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Original Research Paper

Variations in Hydrobiological Characteristics of Atyal Pond in Gadhinglaj Tahsil, Dist. Kolhapur, Maharashtra

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ABSTRACT

The paper describes physicochemical characteristics of Atyal pond (Tahsil Gadhinglaj, Dist. Kolhapur) of Maharashtra. Limnological studies were conducted during the October 2007 to September 2008. Variables analysed from surface water of the tank were temperature, transparency, pH, electrical conductivity, dissolved oxygen, alkalinity, hardness, chlorides, biochemical oxygen demand and primary productivity. It was observed that the water of Atyal pond is rich in nutrients, which shows that the pond has become eutrophic. The pond shows increased pollution level due to various activities taking place in and around the water body.

INTRODUCTION

Due to overexploitation water resources have become polluted and chocked with excessive growth of algae. The environmental pollution affects the general quality of our surroundings and poses risk to our health and wellbeing (Parimalam et al. 1994). Water is one of the essential items needed for living beings for their survival and growth. It also maintains an ecological balance between various groups of organisms and their environment (Santhosh Kumar 1984). The physicochemical characteristics of an aquatic body not only reflect the type and diversity of aquatic biota but also the water quality and pollution (Mir et al. 2004).

Atyal pond was selected for the present study, which is located in Kolhapur district (16°1’53.10" N to 74°18’52.69" E) of south-western part of Maharashtra. The area of Atyal pond is 0.40 hectare with a depth of 25 ft. The satellite image of the pond is shown in Fig. 1. The pond is artificial and surrounded by sugarcane fields, and has been constructed mainly for domestic purposes.

The rain water is main source of the pond. In rainy season water collects in the pond from the adjoining areas. As the pond is surrounded by crop fields, the fertilizers and pesticides used in the fields are leached through into the ponds, due to which there is a great threat of degradation of water quality. Therefore, the assessment of water quality of Atyal pond is an important aspect. Still today there is no sufficient baseline data about physicochemical parameters of Atyal pond. Hence, the present work has been undertaken to study the water quality of this reservoir. The waterbody is used mostly for washing clothes and for cattle.

MATERIALS AND METHODS

Collection of water samples: The samples of surface water were collected monthly from different

sites during October 2007 to September 2008. The samples were collected in plastic containers in the morning and brought to the laboratory for further analysis.

Analysis of physicochemical properties: For the analysis of water, the standard methods were used. Some parameters like temperature, pH and transparency were estimated at the sites. The samples for DO, BOD and primary productivity were fixed in the BOD bottle at the sites and then brought to the laboratory for analysis. Winkler's method was used for the oxygen analysis, while the remaining analysis was made by the standard methods of APHA et al. (1985).

RESULTS AND DISCUSSION

The surface water temperature ranges between 23 to 31°C throughout the year (Fig. 2). It was recorded minimum during November, and maximum in May. The monthly variation showed that the water temperature followed the seasonal pattern of temperature fluctuation. The range of atmospheric temperature is 24 to 38°C (Fig. 3). According to the prevailing atmospheric temperature, the average atmospheric temperature is minimum in October, and maximum in May. Temperature is a vital parameter for growth of organisms. Air and water temperature play important role in the physicochemical and physiological behaviour of biotic components of aquatic ecosystems. It also reflects on the dynamics of biotic components and other climatic factors.

The transparency ranges between 8 to 30 cm. The minimum transparency is recorded in May and maximum in September (Fig. 4). The rain water brought large amounts of dissolved and undissolved inorganic and organic materials, that made water turbid and cause lower transparency in rainy months. These observations are in agreement with the findings of Timms & Midgley (1970).

The range of pH is 6.6 to 7.4. The minimum pH was recorded in the month of September, and maximum in the months of October and November (Fig. 5). The pH is considered as an important environmental factor. Higher pH value is normally associated with the high photosynthetic activity in water (Hujare 2008).

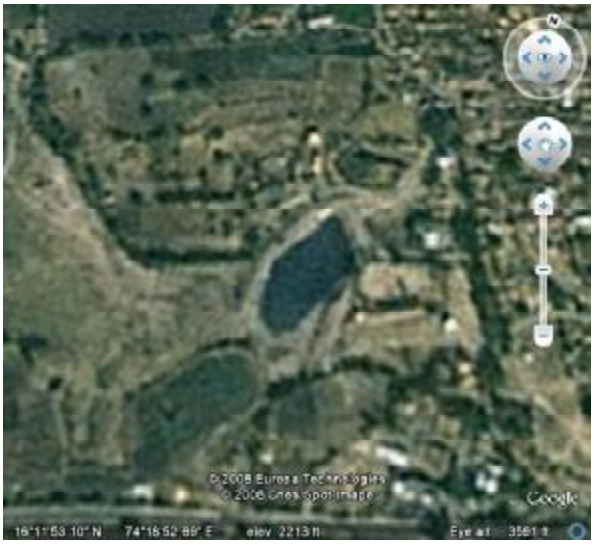

Fig. 1: Satellite image of Atyal pond.

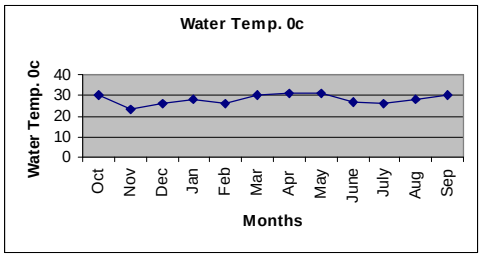

Fig. 2: Monthly variation in water temperature.

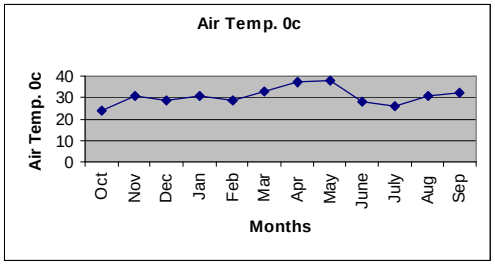

Fig. 3: Monthly variation in atmospheric temperature.

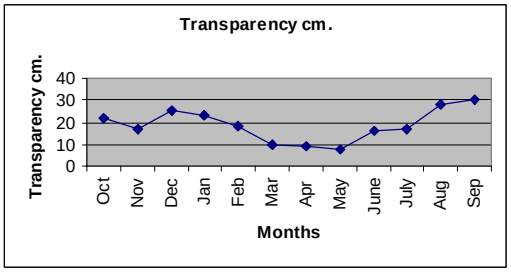

Fig. 4: Monthly variation in transparency (cm).

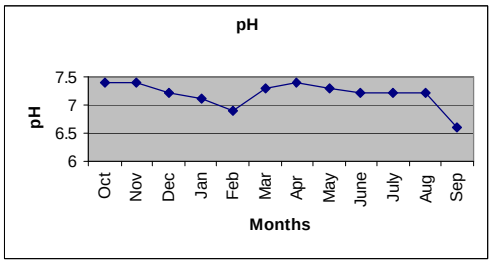

Fig. 5: Monthly variation in pH.

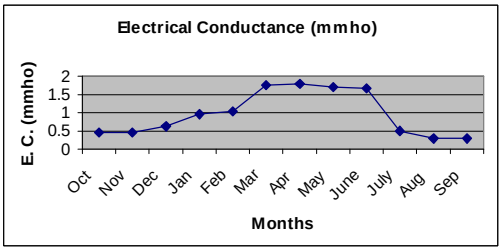

Fig. 6: Monthly variation in E. C. (mmho).

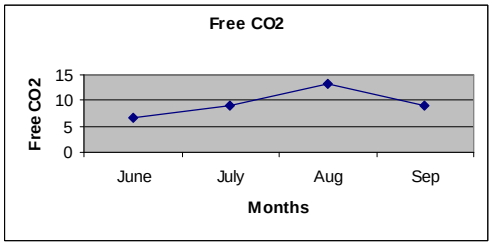

Fig. 7: Monthly variation in Free CO_2.

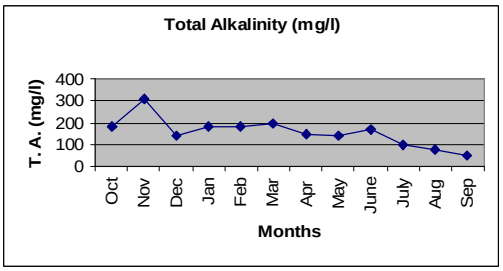

Fig. 8: Monthly variation in total alkalinity (mg/L).

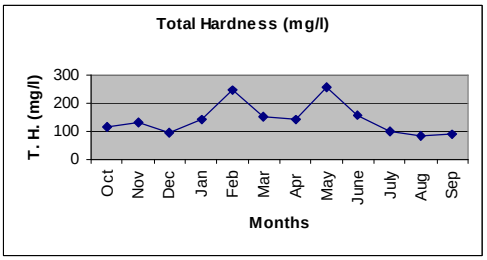

Fig. 9: Monthly variation in total hardness (mg/L).

The electrical conductivity values range from 0.28 to 1.80 mmho, being minimum in August and maximum in April (Fig. 6). The relation of electrical conductivity with temperature is explained on the basis of the fact that solubility of minerals and other inorganic matter increases with increase in water temperature Kataria et al. (1995).

The range of free CO_2 concentration is 6.6 to 7.4 mg/L. The free CO_2 concentration is minimum

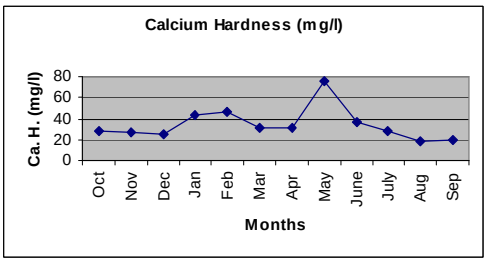

Fig. 10: Monthly variation in calcium (mg/L).

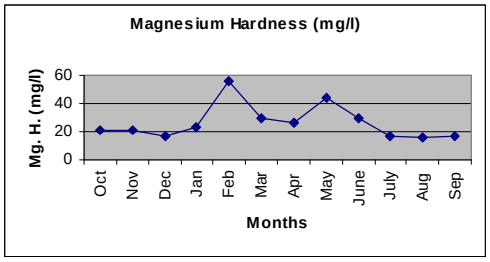

Fig. 11: Monthly variation in magnesium (mg/L).

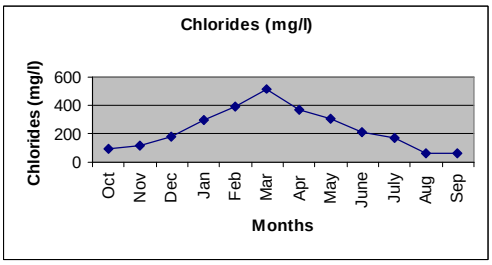

Fig. 12: Monthly variation in chlorides (mg/L)

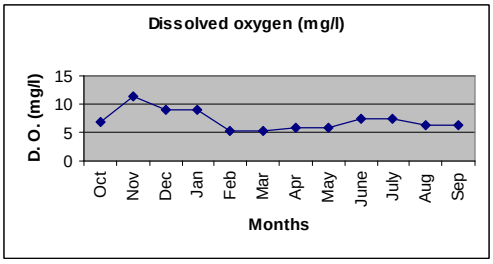

Fig. 13: Monthly variation in dissolved oxygen (mg/L).

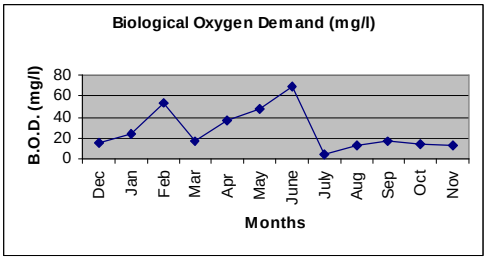

Fig. 14: Monthly variation in Biochemical Oxygen Demand (mg/L).

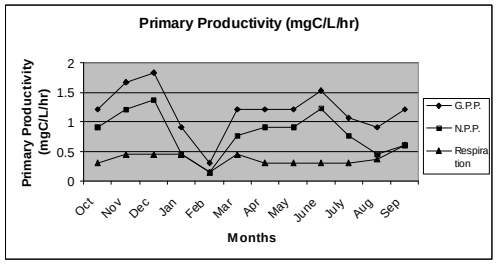

Fig. 15: Monthly variation in primary productivity (mgC/L/hr).

during the month of June and maximum during the month of August (Fig. 7). The free CO_2 concentration in water indicates the presence of decomposable organic matter, bacterial action on organic matter and physiological activities of biotic components. Lower level of free CO_2 during summer months is mainly due to high photosynthetic activity utilizing free CO_2, which is in agreement with the work of Yousuf et al. (1986).

The range of total alkalinity is 52 to 310 mg/L. The alkalinity was minimum in September, and maximum in November (Fig. 8). The alkaline nature of freshwater ponds is reported by Sampath Kumar & Ramkrishnan (2004) in Tiruvannamalia. The total alkalinity of water is mainly due to carbonates and bicarbonates. The alkalinity range of the studied waterbody is higher showing its eutrophic nature. Munawar (1970) also observed high alkalinity values in eutrophic waters.

In the present investigation total hardness of water ranges between 82 and 258 mg/L. It is minimum in August and maximum in May (Fig. 9). The values are similar with Rajalakshmi & Shakila (2007). The total hardness of water is characterized by contents of calcium and magnesium salts. Mathivanan et al. (2005) also stated that the hardness might be due to addition of Ca and Mg salts

from detergents and other man-made activities. The calcium ion concentration varies from 17.64 to 75.38 mg/L (Fig. 10) and, the magnesium from 15.63 to 55.76 mg/L (Fig.11). The chloride values range from 59.64 to 511.2 mg/L. It is minimum in August, and maximum in March (Fig. 12). High chloride concentration is also an indicator of large amount of organic matter (Yadav 2002, Dhanapakiyam et al. 1999).

The higher concentration of chloride in water is an index of pollution of animal origin and there is direct correlation between chloride concentration and pollution levels. Goel et al. (1985) reported higher values of chlorides ranging from 10.65 to 455 mg/L in some freshwater bodies from southern Maharashtra. In the present study, chloride concentration is increased due to the addition of pesticides and fertilizers from the agricultural fields. In the investigated pond, the chlorides are also higher due to the constant washing of clothes and animals by the local people.

Dissolved oxygen varied from 5.27 to 11.35 mg/L being minimum in March, and maximum in November (Fig. 13). DO showed significant inverse relationship with water temperature. This might be attributed to two reasons, i.e., in summer at high temperature the rate of oxidation of organic matter increases and oxygen is consumed and secondly at high temperature oxygen holding capacity of water decreases (Welch 1952).

Biochemical oxygen demand values varied from 103 to 44 mg/L. Highest BOD value was recorded in November, while lowest in January (Fig. 14). BOD is proportional to the amount of decomposable organic matter present in water (Solanki et al. 2007).

Productivity of lakes depends on presence of planktonic biomass. Enrichment of nutrients and dissolved matter in the water bodies affects diversity of water. Abundance and variation in the biotic factors provide information of energy turnover in aquatic ecosystem. Most workers have studied the influence of nutrients and physicochemical factors on algal density (Funk & Gautin 1971).

The values of Gross Primary Productivity, Net Primary Productivity and Respiration Rate range from 0.30 to 1.82, 0.15 to 1.36 and 0.15 to 0.60 mgC/L/hr respectively in all the months (Fig. 15). The maximum values were recorded in December, and minimum in February. Phytoplankton serve as food for aquatic animals specially for fishes and play an important role in maintaining ecological balance and quality of water (Pandey et al. 1994).

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