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Biological Parameters and Zooplankton Diversity of a Tampara Lake, Chatrapur, Odisha

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ABSTRACT

The biological parameters and zooplankton diversity of a Tampara Lake shows healthy aquatic ecosystem. The plankton constitutes the basic food source of any aquatic ecosystem. Zooplankton diversity is one of the most important ecological parameters in water quality assessment. Zooplankton are strongly affected by environmental condition and quickly respond to any change in water quality. So these are good indicator of ecosystem and occupy an intermediate position between phytoplankton and fish. Hence qualitative and quantitative studies of zooplankton are of great importance. During the study zooplankton diversity in relation to biological parameters was discussed to the investigation find that 22 species of zooplankton belonging to four major groups, i.e. 10 species of Rotifera six species of cladocera and three species of copepoda and three species of protozoan.

Introduction

Zooplankton are microscopic, free floating organisms occurred in all natural water bodies. They are a major mode of energy source between phytoplankton and other aquatic animals. They occupy an intermediate position in the aquatic food web. (Altaff,2004). Abundance of plankton species in a water body is an indicator of biological productivity. Plankton constitutes a source of protein, carbohydrate, amino acids, lipids , fatty acids, minerals and enzymes. Different environmental factors that determine the characteristics of water have great importance upon the growth and the abundance of zooplankton (Thirumala et al. 2007). The term water quality is defined as those physical, chemical, and biological characterists by which the users evaluate the acceptability of water (Neelima and Kumar, 2005). Therefore the water quality is a major factor in determining the welfare of the society (Dwivedi and Pathak, 2000) It is also plays a vital role in governing the production of planktonic biomass. They could represent an inexpensive ingredient to replace the feed and an alternative to more expensive brine shrimp in aquaculture (Ramarani and Ramlingam, 2001). A regular monitoring of water bodies with required number of parameters, not only prevents outbreak of diseases and occurrence of other hazards but also checks the water from further deterioration (Kakati and Sharma, 2003). The management of any aquatic ecosystem in a means of conservation of fresh water habitat with an aim to maintain the water quality or to rehabilitate the physico-chemical and biological settling of water (Ravi Kumar et. al. 2005). species tolerance to physicochemical parameters has frequently invoked to explain the composition of Zooplankton communities (Swadling et al. 2000; Manca and Armiraglio, 2002; Waervogen et al. 2002; Duggan et al. 2002). Species richness is known to be related with ecosystem morphometry, particularly surface area and depth (Shaw and Kelso, 1992; Dodson, 1992). Zooplankton can disperse easily over short distances (Allen, 2007), dispersal can be limiting on larger spatial scales, particularly when distances between water bodies surpass 10 km (Havel and Shurin, 2004). The earlier studies on the qualitative and quantitative nature of the plankton community revealed species identification, month wise distribution, and population density relationship with physicochemical factors . (Fahd et al. 2000; Gutierrez-Aguirre and Suarez Morales, 2001; Saha et al. 2001; Tavemini et al.2005, 2008; Hessen et al. 2006; Park and Shin, 2007; Sharma and Cyril, 2007). Influence of environmental features such as water ionic content, hydro period and surface area were better explained with the micro crustacean distribution (Manca and Armiraglio, 2002; Benzins and Bertilsson, 1990). The biotic and a-biotic interactions are considered as pioval for community organization (Wellborn et al. 1996; Winder et al.2003; Felix and Mojisola, 2008). Hence investigation in relation to zooplankton assemblage and fluctuation of physicochemical parameters in unutilized small freshwater ponds are warranted. This is for assessing their potential and suitability in order to utilizing them for inland aquaculture. Based on the above mentioned facts, it is suggested to make an inventory of the physicochemical parameters and zooplankton diversity of Tampara lake.

Study Area

The Tampara lake at the Chatrapur being one of them. It is situated between east longitude 84.98^0 and between north latitudes 19.35^0 . The lake lies within the boundary of district headquarters the NH-5 to the North and Bay of Bengal to the South. It extends 5.8km in length and 670 meters in width. It is a natural ecosystem that is seasonally connected to the Rushikulya riverine system and therefore, natural enrichment of it's chemical and biological components takes place leaving no requirement of human intervention. It is also a source of water for both floral and faunal components.

Material and Methods

The sampling was conducted over a period of seven

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month from October 2010 to April 2011 which fall in both winter and summer seasons. The water samples were collected using one litre, widemouth container for the estimation of water quality parameters in the morning hours between 7-9 AM once in a fortnight. The collected samples were immediately taken to the laboratory for analysis. The estimation was done by using the standard book for Kumar and Kekrani (2000).

Zoooplankton samples were collected by filtering 200 litre of water from the surface of the water body through plankton net (40 µm mesh size) and was fixed immediately with 4% formalin. The systematic identification of Zooplankton was made by using standard keys of Dhanapati(2000) and Altaff(2004). The quantitative analysis of planktons organisms was carried out using Sedgwick Rafter's plankton counting chamber.

Results and discussions

In the present investigation, the air temperature ranged from 27 to 31^{0}C and water temperature from 25 to 29^{0}C. Kumar and Kakrani (2001) opined that the rise in temperature of water elevates the metabolic activity of an organisms. It also influences the growth and distribution of plankton. Welch (1952) has observed the smaller the water body, more quickly to react the changes in atmospheric temperature. The pH of the water body showed alkaline in nature i.e. 7.3 to 8.0. This range is good for growth of aquatic organisms (Lendhe and Yeragi, 2004). Bell(1971) has stated the pH ranges between 6.5 to 9.0 provides an adequate protection to the life of fresh water organisms. Jhingran (1974) reported that pH ranges between 6.0 to 8.5 indicates medium productivity, more than 8.5 highly productivity and less than 6.0 low productive nature of water body. Total hardness ranged between 52 ppm in February 2011 and 161.60 ppm in October, 2010. Fishes have been found to susceptible to diseases when hardness is below 20 ppm. If it ranged more than 300 ppm, it affects fish production due to more pH as reported by Das(1996).

Dissolved oxygen content in the water sample ranged from 4.33 to 6.99 mg/l. Mustafa and Ahmed (1985) opined the partial of O_2 dissolved in water depends upon the partial pressure of gas in the air close to water, rate of photosynthesis and oxygen holding capacity of water. Tarzwell (1957) reported that for supporting life, minimum of 3mg/l DO is required. Free CO_2 ranged from 2.0 to 5.16 mg/l during the study period. In morning sample, there is an accumulation of free CO_2 due to overnight community respiration. Salasker and Yerangi (2003) noted that slightly increased CO_2 in winter season. Free CO_2 is essential for photosynthesis and its concentration affects the aquatic fauna and its productivity. The total alkalinity was ranged from 92.5 to 255 ppm. In the water body, the alkalinity is imparted by number of bases viz. carbonates, bicarbonates, hydroxides, phosphates, nitrates, silicates, borates etc. (Kumar and Kakrani, 2000). Baskaran et al. (1988) observed a decreasing trend of total alkalinity from 115 ppm to 80 ppm.

The salinity of the water sample showed fluctuations during the period of study. It has been found to be maximum of 247.43 ppm in October 2010 and minimum of 140.79 ppm in February 2011. The fluctuation in salinity is probably due to fluctuation in total solids (Boyd and Tucker, 1998). The minimum value of chlorides (77.98 ppm) was found in the month of February 2011 and the maximum value of 137.06 ppm during the month of October 2010 was noted. Chloride content above 250 ppm makes water salty in taste; however a level upto 1000 ppm is safe for human consumption (Kumar and Kakrani, 2000). The phosphate content of water sample showed 0 to 0.9 mg/l. It is an essential nutrient, play a vital role in biological activities of aquatic organisms. Lendhe and Yeragi (2004) reported the range of phosphates from 1.20 mg/l to 3.70mg/l in Phirange Kharvav lake.

In the present study, 22 species of zooplankton belong to four major type Rotifera (10 species), cladocera (6 species). copepoda(3 species) and protozoa(3 species) were recorded among these Rotifer (Brachionus falcators, Brachionus calyciflorus, Branchionus diversicornis, Branchionus forficula, Branchionus rubens, Branchionus caudatus, Branchionus angularis, keratella tropica, testudinella parva, filinia longiseta), were dominant followed by cladocerans (Diaphnasama excisum, Chydoros spacrtus, Ceriodaphnia cornuta, Sida crystallia, Dophni crystallia and diaphanasoma sarsi) copepoda (Masocyclops aspericornis, Heliodiaptomus bitus and diaptomus nauplius), protozoan (Vorticella sp. Paramecium sp. and Microsetella sp.). The population of zooplankton recorded was positively correlated with the fluctuation of temperature, salinity, chloride, and phosphate, whereas it was negatively correlated with other physicochemical parameters studied. Species richness in the productivity of aquatic ecosystem is due to presence of nutrients. In a saturated community, site-specific interactions can limit the number of new species capable of colonizing (Shurin, 2000). Further, the quality and quantities of plankton differ with biological and climatic factors (Sukumar and Das, 2002). Therefore, in the present study, only 22 species belong to 4 major types were recorded. The total zooplankton population was found in increasing trend during winter months , whereas the reverse trend was seen during summer months. The physico-chemical parameters prevailed during winter months were favouring the production of zooplankton. The sudden decrease in zooplankton population during summer months indicates the fact that the prevailed physico-chemical conditions were disfavouring for the growth of zooplankton because of lentic water system. The effect may also be due to over predation of zooplankton by higher trophic member, the planktivorous organisms, which are regulating the zooplanktonic population in a water body. In the present study, the zooplankton community showed variation in density and biomass in relation to physicochemical variables and seasons.

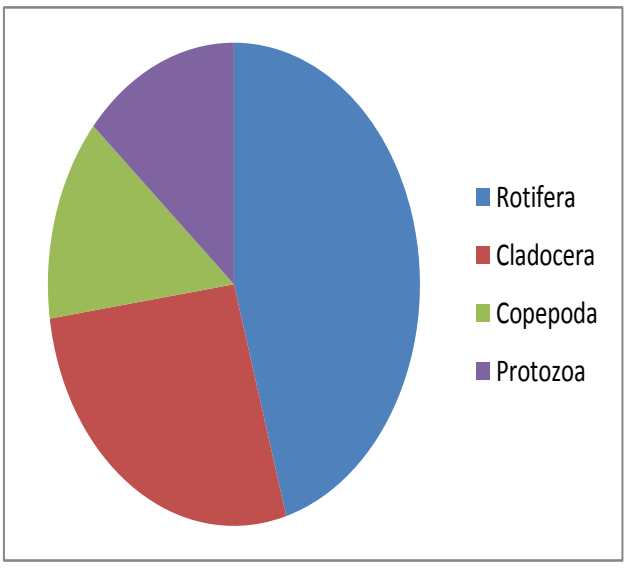

Fig 1. Shows number of Zooplankton

Table 1. Monthly variation in the Physico-Chemical parameters of the Tampara Lake

Parameter	October 2010	November 2010	December 2010	January 2011	February 2011	March 2011	April 2011
Temperature (^{0}C) Air Water	29 28	29 27	27 25	29 28	31 27	29 28	31 29
pH	7.3	7.5	7.6	7.8	7.8	7.8	8.0
Total hardness (ppm)	161.60	139.77	127.50	81.50	52.00	98.50	99.00
Dissolved Oxygen (mg/l)	4.33	6.99	6.33	6.42	6.55	6.99	7.40
Free carbon dioxide (mg/l)	4.48	4.11	3.95	2.79	2.00	2.00	5.16
Total Alkalinity (ppm)	255.00	215.00	167.50	92.50	142.50	115.00	120.50
Salinity (ppm)	247.43	230.36	196.22	162.11	140.79	153.58	168.94
Chlorinity(ppm)	137.06	127.60	108.69	89.79	77.98	85.07	93.58
Phosphate (mg/l)	0.03	0.06	0.05	0.02	0.05	0.02	0.04

However, the zooplankton biomass increase observed during favourable period (December-February) can be utilized for aquaculture purposes, since they play an integral role in transferring energy to consumer in the aquatic food web.

Table 2. List of Zooplankton in Tamapra Lake

Zooplankton	No. of Species
Rotifera	10
Cladocera	6
Copepoda	3
Protozoa	3
Total	22

Conclusion

Water quality regulates biotic diversity and trophic level of an ecosystem. The present investigation involves the analysis of physico-chemical and biological parameters which reflect an abiotic status of an ecosystem. This is in turn, helps in planning exploitation, antipollution and conservation strategies.

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