Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 5, No. 3, p. 255-261, 2014
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Assessment of amphibian environment through Physico-chemical analysis in Pakistan

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Article published on September 25, 2014

Key words: Amphibian environment, Water quality, Physico-chemical analysis, District Hyderabad, Sindh, Pakistan.

Abstract

Non-optimal water quality has dreadful effects on development and survival of amphibians, especially their eggs and larvae are more susceptible as cannot resist against harmful components of their aquatic habitat by moving away. Therefore Physico-chemical nature of amphibian habitats located in three Talukas of District Hyderabad was analyzed for the period of one year (2012) through parameters including pH, Electric Conductivity (EC), Total Dissolved Solids (TDS), Total Hardness (T-Hard), Total Alkalinity (T-Alk) and Carbon dioxide (CO_2) via using specific instrumentation and titration methods. Environmental study indicated water contamination due to high level of all the parameters except pH which may make environment intolerable for amphibian fauna in whole study area.

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Introduction

Research of past two decades has proved amphibian declination is mainly due to water pollution. The water may appear clean but there are enormous Physico-chemical elements dissolved there which contaminate water quality and affect the life especially of aquatics which remain confined at one place from being spawned till developed into adult. The adult amphibians also remain exposed to water quality because of their respiratory skin through which water enters the body continuously and thus remain unprotected to contaminants. The parameters selected for present research are constituents of natural water but when affected by anthropogenic discharges, rise enormously out of normal limit and get termed as pollutants. Each Physico-chemical parameter performs different function as pH is a prominent chemical characteristics that shows level of hydrogen ions that have great impact on eggs and larvae which are extremely sensitive to acidity or extreme basicity of their primary and exclusively aquatic environment (Beattie and Tyler, 1992), whereas Electric Conductivity (EC) displays Concentration of dissolved salts (electrolytes) that are conductors of heat, helping electricity to pass through the water, thus measurement of EC is actually the measurement of all the impurities of water in form of excessive inorganic components **(**APHA. 1971, 1992; EPA, 1986; Boyer, *et al*. 1995; Boyd and Claude, 1999). Measurement of Total Dissolved Solids (TDS) acts as an aggregate indicator of all the chemical contaminants or impurities present in water **(**Hogan and Marc, 1987; Boyd and Claude, 1999; Ela and Wendell P, 2007). High or extremely low TDS volume affected by the presence of both organic and inorganic compounds may lead amphibians to mortality (Tatersall and wright, 1996; Horne and Dunson, 1994). Hardness represents overall concentration of divalent salts such as calcium, magnesium, iron and zinc etc but Calcium and magnesium are the most common sources for making water hard (Wurts and Durborow, 1992; Wurts and Masser, 2004). Alkalinity is one more important parameter which exhibits base neutralizing or "buffering" capacity of water indicating water's ability to resist pH changes (Wurts, and Durborow, 1992) as alterations in pH volume may induce stress, poor growth and even death of aquatic eggs and larvae (Cai and Hu, 2010; Wurts and Durborow, 1992; EPA 1976). Carbon dioxide (CO_2) is water soluble gas and most common source of acidity in water (Cameron and Iwama, 1989). The excesses of dissolved CO_2 will negatively affect the health of the aquatic organisms by causing hypoxia, metabolic abnormalities and also influence their growth and reproduction (Burleson and Smatresk, 2000; Croc Crocker and Cech, 1996).

Therefore present study aimed to measure the volume of described parameters in amphibian environment to know whether their concentration is within normal range or not so that required management plans may be implemented to save these valuable animals which play important role in maintaining ecosystem balanced by reducing population of invertebrates and Eutrophication.

Material and method

The area of present research "District Hyderabad" convers extent of 3,198 Km^2 located at 25.367 °N latitude and 68.367 °E longitude with an elevation of 13 meters (43 ft.). Present investigation was conducted in 12 permanent amphibian dwellings in agricultural ponds randomly situated in three Talukas viz: Qasimabad, Latifabad and Hyderabad. Each Taluka was studied separately and marked for regular sampling with the help of Global Positioning System (GPS) (Fig. 1). The names of amphibian locales in each Taluka are mentioned below:

Taluka Qasimabad: Ferozabad, Jam Fatah, Moriana, Faiz Karim,

Taluka Latifabad: Sadabad, Ismail khaskheli, Faridabad, khaiman, Goth Almani.

Taluka Hyderabad: Hussain pur, Dawood khan, Goth Ghulam Mohammad.

The survey was conducted every monthly from March

to November (excluding July) during 2012 and the timing of sampling was fixed between 09 am to 06 pm. The water samples were collected in Van Dorn plastic bottles and were kept in stopper polyethylene plastic bottles prior to analysis. All the water samples were delivered to the laboratory where pH was recorded using pH meter (Orion 420), whereas as Conductivity meter (Model: Orion. 115 and WTW 320) were used to measure the volume of EC and TDS. Other parameters including T-Hard, T-Alk and CO_2 were analyzed through titration procedures. All the chemicals and reagents used were of analytical grade. The method applied for the determination of each parameter was provided by Denial, 1948 and Sunita, 2002.

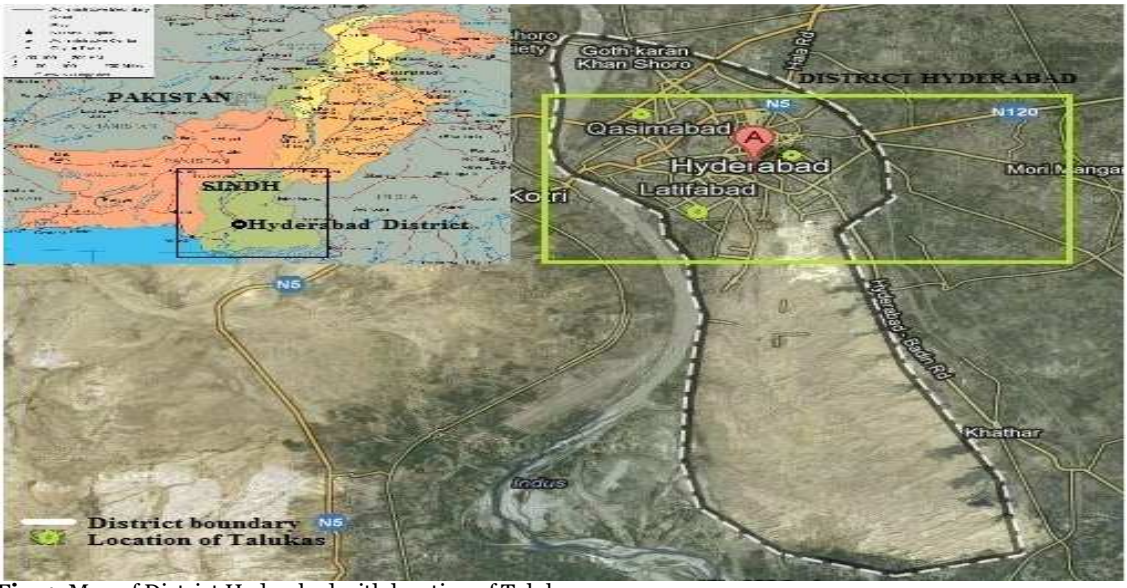

Fig. 1. Map of District Hyderabad with location of Talukas.

Result and discussion

amphibian declination is an issue of global concern worldwide, hence different wildlife organizations such as IUCN (International Union for the Conservation of Nature) take efforts for their conservation by implementing strict rules against any kind of encroachment but unfortunately in Sindh province amphibian diversity and their environmental status is poorly studied, hence no proper and definite conservation attempts are ever conducted here. Previous studies concerning existence of amphibians reported the occurrence of four species i.e. *Hoplobatrachus tigerinus, Euphlyctis cyanophlyctis, Allopa hzarensis* (Family Ranidae) and *Bufo stomaticus* (Family Bufinadae) from several Districts of Sindh Province including Hyderabad that was reportedly lacking *A. hazarensis* (Shaikh, et al. 2014). Whereas environmental study is previously documented only from District Larkana that is reported to provide amphibians unstable environ (Kalsoom, et al. 2013).

Present study of District Hyderabad in direction to find the reason behind occurrence of poor amphibian diversity exhibited high pollution in all the inhabitations located in three Talukas during entire range of study period (Table 1-3). The pH volume in all the Talukas as indicated by Figure 2 was persistently normal in accordance with the scientific studies that suggest maintaining pH within 6.5 to 9.0 for keeping amphibian hinterlands balanced regarding volume of hydrogen ions (Beattie and Tyler, 1992). EC volume was persistently high in all the amphibian haunts as it is emphasized to keep amphibian eggs and larvae away from EC beyond 150 - 500 µs/cm as unfavorable range of EC is able to

damage eggs or induce abnormalities into physical and physiological characteristics of larvae (Boyer, et al. 1995, APHA. 1971, 1992). It was noted to be highest in all the Talukas but especially in Taluka Hyderabad (Fig. 3). At some instance (during October and November) the discussed parameter was recorded relatively normal but no habitat was found entirely free from high EC. TDS volume was also recorded to be extremely high than that of the normal level (50.0 - 250.0 mg/L), that may lead amphibians to mortality because of excessive organic and inorganic components that may contribute in making amphibian survival difficult (Tatersall and wright, 1996). This parameter was recorded high in all the Talukas but amphibian habitations in Taluka Hyderabad were found more abundantly concentrated (Fig. 4). Total Hardness might also affect amphibian population and survival as it was frequently higher than normal quantity, for example Wurts and Durborow, 1992 described its negative effects when extending out of 75 to 200 mg/L. T-Hard remained high from March to June; however it was recorded within normal concentration in other months of present research (Fig. 5). Habitats in Taluka Latifabad were harder than the haunts in other Talukas. Total Alkalinity was also entirely above the normal level (50-150 mg/L), thus amphibian habitats may fail to maintain hydrogen ion concentration and cause severe destruction to eggs and larvae (EPA 1976; Cai and Hu, 2010). It was found over concentrated in all the habitations of entire District but extreme level was recorded from all habitats of Taluka Hyderabad (Fig. 6). CO_2 was also out of favorable limit which lies between 12-25 mg/L. Its persistently low volume may become influential to amphibians especially in Taluka Hyderabad that was found more affected by uneven volume of CO_2 (Fig. 7). Overall study revealed whole amphibian habitations consisted of normal pH volume but all other parameters were the indicators of high contamination throughout the study period. Among three Talukas of District Hyderabad, Taluka Hyderabad was analyzed to provide most polluted ambient to amphibians (Table 3). Monthly changes in water quality remained constant at all the study sites. Highest volume of all the parameters was analyzed during May and lowest volume was recorded in November, except CO_2 that fluctuated in antagonistic manner to other parameters (Figure 2-7).

Table 1. Physico-chemical quality of amphibian environment in Taluka Qasimabad.

Parameters	March	April	May	June	August	September	October	November
pH	7.6±0.4	7.3±0.4	7.8±0.2	7.4±0.4	7.4±0.2	7.7±0.6	7.5±0.3	7.1±0.3
EC µS/cm	2028.2±2642.3	2013.4±1817.8	2101.1±1974.4	1006.9±1045.7	700±9.2	504.3±332.5	567.5±639.8	475.7±301.0
TDS mg/L	1003.1±614.3	1191.9±688.9	2322.9±965.1	1365.6±1235.5	1348.4±1232.1	677.2±702.3	653.6±692.0	626.1±478.1
T-Hard mg/L	245.0±183.9	111.6±59.4	262.7±93.8	235.0±142.9	199.3±36.6	192.7±15.1	199.5±71.2	103.3±20.3
T-Alk mg/L	196.0±155.9	302.8±358.5	415.2±265.0	304.0±121.3	246.6±102.2	253.2±250.4	236.6±119.4	117.2±80.3
CO_2 mg/L	14.8±4.1	8.7±7.4	6.1±3.9	13.0±16.2	12.9±16.2	20.0±16.9	14.3±3.4	21.0±16.0

Table 2. Physico-chemical quality of amphibian environment in Taluka Latifabad.

Parameters	March	April	May	June	August	September	October	November
pH	7.8±0.2	7.8±0.14	7.8±0.1	7.7±0.7	7.6±0.2	7.6±0.7	7.6±0.3	7.5±0.5
EC µS/cm	1497.2±916.8	1779.0±1028.2	3467.0±1440.5	2038.2±1844.0	1010.7±1048.2	698.8±891.2	500.3±335.0	934.4±713.6
TDS mg/L	1358.9±1770.4	380.2±428.7	1407.7±1322.9	469.0±597.1	337.8±222.8	463.6±594.7	323.8±229.8	318.7±201.7
T-Hard mg/L	280.3±121.7	251.7±179.5	340.7±186.6	240.0±143.4	200.3±71.1	116.7±44.8	139.3±37.5	164.4±86.4
T-Alk mg/L	412.4±339.1	320.0±167.1	419.4±266.4	240.6±120.8	237.4±71.3	285.4±216.2	295.0±218.9	226.6±134.8
CO_2 mg/L	13.6±7.4	18.4±9.1	8.8±2.6	19.6±15.1	10.3±3.0	19.4±14.4	10.1±2.8	20.2±12.7

The high level of pollution in water reservoirs wherein amphibians dwell may affect survival of not only eggs and larvae but also adult amphibians. Therefore there is need of conservation plans to be implemented urgently to save amphibian fauna from being deteriorated in District Hyderabad.

Table 3. Physico-chemical quality of amphibian environment in Taluka Hyderabad.

Parameters	March	April	May	June	August	September	October	November
pH	8.2±0.9	8.2±1.2	8.6±0.5	8.4±1.4	8.0±1.1	8.0±1.1	7.8±0.7	7.7±0.3
EC µS/cm	2028.2±2642.3	2101.1±1974.4	4024.6±2209.0	3760.6±2001.8	700.0±891.2	475.7±301.0	567.5±639.8	504.3±332.5
TDS mg/L	2265.7±1713.0	2346.4±1220.4	2806.4±1652.2	434.9±483.3	1060.2±1799.8	2310.8±1220.5	834.2±1272.4	186.4±175.4
T-Hard mg/L	173.6±28.4	167.1±148.6	327.7±370.7	322.9±369.1	130.7±92.2	319.7±369.1	155.0±139.3	147.7±58.4
T-Alk mg/L	563.4±393.9	300.0±111.8	715.0±186.4	245.4±122.1	462.0±478.8	294.0±121.3	202.0±79.4	195.8±85.0
CO_2 mg/L	11.1±6.8	16.5±6.6	9.2±2.4	10.7±6.7	18.3±5.4	10.7±6.6	18.3±5.4	19.6±6.7

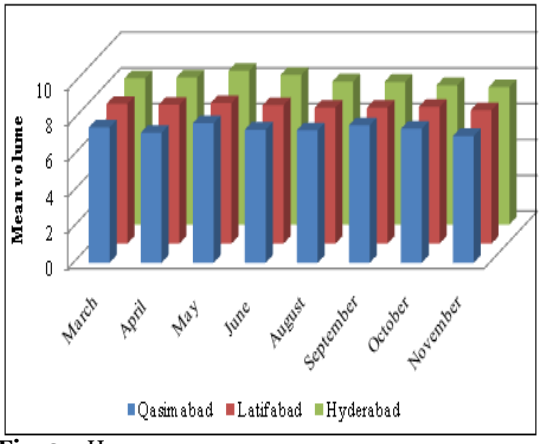

Fig. 2. pH.

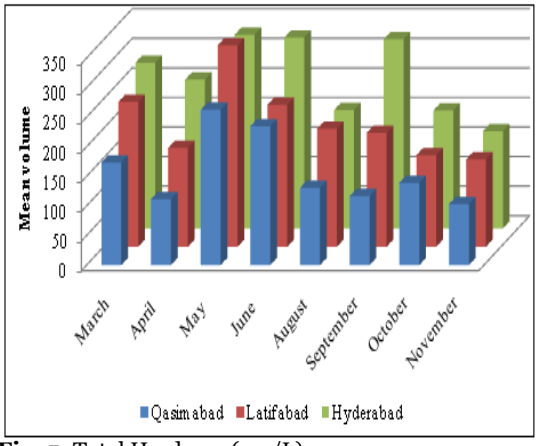

Fig. 5. Total Hardness (mg/L).

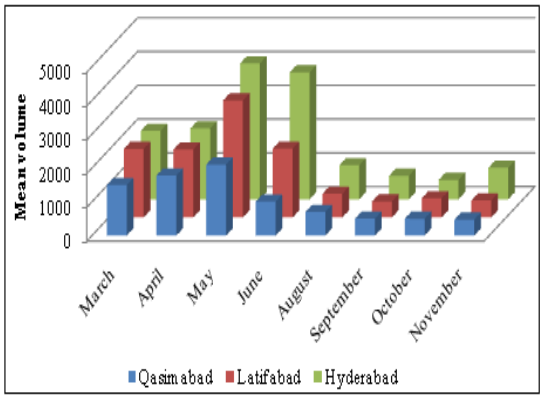

Fig. 3. Electric Conductivity (µS/cm).

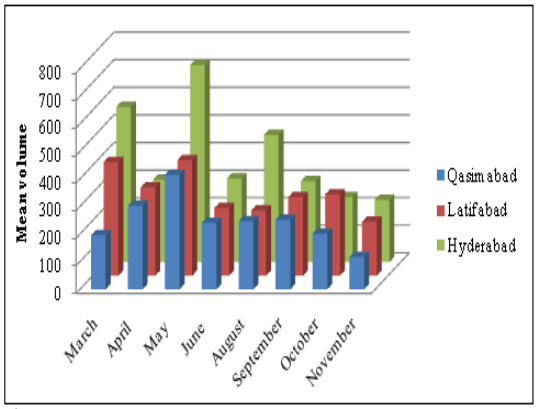

Fig. 6. Total Alkalinity (mg/L).

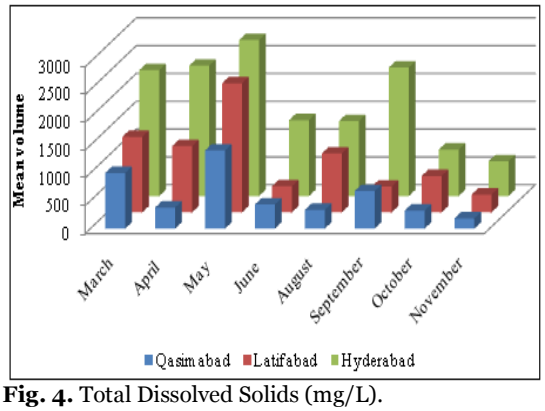

Fig. 4. Total Dissolved Solids (mg/L).

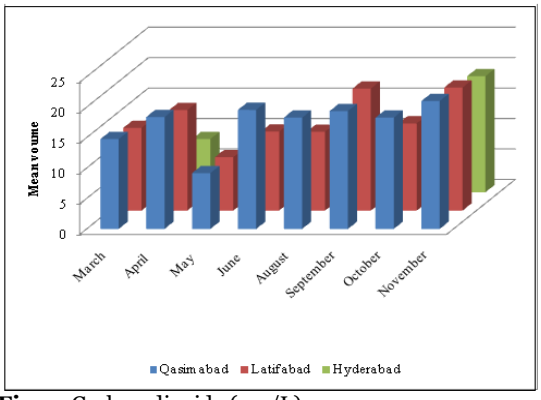

Fig. 7. Carbon dioxide (mg/L).

Acknowledgment
Financial support for this study was provided by Higher Education Commission of Pakistan.

References

American Public Health Association (APHA). 1971. Standard Methods for the Examination of Water and Waste Water. American Public Health Association report, NewYork, USA.

American Public Health Association (APHA). 1992. Standard methods for the examination of water and wastewater. 18th ed. American Public Health Association, Washington, DC.

Beattie RC, Tyler Jones R. 1992. The effects of low pH and aluminum on breeding success in the frog *Rana temporaria*, Journal of Herpetology **26,** 353-360.

Boyer, Robin, Christian E, Grue. 1995. The Need for Water Quality Criteria for Frogs. Environmental Health Perspectives **103**, 352–357.

Boyd Claude E. 1999. Water Quality*:* An Introduction. The Netherlands: Kluwer Academic Publishers Group, ISBN 0-7923-7853-9.

Burleson ML, Smatresk NJ. 2000. Branchial chemoreceptors mediate ventilatory response to hypercapnic acidosis in channel catfish. Comparative Biochemistry and Physiology **125,** 403-414.

Cai WJ, Hu X. 2010. Alkalinity Distribution in the Western North Atlantic Ocean Margins. Journal of Geophysical Research **115,** 1-15.

Cameron JN, Iwama GK. 1989. Compromises between ionic regulation and acid-base regulation in aquatic animals. Canadian Journal of Zoology **67,** 3078-3084.

CM Hogan, Marc Papineau. 1987. Development of a dynamic water quality simulation model for the Truckee River, Earth Metrics Inc., Environmental Protection Agency Technology Series, Washington D.C.

Crocker CE, Cech JJ. 1996. Effects of hypercapnia on the growth of juvenile white sturgeon. Acipenser transmotanum. Aquaculture **147,** 293-299.

Denial C, Harris. 1948. Quantitative chemical analysis. 3rd edition, 52-57.

Ela WP. 2007. Introduction to Environmental Engineering and Science, Prentice Hall, 3rd ed, ISBN 0-13-148193-2.

Environmental Protection Agency (EPA). 1976. Quality Criteria for Water (PDF). 534.

Environmental Protection Agency (EPA). 1986. Quality Criteria for Water (PDF). 477.

Horne MT, Dunson WA. 1994. The interactive effects of low pH, toxic metals, and DOC on a simulated temporary pond community. Environmental pollution **89,** 155-161.

Kalsoom S, Gachal GS, Saima QM, Sodho NA, Yusuf SM, Qadri AH. 2013. Impact of Non-optimal Environmental Conditions on Survival of Amphibians in Pakistan. International Journal of Advanced Research **1,** 140-146.

Shaikh K, Gachal GS, Yusuf SM, Nabi G, Qadri AH, Afghan A. 2014. Checklist and Distribution of Amphibian fauna in Sindh, Pakistan. Sindh University Research Journal **46,** 159-162.

Sunita Rattan. 2002. Experiments in Applied Chemistry, 2nd Edition, 77-93.

Tatersall GJ, Right PA. 1996. The Effects of Ambient pH on Nitrogen Excretion in Early Life Stages of the American Toad (*Bufo americanus*). Comparative Biochemistry and Physiology **113,** 369-374.

Wurts WA, RM Durborow. 1992. Interactions of pH, carbon dioxide, alkalinity and hardness in fish ponds. Southern Regional Aquaculture Center Publication No. 464.

Wurts WA, Masser MP. 2004. Liming ponds for aquaculture. Southern Regional Aquaculture Center, Publication No. 4100.