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Research Paper

Zooplankton Community and Trophic Nature of Ponds

Biology

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ABSTRACT

From time immemorial, Ponds are playing a significant role in our life. But, with changing times these ponds are suffering with large number of pollutants and domestic effluents; which are not only contaminating diseases but also causing ecological imbalance due to biomagnification. The distribution, seasonal dynamics and abundance of Zooplanktons in such ponds fluctuate according to the nature of Eutrophy and level of pollution. Study has been made on five different fresh water localities to understand such relation between Eutrophy and Zooplankton community in the present investigation. Some of these planktons are specific to the environment in which they stay and necessarily not found elsewhere. Among the zooplanktons especially the species belonging to Mastigophora, Rotifera, Cladocera, Copepoda, Ostracoda are best indicators of water quality, aquatic pollution and tropic nature of a given environment.

Introduction

The Indian landscape is dotted with over 4290 large (> 15 m maximum depth or > 1 million-cu.m storage) and innumerable smaller man made water bodies (Sugunan, 1995; Suryanarayanan, 1996).As per one of the recent estimations, there were 1.3 million man made water lakes and ponds across India, some as large as 2500 sq. miles (Courtesy: Everyman's Science, 2008). Although tanks and ponds gained importance for religious purposes (temple tanks) since ages, over the past century, numerous reservoirs have been constructed for irrigation, flood control and hydropower and are being used for developing fisheries. With the rapid growth in human population, increase in industrial activity and the consequent demand of water, the water bodies, both lentic and lotic, are becoming increasingly polluted by domestic wastes, agricultural runoff and industrial effluents. These aquatic habitats and their biota have been extensively investigated since the early 19th century, and interest has grown rapidly in recent years due to the rising demand and the need for managing good water quality.

From the pioneering work done by de Beauchamp (1952), Ward and Whipple (1959) and Edmondson (1964) it is known that planktons use chemical stimuli to regulate reproduction and induce predator defenses. One of the primary channels of sensory inputs in case of zooplanktons as a response to available environment is by chemical signals. Indeed, much of the zooplankton behavior including feeding, predator defense, migration and mating is triggered by chemical stimuli (Snell, 1998). An attempt has been made in the foregoing account to understand the interaction between rotifers and their choice for a specific environment that could lead us to label them as indicators of particular trophic nature and pollution level of residing area.

Materials and Methods

To understand the role played by planktons in the determination of trophic nature of different environments, present work was carried out on five different localities in the city of Vizianagaram belonging to the state of Andhra Pradesh, India. They include moderately polluted (Pond-1), semi clean (Pond-2), polluted(Pond-3), clean (Pond-4) water bodies and highly polluted sewage ditch (Pond-5).

While certain populations of planktons were observed to be more abundant in certain habitats, others completely absent or found in limited number in certain other habitats. When a study was made to understand the inter relationship between hydrographical parameters and bio-composition in relation to trophic nature of ponds was studied, many interesting results were obtained. These observations led to the following conclusions:

1. Some species of rotifers can survive only in certain specific environments.

2. Certain species appear in abundance in certain environments while they were in limited in other areas.

3. The physical and chemical factors like temperature, turbidity, dissolved oxygen; hydrogen-ion concentrations play an important role in controlling the abundance of rotifers.

4. The pH of natural waters usually varies between pH 06 and 09. It is only under certain circumstances that the pH of natural waters is more acidic or more alkaline than these levels. A common factor causing pH levels to rise over 09 is intense photosynthetic activity resulting from algal growth in enriched waters causing eutrophic condition (Gabriela & Paez, 2005).

5. The chemical factors such as the carbonates, bicarbonates, chlorides and hardness also play important role in controlling the abundance and species composition of rotifers. As a whole, it results into specific identification of trophic nature of a particular environment.

Observation

The solid waste products such as sewage, domestic wastages, plastics, wastes from slaughterhouses, food industry, agricultural products, pesticides, heavy metals (Pb,Zn,Cu,Al etc.) are dumped regularly into these ponds from many years. Metals such as copper and cadmium may eventually reach aquatic ecosystems affecting the planktonic communities through their influence on the prey-predator interactions. The impact of all these pollutants is so heavy that species diversity of the ponds change much frequently.

Plantons as indicators of Pollution

As revealed from the present study Euglina, Filina longiseta, Brachionus, Neodiaptomous striglipes among calanoides, Cypris and Rotatoria were obtained from ponds in heavy pollution i.e., pond-1, pond-3 and sewage ditch. Some others like B.bidentata and B. urceolaris were obtained from moderately polluted waters.

As indicator of Water Quality

Presence of Euglina vulgaris, Paramoecium caudatus ,Fillinia, Rotatoria, Polyarthra and Epiphanes indicate poor water quality (observed in pond-3 & sewage ditch), while Monostyla, Asplanchna, Euchlanis and Keratella indicate comparatively better water quality as observed in water reservoir.

Dissolved Oxygen

Rotifers respire by their whole body since they do not have respiratory organs. They were unable to live in anaerobic conditions. Mesocyclops leucarrta, Microcyclops varicans, Thermocyclps crasas, Rotatoria neptunia and R.rotatoria, obtained from sewage ditch and pond-3 indicate that they can tolerate micro aerobic habitats, showing poor DO_2 content in the ponds. Paramoecium, Euglina, Chlamydomonas,Keratella cochlearis, B.urceolaris and Monostyla bulla were found in water where good sunlight falls up to the depth. Lecanes and more algal bodies were observed in the water reservoir where more numbers of hydrophytes were found.

Chloride content
The chloride content in the body regulates badly the process of osmoregulation. L.ovalis, Heliodiaptomous, Cypris, Heterocypris and P.vulgaris were found in ponds having low chloride contents. Lecane luna could tolerate chloride content up to 25-60 mg/lt. Hexarthra fennica, Cypris and B. Plicatilis had shown high chloride toleration capacity.

Indicators of pH Concentration
In ponds having pH of water above 7.5(7.5-9.0ppm) such as pond-1, pond-3 and sewage ditch; following rotifers were recorded e.g., Phylodiaptomous,B. plicateles, B. calyciflorus, B. quadridentata, Hexathra, Polyarthra vulgaris, Heterocypris and Strandesia. Whereas ponds those having pH below 7.5(6.0-7.4ppm), following rotifers were noticed, they were Chironomous larvae, Keratella cochlearis, Lecane papuna and Lecane lunaris. pH below 7.5 was obtained at several occasions in pond-2 and water reservoir after fresh spell of rain. Rotifers such as B. angularis, B. caudatus and Lepadella having better tolerance for alkalinities were obtained from both the ponds.

Variation of Temperature
Cypris,Lecane luna and Mytilina ventralis were obtained when the water temperature was above 30 degrees, while B. urceolaris, Asplancha seiboldi, Pompholyx sulcata and Hexarthra fennica were recorded below 20 degrees. Rests of the rotifers were obtained between 20-30 degrees range of temperature.

Fertility of ponds
In the plankton samples of pond-1 and pond-3, Chironomous larvae, Cypris,Heterocypris, Strandesia B. bidentata, B. calyciflorus, B. caudatus and F.longiseta were observed indicating eutrophication of water. When the ponds were fertilized with Calcium lime for production of fisheries B.forficula and Hexarthra population was rich. It is felt that the rich increase of zooplanktons such as euglena, blue green algae (Mycrocystis) and large number of chlorophycea help in the random increase of rotifers. In shallow water bodies, turbidity is generally high because of mixing of bottom sediments by wind action or by movement of macroscopic invertebrates or by fishes. This brings particles with adsorbed toxicants into the water column and eventually, as they were ingested by zooplankton and fish, they have an adverse effect on their demography.

In addition to the above-described species, some others rotifers were also considered as indicators of eutrophy. The species like K.cochlearis, P.vulgaris, P.remata, B.caudatus, B.forficula, A.intermedia, Platyias quadricornis & Pedalia fennica exclusively been collected from eutrophic areas like pond-1. Epiphanus clavulata, Eosphora najas, Rotaria neptunia and Rotaria rotatoria have been recorded only from heavily polluted waters.

Discussion
Rotifers, Copepoda and Cladocerans are common components of freshwater zooplankton communities. Species of the genus Brachionus are sensitive to changes in the water quality. Consequently, their use as standard bioassay organisms has been universally recognized (APHA, 1998). Information on the acute toxicity tests of lead (Pb) on Brachionus is available in literature (Snell & Janssen, 1995, Legaspi & Rico 2001). Many workers have realized the importance of micro- and macro- invertebrates as indicators of the trophic nature of water. Classical contributions had been made to such studies by Ruth Patrick (1950), Arora (1966), Kameswara Rao (1978), Walsh (1993) and Jack et al (1996). Kolkwitz and Marsson (1909) classified the organisms into three distinct categories depending upon the ecological niche in which they inhabit. Those occupying clean water were named Oligosaprobic; semiclean, mesosaprobic and grossly polluted zones as polysaprobic.

Studies carried out by Yi-Lomg Xi, Xiao-ping and Zhao-Xia Chu (2006) had shown that DDT, Dicophol, Estradiol and other pesticides do had a direct impact on growth, fecundity and survival of rotifers. Species belonging to Cypris, Brachionus and Daphnia can withstand heavy concentration of such chemicals. Dugan (2001) and Dumont (2002, 2007) had shown that the ecology of a plankton is directly or indirectly indicate the ecology of the habitat it is living. Similarly, the Plankton distributions in these ponds too vary as per the growing level of pollution. It was noticed in several occasions that the plankton fauna comprising of Filinia, Brachionus, Rotatoria ,Polyarthra, Neodiaptomous striglipes, Heliodiaptomous and Phylodiaptomous, Mesocyclops leucarrta, Microcyclops varicans and Thermocyclps crasas populations were at their peaks during high pollution levels corresponding to the bacterial, algal and euglenoid population in the ponds.

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