Exploring the Diversity and Habitat Preferences of Anuran Species in Sohagibarwa Wildlife Sanctuary

Abstract: Despite the widespread recognition of protected area coverage and the need of conserving iconic species, non-charismatic species, like anurans, are mostly ignored by conservation initiatives and regulations. The expansion of agriculture and anthropogenic activities causes habitat loss and fragmentation that negatively affects biodiversity. We analysed the diversity and habitat preferences of anuran species in Sohagibarwa wildlife sanctuary in June – November, 2023 and 2024. Twenty one Anuran species, belonging to 9 genera and 4 families, were recorded. To create a species list, the area's species diversity was assessed using the Visual Encounter Surveys approach. Their preferred habitats include permanent or temporary aquatic bodies, residential locations, wooded areas, termite nests, tree holes, log voids, and more. The results of the study suggest that the area has moderate level of anurans species diversity. The study may serve as a first step in setting up baseline data for the Anuran's checklist, which may then be expanded to include all herpetofauna and other diversity.

Keywords: Agricultural Ecosystems, Amphibians, Anurans, Habitat loss.

Introduction:

The most prevalent group of Amphibians is the Anuran. Out of the three current orders of amphibians, anurans are by far the most diverse, widespread, and speciose. Anurans differ from other amphibians in a number of synapomorphies. Due to their functions as secondary and tertiary consumers in food webs, anurans are significant species as elements of the faunal community structure in ecosystems. For most threatened amphibians, elucidating their habitat requirements remains a fundamental step for conservation planning. There are three main reasons for this. Firstly, amphibians may be sensitive to even minor habitat alterations, due to their complex life-cycles and physiological dependence on the immediate environment (Cushman 2006). Secondly, only basic information is available on the habitat requirements of most taxa (Hazell 2003; Cushman 2006). Thirdly, habitat alteration is considered the principal process endangering amphibians globally (Stuart et al. 2004). Anurans are often generalist predators and opportunistic foragers. In a single environment, multiple anuran species may coexist and compete for resources. They were known to be susceptible to environmental contaminants and to have biphasic life cycle. The anurans' semi-permeable skin makes it environmentally sensitive, making it a valuable bioindicator of ecosystem and human health.

There is very little information available about the habitats, distribution, abundance, and ecology of anurans because we barely understand how habitat quality and quantity

affect anuran distribution and abundance, which is crucial for carrying out amphibian conservation programs. For amphibians, research of this kind has traditionally focussed on relationships between their occurrence in wetlands and the attributes of those wetlands (e. g. Size, Depth, Vegetation Characteristics, Surrounding Landscape Characteristics). Because amphibians are smaller than other vertebrates and have a higher relative abundance, field methods can be used to quantify them from a limited region.

Comparing the Terai region of Uttar Pradesh to the neighboring Indian states, relatively little is known about the amphibian fauna there. The current study was started at Sohagibarwa Wildlife Sanctuary in Maharajganj district of Uttar Pradesh to evaluate the anuran diversity because these animals are frequently harmed by habitat degradation and environmental pollution. In this study, we conducted surveys in and around the Sohagibarwa Wildlife Sanctuary & based on the comprehensive surveys, data has been collected and created as an Anuran checklist for Sohagibarwa Wildlife Sanctuary in India.

Materials and Methods

Study Area: The Maharajganj district of Uttar Pradesh is home to the Sohagibarwa Wildlife Sanctuary. With the international Indo-Nepal border to the north and the interstate Uttar Pradesh-Bihar border to the east, the sanctuary is situated on the state's edge. Pakadi, Laxmipur, North Chowk, South Chowk, Madhwaliya, Seopur, and Nichlaul are the seven forest ranges that make up the Sohagibarwa Wildlife Sanctuary in Uttar Pradesh, India. At an average elevation of 100 meters above mean sea level, the sanctuary's topography is almost level.

From northwest to southeast, the landscape gently drops. Drained by the Little Gandak, Pyas, Rohin, and Great Gandak rivers, the sanctuary contains a large number of ponds, lakes, wetlands, and open grasslands. The climate in the area is generally pleasant throughout the year, with the exception of a somewhat chilly winter in December and January. The forest cover in the region that this sanctuary covers is stunning. Around 75% of the land is covered with sal forest, with trees like Khair (Acacia catechu), Jaamun (Syzigium cumini), Gutel (Trewia nudiflora), and Semal (Bombax ceiba) growing in other wet areas.

The lower part of the sanctuary, which floods during rainy seasons, is made up of sections of cane forest and grasslands. Numerous amphibian species can flourish in the Sohagibarwa wildlife sanctuary area because it provides a variety of habitats, such as marshes, woodlands, agricultural fields, and temporary and permanent lentic water bodies. The current study was conducted between June and November of 2023 and 2024, encompassing the pre-monsoon, monsoon, and post-monsoon seasons in succession. Every possible habitat was sought by visiting each range.

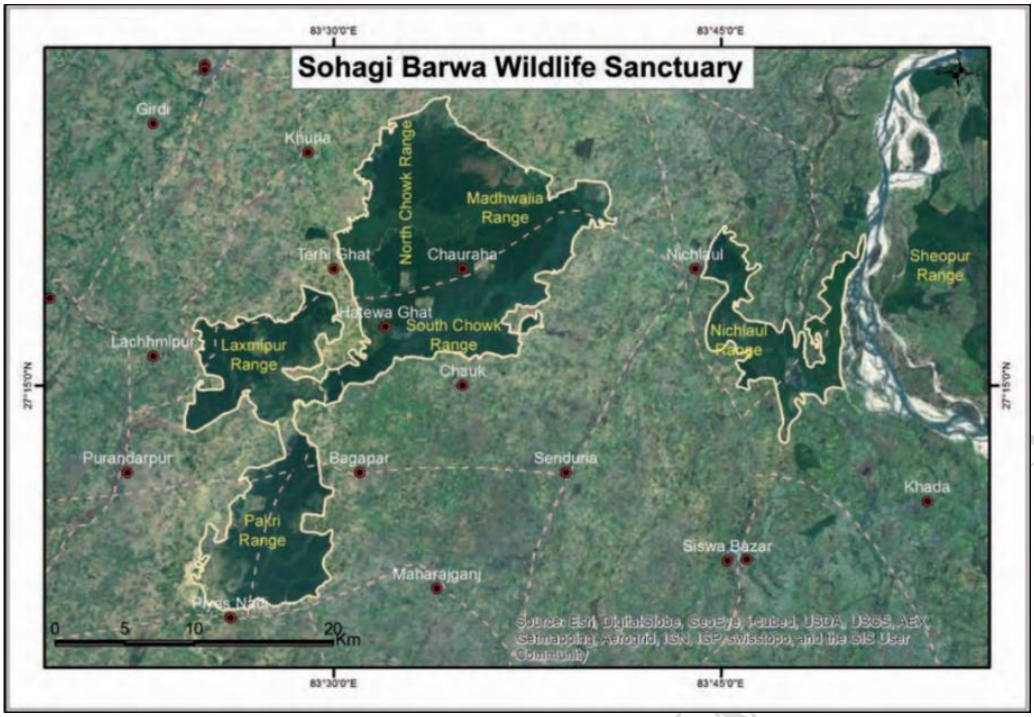

Figure 1: Map of Sohagibarwa Wildlife Sanctuary, Maharajganj.

Methodology: This study was carried out during the Pre-monsoon, Monsoon and Post Monsoon season, June to November 2023 & 2024, coinciding with the breeding season when Anurans are most active. No specimens were collected but each species was photographed for reference. Different habitats like agricultural fields, wetlands, grassland, forest areas were thoroughly surveyed. We laid stress primarily to estimate the varied types of suitable habitats, where the anuran species mainly thrives. Walk through the study sites and actively search for anurans along trails, ponds, streams, forest floors, gleaning leaf litters, prodding bushes, wood logs, and rock crevices etc. Visual encounter surveys (VES) were carried out between 18:30 h–22:00 h. We also occasionally performed acoustic searching along the wooded trail, degraded forest edges and along water bodies where visual encounter was not possible. Further, GPS locations were also recorded. The sampling sites included various microhabitats like wetlands, forests, agricultural area, etc. Animals were observed at night, using headlamps to spot nocturnal species. Photographs of the representative species and their habitats were taken with a digital camera Canon 7D. All species encountered were identified using keys and other publications (Gunther 1864; Boulenger 1890; Smith 1931, 1935, 1943; Dutta 1997; Daniels 2002; Daniels RJR 2005; Giri & Bauer 2008; Whitaker & Captain 2008; Aengals et al. 2012; Gururaja 2012). The IUCN Red List was used to determine the threat status of the observed species in the area.

Geographical co-ordinates for each site were noted. All the data gathered from the survey were used for estimating anuran species diversity. Statistical analysis to obtain indexes like Simpson, were done with Ms-Excel, and statistical software. The survey was performed in all possible habitats and microhabitats such as Leaf litter (LL), Tree hole (TH), Wooden logs (WL), Small bushes in forest (SBF), Human residential area

(HRA), Cultivated fields (CF), Patchy grasslands (PG), Forest and Hillly areas (FHA), Terrestrial land (TL) and water bodies (WB).

Results:

S.No	Common Name	Scientific Name	Family	Authority	Habitat Preference	IUCN Status
1.	Indian Bullfrog	*Haplobatrachus tigerinus*	Dicroglossidae	Daudin, 1802	LL, WB, CF	LC
2.	Jerdon's Bullfrog	*Hoplobatrachus crassus*	Dicroglossidae	Jerdon, 1854	LL, WB, CF	LC
3.	Indian skipper frog	*Euphlyctis cyanophlyctis*	Dicroglossidae	Schneider, 1799	WB, CF	LC
4.	Indian Green Frog	*Euphlyctis hexadactylus*	Dicroglossidae	Lesson, 1834	WB	LC
5.	Terai Cricket Frog	*Minervarya teraiensis*	Dicroglossidae	Dubois, 1984	LL. SBF, HRA, CF, PG,FHA, TL, WB	LC
6.	Bombay wart frog	*Minervarya syhadrensis*	Dicroglossidae	Annandale, 1919	WB , CF	LC
7.	Maskey's Burrowing Frog	*Sphaerotheca maskeyi*	Dicroglossidae	Schleich & Anders, 1998	SBF, PG, TL, WB	LC
8.	Roland's burrowing frog	*Sphaerotheca rolandae*	Dicroglossidae	Dubois, 1983	SBF, TL, FHA, PG	LC
9.	Indian Burrowing Frog	*Sphaerotheca breviceps*	Dicroglossidae	Schneider, 1799	SBF, PG, TL, FHA	LC
10.	Asian Common Toad	*Duttaphrynus melanostictus*	Bufonidae	Schneider, 1799	LL, CF, TL, SBF, HRA, TL	LC
11.	Indian Marbled	*Duttaphrynus*	Bufonidae	Lutken,	TL, SBF, PG, CF,	LC

	Toad	*stomaticus*		1864	HRA	
12.	Common / Golden Tree Frog	*Polypedates leucomystax*	Rhacophoridae	Gravenhorst, 1829	LL, FHA, WL	LC
13.	Terai Tree frog	*Polypedates taeniatus*	Rhacophoridae	Boulenger, 1906	LL, FHA, SBF	LC
14.	Indian Tree Frog	*Polypedates maculatus*	Rhacophoridae	Gray, 1830	WL, LL, FHA	LC
15.	Narrow – mouthed frog	*Uperodon systoma*	Microhylidae	Schneider, 1799	TL, LL, FHA	LC
16.	Assamese balloon frog	*Kaloula assamensis*	Microhylidae	Das, Sengupta, Ahmed and Dutta, 2005	TH, WL, HRA, FHA	LC
17.	Sri Lankan painted frog	*Kaloula taprobanicus*	Microhylidae	Parker, 1934	TH, TL, FHA, WB	LC
18.	Variegated globular frog	*Uperodon variegatus*	Microhylidae	Stoliczka. 1872	TL,WB, FHA	LC
19.	Indian Baloon Frog	*Uperodon globulosus*	Microhylidae	Gunther, 1864	TL, WB, LL,	LC
20.	Ornamented pygmy frog	*Microhyla ornata*	Microhylidae	Dumeril and Bibron, 1841	WL, LL, FHA	LC
21.	Reddish Narrow mouthed frog	*Microhyla rubra*	Microhylidae	Jerdon, 1854	WL, LL, TL, FHA	LC


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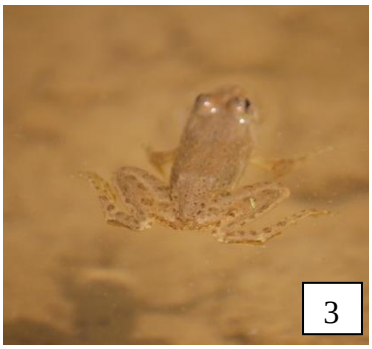
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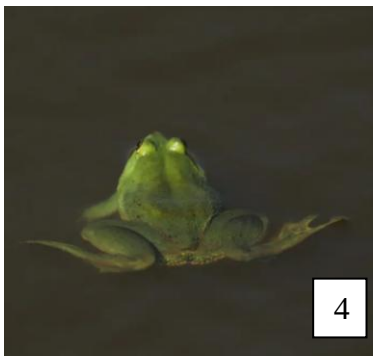
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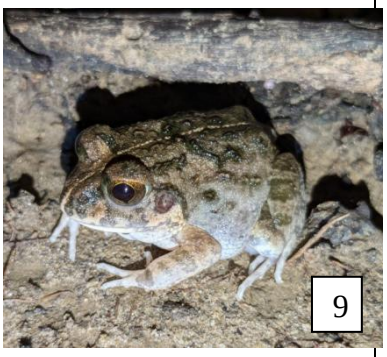
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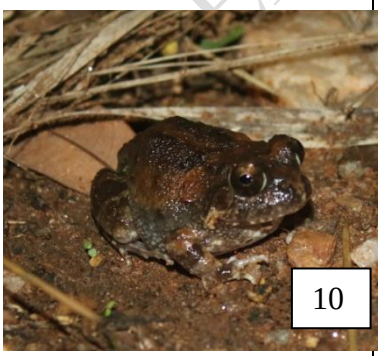
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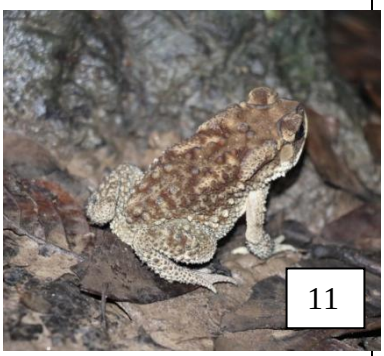
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1. *Haplobatrachus tigerinus* 2. *Hoplobatrachus crassus* 3. *Euphlyctis cyanophlyctis* 4. *Euphlyctis hexadactylus* 5. *Limnonectes teraiensis* 6. *Limnonectes syhadrensis* 7. *Sphaerotheca maskeyi* 8. *Sphaerotheca rolandae* 9. *Sphaerotheca breviceps* 10. *Duttaphrynus melanostictus* 11. *Duttaphrynus stomaticus* 12. *Polypedates leucomystax* 13. *Polypedates taeniatus* 14. *Polypedates maculatus* 15. *Uperodon systoma* 16. *Kaloula assamensis* 17. *Kaloula taprobanicus* 18. *Uperodon variegatus* 19. *Uperodon globulosus* 20. *Microhyla ornate* 21. *Microhyla rubra.*

Fig. 2: Photographs of reported Anurans species

Discussion:

A total of Twenty one Anuran species under four families i.e., Bufonidae, Dicroglossidae, Microhylidae and Rhacophoridae and 9 genus were recorded from all the different areas and ranges of Sohagibarwa Wildlife Sanctuary. The area is

dominated mostly by family Dicroglossidae, followed by Microhylidae, Rhacophoridae and Bufonidae.

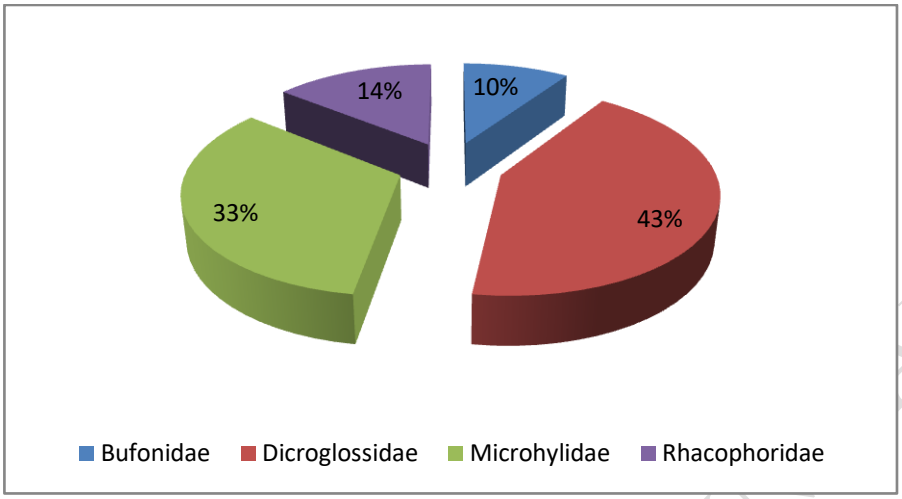

Figure 3: Pie Chart showing family dominance of Anurans species

Many species of anurans are found to spend a good part of their life hiding, either in water under detritus, or on land under leaf litter, rocks or logs, underground holes termite mounds and even at a good height at tree trunks. The most common species *Haplobatrachus tigerinus* was observed in large number during the dawn and night period. This was observed to be the most common 'road kill' anurans in study location. Indian Bullfrog was frequently found in rainy season in and around lentic water bodies, paddy field areas, and occasionally also at residential areas. Jerdon's Bull Frog (*H. crassus*) was morphologically much similar to the Indian Bullfrog except back skin have less fold but more warts than Hoplobatrachus tigerinus. Both these bull frogs were observed to be good long distance jumpers and most sighted frogs on roads and near streams.

Euphlyctis cyanophlyctis is a very aquatic species found in marshes, pools and various other wetlands within a variety of habitat types. They have a wide tolerance for environmental conditions and can adapt to different quality habitats, including areas that might be degraded or disturbed, i.e., from polluted to healthy water body and also in wide range of DO availabilty. The skipper frog was found to be very much common in both lotic and lentic water bodies. *Euphlyctis hexadactylus* is a large size, green frog with a flat muzzle and fully webbed toes, was mostly seen in paddy fields, swamps, and freshwater ponds with a lot of aquatic vegetation.

Several environments, including lowland grasslands, riverbanks, disturbed forest edges, and human-dominated agriculture and urban areas, have been recorded to support *Duttaphrynus melanostictus* during this study They are rare in deep, confined woodlands. *Duttaphrynus stomaticus* was found in a variety of habitats, including grasslands, scrublands, forests, and agricultural land. They are also found in human habitations. During the day, they were observed hiding from predators under rocks or fallen leaves and mostly active at night, found near ants colonies, feeding on them.

Open grasslands, frequently near permanent lakes and streams, were home to *Limnonectes teraiensis*. From marginal vegetation of ponds near paddy field and human settlement, *Limnonectes (Minervarya) syhadrensis* calls these areas home.

Sphaerotheca breviceps (Indian burrowing frog) were observed frequently near temporary water bodies burrowed inside the holes in soil, leaf litter and logs. Wet lowland forests or periodically flooded grasslands were home to *Sphaerotheca maskeyi*. *Sphaerotheca rolandae* was observed calling near the edges of small ponds primarily at night. During the dry season, it was found that they burrow in loose soil like termite mounds and feed on them during the day.

Wetlands and woodlands were both home to *Polypedates leucomystax.* It was also reported on buildings, in wayside shrubs, and in garden ponds in urban areas close to human settlements. In woodland and near freshwater marshy environment, smooth-skinned arboreal frog called *Polypedates taeniatus* was observed dangling from the twigs of bushy plants. *Polypedatus maculatus* is a species that was frequently found in tree holes, banana tree stems, small shrubs in forest bushes, wet or moist areas of homes, such as bathrooms, as well as inside hand pumps and wells. Nonetheless, they were commonly observed in and near lentic water bodies throughout the breeding season, ideally in the transient puddles and pools created by rainfall.

As it burrows into the ground, the fossorial frog. marbled balloon frog, *Uperodon systoma*, after a period of intense rain, was discovered in a deep wooded area, traveling along a forest route. In the vicinity of cavities surrounding water puddles or outside termite mounds, *Uperodon variegatus* was discovered. Following a period of intense rainfall, *Uperodon globulosus* was seen moving across the open space surrounding the forest rest house in the core forest region.

Kaloula taprobanicus was discovered to live in a variety of places, including leaf litter, behind fallen logs, and even at a fair height on tree trunks, in places close to human settlements as well as dense forests. *Kaloula assamensis* was observed consuming ants on mango trees up to 20 feet in height.

It was found that *Microhyla rubra* lived on the ground along sandy beds and on the forest floor near puddles of water. Numerous habitat types, including lowland scrub forests, grasslands, pasturelands, arable land, leaf litter, fallen logs, and urban areas, were home to *Microhyla ornate*.

Simpson's Index (D) value that is based on probability, essentially measuring dominance of a single species within a community is 0.09. A value of 0.09 is quite low, indicating that the community has a high level of diversity, as the probability of selecting two individuals of the same species is very low. Simpson's Diversity Index (1-D) value, that is a measure of diversity taking account of number of species present as well as the relative abundance of each species is 0.91. A value of 0.91 indicates high diversity, meaning the community is highly diverse, with a good number of different species present. Simpson's Reciprocal Index (1/D) for this set is 11.46. A value of 11.46 means that the community has a relatively high level of diversity, and it indicates the expected number of different species one would encounter if randomly selecting individuals from the population. The higher this value, the more evenly distributed the species are in the community.

Conclusion:

The observations of this study showed the Anurans diversity in the study area. This study may generate the base line data for the anurans diversity in Sohagibarwa Wildlife Sanctuary. With a good number of distinct Anuran species present, this study shows great diversity, indicating that the community is very diversified. *Bufo melanostictus, Euphlyctis cyanophlyctis, Microhyla ornata, Limnonectes teraiensis, Hoplobatrachus tigerinus,* and *Polypedates maculatus*—shows the greatest regional overlap. The two species that were least frequently observed were *Microhila rubra* and *Uperodon variegatus.*

It was the preliminary study on the amphibian faunal diversity of Maharajganj district of Uttar Pradesh state but further study is also required to explore the diversity of Anurans in the study area by addition of new amphibians species, habitat study, population estimation, and to find out the severity of the threats to diversity, and also to propose several conservation strategies in the study area

Acknowledgement:

The authors thank almighty god for giving the inspiration to do this research work. The authors are thankful to Divisional Forest Officer, Maharajganj, for providing us with all arrangements and assistance throughout field work and also to Forest Field Staff and watchers who accompanied us throughout the survey. Special thanks to the then DFO, Mr. Pushpa Kumar K.

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