New records and an updated checklist of amphibians from Lai Chau Province, Vietnam

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Abstract
We provide a checklist of 45 species of amphibians from Lai Chau Province, northwestern Vietnam. Thirteen of species are recorded for the first time from Lai Chau Province; these include four species of Dicroglossidae, four species of Megophryidae, three species of Ranidae, and two species of Rhacophoridae. We also provide descriptions of the newly recorded species. The amphibian fauna of Lai Chau Province is of high conservation concern, with three species endemic to Vietnam, 10 species listed in the IUCN Red List, and two species listed in the Red Data Book of Vietnam.

Keywords
Faunal/herpetological survey, morphology, taxonomy

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Introduction
Lai Chau Province is located in northwestern Vietnam and encompasses an area of 283,667 ha of secondary and primary evergreen forest (The People’s Committee of Lai Chau Province 2019). In terms of amphibian diversity, Lai Chau Province is one of the most poorly studied provinces in northern Vietnam. In their herpetofaunal
book of Vietnam, Nguyen et al. (2009) recorded 24 species of amphibians from Lai Chau Province. In recent years, more surveys have been undertaken in the area and numerous new findings have been recorded from this province. For example, two new species were recently discovered, namely Megophrys hoanglienensis Tapley, Cutajar, Mahony, Nguyen, Dau, Luong, Le, Nguyen, Nguyen, Portway, Luong & Rowley, 2018 and Tylototriton sparrboomi Bernardes, Le, Nguyen, Pham, Pham, Nguyen & Ziegler, 2020 (Tapley et al. 2018; Bernardes et al. 2020). In addition, eight new provincial records of amphibians were reported from Lai Chau, viz. Leptobrachella minima (Taylor, 1962), Nidirana chapaensis (Bourret, 1937), Sylvirana cubitalis (Smith, 1917), S. menglaensis (Fei, Ye & Xie, 2008), Kurixalus bisaccatus (Taylor, 1962), Polypedates megacephalus Hallowell, 1861, Rhacophorus kio Ohler & Delorme, 2006, and Theloderma bicolor (Bourret, 1937) (Pham et al. 2018, 2019; Sung et al. 2019).

As a result of our recent field survey in Lai Chau Province in May 2020, we provide an updated checklist of 45 species of amphibians, including 13 new records from the province.

Methods

Sampling. The field survey was conducted by Cuong The Pham, Chung Van Hoang, Anh Van Pham, Tien Quang Phan, and Nenh Ba Sung on 11–23 May 2020 in Sin Ho and Tam Duong districts, Lai Chau Province (Fig. 1). The main habitat type was secondary forest of medium-sized and small hardwoods mixed with shrubs and bamboo at elevations between 1100 and 2500 m above sea level (a.s.l.) (Fig. 2). The coordinates (WGS 84) were recorded using a GPS Garmin 60CX receiver.

Specimens were collected between 19:00 h and 24:00 h. 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 5 h, and then later transferred to 70% ethanol for permanent storage. Tissue samples 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), Hanoi, Vietnam.

Morphological examination. Measurements were taken on preserved specimens with digital calipers to the nearest 0.1 mm. The following abbreviations were used: SVL = snout–vent length, HL = head length (from the back of mandible to tip of snout), HW = maximum head width (across angles of jaws), RL = rostral length (from anterior corner of orbit to tip of snout), NS = distance from nostril to the tip of snout, EN = distance from anterior corner of orbit to the 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, TYD = 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 1–IV, 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 fourth toe), TLI–5 = toe length I–V, IMT = inner metatarsal tubercle length. For the webbing formula, we followed Glaw and Vences (2007). Sex was determined by examination of the presence of nuptial pads and gonadal inspection.

Specimen identification. For taxonomic identification, we referred to Boulenger (1903), Bourret (1942), Liu (1950), Liu et al. (1960), Liu and Hu (1960), Taylor (1962), Ho et al. (1999), Fei et al. (2008, 2010), Ohler et al. (2000), Bain et al. (2003), Hu et al. (2005), Ye et al. (2007), Hecht et al. (2013), Ziegler et al. (2014), McLeod et al. (2015), Nguyen et al. (2016), Tapley et al. (2017), Luong et al. (2018, 2019), and Pham et al. (2012). Species names follow Nguyen et al. (2009) and Frost (2020).

Results

Family Megophryidae Bonaparte, 1850

Leptobrachium ailaonicum (Yang, Chen & Ma, 1983)

Ailao Spiny Toad

Figure 3A

Material examined. VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.566584°N, 103.759786°E; alt. 2394 m; 18.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the ground near small stream, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 1 ♂; IEBR 4761 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.410067°N, 103.611183°E; alt. 2367 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the ground near small streams, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 4 ♂; IEBR 4762–4765.

Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Ho et al. (1999) and Fei et al. (2010). Size large (SVL 66.2–69.1 mm); head as wide as long (HW 26.8–29.7 mm, HL 26.6–28.4 mm); snout round, longer than eye diameter (RL 9.7–10.2 mm, ED 8.4–9.2 mm); nostril round, laterally positioned, closer to the tip of snout than to eye (NS 3.7–5.4 mm, EN 5.0–5.9 mm);
canthus rostralis indistinct, eye large (ED 8.4–9.2 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue large, notched posteriorly; the males with 30–40 spines. Arm long (FLL 17.7–19.7 mm), relative lengths of fingers I<II<IV<III, tips of fingers swollen; fingers free of webbing, lateral fringes absent; subarticular tubercles distinct, formula 1, 2, 3, 2; inner metatarsal tubercle, round, protuberant, larger than outer metatarsal tubercle, oval. Thigh short (FeL 29.8–35.1 mm); tibia approximately four times longer than wide (TbL 28.4–32.9 mm, TW 6.9–8.5 mm); tips of toes swollen; relative lengths of toes I<II<III<IV; webbing formula I⅔–I⅔–II⅔–II⅔–IV⅔–I; subarticular tubercles absent; inner metatarsal tubercle present, oval;
outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adpressed along body. Skin: dorsal surface of head, body, and upper limbs smooth with microscopic network of ridges; flanks, belly, chest, throat, ventral forelimbs and thighs with small pustules.

Coloration in life: dorsal surface of head, body and upper limbs brownish purple with dark brown mottling on back; ventral brown with white pattern; flanks with dark brown spotting and white pustules. Tips of digits, metacarpal and metatarsal tubercles white.

**Distribution.** In Vietnam, this species has been reported from Lao Cai and Son La provinces (Luong et al. 2019). Elsewhere, the species is known from Yunnan Province of China (Frost 2020).

**Megophrys gigantica** Liu, Hu, & Yang, 1960

Giant Spadefoot Toad

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.411667°N, 103.609767°E; alt. 2441 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a small, rocky stream, surrounding habitat covered by mixed secondary forest of medium-sized to large hardwoods and bamboo; 1 ♂; IEBR 4769.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu et al. (1960), Fei et al. (2010), and Luong et al. (2019). Size large (SVL 82.8–89.9 mm); head as wide as long (HW 32.3–39.1 mm, HL 33.1–39.8 mm); snout pointed, longer than eye diameter (RL 10.1–11.5 mm, ED 9.5–10.9 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 4.9–6.4 mm, EN 4.8–6.5 mm); canthus sharp, loreal region concave; eye large (ED 9.5–10.9 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue heart-shaped, slightly notched posteriorly. Arm long (FLL 15.3–19.8 mm), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; subarticular tubercles indistinct; two round palmar tubercles, inner larger and more prominent. Thigh slender, long (FeL 40.0–44.9 mm); tibia approximately four times longer than wide (TbL 42.9–50.1 mm, TW 10.0–12.6 mm); relative lengths of toes I<II<IV<III<IV; webbing formula I1–1½ II1–2 III2–3 IV3–1½; tips of toes slightly swollen; toes with dermal fringes; subarticular tubercles absent; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching between eye and nostril when leg adpressed along body. Skin: dorsal surface smooth; supratympanic fold present, from posterior edge of eye to axilla; flanks smooth; ventral surface smooth; outer edge of the eyelid without a horn-like tubercle.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu et al. (1960), Fei et al. (2010), and Luong et al. (2019). Size large (SVL 82.8–89.9 mm); head as wide as long (HW 32.3–39.1 mm, HL 33.1–39.8 mm); snout pointed, longer than eye diameter (RL 10.1–11.5 mm, ED 9.5–10.9 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 4.9–6.4 mm, EN 4.8–6.5 mm); canthus sharp, loreal region concave; eye large (ED 9.5–10.9 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue heart-shaped, slightly notched posteriorly. Arm long (FLL 15.3–19.8 mm), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; subarticular tubercles indistinct; two round palmar tubercles, inner larger and more prominent. Thigh slender, long (FeL 40.0–44.9 mm); tibia approximately four times longer than wide (TbL 42.9–50.1 mm, TW 10.0–12.6 mm); relative lengths of toes I<II<IV<III<IV; webbing formula I1–1½ II1–2 III2–3 IV3–1½; tips of toes slightly swollen; toes with dermal fringes; subarticular tubercles absent; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching between eye and nostril when leg adpressed along body. Skin: dorsal surface smooth; supratympanic fold present, from posterior edge of eye to axilla; flanks smooth; ventral surface smooth; outer edge of the eyelid without a horn-like tubercle.

Coloration in life: dorsal surface yellowish brown, without black marking; loreal and supratympanic fold edged in black below; upper lip yellow; flanks yellowish brown; ventral surface brown with yellow pattern.

**Distribution.** In Vietnam, this species has been reported from Lao Cai and Son La provinces (Luong et al. 2019). Elsewhere, the species is known from Yunnan Province of China (Frost 2020).

**Megophrys jingdongensis** Fei & Ye, 1983

Jingdong Horned Toad

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.381867°N, 103.604400°E; alt. 1470 m; 15.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by mixed secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂; IEBR 4770–4771.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu et al. (1960), Fei et al. (2010), and Luong et al. (2019). Size large (SVL 82.8–89.9 mm); head as wide as long (HW 32.3–39.1 mm, HL 33.1–39.8 mm); snout pointed, longer than eye diameter (RL 10.1–11.5 mm, ED 9.5–10.9 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 4.9–6.4 mm, EN 4.8–6.5 mm); canthus sharp, loreal region concave; eye large (ED 9.5–10.9 mm), tympanum indistinct; supratympanic fold distinct, vomerine teeth absent; tongue heart-shaped, slightly notched posteriorly. Arm long (FLL 15.3–19.8 mm), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; subarticular tubercles indistinct; two round palmar tubercles, inner larger and more prominent. Thigh slender, long (FeL 40.0–44.9 mm); tibia approximately four times longer than wide (TbL 42.9–50.1 mm, TW 10.0–12.6 mm); relative lengths of toes I<II<IV<III<IV; webbing formula I1–1½ II1–2 III2–3 IV3–1½; tips of toes slightly swollen; toes with dermal fringes; subarticular tubercles absent; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching between eye and nostril when leg adpressed along body. Skin: dorsal surface smooth; supratympanic fold present, from posterior edge of eye to axilla; flanks smooth; ventral surface smooth; outer edge of the eyelid without a horn-like tubercle.

Coloration in life: dorsal surface yellowish brown, without black marking; loreal and supratympanic fold edged in black below; upper lip yellow; flanks yellowish brown; ventral surface brown with yellow pattern.

**Distribution.** In Vietnam, this species has been reported from Lao Cai and Son La provinces (Luong et al. 2019). Elsewhere, the species is known from Yunnan Province of China (Frost 2020).
descriptions of Fei et al. (1983, 2009), Nguyen et al. (2016), and Luong et al. (2018). Medium-sized (SVL 50.8–54.4 mm); head narrower than long (HW 18.7–19.7 mm, HL 19.7–20.8 mm); snout pointed in dorsal view, longer than eye diameter (RL 6.5–7.0 mm, ED 6.4–6.6 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 3.2–3.5 mm, EN 3.3–3.5 mm); canthus rostral sharp, eye large (ED 6.4–6.6 mm), tympanum distinct (TYD 3.0–3.7 mm); supratympanic fold distinct, vomerine teeth present; tongue large, slightly notched posteriorly. Arm moderately slender (FL 10.8–11.0 mm), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; fingers without lateral fringes; subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent. Thigh slender (FeL 24.4–30.2 mm); tibia approximately six times longer than wide (TbL 30.2–33.5 mm, TW 4.9–5.8 mm); tips of toes round; relative lengths of toes I<II<III<IV; webbing formula I–I–III–2½II–III–2 IV–3–IV; subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the snout when leg addressed along body. Skin: dorsal surface of head and body smooth; flanks with small, scattered tubercles; small horn on upper eyelid; cloaca above and below with small tubercles; two dorsolateral parallel ridges on either side present; supratympanic fold present; ventral surface smooth.

Coloration in life: dorsal surface and lateral sides of head, body, forelimbs and hindlimbs grey; a dark brown triangular marking with a light central blotch between eyes; throat, chest and anterior part of belly primarily brown; belly cream with dark brown patterns; pectoral glands white.

**Distribution.** In Vietnam, this species has been reported from Lao Cai, Ha Giang, and Vinh Phuc provinces (Nguyen et al. 2009, 2016; Luong et al. 2018). Elsewhere, the species is known from Yunnan and Guangxi provinces, China (Frost 2020).

**Megophrys rubrimerata** Tapley, Cutajar, Mahony, Chung, Dau, Nguyen, Luong & Rowley, 2017

Red-thighed Horned Frog

**Figure 3D**

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.380933°N, 103.605000°E; alt. 1381 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂, 1 ♀; IEBR 4772

Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.410067°N, 103.611183°E; alt. 2367 m; 19.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂, 1 ♀; IEBR 4777–4778.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the description of Tapley et al. (2017). Size small (SVL 28.6–30.9 mm in males and SVL 29.3 mm in the female); head narrower than long (HW 9.6–11.3 mm, HL 10.2–11.5 mm in males; HW 12.8 mm, HL 13.4 mm in the female); snout round in dorsal view, as long as eye diameter in males (RL 3.5–3.9 mm, ED 3.0–3.9 mm); longer than eye diameter in the female (RL 4.8 mm, ED 4.1 mm); nostril oval, laterally positioned, closer to the tip of snout than to the eye (NS 1.3–1.9 mm, EN 1.6–2.2 mm in males; NS 2.2 mm, EN 2.5 mm in the female); canthus rostralis angular, eye large (ED 3.0–3.9 mm in males; ED 4.1 mm in the female), tympanum distinct (TYD 1.5–1.7 mm in males; TYD 2.0 mm in the female); supratympanic fold narrow, vomerine teeth present; tongue moderately large and not clearly notched posteriorly. Arm short and stocky (FL 5.6–7.0 mm in males; FL 7.4 mm in the female), relative lengths of fingers I<II<IV<III, tips of fingers round; fingers free of webbing; fingers without lateral fringes, subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent. Thigh relatively short and stocky (FeL 13.4–15.3 mm in males; FeL 18.3 mm in the female); tibia approximately seven times longer than wide (TbL 15.6–17.1 mm, TW 2.2–3.0 mm in males; TbL 21.7 mm, TbW 3.1 mm in the female); tips of toes round; relative lengths of toes I<II<IV<III; toes free of webbing; subarticular tubercles absent; inner metatarsal tubercle present; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the nostril when leg addressed along body. Skin: dorsal surface of body, limbs, and lateral surface of head weakly granular; flanks with small, scattered tubercles; chest, belly, and ventral surfaces of limbs smooth.

Coloration in life: dorsal surface and lateral sides of head, body, forelimbs and hindlimbs grey; a brown Y-shaped marking on dorsum between the eyes; hind and forelimbs possess brown bars; tubercles on flanks encircled by brown; groin red-orange; ventral surface grey with white pattern; inner metatarsal tubercles on feet red-orange.

**Distribution.** In Vietnam, this species has been reported from Lao Cai Province (Tapley et al. 2017). Elsewhere, the species is known from Yunnan Province, China (Frost 2020).

Family Dicroglossidae Anderson, 1871

**Limnonectes bannaensis** Ye, Fei & Jiang, 2007

Banna Large-headed Frog

**Figure 3E**

**Material examined.** VIETNAM – Lai Chau Province • Sin Ho District, Sao Sang-Ta Ngao Village; 22.266850°N, 103.590027°E; alt. 1647 m; 28.IV.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 2 ♂, 1 ♀; IEBR 4777–4778.
Morphological characteristics of the black mottles. Pectoral region, belly, and outer edges of limbs with ish; upper limbs with brown transversal bands; throat, brownish vertebral stripe; lower region of flanks brown mostly with black mottling or marbling, sometimes with face of head and body smooth; flank with small tuber of eye when leg adpressed along body. Skin: dorsal surface present, round; outer metatarsal tubercle absent; tibio-tarsal articulation reaching posterior edge of upper metaatarsal tubercle large; outer metatarsal tubercle absent; tibio-tarsal articulation reaching posterior edge of eye when leg adpressed along body. Skin: dorsal surface of head and body smooth; flank with small tubercles; small and homogenous tubercles on the leg and foot, ventral surface smooth.

Coloration in life: dorsal surface yellow-brown, mostly with black mottling or marbling, sometimes with brownish vertebral stripe; lower region of flanks brownish; upper limbs with brown transversal bands; throat, pectoral region, belly, and outer edges of limbs with black mottles.

Distribution. In Vietnam, this species has been reported from Cao Bang, Ha Giang, and Dien Bien provinces in the north southwards to Quang Binh Province (Frost 2020). Elsewhere, the species is known from Laos and Yunnan and Guangxi provinces, China (Frost 2020).

**Nanorana aenea (Smith, 1922)**

*Doi Chang Asian Frog*

**Figure 3F**

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.35683°N, 103.605617°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a large stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods and shrubs; 1 ♀, 2 ♀; IEBR 4786–4791.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Taylor (1962) and Pham et al. (2012). Size large (SVL 59.8–82.0 mm in males, SVL 57.4–65.8 mm in females); head as wide as long (HW 23.8–32.4 mm, HL 23.7–29.3 mm in males; HW 21.5–25.4 mm, HL 21.6–26.2 mm in females); snout round, longer than eye diameter (RL 9.2–13.1 mm, ED 7.1–8.6 mm in males; RL 8.7–9.7 mm, ED 7.3–8.0 mm in females); nostril oval, laterally positioned, closer to the eye than to tip of snout (NS 4.8–6.5 mm, EN 4.0–5.3 mm in males; NS 4.7–5.0 mm, EN 4.0–4.5 mm in females); canthus rostralis distinct, eye large (ED 7.1–8.6 mm in males; ED 7.3–8.0 mm in females), tympanum indistinct; supratympanic fold indistinct, vomerine teeth present; tongue notched posteriorly. Arm short (FLL 8.7–9.7 mm in males; FLL 9.7–12.8 mm in females), relative lengths of fingers IV<II<III in males and relative lengths of fingers II<1<III in females, tips of fingers slightly swollen; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; inner metatarsal tubercle indistinct. Thigh short (FeL 18.8–24.5 mm in males; FeL 21.4–32.7 mm in females); tibia approximately three times longer than wide (TbL 19.1–24.0 mm, TW 7.3–8.6 mm in males; TbL 21.6–31.8 mm, TW 8.8–11.1 mm in females); tips of toes swollen; relative lengths of toes I>II>I>III<IV; webbing complete; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle large; outer metatarsal tubercle absent; tibio-tarsal articulation reaching posterior edge of eye when leg adpressed along body. Skin: dorsal surface yellow-brown, mostly with black mottling or marbling, sometimes with brownish vertebral stripe; lower region of flanks brownish; upper limbs with brown transversal bands; throat, pectoral region, belly, and outer edges of limbs with black mottles.

**Distribution.** In Vietnam, this species has been reported from Cao Bang, Ha Giang, and Dien Bien provinces in the north southwards to Quang Binh Province (Frost 2020). Elsewhere, the species is known from Laos and Yunnan and Guangxi provinces, China (Frost 2020).
**Distribution.** In Vietnam, this species has been reported from Lao Cai, Son La, and Nghe An provinces (Nguyen et al. 2009; Pham et al. 2012). Elsewhere, the species is known from Yunnan Province of China and northwestern Thailand (Frost 2020).

*Nanorana yunnanensis* (Anderson, 1879)

Yunnan Paa Frog

Figure 3G

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.564433°N, 103.598238°E; alt. 1679 m; 17.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water near a waterfall of a the rocky stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods; 1 ♀; IEBR 4792 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.411667°N, 103.607750°E; alt. 2447 m; 18.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water near a waterfall of the rocky stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods; 3 ♀, 1 ♂; IEBR 4793–4796.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu (1950) and Fei et al. (2010). Size large (SVL 83.7–110.6 mm in males, SVL 73.1 mm in the female); head wider than long (HW 32.0–42.7 mm, HL 31.0–39.5 mm in males; HW 30.0 mm, HL 28.6 mm in the female); snout round, longer than eye diameter (RL 11.0–14.2 mm, ED 7.8–9.3 mm in males; RL 10.1 mm, ED 6.9 mm in the female); nostril oval, laterally positioned, closer to the eye than to tip of snout (NS 6.8–8.8 mm, EN 4.0–5.8 mm in males; NS 6.5 mm, EN 3.9 mm in the female); canthus rostralis indistinct, eye large (ED 7.8–9.3 mm in males; ED 6.9 mm in the female), tympanum hidden; supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm short (FLL 15.4–21.6 mm in males; FLL 12.7 mm in the female), relative lengths of fingers I<II<IV<III, tips of fingers obtuse; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 2, 2; two palmar tubercles, inner larger and more prominent. Thigh short (FeL 37.8–52.2 mm in males; FeL 36.1 mm in the female); tibia approximately three times longer than wide (TbL 42.2–55.0 mm, TW 14.7–19.7 mm in males; TbL 37.1 mm, TW 10.9 mm in the female); tips of toes round; relative lengths of toes I<II<III<IV; webbing formula I0–½II½–0III0–0IV0–0V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the shoulder when leg adpressed along body. Skin: dorsal surface of head and body brown, with indistinct black spots; limbs with dark brown cross bars; upper hind limbs brown with black horny spinules; ventral surface cream with white spots. Adult males with black horny spines on chest, throat, inner metacarpal tubecle and on the upper side of the first and second fingers.

**Distribution.** In Vietnam, this species has been reported from Lao Cai, Son La, Cao Bang, and Nghe An provinces (Nguyen et al. 2009; Frost 2020). Elsewhere, the species is known from Myanmar and Yunnan and Guizhou provinces of China (Frost 2020).

*Quasipaa verrucospinosa* (Bourret, 1937)

Spiny Frog

Figure 3H

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.381500°N, 103.604333°E; alt. 1465 m; 15.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 1 ♀, 2 ♂; IEBR 4797–4799.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Hu et al. (2005) and Fei et al. (2010). Size large (SVL 106.4 mm in the male, SVL 86.0–86.7 mm in females); head wider than long (HW 42.7 mm, HL 40.7 mm in the male; HW 34.7–35.0 mm, HL 32.7–33.4 mm in females); snout round, longer than eye diameter (RL 15.0 mm, ED 9.9 mm in the male; RL 12.6–12.8 mm, ED 8.5–9.5 mm in females); nostril oval, laterally positioned, closer to the eye than to tip of snout (NS 8.3 mm, EN 6.3 mm in the male; NS 6.6 mm, EN 6.1 mm in females); canthus rostralis indistinct, eye large (ED 9.9 mm in the male; ED 8.5–9.5 mm in females); tympanum indistinct; supratympanic fold distinct; vomerine teeth present; tongue notched posteriorly. Arm short (FLL 18.3 mm in the male; FLL 14.7–15.8 mm in females), relative lengths of fingers I<II<IV<III in the male and relative lengths of fingers I<II<IV<III in females, tips of fingers slightly swollen; fingers free of webbing; subarticular tubercles distinct, formula 1, 1, 1, 1; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent. Thigh short (FeL 52.7 mm in the male, FeL 48.1–48.1 mm in females); tibia approximately three times longer than wide (TbL 59.1 mm, TW 20.5 mm in the male; TbL 46.8–47.0 mm, TW 12.8–15.0 mm in females); tips of toes swollen; relative lengths of toes I<II<IV<III; webbing complete; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, round; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the shoulder when leg adpressed along body. Skin: dorsal surface of head and body granular, back with large oval warts intermixed with small tubercles; upper surface of fore and hind limbs granular; small black spinule
present on fingers I and II during breeding season; ven-
ter smooth.

Coloration in life: dorsal surface of head dark brown; 
lips and upper limbs with black bars; deep-brown upper 
surface of limbs; throat with black marbling; belly cream 
with black pattern (Hu et al. 2005; Fei et al. 2010).

**Distribution.** In Vietnam, this species has been reported 
from northern to central Vietnam (Nguyen et al. 2009). 
Elsewhere, the species is known from Yunnan Province 
of China and Longcheng of Laos (Frost 2020).

Family Ranidae Batsch, 1796

**Odorrana chloronota** (Günther, 1876)

Chloronater Huia Frog

Figure 4A

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.355233°N, 103.608200°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the ground near a waterfall of a rocky stream, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 8 ♂, 1 ♀; IEBR 4800–4808.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Bourret (1942) and Bain et al. (2003). Males smaller than female (SVL 44.2–45.6 mm in males, SVL 96.0 mm in the female); head narrower than long (HW 14.0–15.0 mm, HL 17.0–19.0 mm in males; HW 31.0 mm, HL 37.0 mm in the female); snout round, longer than eye diameter (RL 6.7–7.3 mm, ED 5.9–6.3 mm in males; RL 13.8 mm, ED 11.8 mm in the female); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 2.5–3.4 mm, EN 4.0–4.7 mm in males; NS 6.0 mm, EN 8.5 mm in the female); canthus rostralis distinct, eye large (ED 5.9–6.3 mm in males; ED 11.8 mm in the female), tympanum distinct (TYD 3.8–4.5 mm in males; TYD 5.0 mm in the female); supratympanic fold indistinct, vomerine teeth present; tongue deeply notched posteriorly; males with vocal sacs. Arm slender (FLL 8.6–11.1 mm in males and FLL 16.2 mm in the female), relative lengths of fingers I<II<IV<III, tips of fingers enlarged into discs; fingers free of webbing; subarticular tubercles absent. Thigh slender (FeL 23.4–26.2 mm in males, Fel. 57.4 mm in the female); tibia approximately seven times longer than wide in males (TbL 27.8–30.6 mm, TW 3.3–4.7 mm) and tibia approximately six times longer than wide in the female (TbL 65.0 mm, TW 10.2 mm); tips of toes enlarged into discs; relative lengths of toes I<II<IV<III<IV in males and I<II<III<IV<IV in the female; webbing complete; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, elongate; outer metatarsal tubercle absent; tibio-tarsal articulation reaching beyond tip of snout when leg addressed along body. Skin: dorsal surface of head and body smooth; flank with small tubercles, dorsolateral fold absent; ventral surface smooth.

Coloration in life: dorsum green with or without black spots, lateral side of head and flanks brownish grey, lips white; hind limbs with distinct black bars; webbing dark grey; throat and chest cream or whitish; ventral surface whitish.

**Distribution.** In Vietnam, this species has been reported from Bac Kan, Lang Son, Vinh Phuc, Quang Ninh and Lam Dong provinces (Nguyen et al. 2009). Elsewhere, the species has been reported from northeastern India and Myanmar to southern China (Frost 2020).

**Odorrana jingdongensis** Fei, Ye & Li, 2001

Jingdong Frog

Figure 4B

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.380933°N, 103.613000°E; alt. 1170 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a large stream, surrounding habitat covered by secondary forest of medium-sized and large hardwoods and shrubs; 2 ♂, 2 ♀; IEBR 4809–4812 • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.351150°N, 103.613000°E; alt. 1170 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the water of a large stream, surrounded by secondary forest of medium-sized and large hardwoods and shrubs; 1 ♂; IEBR 4813.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those reported by Fei et al. (2010) and Ziegler et al. (2014). Size large (SVL 64.1–74.3 mm in males and SVL 88.0–105.7 mm in females); head narrower than long (HW 21.2–23.7 mm, HL 24.8–27.6 mm in males and HW 32.4–34.6 mm, HL 34.2–37.9 mm in females) snout round, longer than eye diameter (RL 10.1–11.3 mm, ED 8.6–10.0 mm in males and RL 14.2–15.3 mm, ED 10.8–11.1 mm in females); nostril oval, laterally positioned, closer to the tip of snout than to eye (NS 4.3–5.6 mm, EN 5.9–6.0 mm in males and NS 6.1–6.5 mm, EN 7.3–8.1 mm in females); canthus rostralis distinct, eye large (ED 8.6–10.0 mm in males and ED 10.8–11.1 mm in females); tibia approximately six times longer than wide in males and ED 10.8–11.1 mm in females); tympanum distinct (TYD 3.9–4.3 mm in males and TYD 4.7–5.2 mm in females); supratympanic fold indistinct, vomerine teeth present; tongue deeply notched posteriorly. Arm slender (FLL 12.7–16.2 mm in males and FLL 17.2–17.5 mm in females); supratympanic fold indistinct, vomerine teeth present; tongue deeply notched posteriorly; males with vocal sacs. Body smooth; flank with small tubercles, dorsolateral fold absent; ventral surface smooth.

Coloration in life: dorsum green with or without black spots, lateral side of head and flanks brownish grey, lips white; hind limbs with distinct black bars; webbing dark grey; throat and chest cream or whitish; ventral surface whitish.

**Distribution.** In Vietnam, this species has been reported from Bac Kan, Lang Son, Vinh Phuc, Quang Ninh and Lam Dong provinces (Nguyen et al. 2009). Elsewhere, the species has been reported from northeastern India and Myanmar to southern China (Frost 2020).

TW 14.1–14.4 mm); tip of toes enlarged into discs; relative lengths of toes I<II<III<IV<IV; webbing formula I0– III0–III0–I½IV1½–0V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle elongate; outer metatarsal tubercle absent; tibio-tarsal articulation reaching beyond tip of snout when leg adpressed along body. Skin: dorsal surface of head and anterior of dorsum smooth, posterior of dorsum and flanks granular with tubercles; upper limbs and ventral surface smooth.

Coloration in life: dorsum green with large brown spots; dorsal surface of limbs brown with black cross bars; flank brown with black spots; belly and throat cream, marbled with brown.

Distribution. In Vietnam, this species has been reported from Lao Cai, Ha Giang, and Dien Bien provinces (Nguyen et al. 2009; Frost 2020). Elsewhere, the species is known Yunnan and Guangxi provinces of China, northern Laos, and northeastern Myanmar (Frost 2020).

*Odorrana nasica* (Boulenger, 1903)
Tonkin Huia Frog
Figure 4C
**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.355233°N, 103.608200°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 3♂, 2♀; IEBR 4821–4822.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu and Hu (1960) and Hecht et al. (2013). Medium-sized (SVL 31.8–39.7 mm in males, SVL 50.8–54.4 mm in females); head as wide as long (HW 11.8–14.1 mm, HL 12.0–13.7 mm in males; HW 17.3–18.3 mm, HL 18.5–19.0 mm in females); snout pointed, longer than eye diameter (RL 5.5–6.2 mm, ED 4.1–4.4 mm in males; RL 7.8–8.5 mm, ED 4.9–5.6 mm in females); nostril round, laterally positioned, closer to the tip of snout than to eye (NS 2.8–3.0 mm, EN 3.0–3.3 mm in males; NS 3.9 mm, EN 4.3–4.6 mm in females); calamus rostralis distinct, eye large (ED 4.1–4.4 mm in males; ED 4.9–5.6 mm in females), tympanum indistinct; supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm slender (FLL 7.0–8.7 mm in males; FLL 11.1–12.2 mm in females), relative lengths of fingers I<II<III<IV; toes fully webbed, formula I0–0II0–0III0–0IV; subarticular tubercles distinct, formula 1, 1, 2, 1; inner metatarsal tubercle small; outer metatarsal tubercle absent. Thigh slender (FeL 14.6–17.4 mm in males; FeL 21.9–24.1 mm in females); Tibia approximately seven times longer than wide (TbL 45.7–47.6 mm, TW 7.2–8.6 mm); tips of toes enlarged into discs; webbing I<II<III<IV<IV; fingers I<II<III<IV<IV, fingers enlarged into discs; webbing formula I0–1II1–1III1–0IV0–0V; subarticular tubercles distinct, formula 1, 1, 2, 1; inner metatarsal tubercle small; outer metatarsal tubercle absent. Thigh slender (FeL 14.6–17.4 mm in males; FeL 21.9–24.1 mm in females); Tibia approximately seven times longer than wide (TbL 16.1–19.5 mm, TW 2.5–3.1 mm in males; TbL 24.2–25.3 mm, TW 3.4–3.9 mm in females); relative lengths of toes I<II<III<IV<IV; toes fully webbed, formula I0–0II0–1III1–0IV1–0V; subarticular tubercles distinct, formula 1, 1, 2, 2; inner metatarsal tubercle absent; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adpressed along body. Skin: dorsal surface of head and body smooth, a narrow glandular dorsolateral fold; upper limbs with small tubercles; ventral surface smooth.

**Identification.** Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Liu and Hu (1960) and Hecht et al. (2013). Medium-sized (SVL 31.8–39.7 mm in males, SVL 50.8–54.4 mm in females); head as wide as long (HW 11.8–14.1 mm, HL 12.0–13.7 mm in males; HW 17.3–18.3 mm, HL 18.5–19.0 mm in females); snout pointed, longer than eye diameter (RL 5.5–6.2 mm, ED 4.1–4.4 mm in males; RL 7.8–8.5 mm, ED 4.9–5.6 mm in females); nostril round, laterally positioned, closer to the tip of snout than to eye (NS 2.8–3.0 mm, EN 3.0–3.3 mm in males; NS 3.9 mm, EN 4.3–4.6 mm in females); calamus rostralis distinct, eye large (ED 4.1–4.4 mm in males; ED 4.9–5.6 mm in females), tympanum indistinct; supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm slender (FLL 7.0–8.7 mm in males; FLL 11.1–12.2 mm in females), relative lengths of fingers I<II<III<IV; toes fully webbed, formula I0–0II0–0III0–0IV0–0V; subarticular tubercles distinct, formula 1, 1, 2, 1; inner metatarsal tubercle small; outer metatarsal tubercle absent. Thigh slender (FeL 14.6–17.4 mm in males; FeL 21.9–24.1 mm in females); Tibia approximately seven times longer than wide (TbL 16.1–19.5 mm, TW 2.5–3.1 mm in males; TbL 24.2–25.3 mm, TW 3.4–3.9 mm in females); relative lengths of toes I<II<III<IV<IV; toes fully webbed, formula I0–0II0–1III1–0IV1–0V; subarticular tubercles distinct, formula 1, 1, 2, 2; inner metatarsal tubercle absent; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adpressed along body. Skin: dorsal surface of head and body smooth, a narrow glandular dorsolateral fold; upper limbs with small tubercles; ventral surface smooth.

**Coloration in life:** dorsal surface of head and body brown, with or without black spots; outer edge of glandular dorsolateral fold blackish; limbs with black cross bars; throat and chest cream with dark brown spots; belly olive.

**Distribution.** In Vietnam, this species has been reported from northern Vietnam: Lao Cai, Cao Bang to Thua Thien Hue, Kon Tum, Gia Lai, Lam Dong, and Dong Nai provinces (Nguyen et al. 2009). Elsewhere, the species is known from northeastern India, Xizang, Yun-nan, Guangxi and Hainan provinces of China, Myanmar, Laos, northern Thailand, and Cambodia (Frost 2020).

**Zhangixalus duboisi** (Ohler, Marquis, Swan & Grosjean, 2000)

Dubois’ Whipping Frog

**Material examined.** VIETNAM – Lai Chau Province • Sin Ho District, Sa De Phin Commune, Sa De Phin Village; 22.315767°N, 103.219167°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 2♂; IEBR 4814–4815.

**Material examined.** VIETNAM – Lai Chau Province • Tam Duong District, Ho Thau Commune, Ho Thau Village; 22.355233°N, 103.608200°E; alt. 1370 m; 23.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by secondary forest of medium-sized and small hardwoods and shrubs; 3♂, 2♀; IEBR 4816–4820.

**Material examined.** VIETNAM – Lai Chau Province • Sin Ho District, Sa De Phin Commune, Sa De Phin Village; 22.315767°N, 103.219167°E; alt. 1833 m; 14.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, about 0.5 m above the ground, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 2♂; IEBR 4821–4822.

**Material examined.** VIETNAM – Lai Chau Province • Sin Ho District, Sa De Phin Commune, Sa De Phin Village; 22.315767°N, 103.219167°E; alt. 1833 m; 14.V.2020; C.T. Pham, C.V. Hoang, A.V. Pham, T.Q. Phan, and N.B. Sung leg.; collected from the bank of a rocky stream, surrounding habitat covered by mixed secondary forest of bamboo, small to medium-sized hardwoods and shrubs; 2♂; IEBR 4814–4815.
Identification. Morphological characteristics of the specimens from Lai Chau were consistent with those in the descriptions of Ohler et al. (2000) and Ziegler et al. (2014). Medium-sized (SVL 54.0–59.0 mm); head as wide as long (HW 18.5–19.6 mm, HL 18.9–20.2 mm); snout obtuse, longer than eye diameter (RL 8.0–9.3 mm, ED 6.4–7.0 mm); nostril oval, laterally positioned, at the midway between eye and tip of snout (NS 4.0–4.5 mm, EN 4.5–5.3 mm); canthus rostralis distinct, eye large (ED 6.4–7.0 mm), tympanum distinct (TYD 4.8–4.9 mm); supratympanic fold distinct, vomerine teeth present; tongue notched posteriorly. Arm slender (FLL 11.3–13.5 mm), relative lengths of fingers I<II<IV<III, fingers enlarged into discs; webbing formula I\(^{\frac{1}{3}}\)–I\(^{\frac{1}{2}}\)III–I\(^{\frac{1}{2}}\)II–II; subarticular tubercles distinct, formula 1, 2, 3, 2; two round palmar tubercles, inner larger and more prominent. Thigh slender (FeL 26.7–28.3 mm); tibia six times longer than wide (TbL 26.4–28.9 mm, TW 4.1–4.8 mm); relative lengths of toes I<II<III<IV<V; webbing formula I0–I0–II0–I–IV1–V; subarticular tubercles distinct, formula 1, 1, 2, 3, 2; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching to the eye when leg adducted along body. Skin: dorsal surface of head, body, and limbs granular; flank slightly granular; throat, chest, belly, and ventral aspect of thigh with small round flat granules.

Coloration in life: dorsal surface of head, body, and limbs green with large, dark, brown spots edged in black and some small white spots; flank and posterior surface of thigh white with dark brown marbleing; belly grey-white with numerous small, medium-grey spots.

Distribution. In Vietnam, this species was previously reported from Lao Cai, Son La and Ha Giang provinces (Nguyen et al. 2009; Ziegler et al. 2014). Elsewhere, the species is known from Yunnan Province, China (Frost 2020).

Discussion

We record four species of Dicroglossidae (Limnonectes bannaensis, Nanorana aenea, Nanorana yunnanensis, and Quasipaa verrucospinosa), four species of Megophryidae (Leptobrachium ailaonicum, Megophrys gigantica, M. jingdongensis, and M. rubrimera), three species of Ranidae (Odorrana chloronota, O. nasica, and O. jingdongensis), and two species of Rhacophoridae (Rhacophorus rhodopus and Zhangixalus duboisi) for the first time from Lai Chau Province. Our new findings increase the species number of amphibians known to occur in this province from 32 to 45.

The amphibian fauna of Lai Chau Province is of high conservation concern as there are three known species to be endemic to Vietnam (Megophrys hoanglienensis, Gracixalus sapaensis, and Tylototriton sparreboomi), 10 species listed in the IUCN Red List (2020) (Nanorana yunnanensis [Endangered; EN], Amolops minutus [EN], Thelodroma bicolor [EN], Megophrys gigantica [Vulnerable; VU], Amolops splendidissimus [VU], Gracixalus jinxiuensis [VU], Leptobrachium ailaonicum [Near Threatened; NT], Quasipaa verrucospinosa [NT], Odorrana chapaensis [VU], O. grahami [VU]), and two species listed in the Red Data Book of Vietnam (2007) (Rhacophorus kio [EN] and Zhangixalus feae [EN]). Considering the vulnerability of the amphibian diversity found in this province, protecting and restoration of the natural habitat and conducting additional studies in this province are essential.

Acknowledgements

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Authors’ Contributions

MDL, TQN, and TZ designed the research; CTP, CHV, and TQP collected materials in the field; AML, CTP, QHD, and TQN wrote the manuscript; TQN, MDL, and TZ reviewed the manuscript.

References


Boulenger GA (1903) Descriptions of three new batrachians from Tonkin. Annals and Magazine of Natural History (Series 7) 12: 186–188. https://doi.org/10.1080/00222930308678835


Hecht VL, Pham CT, Nguyen TT, Nguyen TQ, Bonkowski M, Ziegler T (2013) First report on the herpetofauna of Tay Yen Tu Nature Re-


**Appendix**

**Table A1.** List of species recorded from Lai Chau Province, Vietnam. An asterisk (*) denotes new provincial records. References include: 1 = Nguyen et al. (2009), 2 = Matsui et al. (2017), 3 = Pham et al. (2018), 4 = Tapley et al. (2018), 5 = Pham et al. (2019), 6 = Sung et al. (2019), 7 = Luong et al. (2019), 8 = Bernardes et al. (2020), 9 = this study.

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<th>Common name</th>
<th>Previous record</th>
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<td>Toads</td>
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<td>Indian Cricket Frog</td>
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<td>5</td>
<td><em>Megophrys jiangdongensis</em> Fei &amp; Ye, 1983*</td>
<td>Ailaos Spadefoot Frog</td>
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<td><em>Megophrys kuatanensis</em> Taylor, 1962</td>
<td>Hoang Lien Horned Frog</td>
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<td><em>Megophrys rubrimima</em> Tapley, Cutajar, Mahony, Chung, Dau, Nguyen, Luong &amp; Rowley, 2017*</td>
<td>Red-thighed Horned Frog</td>
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<td><em>Limbroscaphus limnonectes</em> (Schneider, 1801)</td>
<td>True frogs</td>
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Notes: 457 Luong et al. | Anuran fauna of Lai Chau Province, Vietnam

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<table>
<thead>
<tr>
<th>No.</th>
<th>Species name</th>
<th>Common name</th>
<th>Previous record</th>
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<tr>
<td>9</td>
<td>Hoplobatrachus rugulosus (Wiegmann, 1834)</td>
<td>Asian Peters Frog</td>
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<td>10</td>
<td>Limnonectes bamaensis Ye, Fei &amp; Jiang, 2007*</td>
<td>Banna Large-headed Frog</td>
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<td>11</td>
<td>Nanorana aenea (Smith, 1922)*</td>
<td>Doi Chang Asian Frog</td>
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<td>12</td>
<td>Nanorana yunnanensis (Anderson, 1879)*</td>
<td>Yunnan Paa Frog</td>
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<td>13</td>
<td>Quasiapaa verrucospinose (Bourret, 1937)*</td>
<td>Verrucosa Spiny Frog</td>
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<td><strong>Ranidae Batsch, 1796</strong></td>
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<td>14</td>
<td>Amolops minutus Orlov &amp; Ho, 2007</td>
<td>Small sucker frog</td>
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<td>15</td>
<td>Amolops splendissimus Orlov &amp; Ho, 2007</td>
<td>Sky-night Torrent Frog</td>
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<td>16</td>
<td>Niidana chapaensis (Bourret, 1937)</td>
<td>Chapa Frog</td>
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<td>17</td>
<td>Odorrana chapaensis (Bourret, 1937)</td>
<td>Vietnam Sucker Frog</td>
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<td>18</td>
<td>Odorrana chloronota (Gunther, 1876)*</td>
<td>Chloronate Huia Frog</td>
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<td>Odorrana grahami (Boulenger, 1917)</td>
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<td>Odorrana jingdongensis Fei, Ye &amp; Li, 2001*</td>
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<td>Odorrana margaretae (Liu, 1950)</td>
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<td>Odorrana nasica (Boulenger, 1903)*</td>
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<td>Sylvirana cubitalis (Smith, 1917)</td>
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<td>Sylvirana guentheri (Boulenger, 1882)</td>
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<td>25</td>
<td>Sylvirana menglaensis (Fei, Ye &amp; Xie, 2008)</td>
<td>Mengla Frog</td>
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<td><strong>Rhacophoridae Hoffman, 1932</strong></td>
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<td>26</td>
<td>Kaniusus bisaccularis (Taylor, 1962)</td>
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<td>Gracixalus carinensis (Boulenger, 1893)</td>
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<td>Gracixalus sapaensis Matsui, Ohler, Eto &amp; Nguyen, 2017</td>
<td>Sa Pa Bubble-nest Frog</td>
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<td>Polyedates megacephalus Hallwell, 1861</td>
<td>Hong Kong Whipping Frog</td>
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<td>Raorchestes longchuanensis (Yang &amp; Li, 1978)</td>
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<td>Raorchestes parvulus (Boulenger, 1893)</td>
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<td>34</td>
<td>Rhaophorus kio Ohler &amp; Delorme, 2006</td>
<td>Black-webbed Treefrog</td>
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<td>35</td>
<td>Rhaophorus rhodopus Liu &amp; Hu, 1964*</td>
<td>Red-webbed Treefrog</td>
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<td>36</td>
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<td>Dotted Bubble-nest Frog</td>
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<td>Theloderma gordoni Taylor, 1962</td>
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<td>Zhangixalus duboisi (Ohler, Marquis, Swan &amp; Grosjean, 2000)*</td>
<td>Dubois' Whipping Frog</td>
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<td>Zhangixalus purpureus (He, 1999)</td>
<td>Sichuan whiping frog</td>
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<td>Tylototriton sparreboomi Bernardes, Le, Nguyen, Pham, Pham &amp; Ziegler, 2020</td>
<td>Sparreboon's Crocodile Newt</td>
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<td>Tylototriton verrucosus Anderson, 1871</td>
<td>Himalayan Crocodile Newt</td>
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