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Research Article

New Records and an Updated List of Amphibians from Ba Den Mountain, Tay Ninh Province, Vietnam

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ABSTRACT

Ba Den Mountain is one of the highest granitic mountains in southern Vietnam and hosts a great diversity of natural habitats and biodiversity potential. In the decades leading up to 2023, only 12 species of amphibians were recorded living on Ba Den Mountain, indicating an incomplete understanding of the amphibian diversity in the area. In 2023 and 2024, we conducted field trips to survey amphibians on Ba Den Mountain, Tay Ninh Province, Vietnam. Based on morphological examination, this study presents an updated checklist of 19 amphibian species from this area. Nine of them were recorded for the first time in Ba Den Mountain: *Glyphoglossus guttulatus*, *Microhyla butleri*, *Microhyla mukhlesuri*, *Micryletta erythropoda*, *Hylarana montosa*, *Hylarana erythraea*, *Chirixalus nongkhorensis*, *Kurixalus* sp., and *Theloderma vietnamense*. Three frogs were new provincial records: *Hylarana montosa*, *Chirixalus nongkhorensis*, and *Kurixalus* sp. Regarding its conservation status, *Glyphoglossus molossus* is listed as a Near Threatened species on both the IUCN Red List (2025) and Vietnam Red List of Threatened Species (IEBR 2025). The mountain's biodiversity is being threatened by tourism development without appropriate conservation measures in place. More surveys and further research are suggested to determine the impact of tourism not only amphibian survival but also on other animal and plant species.

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INTRODUCTION

Ba Den Mountain (known in English as "Black Lady Mountain") is an isolated granitic outcrop situated amidst agricultural land in Tay Ninh Province, southern Vietnam, covering an area of 1,730 hectares (Pham et al. 2000; Nguyen 2019). It is one of the highest granite mountains in southern Vietnam, with its highest peak up to 986 metres above sea level. It is totally isolated and surrounded by flat agricultural land (Pham et al. 2000). Due to the heterogeneity of its landforms, this mountain has a great diversity of both natural habitats and biodiversity potential. In the herpetofauna list of Vietnam, Bourret (1942) recorded eight species of amphibians in Tay Ninh Province. Nguyen and Ho (1996) and Pham et al. (2000) listed 12 records of amphibians in Ba Den Mountain, Tay Ninh Province. Pham et al. (2024) recorded *Occidozyga martensi* and analysed the feeding ecology of the species from the mountain. H.T.T. Nguyen et al. (2024) documented a new provincial record of *Microhyla ninhthuanensis* from this area as well as from Tay Ninh Province. Recently, Tran et al. (2025) observed a case of a leucistic tadpole of *Hoplobatrachus chinensis* in this area. Despite sporadic surveys over the past several decades, including recent efforts, no comprehensive assessment of the current amphibian diversity on Ba Den Mountain has been conducted.

In this study, we report nine new records and present an updated checklist for the amphibian fauna of Ba Den Mountain, Tay Ninh Province, Vietnam. Updating species lists is essential for improving our understanding of regional biodiversity, identifying the conservation status of species, taxonomic change, and detecting changes in species distribution over time, especially under the influence of habitat loss and climate change (Do et al. 2017; Krzikowski et al. 2022).

MATERIALS AND METHODS

Study Area and Field Survey

Ba Den Mountain (11°21'06"–11°24'37"N, 106°08'41"–106°11'28"E) is an isolated granite outcrop situated amidst agricultural land in Tay Ninh Province, southern Vietnam (Figure 1). The highest point of the mountain is 986 metres above sea level, making it the highest mountain in southern Vietnam, south of the Central Highlands. The top of the mountain is dominated by secondary tropical monsoon forest dotted with large boulders, caves, and crisscrossed by streams.

Fieldwork on Ba Den Mountain was carried out during 28–30 September 2023, 26–29 February 2024, 12–14 April 2024, and 16–20 July 2024. Each survey night involved 2–3 researchers with one local people and approximately six person-hours of active search effort between 18:00–23:00 hours. Frogs were collected by hand. After photographing live frogs with a Canon T7 camera equipped with a 60 mm macro lens, each specimen was fixed in 70 % ethanol for 24 hours, and then transferred to 70 % ethanol for storage. Liver tissue samples were preserved for future molecular analysis but were not used in the present study. Together, preserved specimens and liver tissue samples were deposited at the Institute of Life Sciences Collection of Zoology (ILS), Ho Chi Minh City, Vietnam.

Morphological examination and identification

Morphological examination: Measurements commonly used in amphibian studies followed Luong et al. (2022, 2025) and were taken on preserved specimens using dial callipers to the nearest 0.1 mm, including: snout-vent length (SVL); head length (HL), distance from posterior corner of mandible to tip of snout; maximum head width (HW); rostral length (RL), distance from anterior corner of orbit to tip of snout; eye diameter (ED); distance from nostril to the tip of snout (NS); distance from anterior corner of orbit to the nostril

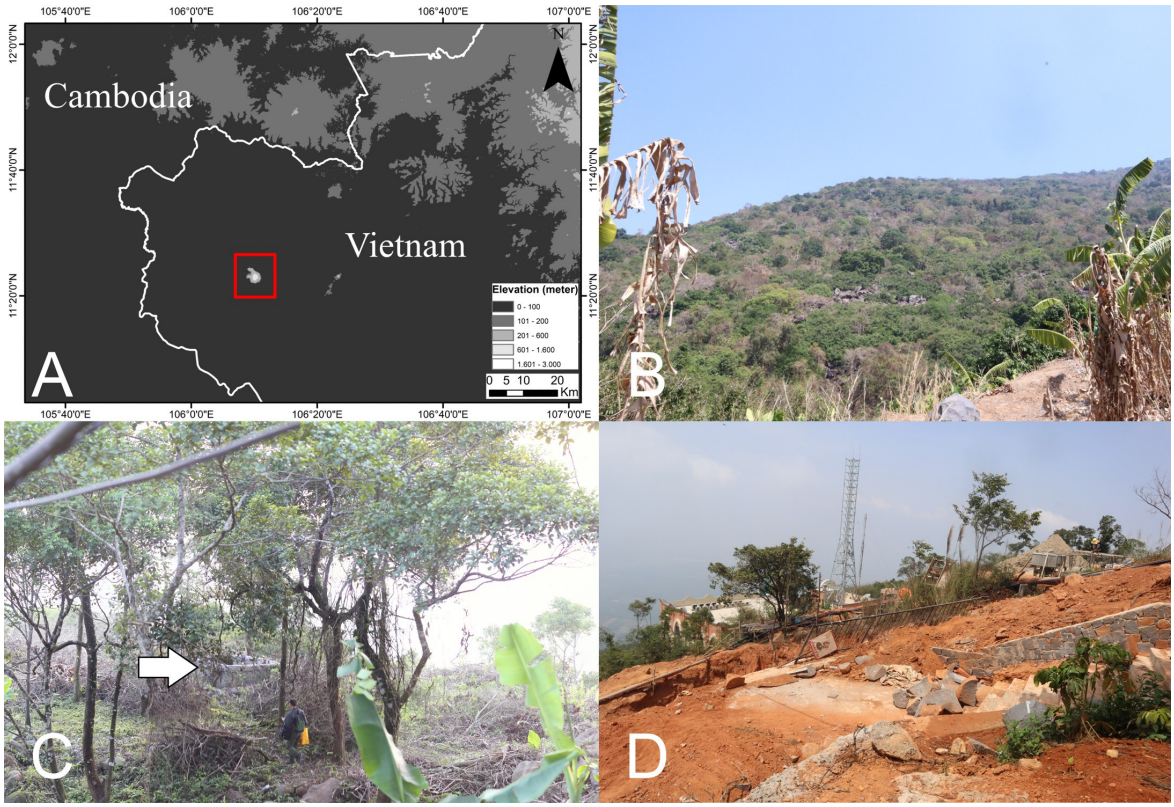

Figure 1. Ba Den Mountain: A. Location of Ba Den Mountain, Tay Ninh Province, Vietnam (red square), B. Habitat of Ba Den Mountain, C. A small artificial pool where *Theloderma vietnamense* was found (white arrow) on the top of mountain in April 2023, D. Deforesting for extensive construction on the top of mountain in February 2024.

(EN); interorbital distance (IOD); internasal distance (IND); maximum width of upper eyelid (UEW); distance between anterior corners of orbits (DAE); posterior margin of mandible to nostril (MN); posterior margin of mandible to anterior corner of orbit (MFE); posterior margin of mandible to posterior corner of orbit (MBE); distance between posterior corners of orbits (DPE); tympanum diameter (TD); distance from anterior margin of tympanum to posterior corner of orbit (TYE); upper arm length (UAL), distance from axilla to elbow; forearm length (FAL), distance from elbow to the tip of third finger; outer palmar tubercle length (OPT); medial palmar tubercle length (MPT); inner palmar tubercle length (IPT); femur length (FeL), from vent to knee; tibia length (TbL), distance from knee to tarsus; maximum tibia width (TbW); foot length (FoL), distance from tarsus to the tip of fourth toe; inner metatarsal tubercle length (IMT); outer metatarsal tubercle length (OMT). The webbing formula followed Savage and Heyer (1997). Sex was identified based on the presence of nuptial pads, internal vocal sac openings or examination of the gonads.

Species identification was based on the literature, including Bourret (1942), Tarkhnishvili (1994), Taylor (1962), Stuart et al. (2006), Hecht et al. (2013), Hasan et al. (2014), Poyarkov et al. (2015), Vassilieva et al. (2016), Sheridan and Stuart (2018), Hasan et al. (2019), Le et al. (2021), Poyarkov et al. (2021), Le et al. (2022), Luong et al. (2022), and V.D.H. Nguyen et al. (2024). Conservation status followed Vietnam Red List of Threatened Species (VNRL) (IEBR 2025), and the IUCN Red List of Threatened Species (IUCN 2025).

RESULTS AND DISCUSSION

Species composition

A total of 19 amphibian species representing six families and two orders were documented from Ba Den Mountain, Tay Ninh Province, Vietnam (Table 1). Among them, the family Microhylidae shows the highest diversity with seven

Table 1. List of amphibian species recorded in Ba Den Mountain, Tay Ninh Province, Vietnam.

Number	Species name	Previous records	IUCN (2025)	VNRL (2025)
	Order Gymnophiona			
	Familia Ichthyophiidae Taylor, 1968			
1	*Ichthyophis* cf. *kohtaoensis* Taylor, 1960+	1	DD	
	Order Anura			
	Familia Bufonidae Gray, 1825			
2	*Duttaphrynus melanostictus* (Schneider, 1799)	1, 5	LC	
	Familia Dicroglossidae Anderson, 1871			
3	*Occidozyga lima* (Gravenhorst, 1829)	1, 5	LC	
4	*Occidozyga martensii* (Peters, 1867)	2, 5	LC	
5	*Fejervarya limnocharis* (Gravenhorst, 1829)	1, 5	LC	
6	*Hoplobatrachus chinensis* (Osbeck, 1765)	1, 4, 5		
	Familia Microhylidae Günther, 1858 (1843)			
7	*Glyphoglossus guttulatus* (Blyth, 1856)*	5	LC	
8	*Glyphoglossus molossus* Günther, 1869	1, 5	NT	NT
9	*Kaloula pulchra* Gray, 1831	1, 5	LC	
10	*Microhyla butleri* Boulenger, 1900*	5	LC	
11	*Microhyla mukhlesuri* Hasan, Islam, Kuramoto, Kurabayashi, and Sumida, 2014*	5	LC	
12	*Microhyla ninhthuanensis* Hoang, Nguyen, Ninh, Luong, Pham, Nguyen, Orlov, Chen, Wang, Ziegler, and Jiang, 2021	3, 5		
13	*Micryletta erythropoda* (Tarkhnishvili, 1994)*	5	LC	
	Familia Ranidae Batsch, 1796			
14	*Hylarana erythraea* (Schlegel, 1837)*	5	LC	
15	*Hylarana montosa* (Sheridan and Stuart, 2018)**	5	LC	
	Familia Rhacophoridae Hoffman, 1932 (1858)			
16	*Chirixalus nongkhorensis* (Cochran, 1927)**	5	LC	
17	*Kurixalus* sp. **	5	LC	
18	*Polypedates megacephalus* Hallowell, 1861	1, 5	LC	
19	*Theloderma vietnamense* Poyarkov, Orlov, Moiseeva, Pawangkhanant, Ruangsuwan, Vassilieva, Galoyan, Nguyen, and Gogoleva, 2015*	5	LC	

(* = new records for Ba Den Mountain; ** = new records for Ba Den Mountain and Tay Ninh Province; + = species recorded in previous studies but not found during our surveys; 1 = Pham et al. (2000), 2 = Pham et al. (2024), 3 = H.T.T. Nguyen et al. (2024), 4 = Tran et al. (2025), 5 = This study; IUCN (2025) = IUCN Red List of Threatened Species; VNRL (2025) = Vietnam Red List of Threatened Species; DD = Data Deficient, LC = Least Concern, NT = Near Threatened).

species, followed by Dicroglossidae (four species), Rhacophoridae (four species), Ranidae (two species), Bufonidae and Ichthyophiidae (one species each).

Updating the list of amphibians by Pham et al. (2000), nine species are recorded for the first time from Ba Den Mountain, including *Glyphoglossus guttulatus*, *Microhyla butleri*, *Microhyla mukhlesuri*, *Micryletta erythropoda*, *Hylarana montosa*, *Hylarana erythraea*, *Chirixalus nongkhorensis*, *Kurixalus* sp., and *Theloderma vietnamense*.

New records in Ba Den Mountain, Tay Ninh Province, Vietnam

Microhylidae

***Glyphoglossus guttulatus* (Blyth, 1856) (Figure 2A)**

Specimens examined (n=2): one adult male (ILS H.11178), 19 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh province (11°23'12"N; 106° 08'43"E); one adult female (ILS H.11177), 19 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'14"N; 106°08'34"E).

Diagnosis: morphological characteristics of the specimens match the descriptions of Taylor (1962) and Vassilieva et al. (2016). Head short, mouth narrow, eye small; canthus rostralis indistinct; vomerine teeth present. Tympanum indistinct, supratympanic fold present. Limbs short; interdigital webbing absent on hands and very shallow on feet. Inner metatarsal tubercle prominent, spade-shaped; outer metatarsal tubercle present. Skin slightly granulated. Body coloration varies from brown to orange with dark blotches with different sizes and shapes on back; ventral surface white.

Description: body moderate (SVL 33.08 mm in male; 36.95 mm in female), roughly triangular in shape; head wider than long (HL/HW 0.72–0.76); snout blunted dorsally; nostrils round, closer to the tip of snout than to eye (NS/EN 0.96–0.97); canthus rostralis indistinct, lore oblique, not concave; vomerine teeth present; pupil diamond-shaped; interorbital distance 1.30–1.46 times broader than internarial, and 1.37–1.53 times broader than upper eyelid; tympanum indistinct. Forelimbs slender (FLL 4.38–6.02 mm), hand length (HAL 14.81–17.52 mm), relative finger lengths I<II<IV<III, tips of fingers blunt-pointed; webbing absent; nuptial pad absent. Hindlimbs with thigh slender (FeL 15.81–16.56 mm), relative toe lengths I<II<V<III<IV, tips of toes pointed; webbing formula I0 – 2II1½ – 3III2 – 3¾IV3¾ – 2V; tibiotarsal articulation reaching behind the eye at mandible when leg adpressed along body; outer metatarsal tubercle present. Skin: dorsal skin slightly granulated; supratympanic fold present; venter smooth.

Colour in life: dorsal surfaces brown to orange with dark blotches on the back; a dark brown stripe runs along the upper part of the supratympanic fold; limbs with dark brown crossbars dorsally; venter white with throat darker in males.

Natural history notes: specimens were found between 08:30 pm to 09:00 pm on the ground near a lake at the base of the mountain. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.

Distribution: in Vietnam, this species has been reported from Kon Tum and Gia Lai southwards to Dong Nai and Ba Ria–Vung Tau provinces. Elsewhere, this species occurs in Cambodia, Laos, Myanmar, Malaysia, and Thailand (Nguyen et al. 2009; Vassilieva et al. 2016).

***Microhyla butleri* Boulenger, 1900 (Figure 2B)**

Specimens examined (n=3): two adult females (ILS H.11133, 11138), 15 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'14"N; 106°08'37"E); one male ILS H.11179, 18 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'12"N; 106°08'43"E).

Diagnosis: morphological characteristics of the specimens match the descriptions of Bourret (1942), Hecht et al. (2013) and Luong et al. (2022). Body small, triangular; eye small; canthus rostralis indistinct; vomerine teeth absent. Tympanum indistinct, supratympanic fold present. Interdigital webbing absent on hands and shallow on feet; tips of fingers with notable grooves except the first. Inner and outer metatarsal tubercles present. Skin smooth with some smooth flattened pustules. Body brown; a double X-shaped marking present with white outline on back, ventral surface cream.

Description: body small, triangular (SVL 21.40 mm in male; 21.50–22.35 mm in females); head triangular, longer than wide (HL/HW 1.01–1.05); nostrils round, closer to the tip of snout than to eye (NS/EN 0.82–0.92); canthus ros-

tralis indistinct, lore oblique, not concave; vomerine teeth absent; pupil horizontal; interorbital distance 1.04–1.31 times broader than internarial, and 1.22–1.73 times broader than upper eyelid; tympanum indistinct. Forelimbs slender (FLL 3.67 – 3.81 mm), hand length (HAL 8.70–9.00 mm), relative finger lengths I<II<IV<III, tips of fingers pointed with notable grooves present on tips of three fingers II–IV; webbing absent; nuptial pad absent. Hindlimbs with thigh slender (FeL 10.47–10.87 mm), relative toe lengths I<II<V<III<IV; webbing formula I2 – 2½II1¾ – 3III2⅓ – 3½IV3½ – 2¼V; tibiotarsal articulation reaching to the middle of eye when leg adpressed along body. Skin: dorsal skin smooth with some rather large smooth flattened pustules; supratympanic fold distinct; venter smooth with cloacal region granular.

Colour in life: dorsum and flank brownish with reddish tubercles; a double X-shaped marking on back, darker than ground colour, and outlined with a white band; a white stripe from eye to beginning of arm; limbs with dark transverse bars dorsally; venter cream with throat darker in males than in females.

Natural history notes: specimens were found between 07:30 pm and 08:30 pm on the ground under dry leaves. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.

Distribution: in Vietnam, this species has been reported from Bac Kan, Lao Cai, and Ha Giang southwards to Ho Chi Minh City, Dong Nai, and Ba Ria – Vung Tau provinces. Elsewhere, this species occurs in Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Singapore, Taiwan, and Thailand (Vassilieva et al. 2016; Frost 2025).

***Microhyla mukhlesuri* Hasan, Islam, Kuramoto, Kurabayashi, and Sumida, 2014 (Figure 2C)**

Specimens examined (n=2): one adult female (ILS H.11136) and one adult male (ILS H.11137) 18 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'12"N; 106°08'43"E).

Diagnosis: morphological characteristics of the specimens match the descriptions of Hasan et al. (2014) and Le et al. (2021). Body small, triangular; eye small; canthus rostralis indistinct; vomerine teeth absent. Tympanum indistinct, supratympanic fold present. Interdigital webbing absent on hands and shallow on feet; tips of fingers lacking grooves. Inner and outer metatarsal tubercles present. Skin smooth with some smooth flattened pustules. Body brown; a double X-shaped marking present on back, darker than ground colour without a white band outlined; ventral surface white.

Description: body small, robust, triangular (SVL 23.48 mm in female; 19.89 mm in male); head triangular, slightly longer than wide (HL/HW 1.03–1.08); snout rounded; nostrils round, closer to the tip of snout than to eye (NS/EN 0.73–0.79); canthus rostralis round, indistinct, lore sloping, and weakly concave; vomerine teeth absent; pupil horizontal; interorbital distance 1.11–1.28 times broader than internarial, and 1.36–1.45 times broader than upper eyelid; tympanum indistinct. Forelimbs slender (FLL 3.13–3.79 mm), hand length (HAL 8.05–8.23 mm), relative finger lengths I<II<IV<III, tips of fingers pointed, lacking grooves; webbing absent; nuptial pad absent. Hindlimbs with thigh slender (FeL 10.54–10.58 mm), relative toe lengths I<II<V<III<IV; webbing formula I2 – 2⅓II2 – 3⅓III3 – 4IV4 – 3V; tibiotarsal articulation reaching the posterior edge or middle of the eye when leg adpressed along body. Skin: dorsal skin smooth with some smooth flattened pustules; supratympanic fold distinct; ventral skin smooth.

Colour in life: dorsum light brown; a double X-shaped marking on the back, darker than ground colour without a white band outlined; flank with a black band from snout to groin, but interrupted at the post corner of eyes; limbs with dark transverse bars dorsally; venter whitish with a few very small

speckles on the throat.
Natural history notes: specimens were found between 07:30 pm and 09:00 pm on the ground under dry leaves. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.
Comment: Pham et al. (2000) reported *M. ornata* in Ba Den Mountain, Tay Ninh Province, Vietnam. However, this species is restricted to South Asia, and applied *M. fissipes* Boulenger, 1884 is applied for populations in China and South Asia (Nguyen et al. 2009). Recently, Yuan et al. (2016) discussed how Pleistocene climatic fluctuations and the Red River barrier shaped the genetic structure of the *Microhyla fissipes* complex (*M. mukhlesuri* and *M. fissipes*); and documented that *M. fissipes* is not found west or south of the Red River in Yunnan, China and Vietnam.
Distribution: in Vietnam, this species has been reported west and south of the Red River (Yuan et al. 2016; Frost 2025). Elsewhere, this species occurs in Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, and Thailand (Frost 2025).

Micryletta erythropoda **(Tarkhnishvili, 1994) (Figure 2D)**
Specimens examined (n=2): two adult males (ILS H.11140, 11141), 15 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'14"N; 106°08'37"E).
Diagnosis: morphological characteristics of the specimens match the descriptions of Tarkhnishvili (1994), Poyarkov et al. (2021) and V.D.H. Nguyen et al. (2024). Body small, oval; eye small; canthus rostralis rounded; vomerine teeth absent. Tympanum distinct, round, supratympanic fold very indistinct. Interdigital webbing absent on hands and very shallow on feet; tips of fingers lacking grooves. Inner and outer metatarsal tubercles present. Skin smooth with tiny and flat tubercles posteriorly. Body brick red or pinkish with many black blotches; ventral cream.
Description: body small, oval (SVL 24.04–25.81 mm in males); head triangular, wider than long (HL/HW 0.91–0.95); snout obtuse, rounded dorsally; nostrils oval, closer to the tip of snout than to eye (NS/EN 0.59–0.64); canthus rostralis rounded, and distinct, lore slightly concave; vomerine teeth absent; pupil round; interorbital distance 1.16–1.27 times broader than internarial, and 1.17–1.35 times broader than upper eyelid; tympanum distinct, round. Forelimbs slender (FLL 4.24–5.19 mm), hand length (HAL 9.21–11.09 mm), relative finger lengths I<II<IV<III, tips of all fingers rounded; webbing absent; nuptial pad absent. Hindlimbs with thigh slender (FeL 8.69 – 8.96 mm), relative toe lengths I<II<V<III<IV; rudimentary web between toes II–III and III–IV; tibiotarsal articulation reaching to posterior edge of tympanum or middle of eye when leg adpressed along body; outer metatarsal tubercle present. Skin: dorsal skin smooth above, posteriorly scattered with tiny and flat tubercles on dorsum of body, flanks, and hindlimbs; supratympanic fold indistinct; ventral skin of body and limbs smooth.
Colour in life: dorsum brick red to pinkish with black blotches; a black patch present from snout to flank with white blotches below the eye and tympanum areas; venter cream with throat notably darker.
Natural history notes: specimens were found at 07:30 pm on grass next to a small puddle. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.
Comment: in the past, the *Micryletta* population on Ba Den Mountain, Tay Ninh Province was identified as *M. inornata* (Pham et al. 2000; Nguyen et al. 2009). Recently, *Micryletta erythropoda* was shown to be a species distinct from *M. inornata* based on molecular evidence and morphology from the type locality in Dong Nai Province (Poyarkov et al. 2018). Poyarkov et al. (2021) indicated the species' presence in various provinces of Vietnam, including Kon

Tum, Gia Lai, Dak Lak, Binh Phuoc, Ba Ria-Vung Tau, Tay Ninh, An Giang, and Kien Giang, without molecular or morphological evidence. V.D.H. Nguyen et al. (2024) recorded *M. erythropoda* in Dak Nong Province, Vietnam based on both molecular and morphological evidence. This study confirms the distribution of *M. erythropoda* in Ba Den Mountain, Tay Ninh Province, and suggests the previous record is misidentified. We noted the presence of an outer metatarsal tubercle (vs. absent in *M. inornata*), foot webbing rudimentary (vs. absent), supratympanic fold indistinct (vs. rather indistinct), lateral sides of head dark brown with white spots (vs. brown with silver white line along upper lip).
Distribution: in Vietnam, this species has been reported from the lowlands of southern Vietnam. Elsewhere, this species is possibly found in Cambodia and Laos (Frost 2025).

***Hylarana erythraea* (Schlegel, 1837) (Figure 2E)**
Specimen examined (n=1): one adult female (ILS H.11142), 15 July 2024, Ba Den Mountain, Ninh Son Ward, Tay Ninh Province (11°23'09"N; 106° 08'34"E).
Diagnosis: morphological characteristics of the specimen match the descriptions by Hasan et al. (2019). The body is moderated in size. Canthus rostralis distinct, lore concave; vomerine teeth present. Tympanum distinct, round, supratympanic fold present. Interdigital webbing absent on hands and present on feet; tips of fingers and toes fingers extend to disks with circummarginal grooves. Inner and outer metatarsal tubercles present. Skin smooth, dorsolateral folds present. Body green with a pair of distinct brown and white stripes along dorsolateral folds; ventral white.
Description: body moderated (SVL 52.2 mm); head triangular, longer than wide (HL/HW 1.18); snout pointed dorsally; nostrils round, closer to the tip of snout than to eye (NS/EN 0.64); canthus rostralis distinct, lore concave; vomerine teeth present; pupil horizontal; interorbital distance 0.90 times broader than internarial, and 0.97 times narrower than upper eyelid; tympanum distinct, rounded. Forelimbs slender (FLL 10.02 mm), hand length (HAL 26.06 mm), relative finger lengths I<II<IV<III, tips of fingers extend to small disks with circummarginal grooves; webbing absent; nuptial pad absent. Hindlimbs with thigh slender (FeL 26.08 mm), relative toe lengths I<II<V<III<IV, tips of toes extend to ogival-shaped disks with circummarginal grooves; webbing formula I0 – 1II0 – 2III0 – 2IV2 – 0V; tibiotarsal articulation reaching between eye and nostril when leg adpressed along body; outer metatarsal tubercle present. Skin: dorsal skin smooth; supratympanic fold present; dorsolateral folds distinct and thick, from behind the eye to groin; venter smooth.
Colour in life: dorsal surfaces green with a pair of distinct brown stripes along the white inner side of the dorsolateral folds; limbs brown dorsally; venter white.
Natural history notes: specimen was found at 08:00 pm on the ground next to a big lake at the base of the mountain. The surrounding habitat was mixed by secondary forest of small hardwoods and shrubs, with some local refreshment stalls around the area to cater to tourists.
Distribution: in Vietnam this species has been reported from Lao Cai, and Da Nang southwards to Ba Ria – Vung Tau, and Kien Giang Provinces (Nguyen et al. 2009). Elsewhere, this species occurs in Brunei, Bangladesh, Cambodia, Indonesia, India, Laos, Malaysia, Myanmar, Singapore, Thailand, and the Philippines (Frost 2025).

***Hylarana montosa* (Sheridan and Stuart, 2018) (Figure 2F)**
Specimen examined (n=1): one adult male (ILS H.11085) 26 February 2024,

Ba Den Mountain, Ninh Son ward, Tay Ninh province (11°22'19"N; 106° 10'01"E).

Diagnosis: morphological characteristics of the specimen match those described by Sheridan and Stuart (2018) and Le et al. (2022). The body is moderate in size. Canthus rostralis distinct, lore concave; vomerine teeth present. Tympanum distinct, round, supratympanic fold present. Interdigital webbing absent on hands and present on feet; tips of fingers and toes fingers extend to disks with circummarginal grooves. Inner and outer metatarsal tubercles present. Skin smooth, dorsolateral folds present. Body brown with dark brown spots, dark stripes continue along dorsolateral folds; ventral surface has brown mottling.

Description: body moderated in size (SVL 50.02 mm); head triangular, longer than wide (HL/HW 1.09); snout pointed dorsally; nostrils round, closer to the tip of snout than to eye (NS/EN 0.90); canthus rostralis distinct, lore concave; vomerine teeth present; pupil horizontal; interorbital distance 0.59 times broader than internarial and 0.79 times narrower than upper eyelid; tympanum distinct, rounded. Forelimbs slender (FLL 8.91 mm), hand length (HAL 24.40 mm), relative finger lengths I<II<IV<III, tips of fingers extend to small disks with circummarginal grooves; webbing absent; nuptial pad present. Hindlimbs with slender thigh (FeL 25.39 mm), relative toe lengths I<II<V<III<IV, tips of toes extend to small disks with circummarginal grooves; webbing formula I0 – 1½II0 – 2III0 – 2IV1 – 0V; tibiotarsal articulation reaching posterior edge of nostril when leg adpressed along body; outer metatarsal tubercle present. Skin: dorsal skin finely granular; supratympanic fold present; flanks slightly glandular; dorsolateral fold distinct, from behind the eye to groin; venter smooth.

Colour in life: dorsal surfaces brown with dark brown spots; dark stripes run from snout to the groin, broken posterior to axilla, continuing along dorsolateral fold; ventral surface with brown mottling; limbs have dark brown crossbars dorsally.

Natural history notes: the specimen was found calling at 08:30 pm in water of a puddle near a small stream. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.

Comment: Pham et al. (2000) reported *H. leptoglossa* in Ba Den Mountain, Tay Ninh Province, Vietnam. However, according to Frost (2025), *H. leptoglossa* only occurs in Myanmar, northeast India, Bangladesh, and adjacent western Thailand. In the past, the occurrence of this species in Vietnam was rejected. It was considered likely that the record was a misidentified *Rana nigrovittata* (now *Hylarana nigrovittata*) (Orlov et al. 2002; Frost 2025). Recently, Sheridan and Stuart (2018) redelimited the *Hylarana nigrovittata* complex, excluding *H. nigrovittata* from southern Vietnam and instead assigning southern records to *H. montosa*.

Distribution: in Vietnam, this species has been reported from Gia Lai, Lam Dong, and Ba Ria – Vung Tau Provinces (Sheridan & Stuart 2018; Le et al. 2022). This is the first record from Tay Ninh Province and confirms the distribution of *H. montosa* from Ba Den Mountain as well. Elsewhere, this species occurs in Cambodia, Laos, and Thailand (Sheridan & Stuart 2018; Frost 2025).

***Chirixalus nongkhorensis* (Cochran, 1927) (Figure 2G)**

Specimens examined (n=2): one adult male (ILS H.11164), 17 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh province (11°23'13"N; 106° 08'35"E); one adult male (ILS H.11182), 18 July 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'12"N; 106°08'43"E).

Diagnosis: morphological characteristics of the specimen match the descriptions of Taylor (1962), Stuart et al. (2006) and Vassilieva et al. (2016). The

body elongated with long slender limbs. Canthus rostralis distinct; vomerine teeth absent. Pupil horizontal. Tympanum distinct, round, supratympanic fold present. Interdigital webbing very shallow on hands and present on feet; tips of fingers and toes extend to disks with circummarginal grooves. Inner metatarsal tubercles present; outer metatarsal tubercles absent. Skin finely granular. Body yellow, brown pigments present less or more prominent; ventral surface uniform white.

Description: body elongated (SVL 24.04–25.81 mm); head triangular, depressed, slightly longer than wide (HL/HW 1.04–1.06); snout rounded; nostrils round, closer to the tip of snout than to eye (NS/EN 0.73–0.75); canthus rostralis distinct, lore concave; vomerine teeth absent; pupil horizontal; interorbital distance 1.19–1.33 times broader than internarial, and 1.45–1.59 times broader than upper eyelid; tympanum distinct, rounded. Forelimbs slender (FLL 3.90–4.42 mm), hand length (HAL 10.50–10.68 mm), relative finger lengths I<II<IV<III, tips of fingers extend to round discs, with circummarginal grooves; webbing formula I2 – 2II2 – 2III2 – 2IV with webbing between fingers I–II and II–III less prominent than between finger III-IV; nuptial pad absent. Hindlimbs with slender thigh (FeL 10.41–13.28 mm), relative toe lengths I<II<V<III<IV; webbing formula I2 – 2II1¼ – 2⅔III1¼ – 2IV1½ – 1V; tibiotarsal articulation reaching between eye and nostril when leg adpressed along body; outer metatarsal tubercle absent. Skin: dorsal and ventral skin finely granular; supratympanic fold present.

Colour in life: dorsal and lateral surfaces yellow with less or more prominent brown pigments; upper lip lighter than the ground colour; ventral surface immaculate white, margin of chin with dark spots; limbs with blurry crossbars.

Natural history notes: specimens were found at 09:00 pm on a small branch of a tree near a large lake at the base of the mountain. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.

Distribution: in Vietnam, this species is known from Lao Cai, Gia Lai, Dong Nai, Binh Thuan, Ba Ria – Vung Tau, and Kien Giang Provinces (Vassilieva et al. 2016; Le et al. 2022). This is the first record of *C. nongkhorensis* from Ba Den Mountain as well as from Tay Ninh Province. Elsewhere, this species occurs in Cambodia, China, India, Laos, Malaysia, Myanmar, and Thailand (Frost 2025).

***Kurixalus* sp. (Figure 2H)**

Specimen examined (n=1): one juvenile (ILS H.11017) 30 September 2024, Ba Den Mountain, Ninh Son ward, Tay Ninh Province (11°23'41"N; 106° 10'29"E).

Diagnosis: morphological characteristics of the specimen match the descriptions of genus *Kurixalus* as Nguyen et al. (2020), and Messenger et al. (2022) with small body size (SVL <50 mm), snout tip pointed, poorly developed webbing on fingers; moderately developed webbing on toes; tips of digits enlarged to discs, all bearing circummarginal grooves, serrated dermal fringes present on forearm and tarsus.

Description: body small (SVL 18.57 mm); head triangular, wider than long (HL/HW 0.96); snout pointed; nostrils round, closer to the tip of snout than to eye (NS/EN 0.71); canthus rostralis distinct, lore concave; vomerine teeth absent; pupil horizontal; interorbital distance 1.28 times broader than internarial, and 1.69 times broader than upper eyelid; tympanum distinct, rounded. Forelimbs slender (FLL 4.41 mm), hand length (HAL 8.75 mm), relative finger lengths I<II<IV<III, tips of fingers extend to disks round discs, with circummarginal grooves; webbing formula I2-2½II2-3½III2- 2IV with webbing between finger I–II and II–III less prominent than between finger III-IV; nuptial pad absent. Hindlimbs with thigh slender (FeL 8.9 mm), relative toe lengths I<II< III< V<IV; webbing formula I1½ – 2II1 – 2¼III1 – 2IV2 – 1V;

tibiotarsal articulation reaching between eye and nostril when leg adpressed along body; outer metatarsal tubercle absent. Skin: dorsal and ventral skin with very small tubercles; supratympanic fold present.
Colour in life: dorsal and upper lateral surfaces brown with some dark spots; lower lateral surface orange; ventral surface orange except throat and chest white with dense dark small spots.
Natural history notes: the specimen was found around 11:30 pm on tree leaves approximately two metres above the ground at an elevation of 252 m above sea level on the mountain. The surrounding habitat was mixed secondary forest of small hardwoods and shrubs.
Comment: our specimen is similar to *K. banaensis* and *K. montokawai* but it was juvenile. The lateral fringes on its limbs and its infra-cloacal tubercles were less developed, which are key characteristics used to separate *K. banaensis* from *K. montokawai* as Nguyen et al. (2014). Further surveys are needed to collect adult specimens to more precisely identify the species.
Distribution: in Vietnam, the *Kurixalus* genus is known from the north to southernmost Binh Phuoc Provinces (Nguyen et al. 2014; Frost 2025). This is the first record of *Kurixalus* species for both Ba Den Mountain and Tay Ninh Province. Elsewhere, this genus occurs in China, Myanmar, Thailand, Cambodia, Philippines, Japan, Malaysia, Indonesia, and Taiwan (Nguyen et al. 2020; Frost 2025).

***Theloderma vietnamense* Poyarkov, Orlov, Moiseeva, Pawangkhanant, Ruangsuwan, Vassilieva, Galoyan, Nguyen, and Gogoleva, 2015 (Figure 2I)**
Specimens examined (n=2): one adult male (ILS H.11000) and one adult female (ILS H.11003), 22 April 2023, Ba Den Mountain, Thanh Tan commune, Tay Ninh Province (11°22'54.7"N; 106°10'08.6"E).
Diagnosis: morphological characteristics of the specimens match the descriptions of Poyarkov et al. (2015). Body elongated. Canthus rostralis distinct, rounded; vomerine teeth absent. Pupil horizontal. Tympanum distinct, round, supratympanic fold present. Interdigital webbing very shallow on hands and present on feet; tips of fingers and toes extend to disks with circummarginal grooves. Inner metatarsal tubercles present; outer metatarsal tubercles absent. Skin rough with many calcified, white-tipped small pearly asperities. Body brown with numerous bluish-white asperities; a distinct dark-brown chevron of an inverted U-shaped presents on the back; ventral dark blackish-brown with bluish-white thin reticulations forming a network-like pattern.
Description: body elongated (SVL 29.36 mm in male; 34.52 mm in female); head triangular, longer than wide (HL/HW 1.08–1.11); snout truncated on dorsal view; nostrils oval, closer to the tip of snout than to eye (NS/EN 0.40–0.55); canthus rostralis relatively distinct, rounded; vomerine teeth absent; pupil horizontal, and diamond-shaped; interorbital distance 1.31–1.32 times broader than internarial, and 0.91–1.09 times broader than upper eyelid; tympanum distinct, rounded. Forelimbs slender (FLL 4.48–6.60 mm), hand length (HAL 14.99–13.02 mm), relative finger lengths I<II<IV<III, tips of fingers extend to wide disks round discs, with circummarginal grooves; webbing formula I2 – 2II1½ – 3III2 – 2IV; nuptial pad present in male and absent in female. Hindlimbs with slender thigh (FeL 15.93–17.74 mm), relative toe lengths I<II<III<V<IV; webbing formula I1 – 2II1 – 2III1 – 2¼IV2 – 1V; tibiotarsal articulation reaching between eye and nostril when leg adpressed along body; outer metatarsal tubercle absent. Skin: dorsal skin very rough with many calcified, white-tipped small pearly asperities, and dense on forehead and on the area posterior to tympanum, skin not co-ossified to skull; supratympanic fold present; ventral skin of thighs and posterior of belly is granular but smooth on chest and throat.

Colour in life: dorsum is brown with irregular brownish-black spots and covered with numerous bluish-white asperities; a distinct dark-brown chevron of an inverted U-shaped presents on the centre of the back with a rusty-brown anterior edge patch; a dark brown pelvic band presents on flank each side; rear of the dorsum, body flanks and dorsal side at the base of hindlimbs and around the tibiotarsal articulation have creamy-white background; forelimbs and hindlimbs have blackish-brown bands and dark brick-reddish discs dorsally; ventral side is dark blackish-brown with bluish-white thin reticulations forming a network-like pattern, with bluish speckles on the throat.
Natural history notes: specimens were found attached to the inner wall of a small artificial pool at an elevation of 951 m above sea level on the mountaintop. The surrounding habitat was a heavily disturbed mixed secondary forest of small hardwoods and shrubs.
Distribution: in Vietnam, this species is known from southern and central Vietnam (Poyarkov et al. 2015; Frost 2025). Elsewhere, this species occurs in Cambodia, Laos, and Thailand (Ginal et al. 2023; Frost 2025).

Taxonomic changes

Ichthyophis glutinosus: Pham et al. (2000) reported *I. glutinosus* from Ba Den Mountain, Tay Ninh Province, Vietnam. However, this species is distributed only in central and southern Sri Lanka (Frost 2025). Orlov et al. (2002) suggested that *I. glutinosus* population from Vietnam is actually *I. bannanicus*. Recently, Nishikawa et al. (2021) synonymised *I. bannanicus* with *I. kohtaoensis* based on molecular evidence. Therefore, we suggest that the previous record

Figure 2. New records of amphibian on Ba Den Mountain: **A.** *Glyphoglossus guttulatus* (ILS H.11178), **B.** *Microhyla butleri* (ILS H.11138), **C.** *Microhyla mukhlesuri* (ILS H.11137), **D.** *Micryletta erythropoda* (ILS H.11140), **E.** *Hylarana erythraea* (ILS H.11142), **F.** *Hylarana montosa* (ILS H.11085), **G.** *Chirixalus nongkhorensis* (ILS H.11182), **H.** *Kurixalus* sp. (ILS H.11017), and **I.** *Theloderma vietnamense* (ILS H.11003).

of *I. glutinosus* by Pham et al. (2000) should be re-identified as *Ichthyophis* cf. *kohtaoensis* but requires further study to determine the exact species.

Microhyla palmipes: Pham et al. (2000) reported *M. palmipes* in Ba Den Mountain, Tay Ninh Province, Vietnam. Bain and Nguyen (2004) considered the occurrence of this species in Vietnam unjustified and excluded it from the herpetofauna of Vietnam. According to Frost (2025), *M. palmipes* is only known from Sumatra, Nias, Java, and Bali, Indonesia. In our surveys, we did not encountered any *Microhyla* species that look similar to *M. palmipes*. Therefore, we suggest re-identify the previous record of *M. palmipes* by Pham et al. (2000) as *Microhyla* cf. *palmipes* on the list of amphibian species in Ba Den Mountain, Tay Ninh Province, Vietnam.

Polypedates leucomystax: Pham et al. (2000) reported *P. leucomystax* in Ba Den Mountain, Tay Ninh Province, Vietnam. Kuraishi et al. (2012) indicated that this forms part of the *P. leucomystax* complex and documented the distribution of *P. mutus* and *P. megacephalus* in Vietnam. Liu et al. (2018) reported on call characteristics of *P. mutus* and *P. megacephalus* and compared differences of morphology between them. The specimens from Ba Den Mountain should be identified as *P. megacephalus* by characteristics including small reticulate structures on the back; absence of black spots on the sides of the body, with spots arranged in reticulate patterns along the posterior; and tibiotarsal articulation reaching between the eyes and nostrils when legs are adpressed along the body.

CONCLUSION

We recorded nine additional species of amphibians from Ba Den Mountain, Tay Ninh Province: *Glyphoglossus guttulatus*, *Microhyla butleri*, *Microhyla mukhlesuri*, *Micryletta erythropoda*, *Hylarana montosa*, *Hylarana erythraea*, *Chirixalus nongkhorensis*, *Kurixalus* sp., and *Theloderma vietnamense*. Among these, *Hylarana montosa*, *Chirixalus nongkhorensis*, and *Kurixalus* sp. are reported from Tay Ninh Province for the first time. Our new records bring the total amphibian diversity of Ba Den Mountain to 19 species.

In terms of conservation status, *Glyphoglossus molossus* is listed as Near Threatened species in both the IUCN Red List (2025) and Vietnam Red List of Threatened Species (IEBR 2025). During surveys, some threats to the wildlife inhabiting the mountain were observed including extensive deforestation and construction projects. In fact, the specimens of *Theloderma vietnamense* that we observed were gathered in a small artificial pool in a deforested area with extensive construction underway (Figure 1C). Unfortunately, the pool and surrounding area were destroyed one year later (Figure 1D). Ba Den Mountain is considered an unprotected area by local authorities, allowing for development projects like the one observed. With unchecked development, we believe the frogs' habitat atop the mountain is imperilled.

AUTHORS CONTRIBUTION

T.G.T designed the research, collected and analysed the data, and wrote the manuscript. N.V.H.D designed the research and supervised the entire process. N.T.T, N.T.N, and N.T.P.T reviewed the manuscript.

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest in any part of this research.

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