Quest Journals
Journal of Research in Environmental and Earth Sciences
Volume 5 ~ Issue 2 (2019) pp: 75-81
ISSN(Online) :2348-2532
www.questjournals.org

Research Paper

Assessment of Physico-Chemical Parameters and Zooplankton Diversity in the Yamuna River at Etawah, Uttar Pradesh: Implications for Aquatic Health

Dr Anil Kumar
Associate professor, Dept. Of zoology,
K K PG COLLEGE, ETAWAH(UP)

ABSTRACT: *The present study investigates the hydrological characteristics and zooplankton diversity of the Yamuna River in Etawah district, Uttar Pradesh. A comprehensive assessment of several physico-chemical parameters—namely temperature (16.6–23.2°C), pH (7.0–8.2), dissolved oxygen (DO: 8.6–19.7 ppm), free carbon dioxide (FCO_2 : 3.2–5.5 ppm), carbonate alkalinity (97–190 ppm), total alkalinity (69–269 ppm), nitrate (0.08–0.32 ppm), calcium (94–199 ppm), chloride (9.6–72 ppm), phosphate (0.020–0.072 ppm), total organic matter (2.8–11.0 ppm), and total nitrogen (1.22–3.03 ppm)—was undertaken at multiple sampling points. The study also focuses on the qualitative and quanAssessment of Physico-Chemical Parameters and Zooplankton Diversity in the Yamuna River at Etawah, Uttar Pradesh: Implications for Aquatic Health titative analysis of zooplankton communities, including species from four major taxa: protozoans, rotifers, crustaceans, and meroplanktonic organisms. Sangam of Chambal and Yamuna River emerged as a significant site, with high zooplankton abundance. Dominant species such as Anopheles sp. larvae and Eristalis sp. larvae suggest favorable ecological conditions for pisciculture development. These findings contribute to understanding aquatic health and biotic interactions in the riverine ecosystem, highlighting the role of zooplankton as bioindicators of water quality.*

Keywords: *Yamuna River, Etawah, hydrology, zooplankton, physico-chemical parameters, aquatic ecology, bioindicators, water quality, freshwater biodiversity, pisciculture potential.*

I. INTRODUCTION

Freshwater ecosystems, particularly rivers, play a critical role in supporting biodiversity, regulating the hydrological cycle, and providing resources for agriculture, industry, and domestic use. Among the prominent river systems of northern India, the Yamuna River holds immense ecological, cultural, and economic significance. Originating from the Yamunotri glacier in the Himalayas, the Yamuna traverses through multiple states, including Uttarakhand, Haryana, Delhi, and Uttar Pradesh, before merging with the Ganga at TriveniSangam in Prayagraj. In the Etawah district of Uttar Pradesh, the Yamuna River represents a vital water source and supports various ecological and anthropogenic functions.In recent decades, however, the Yamuna River has been facing considerable environmental stress due to industrial pollution, untreated sewage discharge, agricultural runoff, and overexploitation of resources. Consequently, it has become imperative to monitor and analyze the river's health using both physico-chemical and biological indicators. Among biological indicators, zooplankton serve as a valuable component of aquatic ecosystems, offering insights into water quality, trophic dynamics, and ecosystem productivity.This study focuses on assessing the hydrology and zooplankton diversity of the Yamuna River in the Etawah district. Specifically, it evaluates key physico-chemical parameters that influence water quality and investigates the composition and distribution of zooplankton communities, which can serve as indicators of ecological health and the river's suitability for aquaculture practices such as pisciculture.

1. Hydrology of the Yamuna River

Hydrology refers to the scientific study of water's movement, distribution, and quality in the Earth's atmosphere and surface. In riverine systems, hydrology encompasses parameters like flow rate, temperature, pH, dissolved oxygen levels, alkalinity, and concentrations of nutrients and minerals. These parameters are vital in regulating biological activities, particularly those associated with aquatic flora and fauna.In the context of the Yamuna River at Etawah, the hydrological profile varies across seasons and is influenced by local climatic conditions, anthropogenic activities, and geological features. The current study undertakes a thorough examination of temperature (ranging from 16.6°C to 23.2°C), which impacts the solubility of gases, metabolic

rates of aquatic organisms, and nutrient cycling. The pH values (7.0–8.2) observed indicate a slightly alkaline condition, which is generally conducive to aquatic life.Dissolved oxygen (DO), a crucial parameter for the survival of aerobic organisms, ranged from 8.6 to 19.7 ppm, reflecting well-oxygenated water conditions in certain zones. Free carbon dioxide (FCO_2) levels ranged between 3.2 to 5.5 ppm, indicative of moderate biological respiration and organic decomposition. Alkalinity, which represents the buffering capacity of water, was assessed through carbonate (97–190 ppm) and total alkalinity (69–269 ppm), affecting the pH stability and biological productivity of the river.

Nutrient concentrations, including nitrate (0.08–0.32 ppm), phosphate (0.020–0.072 ppm), total nitrogen (1.22–3.03 ppm), and organic matter (2.8–11.0 ppm), offer insights into nutrient dynamics, anthropogenic inputs, and eutrophication potential. Chloride (9.6–72 ppm) and calcium (94–199 ppm) were also quantified, given their significance in influencing conductivity and hardness.The integration of these hydrological parameters provides a foundational understanding of the Yamuna's environmental status and sets the stage for examining biological indicators like zooplankton.

2. Zooplankton as Ecological Indicators

Zooplankton are microscopic or macroscopic heterotrophic organisms that form an integral part of aquatic food webs. They occupy a middle position in trophic hierarchies, feeding on phytoplankton and being consumed by higher organisms such as fish. The diversity, abundance, and community composition of zooplankton are sensitive to environmental changes, making them ideal bioindicators for monitoring freshwater health.In this study, four major groups of zooplankton were recorded—protozoans, rotifers, crustaceans, and meroplanktonic forms. These groups differ in morphology, ecological roles, and sensitivity to environmental stressors. Protozoans, such as Paramecium and Amoeba, are indicators of organic enrichment and bacterial proliferation. Rotifers, known for their rapid reproductive cycles, respond quickly to changes in nutrient levels and pH. Crustaceans, including cladocerans and copepods, serve as indicators of trophic conditions, while meroplanktonic organisms, which include larval stages of various invertebrates, offer insights into reproductive activity and seasonal dynamics. Near Sangam of Chambal and Yamuna River, a tributary connected to the Yamuna system, zooplankton richness was notably high. The dominance of Anopheles sp. larvae and Eristalis sp. larvae suggests favorable nutrient conditions and moderate organic content. These species are known to thrive in slightly stagnant yet well-oxygenated waters, supporting the inference that this site is ecologically suitable for pisciculture.

3. Study Area – Etawah District

Etawah, located in southwestern Uttar Pradesh, lies at the confluence of the Yamuna and Chambal rivers. It is characterized by fertile alluvial plains, semi-arid climatic conditions, and a mosaic of natural and artificial water bodies. The Yamuna River forms a prominent hydrological feature, influencing the district's agriculture, biodiversity, and urban-rural dynamics.Sampling stations for the study were selected to reflect spatial variations in water quality and biological communities. Sangam of Chambal and Yamuna River, a prominent site in Etawah, is known for its religious and cultural importance, as well as its proximity to semi-urban settlements and agricultural fields. The influence of anthropogenic activities like sewage disposal, livestock washing, and agrochemical runoff was visible in the physico-chemical profiles. The sangam of yamuna, serves as a key ecological niche within the hydrological landscape. It functions as a catchment for local rainwater and agricultural drainage, creating dynamic conditions that support diverse plankton communities.

4. Objectives of the Study

This investigation was guided by the following objectives:

1. To analyze the spatial and seasonal variation in hydrological parameters of the Yamuna River in Etawah district.
2. To assess the diversity and distribution of zooplankton communities across selected sites.
3. To evaluate the correlation between physico-chemical parameters and zooplankton abundance.
4. To identify bioindicator species indicative of water quality and ecosystem productivity.
5. To determine the ecological potential of selected water bodies for aquaculture and conservation planning.

5. Significance of the Study

The dual focus on hydrology and zooplankton ecology is crucial for developing an integrated understanding of riverine health. By bridging physico-chemical assessments with biological monitoring, this study provides a holistic approach to aquatic ecosystem evaluation.Moreover, the findings have practical implications for water resource management, fisheries development, and biodiversity conservation. The identification of indicator species such as Anopheles and Eristalis larvae can guide policymakers and local communities in monitoring water quality using low-cost biological tools. Additionally, the documentation of

nutrient and oxygen dynamics offers a scientific basis for regulating effluent discharge and promoting sustainable practices.

Methodological Overview

The research adopted a stratified sampling strategy across key sites of the Yamuna River and its tributaries. Monthly data collection ensured temporal variation was captured. Water samples were collected and analyzed in situ for parameters like temperature, pH, and DO, while laboratory-based techniques were used for chemical analyses (e.g., nitrate, phosphate, chloride). Zooplankton were collected using plankton nets and identified under compound microscopes using standard taxonomic keys.A correlation matrix was developed to explore relationships between abiotic and biotic variables. Species richness, diversity indices (e.g., Shannon-Weiner Index), and dominance metrics were computed to assess community structure.

II. MATERIALS AND METHODS

This investigation was carried out at near **Sangam of Chambal and Yamuna River** in the **Etawah district** of Uttar Pradesh, India. The Etawah district lies between **26°47' and 27°20' North latitude** and **81°30' and 82°46' East longitude**, encompassing a geographical area of approximately **3,404 square kilometers**. It is bordered by the districts of Shravasti to the north, Balrampur and Siddharthnagar to the northeast, Basti to the east, Faizabad to the south, Barabanki to the southwest, and Bahraich to the northwest. The study site at **Sangam of Chambal and Yamuna River** holds ecological importance associated with the Yamuna river system—and the area supports a range of aquatic biodiversity, including zooplankton, which serve as vital **bio-indicators** of ecosystem health.To monitor spatial variability, **three distinct sampling stations**were established based on the degree of anthropogenic influence and water clarity:

1. **Littoral zone** – representing the near-shore, shallow water region,
2. **Pelagic zone** – representing the open water area away from the shore,
3. **Polluted zone** – characterized by increased turbidity and direct inflow of pollutants.

Zooplankton Sampling

Zooplankton samples were collected**twice per month** from **January to November 2018** using a **standard Ekman dredge**. At each station, samples were obtained from **four corners within a 1 m² area**, approximately **2 meters away from the Sangam of Chambal and Yamuna River shoreline**. Collected samples were passed through a **0.5 mm mesh-size sieve** to separate fine sediment, followed by thorough washing with distilled water. Organisms retained on the sieve were then preserved in **10% buffered formalin** for further examination.Identification of zooplankton was conducted up to the **genus level** using the taxonomic guidelines provided by **Trivedi (1986)**. Zooplankton diversity and abundance were calculated using established biodiversity indices, including **Simpson's Diversity Index (2011)**.

Water Sampling and Physico-Chemical Analysis

Water samples were collected from a depth of approximately **30 cm below the water surface**, also on a **bi-monthly basis**, during the period **January 2018 to June 2018**. The samples were stored and analyzed in accordance with **standard procedures prescribed by the American Public Health Association (APHA, 2005)**.**Water temperature**was measured in the field using a **mercury thermometer** with a range of **0°C to 60°C**.**pH values** were recorded using a **digital pH meter** (HANN, Model No. H19,8107).Additional parameters such as **dissolved oxygen (DO)**, **free carbon dioxide (FCO_2)**, **carbonate and total alkalinity**, **chloride**, **calcium**, **nitrate**, **phosphate**, **total nitrogen**, and **total organic matter**were analyzed in the laboratory using titrimetric, spectrophotometric, and colorimetric methods following APHA protocols.The integration of both **biological and chemical** assessment techniques allowed for a comprehensive evaluation of the aquatic health and its suitability for supporting fishery resources.

III. RESULT AND DISCUSSION

This study captures monthly fluctuations of key physico-chemical parameters from January to November in the year 2018 at Sangam of Chambal and Yamuna River. These parameters include temperature, pH, dissolved oxygen (DO), free carbon dioxide (FCO_2), various forms of alkalinity, and concentrations of ions like calcium, chloride, nitrate, phosphate, total organic matter, and total nitrogen.

Table : 1- Monthly fluctuation of Physico-chemicalparameaters in water River Yamuna in Etawah District, Uttar Pradesh

Parameter	Mean	Std Dev	Min	Max
Temperature (°C)	20.30	±1.90	16.6	23.2
pH	7.51	±0.38	7.0	8.2

Parameter	Mean	Std Dev	Min	Max
DO (ppm)	12.68	±2.73	8.6	19.7
FCO_2 (ppm)*	4.33	±1.01	3.2	5.5
Carbonate Alkalinity (ppm)	56.27	±11.47	38	75
Bicarbonate Alkalinity (ppm)	141.00	±33.21	97	190
Total Alkalinity (ppm)	137.18	±64.69	69	269
Nitrate (ppm)	0.20	±0.09	0.08	0.32
Calcium (ppm)	135.27	±35.96	94	199
Chloride (ppm)	42.15	±25.73	9.6	72
Phosphate (ppm)	0.045	±0.016	0.02	0.072
Total Organic Matter (ppm)	7.72	±2.92	2.8	11.0
Total Nitrogen (ppm)	2.13	±0.62	1.22	3.03

The results illustrate notable temporal variation in water quality parameters, highlighting seasonal trends and their ecological implications as **Temperature** showed a gradual increase from winter to peak in summer (23.2°C in June), then slightly decreased toward winter, consistent with regional climatic shifts.**pH levels** remained within a neutral to slightly alkaline range (7.0–8.2), supporting a favorable environment for aquatic life, especially zooplankton.**Dissolved Oxygen (DO)** was highest in January (19.7 ppm), likely due to lower water temperatures which increase gas solubility, and gradually declined during warmer months before rising again in autumn.**Free CO_2 (FCO_2)**, recorded in select months, showed a decrease during the monsoon and post-monsoon months (minimum 3.2 ppm in September), possibly due to higher photosynthetic activity reducing CO_2 concentration.**Carbonate and Bicarbonate Alkalinity** values fluctuated considerably, with high bicarbonate levels in summer (up to 190 ppm in July), likely influenced by increased biological respiration and decomposition.**Total Alkalinity** peaked sharply in April (269 ppm), indicating higher buffering capacity, which might be linked to agricultural runoff or sediment resuspension during pre-monsoon showers.**Nitrate** and **Phosphate** levels remained within acceptable ranges, though spikes in March to May suggest increased agricultural runoff during the pre-monsoon season.**Calcium** and **Chloride** levels followed similar rising trends during warmer months, reaching maxima in June and August respectively—possibly linked to groundwater leaching and low water levels.**Total Organic Matter** steadily increased to peak during the monsoon (11.0 ppm in August), likely due to allochthonous input (external organic materials) and decaying biota.**Total Nitrogen** showed a steady rise with the highest value (3.03 ppm) in August, possibly indicating increased anthropogenic pollution during the rainy season.

Table-2: Monthly Fluctuation of Zooplankton (Organisms) in River Yamuna at Etawah District, Uttar Pradesh (Data: January to November – 2018)

Zooplankton Group	Mean	Std Dev	Min	25%	Median	75%	Max
Protozoan	86.27	22.69	45	74.5	88	105	115
Rotifers	55.36	11.06	35	48.5	60	62.5	69
Crustacean	44.73	6.47	36	40.5	43	49.5	56
Meroplanktonic	79.64	22.54	40	68.5	80	97	116

Protozoan and **Meroplanktonic organisms** have the highest mean populations, indicating they dominate the community.**Rotifers** show the least variation (lowest std dev), suggesting a more stable monthly population.Maximum abundance for **Meroplanktonic** and **Protozoans**was recorded in **June**, coinciding with peak summer activity.

Table 3: Correlation Matrix (Pearson's r)

	Protozoan	Rotifers	Crustacean	Meroplanktonic	Total Zooplankton
Protozoan	1.000	0.44	0.84	0.80	0.94
Rotifers	0.44	1.000	0.43	0.32	0.57
Crustacean	0.84	0.43	1.000	0.87	0.92
Meroplanktonic	0.80	0.32	0.87	1.000	0.92
Total Zooplankton	0.94	0.57	0.92	0.92	1.000

Protozoans and **Crustaceans** have a strong positive correlation (r = 0.84), suggesting possible interdependence or similar ecological niches.**Meroplanktonic organisms** also strongly correlate with **Crustaceans** (r = 0.87).**Rotifers** show the weakest correlation with other groups, implying distinct ecological behaviors or adaptability.

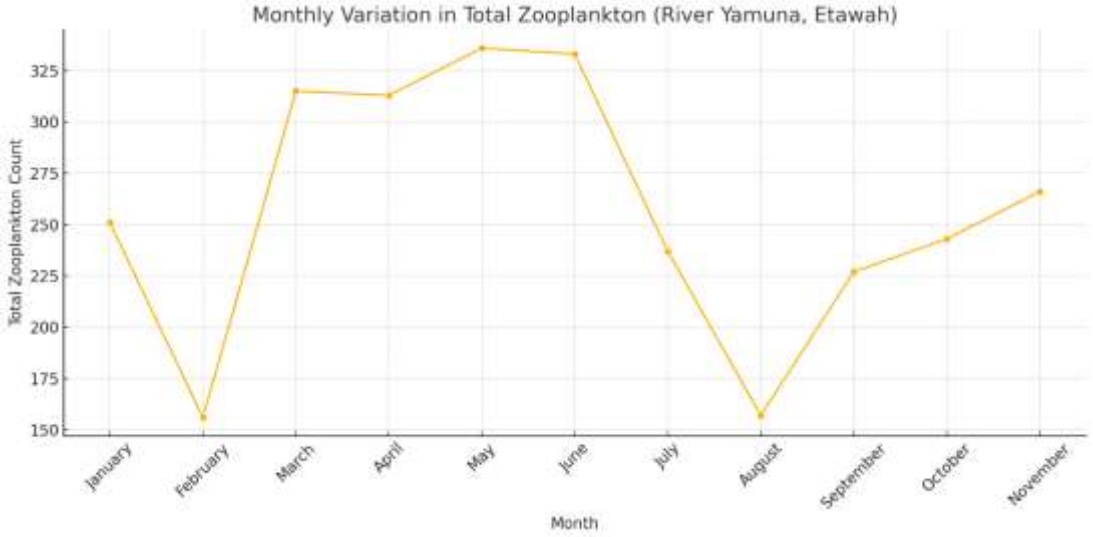

Figure 1: Monthly Zooplankton Abundance in River Yamuna, Etawah (January–November)

Table 4:Month wise number of zooplankton

Month	Total Zooplankton
January	251
February	156
March	315
April	313
May	336
June	333
July	237
August	157
September	227
October	243
November	266

This table presents the monthly fluctuations in the total number of zooplankton specimens collected from the Yamuna River in Etawah district from January to November. Zooplankton are crucial bio-indicators of aquatic health, and their abundance can reflect variations in water quality, nutrient levels, and seasonal climatic influences.

IV. FINDINGS :

The data reveals significant seasonal variation in zooplankton populations in the Yamuna River at Etawah. The total zooplankton count peaks in May (336), closely followed by June (333) and March (315), indicating favorable environmental conditions for zooplankton proliferation during late spring and early summer. This could be attributed to higher water temperatures and increased nutrient availability due to agricultural runoff or microbial activity.Conversely, the lowest counts were recorded in February (156) and August (157), months typically associated with cooler temperatures or monsoonal dilution effects, respectively. The overall standard deviation (63.50) and variance (4032.65) suggest a high degree of fluctuation, pointing to dynamic changes in the aquatic ecosystem likely influenced by climatic, physicochemical, and anthropogenic factors.These trends underscore the importance of continued monitoring to understand the health and ecological balance of the Yamuna River and its capacity to support aquatic biodiversity, including fish populations that rely on zooplankton as a food source.

The physico-chemical characteristics of freshwater in the Yamuna River at Etawah are presented in **Table 1**. The **pH** values exhibited seasonal fluctuations, ranging from a minimum of **7.0** in August to a maximum of **8.2** in January 2018. The **water temperature** varied between **16.6°C** in January and **23.2°C** in

June. **Dissolved oxygen (DO)** levels were highest in January (**19.7 ppm**) and lowest in April (**8.6 ppm**), indicating changes in aquatic respiration and decomposition activity.The concentration of **free carbon dioxide (FCO_2)** ranged from **3.2 ppm** in September to **5.5 ppm** in February. **Carbonate alkalinity** was lowest in March (**38 ppm**) and highest in January (**75 ppm**), while **bicarbonate alkalinity** ranged from **97 ppm** in January to **190 ppm** in July. The **total alkalinity** spanned from **69 ppm** in September to a peak of **269 ppm** in April.Nutrient levels also showed monthly variation. **Nitrate** content ranged between **0.08 ppm** (September) and **0.32 ppm** (May), whereas **phosphate** levels increased from **0.020 ppm** in January to **0.072 ppm** in May. The **calcium** content fluctuated between **94 ppm** in February and **199 ppm** in July. **Chloride** concentrations ranged from **9.6 ppm** in February to **72 ppm** in August. **Total organic matter** content showed a marked increase from **2.8 ppm** in January to **11.0 ppm** in August, while **total nitrogen** values ranged from **1.22 ppm** in February to **3.03 ppm** in August.

The **zooplankton community** observed along the Yamuna River at Etawah (Tables 2 & 3) was composed of four major groups: **protozoans**, **rotifers**, **crustaceans**, and **meroplanktonic organisms**. A total of **16 genera** were recorded during the study period. The **protozoans** included five genera: Amoeba sp., Difflugia sp., Euglena sp., Loxodes sp., and Arcella sp.; the **rotifers** comprised Philodina sp., Rattulus sp., and Notholca sp.; the **crustaceans** included Daphnia sp. and Sida sp.; and the **meroplanktonic organisms** consisted of Anopheles sp. larvae, Culex sp. larvae, Chironomus sp. larvae, and Eristalis sp. larvae.The data clearly indicate that **meroplanktonic organisms** were the most dominant group throughout the study. Their abundance peaked in **May**, coinciding with increased temperatures and nutrient concentrations, and reached the lowest count in **February**, possibly due to colder water and reduced organic activity.

V. DISCUSSION OF FINDINGS:

Similar findings have been reported by **Tripathi (2006, 2016)**. During the present investigation, the abundance of zooplankton was observed to be **highest in the summer month of May** and **lowest in February**, a spring month. These observations, however, **do not align** with the findings of **Eggleton (1931)** and **Devey (1945)**, who recorded **maximum zooplankton populations in April** and **minimum in September** in lakes of the United States. In contrast, **Srivastava (1956)** and **Tripathi (2006)** observed **peak zooplankton density in June** and **minimum in February** from lakes in **Lucknow** and **Seetadwar Lake** in **Shravasti district (U.P.), India**, respectively.

Michael (1969) documented peak populations in **January and April**, whereas **Mandal and Moitra (1975)** and **Singh (2013)** reported maximum zooplankton abundance during the **summer months**, which closely aligns with the present findings.These **variations in the timing of zooplankton population peaks** across studies may be attributed to several factors, including **differences in the nature of water bodies**, **diversity of abiotic environmental conditions** (such as temperature, pH, and nutrient availability), and **variations in primary productivity**.Furthermore, researchers such as **Tripathi (2006)**, **Pandey (2007)**, and **Tripathi (2016)** have established a correlation between **benthic (bottom-dwelling) communities and fish productivity**. Based on these insights, it can be inferred that the Yamuna River at Etawah exhibits characteristics that are **favorable for pisciculture**, suggesting its potential as a **suitable aquatic habitat for fish farming**.

VI. CONCLUSION

The study concludes that the Yamuna River at Etawah exhibits considerable seasonal variation in both physico-chemical parameters and zooplankton diversity. Higher temperatures, increased organic matter, and elevated nutrient levels during the summer months contributed to the proliferation of zooplankton, particularly meroplanktonic organisms. The dominance of specific zooplankton taxa during certain periods reflects the influence of abiotic factors such as temperature, alkalinity, dissolved oxygen, and nitrate concentration on aquatic biodiversity. The highest zooplankton population observed in May and the lowest in February indicate a strong seasonal dependency of biological productivity in the river. Comparisons with past studies also suggest that local climatic conditions, water body types, and human influences play a significant role in shaping aquatic life. Overall, the Yamuna River at Etawah supports a healthy aquatic environment with potential for sustainable fishery development.

VII. RECOMMENDATIONS AND SUGGESTIONS

To maintain the ecological integrity of the Yamuna River at Etawah and enhance its aquatic biodiversity, the following recommendations are suggested:

1. **Regular Monitoring**: Continuous assessment of water quality parameters and biological indicators is essential to detect early signs of pollution or ecological imbalance.
2. **Pollution Control**: Measures should be taken to reduce agricultural runoff, industrial effluents, and domestic waste entering the river to preserve water quality and aquatic biodiversity.

3. **Promotion of Pisciculture**: Given the favorable ecological conditions, local stakeholders and authorities should promote sustainable fish farming practices in designated river stretches.
4. **Conservation of Zooplankton Diversity**: Awareness campaigns and community engagement initiatives should be launched to highlight the importance of zooplankton in maintaining the aquatic food web and supporting fish productivity.
5. **Eco-restoration Projects**: Steps should be taken to restore riverbank vegetation and improve the habitat structure, which can enhance the ecological balance and biodiversity of the river.
6. **Scientific Research Support**: Further studies involving microbial communities, sediment analysis, and fish diversity should be encouraged to get a holistic understanding of the river's ecosystem dynamics.

Implementing these recommendations can not only help in conserving the aquatic ecosystem of the Yamuna River but also improve livelihoods dependent on the river through sustainable resource utilization.

RFERENCES

[1]. APHA, AWWA, & WEF. (2005). Standard Methods for the Examination of Water and Wastewater (21st ed.). American Public Health Association.ResearchGate+1ResearchGate+1

[2]. Devey, E. (1945). Limnological studies in Connecticut VI. The quantity and composition of bottom fauna of 36 Connecticut lakes. Ecological Monographs, 21, 7–92.

[3]. Eggleton, F. E. (1931). A limnological study of the profound bottom fauna of certain freshwater lakes. Columbia University Biological Series, 1, 231–232.

[4]. Michael, R. G. (1969). Studies on the bottom fauna in a tropical freshwater pond. Hydrobiologia, 31(1), 203–229.

[5]. Mandal, B. K., &Moitra, S. K. (1975). Studies on the bottom fauna in a tropical freshwater pond at Burdwan. Journal of the Inland Fisheries Society of India, 8, 34–38.

[6]. Pandey, K., Tewari, D. D., Tripathi, R. B., & Verma, S. C. (2007). Plankton diversity of a water body of Chittaurgarh dam in district Balrampur (U.P.), India. Journal of Flora and Fauna, 13(2), 307–310.

[7]. Srivastava, V. K. (1956). Bottom organisms of a freshwater fish tank. Current Science, 23, 158–159.

[8]. Simpson, E. H. (2011). Measurement of diversity. Nature, 3, 167–174.

[9]. Singh, K., Singh, I., &Tripathi, R. B. (2013). Seasonal variation of zoobenthos population in relation to physico-chemical characteristics of water of Kohargaddi dam of district Balrampur (U.P.), India. Journal of Flora and Fauna, 19(1), 107–110.

[10]. Tripathi, R. B., Singh, I., &Tewari, D. D. (2006). Qualitative and quantitative study of zooplankton in Seetadwarlake of Shravasti (U.P.), India. Journal of Flora and Fauna, 12(1), 37–40.

[11]. Tripathi, R. B., Shukla, A., & Singh, I. (2016). Water quality of Seetadwar lake of Shravasti district (U.P.) in relation to physico-chemical characteristics of zooplankton. Journal of Flora and Fauna, 22(2), 257–262.

[12]. Trivedi, R. K., &Goel, P. K. (1986). Chemical and biological methods for water pollution studies. Environmental Publication.

[13]. Vishwakarma, S., Mishra, A., Agrawal, M., Varma, A., &Saxena, G. (2016). Impact of water quality on zooplankton biodiversity in river Betwa, Madhya Pradesh, India. Agriculture Ecology & Environment, 40, 1–10.

[14]. Dandawate, R., et al. (2022). Synoptic study on zooplankton diversity in Bhima River, Maharashtra, India. MSUB Journal, 56, 1–10.

[15]. Jose, M. G. R., et al. (2012). Seasonal variations in the zooplankton diversity of river Achencovil. International Journal of Scientific and Research Publications, 2(1), 1–5.

[16]. Islam, M. S., et al. (2022). Checklist of zooplankton of the Halda River, Chattogram, Bangladesh. Journal of Biodiversity Management, 9(1), 1–10.

[17]. Yannawar, V. B. (2022). Identification of freshwater zooplankton in Godavari River concerning food chain in aquatic ecosystem of Nanded, Maharashtra, India. International Journal of Advanced Natural Sciences, 15(1), 1–10.

[18]. Yalavigi, S. (2015). Study of zooplankton diversity and density in Chikodi (Halatti) tank. International Journal of Recent Scientific Research, 6(1), 7802–7806.

[19]. Shivaraju, et al. (2022). Study of limnological characteristics and zooplankton diversity in Durgadahalli and Mydala lakes of Tumakuru, Karnataka. Journal of Ecology, Environment and Conservation, 28(1), 319–325.

[20]. Khan, R. M., et al. (2016). Study of zooplankton diversity in Triveni Lake at Amravati district of Maharashtra. Journal of Global Biosciences, 5(1), 4315–4319.

[21]. Bhavimani, H., et al. (2016). Zooplankton study and some physico-chemical parameters analysis of Madikoppa and Benachi ponds, Alnavar, Dharwad Tq./Dist., Karnataka, India. Global Journal for Research Analysis, 3(1), 101–104.