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RESEARCH ARTICLE

Impact of Non-optimal Environmental Conditions on Survival of Amphibians in Pakistan

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Abstract

Non-optimal ecological conditions are greatly considered as a reason for the decline of amphibians in most regions of the world. In this context, present study was carried outwithin7,423 km^{2}area of District Larkana ofPakistan,to evaluate amphibian's ecological status by some Physico-chemical and biological parameters.The Physico-chemical Parameters included water temperature, pH, Conductivity and Total dissolved solids, amongst which only Conductivity (1610.68±766.39) was analyzedbeing beyond the favorable limit. Biological Parameters viz:amphibian population, predator population and occurrence of vegetationwere determined. Amphibian population was recorded to contain only 1868members coexisting with 1435 individuals of Predators. Vegetation was recorded beingenough to support amphibian survival. Over all analysisrevealed that amphibians aremostthreatenedbypredators than other environmental factors in District Larkana.

Introduction

Since past two decades, amphibians have gained much importance fortheir decline in population worldwide mainly due to ecological problems that destroy their habitat. Ecological status of amphibian fauna is largely studied in several parts of the world but narrowly studied in Pakistan.

Previous study on amphibian fauna of District Larkana was done by Kalsoom, et al. 2013 that reported existence of only three amphibianspecies (*Hoplobatrachus tigerinus*, *Euphlyctiscyanophlyctis* of Family Ranidae and *Bufo stomaticus* of Family Bufonidae). Existence of such a few species out of approximately 6,500 speciesworldwide(Frost, et al. 2006), and 28 species recorded from some areas of Pakistan (Khan, 2008) motivated to carry out present study to analyze some basic ecological parameters to knowwhether amphibian fauna have a stable survival or not in District Larkana.

The selection of aquatic habitat for present study is due to the fact that every amphibian needs water during the breeding season thus water quality has great effect on their growth, development and survival(Dely, 1967 and Piotr, 2006).

The water temperature has great influence on growth and development of amphibian larvae that are sensitive to environmental temperature (Gillooly and Dodson 2000, Angilletta,*et al*. 2004). Acidification has been provedas a major threat to amphibians hence pH was considered as important parameter along with Conductivity and TDS whose increased volume may lead amphibians to mortality (Gloset al., 2003;Tattersall and wright, 1996; Horne and Dunson, 1994).

Population of amphibians and their predators was aimedto determine for the present study in order to assess amphibian's struggle for their survival as predators mainly feed on the larvae and young ones of amphibians that are unable to compete or escape and become food of potential predators ultimately.

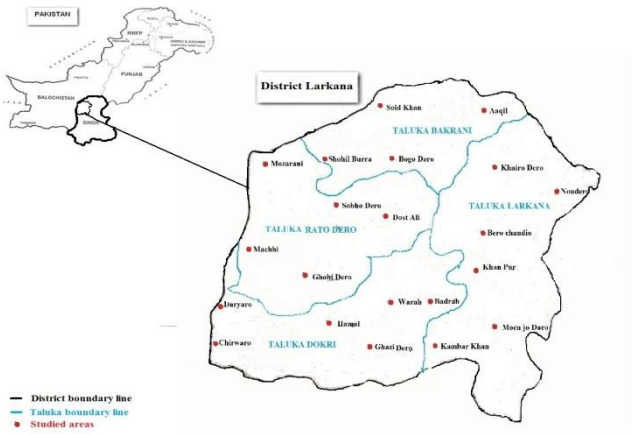
Vegetation was selected for present study for its important role in warming up the aquatic habitat of amphibians. Those habitats which are covered with vegetation like trees remain colder than those that have less vegetation cover.

Material and Method:

Study area

Five Sampling sites were selected in each of four Talukas of District Larkana viz: Larkana, Dokri, RatoDero and Bakrani surveyed during May, June and July 2013 (Fig. 1). Larkana is one of the main districts of Sindh province,renownedmainly for crop production consisting of rice, wheat, sourgum, vegetables and fruits that offer habitat toamphibian fauna.

Figure 1: Map of District Larkana Sindh, Pakistan



Physico-chemicalparameters

Water temperature was checked by using mercury thermometer, pHand Conductivity were measured by using pH meter (Orion. 420) and Conductivity Bridge (Orion. 115), whereas Total dissolved solids (TDS) concentration was calculated by formula (Leblond and Duffy, 2001).

Biological parameters

Distribution of amphibians, their predatorsand vegetation was recorded. In order to avoid recapturing of same specimen of amphibians and their predators, every quadrate was marked at minimum distance of 10 meters from each other. The methodused forthe collection of specimenswas catching manually with scoop net(for capturing amphibians),fishing net (for catching fish predators),Tongs, Hooks, and Bags(for capturing snake predators, handled and helped by snake charmer).

Preservationof specimens

The different amphibian and predator specimens were preserved in formalin solution containing 10 % formaldehyde and 90 % water, stored in separate jars individually while extra specimens of a species already preserved were released alive in the field.

Identification

Identificationof amphibian specimens was done on the basis of morpho-taxonomic key, and catalogues mainly of Khan, 2008, 2004, 2002, 1987 and Minton, 1966.Other relevant literature viz:Nauwelaerts*et al*., 2004; Das and Dutta, 1998; Dubois and Ohler, 1995; Ford and Cannatella, 1993; Balletto*et al*., 1985 and Boulenger, 1890 also contributed in identification.

Fish predators were identified through morpho-taxonomic literature (Pethiyagoda, et al., 2012;Helfman, et al., 2009; Stiassny, et al., 2007; Nelson and Joseph, 2006; Moyle and Czech, 2003; Menon, 1999;Helfman, et al., 1997).

Khan, 2004; Ahmed, et al., 1976; Minton, 1966 and1962 contributed in identification of reptilian predators.

Identification of vegetation was achieved by the help of literature including Catling and Mitrow, 2011; Geetha et al., 2010;Peterson and Lee, 2010; Ahmed, et al., 2008; Araya and Yoseph, 2008; Amro, et al., 2007; Batwa, et al., 2006; Almas and Khalid, 2002;Unaipon, 2001;Al-Sadhan et al, 1999; Spina and Mary, 1994; Akhtar and Ajmal, 1981.

Results:

Physico-chemical analysis of aquatic habitat of amphibian fauna divulgedwater temperature, pH and total dissolved solids within tolerable range in all the Talukas of District Larkana, but Conductivity was analyzed being extremely high (Fig 2-5).

Figure 2: Measurement of water temperature in studied area

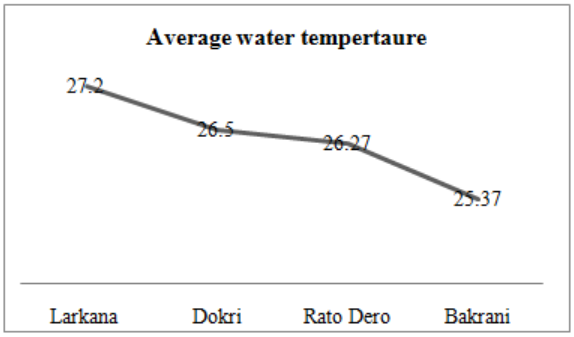


Figure 3: Measurement of pH in studied area

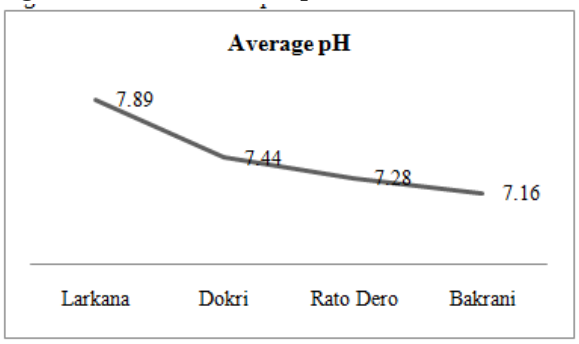


Figure 4: Measurement of Total dissolved solidsin studied area

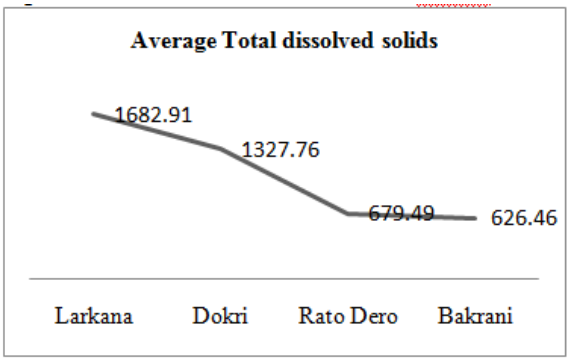
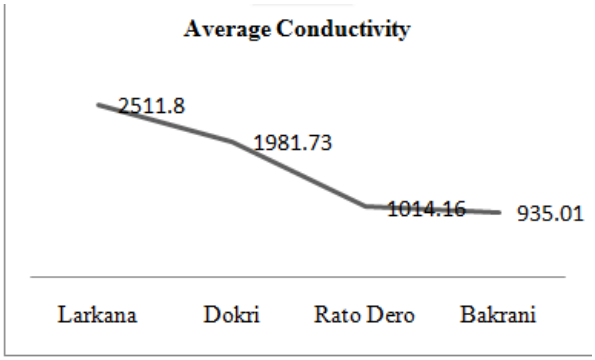
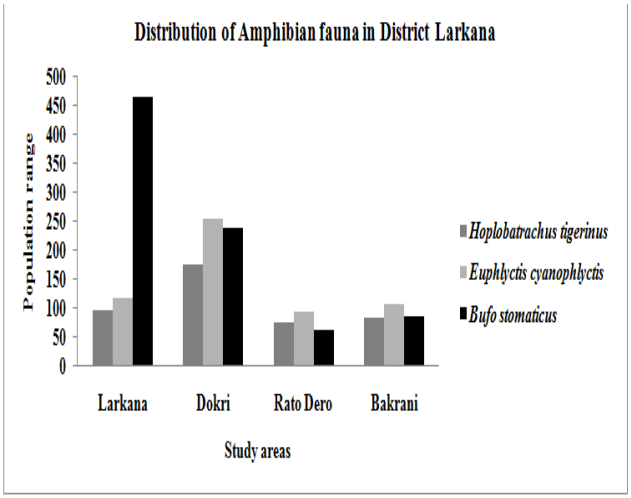


Figure 5: Measurement of Conductivity in studied area



Only three amphibian species were found that are already reported by Kalsoom, et al., 2013. Largest amphibianpopulation was counted in Taluka Larkana bearing 682individuals; however TalukaRatoDeroembraced only 236 members making smallest amphibian population in comparison to other Talukas (Fig. 6).

Figure 6: Distribution of amphibian fauna in four Talukas of District Larkana



Among potential predators of amphibians, only those species are mentioned which were found during the field surveys. Predator species recorded in studied areas are grouped into two categories.

1. Fishes: Thaili (*Catlacatla*), Rohu (*Labeorohita*), Dahi (*Labeocalbasu*), Makhni (*Osteobarmacatio*), Popri (*Puntiusticto*), Morakhi (*Cirrhinusmirgala*).
2. Reptiles: Pakistan ribbon snake (*Psammophisleithi*), common rate snake (*Ptyasmucosus*), slender blind snake (*Typhlopesporrects*).

In all nine(09) predator species were recorded from four Talukas of District Larkana in a random number and their populationwas recorded as highest in TalukaRatoDero containing 596 members and smallestpopulation of 140 members in Taluka Larkana (Table 1).

Table1. Population of predator species recorded from habitat of amphibian fauna in District Larkana

Collection sites	Thaili (*Catlacatla*)	Rohu (*Labeorohita*)	Dahi (*Labeocalbas*)	Makhni (*Osteobarmacatio*)	Popri (*Puntiusticto*)	Morakhi (*Cirrhinusmirgala*)	Ribbon snake (*Psammophisleithi*)	Common rate snake (*Ptyasmucosus*)	Slender blind snake (*Typhlopesporrects*)
Larkana	23	17	27	12	35	0	14	12	0
Dokri	10	35	22	25	33	38	01	01	01
RatoDero	95	102	99	97	94	94	0	13	02
Bakrani	96	98	98	49	65	97	13	09	08

Table 2: Population Status of Amphibians and their Predators in District Larkana

S. NO.	Larkana	Dokri	RatoDero	Bakrani	Total
Amphibian Population	682	669	236	281	**1868**
Predator Population	140	166	596	533	**1435**

Table 3: Vegetation present in amphibian habitat inDistrict Larkana.

Vegetation	Larkana	Dokri	RatoDero	Bakrani
Khabar(*Salvadoraoleoides*)	Nil	Nil	Present	Nil
Kandi (*Prosopis cineraria*)	Present	Nil	Present	Present
Lai/Laya (*Tamarixdioica)*	Nil	Nil	Present	Present
Lai/Laya (*Tamarixaphylla*)	Nil	Nil	Nil	Present
Pan (*Typhalatifolia*)	Nil	Nil	Present	Present
Elephant grass (*Typhaelephantiana*)	Present	Nil	Present	Present
Cattail or Cumbungi *(Typhadomingensis)*	Present	Nil	Nil	Present
Common Reed(*Phragmiteskarka*)	Present	Nil	Present	Present
Leaf vegetable *(Ipomoea aquatic)*	Nil	Present	Present	Nil
Giant salvinia or kariba weed (*Salviniamolesta).*	Nil	Present	Present	Nil

Altogether ten (10) species of vegetation surrounded aquatic habitat of amphibians in District Larkana with random occurrence in its four Talukas.Abundant vegetation was foundin TalukaRatoDero and Bakrani, but very seldom in other Talukas(Table 3).

Discussion:

The Physico-chemical analysis of all aquatic habitats of amphibian fauna in District Larkana (Fig. 1)as a whole showed that water temperature (26.38±0.76), pH (7.44±0.32) and Total dissolved solids (1079.16±513.48) were not effective parameters (Fig. 2-4). ButConductivity (1610.68±766.39) was recorded to be extremely high beyond the favorable limit(Fig. 5) as it is suggested between 150 - 500 µS/cm to support diverse aquatic life (Boyer, et al. 1995).

But conductivity may not be blamed to affect amphibian survival in extensive studied area. If it was conductivity causingamphibiansto decline, Larkana and Dokri Talukas could not sustain highest amphibian population(Fig. 6) where habitat had highest conductivity and almost no vegetation.Meanwhile habitat with low conductivity and sufficient vegetation in TalukaRatoDero and Bakrani could offer largest amphibian population.

Present study shows that amphibians can well survive and lead to large population even in high conductivity and lack of vegetation if they are not exposed to predators as in Taluka Larkana and Dokri (Table 1-2). Similarlylow Conductivity and large vegetation(Table 3) have nothing to do with saving amphibians when they are exposed to predators as in TalukaRatoDero and Bakrani.

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