HAMADRYAD
Accepted Manuscript

Title The Silent Toll of Roads: Common toad (*Duttaphrynus melanostictus*) roadkills during winter in Mithamoin Haor, Kishoreganj, Bangladesh

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Date submitted 19/04/2025

Date accepted 08/12/2025

Available online

Citation Biswas, S., Papon, A.I., Datta, A.K. and Hasan, M.K. (2025) The Silent Toll of Roads: Common toad (*Duttaphrynus melanostictus*) roadkills during winter in Mithamoin Haor, Kishoreganj, Bangladesh. *Hamadryad* in press

Abstract A survey was conducted to assess amphibian mortality on roads in the Mithamoin Haor, Mithamoin Upazila, Kishoreganj District, Bangladesh. A total of 269 individuals of *Duttaphrynus melanostictus* were recorded as roadkills across six different transects in a five-day survey under similar habitat conditions. The roadkill rate was 3 toads per 100 m, with a vehicular density of 16.44 per kilometer. A strong positive correlation was found between amphibian road kills and vehicular density (r = 0.999).

Keywords road mortality, amphibians, wildlife-vehicle collision, habitat fragmentation, wetlands, Bangladesh

Introduction

Roads are one of the most prevalent human-made infrastructures resulting in transportation networks and impacts on biodiversity worldwide (Forman and Alexander, 1998). The presence of roads causes habitat fragmentation, restricts wildlife movement, reduces access to vital resources such as food and mates, and leads to direct fatalities (Fahrig et al., 1995; Malo et al., 2004; Cushman, 2006; Jaarsma et al., 2006; van der Ree et al., 2015). Amphibians are particularly vulnerable to road mortality among various taxa due to their slow mobility, permeable skin, and seasonal migration behaviour (Fahrig and Rytwinsky, 2009). It has been identified as a leading cause of amphibian population decline, often exacerbated by high traffic intensity and habitat fragmentation (Cushman, 2006; Goldingay and Taylor, 2006; van der Ree et al., 2015). Roads are one of the barriers for the dispersal of amphibians (Gibbs, 1998). Amphibians frequently traverse roads during breeding migrations, making them highly susceptible to vehicle collisions (Hels and Buchwald, 2001). Studies have shown that roads near wetlands and forested habitats experience higher amphibian mortality rates, with some species experiencing local extinctions due to sustained roadkill pressure (Gibbs and Shriver, 2005; Seshadri et al., 2009). Moreover, road mortality not only reduces population sizes but also disrupts genetic connectivity among subpopulations, posing a threat to long-term species survival (Carr and Fahrig, 2001).

While several studies have examined the global impact of road mortality on amphibian populations (van Gelder, 1973; Fahrig et al., 1995; Ashley and Robinson, 1996; de Maynadier and Hunter, 2000; Hels and Buchwald, 2001; Cooke and Sparks, 2004; Mazerolle, 2005; Pellet et al., 2004; Gibbs and Shriver, 2005; Goldingay and Taylor, 2006; Elzanowski et al., 2009; Lesbarrères and Fahrig, 2012), research on this issue remains scarce in Bangladesh, with only two studies having assessed the effects of roads on amphibians (Biswas et al., 2024; Khandakar et al., 2020). Over the past 50 years, the length of paved roads in Bangladesh has expanded significantly, growing from 2,500 km to 184,256.1 km, while rail networks now span 2,955.53 km (Roads and Highways Department, 2024; Local Government Engineering Department, 2020; Bangladesh Railway, 2024). Bangladesh spans an area of 147,570 km², with 54,200 km² classified as major habitat types, including forests, wetlands, bushy and grassy areas, bamboo-covered regions, and homestead vegetation (IUCN, 2015). A significant portion of major wildlife habitats, approximately 33,958.732 km² (62.69%), is intersected by linear structures, which also constitute 23.01% of the country’s total area (IUCN, 2015; Roads and Highways

Department, 2024; Local Government Engineering Department, 2020; Bangladesh Railway, 2024). This rapid linear infrastructure expansion poses increasing challenges for wildlife, particularly species that must traverse these barriers like amphibians. Herein we provide an initial assessment of road mortality on common toads (*Duttaphrynus melanostictus*) in Mithamoin Haor, Bangladesh, a large wetland area.

Methodology

Study area: The study was conducted at Mithamoin Haor, one of the largest wetlands located in Mithamoin Upazila, Kishoreganj District, in the northeastern part of Dhaka Division, Bangladesh (approximately 24.4022° to 24.4475° N and 91.0311° to 91.1208° E) (Fig.1). The area covered 222.92 square kilometers and represents a significant wetland ecosystem with rich aquatic flora and faunal diversity. Mithamoin Haor serves as a vital breeding and feeding ground for various inland freshwater fish species (Nahiduzzaman et al., 2023; Hossain, 2014). The region is seasonally flooded during the monsoon, while agricultural activities dominate in the dry season across this expansive floodplain. The three major roads and multiple sub-roads that dissect the open wetland lead to habitat fragmentation and facilitate increased human disturbance, posing potential risks to wetland diversity (Fig. 2A, 2B) (Nahiduzzaman et al., 2023). The main roads are elevated approximately 8–10 m above the surrounding land, while the sub-roads remain at land level. During the monsoon, the sub-roads are fully submerged, and the elevated main roads are partially inundated.

Methods: The survey was conducted on a 7.5 m wide road passing through open land over five consecutive days (20–25 December 2024). Six transects, each 1.5 km, were walked on foot between 1830 and 2100 h. Headlamps were used to detect and record the carcasses along transects. Surveys were focused to coincide with peak amphibian activity and vehicular movement in the evening hour (Fig. 2C, 2D). This timing also minimized carcass loss due to scavenging by birds or other animals and overt, repeated trampling of carcasses leading to disfigurement and identification issues, due to high vehicular traffic during the day. A total of 15.25 hours were spent and all the selected transects were surveyed once. The roads were thoroughly searched on foot for road-killed amphibians, and all carcasses were identified as Asian common toad (*Duttaphrynus melanostictus*) (Fig. 4). Other road-killed organisms were listed but not included in the analysis. Encounter rates were expressed as the number of kills per kilometer. No dead individuals or materials were collected or preserved during this study.

Species were identified based on external morphology using standard field guides, including Captain and Whitaker (2015), Hasan (2014), and Daniel (2002). Vehicular data (vehicle types, number, speed, and tyre width) were collected during a five-day survey over the time 1830–2030 hours. Pearson correlation test was used to assess the relationship between traffic intensity and encounter rates.

Study Species: The Asian common toad (*Duttaphrynus melanostictus*) is a large and robust bufonid species widely distributed across South and Southeast Asian countries (IUCN SSC Amphibian Specialist Group, 2023; Frost, 2024). It can reach up to 150 mm in snout-vent length and is characterized by prominent cranial crests, distinct tympanum, elliptical parotoid glands, and heavily tuberculated skin often tipped with dark brown spines (Amphibian Web, 2025; Daniels, 2005). The species is highly adaptable and commonly found in human-dominated landscapes such as urban parks, gardens, agricultural fields, and roadside areas, reflecting its strong anthropophilic nature (IUCN, 2015; Hasan et al., 2014). Breeding usually occurs during the monsoon, when individuals congregate near temporary or permanent water bodies to reproduce. In tropical southeast Asia, the toad is known to breed throughout the year (Church, 1960). Due to its tolerance of habitat disturbance, *D. melanostictus* remains one of the most abundant amphibians in Bangladesh and serves as an important component of urban and rural ecosystems (IUCN, 2015).

Results

A total of 269 common toad roadkills were recorded in a total 9 km road survey in Mithamoin Haor during the winter season. The highest proportion of roadkills (31.23%) was observed in T5, followed by T2 (27.88%), T3 (18.59%), T1 (11.15%), and T6 (9.29%), while the lowest was in T4 (1.86%). The roadside areas, characterized by the presence of various water sources, such as drainage systems, small water pools, paddy fields, and maize cultivation, exhibited the highest amphibian mortality. Almost all the habitats beside the roads were similar. The average mortality rate was calculated at 29.88% amphibians per kilometer per day, with a traffic intensity of 16.44 vehicles per kilometer.

Among the vehicle types, three-wheelers were the most abundant (78 vehicles; 52.7% of total) with an average speed of 30 km/h, followed by motorcycles (45 vehicles; 30.4%) with an average speed of 65 km/h, and heavy motor vehicles, which were the least abundant (25 vehicles; 16.9%), with an average speed of 50 km/h (Table 1). Additionally, the tyre widths ranged from 3.25–4 inches for three-wheelers, 2.3–4 inches for motorcycles, and 6–12 inches for heavy motor vehicles. Statistical analysis revealed a significant positive correlation between traffic intensity and amphibian roadkill (Pearson correlation; $r = 0.99$, $t = 14.31$, d.f. = 4, $P = 0.00014$) (Fig. 3). Notably, direct evidence of breeding behaviors was recorded of toads, including calling males, orange marks of breeding males, and black eggs in female roadkill.

In addition to the 269 dead toads, twelve Asian house shrews (*Suncus murinus*) and five Common house rats (*Rattus rattus*) were recorded. Several live frog species were observed during nocturnal surveys, including the Indian bullfrog (*Hoplobatrachus tigerinus*) and Common skittering frog (*Euphlyctis cyanophlyctis*), along with reptile species such as Common house gecko (*Hemidactylus frenatus*) and Checkered keelback (*Fowlea piscator*) (Fig. 5).

Table 1. Vehicle counts, relative abundances, speeds, and tyre widths.

Vehicle Type	Number of Vehicles	Relative Abundance (%)	Average speed (Km/h)	Tyre width (inches)
Three-wheelers	78	52.7	30	3.25-4
Motorcycles	45	30.4	65	2.3-4
Heavy motor vehicles	25	16.9	50	6-12
Total	148	100		

Discussion

The present study demonstrates the influence of linear road infrastructure on mortality of the *Duttaphrynus melanostictus* in Mithamoin Haor during the winter season. A total of 269 individuals recorded along a short survey distance (9 km) indicates that road networks impose a substantial threat to this species. The occurrence of only *D. melanostictus* in the roadkill dataset likely reflects its higher activity in winter season (November to February) and possible local adaptations (Ahmad and Alam 2015). The presence of small water bodies and roadside drainage further intensify mortality, as amphibians routinely move between terrestrial and aquatic microhabitats for foraging, refuge, and breeding. A notable pattern observed in this study is the marked variation in roadkill frequency among different transects. Mortality was highest at T5 (31.23%), lowest at T4 (1.86%). These differences may be driven by multiple interacting factors, including road elevation, traffic intensity, the presence of water sources and habitat pressure from motorized vehicles such as tractors. Elevated concrete roads (Transects 1, 2, 3, 5, and 6) contain narrow gaps between boulders that may function as microhabitats for resting individuals. However, evening movements associated with foraging and matesearching increase the likelihood to toads crossing roads and encountering vehicles. Conversely, lower-elevation sub-roads such as T4 provide easy across for toads but also expose them more directly to vehicular threats. The detection of older carcasses and multiple fresh carcasses with visible eggs further emphasizes the vulnerability of breeding individuals. The encounter rate recorded in this study reflects a 115.2% increase in mortality of *D. melanostictus* during the winter season compared to Khandaker et al. (2020). Several factors may underline this disparity. Traffic intensity, vehicle types, and vehicle speeds are known to strongly influence amphibian roadkill patterns (Seshadri et al., 2009; Khandakar et al., 2020; Fahrig and Rytwinsky, 2009). Here, 29.88% toads per km per day were killed at a traffic intensity of 16.44 vehicles per whereas Khandaker et al. (2020) reported 1.27% amphibians per km day under a low traffic intensity of (7.17% vehicles per km) in Nijhum Dweep National Park. Differences in ecological settings (offshore island vs. inland wetland), seasonality, sampling effort (3 km for 35 days vs. 9 km for 5 days), vegetation structure, amphibian community composition, and protection status (protected vs. non protected are) likely further contributed to variation between two studies. Additionally, key factors such as vehicle speed and tyre width, which are important determinants of amphibian mortality, were not considered by Khandakar et al. (2020), limiting direct comparison.

Mithamoin Haor is an ecologically important wetland, yet its biodiversity understudied, particularly that of amphibians and reptiles (Nahiduzzaman et al., 2023; Dutta et al. 2021). The increasing use of agro-biocides in surrounding agricultural lands may exacerbate population declines by contaminating habitats, reducing prey availability, and affecting physiological health (Wanger et al. 2023; Brühl et al. 2013). Expanding road networks within such sensitive landscapes further intensifies the threats by fragmenting habitats and increasing vehicle-related mortality. The present findings highlight an urgent need to investigate the amphibian status in non-protected areas where the impacts of roadkill remain poorly documented but may significantly contribute to local, regional, and potentially global amphibian declines (Fahrig and Rytwinsky, 2009; Khandakar et al., 2020; Rabbe et al., 2022).

Overall, our findings indicate that road networks may pose a substantial local threat to *D. melanostictus* in Mithamoin Haor, as reflected by the high mortality recorded along surveyed transects. Although this study focused on a single species, the patterns observed suggest that similar risks may exist for other amphibians that share the same wetland habitats and breeding habitat. Further research on wildlife diversity, vulnerability, and the impacts of traffic intensity would help clarify the broader implications of roadkill in this landscape and support evidence-based management of the Haor ecosystem. In addition, assessing the effects of biocide use is important, as it may also influence wildlife vulnerability and mortality patterns.

Acknowledgement

We sincerely thank the local communities of the study area for their cooperation and assistance. We are grateful to Mr. Palash Ahmed for providing important information on Mithamoin Haor and for his support during the survey. We also thank our field assistants, Mr. Anamul Haque and Mr. Md. Riyad, for their dedicated help during data collection.

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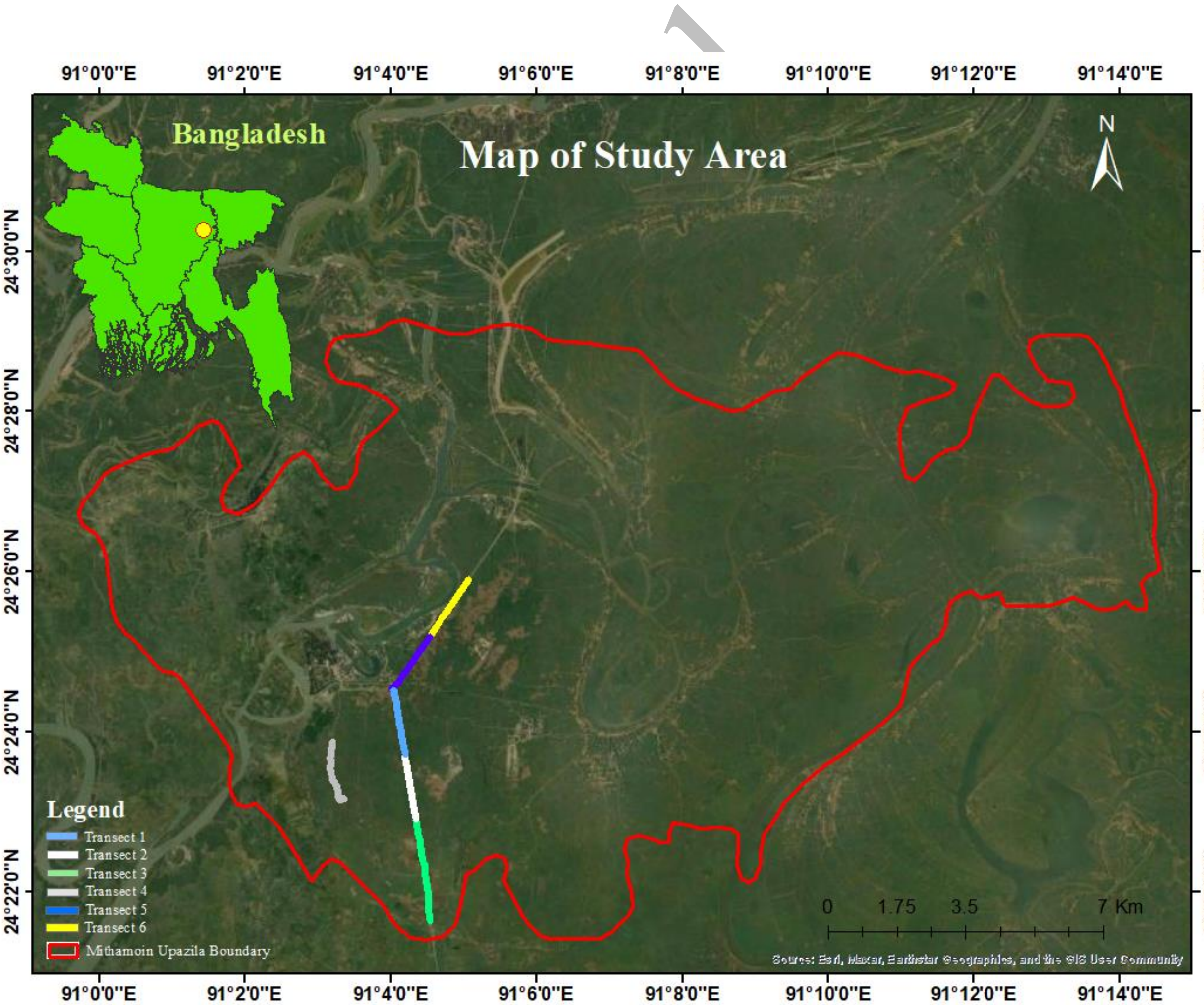

Figure 1: Map indicating the study area and showing the survey transects in Mithamoin Haor, located in Mithamoin Upazila, Bangladesh.

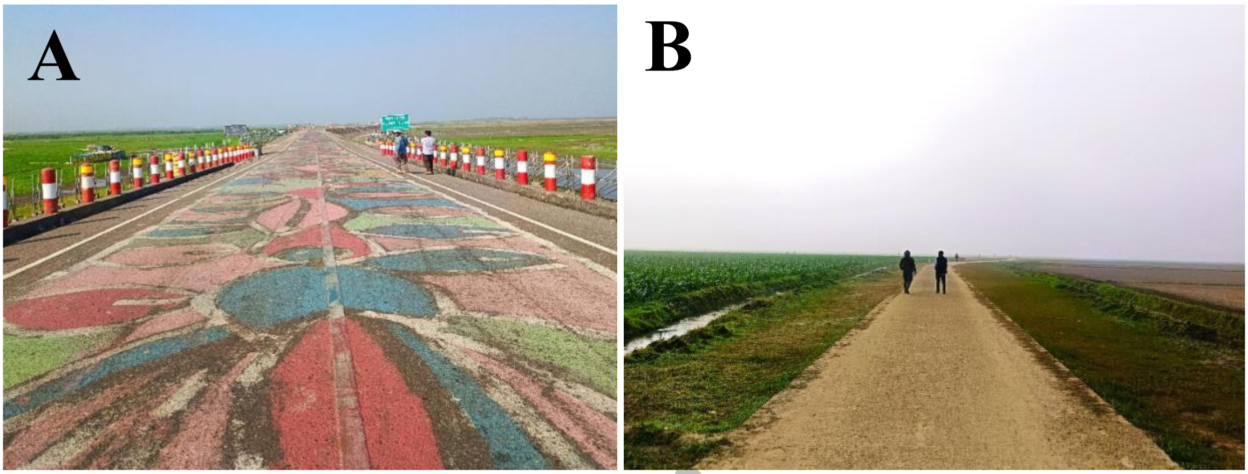

Figure 2: (A) Elevated major roads traversing the wetland (transects 1–3); (B) Sub-road at land level (transect 4), which remains submerged during the rainy season.

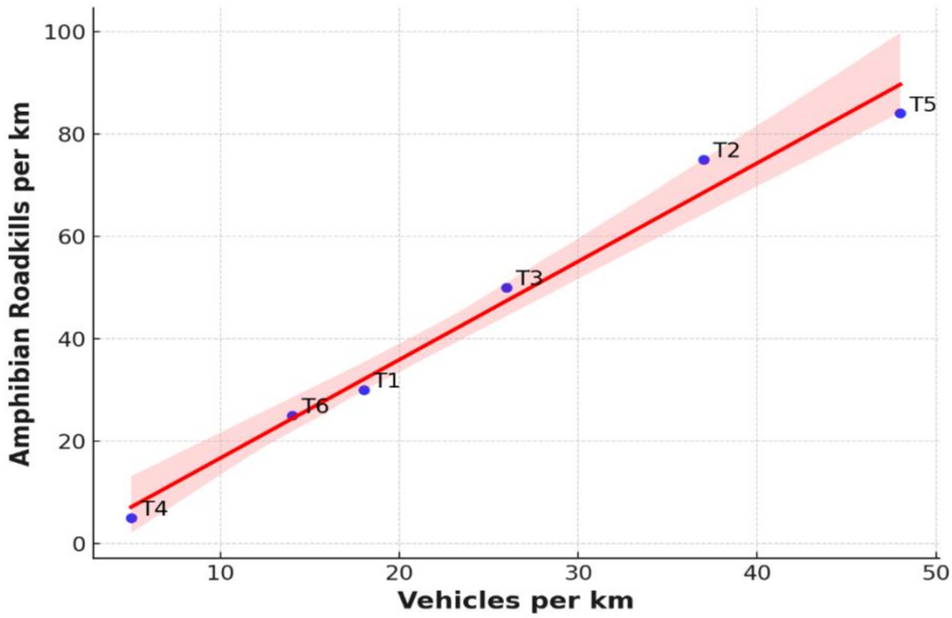

Figure 3: Correlation between the number of vehicles per km and amphibian mortality per km in Mithamoin Haor, Dhaka, Bangladesh.

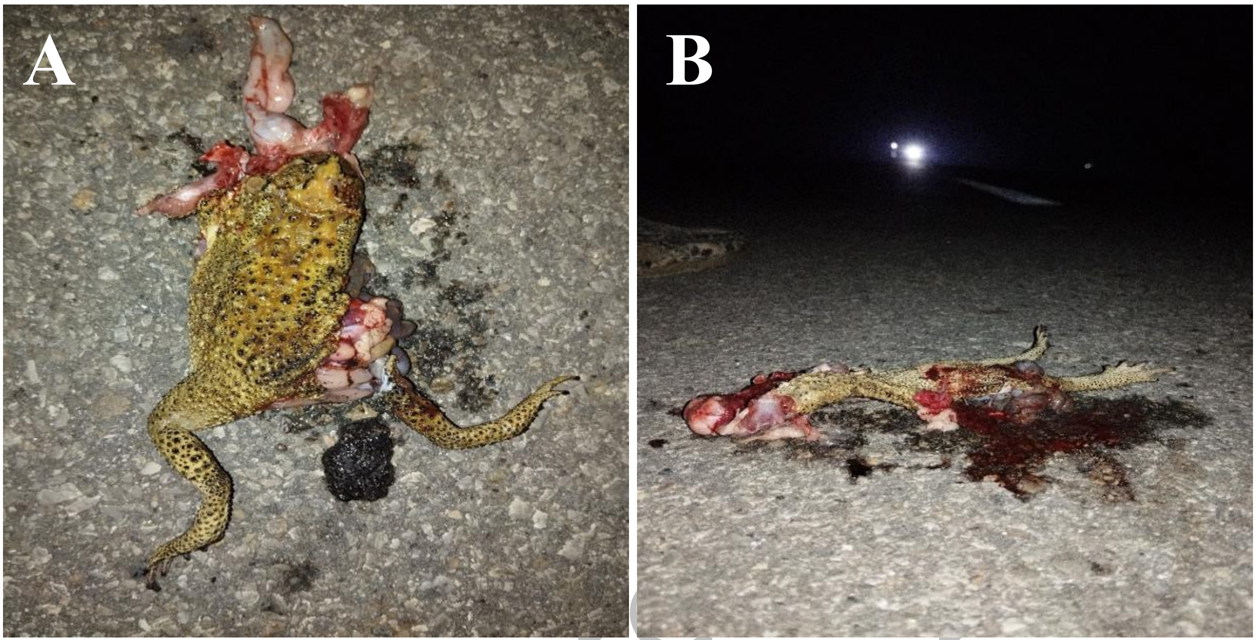

Figure 4: Mortality observations of *Duttaphrynus melanostictus* (A) gravid female with visible black eggs (B) adult male

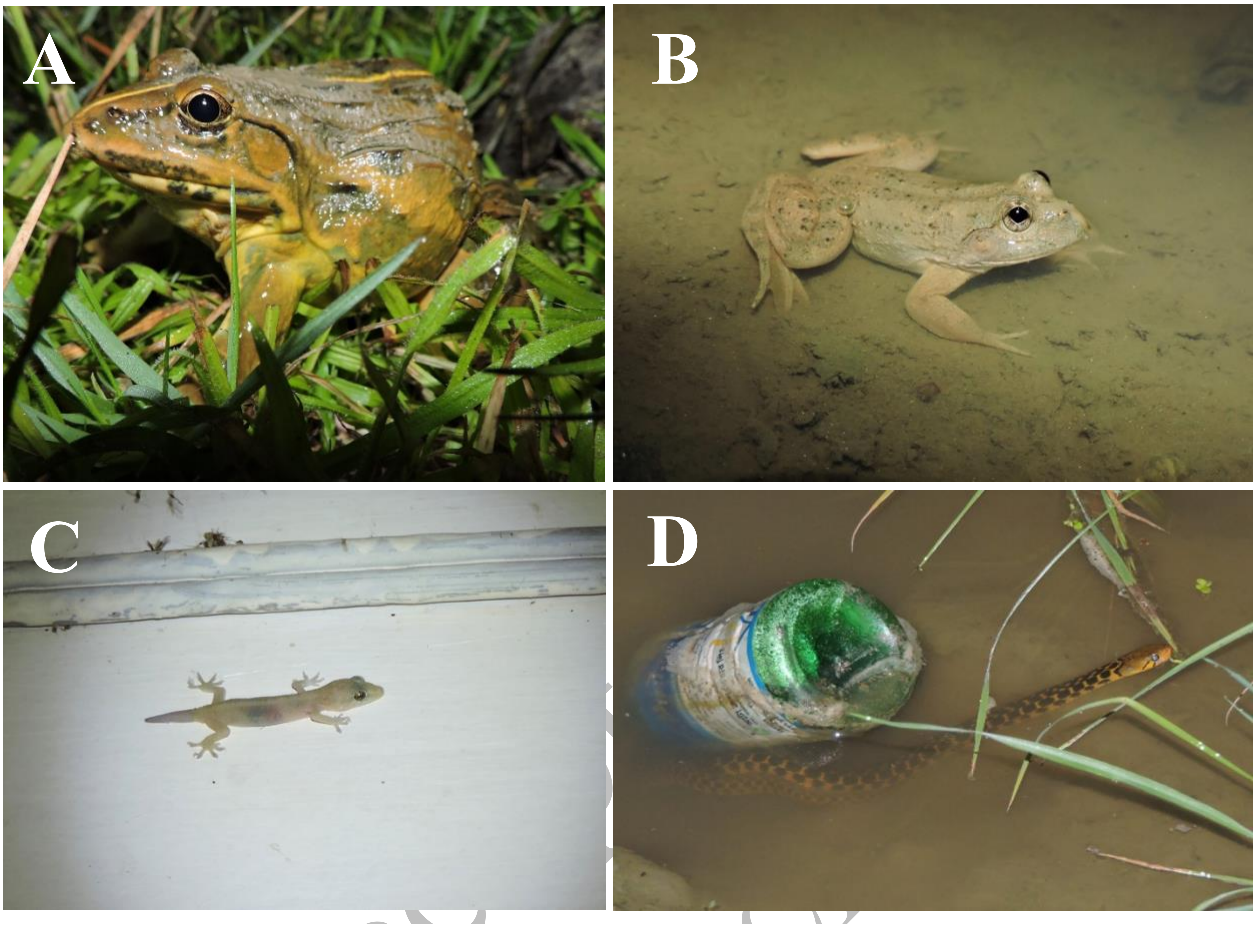

Figure 5: **(A)** *Hoplobatrachus tigerinus*, **(B)** *Euphlyctis cyanophlyctis,* **(C)** *Hemidactylus frenatus,* **(D)** *Fowlea piscator* near a pesticide bottle in the paddy field.