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PRE-AND POST-MONSOON DYNAMICS OF ALGAL COMMUNITIES IN RIVER BETWA, ORCHHA BUNDELKHAND REGION

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ABSTRACT

In riverine ecosystem, algae play a very important role in primary productivity of the food chain. Freshwater algae live in broad spectrum of environmental conditions. In natural habitats, they typically exist as part of mixed communities comprising multiple species and genera. Various algal forms can be preliminarily identified based on their thallus structure, including its shape and coloration within a specific habitat. The algal diversity studies are important for proper documentation of algal flora indicating the ecological status of the aquatic environment. In India, where the climate is predominantly monsoonal, various forms of algal diversity are observed during both the pre-monsoon and post-monsoon seasons in the Betwa River at Orchha, located in the Bundelkhand region. The Betwa River, a tributary of the Yamuna, flows through in , it travels northeast and before entering , passing through Orchha along its course. The amount of water discharge velocity and transparency influence the occurrence and abundance of algal diversity. During the study conducted in year 2024 in the Betwa River, a total of 18 algal species were identified. Among these, Chlorophyceae were the most abundant compared to other algal groups. Their population was notably higher during the post-monsoon season than in the pre-monsoon period.

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References: 35

INTRODUCTION

Algae are a complex and heterogeneous group of organisms characterized by their photosynthesis nature and their simple reproduction mechanism. It constitutes a large and diverse group of simple, typically autotrophic organisms, ranging from unicellular to multicellular forms (Verma and Prakash, 2020). Algae represent a paraphyletic and polyphyletic group, as they do not include all the descendants of the last universal ancestor, nor do they all descend from a common algal ancestor although their chloroplasts seem to have a single origin. Algae are found in variety of habitats. They can often be found in aquatic (fresh water and marine) as well as certain terrestrial habitats. Algae can survive extreme environment (light, salinity and temperature). Having a paramount role as primary producers in the ocean and food web, they perform significant ecological function (capturing carbon, providing habitat, being a part of the food web etc.)

The river ecosystem is a lotic ecosystem and the seasonal fluctuations in algal diversity in any water body is due to different response of different algal species to changing levels of lights intensity, temperature and availability of nutrients etc. with the change in seasons of a year any aquatic environment has physico-chemical parameters. The physico-chemical characteristics greatly influence the biotic components in a water body (Verma, 2019; Bhagde et al., 2020). The occurrence and abundance of these algae varies seasonally and their study provides a relevant focus for research on eutrophication of water bodies and its adverse impact on aquatic life (Prakash et al., 2015; Verma et al., 2016). Assessed the water quality of the Betwa and nearby water bodies around

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the Jhansi area indicates slightly alkaline pH ranges and increased conductivity due to soluble ions and nutrient enrichment, particularly in the summer months (Zaidi *et al.,* 2011). Because of the oldest flowing water system of Betwa river in central India, its water quality is under stress, hence regular monitoring and appraisal is required to know the health of the rivers. Multivariate statistical evaluation of seasonal water quality including nutrient load implications important for algal dynamics (Akiner *et al*., 2024).

Phytoplankton's is one of the most important organisms in marine and costal environment and are generally comprised of a number of taxonomic groups (Mellard *et al*., 2011). Phytoplankton account for most of the primary productions of the global ocean and produce more than 50% of the oxygen and organic materials depending to their season (Halbling and Villafane, 2009). In societies like our India with developing economics, the optimum development, efficient utilization and effective management of their water resources should be the dominant strategy for economic growth. But in recent years unscientific management and use of these resources for various purpose almost invariably have created undesirable problems in its wake, water logging and salinity in the case of agriculture use and environment pollution of various limited as a result of mining, Industries and municipal use (Kumar *et at.,*2 008). Water is a matchless treasure of the world. There is no replacement for water and yet not introduced by technological science to fulfil the layman this priceless water is consumed by the people without knowing that it is in inconsumable phase. In India, most of the natural water source becomes polluted due to the discharge of domestic sewage industrial effluents, land and agricultural drainage along with excessive human activities (Shrivastava and Kanungo, 2013; Prakash and Verma, 2022; Singh et al., 2023). In tropical countries such as India, climatic conditions are very favourable for algal growth subaerial surface such as building terrace, walls, tree, trunks and soil surface are generally covered by extensive algal growth Existing climatic conditions in these areas coupled with occupational activity in agriculture favours the release and horizontal and vertical movement of dried algal fragments in the atmosphere (Balakrishnan and Gunale, 1980). The relative significance of the growth and mortality factors varies spatially and temporally. This is especially true in tropical environments influenced by monsoon. Monsoon events can be thought of as a disturbance which impacts the niche opportunities available to a species in a system. Climate change influences almost all the aspects (Kumar, 2021; Chakraborty et al., 2021). This occurs either by altering the levels of available nutrients or by influencing mortality (Shea *et al*., 2004). The phytoplankton is microscopic algae suspended in water whose movement are less dependent on current they include micro and microscopic suspended or free floating nonmotile or motile unicellular colonial or filamentous algae. They are ecologically significant as they form the basic link in the food chain of all aquatic animals (Mishra *et al*., 2001). Bio – indicators are taxa or groups of organisms that give signals when affected by environmental pressure due to human activities or destruction of biotic system. Algae are most widely used indicators of biological integrity and physico chemical conditions in aquatic ecosystems (McCormick and Carns, 1994). Algae are ubiquitous group of plants with aquatic photosynthetic mechanisms with specific pigment system (Adoni *et al*., 1985). They are too closely associates of the aquatic environment, and help in maintenance and purification of environment in both aquatic and terrestrial habitat too. A study of algal diversity and their availability popularly known as phycology that's contributes an important branch of botanical research having for researching implications (Chaturvedi *et al.,* 1999). In the dry summer the river appears as narrow flow but, it overflows both the banks during heavy rain of monsoon especially in the months of August and September. The water of the Betwa River is a good habitat for different kinds of aquatic animals and plants, among them microalgae are important microscopic organisms and constitute part of the aquatic floral diversity. The diversity of algae is totally related to the amount and the variation of physico-chemical parameters and biological significant in the river (Debnath and Ray, 2023).

MATERIALS AND METHODS

Study Area: Bundelkhand region of Uttar Pradesh comprising of seven districts viz Banda, Chitrakoot, Hamirpur, Jhansi, Lalitpur and Mahoba which is known as social economically backward region of the country(Fig 1.1). It is situated in the south west of the river Yamuna and slope west to north east The water quality of lake/ pond river has deteriorated sufficiently to cause serious disturbance to the biodiversity of lake / pond / river environment due to lack of proper planning and negligence of regulations an appreciable amount of environment degradation and ecological damage to lake / pond / river water in this region (Kumar *et al*.,2010) The 'Betwa' or 'Betravati' is a river in Northen India and a tributary of the Yamuna it flows north – east through MadhyaPradesh and Orchha to Uttar Pradesh GPS Coordinales Latitude: 25' 54'59.99"N Longitude: 80' 11' 60.00”E 9 (Fig.1.2).

Collection and Characterization of Sample

The present study was conducted during pre-monsoon (March to May 2024) and post-monsoon (October to December 2024) from Betwa river. The algalsample were collected in clean plastic containers, water bottle test tube and came to the laboratory and washed it properly below the running tap water to remove the soil and associated debris from it. For observation under microscope, we require glass slide and coverslips. sample is taken on the slides and cover it with cover glass after this place on stage of microscope first see in 10x then for further magnification use 40x lens than we take a photography by camera on the basis of characteristic feature identified the class, order and genera with the help of available book (Desikachary, 1959; Gupta, 2005), monographs and online sources.

Fig. 1.1 Betwa River near Orchha.

Fig 1.2: Map of river Betwa near Orchha Madhya Pradesh.

Table 1: Algal flora during pre and post monsoon seasons in Betwa River.

Algal class	Algal Genera	Pre-mansoon season	Post-mansoon season
Chlorophyceae	*Cladophora*	+	+
	Closterium	-	+
	Coelastrum	-	+
	Pandorina	+	+
	Spirogyra	+	+
	Pithophora	+	-
	Ulotheix	+	+
	Volvox	+	-
	Zygnema	-	+
Myxophyceae	*Anabaena*	+	+
	Oscillatoria	-	+
	Phormidium	+	-
	Rivularia	-	+
Bacillariophyceae	*Navicula*	-	+
	Pinnularia	-	+
	Synedra	+	-
	Cyclotella	+	-
Euglenophyceae	*Euglena*	-	+

● + sign Indicate present and – sign indicate absent

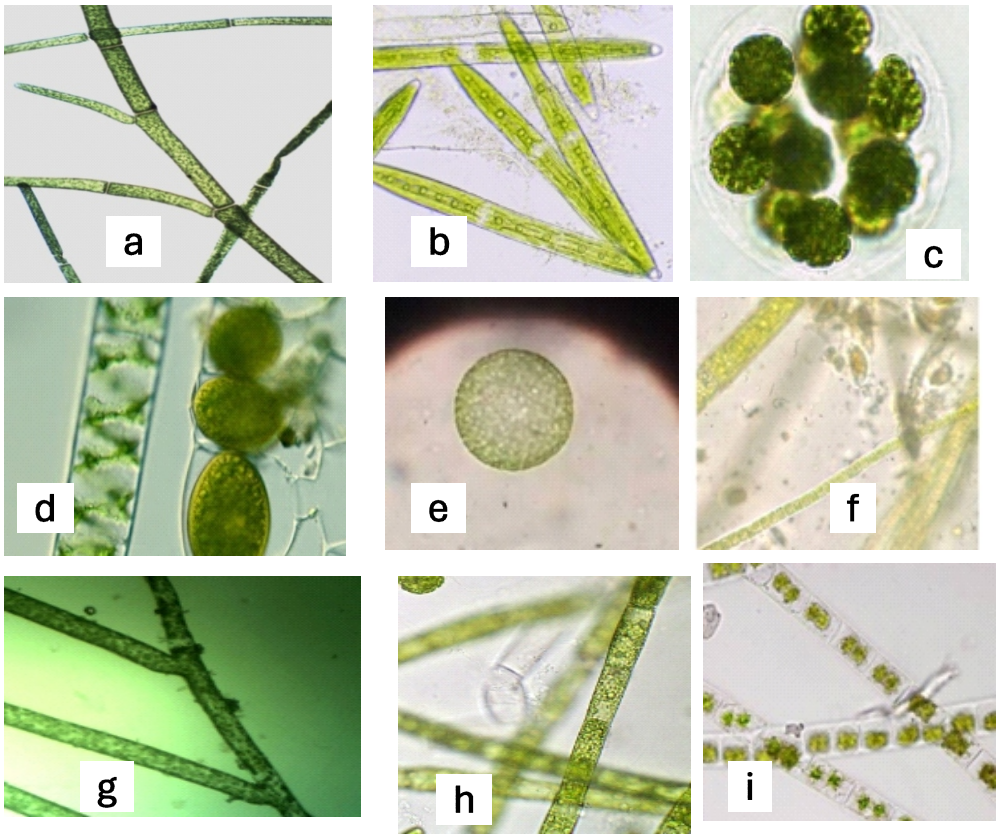

Fig.2: Photograph of Chlorophyceae members (a) *Cladophora* (b)*Closterium* (c) *Pandorina*(d) *Spirogyra* (e) *Volvox* (f) *Ulothrix* (g) *Pithophora* (h) *Oedogonium* and (I) *Zygnema.*

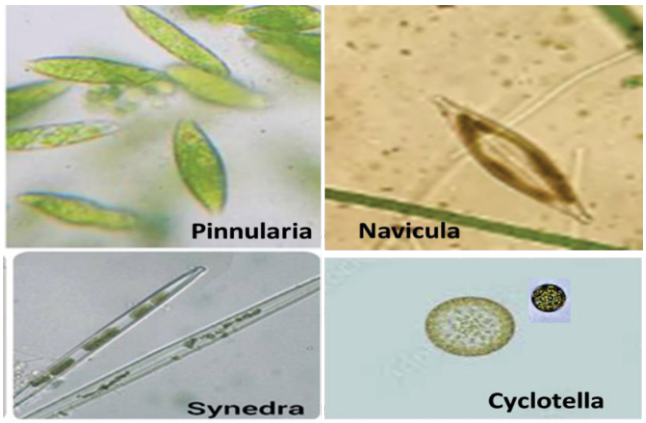

Fig. 2.2: Photograph of members Bacillariophyceae.

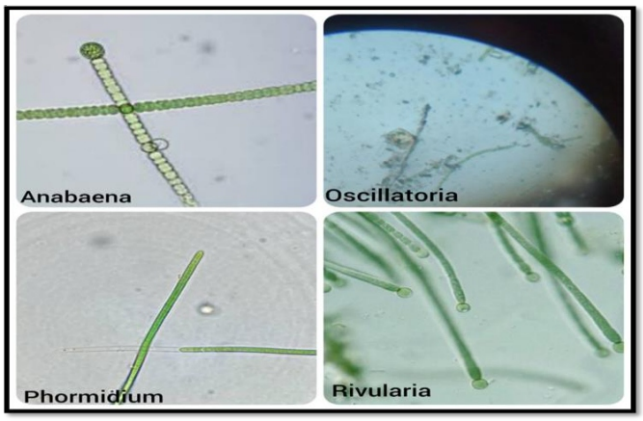

Fig. 2.3: Photograph of member Myxophyceae.

Fig. 2.4: Photograph of member Euglenophyceae.

Result and Discussion

During the study period from river Betwa near Orchha, total 18 algal taxa were identified on the basis of morphological characteristic, taxonomically and microscopic study. The diversity as well as distribution of algae has been studied throughout the Betwa river in pre and post monsoon seasons. These microalgae belonging to four major classes (Table.1) and among them, Chlorophyceae were dominant over all other groups (Fig 2.1). Euglenophyceae were the least present, i.e. only one species because related research findings previously reported that Euglenophyceae were more present in polluted water (Fig.2.4). The Chlorophyceae group includes nine members in which *Spirogyra, Pandorina* and *Cladophora* was found abundantly in pre and post monsoon periods. *Coelastrum, Ulothrix, Volvox* and *Pithophora were* appeared during premansoon seasons while *Closterum, Zygnema* sp. Dominate during post mansoon period. Members of Myxophyceae include five members (*Anabaena, Oscillatoria, Phormidium* and *Rivularia* were reported (Fig.2.2). Group Bacilliriophyceae include three members i.e. *Diatoms, Pinnularia* and *Synedra* sp. (Fig.2.3) while the group Euglenophyceae include only single member of *Euglena* species were found.

The overall variety of algal population is higher during post monsoon periods than the pre monsoon periods as indicated in the Table 1. Similar results have also been derived in studies conducted on algae in West Garo hills, Meghalaya (Barman *et al*., 2015). Related studies in this area have been carried out by many researchers with different algal communities (Singh and Chaudhary, 2011; Prasad and Mishra., 1992; Mishra *etal*., 2002; Keshri *et al*., 2013 and Verma *et al*., 2016). In the Betwa rivers supports much diversified phytoplanktonic and zooplanktonic community and dominated by Chlorophycean members (Mishra and Yadav, 2019). The seasonal climatic trends (pre-monsoon vs post-monsoon variability) and hydrological impact influencing ecological dynamics including algal assemblages and other aquatic flora (Desai et al., 2019; Kumar et al., 2022). Sometime in the river, availability of diatoms indicates the seasonal sampling that are directly relevant to algal community dynamics methodology (Tiwari and Mishra 2025). The presence of these biotic communities in the sufficient quantities is considered as an essential tool for the actual management of aquatic biota. There are so many factors influencing the dominance of algal diversity in river such as water temperature, nutrient availability, water Flow and turbidity as well as pH and salinity of the water bodies.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest regarding this paper. All authors confirm that there are no competing interests to disclose

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