-552.
7. Gaidhane D.M. (2021). Plankton diversity in Wardha river near Rajura in Chandrapur District of Maharashtra, India, Int. Res. Journal of Science & Engineering. ; 9(4):119-123.
8. Gupta T, Dey M.(2013) Hydrobiological characteristics of some semi-intensive fish culture ponds of Lumding town of Nagaon district, Assam, Current World Environment ;8(1):107-115.Available:http://dx.doi.org/10.12944/CWE.8.1.15

9. Harilal CC. (2005) Phytoplankton diversity of two rivers of Kerala with special reference to aquatic nutrients. Pollution Research.;24 (4):773.
10. Harsha TS, Malammanavar SG (2004). Assessment of phytoplankton density in relation to environmental variables in Gopalaswamy pond at Chitradurga, Karnataka. Journal of environmental Biology ;25(1):113-116.
11. Homyra NES, Naz S. (2006). Diversity of phytoplankton in central park lake, Rajshahi, Bangladesh. Pollution Research ;25(2):223.
12. Ibrahim S (2009), A survey of zooplankton diversity of Challawa River, Kano and evaluation of some of its physicochemical conditions, Bayero Journal of Pure and Applied Sciences.;2(1):19-26.Available:https://doi.org/10.4314/bajopas.v2i1.58450.
13. Khatri N, Raval K, Jha AK (2021). Integrated water quality monitoring of Mahi River using benthic macroinvertebrates and comparison of its biodiversity among various stretches. Appl Water Sci.;11:143.
14. Kumar P, Wanganeo A, Sonaullah F, Wanganeo R (2012). Limnological study on two high altitude Himalayan ponds, Badrinath, Uttarakhand, International Journal of Ecosystem ;2(5):103111. Available:http://dx.doi.org/10.5923/j.ije.20120205.
15. MajumderS, Dhua R P, Kar S, Mishra T, Mahapatra S S, Shit S, Patra A (2015). Zooplankton diversity influenced by hydro biological parameters in some ponds of southeastern part of Bankura town of WB, India, International Journal of Advanced Research ;3(5):354368.
16. Malik D.S, Bharti U (2012). Status of plankton diversity and biological productivity of Sahastradhara stream at Uttarakhand, India. Journal of Applied and Natural Science. 2012;4(1):96-103.
17. Martins F.S, Moutinho A, Espinha Marques J, Formigo N, Antunes S.C. (2020) Plankton characterization of alpine ponds: a case of study for the assessment of water quality in Serra da Estrela (Portugal), International Journal of Limnology.;56:4. Available: https://doi.org/10.1051/limn/2020001
18. Parveen S, Mola HRA (2013). Comparison of physico-chemical parameters and zooplankton diversity in two perennial ponds at Aligarh, India, Journal of Environmental Biology.; 34(4):709716.
19. Patterson D. J. (1998): Free-living Freshwater Protozoa., Manson Publishing Ltd 73 Corringham Road, London NW1 7DL. phytoplankton diversity and productivity in the ocean. Natural Community ; 5:4299. Resources ISSN: 2578-4994 Volume 2 Issue 1,pp1-8.
20. R. K. Trivedy and P. K. Goel (1983), "Chemical and Biological Methods for Water Pollution Studies," Environmental Publications, Karad, 1984, pp. 1-22.
21. Rajendra kumar N, Talati (2023): Phytoplankton and Zooplankton Diversity in Rural Wetlands of Anand and Kheda Districts, Gujarat India, Holistic Approach Environ ;133:106–112.
22. Verma AK (2020). Limnological studies of Muntjibpur pond of Prayagraj (U.P.) in relation to planktons, International Journal of Fauna and Biological Studies. ;7(4):27-30.
23. Welch, P.S. (1952) Limnology. 2nd Edition, McGraw-Hill Book Co., New York.
24. Wetzel, R.G. (1983) Limnology. 2nd Edition, Saunders College Publishing, Philadelphia.
25. WHO (1984) International Standards for Drinking Water. 2nd Edition, World Health Organization, Geneva.

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