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Plankton diversity in lentic water bodies of Cochin, Kerala, India

Lovedeep Sharma and Sachin Pandit

Department of Fisheries Resource Management
Kerala University of Fisheries & Ocean Studies, Ernakulam, Kerala, India

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ABSTRACT

Plankton samples have been collected from six freshwater pond ecosystems located in Ernakulam district, Kerala, India. Samples were analyzed qualitatively to account for the diversity of phytoplankton and zooplankton in the region, as it is the basic unit of the food chain in any aquatic ecosystem. Higher diversity of *Pediastrum sp.*, of Chlorophyceae, was observed, other phytoplankton species encountered were *Anabaena, Closterium, Oscillatoria, Chlorophyta*, and *Euglena* sp. Ten genera belonging to five classes of zooplankton were recorded from the ponds. Major groups viz. Rotifera, Copepoda and Ostracoda were identified with some unidentified nauplii species. *Pediastrum duplex* and *P.simplex* present in these ponds are indicators, being meso-eutrophic species, which could help understand the water quality. The optimum diversity of both Phyto and zooplankton showed the suitability of ponds for commercial fish production with proper management.

Key words: *Chlorophyceae, Freshwater, Plankton, Socio-economic*

Introduction

The phytoplankton is the basic component of aquatic ecosystems, forms the basis of the food chain and represents a biological wealth of the water body vis a vis plays the role of a key group for energy production. Zooplankton plays a major role in the food chain as they are the primary consumer atthe trophic level and contribute to the next trophic stage as well as crucial for the balance of any aquatic ecosystem as they are an important food source for almost all freshwater fish species, especially at early life history stages (Lampert and Sommer, 1997).

Fish chooses food based on the greatest nutritional suitability and availability, but the major factor determining the availability of different planktonic organisms' food sizes that support their ingestion (Timmerman *et al.*, 2000) and also prey density (Dzierzbicka-Glowacka, 2006). Fish larvae basically prey upon zooplankton like copepods, rotifers and cladocerans in wild conditions (Fossum, 1996).

Ponds are inland lentic water bodies that are useful in several ways, viz. open water sources for domestic purposes, fish culture, andartificial infiltration of groundwater (Smitha and Sajitha, 2013). The present attempt has been made to understand the diversity of phytoplankton and zooplankton in ponds located on the premises of Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, Kerala.

Materials and Methods

Study Area: Planktons were collected from perennial freshwater ponds located (latitude 9.910436° N and longitude 76.318692° E) in the vicinity of KUFOS. These ponds are used for commercial fish

production, mainly including species viz. Pearl spot (*Etroplus suratensis*), IMCs (*Labeo catla*, *Labeo rohita*) and Tilapia. Rainwater is the main source of water for these ponds.

Sample collection: The plankton samples, both phyto- and zooplankton, were collected from different sites of each pond using a plankton net with a mesh size of 50 µ. About 50 litres of waterwas filtered from each pond. The collected plankton samples were preserved in 5% buffered formalin. Qualitative analysis of zoo- and phytoplankton was carried out in the laboratory using Leica Compound Microscope (4X and 10X lenses) and the identification of phyto- and zooplankton was done with aid of the plankton identification keys by various authors.

Results

A great diversity of plankton especially zooplankton has been found in the ponds. Six genera of phytoplankton belonging to four classes were recorded in all the ponds. A major proportion of phytoplankton is included in the green algae group. The genus *Pediastrum* was observed to show the highest diversity. Ten genera belonging to five classes of zooplankton were recorded from ponds and major groups such as Rotifera, Cladocera, Copepoda and Ostracoda were identified with some unidentified nauplii species. Tables 1 and 2 depict the details of phytoplankton and zooplankton diversity found in different ponds. More than 70% of phytoplankton was dominated by *Pediastrum* genera and among the genus *Pediastrum*, *the* most dominating species are *P. duplex* and *P. simplex. as* shown in Fig. 1. Other species like *Anabaena, Closterium, Oscillatoria, Chlorophyta*, and *Euglena* **s**p were also reported. The contribution of these phytoplankton has been presented in Fig. 2.

Rotifers were more abundant among zooplankton, *Brachionus* and *Keratella* were observed abundantly. Among Rotifers, species *Brachionusforficula* and *B.falcatus* were the two most dominant species reported from all the five ponds included in the study while *B. calyciflorus*, *B.diversicornis*, and *Monostyla* were also reportedas infrequency. Other than Rotifer, Copepod and Cladoceran groups were also abundant. Copepod was also present uniformly in all the sampling sites. The copepod species such as *Cyclopoid copepod* and *Herpactocoid copepod* were recorded commonly. Cladoceranis commonly known as "water fleas" including *Daphnia, Moina*and *Bosmina*. Ostracods are bivalve crustaceans, also reported but not much in density.

Discussion

During the study period, Chlorophyceae was found to be the most dominant class followed by Euglenophyceae. Rotifers were more abundant followed by Copepoda and Cladoceran. Similar results have been reported from different lentic water bodies around the country, it was reported that Chlorophyceae is the dominant phytoplankton class and in zooplankton Rotifers, (31%) followed by Copepoda and Cladoceran were dominant, in Village Pond at Dhanuvachapuram, Trivandrum, Kerala (Nath *et al*., 2015). While in another study from pond water sample reported to have Cyanophyceae (39%) as dominant group, followed by Chlorophyceae (34%) Bacillariophyceae (23%) and Euglenophyceae (4%) Kattakada thaluk in Thiruvananthapuram, Kerala (Joseph, 2017). From the four wetlands of Tiptur taluk of Tumkur district, Karnataka and reported Chlorophyceae was the most dominant class (62%), followed by Bacillariophyceae, Cyanophyceae and Euglenophyceae in phytoplankton group and in zooplankton group rotifers found to be dominant followed by protozoa, copepod and cladoceran (Jagadeeshappa and Kumara, 2013).

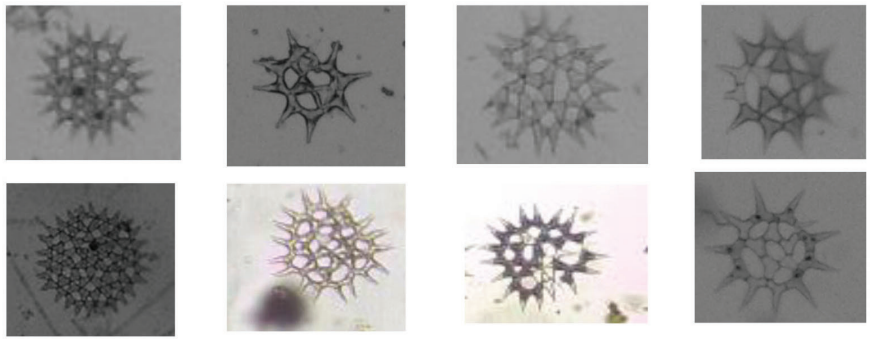
Pediastrum observed to be the most abundant genus among phytoplankton in present study. Similarly, Nandan *et al.* (2020) opined that *the Pediastrum* group is the most abundant phytoplankton group in the Vembanad estuary of Kerala in all seasons. Diversity of identified planktonic groups such as Hydrodictyaceae, Cyanophyceae, Oscillatoriaceae, Chlorophyceae Euglenophyceae, and Closteriaceae in different freshwater ponds also reported from various freshwater ecosysytems in the country (Vijaya Rani *et al.*, 2016; Akter *et al.*, 2018 and Nath *et al.*, 2015).

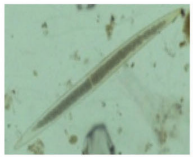
The group copepod is represented by *Cyclopid* spp. and *Herpectcoid* spp. and the group cladocerans by *Moina spp., Daphnia spp.,* and *Bosmina spp.* Cladocerans are the main consumers that feed on algae and fine particulate matter which affects the cycling of matter and energy in the detritus food chain (Sitre, 2013). Plankton study is the primary step for any scientific utilization of water resources (Jhingran, 1985). As primary producers, phy-

Fig. 1. Phytoplankton and Zooplankton

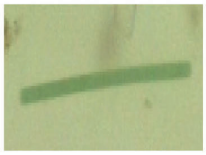
Phytoplankton

Pediastrum sp.

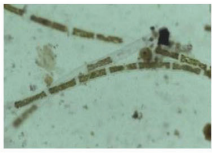




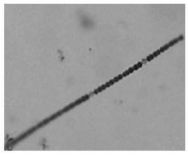
Closterium



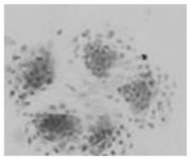
Oscillatoria



Spirogyra



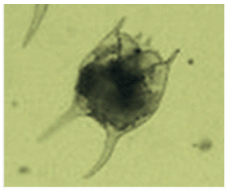
Anabaena



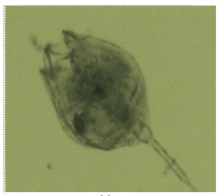
Chlorophyta

Zooplankton

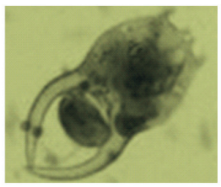
Rotifers (i-v)



i



ii



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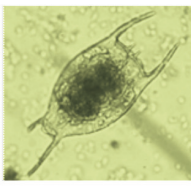

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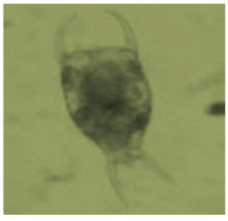
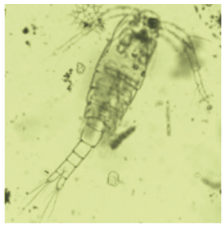


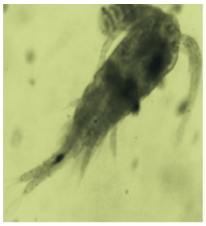
v

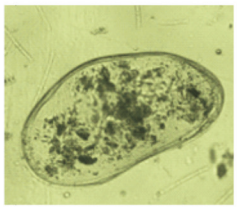
Copepods (i-iv)

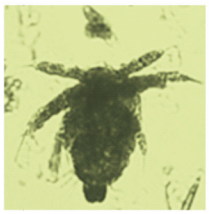

i


ii


iii

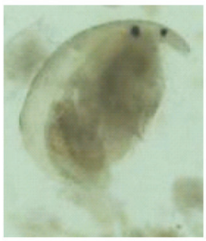

iv


Ostracods


Nauplii

Cladocerans (i-iv)


i


ii


iii


iv

Table 1. Diversity of Phytoplankton

Sl. No.	Class	Family	Genus
1	Chlorophyceae	Hydrodictyaceae	*Pediastrum*
2	Cyanophyceae	Nostocaceae	*Anabaena*
3	Cyanophyceae	Oscillatoriaceae	*Oscillatoria*
4	Chlorophyceae	Chlorophyceae	*Chlorophyta*
5	Zygnematophyceae	Closteriaceae	*Closterium*
6	Euglenoidea	Euglenaceae	*Euglena*

Table 2. Diversity of Zooplankton

Group	Class	Family/Order	Genus
Rotifer	Monogonata	Branchionidae	*Keratella*
Rotifer	Monogonata	Branchionidae	*Brachionus*
Copepod	Hexanaupila	Cyclopoida	*Cyclopoid*
Crustacean	Ostracoda	Ostracoda	*Ostracod*
Rotifer	Monogonata	Lecanidae	*Monostyla*
Crustacean	Crustacea	Unidentified	*Nauplii*
Cladoceran	Branchiopoda	Moinidae	*Moina*
Cladoceran	Branchiopoda	Daphniidae	*Daphnia*
Cladoceran	Branchiopoda	Bosminidae	*Bosmina*
Copepod	Crustacea	Herpecticoida	*Herpacticoid*

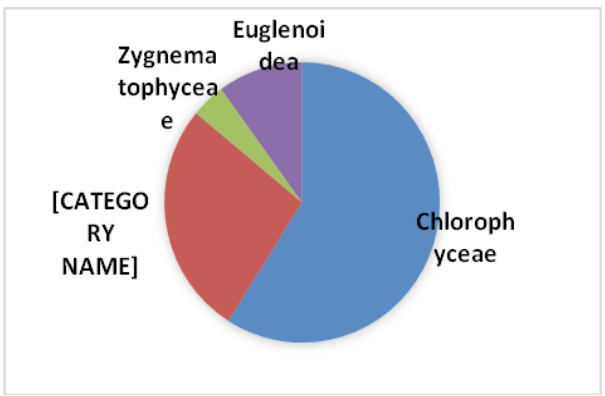
toplankton forms essential sources of energy sources and act as a direct food source for the aquatic organisms (Battish, 1992). During the study period, Chlorophyceae was found to be the most dominant class followed by Euglenophyceae. Rotifers were more abundant followed by Copepoda and Cladoceran

Similar results have been reported from different lentic water bodies around the country, it was reported that Chlorophyceae is the dominant phytoplankton class and in zooplankton Rotifers, (31%) followed by Copepoda and Cladoceran were dominant, in Village Pond at Dhanuvachapuram, Trivandrum, Kerala (Nath *et al*., 2015). It was reported that Cyanophyceae (39%) formed the dominant group, followed by Chlorophyceae (34%) Bacillariophyceae (23%) and Euglenophyceae (4%) from an artificial pond at Kattakada thaluk in Thiruvananthapuram, Kerala (Joseph, 2017). Another study from four wetlands of Tiptur taluk of Tumkur district, Karnataka and reported Chlorophyceae was the most dominant class (62%), followed by Bacillariophyceae, Cyanophyceae and Euglenophyceae in phytoplankton group and in zooplankton group rotifers found to be dominant followed by protozoa, copepod and cladoceran (Jagadeeshappa and Kumara, 2013). Islam *et al.* (2017) identified seven species of algae such as *Microcystis, Chlorella, Euglena, Anabaena, Chara,* and *Nitella* in the vicinity of the Bangladesh agricultural university campus, Mymensingh.

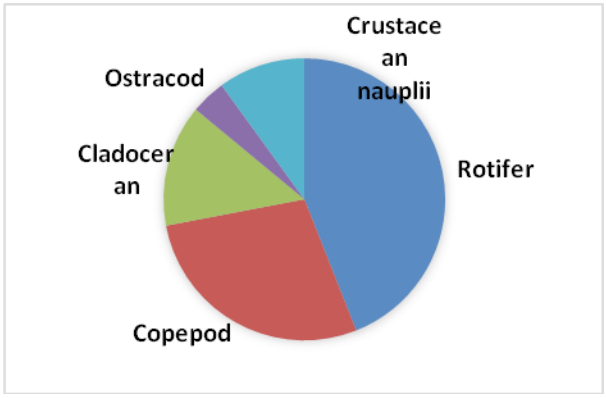
The *Pediastrum* genus is the most abundant form of identified phytoplankton group in Pond no. A-F of KUFOS, Kerala vicinity. Nandan *et al.* (2020) opined that *the Pediastrum* group is the most abundant phytoplankton group in the Vembanad estuary of Kerala in all seasons. Nair *et al.* (1975) opined that dominant phytoplankton species such as the *Pediastrum* group are abundant during monsoon season in south Vembanad, Kerala. Diversity of identified planktonic groups such as Hydrodictyaceae, Cyanophyceae, Oscillatoriaceae, Chlorophyceae and Euglenophyceae, Closteriaceae in different freshwater ponds also reported by (Vijaya Rani *et al.,* 2016; Sharma *et al.,* 2013; Akter *et al.,* 2018; Nath *et al.,* 2015).

The group copepod were represented by *Cyclopid* spp. and *Herpectcoid* spp. and the group cladocerans by *Moina* spp., *Daphnia* spp. and *Bosmina* spp. Cladocerans are the main consumers that feed on algae and fine particulate matter which affects the cycling of matter and energy in the detritus food chain (Sitre, 2013). Rotifers identified as important indicators of water quality due to the short life cycle and changes in biomass, and species composition with quick response to environmental changes (Luharia *et al.,* 2019). During the study period, qualitative estimation of zooplankton group with the order as follows rotifer>cladoceran>copepod>other crustaceans. Similar observations were made in Ramala lake, Chandrasekharpur district, and Maharashtra (Kulkarni *et al.,* 2007). Qualitative estimation of cladoceran diversity is next to rotifer diversity, which may be due to favourable conditions of temperature and availability of abundant food or due to thick organic matter in the aquatic ecosystem (Solanki *et. al.,* 2016; Kulkarni *et. al.,* 2007). From an ecological point of view rotifer, copepod, cladocerans and ostracods regarded as the most important and play a vital role in the allocation of energy at various trophic levels (Manjare, 2015).

During the study period, qualitative estimation



a



b

Fig. 2. a) Contribution of different classes of phytoplankton; b) Division-wise contribution of Zooplankton

of zooplankton group with the order as follows rotifer>cladoceran>copepod>other crustaceans. Similar observations were made in Ramala lake, Maharashtra (Kulkarni *et al.,* 2007). Qualitative estimation of cladoceran diversity is next to rotifer diversity, which may be due to favourable conditions of temperature and availability of abundant food or due to thick organic matter in the aquatic ecosystem (Solanki *et al.,* 2016; Kulkarni *et al.,* 2007). From an ecological point of view rotifer, copepod, cladocerans and ostracods are regarded as the most important and play a vital role in the allocation of energy at various trophic levels (Manjare, 2015).

Conclusion

A total of 6 genera of phytoplankton and 10 genera of zooplankton were recorded in the ponds. These managed fish culture ponds, which were limed, manured and fertilized periodically showed greater plankton diversity with zooplankton dominance. It implies that all the stocked fish make effective use of all available ecological niches and are periodically replenished by fertilization in the managed pond. So, it can be inferred from the present study with the high diversity of zooplankton indicated the abundance of organic detritus, bacteria and thick organic matter in the aquatic ecosystem. Because of the effective use of ecological niches, and the high diversity of plankton, it concluded that ponds can be utilized through appropriate species stocking and scientific management culture practices for socio-economic benefits.

Conflict of interest: There is no conflict of interest.

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