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Habitat Characterization of Littoral zone of Upper Lake, Bhopal, Madhya Pradesh

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Abstract

Water management is a critical issue for the survival of all organisms residing on earth. In this study, Bhopal, also famous as city of lakes, has been taken as it has number of lakes fulfilling daily needs of the city. Upper lake and lower lake, together forms Bhoj wetland and is a Ramser site and shahpura lake are three important lakes of the city serving multipurpose need of the city of drinking, agriculture etc. Biotic and abiotic interaction in aquatic and terrestrial area determines its abundance and health of the area. If any one factors gets disturbed then the whole cycle of system gets disturbed and risk the rate of survival. Therefore, it is important for each factor to be in control for sustainable development. Likewise, aquatic organisms serves important role in deciding the health of the lakes. Presence and absence of certain organisms can be indictor of pollution or pollution free environment. In the littoral zone of the lakes, habitat of the samples was surveyed by observing the flora of the area and categorizing in submerged, floating and emerged. Water parameters like temperature, dissolved oxygen, biological oxygen demand, alkalinity, total dissolved solids, total hardness and electrical conductivity were determined and macro benthic invertebrates were identified in the area. To determine the relation, correlation coefficient was determined between the two factors, macro benthic invertebrates and 11 parameters of water. In the given study correlation was taken out accordingly for the three seasons, pre-monsoon, monsoon and post-monsoon. In upper lake, according to the result observed, range of correlation coefficient during pre-monsoon season of family Annelida of DO was 0.02-0.18, BOD (-0.23 to 0.23), total hardness (-0.12 to 0.54) while in Family Arthropoda DO (0.01 to 0.20), BOD (-0.05 TO 0.06), total hardness (-0.01 to 0.6) and in Family Mollusca DO (-0.01 to 0.024), BOD (-0.015 to -0.27), total hardness (-0.08 to 0.50. Therefore, the survival of macro invertebrates are strongly depends upon the water quality of their habitats and also the food available in the area. So, any disturbance in habitat quality affects the food chain and thus the sustainable development of lakes.

Key words: littoral zone, habitat, water quality, macro benthic invertebrates, correlation, DO, BOD, total hardness.

Introduction

Aquatic ecosystem is the most diverse ecosystem in the world. The first life originated in the water and first organisms were also aquatic where water was the principal external as well as internal medium for organisms. Thus water is the most vital factor for the existence of all living organisms.

Fresh water habitats are divided into two systems- lentic systems and lotic systems. Lentic system includes the still waters such as ponds, lakes, swamps and mires. Lotic systems are running-water systems such as rivers, groundwater which flows in rocks and aquifers.

Freshwater ecosystems have been critical to livelihood and survival for every creature on earth. Human life rely on freshwater systems not only for drinking water, but also for agriculture, transportation, energy production, industrial processes, waste disposal, and the extraction of fish and other products. As a result of this dependence, human settlements worldwide are concentrated near freshwater ecosystems for fulfilling their demand of food and earning, factors of survival. (Small and Cohen, 1999).

Freshwater habitats can be classified by different factors, including temperature, light penetration, and vegetation. Lakes and ponds are divided into three different “zones” which are usually determined by depth and distance from the shoreline. The topmost zone near the shore of a lake or pond is the *littoral zone*. This zone is the warmest since it is shallow and can absorb more of the Sun's heat. It sustains a fairly diverse community, which can include several species of algae (like diatoms), rooted and floating aquatic plants, grazing snails, clams, insects, crustaceans, fishes, and amphibians. In the case of the insects, such as dragonflies and midges, only the egg and larvae stages are found in this zone. The vegetation and animals living in the littoral zone are food for other creatures such as turtles, snakes, and ducks.

Study Area

The undertaken work has been conducted in the capital city of Madhya Pradesh, Bhopal, which is also known as "city of lakes" and is famous for it's of picturesque beauty and historic artifacts. The Bhojtal, formerly known as Upper Lake, is a large lake which lies on the western side of the capital city. It was constructed in 11th century. Its catchment area is 372.35 sq.km and surface area is 36 sq.km. its full tank level is 508.65 cm. Five sampling station was selected in upper lake:

- Hamidia(Station I)
- Shitla mandir (Station II)
- Van vihar(Station III)
- Boat club (Station IV)
- Kamla park (Station V)

Material and Method

The samples of water (Surface) were collected from different sites three times a year pre-monsoon (feb to april), monsoon (june to aug) and post-monsoon (oct to dec) season during 2013 to 2015. Before collection of the samples the clean, dried and well labeled samples bottles and high quality of plastic canes with 1 litre capacity were kept ready. Water samples for physico-chemical parameters were analyzed for urgent parameters i.e Temperature, pH, conductivity, Dissolve oxygen and Total alkalinity in the field only and then kept in the icebox to the transported to the laboratory. In laboratory the samples were stored in a refrigerator at 4 ºC. For analysis of physico-chemical parameters the book follows as Adoni (1985), APHA, (1998) and Trivedy and Goel (1984).

The samples of sediments were collected from the surface of lakes from all the stations between 9am -5pm by using Peterson grabe mud sampler. The collected samples were sieved through 0.5 mm sieve (Ankar and Elmgreen, 1976) and the materials which retained on sieve were collected. Benthic organisms from the retained mud were sorted out with the help of forcep and brush and were preserved in narrow mouthed plastic bottle which contained 70% alcohol as preservative (Adoni, 1985). Some fauna which were attached from rocks, stones and macrophytes were also collected. All macro faunal organisms were identified to species level with the help of available key and manuals Needham and Needham, 1962 and Pennak (1989) under the Metzer light microscope. The population of organisms were counted species wise i.e.,

no of individuals of a species per sample and were expressed as number / m2. In twenty four months study period, thrice sampling were done.

Abbreviation used

A1- air temperature

A2- water temperature

A3- pH

A4-TDS

A5-Alkalinity

A6-DO

A7-BOD

A8-Total hardness

A9-Calcium hardness

A10-Magnesium Hardness

A11-Electrical conductivity

Observation

UPPER LAKE

Table no. a: Correlation coefficient between physicochemical parameters with benthic macro invertebrates of pre-monsoon season (upper lake).

Pre Monsoon	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
Annelida	0.713182	0.852638	-0.21038	-0.50322	-0.64855	0.155393	-0.23909	0.548721	0.00183	0.007009	-0.49308
Arthropoda	0.070822	0.599357	0.339887	-0.4718	-0.49651	0.203153	0.014408	0.601578	0.048644	0.116968	0.019573
Mollusca	0.434245	0.700457	0.010141	-0.4182	-0.49382	-0.01994	-0.27802	0.365789	0.105756	-0.03469	-0.51677

Table no. b: Correlation coefficient between physicochemical parameters with benthic macro invertebrates of monsoon season (upper lake).

Monsoon	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
Annelida	-0.43492	-0.22475	0.050655	0.061911	0.342483	0.180882	0.231153	-0.1296	0.376499	-0.0927	0
Arthropoda	-0.42116	-0.54636	0.208872	-0.34656	-0.17677	0.108984	0.062649	-0.10176	-0.22553	0.185542	0.307503
Mollusca	0.779374	0.545107	0.170965	-0.49604	-0.78339	0.024758	-0.22318	0.503389	-0.49388	0.315879	-0.14992

Table no. c: Correlation coefficient between physicochemical parameters with benthic macro invertebrates of post monsoon season (upper lake).

Post monsoon	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
Annelida	-0.17538	0.018178	0.195827	0.061316	-0.08362	0.029921	-0.28592	-0.13617	0.460329	0.218858	0.159954
Arthropoda	0.142751	0.297283	-0.00744	0.115412	-0.23082	0.14926	-0.05768	-0.0174	0.411842	0.083778	0.101453
Mollusca	0.04009	0.233945	0.070923	-0.06778	-0.03763	0.021613	-0.1506	-0.08606	0.405383	-0.01082	0.097061

- **Upper lake**

According to table no a, correlation coefficient between water parameters and benthic invertebrates during pre-monsoon season family Annelida is positively correlated to A1, A2, A6, A8, A9 and A10 and negatively correlated with A3, A4, A5, A7 and A11. Family Arthropoda is positively correlated to A1, A2, A3, A6, A7, A8, A9, A10 and A11 and negatively correlated with A4 and A5. Family Mollusca is positively correlated to A1, A2, A3, A8 and A9 and negatively correlated with A4, A5, A6, A7, A10 and A11.

According to table no b, correlation coefficient between water parameters and benthic invertebrates during monsoon season family Annelida is positively correlated to A3, A4, A5, A6, A7 and negatively correlated with A1, A2, A8 and A10. Family Arthropoda is positively correlated to A3, A6, A7, A10 and A11 and negatively correlated to A1, A2, A4, A5, A8, and A9. Family Mollusca is positively correlated to A4, A5, A7, A9 and A11 and negatively correlated to A1, A2, A3, A6, A8 and A10.

According to table no c, correlation coefficient between water parameters and benthic invertebrates during post-monsoon season family Annelida is positively correlated to A2, A3, A4, A6, A9, A10 and A11 and negatively correlated to A1, A5, A7 and A8. Family Arthropoda is positively correlated to A1, A2, A4, A6, A9, A10 and A11 and negatively correlated to A3, A5, A7 and A8. Family Mollusca is positively correlated to A1, A2, A3, A6, A9 and A11 and negatively correlated to A4, A5, A7, A8 and A10.

Conclusion

As seen in observation from the table no. a, b, c family Annelida responded positive correlation during pre and post-monsoon season to water temperature means temperature was favorable for its survival. During monsoon with the dilution of water it responded negative correlation.

It showed positive correlation to pH during monsoon and post-monsoon. pH in lake greatly depends on the kind of water influx from the catchment area and also from the waste water input from the surrounding area. Waste water mainly consist waters from residential area, agricultural fields, medical waste etc. TDS showed positive correlation with Annelida family during monsoon and post-monsoon season, it any be due to influx of pesticide and chemical wastes from agricultural fields and medical waste water. DO showed positive correlation with family Annelida in all three seasons. BOD affected negatively during pre and post-monsoon. Annelids correlated negatively during monsoon and post-monsoon.

According to table a, b, c family Arthropoda showed positive correlation to air and water temperature. pH had positive correlation in pre and in monsoon but showed negative correlation during post monsoon, may be due to increase in pH due to input of water from different areas. DO showed positive correlation in all three seasons, which showed their positive growth. Total hardness showed positive correlation only during post-monsoon season.

According to table a, b, c Family Mollusca, showed positive correlation with A1, A2 and A3. A4 and A5 were negatively correlated during monsoon, may be due to sudden change of influx. DO showed positive correlation during pre and monsoon season. EC showed positive correlation during monsoon and post-monsoon. A8 was positive correlated during pre-monsoon.

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