



Research Article

AMPHIBIAN DIVERSITY OF GAYA DISTRICT, BIHAR, INDIA

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ABSTRACT

Health of an ecosystem can be found out through the assessment of diversity of particular area. Present study was carried out in Gaya district for the assessment of amphibian diversity of this area. For the assessment of Amphibian Diversity and their habitat preference in and around the three different water bodies (1) Khaira Pokhar Pond (2) Bhurha Pond and (3) Daboor village Pond of Gaya District India, survey was conducted during the period July 17 to June 19. A rapid survey and photography of amphibian fauna was done and amphibians were recorded from different habitats of the study area. A total of 11 amphibian species belonging to 4 families and 8 genera were recorded. Out of these 6 amphibian species belonging to 4 families and 6 genera recorded from in and around Khaira Pokhar pond (Site 1), 10 amphibian species of 4 families and 7 genera has recorded from the area of the Bhurha Pond (Site) and 8 amphibian species belonging to 4 families and 7 genera identified and recorded from in and around the area of Daboor village Pond (Site 3) This study shows that the Gaya district India is the rich in amphibian diversity and also support many different other types of flora and fauna in this region. Analysis of the collected data of the amphibian population of these different study areas of Gaya India revealed that the Shannon–Wiener species diversity index minimum (1.63) at Site I and maximum (2.21) at Site II. In contrast Dominance value was minimum (0.11) at Site II and maximum (0.21) at Site I. We also calculate the Evenness index that was maximum (0.92) at site III whereas minimum (0.84) at Site I. This was preliminary study on the amphibian diversity of this district; further study may explore new type of species and habitat used by them. During this study Common Indian tree frog (*Polypedates maculatus*) was the first record from district. This species of frog was LC in IUCN list category.

Keywords: Amphibian diversity, Dominance index, Evenness index, Gaya district, *Polypedates maculatus*.

INTRODUCTION

The amphibian fauna of Bihar is very less studied as compared to nearby states. It was also found that very less work has been conducted on the amphibian diversity of Bihar particularly Gaya district. Any specific literature and publication about the amphibian diversity of this district is not available not available, However the Gaya district is very rich in biodiversity. These sites of Gaya district are rich in herpatofauna (Amphibians and reptiles) co-inhabiting with wide range of biodiversity of different other species (Vitt & Caldwell, 2013), However due to deforestation and changing in agricultural pattern of this area adversely affect the various fauna of this area but its impact on amphibian fauna is remaining unknown in the given study area. There are

8,230 Amphibians species have been reported around the world (Amphibia web world, 20.10.20), out of which 439 amphibian species (398 frogs, 2 salamanders and 39 caecilians) found in India (Frost, 2009). Recently (Dinesh *et al.*, 2020) prepared a checklist of amphibian species found in India and described them (Dinesh *et al.*, 2020), however there is very less description about the amphibian species of Bihar state.

First of all (Venkateswarlu, 1972) described the amphibian fauna of Bihar but that was very short description about the batrachians of this area. Later on (Sarkar, 1991) described the amphibian species of Bihar including Jharkhand. But till today the diversity of amphibians of Gaya district remains unknown, hence attempt has been made to

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study the species diversity of amphibians and their habitat preference of this area. Many workers and scientists worked on the amphibian diversity and their habitat preference such as (Abraham *et al.*, 2001; Dahanukar & Padhye, 2005; Krishnamurthy, 2003; Purushotham *et al.*, 2011). Similar important works on amphibian were reported by Bordoloi, & Ohler, (2003) and (Ningombam & Bordoloi, 2007) from the North-East India. These works have amply documented the diversity and microhabitats of amphibian species.

Site I. Khaira Pokhar pond (24.6036° N and 84.6309° E) was a large permanent water body occupying about 500 m² area with a mean depth of 2m. Both floating and submerged aquatic weeds were noted in this pond. Because of this pond situated in the vicinity of very important for amphibian species. This pond was in the vicinity of mountainous surroundings and thick forest covers as well the patchy grass land. Besides this pond, few small temporary water bodies, around this pond were also included for the sampling and identification of amphibian species of this area. 6 amphibian species belonging to 4 families and 6 genera recorded from this area. The amphibian species recorded from this site were *Duttaphrynus melanostictus*, *Hoplobatrachus tigerinus*, *Euphlyctis cyanophlyctis* and *Polypedates maculatus*. Site 2, Bhurha Pond of Gurua block (24.6660° N and 84.7491° E), covering an area of about 10000 m² with catchment area about 40 acre. This pond is surrounded by cultivation land, thick matty grasslands and various microhabitats of amphibians. It was a low lying area and in the monsoon, most of the area of this study site was inundated by temporary water and watery area become large during monsoon season. This site of study is also very rich in amphibian diversity and all the 10 amphibian species belonging to 4 families and 7 genera recorded from these areas. The main amphibian species were *E. cyanophlyctis*, *H. tigerinus*, *D. melanostictus*, *Sphaerotheca brachiceps* and *P. maculatus*. Site-3 Daboora village pond (24.8112° N and 84.7259° E) was selected as site II covering an area of 5 acre with catchment area 20 acre. This pond is dominated by large amount of planktonic diversity act as food for amphibians. This site or study is very rich in amphibian diversity have large catchment area about that is surrounded by thick matty grasslands as well the agricultural fields provide suitable habitat for various species of amphibians and 8 amphibian species belonging to 4 families and 7 genera recorded from here. It has about 15-20 temporary water bodies associated with it that provide thick vegetation around it that holds a great variety amphibian species. Main amphibian species are *E. cyanophlyctis*, *H. tigerinus*, *D. melanostictus*, *S. brachiceps* and *P. maculatus* found abundantly here. The record of *P. maculatus* (common tree frog) was first from this sites and this district also.

MATERIALS AND METHODS

Study area

In the present study we have surveyed in and around the areas of three major ponds viz. Khaira Pokhar Pond (Amas), Bhurha Pond (Gurua) and Dabur village Pond (Guraru) of Gaya district selecting their different microhabitats as well

the temporary and permanent water bodies. Gaya district is located between Latitude: 24.7969 Longitude: 85.9994 and is the main southern most district of Bihar, India. During the present study three major ponds of Gaya dist. were surveyed for finding out the amphibian diversity of this area. The study area (Figure 1-3) of present study is the Gaya district of Bihar province. We carried out the present study between July 17 to June 19 which included a consecutive pre-monsoon, monsoon and post-monsoon periods. We selected three study sites of this district from the perspective of contrasting habitat characteristics that differ in amphibian species and their habitat preference also.

Study design

During present study various sampling methods viz. visual encounter survey, point count survey, opportunistic search road transect survey were used for the sampling of amphibians of this area. Survey was conducted bi-monthly in all the study sites. Various habitats and microhabitats such as Leaf litter & Bamboo grooves (LL& BG), Tree hole (TH), Human residential area (HRA), Cultivated fields (CF), Patchy grasslands (PG), Forest and Hilly areas (FHA), Terrestrial land (TL) and water bodies (WB) were surveyed during the whole year. The timing of the survey was in between 5.30 am to 8.00 am in early morning and 7.00 pm to 11.00 pm in night. Anuran amphibian species were recorded by direct sighting method and also by recording the calls from the concerned species. Specimens were photographed at the site by Nikon camera D 7000 and lens 60 mm micro for further identification and documentation purpose. We calculated Shannon–Wiener diversity index, Pielou's evenness index and Simpson's dominance index using D index software version 4.0. Photographs of the different amphibian species as well their microhabitats were taken with a digital camera. Geographic position of study sites were also recorded by using GPS mobile software. Coordinates were recorded as latitude and longitude in degrees. The identification of amphibian specimens photographed done by using various identification keys and available publications (Ahmed *et al.*, 2009; Bossuyt & Dubois, 2001; Chanda, 2002; Daniels, 2005; Das, 2008; Dubois, 1975; Dutta & Manamendra Arachchi, 1996; Frost, 2016; Kabir *et al.*, 2009). Also some identification was confirmed by consulting Batrachologists. Nomenclature of Amphibians in this paper followed (Frost, 2016).

RESULT AND DISCUSSION

A total of 11 amphibian's species of only of order Anura belonging to 4 families and 8 genera were recorded. Out of these from the area around Khaira pokhar Pond (Site 1), 10 Anuran amphibian species belonging to 4 families and 7 genera recorded from the area around Bhurha pond of Gurua block (Site 2) and 8 Anuran amphibians belonging to 4 families and 6 genera from the area around the Daboora village pond Guraru block (Site 3) of Gaya India. Many species of anuran amphibians are found to spend a good part of their life hiding, either in water under leaf litter, detritus, or on land under rocks or logs and even underground holes and termite mounds (Ray, 1999). Therefore with the

increasing in microhabitats area and breeding sites area the diversity of anuran amphibian species increases greatly (Figure 1-3). However, the amphibian diversity of different study sites of Gaya India region is moderate. During the survey we found only eleven species of anuran amphibians under four families named, Bufonidae, Dicroglossidae, Microhylidae and Rhacophoridae. The amphibian species were represented by *D. melanostictus*, *D. stomaticus*, *Microhyla ornate*, *M. rubra*, *Uperodon systoma*, *H. tigerinus*, *H. crassus*, *S. braviceps*, *E. cyanophlyctis*, *Fejervarya limnocharis*, and *P. maculatus* (Table 1). Among the recorded Anuran species the highest number of species recorded belonging to family Dicroglossidae and the minimum number of species recorded from the family Microhylidae.

During our survey, family Dicroglossidae was found the most dominant family of frogs with 5 species followed by

Microhylidae 3 species, Bufonidae with 2 species and only single species of Rhacophoridae was found. It was observed that the *D. stomaticus*, *E. cyanophlyctis*, *H. tigerinus* and *P. maculatus* species were found in all the possible habitats. These four species had wide distribution and dominant throughout the Gaya district. While the *D. melanostictus*, *F. limnocharis* and *H. crassus* were found mainly in agricultural fields and sub urban areas and recorded less in number. The food availability and habitat suitability was the prime factor for their occurrence in those fields. The Indian burrowing frog *S. braviceps* and marbled balloon frog *U. systoma* was found rare and found in and around Site 1 and 2 only. The forest area and agriculture field provides the suitable habitat for the burrowing frog and Indian tree frog hence they preferred that areas and showed widespread distribution at all the sites of study. All the recorded species are least concern in the IUCN status.



Figure 1. Khaira pokhar Pond (Amas) Pankaj.



Figure 2. Bhurha Pond (Gurua) Pankaj.



Figure 3. Daboor village pond (Guraru) Pankaj.

Table 1. Amphibians (anuran) of Gaya with their habitat preference, occurrence, abundance and IUCN status.

Family	Species	Common name	Habitat preference	Occurrence	IUCN status
Bufonidae	<i>Duttaphrynus melnotictus</i> (Schneider,1799)	Common Asian toad	HRA, FHA,TL	I,II, III	LC
Bufonidae	<i>Duttaphrynus stomaticus</i> (Lutken,1864)	Marbled toad	TL, HRA, LL&BG	II	LC
Dicroglossidae	<i>Hoplobatrachus tigerinus</i> (Daudin,1803)	Indian bullfrog	WB, TL, CF, FHA, PG	I, II, III	LC
Dicroglossidae	<i>Hoplobatrachus crassus</i> (Hoffman,1932)	Dicroglossidae Jerdon's bullfrog	WB, TL, CF, FHA, PG	II, III	LC
Dicroglossidae	<i>Sphaerotheca braviceps</i> (Schneider,1799)	Indian burrowing frog	FHA, PG, TL	I,II, III	LC
Dicroglossidae	<i>Euphlyctis cyanophlyctis</i> (Schneider, 1799)	Skittering frog	WB, CF	I,III	LC
Dicroglossidae	<i>Frejervarya limnocharis</i> (Gravenhorst,1829)	Asian grass frog	WB, CF	II,III	LC
Microhylidae	<i>Microhyla rubra</i> (Jerdon, 1853)	Guandong rice frog	CF, FHA, TL	I, II,III	LC
Microhylidae	<i>Microhyla ornate</i> (Dumeril & Bibron 1841)	Ornate narrow mouthed frog	PG, FHA,TL	II	LC
Microhylidae	<i>Uperodon systoma</i> (Schneider,1799)	Marbled balloon frog	FHA, Near WB	I, II	LC
Rhacophoridae	<i>Polypedates maculatus</i> (J.EGray,1830)	Common tree frog	HRA, TL, TH, FHA	I,III, III	LC

Abbreviations:-VC-Very Common, C-Common, UC- Un-Common, R-Rare.

Leaf litter & Bamboo grooves (LL& BG), Tree hole (TH), Human residential area (HRA), Cultivated fields (CF), Patchy grasslands (PG), Forest and Hilly areas (FHA), Terrestrial land (TL) and water bodies (WB).

Table 2. Percent relative abundance of anuran species recorded during point counts survey in three study sites in Gaya, India.

Species	Site 1	Site 2	Site 3
<i>Duttaphrynus melnotictus</i> (Schneider,1799)	22.32	9.40	14.20
<i>Duttaphrynus stomaticus</i> (Lutken,1864)	0.00	11.50	0.00
<i>Hoplobatrachus tigerinus</i> (Daudin,1803)	7.31	6.90	18.40
<i>Hoplobatrachus crassus</i> (Hoffman,1932)	0.00	5.20	11.20
<i>Sphaerotheca braviceps</i> (Schneider,1799)	25.40	11.90	19.30
<i>Euphlyctis cyanophlyctis</i> (Schneider, 1799)	24.86	0.00	4.30
<i>Frejervarya limnocharis</i> (Gravenhorst,1829)	0.00	2.50	9.20
<i>Microhyla rubra</i> (Jerdon, 1853)	17.30	15.20	15.80
<i>Microhyla ornate</i> (Dumeril & Bibron 1841)	0.00	7.80	0.00
<i>Uperodon systoma</i> (Schneider, 1799)	0.00	17.20	0.00
<i>Polypedates maculatus</i> (J.EGray,1830)	3.01	12.40	7.60

Table 3. Calculated diversity indices of all study sites of Gaya, India.

Diversity index	Site- I	Site- II	Site -III
Shannon-Wiener Diversity Index (H')	1.63	2.21	2.01
Simpson's Dominance Index (D _{SIMP})	0.21	0.11	0.14
Pielou's Evenness Index (J')	0.84	0.90	0.92

*Duttaphrynus melanostictus**Duttaphrynus melanostictus**Duttaphrynus stomaticus**Duttaphrynus stomaticus**Hoplobatrachus tigerinus**Sphaerotheca braviceps**Euphlyctis cyanophlyctis**Polypedates maculatus**Polypedates maculatus***Figure 4.** Different amphibian species found in Gaya, India.

A total 11 anuran amphibian species under 4 families and 8 genus we rerecorded from three study areas (Table 1). Number of species in each study area varied from 8 to 11. *Bhurha Pond* supports the highest number of species (10) where as *Khaira pokhar Pond* supports the lowest number of species (6). Family Dicroglossidae comprised 60% of the population (5 species), followed by Rhacophoridae 16 % (1 species), Microhylidae 3% (3 species), and Duttaphrynus

23% (2 species). All the three study areas had the highest number of frogs from the Family Dicroglossidae (5 species) and the lowest number from Rhacophoridae (1 species). Different diversity indices are calculated for all the study sites that reveals the idea about dominance, species diversity, composition. All the calculated values such as Shannon wiener diversity index, Simpsons dominance index, and Pielou's evenness index for all sites (Table 3).

The Shannon–Wiener species diversity index (H'), mainly depends on comparative species abundances, was observed to be minimum at site-I (1.63) while comparatively high values were calculated from site-II (2.21) and site-III (2.01). These two sites contain lotic as well lentic water bodies were moist and high amphibian diversity were recorded in both the sites (site-II and site-III). Evenness is an important property of ecological communities and it is defines as the degree to which the abundances are equal among the species present in a sample or community (Molinari, 1989). A community in which species composition is equally abundant has high evenness than a community in which the species differ widely in abundance has low evenness. Pielou's evenness index (J') of was also very high for site-III (0.92) and site-II (0.90) while minimum at site-I (0.84). Simpson's dominance index (D_{SIMP}), which is also based on proportional abundance like H' revealed contrasting values to those of H' . The maximum was recorded from site-I (0.21) while comparatively much lower values at site-II (0.11) and site-III (0.14).

Although both Shannon–Wiener and Simpson's indices consider the proportional abundance of species, H' is more sensitive to rare species, where as D_{SIMP} put greater emphasis to common species. Therefore these indices point out occurrence of many diverse anuran species at site II and site III while only specially adapted species are confined to site I. The use of diversity indices has increased due to the necessity of testing different methodologies to develop the ecological status. Richness is an indicator of the relative wealth of amphibian species in a community. Amphibians are moisture loving creatures. Therefore the species diversity is expected to be high in moist places. This could be well established by the data that the amphibians preferred the habitat with high moisture and more microhabitat of the region that was indicated from site II and site III in the present study. However, perhaps to avoid competition some of the amphibian species of Gaya India have adapted large forest area axis evident from the data recorded from various sites.

Asian toad and Marbled Toad of family Duttaphrynus were found mainly near to the human habitations and in the agricultural fields. Hoplobatrachus and Polypedates species showed widespread distribution and were relatively more common than other species. They can be observed in majority of the habitats, including grasslands, water bodies, agricultural fields and human habitations. *Euphlyctis cyanophlyctis* is showed restricted distribution and was found only in and around all the water bodies. During the study also we have recorded some direct and indirect threats to the Amphibian diversity of the study area such as extensive use of insecticides and weedicide by farmers to control the agricultural pest inhabiting the same localities, urbanization, road kills, habitat fragmentation, habitat loss and also modern agricultural practices.

CONCLUSION

The observations of this study showed the Anurans diversity and richness in and around the study area. This study may generate the base line data for the anurans diversity in Gaya district India. It was the preliminary study on the amphibian faunal diversity of this district of Bihar state but further study is also required for 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.

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