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RESEARCH ARTICLE

The Role of Benthic Invertebrate Species in Freshwater Ecosystem Zoobenthic species influence energy flows and nutrient cycling in Shahpura Lake, Bhopal (M.P.)

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Abstract

The present study was carried out to know the status of benthic fauna and its Physico-chemical parameter of the Shahpura Lake. The paper deals with the role of annelida worms a major group of aquatic macroinvertebrates in assessing the water quality of Lake. Ten species of oligochaetes have been collected for seven months in monthly sampling from five selected stations during study period in 2008-2009 out of these five species of oligochaetes and Hirudinea in pollution load. According to organisms, water quality at five sampling stations has been classified into least polluted, moderately polluted and highly polluted categories. This classification in agreement with Physico-chemical parameters.

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Introduction

Present work reports a study on Shahpura Lake situated in one of the elite localities of Bhopal, the capital city of Madhya Pradesh. The degradation of lake has occurred not only due to effluent inflow but also by salutation, domestic sewage, and immersion of idols and other activities around the lake like washing clothes, cattle, vehicles, and dumping of soil wastes. It receives domestic raw sewage from surrounding habitation. Apart from it a large number of heavy metals is contributed by corrosion of metal pipes in water bodies etc.

Geographical Morphometric features of Shahpura Lake:

Latitude 23^o12'00"E and Longitude 77^o25'30"N

Catchment area	: 8.29 sq.km
Submergence area	: 0.96 sq.km
Gross storage	: 2.29 m cum
Live storage	: 2.09 m cum
Lowest still level	: 483.71 m
Full reservoir level	: 488.30 m
Maximum water level	: 489.00 m
Water spread at FRL	: Approx. 80 ha
Water spread at MWL	: Approx. 96 ha

The area under study enjoys a sub-tropical climate. The lake is shallow aquatic ecosystem with a mean depth of 1-2 m. The lake, in most parts is muddy due to the accumulation of silt but towards the NW side, it has hard and clayey substratum. The maximum depth at full tank is 9-10m and the deepest point lies in the centre of the reservoir. The main inlet, the nullah joins the lake at its northern end. The catchment area stretches over to 8.29 sq. km. which includes the area of agriculture land on its western side, the barren rocky land mass on its northern side, and hillocks and residential area on its eastern side. The reservoir has a gross storage capacity of 2.29m³ which sometime

submerge the neighboring land lying on the eastern side. Shahpura lake is a man made water impoundment, which was formed in 1974-1975 under the Betwa irrigation scheme, after constructing an earthen dam near Chunabhatti village in the south part of the Bhopal city. After closing down of the oxidation pond in the year 1977-78 the drain brings the storm water in the monsoon and sewage of the settlements came up in the upstream of the drain. The reservoir connects two village, shahpura at its eastern side and chunabhatti at its western side.

Macro invertebrate organisms occupy specialized habitats and represent the best example of detritus food chain. Many contributors have described Macro invertebrate's organisms in relation to water quality. Some of these organisms have been identified as indicators of pollution. Keeping this in view the present study has been undertaken to investigate the macro invertebrate's organisms of the lake with special reference to their monthly fluctuation and relationship with pollution.

Hence the present study was planned with the following objectives:

- To work out the variation of some important physico-chemical properties of water and its correlation with growth of Macro invertebrates.
- To work out the monthly variations of qualitative and quantitative studies of Macro invertebrates. Means of management for up gradation of quality of lake water to provide niche to inhabitation.
- To Assessment of water quality of the Shahpura Lake.

A number of research project have been taken to understand the status of lake. There is a need for continuous evolution of the pollution level in order to promote better living conditions around the lake.

Material and Methods

Five sampling stations were selected based on their different characteristics such as bottom sediment, beach structure, human activities and macro vegetation location near Manisha nullah (S1), Campion nullah (S2), Panchsheel nullah (S3), Chunabhatti nullah (S4), Embankment (S5). Each sampling station had two Zone, viz. Surface and bottom. Samples of sediments of each sampling station were collected in Peterson grab sampler at the entire stations. The sediments sample were sieved (0.2m and 0.5m mesh) and sorted out manually using forceps for animals like, oligochaetes. In each sample the number of Individuals of different species and groups was count and their percentage calculated per meter square of bottom area. To the extent possible, oligochaetes worms and Hirudenia were studies in living conditions and organisms preserved 70% alcohol. The samples of the water overlying the surface & bottom were analyzed for pH, Air & Water temperature, TDS, Conductivity, Dissolved oxygen, Free CO₂, Transparency, Total Alkalinity, Total hardness, Chlorides.

To know the faunal diversity, Shannon and Weaver diversity index was calculated using the formula.

$$H = (ni / N) \log (ni / N)$$

Where,

H = The diversity is expressed as number of bits per individual species.

N = Total number of individuals.

ni = Number of individual in 1st species.

Physico-chemical characteristics of surface & bottom water:

Maximum and minimum monthly values of the selected physico chemical parameters at different sites have been show in fig. most of the pollution relevant: parameter such as. Water Temperature, pH, Electric Conductivity, TDS, D.O., Total Alkalinity, Total hardness, Calcium hardness, Magnesium and Chloride.

Results and Discussion

Physico-chemical characteristics of surface & bottom water:

Maximum and minimum monthly values of the selected physico-chemical Parameters at different sites have been show in table most of the pollution relevant: parameter such as. Water Temperature, pH, Electric Conductivity, TDS, D.O., Total Alkalinity, Total hardness, Calcium hardness, Magnesium hardness, and Chloride.

Biological characteristics

During the present study on Shahpura Lake Macro invertebrates show a rich diversity in which insects were dominant phyla throughout the study period. The sediments of reservoir were found to 10 species of oligochaetes and 2 species of Hirudinea. In class Annelid identified 10 spp. Hirudinariaesp., Lumbriculussp., Autodrillus Piqueti sp., Branchivora sp., Nais sp., Tubifex tubifex sp., Chectogester sp., and Dero dorsalissp., Pristinasp., hortensissp. The number of organisms recorded at different stations. The Lumbriculus are known as important group of benthos with maximum population density and maximum tolerance to organic pollution. Hirudinea were the second abundant group in the areas of the lake investigated. Their population was almost uniform in density. Insects are know to exhibit high tolerances to oxygen depletion occurring in deeper depth kaul

also reported similar condition in some Lakes of Kashmir valley observed *Lumbriculus* and *Tubifex tubifex* as the pollution indicator species. Milbrink showed that oligochaetes occur as eutrophic indicator group.

Shannon Weaver diversity index: - For the macro invertebrate of Lake Shahpura at five different study sites. The Shannon's diversity index values were observed in the range of 2.728 at Manisha nullah, 2.833 at Campion nullah, 2.703 at Panchsheel nullah, 2.54 at Chunabatti nullah and 2.453 at Embankment. Brian D. Huges (1975), observed the influence of factors other than pollution on the value of Shannon's diversity index for benthic macro invertebrate in lake. During the course of Present study the maximum macro invertebrate species diversity was recorded 2.833 on the stone and gravel type ground at Campion nullah (site2), while as lower range 2.45 at Embankment (site-5), with sand and soil Pliuraite (2001) also reported benthos. Embankment (site-5), with sand and soil. Pliuraite (2001) also reported highest macro-invertebrates.

Table1- Range of monthly values of Physico-chemical parameters characteristics of Water at different stations in Shahpura Lake.

Parameter	Monthly variation of physico-chemical parameters of the water at different stations				
	S1	S2	S3	S4	S5
Water Temp. (°C)	20-32	21-32	19-33.5	19.5-33	20-33.6
pH	8.0-8.5	8.2-8.6	8.1-8.6	8.1-8.7	8.1-8.7
Electric Cond.(ppm)	630-790	470-730	480-790	490-780	480-780
D.O. (mg/l)	2.1-8.4	2.7-6.4	1.7-8.8	1.3-8.8	1.8-12.0
Total Alkalinity (mg/l)	140-338	144-342	160-370	126-382	152-308
Total hardness (mg/l)	92-338	68-342	84-334	82-340	90-308
Calcium hardness (mg/l)	76-178	62-188	52-186	66-192	66-168
Magnesium hardness (mg/l)	5.83-29.5	18.1-29.1	3.8839.8	4.86-23.3	5.31-38.8
Chloride (mg/l)	47.9-90.9	47.9-86.9	50.0-89.0	45.5-96.0	61.5-82.8

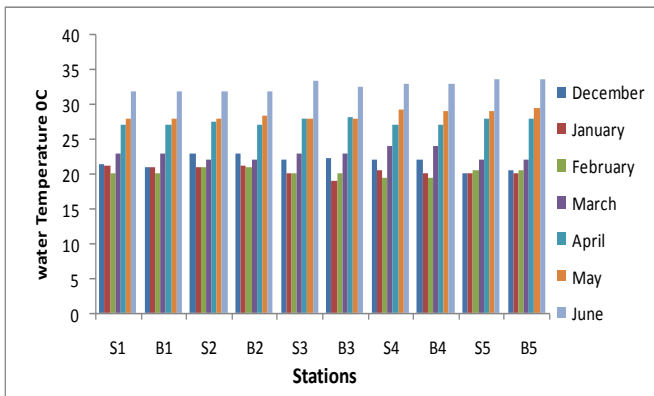


Fig.1. Graph showing monthly variation in Water Temperature at different stations.

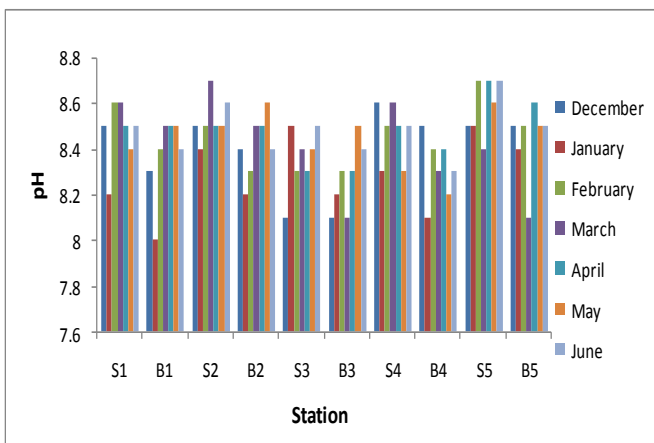


Fig.2. Graph showing monthly variation in pH at different stations.

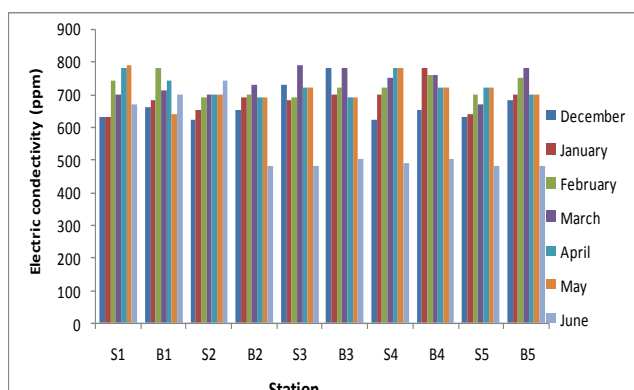


Fig.3. Graph showing monthly variation in Electric Conductivity, at different stations.

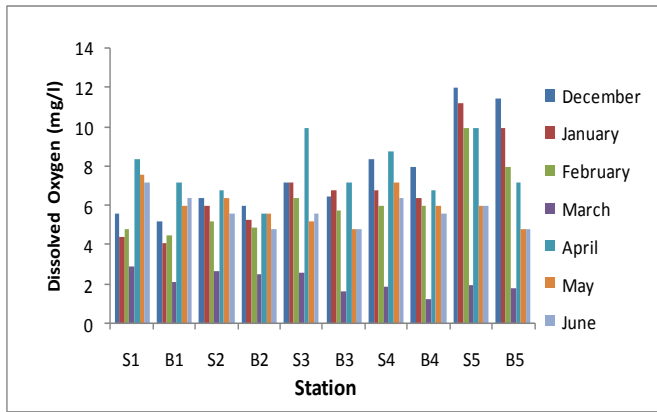


Fig.4. Graph showing monthly variation dissolved Oxygen at different stations.

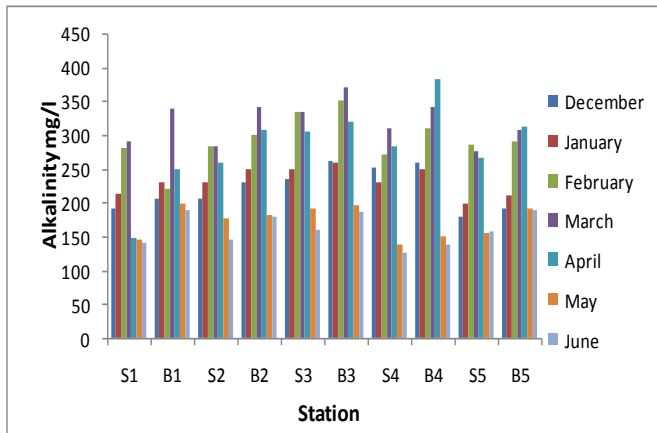


Fig.5. Graph showing monthly variation in Total Alkalinity at different stations.

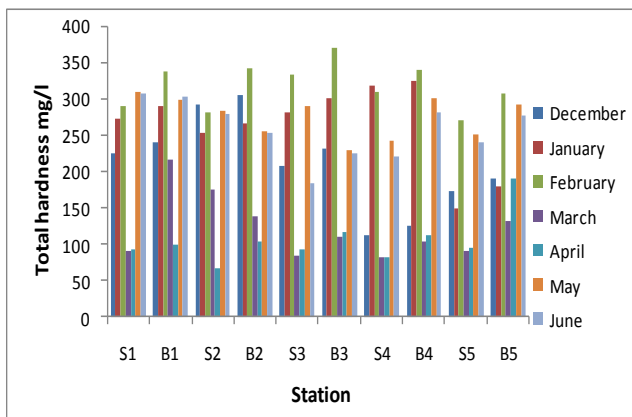


Fig.6. Graph showing monthly variation in Total Hardness at different stations.

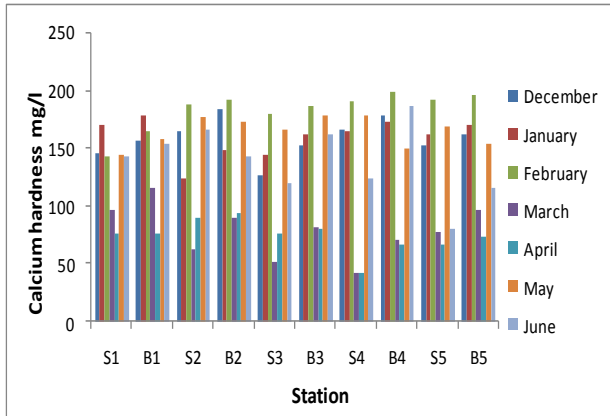


Fig.7. Graph showing monthly variation in Calcium Hardness at different stations.

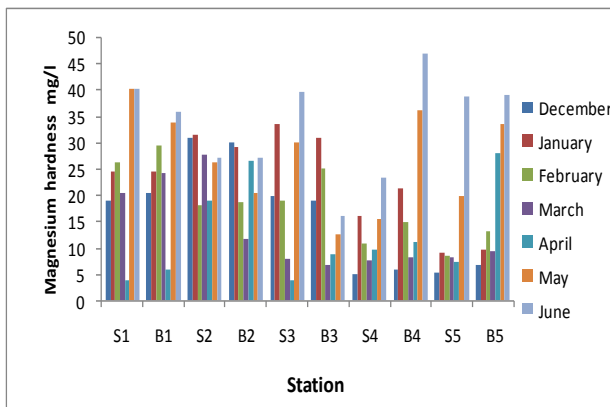


Fig.8. Graph showing monthly variation in Magnesium hardness at different stations.

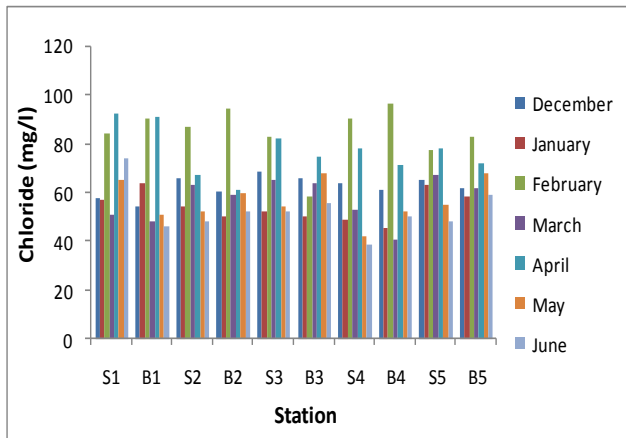


Fig.9. Graph showing monthly variation in Chloride at different stations.

Table2:- Shannon Weaver diversity index of different sites of Shahpura lake :

Sites	S1	S2	S3	S4	S5
No.of spp.	10	7	8	6	8
Total no. of individuals	479	505	489	445	497

Shannon_H	2.728	2.833	2.703	2.54	2.453
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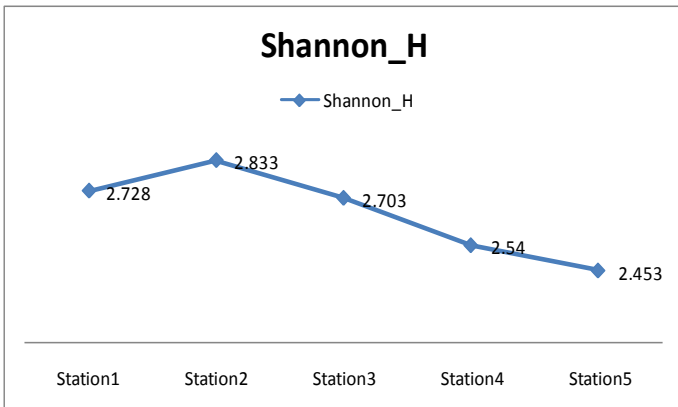


Fig.10 Shannon weaver diversity index of Shahpura lake in during Present study at different stations

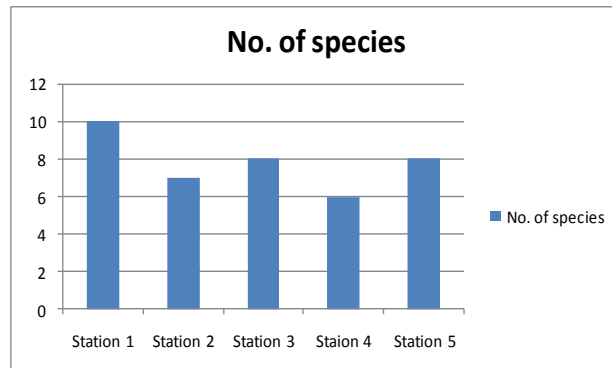


Fig no. 11. : Relative abundance of the Oligochaetes species in Shahpura lake at different stations.

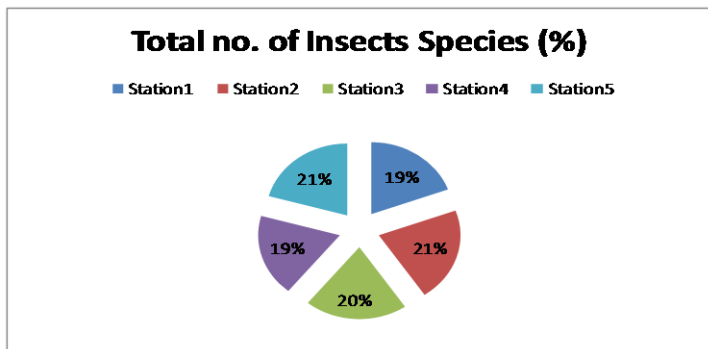


Fig .12. Total diversity of Insects species in different station of Shahpura Lake during study period.

CONCLUSION

The present study indicates the current status of water quality. Water temperature, pH values are well within permissible limits. The D.O. is correlated with growth of oligochaetes. The statistical analysis in the present study exhibited positive correlation between total organisms with water temperature; oligochaetes with pH, temperature and negative correlation were shown with oligochaetes total hardness and Alkalinity.

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