ORIGINAL RESEARCH ARTICLE

STUDIES ON ALGAL DIVERSITY, MORPHOMETRY OF PONDS AND NYGAARD'S TROPHIC STATE OF INDICES: IN RELATION OF FIVE PONDS AT KHANDWA (M.P.), INDIA

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ABSTRACT:

Khandwa district of M.P. has many natural and manmade wetlands covered by algal blooms. Algal flora were collected from five ponds present in and around Khandwa city, which situated on central railway. A total of 130 taxa of phytoplankton were collected during the year with Cyanophyceae 44 species belonging 28 genera, Chlorophyceae 52 species belonging 34 genera and Bacillariophyceae 24 species belonging 22 genera being main components; Euglenophyceae, Xanthophyceae and Dinophyceae were represented by a few species. Maximum number of species of Cyanophyceae was encountered during summer season, whereas the species richness of Chlorophyceae was occurred maximum during October.

KEYWORDS: Algal, Diversity & Nygaard's Trophic, Five Ponds, Khandwa (M.P.)

INTRODUCTION:

Water is one of the most vital factors in the existence of living organisms. Water covers about 70% the earth of which more than 95%, exists in gigantic oceans. The term "Limnology" is derived from the Greek word, limne or limnos, meaning "pool, marsh or lake". Limnology is a very complex scientific subject and we owe its first definition (the oceanography of lakes) to Professor F.A. Forel (1892) who has been called the father of "Limnology". Now-a-days limnology is defined as the "science of inland waters," concerned with all the factors that influence living organism within those waters (Singh, H.R. 1989).

Khandwa has ponds like Nagchoon Talab, Doodh Talai, Singhad Talai, Padam Kund and Rameshwar Kund, for a long time they supplied potable water to the residents. They are however not in use now-a-days. No work on their Limnological parameters has so far been reported, with increasing population and depleting sources of potable water their assessment has become a matter of great importance. So it has become highly imperative to conduct such investigation. The ecological studies encompass not only the various branches of science but humanities also. A study of Limnological parameters and algal flora is a prerequisite for assessment of water quality and its subsequent use. The ponds can then be used for pisciculture and cultivation of plants of economic importance. The study of ponds will have a social significance also.

Recently Mahajan, S.K. and Mishra, S. (1986, 1988a, 1988b, 1990a, 1990b, 1990c, 1990d, 1991a, 1991b, 1991c, 1993, 1994a, 1994b, 1994c) had conducted investigation in East Nimar. Thus the literature review suggests that studies on M.P. freshwaters dates back to the latter half of the last century and were in the nature of presenting species list and descriptions of taxa, new to then Madhya Pradesh. Attempts on the seasonality of freshwater plankton were made, followed by a long series of Hydrobiological studies of freshwater impoundments, mostly on ponds and reservoirs. However such studies at Khandwa are scanty, keeping this in mind the present study is designed to survey the phytoplankton, selecting five ponds, at Khandwa (M.P.).

STUDY AREA:

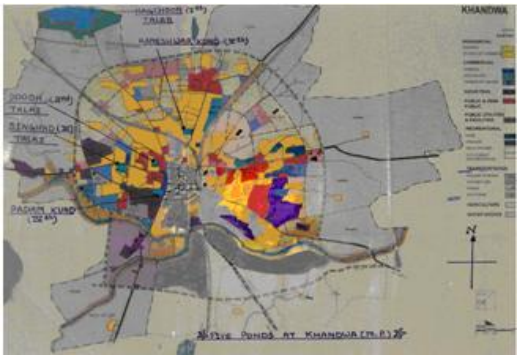

Figure 1: Map showing study area

Khandwa, the district headquarter of East Nimar is a Junction of Central Railway. It has a very long history. Infect its name itself is supposed to originate from Khandwan, a forest mentioned in the epic Mahabharata. It has been a connection between North and South India. Its area is

10779 Km^2 and is situated at 21^0, 05′ to 22^0, 25’ N latitude and 75^0, 57’ to 77^0, 33’ E longitude and 304 m above MSL. Topographically it lies on the uplands between the Valleys of Narmada and Tapti flowing parallel to each other from East to West. The average annual rainfall is 736.8 mm. The climate is in general hot. The city itself has many ponds is in all the directions with rich aquatic flora. The fresh water ecosystems are very important to urban men just like parks etc.

Khandwa district of M.P. has many natural and manmade impoundments. These are among the five ponds selected as a site for monitoring of limnolgical parameters. These ponds are present in and around Khandwa city, which situated on central railway, namely I. Nagchoon Talab, II. Doodh Talai, III. Singhad Talai, IV. Padam Kund and V. Rameshwar Kund. The better supply of potable water for the town of Khandwa had been a pressing question for years past and numerous schemes had been elaborated and discussed in the report given by Mr. C.S.R. Palmer, E.E. dated 28th may 1890. On 15th July 1890, by J.H. Glass, Esqr., Superintending E. Control provinces on Khandwa water works.

Nagchoon Talab:

Lakes as such in the District are none, but a few ponds exist of which one at Nagchoon situated at a distance of 6.4 Km. North-West of Khandwa city deserves mention. The talab covers an area of about 202.3 hectares (500 acres).

Figure 2: A front view of the Nagchoon Talab, looking in the East-South direction

This was formed by damming up a stream. Later on its catchments area was enlarged to nearly 23.3 sq. Km. (9 sq. miles) by the construction of at canal 6.4 sq. Km. (4 miles) long to Ajainti. It is one of the water supplying sources of the Khandwa town. The water is usually carried from it to the town by gravitation but when the Nagchoon Talab (old name – Mohghat reservoir, before 1884 and New Name – Atal Sarowar, after 2006) runs low, the water is pumped. The pumping station was constructed in the year 1887. The Nagchoon Talab established by R. Mitra E.E., agent of Khandwa Municipality, dated 18th July 1899, agreement with Rajputana Malva Railway company to supply water. The Talab for last few years is being utilized as one of the fish – breeding centres of the district. The substratum of the spot is dominated by sand and gravel. The talab has a total surface area about 26,502,000 sq. ft. and a total capacity 275,205,000 in feet. The main

source of water is natural. Large Ajainti nallah through which rain water is carried into talab, having one outlet naming small Ajainty nallah. The reservoir is primarily used for drinking purposes and others.

The left front side of Nagchoon is situated East-South side of talab. The spot is having rich macrophytes and the peripheral zone covered with thick mat of grass, and embankment. The substratum of the spot is dominated by muddy soil. The talab water of this sampling spot is covered by Typha sp., Cyperus sp., Ipomoea sp., etc. In addition to many macrophytes are also present. This spot is covered with decomposed vegetation. It is one of the main sampling sites, with 6 to 10 fit depth during monsoon [July-August]. Sources of main water supply to the body are from Nagchoon talab and rains. The right front side of Nagchoon Talab is situated West-South side of talab. The spot is having scanty macrophytes and the zone covered with thick mat of grass. The substratum of the spot is dominated by muddy soil. The spot is undisturbed by external factors; the water is not covered with Typha. It is one of the beautiful picnic spot of the Khandwa city.

Doodh Talai:

Doodh Talai is situated western part of Khandwa city. Talai has a surface area of 140337 sq. fit. and a shore line of talai is irregular, interrupted at one side by road, colony and a half Km. wide area attached with it. Its basin is shallow with a slite slope.

Figure 3: View of Doodh Talai

The talai is eutrophic and receives several effluents of domestic sewage. The maximum depth of water in the talai was near about 10 to 12 fit during monsoon (July-August) and minimum 3-5 fit in summer (May-June). Sources of water supply to the talai are rains and domestic sewage from adjoining colonies. It is free from macrovegetation. The water is covered with thick blooms of algae mainly Spirulina sp. Municipal Corporation has planned to develop Doodh Talai as picnic spot with swimming pool.

Singhad Talai:

Figure 4: View of Singhad Talai

The talai has a total surface area of about 27014 sq. fit. and a peripheral circumference is irregular and completely covered with grass. The main source of water is domestic sewage. Its basin is shallow with a slite slope. The talai is eutrophic and receives domestic, human and animal excreta and city debris. Long time ago, the Trapa (singhada) were harvested in Talai, so place known as Singhad Talai. Now-a-days it is free from macrovegetation. Some macrophytes seeing at this point like Ipomoea, Cyperus and other grass. The maximum depth of water in the talai was near about 8 to 10 fit. during monsoon (July-August) and minimum 3-5 fit in summer (May-June). Saify Nagar and Shrinagar colonies are attached with Singhad Talai.

Padam Kund:

Figure 5: View of Padam Kund

The Padam Kund under investigation is in colony Padam Nagar and Sanjay Nagar situated at western part of Khandwa city. The reservoir was constructed approximately 1800 years ago. The reservoir impounds an area of 96 sq. fit. and depth is 15x18 fit. The Kund used to bloom with Lotus flowers and hence it is named as Padam Kund. It is rectangular in shape and embodied with ancient lithics that are as old as Kund itself. It is rectangular in shape and maximum depth of water in the Kund is 15 to 18 fit. and overflow during monsoon (July-August) and minimum 10-12 fit. in summer (May-June). The Kund is puccka and has straight embankment. Sources of water supply to the Kund are rains. It is free from macrovegetation. The water of the Kund is used for bathing and drinking by the men and animals.

Rameshwar Kund:

Figure 6: View of Rameshwar Kund

Mr. Palmer, passes in review the several schemes which have from time to time been put forward for Khandwa, and comes to the conclusion that the Rameshwar gravitation scheme, which was first brought to notice in 1871 by Mr. A.R. Binnic, E.E.. Thus the Rameshwar gravitation scheme was projected by Mr. Binnic and Mr. Plaus and estimates were prepared by Mr. Hooper in 1874. The proposals were to construct a reservoir on

the Rameshwar Nallah and to lead thence a 9" main to the clock tower. The tank was shown to be able to supply 8 gallons per head for 15,000 people and 2000 gallons per diem for the each of the two Railways, and to have a surplus of 3 million cubic feet. The Rameshwar Kund under investigation at the Rameshwar Nallah, bears many macrophytes at both side. The substratum of the spot is dominated by mud and gravel. The colour of the water varied from pinkish grey to brown, dark brown colour of water at the effluent mixing point. Water has got a distinct odour and sufficient foam, making its unfit for drinking purpose.

MATERIALS AND METHODS:

Nygaard`s Phytoplankton Quotients and Water Quality			
Index	**Mode of Calculation**	**Oligotrophic**	**Eutrophic**
Myxophycean	Myxophycean / Desmideae	0.0-0.4	0.1-3.0
Chlorophycean	Chlorococcales / Desmideae	0.0-0.7	0.2-9.0
Bacillariophycean	Centric Diatom / Pennate Diatom	0.0-0.3	0.0-1.75
Euglenophycean	Euglinophyceae/Myxophyceae+ Chlorococcales	0.0-0.2	0.0-1.0
Compound	Myxophycean+ Chlorococcales+ Centric Diatom+ Euglenophycean / Desmideae	0.0-0.1	1.2-2.5

Sampling periodicity:

The present study was carried out for the period of one year from March 2014 to February 2015. Monthly water samples were collected in clean polythene bottles. The clean containers were rinsed several times with pond water before collecting the samples. The samples were taken to the laboratory within one hour for Hydrobiological analysis.

The water bodies in general appeared to be relatively similar for many biologists till recently. But with advent of limnology and environmental science, it is established that these water bodies manifest the most amazing physical, chemical and biological diversity. As proposed a survey of the local water bodies were conducted on a fixed duration of every month and different parameter were determined form 01.03.2014 to 28.02.2015. Periodic sampling was done at five sampling stations, naming 1.Nagchoon Talab 2.Doodh Talai 3.Singhad Talai 4.Padam Kund and 5.Rameshwar Kund. In general it was found in Algae, 130 species belonging to 92 genera. Identification was done with the help of standard books and monographs, Desikachary, 1959 and Prescott, 1938. The Algal materials preserved in the Department of Botany, S.N.

Govt. P.G. College, Khandwa. Nygaard,(1949) proposed Myxophycean, Chlorophycean, Diatom, Euglenophycean and compound quotient indices to assess the water quality.

Nygaard`s trophic state of indices:

Nygaard (1949) proposed Myxophycean, Chlorophycean, Diatom, Euglenophycean and compound quotient indices to assess the water quality.

The compound quotient modified by Nygaard (1976) given below :

$$C.Q. = \frac{\text{Myxophycean + Chlorococcales + Diatom + Euglenophycean}}{\text{Desmideae}}$$

Where : C.Q. = Compound Quotient

If the quotient value is less than :

2 = Oligotrophic

2 - 6.1 = Weak Eutrophic

Above 6 = Eutrophic

In the present study, the modified compound quotient is used to assess the water quality.

RESULTS AND DISCUSSION:

Showing Class Wise Composition of Phytoplankton Diversity from Five Ponds:

Sr. No.	**Class**	**Genera**	**Species**
1.	Cyanophyceae	28	44
2.	Bacillariophyceae	22	24
3.	Xanthophyceae	03	03
4.	Chlorophyceae	34	52
5.	Charophyceae	01	02
6.	Euglenophyceae	01	02
7.	Dinophyceae	03	03
Total	**07**	**92**	**130**

In the present investigation, characters accounting for the ponds diversity are studied, over a period of 12 months selecting five representative, permanent ponds and results are analyzed on the basis of earlier literature.

Morphometry: The obtained values for the volume of the ponds by morphometrical studies are given below:

1.	Nagchoon Talab	:	768900 m^3	75429090 liters
2.	Doodh Talai	:	452700 m^3	44409870 liters
3.	Singhad Talai	:	87140 m^3	8548434 liters
4.	Padam Kund	:	160 m^3	15696 liters
5.	Rameshwar Kund	:	3000 m^3	294300 liters

Nygaard's Phytoplankton Quotients and Water Quality of Five Ponds:

Sr.No.	Index	Mode of Calculation	Phytoplankton Quotient
1.	Myxophycean	Mixophyceae Desmideae	Nagchoon Talab - 1.13 Doodh Talai - 2.9 Singhad Talai - 2.26 Padam Kund - 1.73 Rameshwar Kund -1.46
2.	Chlorophycean	Chlorococcales Desmideae	Nagchoon Talab - 0.8 Doodh Talai -0.53 Singhad Talai - 0.4 Padam Kund - 0.4 Rameshwar Kund -0.34
3.	Diatom	Centric diatoms Pennate diatoms	Nagchoon Talab - 0.16 Doodh Talai - 0.1 Singhad Talai - 0.11 Padam Kund - 0.18 Rameshwar Kund -0.12
4.	Euglenophycean	Euglenophyceae Myxophyceae + Chlorococcales	Nagchoon Talab - 0.06 Doodh Talai - 0.03 Singhad Talai - 0.05 Padam Kund - 0.06 Rameshwar Kund -0.07
5.	Modified Compound Quotient	Myxophyceae + Diatoms + Chlorococcales + Euglenophyceae Desmideae	Nagchoon Talab - 2.46 Doodh Talai - 13.0 Singhad Talai - 6.5 Padam Kund - 5.11 Rameshwar Kund -5.44

- Thus the present study infers that Nygaard`s indices may not be applicable universally for all aquatic bodies to assess the trophic status. It is to be determined by experimental studies on phytoplankton of different water bodies.
- 14 Cyanophycean members were reported from Nagchoon Talab, 35 from Doodh Talai, 23 from Singhad Talai, 13 from Padam Kund and 12 from Rameshwar Kund. These members were reported throughout the year.

- A total of 6 Bacillariophycean members were encountered in Nagchoon Talab, 24 species in Doodh Talai, 22 species in Singhad Talai, 12 species in Padam Kund and 20 species in Rameshwar kund. Summer months recorded more Bacillariophycean members than winter months.
- 52 species of Chlorophyta were reported from Nagchoon Pond, 22 species from Doodh Talai, 29 species from Singhad Talai, 26 from Padam Kund and 25 species from Rameshwar Kund. Chlorophycean pecks were recorded during summer and rainy months.
- 03 species of Xanthophyta 02 species of Euglenophyta and 03 species of Dinoflagellates were reported in all the sampling ponds during summer months.
- Regarding species abundance numerically the Cyanophyta in Doodh Talai Bacillariophyta in Doodh Talai and Singhad Talai and Chlorophyta in Nagchoon Talab, Singhad Talai and Padam Kund, formed most abundant groups. While Chlorophyta in Rameshwar Kund and Doodh Talai, Bacillariophyta in Rameshwar kund and Padam Kund ranked next. The Third position was occupied by Bacillariophyta in Nagchoon Talab and Cyanophyta in Padam Kund Rameshwar Kund and Nagchoon Talab respectively. Euglenophycean members and Dinoflagellates were absent during several month.
- With reference to seasonal distribution the phytoplankton peaks ware reported during summer season and the total number decreased during February and March

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