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Spatio-Temporal Variations in Amphibian Communities in Semi-Urban Ponds of District Panchkula

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Abstract

Surveillance studies were undertaken in the village ponds of Saketri, Shamtu, and Khangsera (district Panchkula, Haryana) to document amphibian diversity and abundance. Four species—*Duttaphrynus melanostictus*, *D. stomaticus*, *Euphlyctis cyanophlyctis*, and *Hoplobatrachus tigerinus*—belonging to the families Bufonidae and Dicroglossidae (order Anura) were recorded, all categorized as "Least Concern" on the IUCN Red List. Results showed species-specific and site-specific variations in abundance, with *D. melanostictus* dominating in Saketri and Shamtu, while *D. stomaticus* was most abundant in Khangsera. Aquatic habitats supported fewer species, with *E. cyanophlyctis* and *H. tigerinus* being the predominant forms. A decline in amphibian populations was observed from 2021 to 2022, with the highest reduction recorded in Shamtu pond (5.90% on land; 11.53% in water). The study suggests that habitat fragmentation, pond surroundings, and urbanization significantly influence amphibian assemblages.

Keywords: Abundance, anuran, diversity, frog, ponds, urbanization

Introduction

India is one of the top 13 countries in the world in terms of biodiversity (Mittermeier and Werner, 1990). Gunther (1864) gave the first systematic record of Indian amphibians, listing 37 species of anurans and two species of caecilians. There are over 8,400 species of amphibians known all over the world inhabiting freshwater habitats (Frost and Darrel 2021). There are more than 7,400 species of anurans, 770 species of urodeles and 214 species of apoda known worldwide till date. Amphibians are globally recognized as sensitive bioindicators of environmental quality due to their permeable skin, biphasic life cycle, and dependence on aquatic as well as terrestrial ecosystems. Their diversity and abundance are directly influenced by habitat quality, climatic conditions, and anthropogenic pressures. In recent decades, amphibian populations have declined worldwide, primarily due to habitat destruction, agricultural intensification, pollution, climate change, and emerging diseases. Amphibian species have particular microhabitat needs (Stebbins and Cohen 1997), and human activities have a variety of negative effects on natural environment. Many factors have been linked to the impact of pollution on amphibians, including high electrical conductance values, high concentrations of nitrates, nitrites, total phosphates, chloride and unionised soil. Low densities of egg masses, poor hatching success, low larvae survival and slow growth rates have all been linked to extreme pH values, high quantities of organochlorine and organophosphate insecticides, medicines, high levels of organic matter and low concentrations of dissolved oxygen. Pond water quality, water chemistry and water sediment are also very crucial for the amphibian occurrence and may help predict the presence of amphibians (Hecnar and M'Closkey 1996).

The district Panchkula, located in Haryana, represents a mosaic of urban settlements, agricultural fields, and forest patches. These landscapes provide varied ecological conditions for amphibians, particularly during the monsoon when temporary water bodies and increased humidity create favorable breeding environments.

Despite their ecological significance, studies on amphibian diversity in residential habitats of Panchkula remain limited.

Material and Methods

Visual Encounter Survey Method (VESM) was applied for estimating the anuran population. For estimation of individuals from rice crop fields, each plot consists of 0.4 ha area with three replications. The count of individuals from each plot was recorded from four corners and centre as five belt transects with size of each belt transect as 50×4 m. All observations were recorded at fortnight intervals (pooled at month level) from May to October months during 2021 and 2022, mostly during early morning 06:00 am to 08:00 am. Capturing of anurans from water was done using scoop net and each specimen was checked for any morphological abnormalities and was released back in their natural habitat. Anurans were identified by using respective identification keys Daniel and Seakar (1989), Daniel (2005) and from ZSI (Zoological Survey of India). Different indices like Simpson's index, Shannon-Weiner index, species evenness and species richness were calculated. Different soil parameters (electrical conductivity, soil pH and organic carbon) were determined using standard methods. Water pH was determined by using portable digital pH meter for the water samples collected from village ponds of district Panchkula.

Results and Discussion

The present study revealed spatio-temporal variations in amphibian abundance and diversity across the three selected village ponds of district Panchkula. A total of four species were recorded, namely *Duttaphrynus melanostictus, D. stomaticus, Euphlyctis cyanophlyctis,* and *Hoplobatrachus tigerinus* belonged to order anura and families bufonidae and dicroglossidae with least concern status (Table 1).
In Saketri pond, all four species were recorded. On land, *D. melanostictus* was most abundant in 2021, while *H. tigerinus* dominated in water. In 2022, *D. melanostictus* and *D. stomaticus* showed nearly equal abundance on land, whereas *H. tigerinus* remained most abundant in water. A decline of 5.68% (land) and 1.97% (water) was observed. In Shamtu pond, only three species (*D. melanostictus, D. stomaticus,* and *E. cyanophlyctis*) were present, with no record of *H. tigerinus*. *D. melanostictus* dominated land habitats, while *E. cyanophlyctis* was the only aquatic species. Populations declined by 5.90% (land) and 11.53% (water) in 2022. In Khangsera pond, all four species occurred. *D. stomaticus* was most abundant on land, while *E. cyanophlyctis* and *H. tigerinus* dominated in water. A decline of 3.30% (land) and 2.95% (water) was recorded in 2022.
Among the three selected village ponds of district Panchkula, village pond of Khangsera showed the maximum amphibian abundance on land (8.03 individuals) as well as in water (2.75 individuals) as compared to Saketri and Shamtu during both years. Village pond of Shamtu showed maximum decrease in population as compared to other two village ponds. Amphibian assemblages varied distinctly between terrestrial and aquatic habitats. While *D. melanostictus* and *D. stomaticus* dominated terrestrial habitats, *E. cyanophlyctis* and *H. tigerinus* were more common in aquatic environments. This pattern is ecologically significant, as terrestrial species exploit upland habitats for foraging and shelter, while semi-aquatic forms depend on ponds for breeding and feeding. The consistently higher abundance of terrestrial species indicates that semi-urbanized ponds may not fully support the ecological requirements of amphibians with stronger aquatic dependency.
The decline in abundance between 2021 and 2022, though moderate in Saketri (5.68% on land; 1.97% in water) and Khangsera (3.30% on land; 2.95% in water), was pronounced in Shamtu (5.90% on land; 11.53% in water). The total amphibian population observed in water was 67.80% less than on land as there were only two aquatic amphibian species while on land two species were terrestrial and two were semi-aquatic
This may be attributed to higher levels of disturbance, road encroachment, and reduced connectivity between aquatic and terrestrial habitats, preventing amphibians from completing their life cycles. The decrease in amphibian abundance may be related surrounding of ponds by roads and and other urban infrastructure separating aquatic and terrestrial habitats due to which amphibian are unable to complete their life cycles (Hamer & McDonnell, 2008). Hamer *et al* (2004) suggested negative relationship between urbanisation and amphibian species richness, abundance and community structure. Krishnamurthy (2003) also suggested that how anthropogenic activities affected the distribution of various amphibians among disturbed and undisturbed habitats and related the uneven distribution of vulnerable amphibian species with human activities. Calderon *et al* (2019) examined the combined effects of habitat degradation and poor water quality on amphibian assemblages in rivers impacted by urban development in San Luis Province, Argentina. Amphibian species richness and abundance were found to be positively correlated with HMA (habitat model affinity), electrical conductivity, and dissolved oxygen, and negatively correlated with phosphate, nitrate concentrations, and total

coliforms. The number of species was also significantly impacted by water turbidity. Within-pond vegetation can have an impact on amphibian population sizes in natural environments. This vegetation produces complex microhabitats that act as an anchorage for developing larvae and attachment sites for egg masses (Formanowicz and Bobka 1989; Seale 1982). Furthermore, the canopy cover above breeding ponds can also have an impact on the composition of frog communities (Werner and Glennemeir 1999). Egan *et al* (2004) assessed the impact of hydroperiod, within-pond vegetation, canopy closure, hydrologic isolation, fish occurrence and pond size on egg mass counts of wood frogs and spotted salamanders in ponds of Western Rhode Island. The annual breeding effort was significantly influenced by hydroperiod.

Study of soil and water parameters in village ponds

Soil and water quality play a crucial role in shaping amphibian communities. In the present study, soil pH ranged from 8.43–8.46, indicating slightly alkaline conditions, whereas water pH ranged from 7.35–7.65, reflecting near-neutral conditions more favorable for amphibian breeding. Dissolved oxygen (5.31–5.39 mg/L) was within the optimal range for amphibian eggs and larvae, although even slight reductions could affect embryonic development. Organic carbon levels (0.72–0.74%) and electrical conductivity (72.87–81.75 µs/mm) suggest moderate fertility and nutrient status of the ponds, which may influence primary productivity and, consequently, prey availability.

Conclusion

Terrestrial habitats supported greater species richness and abundance than aquatic habitats, where only two semi-aquatic species persisted. Among the three ponds, Khangsera supported the highest amphibian abundance, while Shamtu showed the greatest decline, likely due to habitat fragmentation and urban infrastructure encroachment. The findings emphasize that even common and widespread species may be vulnerable to anthropogenic pressures in semi-urban landscapes. Continuous monitoring, coupled with habitat management, is recommended to ensure the persistence of amphibian populations and to safeguard their ecological role in regulating pest populations and maintaining ecosystem balance.

Table 1: Inventory of amphibian species recorded in village ponds of district Panchkula

S.No.	Common name	Scientific name	Family	Order	IUCN status
1.	Common Asian toad	*Duttaphrynus melanostictus* (Schneider 1799)	Bufonidae	Anura	Least concern
2.	Indian marble toad	*Duttaphrynus stomaticus* (Lütken 1864)	Bufonidae	Anura	Least concern
3.	Indian skittering frog	*Euphlyctis cyanophlyctis* (Schneider 1799)	Dicroglossidae	Anura	Least concern
4.	Indian bull frog	*Hoplobatrachus tigerinus* (Daudin 1802)	Dicroglossidae	Anura	Least concern

Table 2: Comparison of mean amphibian population in village ponds of district Panchkula

S.No.	Villages	2021	2022	Mean	% Population (decrease)	Total mean	Overall % decrease in population
On land							
1.	Saketri	7.21	6.80	7.00	5.68	6.71	---
2.	Shamtu	5.25	4.94	5.09	5.90		
3.	Khangsera	8.17	7.90	8.03	3.30		

In water							
4.	Saketri	2.53	2.48	2.50	1.97	2.16	67.80
5.	Shamtu	1.30	1.15	1.22	11.53		
6.	Khangsera	2.79	2.71	2.75	2.95		

Table 3: Soil parameters in village ponds of district Panchkula

S.No.	Villages	pH			EC (µs/mm)			OC (%)		
		2021	2022	Mean	2021	2022	Mean	2021	2022	Mean
1.	Saketri	8.42	8.50	**8.46**^{a}	74.48	77.28	**75.88**^{a}	0.74	0.74	**0.74**^{ab}
2.	Shamtu	8.30	8.56	**8.43**^{a}	81.97	81.54	**81.75**^{a}	0.75	0.77	**0.76**^{b}
3.	Khangsera	8.55	8.52	**8.53**^{a}	77.59	68.15	**72.87**^{a}	0.73	0.71	**0.72**^{a}
4.	**Mean**			**8.47**			**76.83**			**0.74**

Table 4: Water parameters in village ponds of district Panchkula

S.No.	Villages	pH			DO (mg/l)		
		2021	2022	Mean	2021	2022	Mean
1.	**Saketri**	7.4	7.3	**7.35**^{a}	5.31	5.31	**5.31**^{a}
2.	**Shamtu**	7.7	7.6	**7.65**^{b}	5.41	5.38	**5.39**^{a}
3.	**Khangsera**	7.5	7.4	**7.45**^{ab}	5.45	5.33	**5.40**^{a}
4.	**Mean**			**7.48**			**5.36**

References:

1. Mittermeier R A and Werner T B (1990) Wealth of plants and animals unites megadiversity countries. *Tropicus* **4**(1): 4-5.
2. Gunther A C (1864) The reptiles of British India. *London: Ray Society by* R. Hardwicke pp: 1-26.
3. Frost and Darrel R (2021) Amphibian Species of the World: An Online Reference.
4. Hecnar S J and McCloskey R T (1997) Spatial scale and determination of species status of the green frog. *Conserv Biol* **11**: 670-82.
5. Stebbins R C and Cohen N W (1997) A Natural History of Amphibians. Princeton university Press, Princeton.
6. Daniel J C (1963) Field guide to amphibians of western India - Part I *J Bombay Nat Hist Soc* **60**: 415-38.
7. Daniel J C and Sekar A G (1989) Field guide to amphibians of western India- Part IV. *J Bombay Nat Hist Soc* **86**: 194-202.
8. Hamer A J and McDonnell M J (2008) Amphibian ecology and conservation in the urbanizing world: A Review. *Biol Conserv* **141**: 2432-49.
9. Hamer A J, Makings J A, Lane S J, Mahony M J (2004) Amphibian decline and fertilizers used on agricultural land in south-eastern Australia. *Agricu Ecosyst Environ* **102**: 299-305.
10. Krishnamurthy S V (2003) Amphibian assemblages in undisturbed and disturbed areas of Kudremukh National Park, central Western Ghats, India. *Environ Conserv* **30**(3): 274-82.
11. Calderon M R, Almeida C A, González P, Jofré B M (2019) Influence of water quality and habitat conditions on amphibian community metrics in rivers affected by urban activity. *Urban ecosyst* **22**: 743-55.
12. Formanowicz DR Jr and Bobka M S (1989) Predation risk and microhabitat preference: an experimental study of the behavioral responses of prey and predator. *Am Midl Nat* **121**: 379-86.
13. Egan R S and Paton P W C (2004) Within-pond parameters affecting oviposition by wood frogs and spotted salamanders. *Wetlands* **24**: 1-13.
14. Seale D B (1982) Physical factors influencing oviposition by the wood frog, *Rana sylvatica*, in Pennsylvania. *Copeia* **(3)**: 627-35.
15. Werner E E and Glennemeier K S (1999) Influence of forest canopy cover on breeding pond distributions of several amphibian species. *Copeia* **9**:1-12.