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# Seasonal planktonic diversity of Angoori barrage, Datia, Madhya Pradesh

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**Abstract**
In the present study, total thirty planktonic members from the four sampling sites of the selected research area in which, twelve phytoplanktons and eighteen zooplanktons each under the four different groups namely (Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae) and (Protozoans, Rotiferans, Cladocerans, Copepods) were recorded respectively. Among all the recorded phytoplanktonic groups, the Chlorophyceae was dominated and order of group wise phytoplanktonic abundance was Chlorophyceae > Bacillariophyceae > Cyanophyceae > Euglenophyceae, while among the zooplanktonic group the Cladocerans was most dominated and order of group wise zooplanktonic abundance was Cladocerans > Rotiferans > Protozoans > Copepods. During the seasonal period, different species of planktons were predominated in different seasons. The percentage composition of phytoplanktons recorded maximum during summer (43.47%), intermediate during winter period (34.78%) and minimum during rainy period (21.73%) while the percentage composition of zooplanktons recorded maximum (48.27%) in summer, intermediate (34.48%) in winter and minimum (17.24%) during the rainy period.

**Keywords:** Seasonal planktonic diversity, Angoori Barrage and Datia

## Introduction
Phytoplanktons are microorganism that can make their own nourishment through photosynthesis. They are recognized as the fundamental ecological element in an aquatic environment, engaging in energy flow and serving as the principal source of nutrients for fish and other aquatic animals. Planktons, particularly phytoplankton, used to assess the hydrological status of any aquatic body, (Mittal and Sengar, 1991) [18]. Phytoplankton are a key supplier of energy in any ecosystem's food web and are regarded as a biological prosperity of water for fishes as well as an essential component in the food chain (Wetzel, 2001) [30]. They are also well known for their outstanding capacity to serve as bioindicators since they react quickly to changes in their environment (Prabha and Dua, 2018) [22]. They are not limited to marine environments, and can also be found in freshwater systems such as rivers and serving as the foundation of food webs and playing a crucial role in the global carbon cycle (Zinat *et al*., 2021) [31].

The animal community of planktonic organism is called Zooplankton. These are weakly swimming invertebrate animals that drift with currents of water as well as along with phytoplankton. Because of their drifting nature, great species variety, and resilience to stress conditions, zooplanktons serve as an essential bridge organism for energy transition in the aquatic food web (Bhat *et al.*, 2014) [1]. As the foundation of food chains and food webs in all aquatic ecosystems, these are the primary natural food sources for fish that are crucial to their survival and development of aquatic organism (Miah *et al.*, 2013) [17]. These faunal communities play a vital role in maintaining the biological equilibrium of aquatic ecosystems.

## Materials and Methods
### Research Area
Angoori barrage is an important large water body situated in the district Datia of Madhya Pradesh. It is close to the Gwalior-Jhansi national highway and the Delhi-Mumbai railway line. The four sampling locations (A-Barrage head, B- Bhagaur, C- Gangwari, D- Pahaadi Lamacha) represent this research area where the investigation was conducted.


**Sample Collection and Preservation:** Water samples were taken from every sampling location in the morning period by filtering the desired amount of water through plankton net of bolting silk fabric, number 25, with a mesh size of 65 m. It is a cone-like net with the top circle coupled to a copper ring with a handle and the bottom's narrow attached to the opening of a sampling bottle. The samples obtained were thoroughly treated by using 4% formalin solution/lugol iodine solution and stored for approximately 24 hours for improved sedimentation. On the second day, the excess fluid was carefully removed, and its concentrated residue was analyzed by using the Sedgwick Rafter cell counting chamber method.

**Analytical Technique:** The keys and standard operating procedures established by the various researchers (Adoni, 1985; Dang *et al*., 2015; Edmondson, 1959; Needham and Needham, 1941; Palmer, 1980; Prescott, 1954; Sehgal, 1983) [2, 4, 8, 9, 20, 23, 25] were used to identify the different members of phytoplankton and zooplankton

**Results and Discussion**

In the present study, total 12 microscopic phytoplanktonic members were observed includes *Volvox* sp., *Tetraedron* sp., *Spirogyra* sp., *Closterium* sp., *Staurastrum* sp., *Arthrodesmus* sp., *Diatom* sp., *Pinnularia* sp., *Navicula* sp., *Anabaena* sp., *Oscillatoria* sp. and *Euglena* sp. It was observed that among the all recorded phytoplanktonic groups, the Chlorophyceae dominated over all other groups with order of abundance was Chlorophyceae > Bacillariophyceae > Cyanophyceae > Euglenophyceae. The seasonal changes in phytoplanktons during the winter, summer and rainy season was also noticed and observed that different species of phytoplanktons were dominated in different seasons. Total 08different types of phytoplanktons were found during the winter season, while 10 members of phytoplanktons were recorded during the summer and only 05 members of phytoplanktons were noticed during the rainy season. Among all the seasonal period, the percentage composition of phytoplanktons recorded maximum during the summer period, intermediate in winter and minimum during the rainy period. The order of percentage composition of phytoplankton abundance during all seasonal period was summer period (43.47%) > winter period (34.78%) > rainy period (21.73%).This modest increase in phytoplanktonic population in summer season due to the proper water temperature, the suitable amount of light availability, low turbidity, and the appropriate DO, BOD, and other factors. The seasonal variations and the specific geographic location and water depth can significantly impact the diversity of phytoplankton (Das *et al.*, 2022) [5]. The study of Patil (2011) [21] also reported that maximum phytoplanktonic density during summer period was due to higher temperature because it stimulates growth of the aquatic autotrophs. According to Hujare (2008) [12] along with the higher summertime temperatures, the higher pH (alkaline pH) may also promote a larger phytoplankton population. Similar to this, summer experienced the highest phytoplankton density and the monsoon observed lowest was also noticed by the work of Malik and Bharti (2012) [15], Shinde *et al*. (2012) [26], Shukla and Singh (2013) [27], and Divya *et al*. (2013) [6], Sebastian and Thomas (2016) [24], Asha *et al*., (2018) [3] Varghese *et al*. (2022) [29].

In the present study, total 18 microscopic zooplanktonic members belong to Protozoans, Rotiferans, Cladocerans and Copepods were also observed from the research area. The recorded members include *Arcella* sp., *Paramecium* sp., *Difflugia* sp., *Vorticella* sp., *Lecane* sp., *Brachionus* sp., *Polyarthra* sp., *Keratella* sp., *Monostyla* sp., *Bosmina* sp., *Ceriodaphnia* sp., *Daphnia* sp., *Diaphanosoma* sp., *Moina* sp., *Simocephalus* sp., *Cyclops* sp., *Diaptomus* sp. and *Mesocyclops* sp. From the group wise zooplanktonic study, it was observed that among all the recorded zooplanktonic groups the Cladocerans group was dominated. The order of zooplantonic abundance was Cladocerans > Rotiferans > Protozoans > Copepods. In this work, seasonal changes in zooplanktonic population were also observed and noticed that different species of zooplanktons were dominated in different seasons. Total 10 zooplanktons were recorded during winter season, while 14 members were recorded during the summer period and only 05 members were noticed during the rainy season. Among all the seasonal period, the percentage composition of zooplanktons recorded maximum during summer, intermediate in winter and minimum during the rainy period. The order of percentage composition of zooplankton abundance during all the seasonal period was summer period (48.27%) > winter period (34.48%) > rainy period (17.24%). The high zooplanktonic abundance during the summer period was due to high water temperature of the water body, an accelerated rate of decomposition of organic matter, which in turn favors high alkalinity and increases the supply of organically enriched nutrients in the water body, while the low zooplanktonic abundance during the rainy period was due to fast drop in water temperature, a spike in water flow, and dilution effect of available nutrients in water body leads to the lowest population. The study of Tyor (2014) [8] also suggest that an improvements in water temperature as well as increased evaporation during the summertime increase the pace of decomposition, resulting in an increase in population variety and density of zooplankton. Frost *et al* (2020) [9] also reported that the abundance and diversity of zooplankton also influenced by various factors, such as temperature, nutrient availability, and predation pressure, and changes in these factors can lead to significant shifts in zooplankton communities that affect the entire ecosystem. Similar observations were also made at the Sina Kolegoan Dam by Jadhav *et al*. (2012) [13] and the Nagatas Dam by Gaike *et al*. (2012) [10] and Dubey *et al*. (2014) [7] in Kaliasote reservoir of Bhopal, along with the earlier work of Kar and Kar (2016) [14], Goswami *et al* (2017) [11] and Manickam *et al* (2018) [16] in different water bodies also support our findings.

**Table 1:** Sessonal Diversity of Phytoplankton [Oct.2020 to Sept. 2022]

| Group | S.No. | Name of Phytoplankton | Winter | Summer | Rainy |
|---|---|---|---|---|---|
| Chlorophyceae | 1 | *Volvox* sp. | √ | × | √ |
| | 2 | *Tetraedron* sp. | √ | √ | × |
| | 3 | *Spirogyra* sp. | × | √ | × |
| | 4 | *Closterium* sp. | √ | √ | √ |
| | 5 | *Staurastrum* sp. | √ | √ | × |
| | 6 | *Arthrodesmus* sp. | × | √ | × |
| Bacillariophyceae | 7 | *Diatom* sp. | √ | √ | √ |
| | 8 | *Pinnularia* sp. | × | × | √ |
| | 9 | *Navicula* sp. | √ | √ | × |
| Cyanophyceae | 10 | *Anabaena* sp. | √ | √ | √ |
| | 11 | *Oscillatoria* sp. | × | √ | × |
| Euglenophyceae | 12 | *Euglena* sp. | √ | √ | × |
| Total Phytoplankton ($ul^{-1}$) | 08 | 10 | 05 | | |

Note: Present (√), Absent (×)

| Seasonal Diversity | Quantitative Diversity of Phytoplankton | Percentage Composition |
|---|---|---|
| Winter Season | 08 | 08/23 = 34.78% |
| Summer Season | 10 | 10/23 = 43.47% |
| Rainy Season | 05 | 05/23 = 21.73% |
| Total Phytoplankton ($ul^{-1}$) | 23 | |

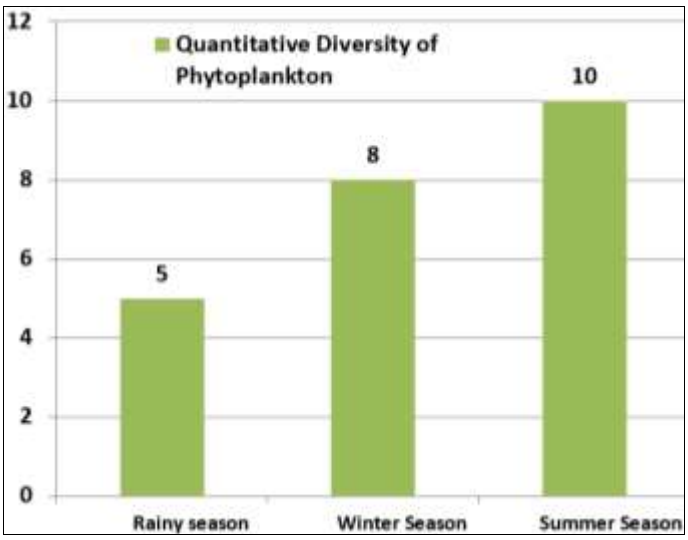


**Fig 1:** Quantitative Diversity of Phytoplankton

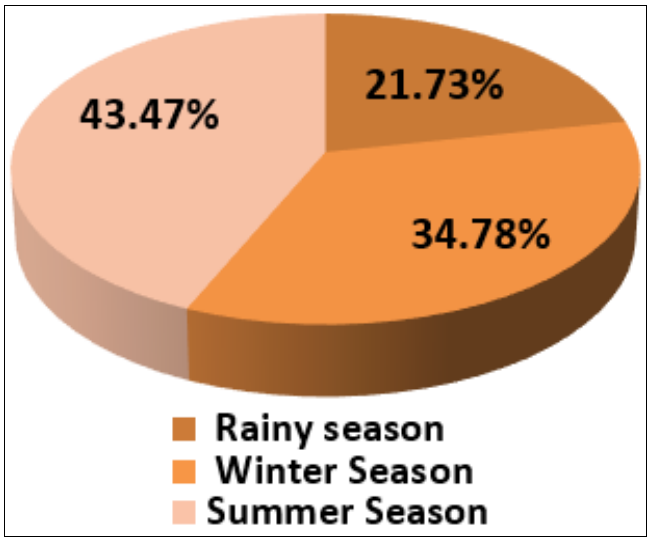


**Fig 2:** Percentage Composition Phytoplankton

**Table 2:** Sessonal diversity of Zooplankton [Oct.2020 to Sept. 2022]

| Groups | S. No. | Name of Zooplanktons | Winter | Summer | Rainy |
|---|---|---|---|---|---|
| Protozoans | 1 | *Arcella* sp. | × | √ | × |
| | 2 | *Paramecium sp* | √ | × | × |
| | 3 | *Difflugia* sp. | × | √ | × |
| | 4 | *Vorticella* sp. | × | √ | × |
| Rotiferans | 5 | *Lecane sp* | √ | × | × |
| | 6 | *Brachionus* sp. | √ | √ | √ |
| | 7 | *Polyarthra* sp. | × | √ | × |
| | 8 | *Keratella* sp. | √ | √ | × |
| | 9 | *Monostyla* sp. | × | √ | × |
| Cladocerans | 10 | *Bosmina* sp. | √ | √ | √ |
| | 11 | *Ceriodaphnia* sp. | √ | √ | × |
| | 12 | *Daphnia* sp. | × | √ | × |
| | 13 | *Diaphanosoma* sp. | √ | × | × |
| | 14 | *Moina* sp. | √ | √ | √ |
| | 15 | *Simocephalus* sp. | × | √ | × |
| Copepods | 16 | *Cyclops* sp. | × | √ | √ |
| | 17 | *Diaptomus* sp. | √ | × | √ |
| | 18 | *Mesocyclops* sp. | √ | √ | × |
| | Total no. Zooplankton | | 10 | 14 | 05 |

Note: Present (√), Absent (×)

| Seasonal Diversity | Quantitative Diversity of Zooplankton | Percentage Composition |
|---|---|---|
| Winter Season | 10 | 10/29 = 34.48% |
| Summer Season | 14 | 14/29 = 48.27% |
| Rainy Season | 05 | 05/29 = 17.24% |
| Total Zooplankton($ul^{-1}$) | 29 | |

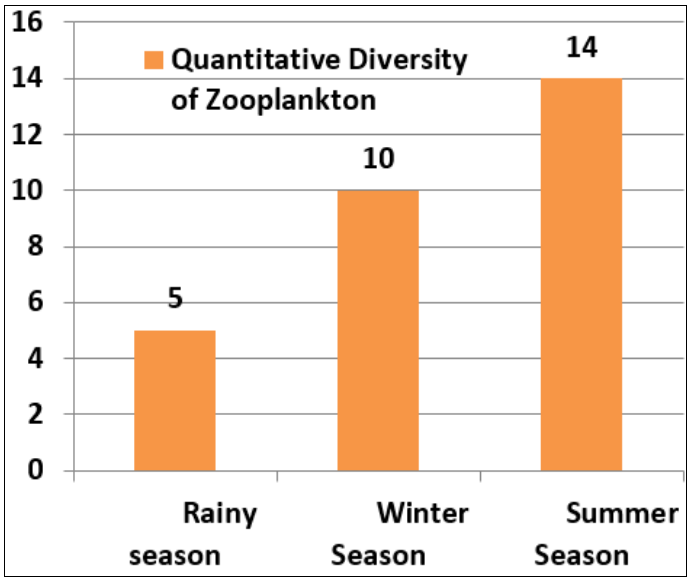


**Fig 3:** Quantitative Diversity of Zooplankton

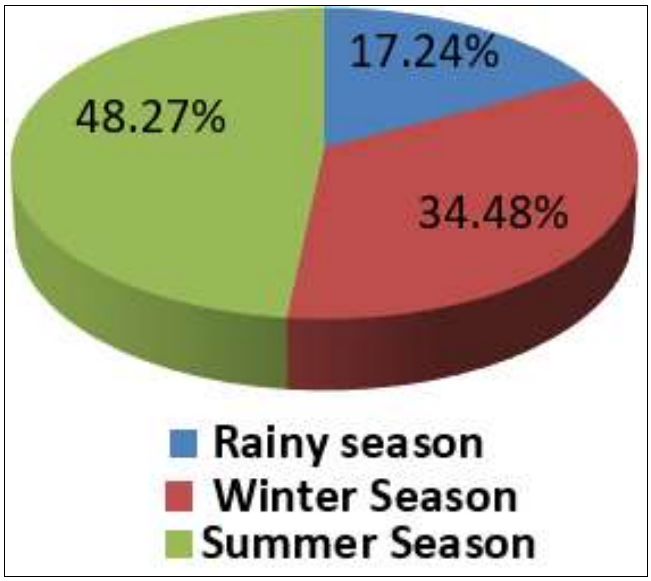


**Fig 4:** Percentage Composition Zooplankton

## Conclusion

The current study indicated that the Angoori Barrage water body of Datia district supports a diverse seasonal community of planktonic microorganisms. Chlorophycean phytoplanktons and Rotifers zooplanktons were mostly dominated in this selected water body. For piscian larvae, rotifers are their preferred natural food sources and also play a crucial part in keeping the aquaculture maintenance. The monsoon time frame was noticed least accessibility of planktonic community while highest during summertime related to the varied water temperature, suitable amount of light availability, water turbidity, rate of decomposition of organically enriched nutrients in the water body as well as other water variables at different time periods that are mainly accountable for their seasonal diversity patterns of the planktonic population. Additionally, this population serves as a critical and decisive indicator of aquaculture productivity. This work also provides useful insights for planktonic diversity and highlights the importance of monitoring the seasonal changes in their abundance for better water resource management.

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