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ABUNDANCE AND DIVERSITY OF ANURANS IN RESIDENTIAL AREAS OF LUDHIANA AND PANCHKULA

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ABSTRACT

In the present study, abundance and diversity of anurans was recorded from residential areas of Ludhiana (Punjab) and Panchkula (Haryana) for 2021 and 2022. From both locations, three anuran species were recorded which included *Duttaphrynus melanostictus*, *D. stomaticus* and *Hoplobatrachus tigerinus*, belonged to order anura, families bufonidae and dicroglossidae. Among district Ludhiana, residential areas of village Barewal Dogran (4.90 individuals) showed maximum anuran abundance as compared to Sherpur (4.14 individuals) and Ladhowal (3.90 individuals). However, in Panchkula, village Maheshpur (4.87 individuals) showed the maximum abundance as compared to villages Railly (4.06 individuals) and Sector-26 Extension (4.32 individuals). Interestingly, 7.95% and 6.30% increase in anuran population was recorded from residential areas of district Ludhiana and Panchkula, respectively during 2022 as compared to previous year. Overall, residential areas of district Panchkula were recorded to be 2.32% more abundant as compared to district Ludhiana. Among three species, *H. tigerinus* was found to be heaviest in body weight (226.2-272.2 g), whereas *D. melanostictus* was lightest one (7.24-7.93 g). The mean body weight of *D. melanostictus*, *D. stomaticus* and *H. tigerinus* males and females recorded ranged from 7.24-7.93, 7.91-8.67 and 226.2-272.2 g, respectively. A positive correlation was found between anuran population with atmospheric temperature (˚C), relative humidity (%) and rainfall (mm) r = (+0.28 to +0.91) among both districts. However, among all weather parameters, a strong correlation was found between anuran population and relative humidity (+0.82 to +0.91). This data may be used by researchers or researchers for the benefit of anuran conservation programmes.

KEY WORDS: Abundance and Diversity, Anurans, Residential

INTRODUCTION

Amphibians are the fascinating first group of vertebrates which can breathe air on land and water (Frost *et al.* 2008). The existing modern lineage of amphibia, belonged to subclass Lissamphibia (Duellman and Trueb, 1994) which further has three orders: urodela or caudata (the salamanders and newts), anura (frogs and toads) and apoda or gymnophiona (caecilians). In India, 447 species of amphibians are known (5.2% of global amphibian species), out of which only one species of newt i.e Himalayan Newt (*Tylototriton verrucosus*), 38 species of caecilians and more than 50% of anurans are known. Amphibian have adapted to utilize different types of habitats like agricultural land, forests, woodlots, meadows, springs, bogs, marshes, swamps, water bodies, wetlands and scrublands for their survival. Their distribution range across habitats is affected by various environmental factors like rainfall, food (insects), moisture and human interference. Habitat modification is the key factor contributing to amphibian declines globally with an estimated 63% of all amphibian species affected, and 87% of the threatened amphibian species affected (Chanson *et al.*, 2008). The most common habitat modifications include clearance for crops, urbanization and industrial development. Hamer and McDonnell (2008) suggested negative relationship between urbanisation and amphibian

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species richness, abundance and community structure. Also, amphibians require more than one habitat for the completion of their life cycle, forests and grasslands (for feeding), water bodies (for breeding) and land (corridors). Habitat fragmentation leads to decrease in larval dispersal and genetic diversity (Gibbs, 1998; Reh and Seitz, 1990) and increase in mortality (Fahrig *et al.,* 1995). Davidson *et al.* (2002) reported that habitat destruction due to urbanization has significantly contributed to the decline of California red-legged frog (*Ranadraytonii*), whereas *Xenopusgilli* has lost 60% breeding sites in South Africa due to its wetland habitat loss.While working on conservation strategies, the habitats, distribution, abundance and ecology of various rare larger wild animals have been reported; however, such information is limited in case of amphibians. There is need for the precise understanding of their home ranges and habitat requirements which will help to plan various conservation strategies for the amphibians. In the current study, the abundance and diversity of amphibians were recorded from selected residential areas of three selected villages each from districts Ludhiana (Punjab) and Panchkula (Haryana) in relation to anthropogenic activities and habitat degradation.

MATERIALS AND METHODS

Study area

The present study was carried out at residential areas from six selected villages three from each districts Ludhiana (Punjab) and Panchkula (Haryana), respectively during 2021 and 2022. Ludhiana is the largest district located in the central region of the state Punjab between the coordinates 30.9010° N and 75.8573° E. The climate of Ludhiana is tropical steppe, hot and semi-arid, with very hot summers and chilly winters except during the monsoon season, when moist air of oceanic origin penetrates the district. The temperature varies between 5-18°C in winter and 20-46 °C in summers with average annual temperature of 23.5°C. The average annual rainfall is 680 mm, which is irregularly spread over the territory in 35 days. The south-west monsoon, which arrives in the last week of June and departs towards the end of September, accounts for around 78% of yearly rainfall. Panchkula is a well-planned city in the state of Haryana between the coordinates 30.6942° N and 76.8606° E. The average annual temperature of Panchkula ranges between 6.1-39.1°C. The average annual rainfall is 1057 mm, which is irregularly spread over the territory in 50 days. The south-west monsoon, which arrives in the last week of June till the end of September, accounts for around 86% of yearly rainfall. The three selected villages from district Ludhiana included Sherpur Kalan (30.8426° N, 75.4490° E), Ladhowal (30.9785° N, 75.7938° E) and Barewal Dogran (30.9644° N, 75.7854° E) and from district Panchkula included Railly (30.6776° N, 76.8521° E), Maheshpur (30.6812° N, 76.8642° E) and Sector 26-Extension (30.6611° N, 76.8822° E), respectively.

Sampling of amphibians

Visual Encounter Survey Method (VESM) was applied for estimating the anuran population (Heyer 1994) from residential areas of selected villages of district Ludhiana (Punjab) and Panchkula (Haryana). Each count of individuals was recorded from an area of a belt transect of size 50×4 m and there were three replications. All observations were recorded at fortnight intervals (pooled at month level) from May to October months during the years 2021 and 2022. In the selected locations, anuran samplings were conducted by active searching and walking in all suitable niches of anurans like wood logs, under stones and leaf litters and including the breeding sites, mostly in the early morning hours from 06:00 am to 08:00 am.

Study of amphibian diversity

During sampling, the total number of individuals of each species was counted. Collected samples were cleaned to study morphometric measurements (Guenette *et al.,* 2007). Photographs of observed anurans were taken and also measured for their Snout-Vent Length (mm). To avoid destroying the natural ecosystem, safety measures were adopted during the survey. To prevent any contamination from microorganisms, hand gloves were tightly worn while handling the samples. To study body weight and other morphometric measurements, a total 20 mature males and 20 mature females of available amphibian species/month/site were selected. Body weight (g) was measured using an electronic weighing balance (Kerro® BL-P1D/20001) and morphometric measurements (mm) were taken using a digital vernier calliper (Themisto® TH-M61) which included HL= Head length (from back of mandible to tip of snout) (mm), HW= Head width (left side back of mandible to right side back of mandible) (mm), HD= Head depth at angle of jaw (depth of head at angle of jaw) (mm), SL= Snout length (distance between anterior comer of eye to the tip of the snout) (mm), EN= Eye to nostril distance (distance between anterior point of eye and nostril) (mm), NS= Nostril to snout distance (distance between anterior point of nostril to tip of the snout) (mm) and ED= Eye diameter (mm). Each anuran individual was checked for any morphological abnormality, photographed for identification and was released back in their natural habitat anurans were identified by using their respective identification keys and from ZSI (Zoological Survey of India, Kolkata). Different indices like Simpson's index, Shannon-Weiner index, species evenness and species richness were calculated.

Atmospheric temperature (°C), rainfall (mm) and relative humidity (%) were taken from Department of Climate Change & Agricultural Meteorology, PAU, Ludhiana and KVK, Panchkula (Haryana), respectively. The correlation of weather parameters with anuran population from selected villages of district Ludhiana (Punjab) and district Panchkula (Haryana) was calculated.

Statistical analysis

For anuran diversity, body weight, morphometric measurements the data were analyzed using Mean ± S.D., ANOVA with Tukey's test with p value = 0.05. Different indices like Shannon-Weiner diversity index, species evenness, species richness and Simpson's index were calculated using different formulae. Correlation coefficient was calculated to find relation between amphibian population and atmospheric temperature (^{0}C), rainfall (mm) and relative humidity (%).

RESULTS

Interestingly, during surveillance from six selected study areas (three from Ludhiana and Panchkula districts each) only three anuran species were recorded which included *Duttaphrynus melanostictus*, *D. Stomaticus* and *Hoplobatrachus tigerinus*, which belonged to order anura and families bufonidae and dicroglossidae and have least concern status as per IUCN list. Among the three selected residential areas of district Ludhiana, village Barewal Dogran (4.90 individuals) showed the maximum amphibian abundance as compared to Sherpur (4.14 individuals) and Ladhowal (3.90 individuals), respectively during both years (2021 and 2022). Among the three selected residential areas of district Panchkula, village Maheshpur (4.87 individuals) showed the maximum amphibian abundance as compared to villages Railly (4.06 individuals) and Sector-26 Extension (4.32 individuals). The incidence of anurans was recorded during the month of May and the last observation was recorded in the month of October. Analysis of monthly differences of amphibian abundance at all study sites showed the highest peak in abundance during July and August months as these months receive maximum precipitation (rainfall) in Punjab and Haryana that leads to congenial environmental conditions for the survival and reproduction of anurans.

In all the selected residential areas of district Ludhiana, among the three species, *H. tigerinus* was found to be heaviest in body weight (g) (226.2±9.98-263.7±14.43), whereas body weight (g) of *D. melanostictus* was found to be the lightest (7.24±0.15-7.88±0.32). The mean body weight of *D. melanostictus* males and females recorded ranged from 7.24 and 7.75-7.88 during 2021 and 2022, respectively. Similarly, the mean body weight of *D.*

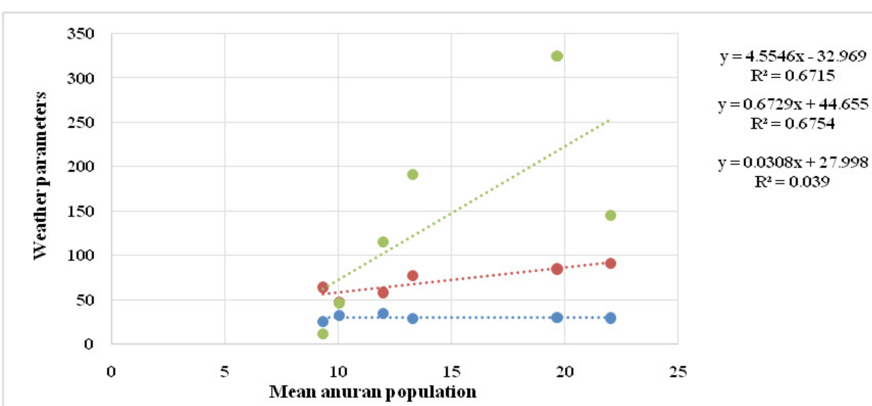

Fig. 1. Correlation of anuran population with different weather parameters of district Ludhiana

stomaticus and *H. tigerinus* males and females recorded ranged from 7.91-7.98 and 8.54-8.67; 226.2-228.1 and 262.6-263.7 during 2021 and 2022, respectively (Table 3). The area wise analysis also revealed smaller individuals in Sherpur as compared to Ladhowal and Barewal Dogran. The SVL, HL: SVL, HL: HW, HL: HD, SL: HL, SL: SVL, EN: NS, EN: HL, ED: SVL and EN:NS ratios were recorded in the range from 38.88-111.01, 0.25-36.65, 0.66-0.77, 1.08-1.35, 0.39-0.48, 0.11-0.13, 0.85-1.26, 0.16-0.20, 0.08-0.13 and 1.13-1.51 mm in males and 48.16-138.12, 0.30-44.38, 0.71-0.81, 1.24-1.48, 0.47-0.55, 0.15-0.19, 0.92-1.38, 0.21-0.27, 0.13-0.20 and 1.17-1.63 mm in females, respectively (Table 5). Similarly, in district Panchkula, among the three species, *H. tigerinus* was found to be heaviest (230.6±22.81-272.2±16.46), whereas body weight (g) of *D. melanostictus* was found to be the lightest (7.27±0.14-7.93±0.24). The mean body weight (g) of *D. melanostictus* males and females recorded ranged from 7.27-7.34, and 7.89-7.93 during 2021 and 2022, respectively. Similarly, the mean body weight of *D. stomaticus* and *H. tigerinus* males and females recorded ranged from 7.92-7.93 and 8.42-8.52; 230.6-234.6 and 272.1-272.2 during 2021 and 2022, respectively (Table 4). The area wise analysis also revealed smaller individuals in village Railly as compared to other two village of Maheshpur and Sector-26 Extension. The SVL, HL: SVL, HL: HW, HL: HD, SL: HL, SL: SVL, EN: NS, EN: HL, ED: HL,

Table 1. Inventory of anuran species recorded in residential areas of district Ludhiana and Panchkula

S.No	Common name	Scientific name	Family	Habitat preferences	Order	IUCN status
1.	Common Asian toad	*Duttaphrynus melanostictus* (Schneider, 1799)	Bufonidae	Dry and wet terrestrial areas, human habitation, road side	Anura	Least concern
2.	Indian marble toad	*Duttaphrynus stomaticus* (Lütken, 1864)	Bufonidae	Terrestrial areas, human habitation, leaf litter, wooden log	Anura	Least concern
3.	Indian bull frog	*Hoplobatrachustigerinus* (Daudin, 1802)	Dicroglossidae	Water bodies, ditch, drain, pool, human habitation	Anura	Least concern

Table 2. Comparison of mean anuran population in residential areas of district Ludhiana and Panchkula

S. No.	Villages of district Ludhiana	Mean population	%Population (increase)	Villages of district Panchkula	Mean population	%Population (increase)
1.	Sherpur	4.14	6.73	Railly	4.06	4.09
2.	Ladhowal	3.90	7.44	Maheshpur	4.87	5.91
3.	Barewal Dogran	4.90	9.40	Sector-26 Extension	4.32	8.93

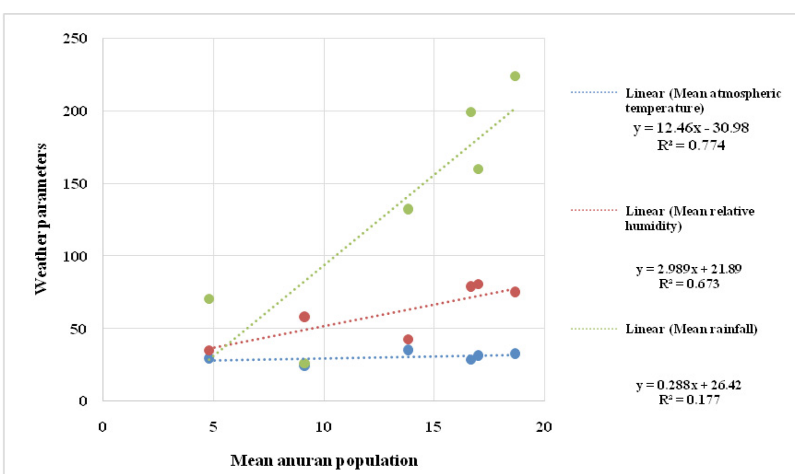

Fig. 2. Correlation of anuran population with different weather parameters of district Panchkula

Table 3. Body weight (g) of anuran species recorded in residential areas of district Ludhiana during 2021 and 2022

S. No.	Anuran species	2021							
		Sherpur		Ladhowal		BarewalDogran		Total (mean)	
		Male	Female	Male	Female	Male	Female	Male	Female
1.	*Duttaphrynus melanostictus*	7.05±1.22	8.35±1.01	7.25±1.11.	7.65±1.19	7.44±1.12	7.65±1.35	7.24±0.15^{a}	7.88±0.32^{a}
2.	*Duttaphrynus stomaticus*	8.10±1.15	8.58±1.20	7.31±1.13	8.49±1.16	8.34±1.05	8.95±1.14	7.91±0.44^{a}	8.67±0.19^{a}
3.	*Hoplobatrachus tigerinus*	207.1±1.10	254.8±1.13	221.7±1.05	256.3±1.22	255.5±1.15	276.7±1.27	228.1±20.27^{b}	2.6±9.98^{c}
		2022							
4.	*Duttaphrynus melanostictus*	7.07±1.02	8.15±1.11	7.38±1.21	7.56±1.39	7.29±1.22	7.55±1.05	7.24±0.13^{a}	7.75±0.28^{a}
5.	*Duttaphrynus stomaticus*	8.15±1.25	8.48±1.25	7.37±1.03	8.39±1.06	8.44±1.25	8.75±1.34	7.98±0.45^{a}	8.54±0.15^{a}
6.	*Hoplobatrachus tigerinus*	201.1±1.02	244.8±1.23	231.7±1.04	266.6±1.02	245.9±1.25	279.8±1.17	226.2±18.69^{b}	63.7±14.43^{c}

Table 4. Body weight (g) of anuran species recorded in residential areas of district Panchkula

S. No.	Anuran species	2021							
		Railly		Maheshpur		Sector-26 Extension		Total (mean)	
		Male	Female	Male	Female	Male	Female	Male	Female
1.	*Duttaphrynus melanostictus*	7.14±1.12	8.27±1.21	7.35±1.01	7.77±1.29	7.54±1.02	7.75±1.05	7.34±0.16^{a}	7.93±0.24^{a}
2.	*Duttaphrynus stomaticus*	8.08±1.25	8.38±1.02	7.41±1.31	8.59±1.26	8.27±1.15	8.59±1.24	7.92±0.36^{a}	8.52±0.09^{a}
3.	*Hoplobatrachus tigerinus*	211.7±1.04	267.3±1.31	217.4±1.15	265.4±1.12	262.7±1.25	283.7±1.07	230.6±22.81^{b}	272.1±8.21^{c}
		2022							
4.	*Duttaphrynus melanostictus*	7.19±1.12	8.37±1.18	7.15±1.10	7.47±1.19	7.47±1.22	7.85±1.25	7.27±0.14^{a}	7.89±0.36^{a}
5.	*Duttaphrynus stomaticus*	8.03±1.05	8.28±1.22	7.47±1.11	8.49±1.16	8.31±1.05	8.49±1.14	7.93±0.34^{a}	8.42±0.09^{a}
6.	*Hoplobatrachus tigerinus*	217.9±1.14	253.4±1.11	227.5±1.25	269.7±1.22	258.6±1.15	293.5±1.24	234.6±17.37^{b}	272.2±16.46^{c}

ED: SVL and ED: EN ratios were recorded in the range from 37.62-109.07, 0.23-35.15, 0.67-0.75, 1.10-1.32, 0.41-0.46, 0.11-0.14, 0.84-1.24, 0.16-0.18, 0.07-0.11, 1.11-1.46 mm in males and 46.23-136.20, 0.28-42.18, 0.67-0.79, 1.22-1.46, 0.45-0.55, 0.13-0.17, 0.90-1.36, 0.19-24, 0.11-0.17 and 1.14-1.60 mm in females, respectively (Table 6).

Relation with weather parameters

A positive correlation was found between anuran population with atmospheric temperature (°C), relative humidity (%) and rainfall (mm) by determining correlation coefficient values which ranged from r = (+0.28-0.42), (+0.82-0.91) and (+0.46-0.88) among both districts. Among all weather parameters, a strong correlation was found between anuran population and relative humidity.

DISCUSSION

The current study was an attempt to understand anuran abundance and richness within selected residential areas in two districts. The result of this study clearly indicates that the difference in habitat surroundings and urbanisation had a significant effect on the species richness and abundance of anurans. In Ludhiana, maximum per cent increase in anuran population during 2022 was recorded in village Barewal Dogran (9.40%) followed by Ladhowal (7.44%) and Sherpur (6.73%). The reason could be that residential areas of Barewal Dogran were surrounded by rice fields from two sides which could have act as source of food (insects) and breeding sites for the anurans which leads to more diversity. Anuran species have particular microhabitat needs (Stebbins and Cohen, 1997) and human activities have a variety of negative effects on natural environment. The best landscape predictors of anuran occurrence were found to be the type of terrestrial habitat surrounding breeding habitats and aquatic vegetation. However, in Panchkula, the maximum per cent increase in anuran population during 2022 was recorded in Sector-26 Extension (8.93%) followed by Maheshpur (5.91%) and Railly (4.27%). The reason could be that residential areas of Sector-26 Extension were surrounded by rice fields and forest area which could have act as source of food and breeding sites for the anurans hence more the diversity than other two villages. Urban development and traffic have been observed to impact negatively on the anuran population even at great distances from their breeding sites. Environmental cues like temperature, moisture or the timing and amount of precipitation are the main components that affect amphibian phenology directly. Inadequate rainfall, extreme drought and shortened hydro periods have all been linked to a decrease in anuran calling activity, catastrophic reproductive failure in many pond-breeding amphibians, metamorphosis at smaller body sizes, the potential local elimination of paedomorphosis in salamanders and local extinctions. Climate change and other changes in the environment that are global in nature have been recognized as potential problems for amphibian populations. Pounds *et al* (2006) provided an illustration of the intricate linkages between frog population losses and changes in the ecosystem at large scale. Overall amphibian declines canbe directly associated with landscape structural changes like decrease in wetland area and density, increase in wetland isolation, decrease in wetland vegetation, forest cover and terrestrial habitat (Lehtinen *et al.,* 1999).

Table 5. Morphometric parameters (mm) of different body parts of anuran species recorded in residential areas of district Ludhiana during 2021 and 2022

S. No.	Morphometric parameters	*Duttaphrynusmelanostictus* Male	*Duttaphrynusmelanostictus* Female	*Duttaphrynusstomaticus* Male	*Duttaphrynusstomaticus* Female	*Hoplobatrachustigerinus* Male	*Hoplobatrachustigerinus* Female
1.	SVL	38.88 ± 1.55^{a}	48.16 ± 2.18^{a}	41.09 ± 2.47^{a}	51.64 ± 2.64^{a}	111.01 ± 2.34^{b}	138.12 ± 2.13^{b}
2.	HL: SVL	0.25 ± 0.02^{a}	0.30 ± 0.01^{a}	0.28 ± 0.02^{a}	0.34 ± 0.02^{a}	36.65 ± 2.70^{b}	44.38 ± 2.61^{b}
3.	HL: HW	0.66 ± 0.02^{a}	0.71 ± 0.02^{a}	0.70 ± 0.03^{a}	0.77 ± 0.02^{b}	0.77 ± 0.02^{b}	0.81 ± 0.01^{c}
4.	HL: HD	1.08 ± 0.02^{a}	1.24 ± 0.01^{a}	1.23 ± 0.05^{b}	1.29 ± 0.04^{b}	1.35 ± 0.03^{c}	1.48 ± 0.06^{b}
5.	SL: HL	0.39 ± 0.02^{a}	0.47 ± 0.01^{a}	0.45 ± 0.03^{b}	0.55 ± 0.02^{a}	0.48 ± 0.03^{b}	0.56 ± 0.01^{b}
6.	SL: S VL	0.11 ± 0.01^{a}	0.15 ± 0.01^{a}	0.13 ± 0.03^{a}	0.19 ± 0.02^{b}	0.13 ± 0.01^{a}	0.17 ± 0.01^{c}
7.	EN: NS	1.18 ± 0.03^{a}	1.29 ± 0.03^{a}	1.26 ± 0.08^{b}	1.38 ± 0.03^{a}	0.85 ± 0.03^{b}	0.92 ± 0.02^{b}
8.	EN: HL	0.16 ± 0.02^{a}	0.21 ± 0.02^{a}	0.20 ± 0.04^{a}	0.27 ± 0.02^{b}	0.19 ± 0.04^{a}	0.27 ± 0.04^{c}
9.	ED: HL	0.34 ± 0.02^{a}	0.40 ± 0.02^{a}	0.39 ± 0.03^{b}	0.46 ± 0.01^{b}	0.24 ± 0.04^{b}	0.31 ± 0.04^{c}
10.	ED:SL	0.75 ± 0.03^{a}	0.84 ± 0.01^{a}	0.82 ± 0.03^{b}	0.90 ± 0.03^{a}	0.47 ± 0.03^{c}	0.54 ± 0.03^{b}
11.	ED: SVL	0.09 ± 0.01^{a}	0.14 ± 0.02^{a}	0.13 ± 0.01^{a}	0.20 ± 0.02^{b}	0.08 ± 0.02^{b}	$0.13\pm.02^{a}$
12.	ED: EN	1.29 ± 0.05^{a}	1.39 ± 0.02^{a}	1.51 ± 0.06^{b}	1.63 ± 0.04^{b}	1.13 ± 0.03^{c}	1.17 ± 0.03^{c}

Table 6. Morphometric parameters (mm) of different body parts of anuran species recorded in residential areas of district Panchkula during 2021 and 2022

S. No.	Morphometric parameters	*Duttaphrynusmelanostictus* Male	*Duttaphrynusmelanostictus* Female	*Duttaphrynusstomaticus* Male	*Duttaphrynusstomaticus* Female	*Hoplobatrachustigerinus* Male	*Hoplobatrachustigerinus* Female
1.	SVL	37.62 ± 1.71^{a}	46.23 ± 2.22^{a}	39.01 ± 2.31^{a}	49.56 ± 2.33^{a}	109.07 ± 2.24^{b}	$136.20\pm.232^{b}$
2.	HL: SVL	0.23 ± 0.02^{a}	0.28 ± 0.02^{a}	0.26 ± 0.02^{a}	0.31 ± 0.02^{a}	35.15 ± 2.60^{b}	42.18 ± 2.83^{b}
3.	HL: HW	0.67 ± 0.03^{a}	0.67 ± 0.02^{a}	0.67 ± 0.03^{a}	0.74 ± 0.03^{b}	0.75 ± 0.02^{b}	0.79 ± 0.02^{c}
4.	HL: HD	1.10 ± 0.02^{a}	1.22 ± 0.01^{a}	1.20 ± 0.05^{b}	1.23 ± 0.02^{a}	1.32 ± 0.04^{c}	1.46 ± 0.05^{b}
5.	SL: HL	0.41 ± 0.02^{a}	0.45 ± 0.009^{a}	0.43 ± 0.03^{ab}	0.51 ± 0.02^{a}	0.46 ± 0.02^{b}	0.55 ± 0.02^{b}
6.	SL: SVL	0.11 ± 0.01^{a}	0.13 ± 0.02^{a}	0.14 ± 0.02^{a}	0.17 ± 0.03^{b}	0.13 ± 0.01^{a}	0.15 ± 0.01^{a}
7.	EN: NS	1.21 ± 0.04^{b}	1.26 ± 0.03^{b}	1.24 ± 0.09^{b}	1.36 ± 0.03^{c}	0.84 ± 0.04^{a}	0.90 ± 0.02^{a}
8.	EN: HL	0.18 ± 0.02^{a}	0.19 ± 0.02^{a}	0.17 ± 0.05^{a}	0.24 ± 0.03^{a}	0.16 ± 0.04^{a}	0.24 ± 0.05^{a}
9.	ED: HL	0.34 ± 0.03^{b}	0.38 ± 0.01^{b}	0.36 ± 0.03^{b}	0.42 ± 0.02^{b}	0.23 ± 0.04^{a}	0.27 ± 0.05^{a}
10.	ED: SL	0.74 ± 0.03^{b}	0.81 ± 0.01^{b}	0.80 ± 0.03^{c}	0.88 ± 0.02^{c}	0.45 ± 0.04^{a}	0.50 ± 0.03^{a}
11.	ED: SVL	0.08 ± 0.01^{a}	0.13 ± 0.01^{a}	0.11 ± 0.01^{b}	0.17 ± 0.03^{b}	0.07 ± 0.02^{a}	0.11 ± 0.01^{a}
12.	ED: EN	1.26 ± 0.06^{b}	1.37 ± 0.03^{b}	1.46 ± 0.06^{c}	1.60 ± 0.05^{c}	1.11 ± 0.02^{a}	1.14 ± 0.02^{a}

CONCLUSION

Our study is the first account about the anuran diversity and abundance in residential areas of districts Ludhiana (Punjab) and Panchkula (Haryana). Our findings further highlight the significance of urban habitats that feature vegetation cover and encourage the establishment of temporary water bodies in providing optimal breeding habitats for amphibian species. The water bodies (ponds and wetlands) restoration and re-establishment of habitat corridors should be encouraged. Long-term research could give light on the effects of urbanisation on the key population parameters of amphibians.

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