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Dynamics of zooplankton diversity in relation to water quality of Heggere tank, Kanale Sagara Karnataka, India

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Abstract

The present study reveals that the diversity of zooplankton communities in Heggere tank, Kanale varies with the physico-chemical parameters of water. The presence of different zooplankton community indicates the nutrient status of water body. The zooplankton communities were recorded more during the post monsoon and pre monsoon seasons. However, the variation of physico-chemical parameters of water in relation to zooplankton population has been discussed in detail in this paper. The trend of monthly occurrence of zooplankton was found as cladocerans>copepods>rotifers>protozoans.

Keywords: *Cladoceran population*, *Nutrient composition*, *Physico-chemical*, *Zooplankton diversity*

Introduction

Zooplankton is ecologically and economically important heterogenous group of tiny aquatic organisms that can move at the mercy of water currents, as they have weak power of locomotion. Their ecology is closely related to fishery limnology, oceanography and meteorology. Also temporal and spatial change in zooplankton abundance and composition reflected the dynamic nature of both physical and biological factors of freshwater resources. Zooplankton are either herbivorous, feeding on phytoplankton or carnivorous, feeding on other zooplankton. They themselves fed upon by fish and are thus the vital transition between primary production (phytoplankton) and fish. Without these primary consumers, herbivorous and other levels of food chain would collapse.

Study Area

Heggere tank (Kanale) is a perennial fresh water body situated at about 14 km away towards North of Sagara town. It lies between 14° 12' to 14° 17' North latitude and 74° 54' and 74° 59' East longitude. This is a medium sized tank. The total water spread area of the tank is 22.1 hectare. Rain water is main source of water for the tank. The river basin of the tank is Krishna. The catchment area of this tank is 1.30 sq. km and is covered by Natural vegetation *i.e.* Areca and Acasia plantation. The water of this tank is used for agricultural and aquaculture practices and domestic activities.

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Materials and Method

Surface water samples were collected at an interval of 30 days from January, 2004 to December, 2004 for physico-chemical analysis. Water samples were collected in black colored carboys of 2 liter capacity. Factors like pH, air and water temperature were recorded on the spot. For dissolved oxygen (DO) the samples were fixed on the spot using Wrinkler's reagents. Later the samples were brought to the laboratory for estimation of other chemical parameters. The remaining parameters were analyzed as per the standard methods (APHA, 1998).

Microscopic studies (Zooplankton)

For the qualitative and quantitative analysis of plankton, two liters of composite water samples at the surface level were collected at an interval of 30 days. One liter of sample was fixed with 20 ml of 1% lugol solution. After sedimentation 100 ml of sample is subjected to centrifugation at 1500 rpm for 20 min for further microscopic investigation. The filtered plankton were collected in separate bottles and preserved using 10% formalin. The identification of plankton up to the level of species was done by standard manual and monographs. Quantitative estimation of zooplankton was done using Sedgwick rafter counting cell.

Results and Discussion

The results of all the four categories of the zooplankton encountered during course of study *viz*., Cladocera, copepoda, rotifers and protozoan are given in Table-1 to 6. While the seasonal fluctuation of physico-chemical parameters are given in Table-7.

The study of physico-chemical parameters and their effects on the aquatic biota are important in understanding the trophic state of a water body. Each factor plays its role in regulating the ecosystem of the waterbody. The concentration of the various constituents along with factors such as rainfall, agricultural runoff is also of equal importance. The changes in one factor are directly or indirectly related to the other factors.

Zooplankton plays an important role in the aquatic food chain and also contributes significantly to secondary productivity and energy flow in fresh water ecosystem. This is due to their rapid turnover rates, metabolism and capacity to build up populations in short duration. They serve as food for both fry and adult fish and hence is cultured as supplementary food in aqua cultures.

In the present study Cladocera invariably constitute a dominant component of freshwater (Table-1). Temperature, pH, alkalinity, calcium and phosphate were the factors found to influence the cladoceran population. Datta *et al.* (1986) have considered the cladoceran abundance to lower temperature, phosphate and salinity. High densities of cladoceran population during rainy seasons may be due to availability of certain nutrients entering from the agricultural runoff. Cladocerans are known to be abundant in water with good littoral vegetation, while ponds and lakes without vegetation have fewer cladoceran species (Idris and Fernando, 1981). Decay of this vegetation during summer may serve as food, thus maximum during that season. Low densities during the other season may be due to predation by copepoda (Hessen, 2003). Another reason may be the positive phototactic swarming from littoral areas to pelagic zone (Kairesalo and Penttila, 1990). These observations are in conformity with the findings of present investigation. If monthly density is considered, cladocerans recorded a minimum of 312 O/l in the month of July 2004 and maximum of 361 O/l in the month of April 2004 (Table-1).

Table-1: Monthly occurrence of different groups of zooplankton density in Heggere tank, Kanale

Months	Cladocera (org./l)	Copepoda (org./l)	Rotifers (org./l)	Protozoans (org./l)
January	321	258	210	10
February	343	265	218	12
March	352	245	214	13
April	361	267	203	08
May	342	241	222	12
June	357	236	198	09
July	312	229	202	08
August	324	245	210	12
September	321	261	214	15
October	317	241	221	16
November	328	242	214	12
December	325	251	215	15

Seasonwise, cladocerans were found to be more during pre monsoon with 349 O/l and low during post monsoon season with 322 O/l (Table 2). A total of six species were found during the course of the study *i.e. Alona pulchella*, *Daphnia carinata*, *Diaphanosoma sarsi*, *Macrothrix goeldi*, *Macrothrix laticornis* and *Moina carinata* (Table-3).

Copepods are aquatic crustaceans, smaller relatives of the crabs and lobsters, in terms of their size, abundance and diversity of way of life. Calanoids copepods are small crustaceans, 1-5 mm in length, commonly found as part of the free living zooplankton in freshwater lakes and ponds (Williamson, 1991). In shallow waters, no thermal stratification is observed and distribution of zooplankton is highly variable. Well developed aquatic macrophytes, copepods are more abundant in littoral than pelagic areas.Large species of copepods find shelter in temporary and weedy ponds and can be found among macrophytes (Arcifa, 1984).The present study witnessed with these reports (Paterson, 1993; Lauridsen and Buenk, 1996).During the present study, copepoda species were found to be in higher densities during pre monsoon season and low densities during monsoon season (Table- 2). Copepods species are regarded as pollution sensitive zooplankton as they disappear from polluted water (Verma *et al*., 1984.).Contrary to this observation is the findings that *Cyclops* sp. are pollution tolerant, found abundantly nutrient rich environment and thus can be considered as eutrophication indicators (Adholia and Vyas, 1992). However, in the present study, copepods were not found in high numbers along with frequent absence of *Cyclops* species.

Table-2: Seasonal variation of zooplankton density in Heggere tank, Kanale (O/l)

Sl. No.	Zooplankton	January, 2004 – December, 2004		
		Pre Monsoon	Monsoon	Post Monsoon
1.	Cladocera	349	328	322
2.	Copepoda	254	242	248
3.	Rotifera	214	206	215
4.	Protozoans	11	11	13

Thus, it can be concluded that, the waterbody showing low nutrient composition and free from pollution except agriculture runoff . With regard to their periodicity, they reached their peak of 267 O/l in the month of April and the minimum population density of 229 O/l in the month of September (Table -1).Seasonally, they were more during pre monsoon season *i.e.* 254 O/l and less during monsoon season with 242 O/l (Table-2).A total of eight species of copepods were found *i.e. Heliodiaptomus vidus*, *Heliodiaptomus* sp, *Mesocyclops hyalinus*, *Mesocyclops leuckarti*, *Naupliar larve*, *Neodiaptomus stregilipes*, *Paracyclops fimbriatus and Tropocyclops prasinus* (Table-4).

Table-3: Occurrence of Cladocera in Heggere tank

S.No.	Organisms	Heggere
1.	*Alona pulchella*	+
2.	*Daphnia carinata*	+
3.	*Diaphanosoma sarsi*	+
4.	*Macrothrix goeldi*	+
5.	*Macrothrix laticornis*	+
6.	*Moina carinata*	+

Rotifers are the smallest animals and occur worldwide in primarily freshwater habitats. They are important in freshwater ecosystem as they occur in all biotypes. About 95% of the rotifers are encountered in fresh waters, while 5% are from brackish or marine waters and most are free living. Like the other zooplankton, rotifers also form a link in the aquatic food chain. They have a rapid turnover and high metabolic rates and feed on detritus. These organisms serve as bioindicators to depict water quality and are extensively cultured for use as fish feed.

Table-4: Occurrence of Copepoda in Heggere tank

Sl. No.	Organisms	Heggere
1	*Heliodiaptomus vidus*	+
2	*Heliodiaptomus sp*	-
3	*Mesocyclops hyalinus*	+
4	*Mesocyclops leuckarti*	-
5	*Naupliar larve*	+
6	*Neodiaptomus stregilipes*	+
7	*Paracyclops fimbriatus*	-
8	*Tropocyclops prasinus*	-

Table-5: Occurrence of Rotifers in Heggere tank

Sl. No.	Organisms	Heggere
1.	*Brachionus calyciflorus*	+
2.	*Brachionus caudatus*	+
3.	*Brachionus falcatus*	+
4.	*Rotatoria neptunia*	+

Table-6: Occurrence of Protozoan in Heggere tank

Sl. No.	Organisms	Heggere
1.	*Difflugia* sp.	+
2.	*Vorticella* sp.	+

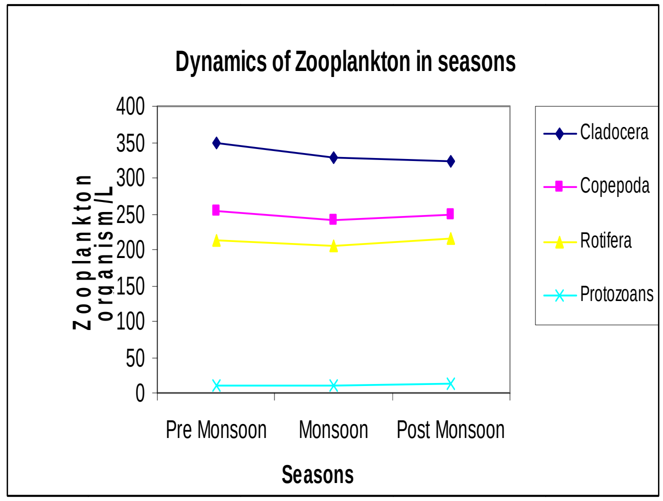
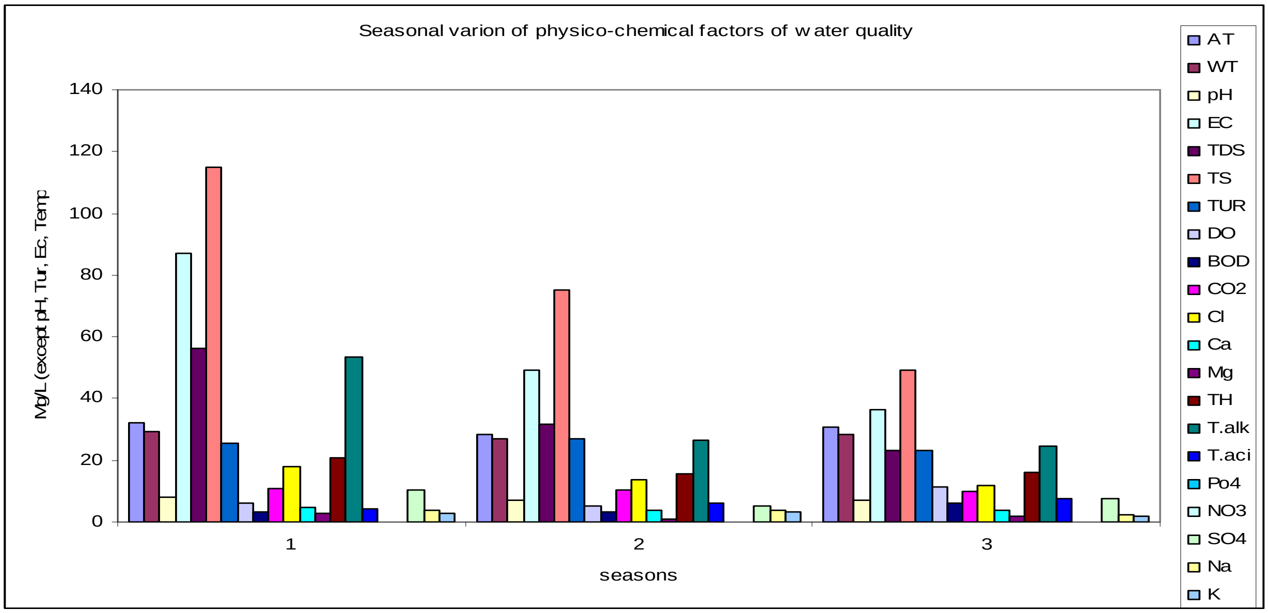


Table-7: Seasonal variation in physico-chemical parameters of Heggere tank, Kanale

S. No	Parameters	Pre-monsoon	Monsoon	Post-monsoon
1	Atmospheric temperature	32.37	28.37	30.87
2	Water temperature	29.12	27.12	28.37
3	pH	7.87	7.12	7.25
4	Electrical conductivity	87.00	49.25	36.25
5	Total dissolved solids	56.35	31.52	23.17
6	Total solids	115.12	75.4	49.10
7	Turbidity	25.65	26.97	23.25
8	Dissolved oxygen	6.14	5.13	11.20
9	Biological oxygen demand	3.15	3.46	5.94
10	Free carbon dioxide	11.00	10.45	9.9
11	Chloride	18.07	13.82	12.05
12	Calcium	4.62	3.84	3.57
13	Magnesium	2.64	0.93	1.74
14	Total hardness	20.81	15.66	16
15	Total alkalinity	53.25	26.5	24.5
16	Total acidity	4.37	6.25	7.5
17	Phosphate	0.15	0.085	0.05
18	Nitrate	0.14	0.19	0.16
19	Sulphate	10.49	5.22	7.79
20	Sodium	3.8	3.95	2.47
21	Potassium	2.85	3.22	1.95

Note: - All the parameters are in mg/l except pH, Electrical conductivity (µmhos/cm) and temperature °C.



Where, high densities were detected from post monsoon season. However, rotifers persisted during all the months. Similar results of bimodal pattern were reported by Pandey *et al* ., (1994) and Goswami (1997) during their limnological studies. Previous observation shows that lower temperature and availability of nutrients favour the rotifers population. Whereas, in the present study, temperature ranges from 24 °C to 30 °C and availability of nutrient is also very less. Hence, our observations are in agreement with above researchers.

The temperature, turbidity, transparency, dissolved oxygen were important factors controlling diversity and density of rotifers. In the present study, low rotifers density was found during monsoon season this may be due to unavailability of nutrients. A total of four species *i.e. Brachionus calyciflorus, Brachionus caudatus, Brachionus falcatus* and *Rotatoria neptunia* were found during the study period (Table-5). A number of studies have shown macrophytes to provide protection from planktivorous fish as well as food on decaying (Junk, 1977). Thus in general, it was observed that water bodies rich in macrophyte growth are rich in rotifer fauna (Narayana, 1994). Similar, observations are noticed in the present study.

Protozoan showed minimum population density in the present study. A total of two species *i.e. Difflugia* sp. and *Vorticella* sp. were recorded during the study period in the waterbody. Zooplankton species were fluctuated seasonally and no single species showed dominant throughout the study period.

Conclusion

The present investigation of physio-chemical parameters and zooplankton population indicates that the tank waterbody contains lower nutrients. The zooplankton communities were more during postmonsoon and premonsoon, as no dilution takes place in the waterbody during that seasons which automatically increases nutrients through anthropogenic and some climatic process.

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