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Research Paper

Checklist of Phytoplankton in Vaduvoor Bird Sanctuary, Tamil Nadu, India

Mohamed Tharik. A[1]., Sai Saraswathi. V[2]., Brinda, T[1]., Ramasubramaniyam, S[3]., and Kumaraguru, A[1,3*].
[1](Biodiversity Conservation Foundation, Trichy, India)
[2](Vellore Institute of Technology, Vellore, India)
[3](Tamil Nadu Forest Department, India)
Corresponding Author: Kumaraguru A

ABSTRACT: *Freshwater phytoplankton is a taxonomic and functionally diverse group of organisms that play a crucial role in the biogeochemical cycle. Phytoplankton plays a tremendous role in nutrient uptake, food chain and helps to maintain healthy aquatic ecosystem. Phytoplankton is a major primary producer, dominates the entire water column and supports the life below water. We examined the species diversity of freshwater phytoplankton samples from Vaduvoor Bird Sanctuary, Thiruvarur District, Tamil Nadu. The study aims to document the diversity of phytoplankton in Vaduvoor Bird Sanctuary, Thiruvarur District, Tamil Nadu, India. We documented 33 phytoplankton species, including 15 Bacillariophyceae species, 10 Chlorophyceae species, 7 Cyanophyceae species, and 1 Euglenophyceae species. Thus, the present study revealed the overwhelming dominance of Bacillariophyceae followed by Chlorophyceae, Cyanophyceae and Euglenophyceae..*

KEYWORDS: *Phytoplankton, Wetland, Aquatic Ecology, Microbiology, Vaduvoor Bird Sanctuary*

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I. INTRODUCTION

Phytoplankton is a polyphyletic group with extreme variation in shape, size, colour, type of metabolism, and life-history traits [1]. Phytoplankton is a unicellular microscopic floating plant organism that differs in size from <1 µm to 500 µm [2]. The phytoplankton is mainly classified into four classes namely Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae [3]. Phytoplankton is the type of algae that lives in fresh and marine water and thereby flourishes the aquatic ecosystem. The photic zone of freshwater ponds, lakes, and rivers, as well as marine habitats such as backwaters, mangroves, estuaries, and seas, is populated by phytoplankton. They optimize their home in the upper strata using numerous mechanisms like using gas vacuoles to controlling buoyancy, migrate from one place to another using flagella and adaptive metabolic process [1,4-6].

Phytoplankton could be a key module of aquatic biota, because it serves as the major primary producer of the aquatic ecosystem and also play a vital role in nitrogen fixation. Consequently, it is important in connecting the biotic and abiotic components in the aquatic ecosystem by forming the basement of the food chain as higher trophic level [1,7,8]. Studies of the ecology of freshwater phytoplankton have provided a better insights into the interaction between competition and predation. [9]. Phytoplankton is a tremendous biological indicator in a fluid environment. Due to their short life span, planktons respond to environmental changes too quickly. However, some species linked to harmful bloom can produce revolting flavors and odors, as well as hazardous circumstances. This study aims to document the phytoplankton species in Vaduvoor Bird Sanctuary, Thiruvarur district, Tamil Nadu, India.

II. MATERIALS AND METHODS

Study Area

The Vaduvoor Bird Sanctuary is a man-made freshwater ecosystem, created and declared as a bird sanctuary in 1999 by TamilNadu Forest Department and it is located in Thiruvarur District, which is known for "the Granary of South India". The sanctuary is located 21km toward the east of Thanjavur and 20km toward the

west of Mannargudi and spread across 1.28 sq.km. The sanctuary was declared as Important Bird Area in 2004 (Criteria A1). The sanctuary has vegetation which mainly consists of *Acacia nilotica, Azadirachta indica, Prosopis chilensis* and *Tamarindus indica*, which were planted under Sanctuary Management Programme. In addition, Vennaru River is the main source of water to the Vaduvoor Lake [10]. The region is rich in coconut groves, paddy field and other vegetation. The sanctuary's rich biodiversity attracts thousands of birds every year. Water samples were taken from Vaduvoor Bird Sanctuary (Latitude 10°42'0.03" N, Longitude 79°19'13.84" E) in the month of February 2020. Figure 1 illustrates the study area and sampling sites in the Vaduvoor Bird Sanctuary.

Figure 1: Map shows the study area and sampling site in Vaduvoor Bird Sanctuary, Thiruvarur District, Tamil Nadu, India

Methods of Sample Collection

The phytoplankton samples were collected with 250 ml water bottles from the surface of the water and immediately filtered with plankton net which is made up of nylon bolting cloth with 50 µm mesh size to avoid contamination (Figure. 2). The biomass of phytoplankton was persevered in specimen bottles containing 4% of neutralized formalin and examine species identification using monographs, standard manuals and text books [11-21].

Phytoplankton samples were centrifuged using 10 to 30ml graduated centrifuges tubes. The samples were allowed to settle down by storing for 24 hours in formalin. The pellet was subjected to microscopic analysis for species identification. The species of phytoplankton were separated under a light microscope by using inoculation needle to isolate the species. Individual phytoplankton species were mounted on glass slides on a drop of 20% glycerin for further analysis followed by Manickam *et al* 2020 [2]. (Fig. 3)

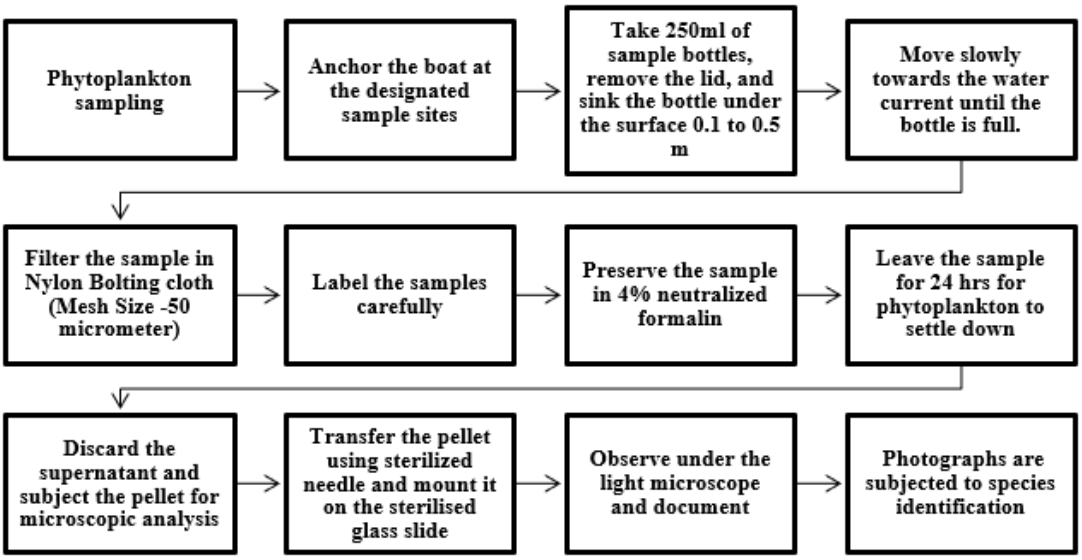

Figure 2: This flowchart shows the method of sample collection and analysis

Phytoplankton Identification

The taxonomical identification of phytoplankton from the collected samples was carried out under the light microscope at 40 X and 100 X magnifications and they were photographed using a smart phone manually [2]. Monographs, standard manuals, and text books were used to identify the phytoplankton [11-21].

III. RESULTS AND DISCUSSION

A total of 33 phytoplankton species were recorded from the Vaduvoor Bird Sanctuary, during the survey taken on the month of February 2020 (Table 1) (Figure 3-5). Among the species recorded, 15 species were identified to the class of Bacillariophyceae which belongs to 6 families and 8 genera, 10 species of Chlorophyceae which belongs to 8 families and 12 genera, 7 species of Cyanophyceae which belongs to 5 families and 6 genera and a species of class Euglenophyceae.(Figure 6)

Table 1: List of phytoplankton recorded in Vaduvoor Bird Sanctuary

Group	Genus	Family	Species
Bacillariophyceae (Haeckel, 1878)	*Fragilaria* (Lyngbye, 1819)	Fragilariaceae (Grev. 1833)	*Fragilaria Crotonensis* *Fragilaria Capunia (*Desm. 1830)
	Synedra (Ehrenberg, 1830)	Fragilariaceae (Grev. 1833)	*Synedra acus* (kutzing, 1844) *Synedra vaucheriae* (kutzing, 1844)
	Cymbella (C.Agardh 1830)	Cymbellaceae	*Syndera ulna* (Ehrenberg, 1832)
	Nitzchia (Hassal 1845)	Bacillariaceae	*Cymbella Aequalis* (W.Smith 1855)
	Navicula (Bory de Saint-Vincent, 1822)	Naviculaceae (Kutz. 1844)	*Nitzchia dissipata* (Rabenhorst, 1860) *Nitzchia palea* (W.Smith, 1856)
	Gomphonema (Ehrenberg, 1832)	Gomphonemataceae (Kutz. 1844)	*Navicula anglica* (Ralfs 1861)
	Cymbella (C.Agardh, 1830)	Cymbellaceae (Grev. 1833)	*Navicla gracilis* *Navicula gastrum* (Kutzing, 1844)
	Pinnularia (Ehrenberg, 1843)	Pinnulariaceae (Ehrenberg, 1843)	*Navicula cuspidata* (Kutzing, 1844) *Gomphonema consrictum* (Ehrenberg, 1844) *Cymbella tumida (Van Heurck, 1880)*

			Pinnularia undulata (W.Gregory, 1854)
Chlorophyceae (Willein Warming, 1884) (green algae)	*Pediastrum* (Meyen, 1829) *Closterium* (Nitzsch ex Ralfs, 1848) *Spirogyra* (Link 1820) *Selenastrum* (Reinsch, 1867) *Pleurosigma* (W.Smith, 1852) *Desmidium* (C. Agardh ex Ralfs, 1848) *Volvox* (Linnaeus, 1758) *Pandorina* (Bory, 1826) *Chlamydomonas* (C.G Ehrenberg, 1786)	Hydrodictyaceae (Dumortier, 1829) Desmidiaceae (Ralfs, 1848) Zygnemataceae (Kutzing, 1843) Selenastraceae Bacillariineae Desmideaceae Volvocaceae Volvocaceae Chlamydomonodaceae	*Pediastrum boryanum* (Meneghini, 1840) Pediastrum duplex (Meyen 1829) *Closterium tumidum* *Spirogyra sp.* *Selenastrum sp.* *Pleurosigma sp.* *Desmidium sp.* *Volvox sp.* *Pandorina sp.* *Chlamydomonas sp*
Euglenophyceae (Schoen., 1925)	*Euglena* (Ehrenberg, 1830)	Euglenaceae (Carter, 1859)	*Euglena sp.*
Cyanophyceae Sachs, 1874 (blue green algae)	*Anabaena* *Oscillatoria* (Vauc. ex Gomont, 1892) Merismopedia (Meyen 1839) Spirulina (Gomont, 1892) Nostoc (Vaucher & Flahault, 1886) *Calothrix* (C.Agardh, 1886)	Nostocaceae Osillatoriaceae (Engler, 1898) Merismopediaceae Spirulinaceae (Gomont, 1892) Nostocaceae Rivulariaceae	*Anabaena sp.* *Oscillatoria putrida* *Oscillatoria sp.* *Merismopedia sp.* *Spirulina sp.* *Nostoc sp.* *Calothrix sp.*

Figure 3: Collected Bacillariophyceae Species
a)Synedra ulna b) Nitzschia palea c) Navicula gastrum d) Gomphonema constrictum e) Navicula cuspidate f) Cymbella tumida g) Fragilaria Crotonensis

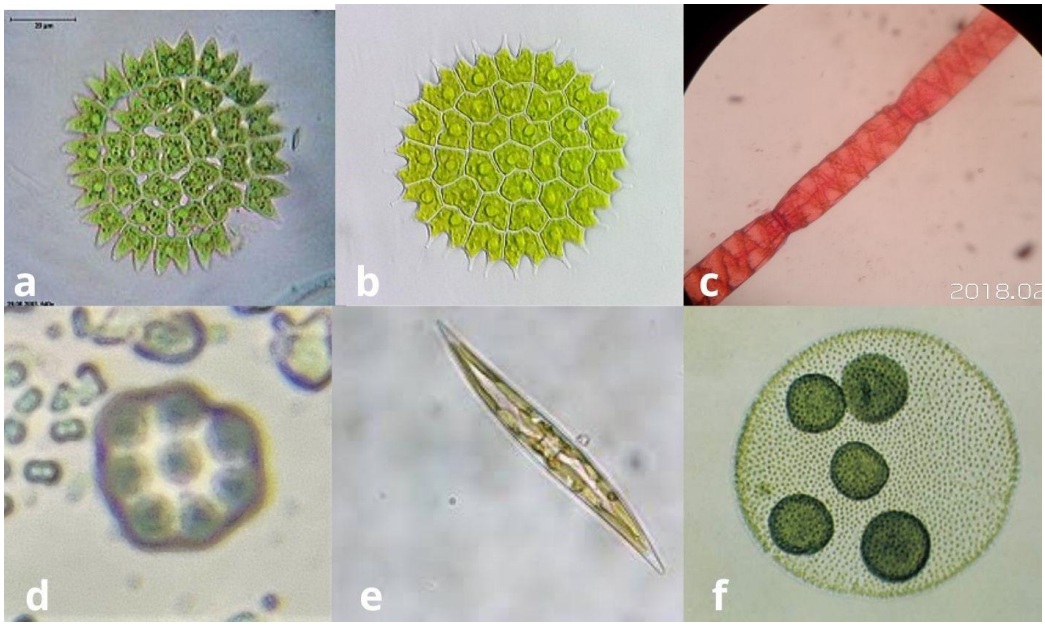

Figure 4: Collected Chlorophyceae Species
a)Pediastrum duplex b) Pediastrum boryanum c) Spirogyra sp. d) Pandorina sp. e) Pleurosigma sp. f) Volvox sp.

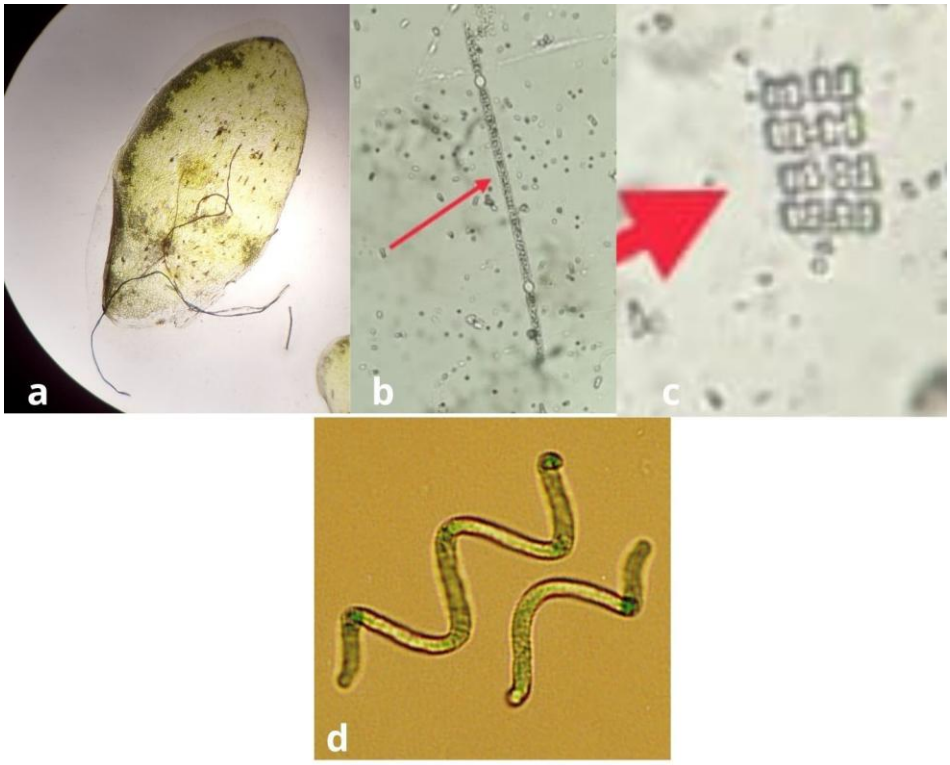

Figure 5: Collected Euglenophyceae and Cyanophyceae species
a)Euglena sp. b) Anabaena sp. c) Merismopedia sp d) Spirulina sp.

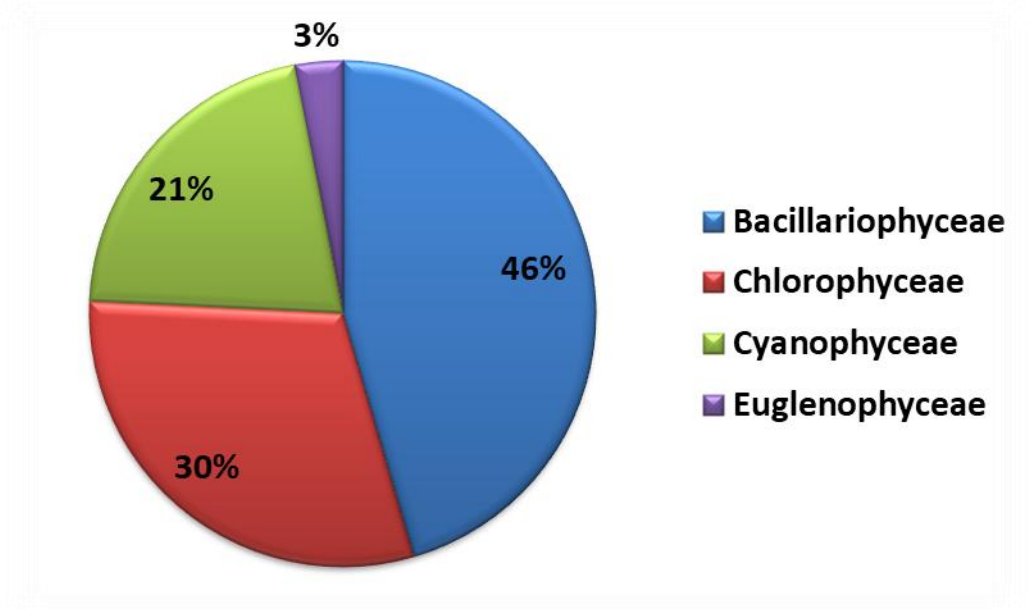

Figure 6: Percentage composition of Phytoplankton recorded in Vaduvoor Bird Sanctuary.

Freshwater phytoplankton is one of the most diverse widespread organisms on the earth. In any ecosystem in this universe, not a single organism can survive indefinitely and independently, because all species were interlinked with each other and have a cyclic transformation of nutrients. Similarly, phytoplankton plays a significant role as a primary producer and base of the food web in the aquatic ecosystem [1,22]. On the other hand, some phytoplankton species become toxic to the water bodies and results in the water becoming unfit for human consumption. Phytoplankton is important in any ecosystem because it performs a variety of environmental tasks and is essential not only to the aquatic ecosystem but also to the social structure. [23-25]. The Indian freshwater ecosystem is currently under the most severe ecological stress as a result of excessive

pollution due to growing industrialization and urbanization [9]. Even the sudden increase in population growth rate and deforestation which leads to climate change can modify the environmental factors and alter the taxonomical composition, structure and seasonal dynamics in phytoplankton [9]. Though Vaduvoor Lake is highly potential for aquatic organisms and various migratory birds, the impact of climate change on the lake and its ecosystem needs a deeper exploration. The diversity of healthy aquatic life such as fishes, turtles, shells, reptiles; important migratory birds such as Spot-billed pelican, Bar-headed goose, Black-winged stilt and Northern shoveler etc., and carnivores like smooth-coated otters are the significance of the study area, because of the rich food source and healthy primary producers in Vaduvoor Bird Sanctuary. By attracting thousands of land and water birds, aquatic lives, plankton diversity and benefiting to agriculture and humans may be considered Vaduvoor Bird Sanctuary as a best model for the other bird sanctuaries. Hence, phytoplankton which forms one of the primary producers of the sanctuary, demands conservation and deeper insights to their diversity, conservation and production.

IV. CONCLUSION:

Biodiversity and ecosystem have a complicated relationship as the ecosystem's structure is inextricably linked to species diversity and distribution. Hence alteration in the ecosystem structure may change the ability of a species to comprehensively execute its function and provide services to the ecosystem, and finally to the disruption of the ecological balance. In the verge of rapid environmental changes and global warming, phytoplankton being the significant base primary producers is subjected to lose of their diversity and consequently variations in taxonomical composition and seasonal dynamics. A long-term study on phytoplankton diversity in freshwater and marine ecosystem will help to understand the quality and health of the particular aquatic ecosystem.

The present study had provided the baseline information of Phytoplankton diversity in Vaduvoor Bird Sanctuary which needs to be explored comprehensively to determine the relationship between ecological structure and diversity of the producers. Bacillariophyceae being a dominant class, followed by Chlorophyceae, Cyanophyceae and Euglenophyceae needs to be further correlated with the climatic factors of the sanctuary to take up further conservation measures. The study also alarms the continuous monitoring of phytoplankton diversity and influential hydrological factors, with a goal towards sustainable management of the water and its related ecosystem of the sanctuary.

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