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Abundance of the Native Frog of Kashmir (*Rana cyanophlyctis*) in Paddy Field Environment

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ABSTRACT

The physico-chemical variables of soil and water, in respect of four different paddy field areas, a perennial spring in a sub-urban area of northeast Srinagar and a remote rural paddy field, revealed lesser abundance of native frog (*Rana cyanophlyctics*) in sub-urban as compared to perfectly rural environment. This seemed to be related to the extensive use of pesticides and chemical fertilizers, changed weather patterns and drought like conditions during their breeding season.

Keywords: *Rana cyanophlyctis*, abundance, paddy fields, chemical fertilizers.

INTRODUCTION

The continuing loss of biodiversity from habitat destruction, over harvesting, pollution of various kinds, inappropriate introduction of exotic plants and animals and many other major aspects of anthropogenic interventions in nature are of extra-ordinary concern the world over. Frogs, toads, salamanders, newts and caecilians is peculiarly interesting group of animals. The group bridges the gulf between fish and reptiles. Although generally regarded as a defeated group of animals yet over 3400 species of frogs and toads that make up the order Anura are known. The order of frogs and Toads according to Heussar, 1974 c.f. Grzimek, 1974, contains six sub-orders with 17 families, 250 genera and 2600 species and is an old group , known from Jurassic period. However, recent studies (Heyer *et al.*,1994) have shown that many populations of frogs world-wide may be suffering declines in number and becoming more patchy than usual in their distribution.

The common frog of Kashmir (*Rana cyanophlyctis*) is sparsely found through out the valley of Kashmir. The frog is generally found in fresh water lakes, wetlands, ponds and paddy fields. However, the population of our native frog is reportedly declining at an alarming rate especially in urban and sub-urban areas for the last two decades. The problem seems to be intensified for the last 4-5 years. The present investigation was an attempt to assess the impact of man-generated stress on the population of our native frog *(Rana cyanophlyctis)*.

STUDY AREA

Four different paddy field (initially seed beds) sites and a perennial spring site in the northeast sub-urban area of Srinagar city located near the Dal lake were selected. For comparison and detailed investigation of population of the native frog another site in the rural area was also selected. The salient features of different sites included:

Site S-1: A perennial spring located in an orchard on the out skirts of Gassu village. Pesticides and fungicides were being used on the apple trees surrounding the spring.

Site S-2: Situated away from the human habitat of Gassu village receiving combined water of spring and Telbal stream. Both organic manure and chemical fertilizers were used in the paddy field.

Site S-3: This site located near Burzahama village receiving the water of Burzahama stream with domestic sewage also entering the paddy fields. Organic manure and chemical fertilizers were used.

Site S-4: A much disturbed site located near the road, school and residential houses in the village of Bhatpora-B receiving irrigation water from Telbal stream. Initially sheep yard manure was used in the seed bed but later on only chemical fertilizers were used in the paddy field.

Site S-5: This site was situated at Shalimar nearly 0.5 Km away from roadside receiving irrigation water from Sarband reservoir (Harwan).Fertilization of the site was made by both organic manure and chemical fertilizers.

Site S-6: The site was situated at a distance of about 180 Km away towards the north of Srinagar. It was located in the village of Chanipora- a rural village of tehsil Karnah, Kupwara. In whole of the area including the site fertilization was mainly made by organic manure and very less quantities of chemical fertilizers were used.

MATERIAL AND METHODS

The water samples from paddy fields and spring and soil samples only from paddy fields were collected at monthly intervals usually during first half of the month from April to August (paddy fields were dry in August). The water and soil samples were collected between 0900-1300 hours in polyethylene bottles and bags respectively.

Water samples for dissolved oxygen were collected in glass stoppered bottles of 250ml capacity and the initial fixation was carried out on the spot. Water temperature was recorded instantly at the sites while the other chemical parameters were determined in the laboratory within 24 hours of sampling. The water analysis was carried out according to standard methods (Mackreth, 1963; Golterman and Clymo, 1969; APHA, 1998).

The soil samples were air dried, grinded and then sieved to use for different parameters. The analysis was carried out according to standard methods (Hanna,1964; Gupta, 2000).

For population census of the native frog of Kashmir (*Rana cyanophlyctis*), frequent visits were made to various sites of paddy field and spring. The visits were made during the early hours of the day and at least 1 hour was spent at each site of study to observe the population density of tadpoles and frogs.

RESULTS

A. Physico-chemical features of water

The average and mean values for various physico-chemical features of paddy fields and spring water at different study sites are depicted in Table 1. The temperature of water which depends upon the exposure to solar radiation, water depth and climate, was recorded as minimum (16 ^{0}C) during April at site S-1 and maximum (27 ^{0}C) during June and July at site S-5 and S-4 respectively. The pH of the water fluctuated between 6.26 at site 6 and 8.34 at site 3 in the months of July and June respectively. The conductivity values, indication of total nutrient level ranged from minimum 150 µS cm^{-1} at site S- 6 in July to maximum 590 µS cm^{-1} at site S- 2 in July again. The dissolved oxygen value was highest (14.92 mgl^{-1}) in the month of April and lowest (2.4 mg l^{-1}) in the month of July at site S-2 and site S-1 respectively. Higher values of dissolved oxygen can be attributed to the presence of algae in the paddy fields. For free carbon dioxide, the values fluctuated between 5.4 mg l^{-1} at site S-3 in June to 36.0 mg l^{-1} at site S-1 in June again. Alkalinity which is a measure of buffering capacity of water fluctuated between 126 mgl^{-1} at site S-3 to 455 mgl^{-1} at site S-1 in the months of June and May respectively. For the chloride concentration, the values varied from 7 mgl^{-1} at site S- 6 in the month of July to 48. 30 mgl^{-1} at site S-4 in the month of April. The values of calcium fluctuated between 30.27 mgl^{-1} at site S-4 to 100.92 mgl^{-1} at site S-1 in the month of April and May respectively. The minimum values of magnesium (6.82 mgl^{-1}) were observed at site S-3 in the month of May as against the maximum 39.85 mgl^{-1} at site S-1 in the month of July. The nitrate nitrogen and total phosphate phosphorous values were observed in the months of June and July only. The values of

nitrate nitrogen varied between 203 μgl^{-1} at site S-1 to 1434 μgl^{-1} at site S 4 in the months July and June respectively. For total phosphate phosphorous the values varied from 92 μgl^{-1} in July at site S-1 to 1102 μgl^{-1} in June at site S-3.

Table 1. Physico-chemical features of different paddy field and spring sites during April to July 2002*.

Parameters			Sites					
			1	2	3	4	5	6
1	Water temp	A	21.0	23.12	22.5	24.12	23.5	NA
	(°C)	R	16-24.0	18-26.5	18.5-26.0	19.27.0	19.5-27.0	--
2	pH	A	7.06	7.70	8.09	7.70	7.13	6.26
		R	6.96-7.29	7.22-8.70	7.89-8.34	7.19-8.16	7.04-7.22	--
3	Conductivity	A	488	477.25	282	472.75	344.66	150
	($\mu S\ cm^{-1}$)	R	469-504	390-590	254-310	400-570	284-430	--
4	Dissolved	A	2.73	9.23	11.76	5.7	7.93	--
	Oxygen (mgl^{-1})	R	2.4-2.92	3.6-14.92	10.48-12.8	4.8-7.2	5.0-9.6	--
5	Free CO_2	A	18.45	12.0	6.2	16.65	12.0	
	(mgl^{-1})	R	8.0-36.0	6.0-16.0	5.4-7.0	10.0-24.0	8.0-14.0	--
6	Total	A	322.75	251.65	182.0	256.65	270.33	65.0
	Alkalinity (mgl^{-1})	R	226-455	140-436	126-214	222-298	128-412	--
7	Chloride	A	14.23	16.17	23.03	28.32	18.66	7.0
	(mgl^{-1})	R	10.33-19.0	10.0-21.60	18.5-31.6	11.0-48.3	15.0-22.0	--
8	Calcium	A	73.22	69.28	46.81	50.66	52.97	--
	(mgl^{-1})	R	45.41-100.92	48.71-85.78	42.05-49.62	30.27-60.55	47.93-61.39	--
9	Magnesium	A	25.28	24.4	11.08	31.42	16.79	--
	(mgl^{-1})	R	14.50-39.85	6.82-39.85	6.82-14.08	23.48-38.10	8.30-30.12	--
10	NO_3-N	A	24.75	1200	1103	1269.5	1237	--
	(μgl^{-1})	R	20.3-29.2	980-1420	--	1105-1434	--	--
11	TPP	A	98.5	559	1102	584	426	--
	(μgl^{-1})	R	92-105	192-926	--	416-752	--	--

A = Average R = Range NA = Not Available
*** = Paddy fields were dry in August.**

B. Physico-chemical features of the soil

The average and range values of various physico-chemical features of paddy field soils at different sites are presented in Table 2. The pH of soil fluctuated between 6.24 at site S-6 in July and 7.47 at site S-4 in August. The values of conductivity of soil suspension ranged from 200 $\mu S\ cm^{-1}$ at site S-5 to 790 $\mu S\ cm^{-1}$ at site S-4 in the months of August and

July respectively. For moisture content the values varied from 13.38% at site S-3 in the month of June to 23.99% at site S-2 in the month of June. The values of field capacity ranged between 40.84% at site S-3 to 60.93% again at site S-3 in the months April and July respectively. The values of organic matter varied from 9.53% at site S-3 to 24.76% at site S-5 in the months of April and August respectively. The total phosphate phosphorous values from soil extract fluctuated between minimum 46µg/g at site S-5 in May to maximum 4408 µg/g at site S-3 in the month of June.

Table 2. Physico-chemical features of soil samples of different paddy field sites during April to August 2002.

Parameters		Sites				
		2	3	4	5	6
1 pH	A	6.93	7.10	7.02	6.69	6.24
	R	6.70-7.25	6.84-7.40	6.50-7.47	6.28-6.99	—
2 Conductivity	A	582	420	560	382	540
(µS cm^{-1})	R	270-740	310-500	310-940	200-680	—
3 Moisture	A	17.60	14.63	16.7	16.15	19.78
content (%)	R	14.25-23.99	13.38-15.96	15.25-16.69	14.09-21.70	—
4 Field	A	52.45	48.80	53.65	55.98	58.28
Capacity (%)	R	44.38-59.40	40.84-60.93	45.24-59.53	49.59-61.42	—
5 Total organic	A	19.04	16.03	15.94	18.45	14.46
matter (%)	R	12.23-23.08	9.53-19.0	10.0-22.03	11.11-24.76	—
6 Total	A	1497.5	1625.25	871.25	167	1404
phosphorous (µg/g)	R	217-3346	182-4408	130-2442	46-363	—

A = Average **R= Range**

C. Population census of *Rana cyanophlyctis*

The population of the native frog of Kashmir was found to be quite low at almost all the sites (Table3), however, the farmers at different sites reported that previously there used to be a good number of the frog. During the period of study no tadpole or frog were seen at site S-1. However, a few tadpoles and baby frogs were seen at site S-2 which was located close to site S-1, in the months of June and July only. Site S-3 represented a comparatively good number of tadpoles during May and early June. Baby frogs were also seen in the months of June, July and August, however, adult frogs and toads were seen only in August in the irrigation canal near the site. No frog or tadpoles were seen at site S-4 throughout the course of study. In the month of August, only toads were seen in the irrigation canal near the site. Initially a good number of tadpoles were observed at site S-5 in May. A

less number of tadpoles and baby frogs were seen in the month of June which further decreased in July and in August no baby or adult frog was seen at the site. However, about half a kilometer away from site S-5, few frogs that were good in number as compared to the frogs seen at other sites, were observed in some paddy fields and irrigation canal in July. Frogs were also seen on the periphery area/ shore area of Dal lake from Nishat Bagh onward to Chesmashahi. The frogs were found in good number at site S-6 in the rural area of Karnah. Frogs were seen in almost 80% of paddy fields in the area.

Table 3. Showing population density of tadpoles, young and adult frogs and toads observed at different sites (25 m² area).

(The observations shown in the table include about 80% toads and only 20% frogs at all the sites).

MONTH		SITES					
		1	2	3	4	5	6
April	TP	—	—	—	—	—	—
	YF	—	—	—	—	—	—*
	AF	—	—	—	—	—	—
May	TP	A	A	60 – 70	A	70 – 80	NR
	YF	A	A	A	A	A	—
	AF	A	A	A	A	2	—
June	TP	A	20 – 25	20 – 25	A	30 – 35	+ 200
	YF	A	8	20 – 25	A	20 – 25	30 – 40
	AF	A	A	A	A	A	20 – 25
July	TP	A	A	A	A	A	A
	YF	A	8 – 10	20 – 25	A	10- 12	70 – 80
	AF	A	8 – 10*	A	A	A	12 –15
August	TP	A	A	A	A	A	NR
	YF	A	10 – 12	25 – 30*	A	A	—
	AF	A	A	12 – 15*	40-50**	A	—

* Found in irrigation canal near the site
** All were toads seen in irrigation canal
TP = Tadpoles YF = Young frogs/toads AF = Adult frogs/toads
A = Absent NR = Not recorded

DISCUSSION

Human activities are responsible for the global biodiversity loss. We modify our environment as per our needs. We are adding pollutants to systems on which we and other organisms depend. The need of the hour is that to study, specify and quantify the direct and indirect factors affecting the frog's population dynamics and to facilitate the mitigations of these declines of *Rana cyanophlyctis*.

From the physico-chemical analysis of water and soil samples it was found that most of the parameters except nitrogen and phosphorous were suitable for the growth of organisms. From the observation, it can be ascertained that chemical fertilizers have great negative impact on frogs. The comparatively higher levels of nitrogen and phosphorus can be attributed to the use of chemical fertilizers in paddy field. Berger *et al.*,(1998) have demonstrated that no tadpoles were found in ponds with high concentrations of NO_3–N and NH_3–N. Slauth (2000) also observed that frogs and toads especially at vulnerable larval stage could be highly susceptible to even low levels of nitrite and nitrate exposure.

Pesticides and fungicides are being extensively used on orchards in the valley of Kashmir. These pesticides can seep into water bodies and paddy fields which form amphibian habitats. Frogs breathe through skin as well as absorb water through it. Internal and external gills of young tadpoles may also be getting exposed to different types of pollutants. Haecker and Maender (2000) found that pesticides are being absorbed by frogs both in terrestrial and aquatic system, disrupting the nervous system of frogs, causing death by respiratory failure.

Frogs are carnivores and feed upon living insects. The pesticides and insecticides used to kill the insects/pests result in the reduction in availability of food for frogs and may add to the decrease in the population of frogs. Elevated levels of nitrates are also sensitive to frog's prey that is insects as has also been noted by Rouse *et al.* (1999).

The evident threat to frogs is the loss of their habitat (Anonymous, 2000). Each year more wetlands and paddy fields are drained and are converted to urban and sub-urban developments. The global climate change has also contributed to this mystery. During the past 6-7 years, the valley of Kashmir has been facing a changed weather pattern. During these years, low and untimely rainfall and snowfall has been recorded. Moreover, drier and drought like conditions especially during the breeding season of frogs have been observed. Anonymous (2002) has also pointed out that global temperature fluctuations and the resulting alteration of precipitation rates appear to play a direct role in the decline in some amphibian populations.

In conclusion it may be pointed out that the present investigation has established the fact that the population of the native frog of Kashmir (*Rana cyanophlyctis*) has declined especially in urban and sub-urban areas. Whereas, there is no single common cause for these declines as has also been reported by Anonymous, 2001, however, these effects can be attributed to the extensive use of chemical fertilizers, pesticides, herbicides, environmental factors like habitat loss and alteration, climate changes

like less rainfall and drought.

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