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New records and an updated checklist of amphibians and snakes from Tuyen Quang Province, Vietnam

Dzung Trung Le¹, Anh Mai Luong², Cuong The Pham³, Tien Quang Phan⁴, Son Lan Hung Nguyen⁵, Thomas Ziegler⁶ & Truong Quang Nguyen^{7,*}

¹Ministry of Education and Training, 35 Dai Co Viet Road, Hanoi, Vietnam

^{2,5}Hanoi National University of Education, 136 Xuan Thuy Road, Hanoi, Vietnam

^{2,3,7}Institute of Ecology and Biological Resources, Graduate University of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Hanoi, Vietnam

⁶AG Zoologischer Garten Köln, Riehler Strasse 173, D-50735 Köln, Germany

⁶Institut für Zoologie, Universität Köln, Zùlpicher Strasse 47b, D-50674 Köln, Germany

*Corresponding author: Email: nqt2@yahoo.com

¹[urn:lsid:zoobank.org:author:2C2D01BA-E10E-48C5-AE7B-FB8170B2C7D1](https://zoobank.org/author:2C2D01BA-E10E-48C5-AE7B-FB8170B2C7D1)

²[urn:lsid:zoobank.org:author:8F25F198-A0F3-4F30-BE42-9AF3A44E890A](https://zoobank.org/author:8F25F198-A0F3-4F30-BE42-9AF3A44E890A)

³[urn:lsid:zoobank.org:author:24C187A9-8D67-4D0E-A171-1885A25B62D7](https://zoobank.org/author:24C187A9-8D67-4D0E-A171-1885A25B62D7)

⁴[urn:lsid:zoobank.org:author:555DF82E-F461-4EBC-82FA-FFDABE3BFFF2](https://zoobank.org/author:555DF82E-F461-4EBC-82FA-FFDABE3BFFF2)

⁵[urn:lsid:zoobank.org:author:7163AA50-6253-46B7-9536-DE7F8D81A14C](https://zoobank.org/author:7163AA50-6253-46B7-9536-DE7F8D81A14C)

⁶[urn:lsid:zoobank.org:author:5716DB92-5FF8-4776-ACC5-BF6FA8C2E1BB](https://zoobank.org/author:5716DB92-5FF8-4776-ACC5-BF6FA8C2E1BB)

⁷[urn:lsid:zoobank.org:author:822872A6-1C40-461F-AA0B-6A20EE06ADBA](https://zoobank.org/author:822872A6-1C40-461F-AA0B-6A20EE06ADBA)

Abstract. We provide a checklist of 57 species of amphibians and 42 species of snakes from Tuyen Quang Province, northern Vietnam. Ten species of amphibians and five species of snakes were recorded for the first time from Tuyen Quang Province. Based on the new herpetological collection from this province we provide the descriptions of newly recorded species. The herpetofauna of Tuyen Quang Province contains a high level of conservation concern with four species endemic to Vietnam, eight species listed in the IUCN Red List, 16 species listed in the Red Data Book of Vietnam, three species listed in the Vietnam Governmental Decree No 06/2019/ND-CP, and three species listed in the CITES appendices.

Key words. Amphibians, morphology, new records, snakes, taxonomy, Tuyen Quang Province.

INTRODUCTION

Limestone karst forests in Southeast Asia harbor an extremely rich biodiversity, which includes various site-endemic taxa (Clements et al. 2006), and species communities on different karst formations in the same overall region can differ from each other considerably (Clements et al. 2006; Sterling et al. 2006; Webb et al. 2010). Recent new discoveries of snakes from northern Vietnam showed the high potential of species diversity from limestone karst forests, for instance *Achalinus timi* Ziegler, Nguyen, Pham, Nguyen, Pham, van Schingen, Nguyen & Le, 2019 from Son La Province, *Parafimbrios vietnamensis* Ziegler, Ngo, Pham, Nguyen, Le & Nguyen, 2018 from Lai Chau Province, and *Achalinus juliani* Ziegler, Nguyen, Pham, Nguyen, Pham, van Schingen, Nguyen & Le, 2019, *Lycodon pictus* Janssen, Pham, Ngo, Le, Nguyen & Ziegler, 2019 and *Sinomicrurus peinani* Liu, Yan, Hou, Wang, Nguyen, Murphy, Che & Guo, 2020 from

Cao Bang Province (Ziegler et al. 2007, 2018a, 2018b, 2019a, 2019b; Nguyen et al. 2018; Janssen et al. 2019; Liu et al. 2020).

Tuyen Quang Province is located in northeastern Vietnam with a complex terrain of limestone karst and lowland areas with elevations of 200–600 m above sea level (Sterling et al. 2006). In terms of the herpetofaunal diversity, Tuyen Quang Province is one of the most poorly studied provinces in northern Vietnam. Le et al. (2007) documented a list of 43 species of reptiles and amphibians from three districts of Chiem Hoa, Na Hang and Son Duong. Nguyen et al. (2009) recorded 41 species of reptiles and amphibians from Tuyen Quang Province. Phan et al. (2018) recently provided a list of 40 species of snakes from this province.

As a result of our recent field surveys in Tuyen Quang Province between 2017 and 2018, we herein provide a checklist of 57 species of amphibians and 42 species of snakes, including 15 new records from this province.

MATERIAL AND METHODS

Sampling. Field surveys were conducted by Cuong The Pham, Truong Quang Nguyen, Anh Mai Luong, Tien Quang Phan, Dzung Trung Le, and Hoa Thi Ninh (hereafter Pham et al.) from 22 August to 2 September 2017 and from 13 to 24 June 2018 in Lam Binh and Na Hang districts of Tuyen Quang Province (Fig. 1). The coordinates (WGS 84) were determined by using the GPS Garmin ver. 60CX.

Specimens were collected between 19:00 and 24:00 hours. After photographing in life, specimens were euthanized in a closed vessel with a piece of cotton wool containing ethyl acetate (Simmons 2002), fixed in 80% ethanol for five hours, and then later transferred to 70% ethanol for permanent storage. Tissue samples (muscles from thigh) were preserved separately in 70% ethanol prior to fixation. Specimens referred to in this paper are deposited in the collections of the Institute of Ecology and Biological Resources (IEBR) and the Vietnam National Museum of Nature (VNMN), Hanoi, Vietnam.

Morphological examination. Measurements were taken in preserved specimens with a digital caliper to the nearest 0.1 mm.

For amphibian specimens, the following Abbreviations used in the text

SVL	= Snout-vent length
HL	= Head length (from the back of mandible to tip of snout)
HW	= Maximum head width (across angles of jaws)
SL	= Snout length or rostral length (from anterior corner of orbit to the tip of snout)
NS	= Distance from nostril to the tip of snout
EN	= Distance from anterior corner of orbit to nostril
IND	= Internarial distance
IOD	= Interorbital distance
ED	= Eye diameter
UEW	= Maximum width of upper eyelid
DAE	= Distance between anterior corners of orbits
MN	= Posterior margin of mandible to nostril
MFE	= Posterior margin of mandible to anterior corner of orbit
MBE	= Posterior margin of mandible to posterior corner of orbit
DPE	= Distance between posterior corners of orbits
TD	= Tympanum diameter
TYE	= Distance from anterior margin of tympanum to posterior corner of orbit
FLL	= forearm length, from elbow to base of outer palmar tubercle
HAL	= hand length, from base of outer palmar tubercle to tip of third finger
FL1–4	= Finger length I–IV



Fig. 1. Map of sampling locations (black circle) in Tuyen Quang Province, northern Vietnam.

OPT	= Outer palmar tubercle length
IPT	= Inner palmar tubercle length
NPL	= Nuptial pad length
FeL	= Femur length (from vent to knee)
TbL	= Tibia length (from knee to tarsus)
TbW	= Maximum tibia width
FoL	= Foot length (from tarsus to the tip of 4 th toe)
TL1–5	= Toe length I–V
IMT	= Inner metatarsal tubercle length

For webbing formula we followed Glaw & Vences (2007). Sex was determined by the presence of nuptial pads and based on gonadal inspection.

For snake specimens, measurements were taken after preservation with a measuring tape. The number of ventral scales was counted according to Dowling (1951). The dorsal scale rows were given at one head length behind head, at midbody, and at one head length before vent, respectively. Scalation was studied by using a stereo microscope (Leica M80). Bilateral scale counts were given as left/right. Identification of sex was made by inspection of presence of hemipenes.

Specimen identification. For taxonomic identification, we referred to Bourret (1936, 1942), Smith (1943), Liu (1950), Taylor (1962), Manthey & Grossmann (1997), Dubois & Ohler (1998), Lathrop et al. (1998),

Ziegler & Köhler (2001), Ziegler (2002), Leviton et al. (2003), Bain et al. (2004), Ohler (2003), Ohler & Delorme (2006), Nguyen (2007), Fei et al. (2008), Stuart & Heatwole (2008), Fei et al. (2009), Vogel et al. (2009), Inger & Stuart (2010), Nguyen et al. (2011), Chen et al. (2013), Hecht et al. (2013), Luu et al. (2013), Nemes et al. (2013), Ostroshabov et al. (2013), Le et al. (2014a, b), Neang et al. (2014), Nguyen et al. (2016a, b), Pham et al. (2016, 2017), Nguyen et al. (2018), Janssen et al. (2019), and Yu et al. (2019). Species names follow Nguyen et al. (2009), Frost (2020), and Uetz et al. (2020).

RESULTS

Taxonomic accounts

Family Megophryidae

Leptobranchella sungi (Lathrop, Murphy, Orlov & Ho, 1998)

Sung's Toad / Coc may sung (Fig. 2a)

Specimens examined (n = 4). One adult male IEBR 4583 (Field number TQ.2017.50) collected by Pham et al. on 27 August 2017, near Trung Phin Village (22°29.584' N/105°23.586' E, at an elevation of 844 m asl.), one adult male IEBR 4584 (Field number TQ.2017.80) collected by Pham et al. on 29 August 2017, near Trung Phin Village (22°30.634' N/105°24.304' E, at an elevation of 926 m asl.), Sinh Long Commune, Na Hang District, two adult males IEBR 4585, 4586 (Field numbers TQ.2017.123, 126) collected by Pham et al. on 1st September 2017, near Na Phuong Village (22°31.574' N/105°16.966' E, at an elevation of 147 m asl.), Thuong Lam Commune, Lam Binh District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed well with the descriptions of Lathrop et al. (1998) and Luong et al. (2019): SVL 47.6–59.0 mm; head longer than wide (HL 22.4–26.0 mm, HW 19.0–22.6 mm); snout distinctly pointed in dorsal view, longer than eye diameter (SL 8.3–9.6 mm, ED 7.5–8.0 mm); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 3.0–4.0 mm, EN 4.8–5.5 mm); canthus rostralis distinct, loreal region concave; eye large, approximately twice diameter of tympanum (TD 2.7–3.8 mm), tympanum round, indistinct; supratympanic fold distinct, extending from posterior corner of the eye to a point behind articulation of jaw; vomerine teeth absent; tongue notched posteriorly.

Forelimbs: FLL 11.6–15.4 mm, relative finger lengths I=II<IV<III, tips of fingers not enlarged into discs; webbing absent; subarticular tubercles indistinct; palmar tubercles round, inner one very large.

Hindlimbs: Thigh short (FL 23.0–27.3 mm); tibia four times longer than wide (TbL 22.9–27.9 mm, TbW 5.2–7.5 mm); relative toe lengths I<II<V<III<IV; webbing rudimentary between toes I–IV and absent between IV and V; subarticular tubercles indistinct; inner metatarsal tubercle oval; outer metatarsal tubercle absent.

Skin: Dorsal surface of head and body, upper part of flanks with dispersed tubercles; upper eyelid granular; dorsolateral fold absent; ventral surface smooth.

Coloration in life. Dorsal surface of head and body brown-copper with a dark bar marking between eyes; canthus and supratympanic fold brown; upper lip with dark bars; flanks light brown with dark point, transverse bars on limbs dark brown; ventral surface opaque white.

Ecological notes. Specimens were found between 19:00 and 21:00 hours on stream shore. The surrounding habitat was secondary forest of medium and small hardwoods and shrub.

Distribution. This species is currently known only from northern Vietnam: Dien Bien, Lao Cai, Yen Bai, and Vinh Phuc provinces (Nguyen et al. 2009; Luong et al. 2019). Elsewhere, the species is known from southern China (Frost 2020).

Leptobranchium chapaense (Bourret, 1937)

Chapa Spadefoot Toad / Coc may sa pa (Fig. 2b)

Specimens examined (n = 2). One adult female IEBR 4587 (Field number TQ.2017.90) collected by Pham et al. on 30 August 2017, near Na Phuong Village (22°28.347' N, 105°21.454' E, at an elevation of 117 m asl.), Thuong Lam Commune, Lam Binh District and one adult female IEBR 4588 (Field number TQ.2018.89) collected by Pham et al. on 17 June 2018, near Nam Duong Village (22°36.721' N, 105°20.094' E, at an elevation of 779 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed with the descriptions of Dubois & Ohler (1998); Lathrop et al. (1998); and Luong et al. (2019): SVL 40.5–57.2 mm; head longer than wide (HL 19.8–26.3 mm, HW 18.2–27.4 mm); snout round, longer than eye diameter (SL 7.2–10.2 mm, ED 6.4–7.5 mm); nostrils oval, laterally positioned, closer to the tip of snout than to eye (NS 4.6–5.7 mm, EN 4.0–5.0 mm); canthus rostralis distinct, loreal region flattened; eye large, approximately twice diameter of tympanum (TD 2.6–3.9 mm); tympanum round, distinct; supratympanic fold distinct, vomerine teeth absent; tongue notched posteriorly.

Forelimbs: FLL 11.8–16.9 mm, hand length (HAL 24.2–32.4 mm); relative finger lengths I<II<IV<III, tips of fingers round; webbing absent; subarticular tubercles distinct; two palmar tubercles round, inner palmar tubercles larger than outer palmar tubercles.



Fig. 2. Dorsolateral view of six newly recorded amphibian species from Tuyen Quang Province. **a.** *Leptobranchella sungi* (IEBR 4583). **b.** *Leptobranchium chapaense* (IEBR 4587). **c.** *Leptobranchium guangxiense* (IEBR 4589). **d.** *Megophrys microstoma* (IEBR 4590) **e.** *Limnonectes limborgi* (IEBR 4593) **f.** *Quasipaa boulengeri* (IEBR 4597).

Hindlimbs: Thigh short (FL 17.8–24.8 mm); tibia five times longer than wide (TbL 15.5–22.24 mm, TbW 3.1–5.7 mm); relative toe lengths I<II<III<V<IV; webbing formula II–2II½–2III1–3IV3–1V; subarticular tubercles distinct; inner metatarsal tubercle oval.

Skin: Dorsal surface of head and body, upper part of flanks smooth; ventral surface smooth.

Coloration in life. Dorsal pattern brown with small, diffuse orange blotches on the sacral region, flanks, and limbs; ventral surface of limbs black with white reticulations, thigh and knee with dark bars; groin and flanks black with white pustules.

Ecological notes. Specimens were found between 20:00 and 21:00 hours on the ground. The surrounding habitat

was mixed secondary forest composed of small to medium hardwoods and shrubs.

Distribution. In Vietnam, *L. chapaensis* was known from Lao Cai and Ha Giang provinces in the North southwards to Thua Thien Hue Province (Nguyen et al. 2009; Luong et al. 2019). Elsewhere, this species is known from China, Laos, Myanmar, and Thailand (Frost 2020).

Leptobrachium guangxiense Fei, Mo, Ye & Yang, 2009
Guangxi Pseudomoustache Toad / Coc may quang tay (Fig. 2c)

Specimen examined (n = 1). One adult male IEBR 4589 (Field number TQ.2018.151) collected by Pham et al. on 26 June 2018, near Na Phuong Village (22°29.653' N, 105°23.574' E, at an elevation of 857 m asl.), Thuong Lam Commune, Lam Binh District.

Description. Morphological characters of the specimen from Tuyen Quang Province agreed with the description of Chen et al. (2013): SVL 60.3 mm. Head wider than long (HL 25.3 mm, HW 25.7 mm); snout round, longer than eye diameter (SL 10.3 mm, ED 8.7 mm); nostrils oval, laterally positioned, closer to the tip of snout than to eye (NS 5.7 mm, EN 5.5 mm); canthus rostralis distinct, loreal region concave; eye large, approximately twice diameter of tympanum (TD 3.8 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue notched.

Forelimbs: FLL 16.1 mm, hand length (HAL 30.8 mm); relative finger lengths II<I<IV<III, tips of fingers round; webbing absent; subarticular tubercles distinct; two palmar tubercles round, inner one larger than outer one.

Hindlimbs: Thigh short (FbL 24.9 mm); tibia four times longer than wide (TbL 22.1 mm, TW 6.2 mm); relative toe lengths I<II<V<III<IV; toes with rudiment of webbing; subarticular tubercles distinct; inner metatarsal tubercle oval.

Skin: Dorsal surface of head and body, upper part of flanks smooth; ventral surface smooth.

Coloration in life. Dorsal pattern dark grey with small, diffused white blotches on the sacral region, flanks, and limbs; upper surface of limbs with transverse bars; ventral surface dark with white spots.

Ecological notes. Specimen was found at 19:30 hours on the ground near a small stream. The surrounding habitat was mixed secondary forest composed of small hardwoods and shrubs.

Distribution. In Vietnam, *L. guangxiense* was known from Tam Dao National Park, Vinh Phuc Province. Elsewhere, this species is known from China (Frost 2020).

Megophrys microstoma Boulenger, 1903
Asian Mountain Toad / Coc nui mieng nho (Fig. 2d)

Specimens examined (n = 3). One adult male IEBR 4590 (Field number TQ.2017.8) collected by Pham et al. on

25 August 2017, near Giang Chi Village (22°34.370' N, 105°20.138' E, at an elevation of 802 m asl.), Sinh Long Commune, Na Hang District and two adult males IEBR 4591, 4592 (Field numbers TQ.2017.111, 112) collected by Pham et al. on 31 August 2017, near Na Phuong Village (22°29.221' N, 105°20.830' E, at an elevation of 312 m asl.), Thuong Lam Commune, Lam Binh District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed with the descriptions of Ohler (2003) and Luong et al. (2019): SVL 33.5–38.4 mm; head wider than long (HL 9.8–11.7 mm, HW 9.9–11.1 mm); snout truncate, protruding, shorter than horizontal diameter of eye (SL 2.1–3.2 mm, ED 3.6–3.9 mm); loreal region vertical, concave; nostril closer to the tip of snout than to eye (NS 1.0–1.2 mm, EN 1.4–2.1 mm); conical dermal appendix on upper eyelid present; eye larger than tympanum (TD 3.0–3.3 mm); tympanum distinct.

Forelimbs: FLL 6.2–7.3 mm; hand length (HAL 18.2–20.4 mm), relative finger lengths I<II=IV<III, tips of fingers round, not enlarged into discs; webbing absent; subarticular tubercles absent; palmar tubercles indistinct.

Hindlimbs: Thigh short (FeL 17.9–18.3 mm); tibia four times longer than wide (TbL 17.7–19.0 mm, TbW 3.2–3.5 mm); relative toe lengths I<II<V<III<IV; tibio-tarsal articulation reaching eye; webbing rudimentary; subarticular tubercles indistinct; metatarsal tubercle indistinct.

Skin: Dorsal surface shagreened, with symmetric glandular ridges; flank shagreened, covered with granules; ventral surface smooth.

Coloration in life. Dorsum reddish brown, upper surface of limbs with transverse bars; a light bar present below the eye; flanks with some small black spots; ventral surface cream with dark marbling.

Ecological notes. Specimens were found between 20:00 and 22:00 hours on tree branches or stones near rocky streams. The surrounding habitat was secondary forest of small hardwoods and shrubs.

Distribution. In Vietnam, this species was known from Lao Cai and Ha Giang provinces in the North southwards to Dak Lak and Lam Dong provinces (Nguyen et al. 2009). Elsewhere, the species is known from China, Laos, Thailand, and Cambodia (Frost 2020).

Family Dicroglossidae

Limnonectes limborgi (Sclater, 1892)
Limborg's Frog / Ech lim-boc (Fig. 2e)

Specimens examined (n = 4). Two adult males IEBR 4593, 4594 (Field numbers TQ.2018.137, 138) by Pham et al. on 20 June 2018, near Na Phuong Village (22°30.169' N, 105°23.864' E, at an elevation of 973 m asl.), Thuong Lam Commune, Lam Binh District and two adult females IEBR 4595, 4596 (Field numbers TQ.2017.2, 47) collected by Pham et al. on 25

August 2017, near Giang Chi Village (22°34.370' N, 105°20.138' E, at an elevation of 802 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed with the descriptions of Bourret (1942) and Inger & Stuart (2010): SVL 24.7–27.1 mm in males and 29.3–30.75 mm in females; head as long as wide (HL 11.4–11.9 mm in males and 10.7–12.0 mm in females, HW 10.2–12.1 mm in males and 10.8–11.7 mm in females); snout short, round, longer than horizontal diameter of eye (SL 3.9–4.5 mm in males and 4.3–4.6 mm in females, ED 2.5–2.8 mm in males and 3.7–4.3 mm in females); nostril equidistant from the orbit and the snout tip; closer to the tip of snout than to eye (NS 1.6–1.8 mm in males and 1.7 mm in females, EN 2.2–2.5 mm in males and 2.2–2.5 mm in females); canthus rostralis obtuse, loreal region slightly concave; tympanum distinct, round, approximately two third of eye diameter (TD 1.7 mm in males and 1.7–2.4 mm in females); vomerine teeth present, in two oblique ridges, equal in distance from each other as to choanae; tongue notched posteriorly.

Forelimbs rather short (FLL 5.4–6.1 mm in males and 7.2–9.1 mm in females), hand length (HAL 11.0–12.1 mm in males and 12.8–14.0 mm in females) relative finger lengths II<I<IV<III; the tips dilated into small disks; fingers without dermal fringe, free of webbing; subarticular tubercle distinct, oval, formula 1,1,2,1; subarticular tubercles moderate; a large, very prominent, compressed, blunt-edged inner metatarsal tubercle.

Hindlimbs slender, thigh shorter than tibia (FeL 12.8–14.1 mm in males and 15.6–16.2 mm in females); tibia five times longer than wide (TbL 13.4–15.2 mm in males and 15.7–17.1 mm in females, TbW 2.9–4.1 mm in males and 4.0–4.1 mm in females); relative toe lengths I<II<V<III<IV; tips of toes swollen; webbing formula $I\frac{1}{2}$ – $2III\frac{1}{2}$ – $3III2$ – $3IV3$ – $2V$; inner metatarsal tubercle distinct, oval; subarticular tubercles indistinct.

Skin: Dorsal surface of head and body smooth with faint traces of a glandular lateral fold; a strong fold extending from the eye to the shoulder; ventral surface smooth.

Coloration in life. Dorsal surface brown; with small dark-grey spots; a dark cross-bar between the eyes and a Λ -shaped mark between the shoulders; thighs and tibia with dark-brown cross bars; ventral surface cream; throat cream with dark pattern.

Ecological notes. Specimens were found on the ground between 19:30 and 22:30 hours on a forest path. The surrounding habitat was mixed secondary forest of small to medium hardwoods and shrubs.

Distribution. In Vietnam, this species was known from Lao Cai and Son La provinces in the North southwards to Dong Nai and Kien Giang provinces (Nguyen et al. 2009). Elsewhere, the species is known from Laos,

Cambodia, Malaysia, Myanmar, and Thailand (Inger & Stuart 2010).

Quasipaa boulengeri (Günther, 1889)

Boulenger's Spiny Frog / Ech gai san bau-len-go (Fig. 2f)

Specimens examined (n = 5). One adult male IEBR 4597 (Field number TQ.2017.14) by Pham et al. on 25 August 2017, near Giang Chi Village (22°30.075' N, 105°23.555' E, at an elevation of 889 m asl.), Sinh Long Commune, Na Hang District, one adult male IEBR 4598 (Field number TQ.2017.45) by Pham et al. on 27 August 2017, near Giang Chi Village (22°30.075' N, 105°23.555' E, at an elevation of 889 m asl.), Sinh Long Commune, Na Hang District, and three adult females IEBR 4599, 4600, 4601 (Field numbers TQ.2017.28, 32, 33) by Pham et al. on 26 August 2017, near Giang Chi Village (22°34.128' N, 105°20.225' E, at an elevation of 799 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed with the descriptions of Liu (1950) and Fei et al. (2009): SVL 115.8–118.5 mm in males, 90.9–101.7 mm in females; head wider than long (HL 42.9–47.1 mm, HW 50.4–54.8 mm in males, 34.5–38.0 mm, 40.4–43.6 mm in females); snout obtusely pointed in dorsal view, longer than horizontal diameter of eye (SL 17.3–18.1 mm, ED 12.13–12.46 mm in males, 13.4–15.4 mm, 10.5–11.8 mm in females); nostril lateral, round, closer to the tip of snout than to eye (NS 9.6–10.0 mm, EN 7.7–8.5 mm in males, 6.8–9.6 mm, 6.9–7.0 mm in females); canthus rostralis short but distinct, loreal region oblique, shallowly concave; tympanum indistinct, approximately half of eye diameter (TD 4.8–7.0 mm in males, 5.4–5.6 mm in females); vomerine teeth in two oblique ridges; tongue notched posteriorly.

Forelimbs short (FLL 23.6–28.1 mm in males, 19.6–22.3 mm in females), relative finger lengths II<I<IV<III; tips of all four fingers swollen; fingers without dermal fringe, free of webbing; subarticular tubercle distinct, round, formula 1,1,2,2; palmar tubercles one, oval; males with nuptial pad on finger I and II.

Hindlimbs long, thigh shorter than tibia (FeL 63.4–64.9 mm in males, 45.8–52.4 mm in females); tibia three times longer than wide (TbL 60.8–62.8mm, TbW 20.8–24.5 mm in males, 49.5–53.4 mm, 16.5–20.1 mm in females); relative toe lengths I<II<III<V<IV in males and relative toe lengths I<II<V<III<IV in females; tips of toes swollen; full webbing; inner metatarsal tubercle distinct, outer metatarsal tubercle distinct, round; subarticular tubercles oval, formula 1,1,2,3,2.

Skin: Skin of the upper parts covered with large elongated warts and small oval tubercles; upper surface of limbs with transverse dark bars; flanks with small round tubercles; males ventral with nuptial pad on chest and belly.

Coloration in life. Dorsal surface of head and body dark-grey; dorsum with black large elongated warts; flanks with small tubercles, more dense near dorsolateral folds; dorsal surface of forelimbs, thighs and tibia with dark cross bars; ventral surface cream, males with nuptial pad on chest.

Ecological notes. Specimens were found between 19:00 and 22:00 hours on stones or on the ground in rocky streams. The surrounding habitat was mixed secondary forest of small to medium hardwoods and shrubs.

Distribution. In Vietnam, this species was known from Cao Bang, Son La and Nghe An provinces (Nguyen et al. 2009). Elsewhere, the species is known from China (Frost 2020).

Remarks. This species is similar to *Quasipaa spinosa* and *Nanorana yunnanensis* (Liu 1950). The specimens of *Quasipaa boulengeri* from Tuyen Quang differ from those of *Q. spinosa* in having large elongated warts versus small warts (see Tran et al. 2010) and also differ from those of *N. yunnanensis* in having ventral side with one patch of nuptial pad on chest and belly of the males (versus with two patches of nuptial pad on both sides of the chest, see Fei et al. 2009).

Family Rhacophoridae

Raorchestes parvulus (Boulenger, 1893)

Karin Bubble-nest Frog / Nhái cay ti hon (Fig. 3a)

Specimens examined (n = 5). Three adult males IEBR 4602, 4603, 4604 (Field numbers TQ.2018.98, 101, 102) and two adult females IEBR 4605, 4606 (Field numbers TQ.2018.103, 129) collected by Pham et al. on 18 June 2018, near Trung Phin Village (22°31.577' N, 105°22.504' E, at an elevation of 1047 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed well with the description of Taylor (1962): SVL 18.6–20.3 mm in males and 20.5–23.1 mm in females; head shorter than wide (HL 7.3–8 mm in males and 7.8–8.9 mm in females), HW 6.6–7.8 mm in males and 6.2–8.6 mm in females); snout round, shorter than eye diameter (SL 2.8–3.7 mm in males and 3.0–3.5 mm in females, ED 1.9–3.7 mm in males and 2.3–3.7 mm and in females); nostrils oval, laterally positioned, closer to the tip of snout than to eye (NS 1.1–1.6 mm in males and 1.2–1.7 mm in females, EN 1.3–2.0 mm in males and 2.1–2.2 mm in females); canthus rostralis indistinct, loreal region concave; eye large, approximately twice diameter of tympanum (TD 1.4–4.3 mm in males and 0.7–1.48 mm in females), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue notched posteriorly.

Forelimbs: Forearm short (FLL 4.6–5.5 mm in males and 5.0–5.9 mm in females), hand length (HAL 9.8–10.2 mm in males and 9.3–10.1 in females); relative

finger lengths I<II<IV<III, tips of fingers enlarged into discs; webbing absent; subarticular tubercles distinct, formula 1,1,2,2; inner palmar tubercles small.

Hindlimbs: Thigh short (FeL 9.4–10.4 mm in males and 9.6–11.5 mm in females); tibia five times longer than wide (TbL 9.0–10.1 mm in males and 9.5–11.0 mm in females), TbW 1.9–2.5 mm in males and 2.0–2.1 mm in females); relative toe lengths I<II<III<V<IV; toes with rudiment of webbing; subarticular tubercles distinct; formula 1,1,2,3,2; inner metatarsal tubercle oval.

Skin: Dorsal surface smooth or with small, scattered, conical warts; ventral surface granular.

Coloration in life. Dorsal greyish, uniform or with a dark bar or triangular blotch between the eyes, and a curved dark band along each side of the back; ventral surface darkly pigmented.

Ecological notes. Specimens were found on the leaves along the trail, between 19:30 and 21:30 hours. The surrounding habitat consisted of mixed secondary forest composed of small hardwoods and shrubs.

Distribution. In Vietnam, *R. parvulus* was known from Lao Cai and Lai Chau provinces in the North southwards to Quang Tri Province (Nguyen et al. 2009; Nguyen et al. 2015). Elsewhere, this species is known from Myanmar, Laos, Thailand, Cambodia and Malaysia (Frost 2020).

Rhacophorus kio Ohler & Delorme, 2006

Black-webbed Treefrog / Ech cay ki-o (Fig. 3b)

Specimen examined (n = 1). One adult male IEBR 4607 (TQ.2018.55) collected by Pham et al. on 15 June 2018, near Nam Duong Village (22°35.644' N, 105°22.056' E, at an elevation of 750 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimen from Tuyen Quang Province agreed well with the description of Ohler & Delorme (2006): SVL 72.8 mm; head longer than wide (HL 25.0 mm, HW 24.1 mm); snout round, longer than eye diameter (SL 11.6 mm, ED 7.2 mm); nostrils round, without flap of skin, closer to the tip of snout than to eye (NS 5.0 mm, EN 6.7 mm); canthus rostralis distinct, loreal region concave; eye large, approximately twice diameter of tympanum (TD 4.1 mm), tympanum round, distinct; supratympanic fold distinct, vomerine teeth distinct; tongue notched.

Forelimbs: Forearm slender (FLL 12.1 mm), hand length (HAL 33.9 mm); relative finger lengths I<II<IV<III, tips of fingers enlarged into discs; webbing formula I1½–III0–0III0–0IV; subarticular tubercles distinct, formula 1,1,2,1; inner palmar tubercle indistinct.

Hindlimbs: Thigh short (FeL 32.8 mm); tibia five times longer than wide (TbL 35.6 mm, TbW 7.4 mm); relative toe lengths I<II<III<V<IV; toes fully webbed; subarticular tubercles distinct, formula 1,1,2,3,2; inner metatarsal tubercle oval.



Fig. 3. Dorsolateral view of four newly recorded amphibian species from Tuyen Quang Province. **a.** *Raorchestes parvulus* (IEBR 4602). **b.** *Rhacophorus kio* (IEBR 4607). **c.** *Rhacophorus orlovi* (IEBR 4608). **d.** *Zhangixalus pachyprotus* (VNMN.06923).

Skin: Dorsal surface of head and body, upper part of flanks smooth; dorsal parts of limbs finely shagreened; ventral surface smooth.

Coloration in life. Dorsal parts of head and body including upper part of flanks green with white spots, lower part of flanks dark brown with yellow spots corresponding to glandular verrucae; a distinct ink black spot in armpit; chest, belly and lower part of thigh lemon yellow, webbing orange yellow with an ink black spot at base between toes.

Ecological notes. The specimen was found on the bough along the trail, at 19:00 hours. The surrounding habitat consisted of mixed secondary forest composed of small hardwoods and shrubs.

Distribution. In Vietnam, *R. kio* was known from Lao Cai and Cao Bang provinces in the North southwards to Kon Tum and Gia Lai provinces in the Centre (Nguyen et al. 2009; Nguyen et al. 2015). Elsewhere, this species is known from India, China, Laos, Thailand, and Cambodia (Nguyen et al. 2009; Frost 2020).

Rhacophorus orlovi Ziegler & Köhler, 2001
Orlov's Treefrog / Ech cay ooc-lop (Fig. 3c)

Specimens examined (n = 5). One adult male IEBR 4608 (Field number TQ.2018.20) and two adult females IEBR 4609, 4610 (Field numbers TQ.2018.3, 5) collected by Pham et al. on 13 June 2018, near Nam Duong Village (22°34.626' N, 105°21.616' E, at an elevation of 565 m asl.), Sinh Long Commune, Na Hang District, one adult male IEBR 4611 (Field number TQ.2018.106) collected by Pham et al. on 18 June 2018, near Trung Phin Village (22°31.428' N, 105°22.751' E, at an elevation of 994 m asl.), Sinh Long Commune, Na Hang District, and one adult female IEBR 4612 (Field number TQ.2018.56) collected by Pham et al. on 15 June 2018, near Nam Duong Village (22°35.839' N, 105°20.621' E, at an elevation of 643 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimens from Tuyen Quang Province agreed well with the descriptions of Ziegler & Köhler (2001) and Ostroshabov et al. (2013): SVL 39.6–43.8 mm in males and 43.8–52.4 mm in females; head shorter than wide (HL

14.8–16.8 mm in males and 16.3–19.3 mm in females, HW 15.4–16.3 mm in males and 16.1–19.1 mm in females); snout slightly pointed, longer than eye diameter (SL 7.1–7.7 mm in males and 6.8–7.7 mm in females, ED 4.5–5.1 mm in males and 5.0–5.8 mm in females); nostrils oval, closer to the tip of snout than to eye (NS 4.6 mm, EN 4.0 mm); canthus rostralis well developed, slightly round constricted; loreal region concave; eye large, approximately twice diameter of tympanum (TD 2.4–3.2 mm in males and 3.0–3.7 mm in females), tympanum round, distinct; supratympanic fold distinct, vomerine teeth distinct; tongue notched posteriorly.

Forelimbs: Forearm slender (FLL 7.4–7.9 mm in males and 7.7–9.4 mm in females), hand length (HAL 20.8–20.9 mm in males and 20.9–27.2 mm in females); relative finger lengths I<II<IV<III, tips of fingers enlarged into discs; webbing formula I12/3–12/3III–2III–1IV; subarticular tubercles distinct, formula 1,1,2,2; inner palmar tubercles round.

Hindlimbs: Thigh slender (FeL 21.3–21.9 mm in males and FeL 23.0–27.4 mm in females); tibia four times longer than wide in males (TbL 22.2–22.4 mm, TbW 5.3–5.4 mm) tibia five times longer than wide in females (TbL 24.2–29.4 mm, TbW 4.7–5.8 mm); relative toe lengths I<II<III<V<IV; webbing formula I3/4–1II½–1III½–1IV1–½V; subarticular tubercles distinct; formula 1,1,2,3,2; inner metatarsal tubercle oval. Skin: Dorsal surface of head and body, upper part of flanks smooth; limbs without distinct dermal flaps and folds except for a weakly developed fold along outer edge of 4th finger and 5th toe; weak tubercles and protuberances on outer edge of tarsus; ventral surface smooth.

Coloration in life. Dorsal surface reddish brown, with some darker markings, flanks light brown with dark brown reticulation and yellow spots; venter whitish to light brownish with some indistinct small dark spots.

Ecological notes. Specimens were found on the bough around small puddles, between 19:30 and 23:00 hours. The surrounding habitat consisted secondary forest composed of small hardwoods.

Distribution. In Vietnam, *R. orlovi* was known from Dien Bien and Son La provinces in the North southwards to Gia Lai Province in the Centre (Nguyen et al. 2009, 2015). Elsewhere, this species is known from Laos (Frost 2020).

Zhangixalus pachyproctus Yu, Hui, Hou, Wu, Rao & Yang, 2019

Protruded-vent Treefrog / Ech cay hau mon loi (Fig. 3d)

Specimen examined (n = 1). One adult female VNMN.06923 collected by Pham et al. on 21 June 2018, near Na Phuong Village (22°29.432' N, 105°23.437' E, at an elevation of 812 m asl.), Thuong Lam Commune, Lam Binh District.

Description. Morphological characters of the specimen from Tuyen Quang Province agreed well with the description of Yu et al. (2019): SVL 93.9 mm; head longer than wide (HL 34.1 mm, HW 33.6 mm); snout round, longer than eye diameter (SL 13.8 mm, ED 6.5 mm); nostrils oval, closer to the tip of snout than to eye (NS 6.9 mm, EN 7.5 mm); canthus rostralis distinct, loreal region concave; eye large, approximately diameter of tympanum (TD 5.1 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth distinct; tongue notched posteriorly.

Forelimbs: Forearm slender (FLL 16.3 mm), hand length (HAL 52.3 mm); relative finger lengths I<II<IV<III, tips of fingers enlarged into discs; webbing formula I1–2/3III–½III–0IV; subarticular tubercles distinct; formula 1,1,2,1; inner palmar tubercles larger.

Hindlimbs: Thigh slender (FeL 50.2 mm); tibia five times longer than wide (TbL 48.2 mm, TbW 8.7 mm); relative toe lengths I<II<III<V<IV; full webbed; subarticular tubercles distinct; formula 1,2,2,3,2; inner metatarsal tubercle oval. Skin: Dorsal surface of head and body, upper part of flanks smooth; ventral surface smooth.

Coloration in life. Dorsal surface of head and body uniformly green, a narrow white stripe present along the flanks; ventral surface cream.

Ecological notes. The specimen was found at 19:30 hours on the bough along a stream. The surrounding habitat consisted of mixed secondary forest composed of small hardwoods and shrubs.

Distribution. In Vietnam, *Z. pachyproctus* was known from Dien Bien, Son La, Cao Bang, Bac Giang, Thanh Hoa, Nghe An and Quang Binh provinces (as *Rhacophorus maximus*, see discussion below) (Nguyen et al. 2009, 2015; Pham AV et al. 2017; Pham CT et al. 2017). Elsewhere, this species is known from northeastern India, Nepal, China, Laos, and Thailand (Nguyen et al. 2009; Luu et al. 2014; Frost 2020).

Family Colubridae

Lycodon futsingensis (Pope, 1928)

Futsing Wolf Snake / Ran khuyet fut-sing (Fig. 4a)

Specimens examined (n = 2). IEBR 4754 and IEBR 4755 (adult females) collected by Pham et al. on 14 June 2018, near Nam Duong Village (22°36.283' N, 105°20.367' E, at an elevation of 850 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimens agreed with the descriptions of Hecht et al. (2013), Le et al. (2014), and Nguyen et al. (2018): Body robust, subcylindrical; head longer than wide, distinct from neck; snout obtuse; nostril lateral; eye large, pupil vertical; head scalation complete: internasals 2, prefrontals 2, parietals 2, supraocular 1, and frontal 1; supralabials 8/8, 3th–5th in contact with eye; infralabials 9/9, 1st–4th border-



Fig. 4. a. *Lycodon futsingensis*, adult female (IEBR 4755). b. *Lycodon pictus*, adult female (IEBR 4756). c. *Lycodon subcinctus*, adult female (IEBR 4757). d. *Protobothrops mucrosquamatus*, adult male (IEBR 4758) from Tuyen Quang Province, Vietnam.

ing chin shields; dorsal scale rows 17–17–15, smooth; scales of the outer dorsal scale row slightly enlarged; ventrals 180–211; subcaudals 81–90, paired; cloacal undivided.

Coloration in life. Dorsal surface of body and tail grayish brown to dark brown with 24–26 light brownish streaks, 12–14 crossbands on dorsal surface of tail; body bands in Y-shaped at the mid-body; dorsal head grey with cream bands from eye to neck; belly white; the underside of the tail dark brown.

Ecology notes. The specimens were collected between 20:00 and 23:00 hours, in rocky streams. The surrounding habitat was mixed secondary forest consisting of small hardwoods and shrubs. Air temperature was 23–29°C and relative humidity was 70–75%.

Distribution. In Vietnam, *Lycodon futsingensis* was known from Dien Bien Province in the north southwards to Quang Binh and Quang Tri provinces in central Vietnam. Elsewhere, this species is known from China and Laos (Nguyen et al. 2009; Uetz et al. 2020).

Remarks. The specimens in Tuyen Quang differ from those in the description of Le et al. (2014) in having fewer crossbands on tail (12–14 vs. 17).

Lycodon pictus Janssen, Pham, Ngo, Le, Nguyen & Ziegler, 2019

Pictus Wolf Snake / Ran khuyet pic-tus (Fig. 4b)

Specimen examined (n = 1). IEBR 4756 (adult female) collected by Pham et al. on 1 September 2017, near Na Phuong Village (22°29.750' N, 105°18.650' E, at an elevation of 252 m asl.), Thuong Lam Commune, Lam Binh District.

Description. Morphological characters of the specimen agreed with the description of Janssen et al. (2019): Body robust, subcylindrical; head longer than wide, distinct from neck; snout obtuse; nostril lateral; eye large, pupil vertical; head scalation complete: internasals 2, prefrontals 2, parietals 2, supraoculars 2, frontal 1; supralabials 8/8, 3rd–5th in contact with eye; infralabials 10/10, 1st–5th bordering chin shields; dorsal scale rows 17–17–15, smooth; scales of the outer dorsal scale row slightly enlarged; ventrals 213; subcaudals 90, paired; cloacal single.

Coloration in life. The body and tail surfaces alternating light brown and cream bands with 25 light bands on the body; 13 light bands on the tail; ventral surface mostly cream with dark bands in part extending towards the venter.

Ecology notes. The specimen was found at 22:00 hours while foraging near a small stream. The surrounding habitat was mixed primary forest consisting of large hard-

woods and shrubs. Air temperature was 26°C and relative humidity was 80%.

Distribution. *Lycodon pictus* was originally discovered from Cao Bang Province in northern Vietnam (Janssen et al. 2019). The species was recently recorded from Guangxi Zhuang Autonomous Region, China, approximately 60 km apart from the type locality (Janssen et al. 2020).

Remarks. The specimen from Tuyen Quang differed from those in the description of Janssen et al. (2019) by having a greater ratio of tail length/total length (TAL/TL 0.224 vs. 0.211–0.215) and fewer light bands on the body (25 vs. 28 or 29).

Lycodon subcinctus Boie, 1827

Malayan Banded Wolf Snake / Ran khuyet dai (Fig. 4c)

Specimen examined (n = 1). IEBR 4757 (adult female) collected by Pham et al. on 26 August 2017 near Nam Duong Village (22°35.100' N, 105°22.083' E, at an elevation of 350 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimen agreed with the descriptions of Smith (1943) and Nguyen (2007): Body robust, subcylindrical; head longer than wide, distinct from neck; snout obtuse; nostril lateral; eye large, pupil vertical.; head scalation complete: internasals 2, prefrontals 2, parietals 2, supraocular 1, frontal 1; supralabials 8/8, 3rd–5th in contact with eye; infralabials 9/9; dorsal scale rows 17–17–15, keeled; scales of the outer dorsal scale row slightly enlarged; ventrals 197; subcaudals 78, paired; cloacal divided.

Coloration in life. Black upper body and tail surface with white markings on the body extending to the outermost scales; creamy yellow abdomen with dark obscure spots.

Ecology notes. The specimen was found at 21:00 hours while hiding in a small hole along the bank of a stream. The surrounding habitat was mixed secondary forest consisting of small hardwoods and shrubs. Air temperature was 30°C and relative humidity was 82%.

Distribution. In Vietnam, this species was known from Lai Chau and Bac Kan provinces in the north southwards to Lam Dong and Binh Phuoc provinces in central Vietnam (Nguyen et al. 2009). Elsewhere, this species is known from China, Thailand, Laos Cambodia, Malaysia, Brunei, Indonesia and the Philippines (Nguyen et al. 2009; Uetz et al. 2020).

Family Viperidae

Protobothrops mucrosquamatus (Cantor, 1839)

Brown Spotted Pit Viper / Ran luc cuom (Fig. 4d)

Specimen examined (n = 1). IEBR 4758 (adult male) collected by Pham et al. on 14 June 2018 near Nam

Duong Village (22°36.283' N, 105°20.367' E, at an elevation of 850 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimen agreed with the descriptions of Bourret (1936), Smith (1943), Leviton et al. (2003), Nguyen (2007), Stuart & Heatwole (2008), Nguyen et al. (2011), Luu et al. (2013), and Nemes et al. (2013): Head longer than wide, triangle shaped, distinct from neck; snout obtuse; nostril dorsolateral; eye large; upper head scales, irregular, scarcely increasing in size anteriorly, no loreal; preocular 1; postocular 1; no temporal; supralabials 10/10; infralabials 14/14, 1st–3rd bordering chin shields; dorsal scale rows 31–25–19, feebly keeled; ventrals 241; cloacal single; subcaudals 56+, paired.

Coloration in life. Dorsal head brown, paler below; dorsum greyish brown, with a series of large brown, dark edged spots; a dark brown line from eye to the angle of the mouth, edged in black; ventral surface brownish with white blotches; dorsal tail light brown, with a series of conspicuous black spots.

Ecology notes. The specimen was found at 20:30 hours while crawling near the waterfall. The surrounding habitat was mixed secondary forest consisting of small hardwood and shrub. Air temperature was 28°C and relative humidity was 90%.

Distribution. In Vietnam, this species was known from Ha Giang and Cao Bang provinces in the north southwards to Kon Tum and Gia Lai provinces in central Vietnam (Nguyen et al. 2009). Elsewhere, this species is known from Russia, China, Myanmar, Taiwan, Myanmar, Thailand, Laos, and Malaysia (Uetz et al. 2020).

Trimeresurus stejnegeri Schmidt, 1925

Bamboo Pit Viper / Ran luc xanh (Fig. 5)

Specimen examined (n = 1). IEBR 4759 (adult male) collected by Pham et al. on 18 June 2018 near Trung Phin Village (22°31.433' N, 105°22.750' E, at an elevation of 555 m asl.), Sinh Long Commune, Na Hang District.

Description. Morphological characters of the specimen agreed with the descriptions of David et al. (2001, 2002), Bain & Nguyen (2004), and Hecht et al. (2013): Head longer than wide, triangle shape, distinct from neck; snout obtuse; nostril dorsolateral; eye large; upper head scales, irregular, scarcely increasing in size anteriorly, no loreal; preocular 1; postocular 1; no temporal; supralabials 9/10; infralabials 13/14, 1st–3rd bordering chin shields; dorsal scale rows 23–21–15, feebly keeled; ventrals 160; cloacal single; subcaudals 55+, paired.

Coloration in life. Dorsum green above, venter lighter than dorsum; a distinct whitish-yellow stripe down the side of the body; no postocular stripe; tip of tail pale reddish.

Ecology notes. The specimen was found at 22:00 hours, while resting on a tree branch near a small pool



Fig. 5. *Trimeresurus stejnegeri*, adult male (IEBR 4759) from Tuyen Quang Province, Vietnam.

in a forest. The surrounding habitat was mixed secondary forest consisting of small hardwoods and shrubs. Air temperature was 30°C and relative humidity was 82%.

Distribution. In Vietnam, this species was known from Lao Cai Province in the north southwards to Quang Binh Province and Da Nang City in the south (Nguyen et al. 2009). Elsewhere, this species is known from China, Taiwan, and Myanmar (Nguyen et al. 2009; Uetz et al. 2020).

DISCUSSION

Our new records bring the total number of amphibian species to 57 and that of snakes to 42 in Tuyen Quang Province (Table 1). Some taxonomic changes of amphibians were made by recent studies, for example, Nguyen et al. (2009) documented the distribution of *Leptobrachella pelodytoides* (Boulenger, 1893) from Lao Cai Province in the North southwards to Gia Lai Province, however, Ohler et al. (2011) indicated that *L. pelodytoides* has a restricted distribution in Myanmar and records of *L. pelodytoides* in Vietnam should be assigned to the *L. ventripunctata* (Fei, Ye & Li, 1990) group. Matsui et al. (2010) and McLeod (2010) stated that the previous record of *Limnonectes kuhlii* (Tschudi, 1838) in Vietnam (Nguyen et al. 2009) should be re-identified as *L. bananensis* Ye, Fei, Xie & Jiang, 2007. Kuraishi et al. (2012)

re-identified the records of *Polypedates leucomystax* (Gravenhorst, 1829) from Vietnam (Nguyen et al. 2009) as *P. mutus* (Smith, 1940) and *P. megacephalus* Hallowell, 1861. Jiang et al. (2019) resurrected the genus *Leptomantis* and described a new genus *Zhangixalus*. Based on morphological and molecular evidences Yu et al. (2019) suggested that previous records of *R. maximus* in Vietnam, Laos and Thailand (Nguyen et al. 2009) should be provisionally assigned to *Zhangixalus pachyproctus* Yu, Hui, Hou, Wu, Rao & Yang, 2019. In this study, we further extend the distribution of a recently described snake (*Lycodon pictus*) in northern Vietnam, including color pattern variation. The new record of the species in Tuyen Quang Province is approximately 70 km distant from the type locality in Cao Bang Province.

Tuyen Quang Province also harbors a high number of species of conservation concern. Four species are currently only known from Vietnam, eight species are listed in the IUCN Red List (2020), three species listed in the Vietnam Governmental Decree No 06/2019/ND-CP, three species listed in the CITES appendices (2020), and 16 species listed in the Red Data Book of Vietnam (2007).

Table 1. List of amphibian and snake species recorded from Tuyen Quang Province, Vietnam. Asterisks (*) denote new provincial records. References include: 1 = Le et al. (2007); 2 = Nguyen et al. (2009); 3 = Phan et al. (2018); 4 = Pham et al. (2019a); 5 = Pham et al. (2019b); 6 = this study. IUCN = IUCN Red List of Threatened species, Decree 061 = Decree No 06/2019/ND-CP of the Government of Vietnam on management of threatened and rare wild plants and animals, CITES = CITES appendices.

No	Species name	Common name	Reference	Red Data Book (2007)	IUCN (2020)	Decree 06 (2019)	CITES (2020)
ANURA		FROGS					
Bufonidae		Toads					
1.	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)	Asian Common Toad	1, 2, 6				
2.	<i>Ingerophrynus galeatus</i> Günther, 1864	Cambodia Toad	1	VU			
Hylidae		Treefrogs					
3.	<i>Hyla simplex</i> Boettger, 1901	Annam Treefrog	1				
Megophryidae		Spadefoot frogs					
4.	<i>Leptobranchella nahangensis</i> (Lathrop, Murphy, Orlov & Ho, 1998)	Nahang Asian Toad	1, 2, 6				
5.	<i>L. sungi</i> (Lathrop, Murphy, Orlov & Ho, 1998)*	Sung's Toad	6				
6.	<i>L. ventripunctatus</i> (Fei, Ye & Li, 1990)	Yunnan Asian Toad	1, 2, 6				
7.	<i>Leptobranchium chapaense</i> (Bourret, 1937)*	Chapa Spadefoot Toad	6				
8.	<i>L. guangxiense</i> Fei, Mo, Ye & Yang, 2009*	Guangxi Pseudomoustache Toad	6				
9.	<i>Megophrys maosonensis</i> Bourret, 1937	Mauson Mountain Toad	1, 6				
10.	<i>M. microstoma</i> Boulenger, 1903*	Asian Mountain Toad	1, 6				
11.	<i>M. pachyprotus</i> Kou, 1985	Huang's Spadefoot Toad	1				
Microhylidae		Narrow-mouthed frogs					
12.	<i>Kalophrynus interlineatus</i> (Blyth, 1855)	Bubble-nest Frog	1				
13.	<i>Kaloula pulchra</i> Gray, 1831	Malaysian Narrow-mouth Toad	1				
14.	<i>Microhyla butleri</i> Boulenger, 1900	Butler's Pigmy Frog	1, 2				
15.	<i>M. fissipes</i> Boulenger, 1884	Ornate Pigmy Frog	1, 2				
16.	<i>M. heymonsi</i> Vogt, 1911	Taiwan Rice Frog	1, 2, 6				
17.	<i>M. pulchra</i> (Hallowell, 1861)	Guangdong Rice Frog	1, 2, 6				
18.	<i>Micryletta inornata</i> (Boulenger, 1890)	Deli Paddy Frog	1				
Dicroglossidae		True frogs					
19.	<i>Fejervarya limnocharis</i> (Gravenhorst, 1829)	Rice-paddy Frog	1, 2, 6				
20.	<i>Hoplobatrachus rugulosus</i> (Wiegmann, 1834)	Common Lowland Frog	1, 2, 6				
21.	<i>Limnonectes bannaensis</i> Ye, Fei & Jiang, 2007	Banna Large-headed Frog	1, 2, 6				

Table 1. Continued.

No	Species name	Common name	Reference	Red Data Book (2007)	IUCN (2020)	Decree 06 (2019)	CITES (2020)
ANURA		FROGS					
22.	<i>L. limborgi</i> (Sclater, 1892)*	Taylor's Frog	6				
23.	<i>L. nguyenorum</i> McLeod, Kurlbaum & Hoang, 2015	Nguyen's Wart Frog	5				
24.	<i>Quasipaa boulengeri</i> (Günther, 1889)*	Boulenger's Spiny Frog	6		EN		
25.	<i>Q. delacouri</i> (Angel, 1928)	Tonkin Asian Frog	1	EN			
26.	<i>Q. spinosa</i> (Davis, 1875)	Chinese Spiny Frog	1		VU		
27.	<i>Q. verrucospinosa</i> (Bourret, 1937)	Verrucose Spiny Frog	1,2				
28.	<i>Occidozyga lima</i> (Gravenhorst, 1829)	Green Puddle Frog	1, 2, 6				
29.	<i>O. martensii</i> (Peter, 1867)	Marten's Frog	1				
Ranidae		Ranids					
30.	<i>Amolops ricketti</i> (Roulenger, 1899)	Chinese Sucker Frog	1				
31.	<i>Hylarana macrodactyla</i> (Gunther, 1859 "1858")	Guangdong Frog	1				
32.	<i>H. taipehensis</i> Van Denburgh, 1909	Taipei Frog	1				
33.	<i>Odorrana andersonii</i> (Boulenger, 1882)	Anderson's Frog	1, 2	VU			
34.	<i>O. bacboensis</i> (Bain, Lathrop, Murphy, Orlov & Ho, 2003)	Tonkin Frog	1, 2				
35.	<i>O. chloronota</i> (Günther, 1875)	Green Cascade Frog	1, 2, 6				
36.	<i>O. geminata</i> Bain, Stuart, Nguyen, Che & Rao, 2009	Geminated Cascade Frog	4		VU		
37.	<i>O. lipuensis</i> Mo, Chen, Wu, Zhang & Zhou, 2015	Lipu Cascade Frog	4				
38.	<i>O. nasica</i> (Boulenger, 1903)	Long-snout Torrent Frog	6				
39.	<i>O. tiannanensis</i> (Yang & Li, 1980)	Tiannan Odorous Frog	1, 2				
40.	<i>Rana johnsi</i> Smith, 1921	John's Frog	1, 2, 6				
41.	<i>Sylvirana guentheri</i> (Boulenger, 1882)	Gunther's Amoy Frog	1, 2, 6				
42.	<i>S. maosonensis</i> (Bourret, 1937)	Mauson Frog	1, 2, 6				
43.	<i>S. nigrovittata</i> (Blyth, 1855)	Black-striped Frog	1				
Rhacophoridae		Treefrogs					
44.	<i>Chiromantis doriae</i> (Boulenger, 1893)	Doria's Asian Treefrog	1, 2				
45.	<i>Kurixalus bisacculus</i> (Taylor, 1962)	Taylor's Tree Frog	1, 2				
46.	<i>Polypedates megacephalus</i> Hallowell, 1861	Hong Kong Whipping Frog	1, 6				
47.	<i>P. mutus</i> (Smith, 1940)	Burmese Whipping Frog	1, 2, 6				
48.	<i>Raorchestes gryllus</i> (Smith, 1924)	Langbian Bubble-nest Frog	1, 2		VU		

Table 1. Continued.

No	Species name	Common name	Reference	Red Data Book (2007)	IUCN (2020)	Decree 06 (2019)	CITES (2020)
ANURA		FROGS					
49.	<i>R. parvulus</i> (Boulenger, 1893)*	Karin Bubble-nest Frog	6				
50.	<i>Rhacophorus kio</i> Ohler & Delorme, 2006*	Black-webbed Treefrog	6	EN			
51.	<i>R. orlovi</i> Ziegler & Köhler, 2001*	Orlov's Treefrog	6				
52.	<i>Theلودerma albopunctatum</i> (Liu & Hu, 1962)	Dotted Bubble-nest Frog	1, 6				
53.	<i>T. corticale</i> (Boulenger, 1903)	Tonkin Bug-eyed Frog	1, 2	EN			
54.	<i>Zhangixalus dennysii</i> (Blanford, 1881)	Denny's Whipping Frog	1				
55.	<i>Z. pachyproctus</i> Yu, Hui, Hou, Wu, Rao & Yang, 2019*	Protruded-vent Treefrog	6				
CAUDATA		SALAMANDERS					
Salamandridae		Salamanders					
56.	<i>Paramesotriton deloustali</i> (Bourret, 1934)	Vietnamese Salamander	1, 2	EN			
GYMNOPHIONA		CAECILIANS					
Ichthyophiidae		Asian Tailed Caecilians					
57.	<i>Ichthyophis bannanicus</i> Yang, 1984	Banna Caecilian	1, 2	VU			
SERPENTES		SNAKES					
Typhlopidae		Blind snakes					
58.	<i>Indotyphlops braminus</i> (Daudin, 1803)	Common blind snake	1				
Xenopeltidae		Sunbeam snakes					
59.	<i>Xenopeltis unicolor</i> Reinwardt, 1827	Sunbeam snake	1, 3				
Boidae		Pythons					
60.	<i>Python molurus</i> (Linnaeus, 1758)	Indian rock python	1	CR	VU	IIB	II
Colubridae		Colubrines					
61.	<i>Ahaetulla prasina</i> (Boie, 1827)	Oriental whip snake	1				
62.	<i>Amphiesma stolatum</i> (Linnaeus, 1758)	Buff striped keelback	1				
63.	<i>Boiga guangxiensis</i> Wen, 1998	Guangxi cat snake	3				
64.	<i>B. kraepelini</i> Stejneger, 1902	Kraepelin's cat snake	3				
65.	<i>B. multomaculata</i> (Boie, 1827)	Many-spotted cat snake	1				
66.	<i>Calamaria septentrionalis</i> Boulenger, 1890	Hongkong dwarf snake	1				
67.	<i>Coelognathus radiatus</i> (Boie, 1827)	Copperhead racer	1	VU			
68.	<i>Dendrelaphis pictus</i> (Gmelin, 1789)	Common bronzeback	1				

Table 1. Continued.

No	Species name	Common name	Reference	Red Data Book (2007)	IUCN (2020)	Decree 06 (2019)	CITES (2020)
	SERPENTES	SNAKES					
69.	<i>Elaphe moellendorffi</i> (Boettger, 1886)	Moellendorf's rat snake	1	VU	VU		
70.	<i>Euprepiophis mandarinus</i> (Cantor, 1842)	Mandarin rat snake	1, 2	VU			
71.	<i>Lycodon futsingensis</i> (Pope, 1928)*	Futsing wolf snake	6				
72.	<i>L. meridionalis</i> (Bourret, 1935)	Southern big-tooth snake	1				
73.	<i>L. pictus</i> Janssen, Pham, Ngo, Le, Nguyen & Ziegler, 2019*	Pictus wolf snake	6				
74.	<i>L. subcinctus</i> (Boie, 1827)*	Malayan banded wolf snake	6				
75.	<i>L. rufozonatus</i> Cantor, 1842	Red-banded snake	1, 2				
76.	<i>O. cinereus</i> (Günther, 1864)	Günther's kukri snake	1				
77.	<i>O. eberhardti</i> Pellegrin, 1910	Eberhardt's kukri snake	1				
78.	<i>O. taeniatus</i> (Günther, 1861)	Striped kukri snake	1				
79.	<i>Ptyas korros</i> (Schlegel, 1837)	Indo-chinese rat snake	1, 2	EN			
80.	<i>P. mucosa</i> (Linnaeus, 1758)	Oriental rat snake	1	EN			
81.	<i>P. multicinctus</i> (Roux, 1907)	Many-banded green snake	3				
	Homalopsidae	Muds snakes					
82.	<i>Hypsigopus plumbea</i> (Boie, 1827)	Boie's mud snake	1				
83.	<i>Myrrophis chinensis</i> (Gray, 1842)	Chinese mud snake	1				
	Lamprophiidae	Mock vipers					
84.	<i>Psammodynastes pulverulentus</i> (Boie, 1827)	Common mock viper	3				
	Natricidae	Keelback snakes					
85.	<i>Fowlea flavipunctatus</i> (Hallowell, 1860)	Yellow-spotted keelback	1				
86.	<i>Hebius boulengeri</i> (Gressit, 1937)	Tai-yong keelback	3				
87.	<i>H. deschauenseei</i> (Taylor, 1934)	Deschauensee's keelback	2				
88.	<i>Opisthotropis jacobi</i> Angel & Bourret, 1933	Chapa mountain keelback	1, 2				
89.	<i>Rhabdophis subminiatus</i> (Schlegel, 1837)	Red-necked keelback	1				
90.	<i>Sinonatrix percarinata</i> (Boulenger, 1899)	Eastern water snake	1				
	Pareatidae	Slug snakes					
91.	<i>Pareas hamptoni</i> (Boulenger, 1905)	Hampton's slug snake	3				
92.	<i>P. margaritophorus</i> (Jan, 1866)	Mountain slug snake	3				

Table 1. Continued.

No	Species name	Common name	Reference	Red Data Book (2007)	IUCN (2020)	Decree 06 (2019)	CITES (2020)
	SERPENTES	SNAKES					
	Pseudoxenodontidae	Bamboo snake					
93.	<i>Pseudoxenodon bambusicola</i> Vogt, 1922	Bamboo snake	1, 2				
	Elapidae	Kraits					
94.	<i>Bungarus fasciatus</i> (Schneider, 1801)	Banded krait	1	EN			
95.	<i>B. multicinctus</i> Blyth, 1861	Many-banded krait	1				
96.	<i>Naja atra</i> Cantor, 1842	Chinese cobra	1, 2	EN	VU	IIB	II
97.	<i>Ophiophagus hannah</i> (Cantor, 1836)	King cobra	1	CR	VU	IB	II
	Viperidae	Vipers					
98.	<i>Protobothrops mucrosquamatus</i> (Cantor, 1839)*	Brown spotted pit viper	6				
99.	<i>Trimeresurus stejnegeri</i> Schmidt, 1925*	Bamboo pit viper	6				

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