The amphibian fauna of Bihar, India, is not well known. Venkateswarulu and Murthy (1972) listed 11 species of anurans, Sarkar (1991) listed 11 species from the Chota-Nagpur Hills in Bihar, and Sarkar et al. (2004) listed 14 species from Bihar (including Jharkhand). However, no sources document the amphibian diversity of Gaya District. The Gaya District (24.7969°N, 85.9994°E) covers 4,976 km² at elevations of 94–104 m asl in southern Bihar. Average annual rainfall is 1,100–1,300 mm, most of which falls during the monsoon season. Temperatures range from a low of 4 °C in winter to a high of 45 °C in summer with relative humidity of 15–19% and 62–98%, respectively. Vegetation is largely dry deciduous forest dominated by Sal trees (Shorea robusta) interspersed with grasslands and cultivated areas. The Falgu, Morhar, and Sorhar Rivers and a number of temporary and permanent ponds, lakes, and wetlands provide aquatic habitats.

Twice daily (0530–0800 h and 1900–2300 h) from March 2017 to February 2018, we used visual-encounter surveys, point-count surveys, call surveys, and opportunistic encounters to assess the composition of amphibian communities at three sites in the district: (1) Ramsagar Pond (24.7735°N, 85.0320°E; Fig. 1A) is a large permanent artificial pond covering a 821.5-m² area with a mean depth of 2 m in densely populated Gaya (city). In addition to the main pond, we also surveyed small temporary pools in the immediate vicinity. (2) Daboor Village Pond (24.8112°N, 84.7259°E; Fig. 1B) is a 2-ha pond in a catchment area of about 8 ha with grasslands and agricultural fields. In addition to the main pond, we also surveyed 15–20 ephemeral pools in the immediate vicinity. (3) A 7–10-km stretch of the Falgu River (24.7528°N, 84.1299°E; Fig. 1C), drains a catchment area about 16 ha, much of which is inundated during the monsoon season.

We identified frogs using keys and descriptions in Dubois (1975), Bossuyt and Dubois (2001), Dutta and Manamendra-Arachchi (1996), Chanda (2002), Daniels (2005), Das (2008), Ahmed et al. (2009), Kabir et al. (2009), and Frost (2020). We recorded habitat for each frog encountered and collectively assessed the relative abundance of species as in Khan (2008): Very common (VC) = 76–100% chance of being encountered when most active in suitable habitat; common (C) = 51–75% chance of being encountered; uncommon (UC) = 26–50% chance of being encountered, and rare (R) ≤ 25% chance of being encountered. We calculated Shannon-Wiener diversity index, Pielou evenness index, Margalef richness index, and Simpson dominance index to compare the diversity and composition of anuran communities at each site.

We encountered ten species of anurans in seven genera and four families from the three sites (Table 1; Fig. 2). All

Fig. 1. Aquatic habitats at the study site in Gaya District, Bihar, India: (A) Ramsagar Pond in Gaya; (B) Daboor Village Pond; and (C) Falgu River. Photographs by Nalinaksh Pankaj.
were present in the Ramsgar Pond (site 1), eight species in six genera and four families were present in the area around the Daboor Village Pond (site 2), and nine species in seven genera and four families were present in the area around the Falgu River (site 3). All of the species encountered have been assessed as being of Least Concern (LC) on the IUCN Red List of Threatened Species (IUCN 2020).

The Marbled Toad (*Duttaphrynus stomaticus*), Skittering Frog (*Euphlyctis cyanophlyctis*), Indian Bullfrog (*Hoplobatrachus tigerinus*), and Common Indian Treefrog (*Polypedates maculatus*) were found in smaller numbers and mainly in agricultural fields and suburban areas. The Indian Burrowing Frog (*Sphaerotheca breviceps*), Roland’s Burrowing Frog (*Sphaerotheca rolandae*), and Marbled Balloon Frog (*Uperodon systoma*) were the least frequently encountered species and the latter two were absent from one or two sites.

Of the calculated diversity indices (Table 2), all of which consider both species richness and relative abundance, the Shannon-Wiener index was lower at site 2 than at sites 1 and 3. This might reflect a greater habitat diversity as the latter sites have both lotic and lentic systems, although the Simpson index, which is less sensitive to rare species and thus places a greater emphasis on common species, was highest at site 2, as was the Margalef index. Evenness reflects the degree to which

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Table 1. Anurans encountered at the study site in Gaya District, Bihar, India. Habitat: LL&BG = leaf litter & bamboo grooves, TH = tree hole, HRA = human residential area, CF = cultivated fields, PG = patchy grasslands, FH = forested hills, T = terrestrial, AQ = bodies of water. Abundance: VC = very common, C = common, UC = uncommon, R = rare.

| Species | Habitat | Abundance | Percent Relative Abundance |
|---------|---------|-----------|---------------------------|
|         |         | Site 1 | Site 2 | Site 3 |
| **Bufonidae** |         |         |         |         |
| Common Asian Toad (Fig. 2A) | *Duttaphrynus melanostictus* (Schneider 1799) | HRA, FH, T | C | 8.8 | 9.2 | 10.4 |
| Marbled Toad (Fig. 2B) | *Duttaphrynus stomaticus* (Lütken 1864) | T, HRA, LL&BG | VC | 14.9 | 13.1 | 12.8 |
| **Dicroglossidae** | |         |         |         |
| Skittering Frog (Fig. 2C) | *Euphlyctis cyanophlyctis* (Schneider 1799) | AQ, CF | VC | 20.2 | 20.0 | 16.8 |
| Asian Cricket Frog (Fig. 2D) | *Fejervarya limnocharis* (Gravenhorst 1829) | AQ, CF | UC | 2.6 | 3.1 | 6.4 |
| Jerdon’s Bullfrog (Fig. 2E) | *Hoplobatrachus crassus* (Jerdon 1853) | AQ, T, CF, FH, PG | C | 8.8 | 10.0 | 9.6 |
| Indian Bullfrog (Fig. 2F) | *Hoplobatrachus tigerinus* (Daudin 1802) | AQ, T, CF, FH, PG | VC | 18.4 | 17.7 | 19.2 |
| **Microhylidae** | |         |         |         |
| Indian Burrowing Frog (Fig. 2G) | *Sphaerotheca breviceps* (Schneider 1799) | FH, PG, T | UC | 6.1 | 9.2 | 5.6 |
| Roland’s Burrowing Frog | *Sphaerotheca rolandae* (Dubois 1983) | FH, PG, T | R | 3.5 | — | 4.0 |
| **Rhacophoridae** | |         |         |         |
| Common Indian Treefrog (Fig. 2H) | *Polypedates maculatus* (Gray 1830) | HRA, T, TH, FH | C | 13.2 | 17.7 | 15.2 |
the relative abundance of various species in a community is equal (Molinari 1989). Pielou’s evenness index was higher for sites 2 and 3 than site 1.

Despite the fact that our study revealed moderate diversity at all three sites and some species were very abundant, we noticed habitat loss, alteration, and fragmentation to various degrees at all sites. At site 1, urbanization was largely responsible, whereas at sites 2 and 3, agricultural practices were to blame. We also observed a number of direct threats, including road mortality and the extensive use of pesticides and herbicides.

Our assessment of anuran diversity was intended to establish a preliminary baseline for further studies that should include efforts to identify additional species, more closely examine habitat associations, and quantify population sizes and trends. These will be necessary to evaluate the severity of the threats and also to propose conservation strategies for these communities.

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Literature Cited
Ahmed, M.F., A. Das, and S.K. Dutta. 2009. Amphibians and Reptiles of Northeast India: A Photographic Guide. Aaranyak, Guwahati, Assam, India.
Bossuyt, F. and A. Dubois. 2001. A review of the frog genus Philautus Gistel, 1848 (Amphibia, Anura, Ranidae, Rhacophorinae). Zeitschrift für Bildende Kunst 89(1):1–122.
Chanda, S.K. 2002. Handbook. Indian Amphibians. Zoological Survey of India, Calcutta, India.
Daniels, R.J.R. 2005. Amphibians of Peninsular India. Universities Press (India) Private Ltd., Hyderabad, India.
Das, A. 2008. Diversity and distribution of herpetofauna and evaluation of conservation status in Barail Hill Range (including Barail Wildlife Sanctuary), Assam, Northeast India. Final Report, Aaranyak, Guwahati, Assam, India.

Dubois, A. 1975. Un nouveau complexe d’espèces jumelles distinguées par le chant: les grenouilles du Népal voisines de Rana limnocharis Boie (Amphibiens, Anoures). Comptes Rendus de l’Académie des Sciences du París (D) 281: 1717–1720.

Dutta, S.K. and K. Manamendra-Arachchi. 1996. The Amphibian Fauna of Sri Lanka. Wildlife Heritage Trust of Sri Lanka, Colombo, Sri Lanka.

Frost, D.R. 2020. Amphibian Species of the World: An Online Reference. Version 6. American Museum of Natural History, New York, New York, USA. https://amphibiansoftheworld.amnh.org/.

IUCN (International Union for Conservation of Nature). 2020. IUCN Red List of Threatened Species. https://www.iucnredlist.org/.

Kabir, S.M.H., M. Ahmed, A.T.A. Ahmed, Z.U. Ahmed, Z.N.T. Begum, M.A. Hassan, and M. Khondoker (eds.). 2009. Encyclopedia of Flora and Fauna of Bangladesh, Volume 25: Amphibians and Reptiles. Asiatic Society of Bangladesh, Dhaka, Bangladesh.

Khan, M.M.H. 2008. Protected Areas of Bangladesh. A Guide to Wildlife. Nishorgo Program, Bangladesh Forest Department, Dhaka, Bangladesh.

Molinari, J. 1989. A calibrated index for the measurement of evenness. Oikos 56: 319–323. DOI: 10.2307/5565616.

Sarkar, A.K. 1991. The Amphibians of Chhotanagpur (Bihar) India. Records of the Zoological Survey of India 89: 209–217.

Sarkar, A.K., S. Das, and S. Ray. 2004. Amphibia, pp. 181–193. In: The Director, Zoological Survey of India (ed.), State Fauna Series 11. Fauna of Bihar (including Jharkhand). Part–1. Zoological Survey of India, Kolkata, India.

Venkateswarlu, T. and T.S.N. Murthy. 1972. Fauna of Bihar State (India), 2–Amphibia. Indian Journal of Zoology 13(3): 129–130.