Study of Phytoplankton Abundance and Species Diversity in Pakki Pond of Purnea District, Bihar (India)

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Abstract

The species diversity and phytoplankton abundance in Pakki Pond in the Bihar region of Purnea were studied in the current study. Between June 2022 and April 2023, the current study was conducted. A form of microscopic plankton known as phytoplankton, which is found as a crucial component of the aquatic ecosystem, is thought to be capable of photosynthesis. Size and shape-variant phytoplankton are photosynthesizing autotrophic organisms. Finding out more about the variety of phytoplankton in this pond is the main objective of this study. The sample was collected with the aid of a blotting silk net. Wide, substantial bottles with a 200ml capacity were used to gather the planktons. The filtrate vial was then brought to the lab. 5ml of 4% formalin solution was added to the laboratory's filtrate collection. Sample analysis was done at 10x and 40x magnifications using a compound microscope.

Keywords: *Phytoplankton, Pond, Species, Shannon-Wiener, Species richness*

Introduction

The flow of energy across the aquatic food chains or food webs is greatly influenced by phytoplankton, which is a very significant component of an aquatic ecosystem. According to Sant Manickam and colleagues (2014), freshwater phytoplankton is essential to aquatic ecosystems such ponds, lakes, and reservoirs. According to Sukumaran et al. (2008), phytoplankton is the main primary producer in practically all aquatic environments and an essential source of food for other creatures. Phytoplankton serves as food for zooplankton. Millions of tiny algae and other phytoplankton are consumed as a result of them. The biological balance and water quality are maintained by phytoplankton, which also provides nutrition, food, or diet for aquatic animals (Pandey et al., 1998). There are numerous anthropogenic factors that are present in water bodies all over the world that have the ability to change primary production patterns and, consequently, pelagic food webs. Increased water diversions and flow management, modifications to sediment supply, significant agricultural and urban pollutant inputs, rising and changed nitrogen loading, introduction of invasive species, and other factors are some of these causes of change. (Blaser et al., 2011, Brooks., 2012, DeLorenzo et al., 2001, Dugdale et al., 2007, Strayer, 2009). In most river deltas and estuaries, freshwater inflows have been altered by channelization and water diversions, thus significantly altering hydrodynamics (Lee et al., 2008, Monsen et al., 2007). These alterations change hydrologic connectivity between shallow water areas and deeper channels, which impacts water residence times and water-quality, the transport and distribution of contaminants and nutrients, and consequently the distribution and productivity of phytoplankton. Water age, also known as water residence time, is the average amount of time for water to enter and leave a system. It has the power to significantly modify primary production patterns. (Cloern, 2007, Lopez et al., 2006a, Lopez et al., 2006b). However, prolonged residence time can increase phytoplankton settling (May et al.,

2003), change community composition (Fraisse et al., 2013), increase water temperature (Lehman, 1992), allow zooplankton to preferentially graze on microplankton, and increase grazing losses by exotic bivalves (Kimmerer and Thompson, 2014). Longer residence time has been shown to favour phytoplankton growth on the water bodies.

In the present study, we investigated the abundance of phytoplankton diversity in Pakki pond of Purnea district of Bihar.

Material & Method

Sample Collection

Three stations in the pond were set up to gather water samples. For the Phytoplankton investigation, water samples were taken at three separate sites. When the weather permitted sampling from the Pond, monthly collections were conducted between the hours of 8:00 and 9:00 AM at the three locations. At stations 1, 2, and 3, there was surface sampling. At the station, samples were taken at the bottom depth (19 m) and the mid-depth (9 m). The laboratory received all of the collected samples. According to the approach, a plankton net with a mesh size 55µm of was used for sampling, which involved hauling it horizontally for five metres.

A 10% solution of Lugol's iodine was used to preserve the filtered water samples after they had been placed in the sample bottle. According to Botes (2003), Emi and Andy (2007), the species of phytoplankton were identified.

H' - Shannon-Wiener diversity index

S - Species richness (number of species), pi –

$$H = -\sum_{i=1}^{k} p_i \log p_i$$

Study Site

Pakki Talab is a pond located in Purnea district of Bihar. Area of this pond is about 5 acre. Situated near Panchmukhi Hanuman temple. Very auspicious place during chhath pooja. This pond is used for fishing and fish farming.

Fig: Pakki Talab Purnea Real and Satellite map Image

Result & Discussion

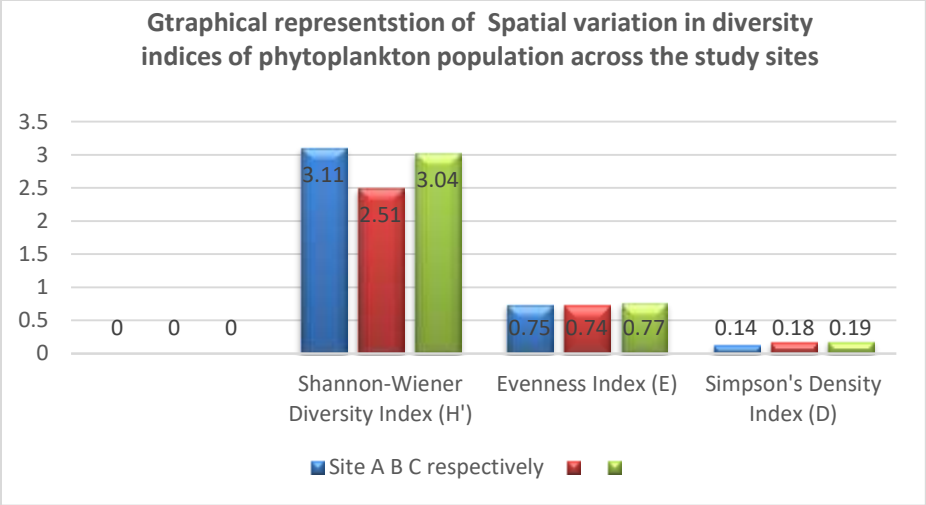
After the six-month survey, 18 phytoplankton species and four families (Bacillariophyceae, Chlorophyceae, Chrysophyceae, and Myxophyceae) were discovered. Flagilaria recorded the highest percentage abundance of 28.49%, followed by Ankistrodesmus with 22.08% and Aphanocapsa with 21.27%, while Eudorina is the least abundant with 0.24% (Table 1). The Shannon-Wiener Diversity Index (H') and the Spatial Variation in the Diversity indices of the study were shown in Table 2 .

Species	***Total Abundance***	***% Abundance***
Flagilaria	102110	19.25
Tabellaria sp.	11529	2.17
Naviculales	3121	0.58
Nituschia	2122	0.40
yclotella	12431	2.34
Ankistrodesmus	81420	15.35
Chlorella	17524	3.30
Ulothrix	3217	0.60
Enteromorpha	1120	0.21
Closterium	5421	1.02
Eudorina	1231	0.23
Oocystis	14521	2.73
Zugrema	1213	0.22
Microspora	5014	0.94
Aphanocapsa	83452	15.73
Anabaena	11234	2.11
Oscillatoria	1214	0.22
Aphanizomenon	8321	1.56
Mallomonas	6321	1.19
Total	**= 530261**	

Table 1. Species composition and abundance of phytoplankton in Pakki Pond (PurneaP)

	Site		
	A	**B**	**C**
Shannon-Wiener Diversity Index (H')	**3.11**	**2.51**	**3.04**
Evenness Index (E)	**0.75**	**0.74**	**0.77**
Simpson's Density Index (D)	**0.14**	**0.18**	**0.19**

Table 2. Spatial variation in diversity indices of phytoplankton population across the study sites



The Shannon-Wiener Diversity Index (H') and the Spatial Variation in the Diversity indices of the study were shown in Tables 1 and 2, respectively. Across the three study sites, the Shannon-Wiener Diversity Index (H') varied from 2.51 to 3.11. Simpson's Diversity Index (D) was between 0.14 and 0.19, while Pielou Evenness Index (E) ranged from 0.74 to 0.77. The research backs up Azma's findings that a Simpson Index score of 0.83 to 0.93 indicates that the communities are mature and stable since a substantial number of people share dominance. Azma and Frutos et al. stated that if the Pielou Index values are less than 0.5, it may be a sign that ecological stress is present.

It is widely acknowledged that the primary factors influencing seasonal variation of phytoplankton community structure are the dynamics of water circulation, nutrient concentrations, rainfall patterns, location, and the physical environment, which varies primarily in accordance with the dry and wet seasons in tropical waters (Fonge et al., 2012; Jeje et al., 1986). More incidences of Ankistrodesmus (19.25%) and Flagilaria (15.35%) were reported over the course of the six-month study period. A total of 19 phytoplankton species were found during the research period. The compositions of the three sites' plankton species were similar overall.

This is analogous to the results of Mohammed et al. (2009) and Anago et al. (2013) who reported phytoplankton and zooplankton abundance in a study of phytoplankton variety from the Koil Coastal waters in India and the Awba Reservoir in Ibadan, Nigeria, respectively. In addition, a study by Fonge et al. on the diversity and abundance of phytoplankton in the Ndop wetland plain, Cameroon, revealed a significant diversity of phytoplankton in studied regions. Station A's high concentration of phytoplankton may be the result of anthropogenic activities. The findings back up the hypothesis put forth by Fonge et al. that the high abundance of phytoplankton species may also be due to continual nutrient input, particularly from the use of nitrate and phosphate fertilisers close to the station.

Richness, variety, and evenness of the species were all increasing across all sites. This could be explained by the emergence of more microhabitats due to an increase in dwelling area.

Conclusion

In conclusion, it can be claimed that the phytoplanktonic communities of Shajangi Pond are mature, stable, and rich in diversity. Season and geography have an impact on phytoplankton diversity and abundance because the study has been conducted all year round, however despite this, phytoplankton diversity has remained steady.

It is necessary to conduct further research to determine the physicochemical and phytoplankton quantity and composition in various water bodies throughout the year.

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