IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(P): 2347-4580; ISSN(E): 2321-8851
Vol. 4, Issue 12, Dec 2016, 21-28

ASSESSMENT OF PHYSICO- CHEMICAL PARAMETERS IN THE AMPHIBIAN HABITATS OF TUMAKURU DISTRICT, KARNATAKA

ANILKUMAR. M[1] & ASIYANUZHAT. F. B[2]

[1]Research Scholar, Department of Zoology, Faculty of Science and Technology,
Tumkur University, Tumakuru, Karnataka, India

[2]Associate Professor, Chairman, Department of Studies and Research in Zoology,
Tumkur University, Tumakuru, Karnataka, India

ABSTRACT

Aquatic ecosystems are dynamic and their tropic state is controlled by physical and chemical conditions of water. Pool-breeding anurans have complex life cycles that place them at risk from habitat loss and the quality of the wetlands. These habitats were polluted on regular basis due to the release of domestic sewage, industrial effluents, organic pollutants and run-off from anthropogenic activities containing fertilizers. Anuran species that tend to spend much of the non-breeding period within and near wetlands. The quality of water always has a deteriorate effect on the survival and development of anuran fauna. For the present research work two different anuran habitats in the District of Tumakuru, Karnataka were selected. Samples were analyzed for the physico-chemical parameters for the period of one year (2015).The water samples were collected from the study habitat and analyzed to determine the water quality parameters such as temperature pH, electrical conductivity (EC), total dissolved solids (TDS), alkalinity, CO_2 and dissolved oxygen (DO) using titration and instrumentation method. The study revealed that high level of physico-chemical parameters in the urban aquatic habitat was vulnerable to the anuran fauna compared to the forest habitat of Tumakuru District, Karnataka.

KEYWORDS: Anuran Habitat, Physico-Chemical Parameters, Tumakuru District, Karnataka

INTRODUCTION

The anuran fauna is an important biotic component of freshwater ecosystems. Researchers have proved anuran decline is mainly due to water pollution. [1] and [2].Chemical elements dissolved in the water contaminate water quality and affect the living organisms especially larvae and adult frogs. The adult anurans remain exposed to water because of their cutaneous respiration through which water enters the body continuously and thus remain unprotected to contaminants. Some workers studying the patterns of amphibian diversity have found significant correlations with water variables. [3].The parameters selected for present research are the constituents of natural water. Each physico-chemical water quality parameter performs different functions. Temperature affects the physical and chemical properties of water and also affects the aquatic vegetation, organisms and their biological activities. As frogs and toads are exothermic, their body temperature varies with the surrounding environment, and it affects the metabolic processes of the animal. [4]. The pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. All chemical and biological reactions are directly dependent upon the pH of water system. pH have great impact on eggs and larvae of anurans which are extremely sensitive to acidity or extreme alkalinity. [5]. Electrical conductivity (EC) is a measure of water capacity to convey electric

current. The conductivity of water depends upon the concentration of ions and its nutrient status, thus measurement of EC is actually the measurement of all the impurities of water in form of excessive inorganic components [6]. Total dissolved solids (TDS) represent the amount of soluble inorganic substance in water. [7]. High or extremely low TDS volume affected by the presence of both organic and inorganic compounds may lead to amphibian mortality. [8]. Hardness represents overall concentration of divalent salts such as calcium, magnesium, iron and zinc, but Calcium and magnesium are the most common sources for making water hard. [9].Total alkalinity of water refers to the quality and kinds of components such as bicarbonates, carbonates and hydroxides. Total alkalinity may be used as a tool for the measurement of productivity. Dissolved oxygen (DO) in water is of great importance to all aquatic organisms. Aquatic habitat receives oxygen directly from the atmosphere and also during the photosynthetic activity of plants in water. The presence of dissolved oxygen is essential to maintain the higher forms of biological life and to keep proper balance of various pollutants thus making the water bodies healthy. [10].Carbon Dioxide (CO_2) is present in water in the form of a dissolved gas. The excesses of CO_2 in water negatively affect metabolism of aquatic organisms by causing hypoxia and necrosis. It also influences their growth and reproduction.

STUDY AREA

Tumakuru City is located in the south eastern part of Karnataka state between 13º 06'30" to 13º 31' 00" North latitude and 76º 59' 00" to 77º 19' 00" East Longitude. The city spreads over an area of 1043sq.km falling within the semiarid region and facing water scarcity as well as quality problems. The diversity and distribution of amphibians in the aquatic habitat of city is not reported. But frogs and toads are inhabited in the ponds, ditches and stagnant pools (author observation). Two habitats were selected for the present study.site1: Amanikere **(**Figure 1) Kannada literature reveals that *'Kere'* means *lake.*It is the largest natural pond in the city, located in the center Tumakuru District. It is surrounded by dense human population. Pond receives moderate rain water during monsoon season. This pond is threatened by the entry of the domestic waste water and industrial effluents. It also faces habitat fragmentation due to construction of park by the City Corporation. Site2: Devarayandurga forest **(**Figure 2) It is a pristine forest located at an altitude of 3896 feet above the sea level. The place is surrounded by large and small trees and many aquatic habitats with less human population.

METHODOLOGY

Water samples for investigations were collected from two different sites from May to December 2015 (in accordance with Monsoon onset in South India) and the timing of sampling was fixed between 2 p.m. to 6p.m. The water samples were collected in plastic bottles. All the water samples were taken to Zoology Research Lab of Tumkur University for analysis. Water temperature was recorded by immersing the thermometer into the samples soon after it was taken out of sites. In order to estimate the depth wise distribution of temperature, samples were collected vertically from top to bottom at regular depth intervals of one meter. pH was recorded using pH meter, whereas as conductivity meter were used to measure the volume of EC and TDS. Other parameters including Total Hardness, Total Alkalinity and CO_2 were analyzed through titration procedures. Modified Winkler's method was followed for determination of the Dissolved Oxygen. All the chemicals and reagents used were of analytical grade. The water samples were analyzed to study the physico- chemical parameters by following the standard methods of APHA [6] and [11].

RESULTS & DISCUSSIONS

The results of the study has summarized in the Table 1 & 2 and illustrated in the Figure 3-10. Concern about anuran declines has increased steadily over the past decade. [12]. Research into anuran declines is ongoing but has already highlighted factors such as chemical pollutants and climate change as potential causes.[13].The natterjack toad, *Bufocalamitta* was protected by law in Britain in 1975. [14].Unfortunately in the district of Tumakuru, amphibian diversity and their environmental status is poorly studied, hence no proper and definite conservation attempts are ever conducted here. Seven Anuran species were identified during the above period *Duttaphrynu*s, *Polypedates, Fejervarya*, *Hyla*, *Rana, Rachophorus* and *Kaloula taprobanica.* Present study in Tumakuru district revealed poor amphibian diversity and species richness exhibited in Amanikere (site1) compared to Devarayandurga forest (site2). During the entire range of study period, from may to december 2015.Temperature of site1has found to be in the range of 28 ºC - 32 ºC and that of the aquatic habit in the forest is in the range of 20 ºC -28 ºC, which has significant impact on the growth and survival of tadpoles and adult anurans..The pH value in the site1 as shown in the Table 1 was persistently below 6 and it can stress animal systems and reduce metamorphosis and survival rate. [15]. At the same time, Table 2 showed that site2 has normal pH value in accordance with the scientific studies that suggest maintaining pH within 6.5 to 8.3 is the range where the majority of aquatic organisms prefer. [16].The effect of acidity on amphibians has also received a great deal of attention in the past, and it can be expected that pH is likely to act as an additional stress among amphibians exposed to agricultural chemicals.EC volume was persistently high in the first site, this unfavorable range of EC is able to damage eggs or induce abnormalities into physical and physiological characteristics of anuran larvae. [17].

It was noted that EC& TDS value was also recorded to be extremely high than that of the normal level (50.0 - 250.0 mg/L) in the urban site compared to forest aquatic habitat, may lead to amphibians mortality because of excessive organic and inorganic components which might contribute in making amphibian survival difficult. [18]. This parameter was recorded high in the urban aquatic habitat Amanikere. Agricultural runoff and sewage leak will increase the conductivity due to additional chloride, phosphate and nitrate ions. Total Hardness might also affect amphibian population and survival as it was frequently higher than normal quantity. [19]. He described negative effect of total hardness when extending out of 75 to 200 mg/L. Total Alkalinity was also entirely above the normal level (50-150 mg/L) in the first habitat. Thus amphibian habitats in the site1 may fail to maintain hydrogen ion concentration and cause severe destruction to eggs and larvae. [20]. CO_2 was also out of favorable limit which lies between 12-25 mg/L in the site1compared to second site. The CO_2 concentrations can influence pH levels and it can react with water to form carbonic acid. Dissolved oxygen refers to the level of free non-compound oxygen present in water. It is an important parameter in assessing water quality. The solubility of oxygen will decreases as temperature increases. This means that colder places can hold more dissolved oxygen than warmer waters. [21].It is well correlated with Devarayandurga forest where the temperature ranges from 20 -28^{0}C (Figure 3) compared to the urban habitat with the temperature was always above 28^{0}C.The direct input of high levels of nitrogen (urine and manure) and the turbidity induced by livestock disturbance leads to poor water quality, low oxygen concentrations, and a generally adverse environment for amphibian eggs and tadpoles. Highly productive ponds experience wide swings in dissolved oxygen and pH that can be detrimental to the survival of amphibian eggs and larvae. [22].If nitrate concentrations are high enough; adverse sub lethal effects or even mortality may result for the anurans. The present study in the district of Tumakuru also revealed the same fact. Overall, the study of physico chemical parameters revealed high level of pollution in the aquatic habitat of urban area which affect survival of

not only eggs and larvae but also the adult frogs and toads. Therefore there is need of conservation plans to be implemented urgently to save amphibian fauna in the Amanikere habitat of Tumakuru District, Karnataka, India.

FIGURES AND TABLES

Figure 1: Amanikere (Satellite View)

Figure 2: Dearayandurga Forest

Table 1: Physico-Chemical Quality of Water in the Anuran Habitat of Amanikere –Tumkur District, Karnataka (2015)

Parameters	May	June	July	August	September	October	November	December
Water Temp.(⁰C)	31.06 ± 0.85	31.00 ± 0.00	29.00 ± 0.00	29.00 ± 0.00	30.00 ± 0.00	29.00 ± 0.00	29.00 ± 0.00	28.00 ± 0.00
pH	6.64 ± 0.12	5.73 ± 0.14	6.73 ± 0.16	5.65 ± 0.18	5.76 ± 0.08	5.78 ± 0.04	5.68 ± 0.21	5.71 ± 0.04
EC (µs/cm)	1495.2±1016.8	1379.0±1068.2	1247.0±1040.5	1036.2±1844.0	1090.7±1048.2	1098.8±891.2	890.3±335.0	944.4±713.6
TDS mg/L	1003.1±614.3	1191.9±688.9	2322.9±965.1	1822.9±562.1	1208.7±722.9	1204.9±632.9	1407.7±562.9	1174.9±623.9
T-Hard mg/L	280.3±121.7	251.7±179.5	340.7±186.6	240.0±143.4	200.3±71.1	237.7±63.5	242.7±45.8	262.7±54.3
T-Alk mg/L	412.4±339.1	320.0±167.1	419.4±266.4	347.6±120.8	304.0±121.3	249.6±105.2	289.6±892.6	292.6±87.0
CO2 mg/L	14.8±4.1	12.8±2.	13.0±16.2	20.0±16.9	21.0±16.0	18.0±14.0	17.0±13.0	20.0±12.0
DO mg/L	3.55 ± 0.13	3.19 ± 0.59	3.06 ± 0.21	2.16 ± 0.45	2.19 ± 0.65	2.18 ± 0.53	2.91 ± 0.67	2.98 ± 0.82

Table 2: Physico Chemical Quality of Water in the Anuran Habitat of Devarayandurga Forest, Tumakuru District, Karnataka (2015)

Parameters	May	June	July	August	September	October	November	December
Water Temp.(⁰C)	28.00 ± 0.82	28.50 ± 0.58	26.00 ± 0.00	25.00 ± 0.00	24.25 ± 0.50	23.50 ± 1.00	22.75 ± 2.06	20.00 ± 3.16
pH	7.34 ± 0.18	7.44 ± 0.15	7.61 ± 0.34	6.26 ± 0.11	6.27 ± 0.08	7.21 ± 0.16	7.28 ± 0.12	8.30 ± 0.11
EC (µs/cm)	873.75 ± 39.02	886.25 ± 65.75	926.50 ± 42.69	988.75 ±79.02	810.00 ± 69.55	976.00 ± 49.55	818.00 ± 72.55	863.00 ± 59.55
TDS mg/L	358.9±290.4	380.2±228.7	469.0±397.1	407.7±222.9	337.8±222.8	463.6±394.7	323.8±229.8	318.7±201.7
T-Hard mg/L	111.6±89.4	116.7±84.8	103.3±98.3	164.4±100.4	145.3±127.3	128.3±117.5	143.3±123.56	163±143.5
T-Alk mg/L	196.0±155.9	220.0±167.1	226.6±184.8	276.6±194.6	266.6±165.9	218.6±176.0	267.6±184.1	278.6±187.4
CO2 mg/L	8.7±7.4	7.1±4.9.	6.2±4.7	5.8±3.6	5.7±4.3	5.8±3.8	6.9±4.9	6.9±5.7
DO mg/L	10.45 ± 0.17	10.20 ± 0.00	12.33 ± 0.10	11.54 ± 0.28	12.43 ± 0.28	10.47 ± 0.28	11.43 ± 0.28	10.41 ± 0.28

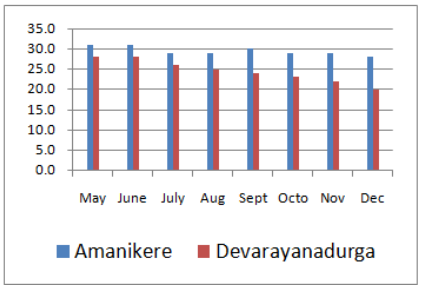

Figure 3: Temperature in ºC

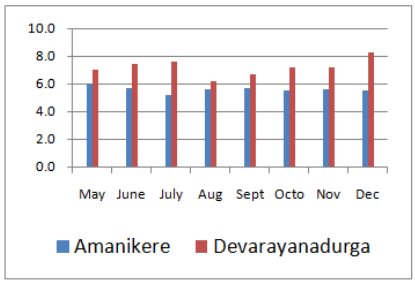

Figure 4: pH

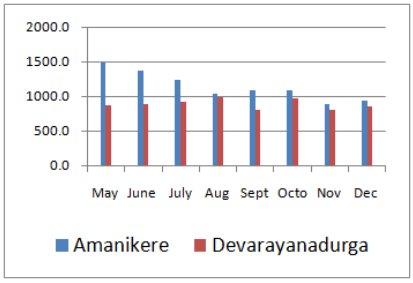

Figure 5: Electric Conductivity (µS/cm)

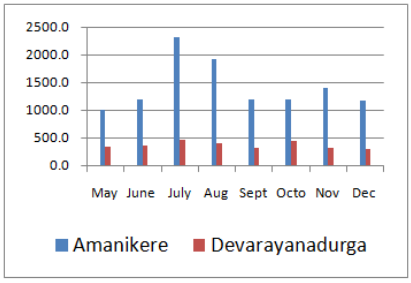

Figure 6: Total Dissolved Solids (mg/L)

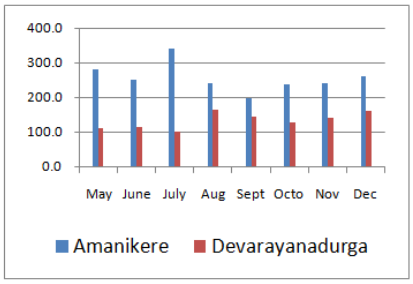

Figure 7: Total Hardness (mg/L)

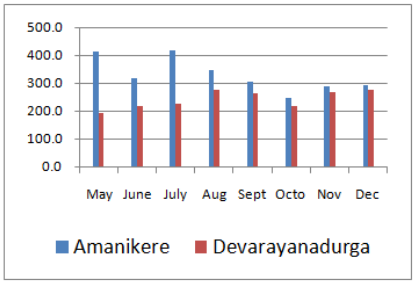

Figure 8: Total Alkalinity (mg/L)

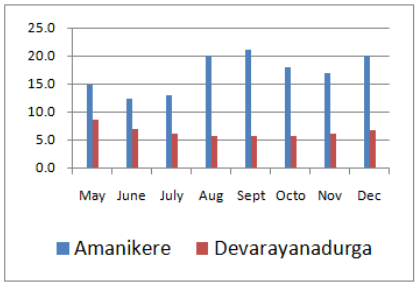

Figure 9: Carbon dioxide (mg/L)

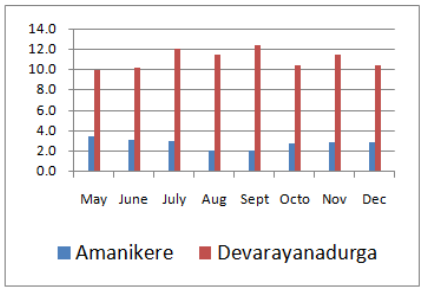

Figure 10: Dissolved Oxygen (mg/L)

REFERENCES

1. Allan, J. D. 2004. Landscapes and rivers capes: the influence of land use on stream ecosystems. *Annual Review of Ecology, Evolution, and Systemati s* 35:257–284.
2. Walsh, C. J., A. H. Roy, J. W. Feminell, P. D. Cottingham, P. M. Groffman, and R. P. Morgan.2005. The urban stream syndrome: current knowledge and the search for a cure. *Journal of the North American Benthological Society* 24:706–723.

3. Gibbs, J.P., 1998.Distribution of woodland amphibians along a forest fragmentation gradient. Landscape Ecology 13, 263–268.
4. Blaustein, A.R., Johnson, P.T., 2003. The complexity of deformed amphibians.Frontiers in *Ecology and the Environment 1, 87–94.*
5. Boone, M. D. Semlitsch, R.D., Little, E.E., Doyle, M.C., 2007. Multiple stressors in amphibian communities: effects of chemical contamination, bullfrogs, and fish. *Ecological Applications* 17, 291–301
6. APHA.1998.Standard methods for the examination of water and wastewater.Twentieth edition.American Public Health Association-, Washington, D.C., USA.
7. Ela Wendell P. 2007. Introduction to Environmental Engineering and Science, Prentice Hall, 3rd, ISBN0-13-148193-2.
8. Geoffrey R Smith, Kathleen G. Temple, Haley A. Dingfelder and David A.Vaala. 2005 : Effects of nitrate on the interactions of the tadpoles of tw ranids *(Ranaclamitans and R.catesbeiana)*
9. Edwards, T.M., McCoy, K.A., Barbeau, T., McCoy, M.W., Thro, J.M., Guillette, L.J., 2006.Environmental context determines nitrate toxicity in southern toad *(Bufoterrestris)* tadpoles. *Aquatic Toxicology* 78, 50–58
10. Rose, C.S. 2005. Integrating Ecology and developmental biology to explain the timing of frog metamorphosis trends in Ecology and Evolution 20:129–135
11. Trivedi R.K and Goel P.K, Chemical and Biological Methods for Water Pollution Studies, *Environmental Publication*, India 1986.
12. Alford, R.A., Richards, S.J., 1999. Global amphibian declines: a problem in applied ecology. *Annual Review of Ecology and Systematics* 30, 133–165.
13. Mayer, F.L.J., Ellersieck, M.R., 1986. Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals.
14. Robert F.Baldwin and Philip.G.de.Mayndier. (2009):Assessing threat to pool breeding amphibian habitat in an urbanizing landscape.*Elsevier, Biological conservation* (2009) 1628- 1638.
15. Sparling, D.W. and G.M. Fellers. 2009. Toxicity of two insecticides to California USA anurans and its relevance to declining amphibian populations. *Environ. Tox. Chem*. 28(8):1696-1703.
16. Beattie RC, Tyler Jones R. 1992. The effects of low pH and aluminum on breeding success in the frog *Ranatemporaria, Journal of Herpetology* 26, 353-360.
17. Baker, J. M. R., and V. Waights. 1994. The effects of nitrate on tadpoles of the tree frog (*Litoriacaerulea*). *Herpetology Journal* 4:106–108
18. Tatersall GJ, Right PA. 1996. The Effects of Ambient pH on Nitrogen Excretion in Early Life Stages of the American Toad (*Bufoamericanus*). *Comparative Biochemistry and Physiology* 113, 369-374.
19. Wurts WA, RM Durborow.1992. Interactions of pH, carbon dioxide, alkalinity and hardness in fish ponds.

Southern Regional Aquaculture Center Publication No. 464.

20. Environmental Protection Agency (EPA).1976. Quality Criteria for Water (PDF). 534..
21. MelindaG. Knutson, William B. Richardson, David M. Reineke, Brian R. Gray 2004: Agricultural pond support amphibian populations, *Ecological Applications*, 14(3), 2004, pp. 669–684, 2004 by the Ecological Society of America.
22. Hall, R.J., Henry, P.F.P., 1992. Review: assessing effects of pesticides on amphibians and reptiles: status and needs. *Herpetological Journal* 2, 65–71.