



Assessment of water quality of Segwal dam using Nygaard's phytoplankton quotient

Pooja Mahajan

Research Scholar, School of Life Sciences, Devi Ahilya Vishwavidyalaya, Indore

E-mail : poojamahajan1307@gmail.com

Article Info

Received: 10-01-2021,

Revised: 28-03-2021,

Accepted: 01-04-2021

Keywords: Lentic system, phycology, organic pollution, hydrology, bio indicators, phytoplankton

Abstract

The present study was carried out to analyse the phytoplankton abundance and distribution in Segwal dam at Barwani district of Madhya Pradesh state. The assessment of water quality was done with the application of Nygaard's phytoplankton quotient. A total of 27 phytoplankton species were identified from the three sampling stations belonging to five taxa. Chlorophyceae was recorded as taxa with highest species score of about 40.74 %, followed by Cyanophyceae, Bacillariophyceae, Dinoflagellates and Euglenophyceae of about 29.63 %, 18.52 %, 7.40 % and 3.70 % respectively. Sixteen physico-chemical parameters were studied and their variations greatly affect the distribution of phytoplankton species. The study shows that despite the variation in species abundance, the physical chemistry of the water did not vary greatly and Segwal dam water is weakly eutrophic.

INTRODUCTION

Plankton is a collective term which refers to both plants and animals that are unable to resist movement of water current. In general, algae are considered as a large assemblage of plants and constitute the most common photosynthetic plankton which have diverse habitat, size, organization, physiology, biochemistry and reproduction. Algae are an informative group to monitor as indicator for environmental degradation. Algae which are freely suspended in water are called phytoplankton. All phytoplankton are sensitive to environmental changes but some are more sensitive than others. Greater diversity of phytoplankton indicates better quality of water body. If there is a drop in the diversity of phytoplankton species and its related members then it may indicate an adverse water quality or sewage water.

However natural seasonal changes may also cause fluctuations in the diversity, distribution and abundance of algal members. In addition, the

seasonal variation in phytoplankton species distribution is also affected by human factors such as irrigation, agriculture and farming.

On the basis of taxonomic schemes, phytoplankton have been identified and put into 24 classes and about 26000 species (Ariyadej *et al.*, 2004). On account of the interaction between physical, chemical and biological properties of water, the production of phytoplankton is determined apart from their distribution, composition and diversity (Pinkney James *et al.*, 2015). Phytoplankton are generally important in tropical reservoir ecosystem in order to assess water quality, pollution assessment, energy flow, food chain and fish yield.

Segwal dam present an important opportunity for studying phytoplankton periodicity in order to study ecological succession and species richness. This dam although not very large, but the survey of phytoplankton species available in the dam and their interaction with physicochemical parameters may provide a good base for research

especially on the pollution related issues. It is one of the bio monitoring technique which would provide a healthy integrity of the dam. Hence the present study is aimed to determine the diversity and abundance of phytoplankton species and its relationship to physicochemical factors which affect their succession in Segwal dam.

MATERIALS AND METHODS

The study was conducted at Segwal dam during the year 2018-2019. Segwal dam is situated in Segwal village at Barwani district, Madhya Pradesh and lies at 22°03'11" N Latitude and 70°21'46" E Longitude. The area has an estimated average rainfall of 734 mm with two distinct major seasons (i.e. rainy and dry). The rainfall is irregular and uneven and about 80 to 90 percent rain is recorded during June to September. A few showers are recorded in short winter. During study period of 2018. The minimum (11.3°C) and mean maximum (45.5°C) temperatures were recorded in February, 2018 and May, 2018 respectively. It is 58 km away from Barwani district headquarter and easily reachable by road. Khandwa is the nearest Central railway station. Biogeographically this region is included in Central India. This reservoir was constructed during the state time before Independence. Its catchment area is 50 sq. Km. And nearly 445 hectares of land is irrigated with the help of this reservoir.

In order to study the algal members, the water samples were collected and preserved in 4% formalin. The identification was done with the help of standard literature (Desikachary, 1959; Cole, 1975; Kamat, 1981; Philipose, 1967; and Randhawa, 1959). For the assessment of water quality, Nygaard's Trophic state of indices (1949, 1976) were applied. Percentage of species per taxa reported from the present study are shown in Table 1, in Table 2 and Nygaard's Trophic state of indices are shown in Table 3. The number and distribution of species during different months of Station I, II and III are shown in Tables 5, 6 and 7 respectively.

RESULTS AND DISCUSSION

From Table 1 it is revealed that in all 27 members of phytoplankton belonging to five taxa are reported, out of which 11 members belong to Chlorophyceae, 8 to Cyanophyceae, 5 to Bacillariophyceae, 2 to Dinoflagellates and 1 to Euglenophyceae. In addition to this 2 microscopic invertebrates i.e. *cyclops* and *Rhabditis* are also

reported in some of the water samples collected from Segwal dam. From Table 2 it is indicated that lowest percentage composition of phytoplankton is of Euglenophyceae (3.70 %) and highest percentage is obtained for Chlorophyceae (40.74%). The results shown in Table 3 indicate that values of Nygaard's Trophic state of indices for Chlorophyceae, Cyanophyceae, Bacillariophyceae, Euglenophyceae and Dinoflagellates are 0.00, 2.5, 0.00, 0.1 respectively. The compound quotient was 3.66. when modified compound quotient was applied, its value is calculated as 5.3 indicating that the man-made reservoir of Segwal dam is under the process of weak eutrophication. This is due to the predominance of blue-greens and diatoms over desmids which generally affects the water quality of the aquatic body. From Table 5, 6 and 7 it is revealed that green algae are dominant in Aug. 18 in Station III while Cyanophyceae and Bacillariophyceae are mostly present in Station I. As regards, Euglenophyceae and Dinoflagellates their members are occasionally present in different months and in most of the months they are observed in the water samples.

The level of physicochemical parameters which is estimated in sampling stations determines the composition and abundance of phytoplankton. The range of temperature (28°C - 29°C) is one of the important factors which determines the species abundance. The temperature was low in Station III and high in station I and II. The variation may be due to difference in sampling station. In addition, sampling station III was closer to nearby vegetation and the shading effect of the vegetation in part blocked the area from receiving direct sun light which caused lowering of the temperature. The p^H of water was 7.1 to 7.2 and it falls below the range of 7.8 as it is the permissible limit for drinking water.

The water conductivity range from 354.30 to 360.70 found in all the sampling stations is within the values specified for conductivity values between 50 to 1500 micromhos. Turbidity is extremely important factor because if it is more, then sun light would be obstructed deeply in water and sun being primary source of energy, the biological phenomena would be adversely affected. This could be the reason why the high turbidity level of Station I (8.9 NTU) and II (8.6 NTU) harbours the highest phytoplankton composition. As regards Station III shows low turbidity (3.1 NTU).

Table 1: Mean physicochemical parameters of sampling stations

Physicochemical parameters	Station I	Station II	Station III	Mean
Temperature (°C)	29.00	29.00	28.00	28.66
Water p ^H	7.2	7.2	7.1	7.1
Water conductivity (micromhos)	360.70	360.20	354.30	358.40
Turbidity (NTU)	8.9	8.6	6.2	7.9
Total dissolved solids (mg/l)	756	654	456	622

Table 2 : Percentage of species per taxa

Algal taxa	Species score	Types of Species	Percentage
Chlorophyceae	11	<i>Ankistrodesmus , Chlorella , Closterium, Cosmarium, Pediastrum , Scenedesmus denticulatus , Scenedesmus quadrifida, Sirogonium , Spirogyra ,Staurastrum, Zygnema</i>	40.74
Cyanophyceae	8	<i>Anabaena, Aphanocapsa, Chroococcus, Cylindrospermum, Merismopedia, Oscillatoria, Oscillatoria, Phormidium</i>	26.39.
Bacillariophyceae	5	<i>Cymbella , Navicula, Nitzchia Pinnularia Synedra</i>	18.52
Euglenophyceae	1	<i>Euglena</i>	3.70
Dinoflagellates	2	<i>Ceratium, Dinobryum</i>	7.40

Table 3 showing class wise composition of phytoplankton diversity from three Stations of Segwal dam

S.No.	Class	Genera	Species
1	Chlorophyceae	10	11
2	Cyanophyceae	7	8
3	Bacillariophyceae	5	5
4	Euglenophyceae	1	1
5	Dinoflagellates	2	2
Total	07	25	27

Anthropogenic activities for example bathing, livestock deposit, irrigation and farming were major contributing factors affecting turbidity level of Segwal dam. Other physico chemical factors such as total hardness, calcium and magnesium, nitrate chloride also show low percentages in Station III while total dissolved solids and potassium indicated more amounts in Station II.

Phytoplankton are extremely important in an aquatic ecosystem because they are the primary producers of all aquatic food chains and their photosynthetic process is important for monitoring sufficient oxygen levels in the water to meet the respiration needs of aquatic animals. Green algae are less preferred by aquatic animals as food. Pollution of water due to various agencies is one of

Table 4 Nygaard's Trophic State of indices

S.No.	Name of Index	Mode of calculation	*Index value
1	Cyanophycean	Cyanophyceae /Desmids = 7/3	2.3
2	Chlorophycean	Chlorococcales /Desmids= 3/3	0.0
3	Bacillariophycean	Centric/Pinnate forms= 0/5	0.0
4	Euglenophycean	Euglenophyceae/chlorococcales+Blue-greens = 1/7+3	0.1
5	Compound quotient	Blue-greens+chlorococcales+Centric +Euglenophyceae /Desmids= 11/3	3.6
6	Modified compound quotient	Bluegreens+Diatoms+ Chlorococcales+ Euglenophyceae /Desmids = 16/3	5.3

*Index value 0 -2 = Oligotrophic, 2 -6 = Weak eutrophic, 6 and above = Eutrophic

Table 5 Station I Showing the number and Distribution of species during different months

Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chlorophyceae	4	5	4	6	5	6	5	6	6	6	4	5
Cyanophyceae	7	6	7	7	6	7	7	6	6	7	7	7
Bacillariophyceae	4	2	3	5	5	5	5	5	5	5	5	5
Euglenophyceae	1	1	-	1	1	-	-	-	1	1	1	-
Dinoflagellates	1	1	-	2	2	1	1	1	-	-	1	1

Table 6 Station II Showing the number and Distribution of species during different months

Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chlorophyceae	4	5	4	5	4	6	5	6	5	6	4	3
Cyanophyceae	6	4	5	6	6	6	6	5	5	6	6	6
Bacillariophyceae	3	3	3	1	2	2	3	2	3	1	2	3
Euglenophyceae	1	-	1	1	1	-	-	-	1	-	-	-
Dinoflagellates	-	1	-	2	2	1	-	1	-	-	1	1

Table 7 Station III Showing the number and Distribution of species during different months

Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chlorophyceae	7	7	7	6	7	6	7	8	8	6	5	8
Cyanophyceae	3	2	3	2	3	3	3	3	2	2	3	3
Bacillariophyceae	2	2	1	1	1	1	2	2	2	2	-	1
Euglenophyceae	1	-	-	1	1	1	-	-	-	1	-	1
Dinoflagellates	1	-	-	1	1	-	-	1	-	-	-	1

the important causes which helps to increase the number of blue green algae . Such conditions are the main reasons for eutrophication of the aquatic body at a faster rate. Due to this water is not suitable for drinking purpose but it is helpful for fish production to a certain extent. The limnological behaviour of an aquatic body is of much importance for the effective water

management in relation to human need. Biological indices offer a cheap , fast and effective means of finding the pollution status of the water. By employing Nygaard's indices it is found that Segwal dam under investigation indicated organic pollution and its water is gradually under the process of eutrophication.

Acknowledgements

Authors are thankful to the Head, School of Life Sciences, Devi Ahilya Vishwavidyalaya, Indore for laboratory and library facilities, Dr. Shakun Mishra, Supervisor, Botany Department S.N. Govt. P.G. College, Khandwa and Dr. Kamla Shivani, Co-Supervisor, Govt. Holkar Science College, Indore for guidance and valuable suggestions.

References

Ariyadej, Chalinda, Reungchai, Tansakul, Pimpan, Tansakul and Saowapa Angsupanich, 2004. Hytoplankton diversity and its relationship to the physico-chemical environment in the Banglang Reservoir, Yala Province Songklanakarin. *J.Sci. Technol.* **26**: 595-607.
Cole, GA, 1975. *Text Book of Limnology*, C.V.Mosby Company, Saint Louis,
Desikachary TV, 1959. *Cyanophyta*, ICAR, New Delhi.

Kamat ND, 1981. Diatoms and diatom populations indicating water quality and pollution, W.H.O.

Nygaard G, 1949. Hydrological studies on some Danish ponds and lakes, II, The quotient hypothesis and some new or little known phytoplankton organisms.

Nygaard G, 1976. Tavlerne fra dansk my plankton Gyldendal, 25.

Philipose MT, 1967. *Chlorococcales*, ICAR, New Delhi.

Pinckney, James, L, Claudia R. Benitez-Nelson, Robert C. Thunell, Frank Muller Karger, Laura Lorenzoni, Luis and Ramon Varela, 2015. Phytoplankton community structure and depth distribution changes in the Cariaco Basin between 1996-2010. *Deep Sea Research Part 1 : Oceanographic Research Papers*, **101**:27-37.

Randhawa MS, 1959. *Zygnemaceae*, ICAR, New Delhi.

How to cite this article

Pooja Mahajan, 2021. Assessment of water quality of Segwal dam using Nygaard's phytoplankton quotient. *Bioscience Discovery*, **12**(2):73-77.

Google Scholar citation: <https://scholar.google.co.in/citations?user=vPzEyC8AAAAJ&hl=en>