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Herpetofauna of the Libungan River Watershed Forest Reserve (LRWFR), North Cotabato, Philippines

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ABSTRACT

The Libungan–Alamada Natural Biotic Area (LANBA) in North Cotabato, Mindanao, Philippines, is a critical yet understudied component of the region's biodiversity. Within this landscape lies the Libungan River Watershed Forest Reserve (LRWFR), a critical watershed system that supports a diverse array of amphibian and reptile communities. This study assessed the herpetofaunal diversity and community composition within the LANBA–LRWFR using a combination of visual encounter surveys and opportunistic sampling across various habitat types. A total of 16 species were recorded, comprising 11 amphibians and five reptiles, with several being endemic to the Philippines and Mindanao. These findings provide the first baseline inventory of the watershed's herpetofauna, contributing crucial data for biodiversity documentation and conservation planning in Mindanao. Additionally, the results served as baseline information for the Protected Area Suitability Assessment (PASA) and watershed characterization of the LRWFR. They have also been presented to the watershed management council and relevant local government units to support evidence-based conservation and management in the area.

Keywords: amphibians, Libungan–Alamada Natural Biotic Area, new records, Philippines, reptiles

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INTRODUCTION

Watersheds play a crucial role in sustaining ecological integrity and human well-being by regulating hydrological processes, maintaining forest cover, and supporting diverse biological communities (Peras *et al*., 2008). In the Philippines, much of the remaining forest ecosystems are nested within watershed landscapes, which serve as vital refugia for numerous plant and animal species. These forested watersheds are particularly critical for amphibians and reptiles—taxa that are highly dependent on intact habitats, microclimatic stability, and freshwater systems (Gojo-Cruz *et al*., 2018). Due to their permeable skin and biphasic life cycles, amphibians are exceptionally sensitive to environmental changes. Similarly, reptiles rely heavily on structurally complex forest habitats for thermoregulation, reproduction, and foraging. Consequently, herpetofaunal assemblages serve as effective indicators of ecosystem health and habitat quality (Urbina-Cardona, 2008; Lesbarrères *et al*., 2014).

The Philippines is recognized as a global biodiversity hotspot, harboring exceptionally high levels of amphibian and reptile endemism (Diesmos *et al*., 2002). Over the past decades, numerous herpetofaunal surveys and taxonomic studies have expanded our understanding of species diversity and distribution across several Philippine islands and mountains (Diesmos *et al*., 2002; Sanguila *et al*., 2016; Pitogo *et al*., 2021; Decena *et al*., 2023a; Flores *et al*., 2023a; Flores *et al*., 2024b; Meneses *et al*., 2024). Despite these advances, many of Mindanao's forested landscapes remain poorly surveyed. This uneven research coverage leaves significant knowledge gaps regarding the distribution, diversity, and conservation status of amphibians and reptiles across several key forest ecosystems.

One such understudied area is the Libungan River Watershed Forest Reserve (LRWFR), situated within the Libungan–Alamada Natural Biotic Area (LANBA) in North Cotabato, Mindanao, Philippines. The area was declared a protected landscape in 1990 under Presidential Proclamation No. 563 to safeguard the headwaters of the Libungan River within the municipalities of Libungan and Alamada (Ong, 2002). Spanning approximately 52,820 hectares, the watershed features rugged mountainous terrain that originates from Mount Piapayungan and drains through the Libungan River toward the Rio Grande de Mindanao and the Liguasan Marsh (Baconguis *et al*., 1990). The landscape features a mosaic of lowland forests, riparian habitats, agricultural lands, and secondary vegetation, offering diverse ecological niches that support rich amphibian and reptile communities (Tabora *et al*., 2023).

Despite its protected status and ecological significance, LRWFR remains biologically underexplored. Anthropogenic pressures—including upland farming, kaingin (slash-and-burn agriculture), logging, small-scale mining, and wildlife hunting—persist within parts of Philippine watersheds, posing significant threats to biodiversity if left unmanaged (Paz-Alberto *et al*., 2015). The lack of baseline data on amphibians and reptiles in LRWFR prevents conservation managers and local stakeholders from assessing ecosystem health, identifying conservation priorities, and developing evidence-based management strategies. This data gap is particularly concerning as many Philippine herpetofaunal species have narrow geographic ranges and specialized ecological niches, leaving them highly vulnerable to habitat disturbance and environmental change (Diesmos *et al*., 2002; Flores *et al*., 2023a; Flores *et al*., 2024b). Establishing baseline biodiversity data in understudied watersheds is critical for improving regional assessments and informing conservation planning. Furthermore, comprehensive species inventories contribute valuable data to national and global databases, serving as a reference for monitoring ecological changes and evaluating land-use impacts (Uetz *et al*., 2021). The findings of this study also contribute to the ongoing Protected Area Suitability Assessment (PASA) and watershed characterization for the Libungan River Watershed Forest Reserve, providing scientific evidence to support local conservation planning and resource management.

This study presents the first inventory of amphibians and reptiles in the Libungan–Alamada Natural Biotic Area, focusing on the Libungan River Watershed Forest Reserve in North Cotabato, Mindanao. Specifically, it aims to document the herpetofaunal species composition within the watershed and generate baseline data to support future biodiversity research, conservation planning, and environmental management in the region.

MATERIALS AND METHODS

A rapid herpetofaunal assessment was conducted from 11–15 October 2022 within the Libungan River Watershed Forest Reserve (LRWFR), North Cotabato Province, Mindanao Island (Figure 1). This area is situated within the vicinity of the Mt. Piapayungan Mountain Range and designated as a Key Biodiversity Area. Prior to the survey, a sampling permit was obtained from the Department of Environment and Natural Resources-Community Environment and Natural Resources Office (DENR-CENRO) in Midsayap, North Cotabato. Sampling was conducted across various habitat types within the LRWFR, with sites ranging from 1,500 to 1,800 meters above sea level (masl). Although situated at an elevation of 1,600–1,800 masl, the area's forest structure, vegetation, and floristic composition correspond to a lower montane forest, featuring an average canopy height of 15–20 meters and emergent trees reaching up to 35 meters. The survey zone includes Lake Baranibud, which covers 20.5 hectares and is recognized as one of the few high-elevation lakes in the Philippines (Figure 2). Using opportunistic sampling and visual encounter surveys following Flores *et al.* (2025), we searched for amphibians and reptiles across secondary forests (Figure 2A), streams, agroforests (Figure 2B), grasslands (Figure 2C), and areas surrounding Lake Baranibud (Figure 2D). All encountered species were photographed using a Canon 3000D camera. Amphibians and reptiles were identified using standard field references, including Pitogo *et al*. (2021), Sanguila *et al*. (2016), Diesmos *et al*. (2015), and Alcala and Brown (1998). Amphibian and reptile nomenclatures follow Frost (2025) and Uetz *et al*. (2025), respectively.

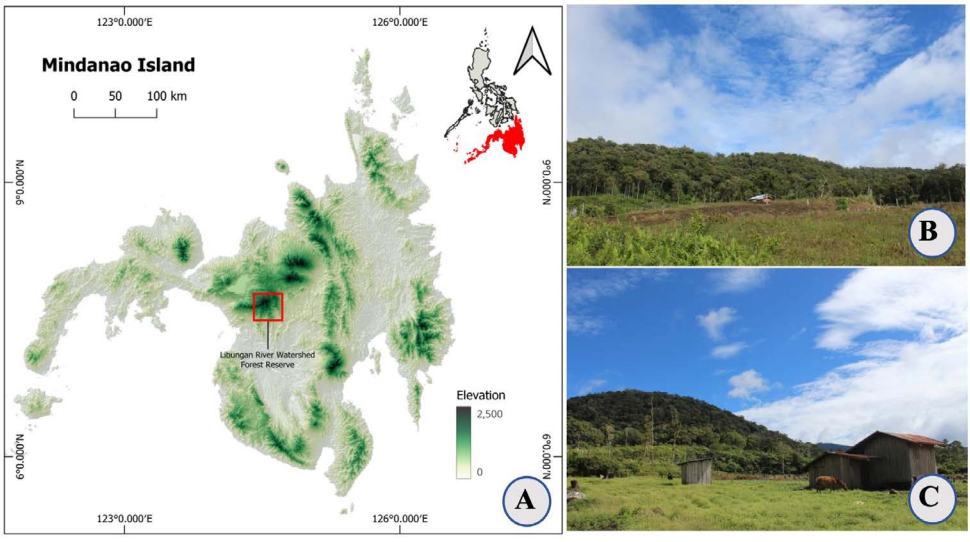

Figure 1. Geographic location of Libungan River Watershed Forest Reserve in Central Mindanao, Philippines. A, Map showing study sides; B–D, forested areas.

Figure 2. Some representative areas surveyed in Libungan River Watershed Forest Reserve. A, Forest; B, agroforest with some *coffea* sp. planted; C, grassland near the camp; D, the vicinity of Lake Baranibud.

RESULTS AND DISCUSSION

This study documented 16 herpetofaunal species across 13 genera and ten families, including Agamidae, Bufonidae, Colubridae, Cyclocoridae, Dicroglossidae, Megophryidae, Psammodynastidae, Ranidae, Rhacophoridae, and Scincidae (Figure 3). Among these, the family Rhacophoridae was the most species-rich with five species, followed by Dicroglossidae and Megophryidae with at least two species each. Additionally, eleven species are endemic to the Mindanao Faunal Region (MFR): *Pelophryne brevipes* (Zamboanga Flathead Toad), *Limnonectes magnus* (Mindanao Fanged Frog), *Leptobrachium lumadorum* (Mindanao Spadefoot Frog), *Pelobatrachus stejnegeri* (Mindanao Horned Frog), *Pulchrana grandocula* (Big-eyed Frog), *Nyctixalus spinosus* (Spiny Tree Frog), *Philautus acutirostris* (Pointed-snouted Tree Frog), *Philautus leitensis* (Leyte Bubble Nest Frog), *Philautus* cf. *poecilius* (Mottled Tree Frog), *Rhabdophis auriculatus* (White-Lined Water Snake), and *Cyclocorus nuchalis taylori* (Southern Triangle-spotted Snake). At least two species are endemic to the Philippines: *Philautus surdus* (Luzon Bubble-Nest Frog) and *Pinoysincus jagori jagori* (Mindanao Forest Skink). Furthermore, native species such as *Bronchocela cristatella* (Green Crested Lizard), *Occidozyga laevis* (Common Puddle Frog), and *Psammodynastes pulverulentus* (Common Mock Viper) were also recorded (Table 1).

Table 1. List of herpetofaunal species (amphibians and reptiles) recorded during the survey in the Libungan River Watershed Forest Reserve (LRWFR). The table shows the taxonomic family, species, common name, conservation status based on the IUCN Red List, distribution status, and the number of individuals recorded with their relative abundance.

Family	Species	Common Name	IUCN Status	Distribution Status	No. of Individuals (RA)
Bufonidae	*Pelophryne brevipes* (Peters, 1867)	Zamboanga Flathead Toad	Least Concern	MFR Endemic	1 (1.01%)
Dicroglossidae	*Limnonectes magnus* (Stejneger, 1910)	Mindanao Fanged Frog	Near Threatened	MFR Endemic	1 (1.01%)
	Occidozyga laevis (Günther, 1858)	Philippine Oriental Frog	Least Concern	Native	9 (9.09%)
Megophryidae	*Leptobrachium lumadorum* (Brown, Siler, Diesmos and Alcala, 2010)	Mindanao Litter Frog	Least Concern	MFR Endemic	3 (3.03%)
	Pelobatrachus stejnegeri (Taylor, 1920)	Mindanao Horned Frog	Least Concern	MFR Endemic	1 (1.01%)
Ranidae	*Pulchrana grandocula* (Taylor, 1920)	Big-eyed Frog	Least Concern	MFR Endemic	16 (16.16%)
Rhacophoridae	*Nyctixalus spinosus* (Taylor, 1920)	Spiny Tree Frog	Least Concern	MFR Endemic	1 (1.01%)
	Philautus acutirostris (Peters, 1867)	Pointed-snouted Tree Frog	Least Concern	MFR Endemic	26 (26.26)
	Philautus leitensis (Boulenger, 1897)	Leyte Bubble Nest Frog	Least Concern	MFR Endemic	16 (16.16%)
	Philautus cf. *poecilius* (Brown and Alcala, 1994)	Mottled Tree Frog	Least Concern	MFR Endemic	3 (3.03%)
	*Philautus surdus (*Peters, 1863)	Luzon Bubble-Nest Frog	Least Concern	Philippine Endemic	16 (16.16%)
Agamidae	*Bronchocela cristatella* (Kuhl, 1820)	Green Crested Lizard	Least Concern	Native	1 (1.01%)
Colubridae	*Rhabdophis auriculatus* (Günther, 1858)	White-lined water snake	Least Concern	MFR Endemic	1 (1.01%)
Cycloridae	*Cyclocorus nuchalis taylori* (Taylor, 1923)	Southern Triangle-spotted Snake	Least Concern	MFR Endemic	1 (1.01%)

Table 1. Continue.

Family	Species	Common Name	IUCN Status	Distribution Status	No. of Individuals (RA)
Psammodynastidae	*Psammodynastes pulverulentus* (Boie, 1827)	Common Mock Viper	Least Concern	Native	1 (1.01%)
Scincidae	*Pinoyscincus jagori jagori* (Peters, 1864)	Mindanao Forest Skink	Least Concern	Philippine Endemic	2 (2.02%)

Note: IUCN Status follows the categories of the International Union for Conservation of Nature Red List. MFR = Mindanao Faunal Region endemic species; Philippine Endemic = species restricted to the Philippines; Native = species naturally occurring in the Philippines but not restricted to the Mindanao Faunal Region. RA (Relative Abundance) represents the percentage of individuals of each species relative to the total number of individuals recorded during the survey.

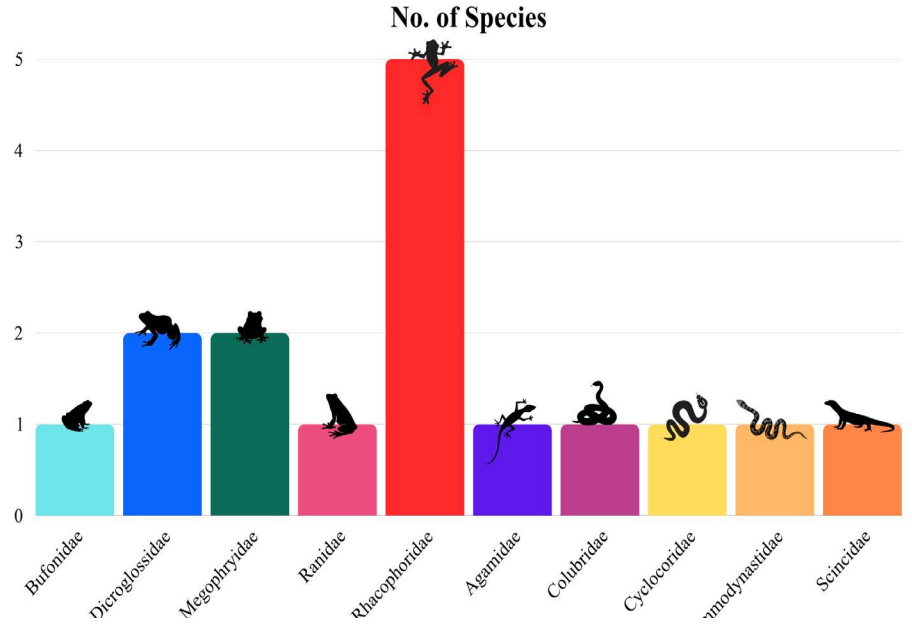

Figure 3. Number of amphibian and reptile species recorded per family in LRWFR. Bar heights indicate species richness for each family, with silhouettes representing representative taxa: Bufonidae (1), Dicroglossidae (2), Megophryidae (2), Ranidae (1), Rhacophoridae (5), Agamidae (1), Colubridae (1), Cyclocoridae (1), Psammodynastidae (1) and Scincidae (1).

The most abundant species recorded during the survey was *P. acutirostris*, accounting for a relative abundance (RA) of 26.26%. This was followed by *P. leitensis* (RA = 16.16%) and *P. surdus* (RA = 16.16%). Together, these three species comprised more than half of all amphibian observations, indicating that local microclimatic and habitat conditions strongly favor these small tree frogs of the genus *Philautus*. The dominance of these arboreal species may also reflect the structural complexity of the lower montane forest, where dense understory

vegetation, moss-covered shrubs, and small trees provide suitable calling perches and breeding microhabitats. Furthermore, amphibians were encountered more frequently than reptiles throughout the survey period. This pattern is likely associated with the persistent rainfall experienced during the sampling duration, which increased amphibian activity, facilitated calling behavior, and enhanced detectability during nocturnal visual encounter surveys. In contrast, many reptile species, particularly diurnal or heliothermic taxa, tend to be less active or more cryptic during wet, cool conditions, thereby lowering their detection rate.

Species accounts

This section details the amphibian and reptile species documented during the survey in the Libungan River Watershed Forest Reserve (LRWFR). Each species account summarizes taxonomy, diagnostic morphological characteristics, distribution, habitat preference, and ecological notes based on field observations and relevant literature. Additionally, insights into microhabitat use and local occurrence are provided to contextualize species presence within the watershed landscape.

AMPHIBIA

Family Bufonidae

***Pelophryne brevipes* (Peters 1867) (Figure 4A)**

This tiny bufonid species is commonly known as the *Zamboanga* Flathead Toad and is endemic to the Mindanao Pleistocene Aggregate Island Complex (PAIC) region. Specifically, it is found on mainland Mindanao and Basilan Island (Sanguila *et al*., 2016). The snout-vent length (SVL) of adult *P. brevipes* reaches up to 16 mm for males and 17 mm for females (Inger and Stuebing, 2009). Morphologically, it features expanded yet truncate finger discs, and males bear mandibular spines. Based on original descriptions, its call is a brief, soft "beep" (Sanguila *et al*., 2016). In this area, *P. brevipes* was found to inhabit secondary-growth edge habitats, where it perches on shrubs and understory foliage, such as *Alocasia* sp., near small streams.

Family Dicroglossidae

***Limnonectes magnus* (Stejneger, 1910) (Figure 4B)**

This species is a large-bodied fanged frog that is endemic to the Mindanao PAIC region, thus commonly known as Mindanao fanged frog (Abraham *et al.,* 2021). The *L. magnus* being large bodied can reach up to 180 mm SVL, which is also the reason why the species was hunted for food consumption. This is also the reason why they are classified by IUCN (2025) as a Near Threatened species. Given its name, this species possess fang like odontoids on the lower jaw, hence "fanged" (Abraham *et al.,* 2021). Apart from this, it also has a well-developed webbed feet that help them adapt to water bodies such as flowing streams, thriving in lowland rice paddies to lowland forest areas (Sanguila *et al.,* 2016; Flores *et al.,* 2025). In this study, several individuals of the *L. magnus* were observed on the small stream hiding beneath the shrubs and leaf litters.

***Occidozyga laevis* (Günther, 1858) (Figure 4C)**

This species is a small, squat, and stocky frog placed within the genus *Occidozyga* based on a combination of external morphology, bioacoustics, and molecular data (Köhler *et al.,* 2021). Males reach up to 31 mm SVL, while females may attain 48 mm (Inger and Stuebing, 2005; Frost, 2025). Morphologically, it can be distinguished by a stout body with a proportionally small head, fully webbed toe, short and robust limbs, upwardoriented eyes (Alcala and Brown, 1998), dorsally corrugated skin with tuberculate protrusions (Inger and

Stuebing, 2005), and a rounded snout (Iskandar *et al*., 2011). In terms of coloration, the *P. laevis* exhibits a dark gray to brown, with the ventral surface of the head speckled dark gray. A yellow tinge may also be present on the venter and the undersides of the thighs (Inger and Stuebing, 2005). This species was also recorded in numerous studies and occupies aquatic microhabitats, such as swamp edges, paddy fields, and slow-flowing streams in agricultural and forest settings underscoring its ecological specialization (Pitogo *et al.,* 2021; Acuevas and Buenavista, 2023; Flores *et al.,* 2025).

Family Megophryidae

***Leptobrachium lumadorum* (Brown, Siler, Diesmos and Alcala, 2010) (Figure 4D)**

This megophryid species is medium in size, generally the SVL of the adults reaches up to 50-70 mm. Morphologically, it can be distinguished through its stocky build, granular dorsal skin and comparatively large eyes (Brown *et al.,* 2009). Most documented occurrences of the species come from secondary forests, lower and upper montane forests, where it appears to be most frequently encountered (Sanguila *et al.,* 2016; Pitogo *et al.,* 2021; Flores *et al.,* 2025) This species is considered to be endemic in Mindanao PAIC region from which it can be found in mainland Mindanao and Basilan island, typically in riparian microhabitats near small streams or seepage zones (Brown *et al.,* 2009). A tadpole survey in Mt. Hamiguitan also documented this species to have a larval developmental abberation having reversed spiracle orientation (Lorenzo and Diesmos, 2018), highlighting both the typical lotic breeding ecology and potential developmental variations in larval stages. However, no formal larval description was made to date. This species was also considered as Least Concern by the IUCN (2025). In the study area, the *L. lumadorum* was found in the grassland near the camp, as well as in the forest floor that have leaf litters.

***Pelobatrachus stejnegeri* (Taylor, 1920) (Figure 4E)**

This species is a large-bodied horned frog which its SVL reaches up to 120mm, apart from this, it features a depressed, oblong body with prominent cranial "horns" and dorsolaterally placed eyes (Sanguila *et al.,* 2016; Pitogo *et al.,* 2021). The *P. stejnegeri* usually utilized lowland and primary forests at 200–1,000 m elevation, typically near streams for foraging and breeding (Flores *et al.,* 2025). Larval morphology was also recently described: tadpoles (28–37 mm Total Length) exhibit an oblong–depressed body, medial vent tube, pointed dorsal fin, and a distinctive bitriangular oral disc or umbelliform which it uses to filter-feed and adhere to substrates, a first formal description for this species (Flores *et al.,* 2023b). In the study area, individuals of this species were found in leaf litters, grasslands and bare grounds.

Family Ranidae

***Pulchrana grandocula* (Taylor, 1920) (Figure 4F)**

This medium-sized ranid species is commonly known as the Big-eyed Frog due to its proportionally large eyes, an adaptation to its nocturnal, stream-dwelling lifestyle (Frost, 2025). Morphologically, the snout-vent length (SVL) of *Pulchrana grandocula* ranges from 40 to 60 mm. The species is characterized by a slender body, a distinct tympanum, long limbs, and partial toe webbing (Sanguila *et al*., 2016; Solania and Fernandez-Gamalinda, 2018). It typically features an olive-brown dorsal coloration, often accompanied by fine patterning or spotting (Pitogo *et al*., 2021). *P. grandocula* is currently listed as Least Concern (IUCN, 2025) due to its stable population and widespread distribution in the southern Philippines (endemic to the Mindanao PAIC region), including Basilan, Bohol, Camiguin Sur, Dinagat,

Samar, Siargao, and Mindanao (Sanguila *et al*., 2016; Frost, 2025). This species typically inhabits lowland to montane riparian zones, including streams, rivers, and associated forested microhabitats, thriving in both disturbed and undisturbed forests (Sanguila *et al*., 2016; Flores *et al*., 2025). In the study area, it was commonly recorded in arboreal microhabitats, such as on ferns and shrubs.

Family Rhacophoridae

***Nyctixalus spinosus* (Taylor, 1920) (Figure 4G)**

This species is commonly known as spiny tree frog, a small orange to reddish-brown tuberculate rhacophorid with an SVL ranging from 30–37 mm. Morphologically, this species can be distinguished by its numerous white dorsal tubercles, well-defined cranial and supratympanic crests, truncated and projecting snout with a pronounced canthus rostralis, large adhesive finger and toe discs with circum-marginal grooves, partially webbed toes, and rough granular dorsal skin marked with yellow to orange spotting across the head, body, and limbs (Taylor, 1920; Alcala and Brown, 1998). In the study area only one individual was recorded, which was found perching on understory shrubs.

***Philautus acutirostris* (Peters, 1867) (Figure 4H)**

This species is commonly known as Pointed-snouted Tree frog, a small rhacophorid frog with an SVL ranging from 20mm to 30mm. *P. acutirostris* is morphologically characterized by having a pointed triangular snout, slender body, unwebbed fingers, and moderately webbed toes (Brown and Alcala, 1994). This species is a Mindanao faunal region endemic species primarily distributed across mainland Mindanao, Jolo and Basilan islands (Brown and Alcala, 1994, Sanguila *et al.,* 2016; Frost, 2025) It inhabits arboreal microhabitats, perching mainly on understory vegetation including ferns, shrubs and other plants that is about 3 meters above ground (Pitogo *et al.,* 2021). It was also one of the most recorded species in numerous studies conducted in Mindanao (e.g. Plaza and Sanguila, 2015; Delima-Baron *et al.,* 2019; Baron *et al.,* 2021; Galolo, 2021; Delima-Baron *et al.,* 2024; Flores *et al.,* 2025). In the study area, multiple individuals were found along the understory plants including *Coffea* sp., ferns, etc. This species was also noted to be the most abundant anuran species in the study area.

***Philautus leitensis* (Boulenger, 1897) (Figure 4I)**

This species is commonly known as Leyte Bubble Nest Frog, also a small rhacophorid with an SVL of 20 mm to 30 mm. Being Mindanao faunal region endemic, this species inhabits montane forests of Mindanao, Bohol and Leyte between 1,100 and 1,150 meters elevation (Brown and Alcala, 1994; Sanguila *et al*., 2016). This species is characterized by having a rounded to slightly truncated snout, nostrils that are closer to the tip of the snout instead of the eye, webbed toes and smooth gular region but granular abdomen (Brown and Alcala, 1994; Beukema, 2011; Sanguila *et al*., 2016). It also occurs on the ground and low elevation in both fores interior and edge habitats which reflects its moderate tolerance to fragmentation (Sanguila *et al.,* 2016; Pitogo *et al.,* 2021). Its ecology and microhabitat preferences suggest reliance on complex understory vegetation and leaf litter, emphasizing the importance of intact forest structure for its conservation (Sanguila *et al.,* 2016). In the study area, this species was mostly recorded in understory plant vegetation showing arboreal habit.

***Philautus* cf. *poecilius* (Brown and Alcala, 1994) (Figure 4J)**

This species is commonly known as Mottled Tree Frog, a small bodied rhacophorid frog endemic to the Philippines, specifically in Mindanao Island (MFR endemic) (Sanguila *et al.,*

2016; Frost, 2025). Morphologically, this species can reach up to 20 mm to 30 mm, and are characterized by having a slender body, smooth skin and moderately webbed toes (Brown and Alcala, 1994). This species was recorded in montane and submontane forests including mossy forests perched on low vegetation and understory plants (Pitogo *et al.,* 2021; Dela Torre and Nuñeza, 2021). The *P. poecilius* exhibits a direct development, laying eggs on leaves or moss without a free-living tadpole stage, a reproductive mode common among *Philautus* species that reduces dependence on aquatic environments (Brown and Alcala, 1994; Bossuyt and Dubois, 2001). In the study area, this species was also found in arboreal microhabitats such as in fern and shrubs.

***Philautus surdus* (Peters, 1863) (Figure 4K)**

This species is commonly known as Luzon Bubble-Nest Frog, an ecologically versatile rhacophorid frog found in the Philippines and the most widely distributed *Philautus* in the country, with known records from Luzon, Catanduanes, Polillo, Bohol and Mindanao (Diesmos *et al.,* 2015; Pitogo *et al.,* 2021; Flores *et al.,* 2025). Because of its widespread distribution, the species was classified as Least Concern by the IUCN (2025). Morphologically, the *P. surdus* can be characterized by its large size and extensive toe webbings, and tubercles on the dorsum especially at shoulder level on either side (Brown and Alcala, 1994). Like other *Philautus*, this species also inhabits arboreal microhabitats such as ferns and shrubs (Delima-Baron *et al.,* 2019). The *P. surdus* also utilize the plant-associated microhabitats for perching, foraging, calling, and egg deposition. Its reproductive mode is direct development, with eggs laid on vegetation bypassing the free-living tadpole stage (Bossuyt and Dubois, 2001). In the study area, this species was also found in arboreal microhabitats.

REPTILIA

Family Agamidae

***Bronchocela cristatella* (Kuhl, 1820) (Figure 4L)**

This species is commonly known as Green Crested Lizard a native species in the Philippines and extends its distribution across Southeast Asia extending to Singapore, Peninsular Malaysia, Borneo, Sumatra. Java, Southern Thailand and Myanmar. Morphologically, this lizard is medium-sized (SVL 80–140 mm), slender, with a laterally compressed body, long limbs, long prehensile tail, small rhombic lateral scales pointing backward and downward, larger ventral scales, naked tympanum, nuchal crest present (lower dorsal crest sometimes reduced), fold of skin from jaw to upper arm insertion, and no head spines. This species occupies arboreal microhabitat and inhabits lowland to hilly dipterocarp forests and forest edges (Smith, 1935; Manthey and Grossmann, 1997; Teo and Thomas, 2019; Amarasinghe *et al.,* 2022). In the study area, only one individual was found in an arboreal microhabitat in a tree branch.

Family Colubridae

***Rhabdophis auriculatus* (Günther, 1858) (Figure 4M)**

This Mindano Faunal Region endemic species is commonly known as White-lined Water Snake, commonly found in different localities such as in Basilan, Bohol, Leyte, Samar and Mindanao. The species was known to have two described subspecies (Günther, 1858; Taylor, 1922; Leviton *et al.,* 2018; Uetz *et al.,* 2025), including the *R. a. auriculatus* and the *R. a myersi* (Leviton, 1970) which can be found in western Mindanao and recognized the nominate form from central and eastern Mindanao, Bohol, Samar, Leyte islands (Sanguila *et al.,* 2016; Leviton *et al*. 2018). This species generally differs to the other subspecies in the degree of light lateral body stripe (Weinell *et al.,* 2019) and widespread and abundant across

Mindanao (Pitogo *et al.,* 2021), thus its conservation status was considered as Least Concern by the IUCN (2025). In the study area, individuals of the species were found in shrubs and leaf litters near the small stream.

Family Cycloridae

***Cyclocorus nuchalis taylori* (Taylor, 1923) (Figure 4N)**

This species, commonly known as the southern triangle-spotted snake, is a Philippine endemic with two known subspecies, the *Cyclocorus nuchalis nuchalis* which is distributed across Basilan and western Mindanao and its congener, *C. n. taylori* which occurs in central and eastern Mindanao (Sanguila *et al*., 2016; Weinell *et al.,* 2019; Uetz *et al.*, 2025). This species was also recorded in different parts of the Philippines including Camiguin Sur, and Dinagat islands (Sanguila *et al.,* 2016) in addition to populations on Siargao Island (Ross and Lazell, 1990). Because of its wide distribution the *C. nuchalis taylori* was considered as Least Concern by the IUCN (2025). In the study area, individuals were observed in the ground leaf litters.

Family Psammodynastidae

***Psammodynastes pulverulentus* (Boie, 1827) (Figure 4O)**

This species is commonly known as common mock viper, a snake that can be found across Asia including Bangladesh, Cambodia, China, Hongkong, NE India, Indonesia, Laos, Nepal, Bhutan, Taiwan, Thailand and Vietnam. In the Philippines, this species was recorded in numerous areas such as in Balabac, Basilan, Bohol, Bongao, Busuanga, Dinagat, Jolo, Leyte, Luzon, Cebu, Mindanao, Negros, Palawan, Panay, Polillo, Samar (Sanguila *et al.,* 2016; Leviton *et al.,* 2018; Uetz *et al.,* 2025). This species is small (half a meter in length) with head distinct from its neck, large eyes and vertical pupil. While past records assigned the genus and species under family Dendrelaphidae (Boie, 1827), Lamprophiidae (Decena *et al.,* 2023b; Decena *et al.,* 2024), Pseudaspidinae (Pyron *et al.,* 2013) or Colubridae (Dieckmann *et al.,* 2013), recent study does not support this affiliation (Uetz *et al.,* 2025). The phylogenetic position of the genus *Psammodynastes* remained contentious until Das *et al.,* (2024) established that the genus belongs to a different clade then eventually assigned to the Family Psammodynastidae (Das *et al.,* 2024) which was supported by the study of Weinell *et al.* (2024). In the sampling area, individuals were found in arboreal positions in shrubs and ferns. Due to its widespread distribution, the species was considered as Least Concern by the IUCN (2025).

Family Scincidae

***Pinoyscincus jagori jagori* (Peters, 1864) (Figure 4P)**

This species is commonly known as Jagor's sphenomorphus, a skink that can be found only in the Philippines including Basilan, Bohol, Bubuan, (Tapiantana Group, Sulus), Camiguin (Sur), Catanduanes, Dinagat, Govenen (Great), Jolo (Sulus), Leyte, Lubang, Luzon, Maripipi, Mindanao, Mindoro, Samar, Siargao (Sanguila *et al.,* 2016; Uetz *et al*., 2025). Thus, considered as a Philippine endemic species (Sanguila *et al.,* 2016). The species also have a congener subspecies *P. j. grandis*, which can be found in Caluya, Cebu, Masbate, Negros, Panay, Sicogon, Gigante. This skink is a forest floor species that mainly utilizes terrestrial microhabitats, so it was frequently encountered in the ground or leaf litter in riparian areas and interior forest (Pitogo *et al.,* 2021; Decena *et al.,* 2023b). Morphologically, the species is a large to medium body size (> 42 mm SVL) (Linkem *et al.,* 2010, Linkem *et al.,* 2011). In the study area, this species was also encountered hiding along leaf litter layers during nocturnal survey.

Figure 4. Herpetofauna recorded in the Libungan River Watershed Forest Reserve (LRWFR), North Cotabato, Philippines. Amphibia: Family Bufonidae: A, *Pelophryne brevipes*. Family Dicroglossidae: B, *Limnonectes magnus*; C, *Occidozyga laevis*. Family Megophryidae: D, *Leptobrachium lumadorum*; E, *Pelobatrachus stejnegeri*. Family Ranidae: F, *Pulchrana grandocula*. Family Rhacophoridae: G, *Nyctixalus spinosus*; H, *Philautus acutirostris*; I, *Philautus leytensis*; J, *Philautus* cf. *poecilius*; K, *Philautus surdus*. Reptilia: Family Agamidae: L, *Bronchocela cristatella*. Family Colubridae: M, *Rhabdophis auriculatus*. Family Cyclocoridae: N, *Cyclocorus nuchalis taylori*. Family Psammodynastidae: O, *Psammodynastes pulverulentus*. Family Scincidae: P, *Pinoyscincus jagori jagori*.

This assessment provides the first formal account of the amphibians and reptiles of the Libungan River Watershed Forest Reserve (LRWFR), an important but previously undocumented part of the Libungan-Alamada Natural Biotic Area (LANBA). The presence of 16 amphibian and reptile species, including 11 endemic to the Mindanao Faunal Region and two endemic to the Philippines, underscores the ecological importance of the LRWFR as a refuge for both native and range-restricted herpetofauna. The high proportion of endemic species suggests that this area acts as a crucial microrefugium within North Cotabato's landscape mosaic (Frei *et al*., 2023; Guerrina *et al*., 2024). The presence of some montane and riparian specialist species, including *Leptobrachium lumadorum* and *Pelobatrachus stejnegeri*, as well as the Near Threatened *Limnonectes magnus*, highlights the importance

of intact riparian corridors, understory cover, leaf-litter substrates, and forest canopy for sustaining these sensitive anuran populations (Sanguila *et al*., 2016; Flores *et al*., 2025). Because these species are highly sensitive to forest degradation, temperature fluctuations, and hydrological changes, their presence suggests that parts of the LRWFR still provide suitable microclimatic conditions (Alcala *et al*., 2012; Almeria and Nuñeza, 2013; Aureo and Bande, 2019). Conversely, the presence of disturbance-tolerant species, such as *Occidozyga laevis* and *Psammodynastes pulverulentus*, reflects the patchy nature of habitat quality and the encroachment of agroforestry and grassland systems into formerly forested areas (Diesmos *et al*., 2004; Decena *et al*., 2023a; Frost, 2025). The presence of these species within LANBA highlights the critical need for continuous conservation efforts, particularly because the reserve forms part of the upper watershed feeding major river systems, including the Rio Grande de Mindanao and the Liguasan Marsh (BirdLife International, 2025). As bioindicators of ecosystem health (Alcala *et al*., 2012; Sanguila *et al*., 2016; Flores *et al*., 2024a), amphibians and reptiles further signal that LRWFR remains an important stronghold against ongoing landscape-level degradation in North Cotabato. However, anthropogenic pressures persist (Figure 5). Expanding agriculture, slash-and-burn practices, and the conversion of riparian zones pose growing threats to both amphibians and reptiles (Suarez and Sajise, 2010; Decena *et al*., 2023a; Densing and Matutes, 2024). Beyond its scientific contribution, this study offers findings with direct applications for wildlife management. The herpetofaunal assessment provided baseline biodiversity data that informed the Protected Area Suitability Assessment (PASA) and the watershed characterization of the Libungan River Watershed Forest Reserve. Furthermore, these results were presented to the watershed management council and relevant local government units to support conservation planning, resource management decisions, and future biodiversity monitoring initiatives within the watershed.

CONCLUSION

This study provides the first documented inventory of amphibians and reptiles within the Libungan River Watershed Forest Reserve (LRWFR) of the Libungan–Alamada Natural Biotic Area (LANBA) in North Cotabato, Mindanao. A total of 16 species were recorded, with a high proportion of Philippine and Mindanao endemics, underscores the ecological significance of the watershed as a refuge for regionally restricted herpetofauna. The presence of forest- and riparian-associated species, along with the near-threatened *Limnonectes magnus*, indicates that portions of the watershed still retain suitable microhabitats and environmental conditions necessary to sustain sensitive amphibian populations. Despite these findings, the presence of disturbance-tolerant species and visible anthropogenic pressures—such as agricultural expansion, slash-and-burn farming, and habitat modification—suggests that parts of the landscape are undergoing ecological transition. These threats could compromise habitat integrity and the long-term persistence of herpetofaunal communities if left unmanaged. Given that amphibians and reptiles are widely recognized as bioindicators of ecosystem health, their continued presence underscores both the conservation value of the LRWFR and the critical need for proactive management.

The results of this assessment fill a critical knowledge gap in Mindanao's herpetofaunal documentation, providing essential baseline data for biodiversity monitoring, environmental impact assessments, and conservation planning. Furthermore, targeted surveys across varying seasons, elevations, and microhabitats will likely reveal additional species, particularly cryptic or seasonally active taxa. Strengthening protected area management, integrating biodiversity data into local land-use planning, and promoting community-based conservation initiatives will be critical to ensuring the long-term preservation of LRWFR and the ecological integrity of the broader Mt. Piapayungan watershed.

Figure 5. Common anthropogenic threats documented within the Libungan River Watershed Forest Reserve (LRWFR), including extensive slash-and-burn farming, forest clearing, and agricultural expansion encroaching into natural habitats. These disturbances contribute to habitat fragmentation and the degradation of riparian and montane forest ecosystems critical to the area's herpetofauna.

RECOMMENDATIONS

While this study provides valuable baseline data, long-term monitoring is required to determine whether these patterns reflect seasonal variation or a trend of ecological decline. Nevertheless, these findings fill a critical knowledge gap and support ongoing regional conservation planning, offering essential insights for future ecological studies, environmental impact assessments, and local management interventions. Protecting LRWFR is essential to maintaining the ecological integrity of LANBA and the broader headwater systems connected to Mindanao's major rivers. In addition, these new locality records confirm that the Libungan River Watershed Forest Reserve and adjacent areas of the Mt. Piapayungan Range serve as critical refugia for Mindanao's endemic herpetofauna. The data further indicate that broader surveys are likely to uncover greater species richness, especially among cryptic or seasonally active taxa.

Furthermore, this study recommends strengthening protected area management within the LRWFR by strictly enforcing regulations against illegal logging, agricultural encroachment, and riparian clearing. It also advocates integrating baseline herpetofaunal data into LANBA's official management plan and establishing long-term monitoring through permanent plots across forest, stream, and agroforest gradients. Local community engagement is also encouraged through stewardship programs, citizen science, and sustainable land-use practices aimed at reducing habitat conversion. Finally, integrating these findings into local land-use planning—via enhanced municipal zoning, environmental impact assessments, and expanded buffer zones—will help conserve critical habitats like Lake Baranibud and the remaining forest patches within the LRWFR.

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