Research Article

Ecological effects on aquatic ecosystem

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ABSTRACT

Introduction: Living systems encounter a variety of stresses during their continuous interaction with environment. Fish are particularly threatened by water pollution. In the present study the effect of nuclear pollution on fishes was investigated. **Materials and Methods:** Two ponds namely, one in Madras Christian College, Tambaram, and the other one in Kalpakkam were selected. **Results and Discussion:** The water samples collected from various points in the Kalpakkam pond were analyzed for twelve parameters like pH, hardness, iron content, chlorine content etc.

KEY WORDS: Aquatic, Ecology, Ecosystem, Fishes, Hardness, Pond

INTRODUCTION

A pond ecosystem is a freshwater ecosystem in which communities of organisms rely on each other and the water environment for their nutrients and survival. Water is the most essential commodity for the survival so as that civilization has originated on the banks of water bodies.[1] Of late, water is polluted by lots of factors among which radiation by power plants exposure plays a key role and waste disposals from industries, domestic effluents, etc., are also included. This makes anthropogenic stress to the pond ecosystems and, in turn, reduces the amount of potable water. A more difficult challenge has been to identify and control environmental contaminants generated by dispersed or non-point sources such as automobile exhaust, livestock water, fertilizer and pesticide applications, and myriad commercial and industrial processes. These non-point pollutants can travel far from their sources when they start seeping or flow into rivers or enter the air. Amphibians tend to be very pollution sensitive due to the fact that they absorb chemicals in the water through their skins.[2-5] Furthermore, fishes have greater sensitivity toward this it undergoes many physiological effects like suffocation, and these are mainly due to the anthropogenic stress and which, in turn, makes an oxidative stress over the ponds. This is one reason why amphibian population are in distress today and even their anatomical changes happened like some frogs with six legs or a tail, etc.

A frog with five legs is shown in Figure 1. Frogs with genetic defects were found in August 1995 in south and central Minnesota by herpetologists, and it was postulated that they were not inherited genetic defects but were due to environmental pollution that affected the frogs in their early lives as eggs or tadpoles.[3,4]

The fishes with only one fin and without fins on either side where shown in Figure 2. This is also believed that these defects were not due to genetic inheritance and these were due to the changes in the environment and pond ecosystem due to pollutions.

Table 1 shows some major disturbances in the ecosystem due to water pollution with the pollutants which affect with their sources, cause and effect. About 50% of the dry mass of the living system is made of proteins. Hence, proteins are the foremost macromolecules in the biological system.[6] Molecular markers are available to detect these abnormalities. Proteins, enzyme analysis, and amino acid sequencing can be used to confirm the abnormalities. A vast majority of proteins show biological activity within a standard range of temperature and pH. Exposure of soluble and globular proteins to extreme pH or extreme high temperature causes proteins to denature. This results in decrease in solubility of enzymes.[7] To separate and characterize the proteins, this denaturation process is carried first so that the proteins to be profiled will be in a linear chain.

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Received on: 07-11-2018; Revised on: 09-12-2018; Accepted on: 05-02-2019

Global and local environmental changes and sustainability of development activities can be assessed by biological markers which are now recognized most probably as vital parameters. Aquatic environments act as sinks for a vast variety of anthropogenic pollutants, most of which are toxic such as burning of fossil fuels, untreated industrial effluents, sewage disposals, agriculture, and non-point source runoff. Amphibians, among vertebrates, are of due concern, as they are highly threatened[2] and decline in their population is a major shortfall.[3-5] Variations can cause DNA mutations. The physicochemical parameters of the water can lead to a direct correlation between the abnormalities in organisms and their survival.[8-13] The main objective of this experiment is to collect water from nearby ponds for studying the effect of pollution by analyzing the water sample for various physical and chemical parameters.

Figure 1: Effect of environmental pollution on frog morphology

Figure 2: Effect of environmental pollution on fishes

MATERIALS AND METHODS

Collection of Water Samples

Water samples were collected from a pond in Kalpakkam. For comparison, water from all directions, namely east, west, north, and center, were collected randomly for the study.

Water Analysis

The water analysis was done using TWAD BOARD water testing kit. The parameters such as pH, alkalinity, hardness, chloride, total dissolved salts, fluoride, iron, ammonium, nitrite, nitrate, phosphate, and residual chlorine were tested.

The procedure for analyzing the water samples is shown in Table 2. The different water samples, namely east, west, north, and center from the Kalpakkam pond, were analyzed by this method using TWAD BOARD water analyzing kit. The water samples were tested for 12 parameters.

RESULTS AND DISCUSSION

The 12 parameters were analyzed using the procedure mentioned in Table 2 and the results are tabulated in Table 3.

Table 3 represents the values of results and BIS guidelines of allowable limits of water quality parameters for samples. It can be seen that center and north samples are same in many parameters.

Figure 3 shows the graphical representation of analysis of water. From the result, it is noted that parameters on north side of the pond and center of the pond do not show much variations between them, whereas east side and west side vary from each other a bit as well as with center and north side. Furthermore, from the result values, we could ensure disinfection on north and center (since values are 0.2), whereas no disinfection is seen on east and west side (since values are 0) and we can ensure that the pond is polluted since ammonia content on west, center, and north was above prescribed level, i.e., 1.0 and phosphate content on east side is also above the prescribed level, i.e., 1.0 as well and nitrite content can be seen normal (refer * and **).

Table 1: Effect of environmental pollution on pond ecosystem

Pollutants	Sources	Cause	Effect
Nitrates, phosphates, ammonium salts	Agricultural fertilizers, sewage, manure	Plant nutrients	Eutrophication
Animal manure and plant residues	Sewage, paper mills, food processing wastes	Oxygen deficiency	Death of aquatic animals
Heat and radiations	Power plants and industrial cooling	Thermal discharge	Death of fish
Oil slicks	Leakage from oil ships	Petroleum	Death of aquatic life due to non-availability of dissolved oxygen in water

Table 2: Water analysis using TWAD BOARD water testing kit

S. No.	Test	Sample volume	Test procedure	Color change
1.	pH	One drop (using ink filler)	Add one drop of water to a portion of pH paper	Compare with pH color chart on the pH booklet
2.	Alkalinity	20 mL (use measuring cylinder)	5 drops "A1" + Titrate with "A2"	Appearance of red/ yellow color
3.	Hardness	20 mL (use measuring cylinder)	5 drops of "H1" + 5 drops of "H2" → Titrate with "H3"	Appearance of blue color
4.	Chloride	20 mL (use measuring cylinder)	5 drops of "C1" + Titrate with "C2"	Appearance of brick red color
5.	TDS (total dissolved salts)	By calculation- TDS = (Alkalinity+Hardness+Chloride) ×1.2		
6.	Fluoride	5 mL (Glass bottle measuring cylinder)	Add 5 drops of "F" reagent	Compare with fluoride color chat
7.	Iron	10 mL (Glass bottle measuring cylinder)	Add 5 drops of "FE1" + one drop of "FE2" + 5 drops of "FE3" → mix. Wait for 2–5 min	Compare with Iron color chart
8.	Ammonia	10 mL (Glass bottle measuring cylinder)	Add 5 drops of "AM" reagent	Compare with ammonia color chart
9.	Nitrite	10 mL (Glass bottle measuring cylinder)	Add 2 drops of "N2" + 2 drops of "N3"	Compare with nitrite color chart
10.	Nitrate	Using syringe take 1 mL water sample in the measuring cylinder+9 mL bottled/mineral water→transfer to the glass bottle	Add one small pinch of "N1" + 2 drops of "N2" + 2 drops of "N3" → Shake for 1 min	Compare with nitrate color chart
11.	Phosphate	10 mL (Glass bottle measuring cylinder)	Add 5 drops of "P1" + one drop of "P2"	Compare with phosphate color chart
12.	Residual chlorine	10 mL (Glass bottle measuring cylinder)	Add 5 drops of "RC" reagent	Compare with residual chlorine color chart

TDS: Total dissolved salts

Table 3: Analysis of water

S. No.	Water quality parameter	BIS guidelines allowable limits	East sample values in mg/L	West sample values in mg/L	Center sample values in mg/L	North sample values in mg/L
1.	pH	6.5–8.5	7.5	7.0	7.5	7.5
2.	Alkalinity	600 mg/L	25	24	27	27
3.	Hardness	600 mg/L	Nil	Nil	Nil	Nil
4.	Chloride	1000 mg/L	32	35	Nil	Nil
5.	Fluoride	1.5 mg/L	1.5	2.0	1.5	1.5
6.	Iron	1.0 mg/L	0.0	0.0	0.3	1.0
7.	Ammonia*	-	1.0	2.0	3.0	3.0
8.	Nitrite*	-	0.0	0.2	0.2	0.2
9.	Nitrate	45 mg/L	75	100	20	20
10.	Phosphate*	-	2.0	1.0	-	-
11.	Residual chlorine**	0.2 mg/L	0.0	0.0	0.2	0.2
12.	Total dissolved solids	2000 mg/L	68.4	70.8	32.4	32.4

*No guideline value prescribed; however, if ammonia, nitrite, and phosphate are present at more than 1.0 mg/L, it indicates pollution. **To ensure effective disinfection, minimum residual chlorine of 0.2 mg/L should be present

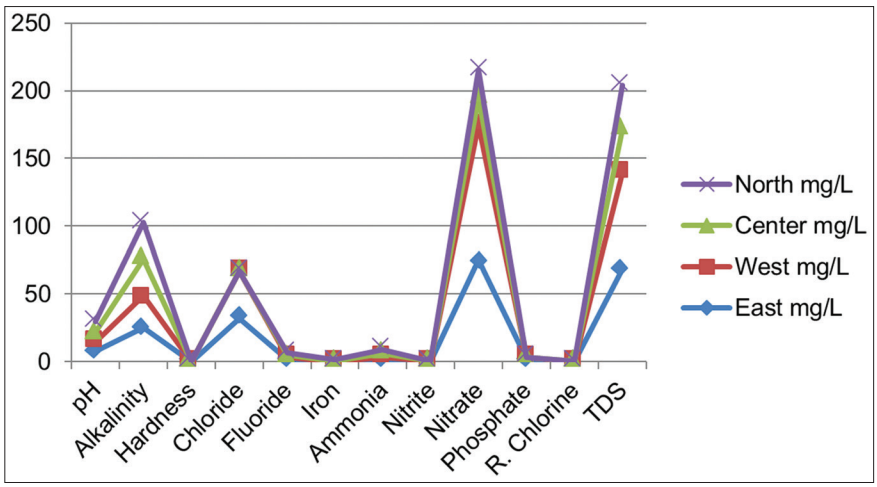

Figure 3: Analysis of water

CONCLUSION

In the current study, only the basic parameters like water analysis were done to study the effect of pollutants on freshwater organisms. We would like to continue with this work in detail in the next project with the correlation of these parameters with any abnormality in organisms in the ponds at the enzymatic level.

REFERENCES

1. Sharmila S, Rebecca LJ, Saduzzaman M. Biodegradation of domestic effluent using different solvent extracts of *Murraya koenigii*. J Chem Pharm Res 2013;5:279-82.
2. Ramesh T, Hussain KJ, Satpathy KK, Selvanayagam M. Community composition and distribution of herpetofauna at Kalpakkam Nuclear campus, Southern India. Herpetol Notes 2013;6:343-51.
3. Wyman RL. What's happening to the amphibians? Conserv Biol 1990;4:350-2.
4. Dalton R. As amphibians come under study. Nature 2000;405:495-6.
5. Chanson SN, Cox JS, Young NA, Rodrigues BE, Fischman AS, Waller DL. Status and trend of amphibian decline and extinction worldwide. Science 2004;306:1783-6.
6. Lehniger AL. The molecular basis of cell structure and function: Biochemistry- nahed s. gad. Int J Environ Sci Eng.1:49-58.
7. Pollard TD. Cell Biology: Amino Acids and Proteins. London: Elsevier Publications; 2017. p. 32-6.
8. Dixit K, Pandey SK, Mehta R, Ahmad N, Gunjan, Pandey J. Study of physico-chemical parameters of different pond water of Bilaspur district, Chhattishgarh, India. Environ Skeptics Crit 2015;4:89-95.
9. Manjare SA, Vhanalakar SA, Muley DV. Analysis of water quality using physico-chemical parameters tamdalge tank in Kolhapur district, Maharashtra. Int J Adv Biotechnol Res 2010;1:115-9.
10. Bahekar R, There Y. Seasonal variation in physico-chemical characteristics of Koradi Lake, district Nagpur, India. Indian Streams Res J 2013;3:1-5.
11. Banerjea SM. Water quality and soil condition of fish ponds in states of India in relation to fish production. Indian J Fish 1967;14:115-44.
12. Umavathi S, Longakumar K, Subhashini S. Studies on the nutrient content of Sulur pond in Coimbator, Tamil Nadu. J Ecol Environ Conserv 2007;13:501-4.
13. Acharya GD, Hathi MV, Patel AD, Parmar KC. Chemical properties of groundwater in Bhiloda Taluka region, North Gujarat, India. E-J Chem 2008;5:792-6.

Source of support: Nil; Conflict of interest: None Declared