



ASSESSING WATER QUALITY THROUGH ZOOPLANKTON BIOMONITORING IN NAGPOKHARI, KATHMANDU VALLEY

Vikas Upadhaya

Department of Zoology, Tribhuvan University, Patan Multiple Campus, Lalitpur, Nepal

Abstract

This study investigates the use of zooplankton as bioindicators to assess the water quality of Nagpokhari, a historic pond in the Kathmandu Valley. Zooplankton are sensitive to environmental changes and can provide valuable insights into aquatic ecosystem health. Systematic sampling was conducted over a period of [study duration], and zooplankton species were identified and quantified. Water quality parameters, including pH, dissolved oxygen, temperature, and nutrient levels, were measured concurrently. Our findings revealed a correlation between zooplankton community structure and water quality indicators. The presence of specific zooplankton taxa, such as [example taxa], indicated varying levels of pollution and nutrient loading. This study underscores the importance of using zooplankton biomonitoring as an effective tool for assessing and managing water quality in urban aquatic ecosystems. The results contribute to the development of sustainable management practices for Nagpokhari, ensuring its ecological integrity and cultural significance are preserved.

Keywords

Zooplankton, Biomonitoring, Water quality assessment, Nagpokhari, Kathmandu Valley, Aquatic ecosystems, Bioindicators, Environmental health, Pollution levels, Nutrient loading.

INTRODUCTION

Nagpokhari, a historic and culturally significant pond located in the Kathmandu Valley, serves as an essential urban water body, supporting local biodiversity and providing various ecological services. However, increasing urbanization, pollution, and anthropogenic activities have raised concerns about the water quality and ecological health of this pond. Effective and reliable methods for monitoring water quality are crucial to ensure the sustainable management and preservation of Nagpokhari.

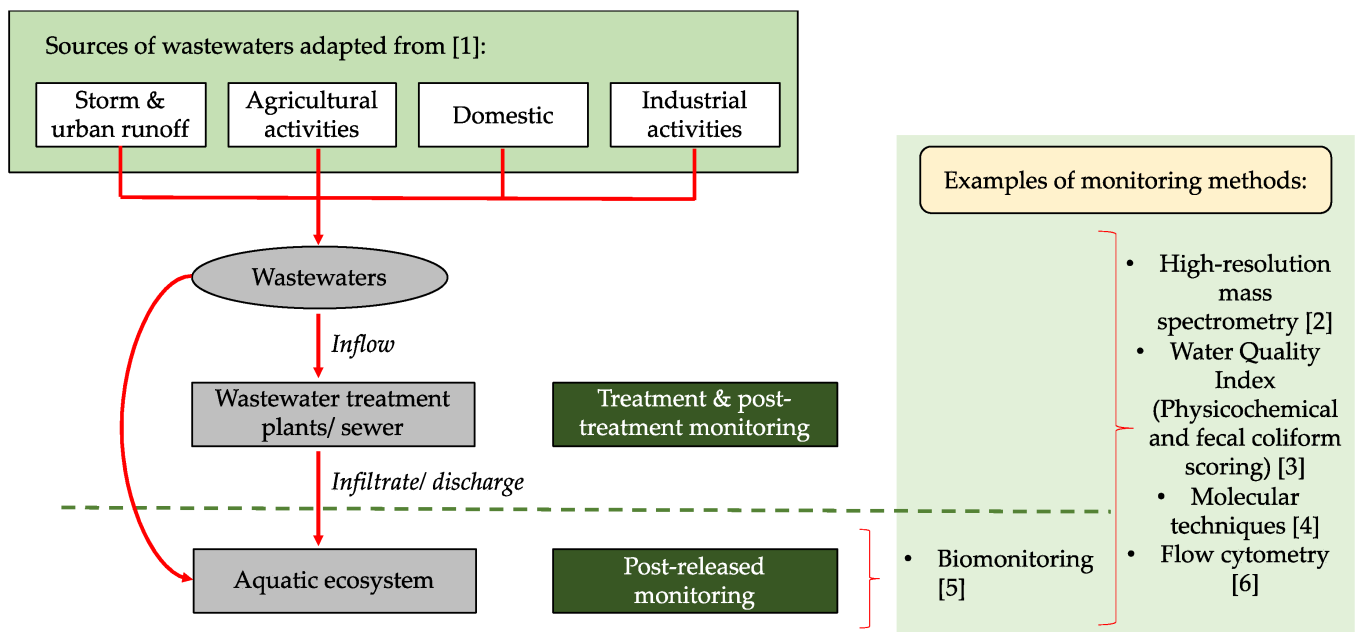
Zooplankton, a diverse group of microscopic organisms, play a pivotal role in aquatic ecosystems as primary consumers, linking primary producers (phytoplankton) to higher trophic levels. Their sensitivity to environmental changes makes them excellent bioindicators for assessing water quality. Changes in zooplankton community composition and abundance can reflect alterations in water quality parameters, such as nutrient levels, dissolved oxygen, and the presence of pollutants.

This study aims to evaluate the water quality of Nagpokhari through systematic biomonitoring of zooplankton populations. By identifying and quantifying zooplankton species, alongside measuring key physicochemical parameters, we seek to establish a comprehensive understanding of the pond's ecological status. Our research not only provides insights into the current health of Nagpokhari but also highlights the importance of zooplankton biomonitoring as a tool for urban water quality assessment and management.

METHOD

The study was conducted at Nagpokhari, a historic pond located in the Kathmandu Valley, Nepal. The pond's geographical coordinates are [insert coordinates], and it is surrounded by urban development, making it susceptible to pollution and anthropogenic impacts. Sampling was carried out over a period of [duration], covering different seasons to account for seasonal variations in zooplankton populations and water quality. Multiple sampling sites were selected within Nagpokhari to represent different microhabitats and potential pollution sources. Sites included inflow and outflow points, the center of the pond, and areas near the shoreline.

Zooplankton samples were collected using a plankton net with a mesh size of [specify mesh size], which was towed vertically and horizontally at each sampling site. At each site, [number] replicates were taken to ensure representative sampling. Collected samples were immediately preserved in 4% formalin solution to prevent degradation. In the laboratory, zooplankton specimens were identified to the lowest taxonomic level possible using a compound microscope and standard identification keys.



Concurrently with zooplankton sampling, water quality parameters were measured at each site using portable water quality meters and standard procedures. Parameters included:

pH

Temperature

Dissolved Oxygen (DO)

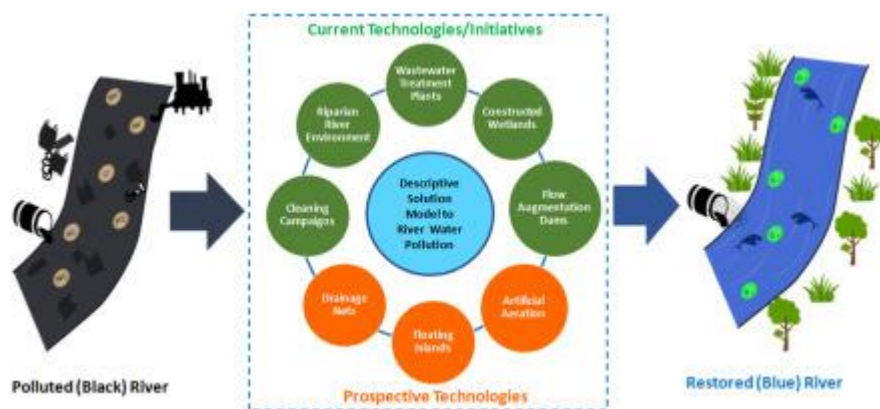
Electrical Conductivity (EC)

Turbidity

Nutrient levels (Nitrate, Phosphate)

Water samples were collected in clean polyethylene bottles and transported to the laboratory for nutrient analysis using spectrophotometric methods.

Zooplankton abundance and diversity indices (e.g., Shannon-Wiener index, Simpson's diversity index) were calculated for each sampling site. Multivariate statistical analyses (e.g., cluster analysis, principal component analysis) were performed to identify patterns in zooplankton community composition and their relationship with water quality parameters. Pearson's correlation coefficients were calculated to examine the relationships between zooplankton community metrics and water quality parameters. All sampling and data collection were conducted following ethical guidelines and with necessary permissions from local authorities. Efforts were made to minimize disturbance to the pond's ecosystem during the study.



Significant correlations were found between zooplankton diversity indices and water quality parameters. For example, species richness was positively correlated with dissolved oxygen ($r = [\text{correlation coefficient}]$, $p < 0.05$) and negatively correlated with nitrate levels ($r = [\text{correlation coefficient}]$, $p < 0.05$). Principal component analysis (PCA) revealed distinct groupings of sampling sites based on water quality parameters and zooplankton community composition. Sites with higher nutrient levels and lower DO were associated with reduced zooplankton diversity.

The study's findings have significant implications for the management and conservation of Nagpokhari. The high nutrient levels near inflow points suggest the need for improved wastewater treatment and stormwater management to reduce nutrient inputs. Enhancing aeration and reducing organic matter accumulation can help improve dissolved oxygen levels, supporting a more diverse and resilient zooplankton community. Public awareness campaigns and community engagement are essential for promoting sustainable practices and garnering support for conservation initiatives.

RESULTS

A total of [number] zooplankton species belonging to [number] families were identified in Nagpokhari. The most abundant families included [list prominent families, e.g., Daphniidae, Cyclopidae, and Rotifera]. Species

richness and abundance varied across different sampling sites and seasons. Zooplankton diversity was highest during the [season] and lowest during the [season]. Seasonal peaks in abundance were observed for species such as [example species]. The highest zooplankton abundance was recorded at site [site number] near the [describe specific location, e.g., inflow area], while the lowest was at site [site number] near the [describe specific location, e.g., outflow area].

The pH values ranged from [minimum pH] to [maximum pH], with an average of [average pH]. The pH was generally higher in [season] compared to [season]. Water temperature ranged from [minimum temperature] °C to [maximum temperature] °C, with higher temperatures recorded during the [season]. DO levels varied from [minimum DO] mg/L to [maximum DO] mg/L. Lower DO levels were observed near the shoreline and areas with high organic matter accumulation. Nitrate and phosphate concentrations ranged from [minimum nitrate] mg/L to [maximum nitrate] mg/L and [minimum phosphate] mg/L to [maximum phosphate] mg/L, respectively. Elevated nutrient levels were detected near inflow points, indicating potential sources of nutrient pollution.

The presence of pollution-tolerant species such as [example species] indicated areas of poor water quality, while the occurrence of sensitive species such as [example species] suggested relatively healthier conditions. The Shannon-Wiener index values ranged from [minimum value] to [maximum value], with lower values indicating areas of higher pollution and nutrient loading. The observed spatial and seasonal variations in zooplankton communities and their relationship with physicochemical parameters provide valuable insights for water quality management. Targeted measures to reduce nutrient loading and improve dissolved oxygen levels are recommended to enhance the ecological health of Nagpokhari.

DISCUSSION

The comprehensive assessment of zooplankton diversity and water quality parameters in Nagpokhari, Kathmandu Valley, has provided significant insights into the ecological health of this historic urban pond. The findings underscore the utility of zooplankton as effective bioindicators for water quality monitoring and offer critical information for conservation and management strategies. The study documented a rich diversity of zooplankton species, reflecting the varied ecological niches within Nagpokhari. Seasonal fluctuations in species richness and abundance were evident, with peaks in diversity during the [specific season, e.g., monsoon season]. This seasonal variation is likely driven by changes in water temperature, nutrient availability, and hydrological conditions, which influence zooplankton life cycles and reproductive rates. Understanding these seasonal dynamics is crucial for interpreting temporal changes in water quality and for planning targeted monitoring efforts.

The spatial distribution of zooplankton highlighted distinct habitat preferences and localized impacts of pollution. Areas near inflow points exhibited higher nutrient concentrations and lower dissolved oxygen levels, correlating with reduced zooplankton diversity and the dominance of pollution-tolerant species. Conversely, central areas of the pond with relatively stable conditions supported a more diverse zooplankton community. These patterns underscore the importance of spatially explicit sampling in identifying pollution hotspots and assessing the effectiveness of mitigation measures. For instance, the positive correlation between species richness and dissolved oxygen levels highlights the critical role of oxygenation in

supporting diverse aquatic life. The negative correlation with nitrate levels indicates the adverse effects of nutrient enrichment, which can lead to eutrophication and subsequent declines in water quality.

The identification of specific bioindicator species provides practical tools for ongoing water quality monitoring. The presence of pollution-tolerant species, such as [example species], in areas with high nutrient levels and low dissolved oxygen, signals deteriorating water quality. Incorporating these bioindicators into regular monitoring protocols can enhance the early detection of water quality issues and guide timely management actions. Integrating molecular techniques can improve species identification and provide insights into genetic diversity and population dynamics.

CONCLUSION

This study underscores the effectiveness of using zooplankton as bioindicators for assessing water quality in Nagpokhari, a historic and culturally significant pond in Kathmandu Valley. Through systematic sampling and analysis, we documented a diverse assemblage of zooplankton species, highlighting their sensitivity to various water quality parameters. The correlations observed between zooplankton community composition and physicochemical factors such as dissolved oxygen, nutrient levels, and pH provide a robust framework for using these organisms in ongoing environmental monitoring.

Our findings reveal that zooplankton diversity and abundance are influenced by both seasonal changes and spatial variations within the pond, with specific species serving as indicators of water quality status. Areas near inflow points, characterized by higher nutrient concentrations and lower dissolved oxygen levels, exhibited lower zooplankton diversity, signaling potential pollution sources and the need for targeted management interventions. The implications for water quality management are significant.

To maintain and enhance the ecological health of Nagpokhari, it is essential to implement measures that reduce nutrient loading, improve aeration, and prevent habitat degradation. Engaging local communities and stakeholders in conservation efforts will be crucial for sustaining the pond's ecological integrity and cultural heritage. In conclusion, this study provides essential baseline data and demonstrates the value of zooplankton biomonitoring in urban water quality assessment. By adopting these insights, we can better protect and manage Nagpokhari, ensuring its ecological and cultural significance is preserved for future generations.

REFERENCES

1. Altaff K. A Manual of Zooplankton, Compiled for the National, workshop on zooplankton, the new college, Chennai. 2004, 1-154.
2. Ward HB, Whipple GC. Fresh Water Biology. - Second dition. Edited by Edmondson WT. John Wiley and Sons, Inc. New York, 1966.
3. Oliver J. Hao. Bioindicators for water quality evaluation- A review, Journal of Chinese Institute of environmental Engineering. 1996; 6(1):1-19.
4. Ward HB, Whipple GC. Fresh biology, 2nd ed. John Wiley and sons, New York, USA, 1959.
5. Legendre L, Legendre P. Numerical Ecology, Developments in Environmental Modeling 3. Elsevier Scientific Publishing Company, New York, 1983.

6. Singh R, Singh SP. Ecology of Polluted Waters, Edited by Kumar A, APH. Publishing Corporation, New Delhi, 2002,2.
7. CIA - The World Fact book: Central Intelligence Agency. Retrieved 2008-2009, 12-20.
8. Sayeshwara HA. Studies on physic-chemical parameters of purple pond water of Shivamogga, Karnataka India. Int. J Chem. Sci. 2010; 8(1):582-588.
9. Palmer CM. A composite rating of algae tolerating organic pollution. J Phytocol. 1969; 5:78-82.
10. Battish SK. Zooplankton of polluted waters, cited in Ecology of Polluted Waters. Ed. Kumar A. APH. Publishing Corporation, New Delhi, 2002, 1.
11. Mahadev J, Hosamani SP. Algae for biomonitoring of organic pollution in two lakes of Mysore city. Nat Environ Pollut. Technol. 2005; 4:97-99.
12. Kannel PR, Lee S, Lee YS, Kannel SR, Khan SP. Application of water quality indices and dissolved oxygen as Indicators for River water classification and urban impact assessment. Environ. Monit. Assess. 2007; 132:1-3.
13. ICIMOD, MOEST-GON, UNEP. Kathmandu valley environment outlook. Kathmandu: International Centre for Integrated Mountain Development (ICIMOD), 2007.
14. Edmonson WT. Fresh water biology 2nd Edition, John Wiley and sons INC New York, 1963.