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A Study of Physico-chemical Parameters and their Relation to Phytoplankton's diversity with reference to seasonal variations of River Narmada at Harda (M.P.) India

Pavan Kumar Rathore[1]*, Rakesh Mehta[1], Sunil Bourasi[2] and Muskaan Jain[3]

[1]Department of Botany, Govt. M.G.M. P.G. College, Itarsi, India.
[2]Department of Botany, Govt. College, Rawti, India.
[3]Department of Microbiology, Harda Degree College, Harda, India.
*Author for correspondence Email: pawanrathore47@gmail.com

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ABSTRACT

Water is important factor of life, all living beings depends on it. Water provides nutrients for all aquatic living beings. Water is home for various algae. Algae are primary producers which characterizes the habitat where they occur. Healthy aquatic ecosystem is dependent on its physico-chemical and biological characteristics. Physico-chemical parameters of river determine the diversity of phytoplankton. The present study has been undertaken to access the spatial diversity of phytoplankton community of River Narmada at Harda and its correlation with the physico-chemical parameters of the water body. The samples were taken from various sites of River Narmada and immediately brought to laboratory for the estimation of various physico-chemical parameters analyzed using standard procedures. The identification of phytoplanktons was done by standard books, monographs and Keys. River Narmada represents 43 taxa, Chlorophyceae represents19 taxa, Cyanophyceae represents 9 taxa and Bacillariophyceae represents15 taxa. Chlorophyceae was dominant irrespective of other species at River Narmada in every season. The river water quality was not satisfactory and it is highly recommended to adopt proper monitoring.

Keywords: *Monitoring, Narmada, Physico-chemical, Planktons, Water.*

INTRODUCTION

Water is a most valuable solvent for various organic and inorganic nutrients. Fresh water ecosystems can provide the well productive environment for aquatic living like algae. Water is home for various algae. Algae are the soft, delicate and readily decomposable primary producers which characterizes the habitat where they occur Sharma *et al.* (2013). The term algae refers to small microscopic unicellular organisms some of which form colonies and thus appears through

naked eyes as tiny green particles which appears at the areas which are moist and at places where water is abundant.

These appear green in colour due to presence of pigment Chlorophyll in them. Some algae are found freely floating on the surface of water these are known as Phytoplanktons. Phytoplankton's represents the microscopic algal communities present in water bodies and are the creators of aquatic food chain. Phytoplanktons are the productive base of the food chain in freshwater ecosystems. Sharma and Singh, (2013), studied a close relation between physico-chemical parameters with phytoplankton and observed significant results. Seasonal variations affect the water bodies, Physico-chemical parameters of river determine the diversity of phytoplankton on the surface of water. Shinde *et al.,* (2012) Healthy aquatic ecosystem is dependent on its physical, chemical and biological characteristics. Due to their short life span phytoplanktons can adopt rapid changes in the structure and physiology with the surrounding, this ability inturn influence ecological interactions. The main sources of water pollution are sewage, industrial waste and agriculture discharges (Hosmani and Bharathi, 1980). The present study has been undertaken to access the spatial diversity of phytoplankton community of River Narmada at Harda and its correlation with the physico-chemical parameters of the water body.

MATERIALS AND METHODS:

Harda is situated on the bank of River Narmada, 22'19'59 N and 77'05'59 E coordinates, Handiya, a village located 20 kilo meters north of District Harda of Madhya Pradesh. The present study has been conducted for a period of one year i.e. 2020-2021. The investigation period was divided into three seasons i.e.winter, summer and rainy season respectively. Water samples were collected from different sampling sites in sampling bottles during 9 am to 5 pm. The samples were immediately brought to laboratory for the estimation of various physico-chemical parameters and Temperature, Transparency, pH, EC and TDS were recorded on spot at the time of sample collection. Calcium, Magnesium, Phosphate, Chloride, Hardness, DO,BOD and alkalinity were analyzed using standard procedures in the laboratory by using methods as prescribed by APHA(2002), Trivedy and Goel (1986).Biological samples of Phytoplanktons were collected from their habitats such as running and stagnant water by method of fowling Taylor*et al.,* (2007) and were preserved by adding 4% formalin solution and Lugol's solution. The identification of phytoplanktons was done by standard book, monographs and Keys given by Fritsch (1935), Smith (1950), Prescott (1962) and Agarkar(1975).

RESULTS AND DISCUSSION:

Physico-chemical Parameters- Water is of enormous significance as it regulates various biotic and abiotic factors of an aquatic ecosystem.

Water Temperature: The River water temperature 20°C was observed during winter, 34°C during summer, and 28°C during Rainy season respectively. Temperature is one of the most important factors in the aquatic environment.

pH: The pH values of the River Narmada water were relatively higher during summer season which is pH 8.5 as compared to rainy season pH 8.2 and winter season pH 8.3 respectively. The phytoplanktons usually survive Higher value of pH is normally associated with high photosynthetic activity in water (Hujare, 2008).

Electrical conductivity: Electrical conductivity of River Narmada water is in measured during winter season is 305µs/cm, during summer season is 265µs/cm, and during Rainy seasons 190µs/cm respectively. Electrical Conductivity of water is directly proportional to temperature.

TDS: TDS of water usually depends on its constituents. The TDS of River Narmada water during winter season is 205 mg/lit., during summer season is 285 mg/lit. and during Rainy season is 145 mg/lit., respectively. Increase in the TDS further directly affects the conductivity as increase in the ion content will inturn increase the conductivity due to which there is rapid increase in the pollution load of River Narmada.

Transparency: Water transparency determines the depth of the photic zone and consequently affects the lower limit of light penetration that influences the primary productivity of River Narmada. Solids were also recorded in rainy season and they are responsible

for decrease in transparency. Transparency was 65cm during winter, 78cm during summer and 45 cm during Rainy season respectively.

Calcium: Calcium is a micro nutrient in an aquatic environment.Calcium contents of water in the river vary from 46 mg/l during winter, 51 mg/l during summer and 25 mg/l during rainy season respectively.

Water hardness: Hardness of the river water fluctuates due to presence of ions, It is 162 mg/l during winter, 126 mg/l during summer and 83 mg/l during rainy season respectively.

Alkalinity: The alkalinity showed the quantities of bicarbonates and carbonates in water which were recorded maximum 165 mg/l during winter, 142 mg/l during summer, minimum of 80 mg/l during rainy season respectively. Bourasi*et al.* (2019) also recorded high alkalinity during winter season at same site of river Narmada.

Magnesium: Magnesium content represents the temporal and spatial variations. Magnesium content was highest 36 mg/l during winter, 13 mg/l during summer and 8.9 mg/l during rainy season respectively.

Chloride: Main sources of chloride in river water are sediments, sewage and industrial effluents. The highest value may be attributed due to the presence of excess organic matter. Chloride content of water in the river during winter season is 17 mg/l, during summer season is 29 mg/l and during rainy season are 12 mg/l respectively.

Phosphate: The highest concentration of the phosphate is due to the organic pollution and it is because of the fact that river receives huge amount of domestic sewage. The concentration of phosphate in water is 1.2 mg/l during winter, 1.4 mg/l during summer and 1.9 mg/l during rainy season respectively.

Dissolved oxygen: DO levels in river Narmada water depends on the physical, chemical and biological activities in water bodies. Analysis of DO is a most important factor in studies of pollution. The DO contentduring winter season is 8.3 mg/l,during summer season is 6.3 mg/land during rainy season is 5.1 mg/l respectively. The high concentrations of DO in river water indicate high aeration rate and rapid aerobic oxidation of biological substances. The higher concentration of dissolved oxygen during winter season was probably due to low water temperature, less turbidity and increased photosynthetic activity of phytoplanktons. Higher dissolved oxygen in water supports more phytoplanktonic growth.

Biological Oxygen Demand: B.O.D. is the measure of oxygen used by the micro-organisms for biological oxidation of organic matter. The B.O.D. test is useful for water resources pollution control management. In present study the higher B.O.D. values are due to high temperature during summer, which promotes ample of microbial activities. As per observation, the value of BOD is 2.6 mg/l during winter, 4.8 mg/l during summer and 3.7 mg/l during rainy season respectively. Observation of Physico-chemical Parameters displayed in Table 1 with reference to seasonal variations..

Table 1: Showing the value of Physico-chemical parameters of River Narmada 2020-21 at Harda.

Sr. No.	Parameters	Winter	Summer	Rainy
1.	Water Temperature (°C)	20	34	28
2.	TDS (mg/lit.)	205	285	145
3.	Magnesium (mg/lit.)	36	13	8.9
4.	pH	8.3	8.5	8.2
5.	Alkalinity (mg/lit).	165	142	80
6.	Water Hardness (mg/lit.)	162	126	83
7.	DO (mg/lit.)	8.3	6.3	5.1
8.	BOD (mg/lit.)	2.6	4.8	3.7
9.	Calcium (mg/lit.)	46	51	25
10.	Phosphate (mg/lit.)	1.2	1.4	1.9
11.	Chloride (mg/lit.)	17	29	12
12.	Electrical conductivity (µs/cm)	305	265	190
13.	Transparency (cm)	65	78	45

Table 2: Diversity of phytoplankton in Respective Seasons of 2020-2021 at River Narmada.

Sr. No.	Phytoplankton	Winter	Summer	Rainy
	Chlorophyceae			
1	*Chlamydomonas sp.*	AA	R	AB
2	*Closterium sp.*	AA	AA	R
3	*Scenedesmus sp.*	AA	AA	R
4	*Eudorina sp.*	AA	R	R
5	*Chlorella sp.*	R	AB	R
6	*Hydrodictyonsp.*	AA	AA	AB
7	*Cosmarium sp.*	AA	AA	R
8	*Spirogyra sp.*	AA	AA	AB
9	*Pediastrum sp.*	AA	AA	AB
10	*Staurastrum sp.*	R	AB	AB
11	*Ulothrix sp.*	AA	R	R
12	*Volvox sp.*	AA	AA	AB
13	*Zygenemasp*	AA	AA	AA
14	*Microspora sp.*	AB	AA	R
15	*Oedogonim sp.*	R	R	AB
16	*Tetraspora sp.*	AB	AB	AB
17	*Mougeotia sp.*	AA	AA	AB
18	*Chlorococcum sp.*	AB	R	R
19	*Pandorina sp.*	R	AA	AB
	CYANOPHYCEAE			
1	*Oscillatoria sp.*	AA	AA	R
2	*Spirulina sp.*	AB	AA	AA
3	*Anabaena sp.*	AA	AA	R
4	*Nostoc sp.*	AA	AA	AB
5	*Rivularia sp.*	AA	AB	R
6	*Microcystis sp.*	AA	AA	AB
7	*Lyngbya sp.*	R	AA	AB
8	*Nodularia sp.*	R	R	AB
9	*Chroococcus sp.*	R	AA	R
	BACILLARIOPHYCEAE			
1	*Cyclotella Sp.*	AA	R	AB
2	*Cymbella sp.*	AA	AA	R
3	*Pinnularia sp.*	*AA*	*AA*	*AA*
4	*Pennales sp.*	*AA*	*R*	*R*
5	*Synedra sp.*	*AA*	*AA*	*AA*
6	*Navicula sp.*	*AA*	*AA*	*AA*
7	*Asterionella sp.*	*R*	*AA*	*R*
8	*Melosira sp.*	*AA*	*R*	*R*
9	*Fragilaria sp.*	*AA*	*AA*	*R*
10	*Nitzschia sp.*	*AB*	*AA*	*R*
11	*Gomphonema sp.*	*AA*	*AA*	*AB*
12	*Tabellaria sp.*	*R*	*AA*	*AB*
13	*Gyrosigma sp.*	*AA*	*AA*	*AB*
14	*Amphora sp.*	*AA*	*R*	*R*
15	*Cocconies sp.*	*AB*	*AB*	*AB*

Abbreviations: AA- Abundance, R- Rare, AB- Absent

The phytoplankton's communities of the present water body were represented mainly by three groups of algae known as Chlorophyceae, Cyanophyceae and Bacillariophyceae. In the present investigation phytoplanktonic diversity of River Narmada represents 43 taxa. Chlorophyceae represents 19 taxa which were dominant of all algal groups in all seasons. They were reported in abundance during the winter season and during rainy season their many forms were disappeared. Cyanophyceae represents 9 taxa and was at its peak in summer and winter season. Bacillariophyceae represents 15 taxa in all seasons. In summer season the abundant sp.were *Zygnema, Closterium, Cosmarium, Fragilaria, Gomphonema, Scenedesmus, Spirogyra, Synedra, Navicula, Cymbella, Microcystis, Pediastrum* were observed, these were identified as eutrophic pollution indicator species. *Navicula* sp. was dominant which was observed throughout the year in fresh water. *Hydrodictyon*, *volvox , Nostoc, Gyrosigma* observed in winter and summer season and are disappeared during rainy season. *Closterium, Scendesmus*, *Chroococcus, Pennales, Ulothrix and Microspora sp.* are rarely observed during the research period. Maximum phytoplanktonic diversity during summer may be due to presence of excessive food substances required for their growth. Rainy season does not support its growth due to less value of Dissolved oxygen, heavy flow of water, low temperature and high water current. Light plays an important role in productivity of phytoplankton as chlorophyll is required for its growth. The penetration of light was immense during winter and summer season and due to excess turbidity in rainy season light penetration is low.

CONCLUSION

Chlorophyceae was reported as dominant, with 19 taxa reported throughout the year and Bacillario-phyceae was reported the second dominant and has 15 taxa, Cyanophyceae has 9 taxa and it was observed in abundance in summer. Phytoplanktonic diversity of the River Narmada was low during Rainy season and was high during summer and winter seasons respectively. The winter season was favourable for phytoplanktons growth due to alkaline pH, high TDS, low temperature and high DO concentration. During winter season the river water was reported as mesotrophic and during summer it became Eutrophic. River Narmada needs constant monitoring, as water of the river is to be used for potable purpose at a large scale.

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Conflict of Interest: The author(s) declares no conflict of Interest.

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