New records of amphibians from Thuong Tien Nature Reserve, Hoa Binh Province, Vietnam

Vinh Quang Luu1,4,5*, Canh Xuan Le2, Huy Quang Do1, Tuoi Thi Hoang3, Truong Quang Nguyen2,4, Michael Bonkowski4 and Thomas Ziegler4,5

Abstract. Six species of amphibians are reported for the first time from Thuong Tien Nature Reserve, Hoa Binh Province, Vietnam: Babina chapaensis, Kurixalus bisacculus, Theloderma asperum, Rhacophorus kio, R. feae, and Tylototriton asperrimus. These new findings bring the total number of amphibian species to 33 in Thuong Tien Nature Reserve.

Keywords. Ranidae, Rhacophoridae, Salamandridae, distribution, taxonomy, Hoa Binh Province.

Introduction

In their recent checklist Nguyen, Ho and Nguyen (2009) recorded a total of 177 species of amphibians from Vietnam. Since then new country records and new species descriptions of amphibians have been regularly published from the country (e.g., Ziegler and Nguyen, 2010; Nguyen et al., 2012, 2013; Luu et al., 2013). These new discoveries clearly underscore the underestimated diversity of amphibians in Vietnam, particularly in remote areas. Thuong Tien Nature Reserve is located between the Kim Boi and Lac Son districts in the Hoa Binh Province, in northwestern Vietnam, covering an area of 7,308 hectares of montane evergreen forest (Figs. 1, 2A). The topography of Thuong Tien Nature Reserve is characterized by medium-high mountains, which reach elevations of over 1,000 m (Tordoff et al., 2004). Although this protected area was established in 2000, the herpetofauna of Thuong Tien Nature Reserve is still poorly studied. Hoang and Luu (2009) recently provided the first preliminary list of 27 amphibian species from this area. As a result of additional field surveys conducted in Thuong Tien Nature Reserve in 2009, we herein report six new records of amphibians from this natural reserve as well as from Hoa Binh Province.

Material and Methods

Field surveys were conducted in the Thuong Tien Nature Reserve (NR) by V. Q. Luu, L. D. Phan, L. X. Tran, H. K. Can, T. Bui, T. H. Nguyen, T. V. Ninh, C. H. Nguyen (VQL et al.) from 5 March to 28 April and from 20 to 28 July 2009. Field surveys had previously been conducted by VQL et al. from 22 February to 14 April 2008 at elevations below 500 m a.s.l. and additional surveys in 2009 were carried out at elevations between 500 and 720 m a.s.l. After taking photographs, the specimens were anaesthetized, fixed in 40-70% ethanol and subsequently stored in 70% ethanol. Specimens were deposited in the collection of the Vietnam Forestry University (VFU), Hanoi, Vietnam.

Measurements were taken with a digital calliper to the nearest 0.1 mm. Abbreviations are as follows: a.s.l.: above sea level; SVL (snout-vent length): from tip of
snout to anterior margin of cloaca; TaL (tail length): from posterior margin of cloaca to tip of tail; HL (head length): from the rear of the lower jaw to the tip of the snout; HW (maximum head width): at commissure of jaws; SN: distance from tip of snout to nostril; EN: distance from front of eye to nostril; terminology of morphological characters followed Nguyen et al. (2012) for anurans and Nguyen et al. (2009) for salamanders.

Statistic analyses were performed with the PAST Statistics software version 2.17 (Hammer et al., 2001). The Sorensen coefficient was used to compare the similarity of the species compositions between Thuong Tien NR and nearby karst formations in the northwestern region. The lists of amphibian species from nearby protected areas were obtained from the literature, i.e., Nguyen et al. (2003) for Cuc Phuong National Park (Ninh Binh Province), Nguyen et al. (2000) for Hang Kia – Pa Co NR (Hoa Binh Province), and Le et al. (2008) for Ngoc Son – Ngo Luong NR (Hoa Binh Province). This index is measured by the following formula:

\[ d_{jk} = \frac{2M}{2M+N} \]

in which M is the number of species occurring in both regions and N is the total number of species with presence in just one region.

Results

Ranidae

_Babina chapaensis_ (Bourret 1937)
Chapa Frog / Chang sa pa (Fig. 2B)

Specimens examined. Two adult males (VFU A.2009.12-13) collected on 27 April 2009 by VQL et al. in Doi Thung I forest, Quy Hoa Commune, Tan Lac District (N 20°36.995’, E 105°29.256’), at an elevation of ca. 680 m a.s.l.

Morphological characters. SVL 47.2-48.2 mm; head longer than wide (HL 18.1-18.7 mm, HW 16.6-17.0 mm); canthus rostralis distinct; nostril directed laterally; loreal region concave; tympanum visible, rounded; supratympanic fold distinct; vomerine teeth present; tongue notched posteriorly; vocal sacs present in males. Forelimbs: relative length of fingers: II<IV<II<III; fingers free of webbing; tips of fingers rounded, without discs; dermal fringe along outer finger absent; palmar tubercles distinct; nuptial pad present in males. Hindlimbs: toes long and thin, relative length of toes: I<II<IV<III<IV; toes less than half webbed; tips of toes rounded; dermal fringe along outer toe absent; subarticular tubercles present; inner metatarsal tubercle present, outer metatarsal tubercle indistinct. Skin: dorsal
surface of head and body smooth; dorsolateral fold distinct; lateral head and flanks smooth; a small fold present along arm; ventral surface smooth. Coloration in life: head and dorsum light brown with a cream vertebral stripe, edged in dark brown, running from between the eye to vent; posterior part of dorsum with some dark spots; upper jaw with a cream stripe, from below the nostril to axilla; dorsolateral fold yellowish brown, edged in black laterally; upper part of tibia and thigh with dark bars; venter cream (determination after Bourret, 1942; Chuaynkern et al., 2010).

Distribution. In Vietnam, this species has been known from Lao Cai, Bac Giang, Ha Tinh, Kon Tum, Gia Lai, Dak Lak provinces. Elsewhere, this species has been

Figure 2. A) Habitat of evergreen forest in Thuong Tien Nature Reserve; B) Chapa Frog Babina chapaensis; C) Taylor’s Treefrog Kurixalus bisacculus; D) Thao Whipping Frog Rhacophorus feae; E) Black-webbed Treefrog Rhacophorus kio; F) Hill Garden Bug-eyed Frog Theloderma asperum. Photos: V. Q. Luu.
reported from Laos and Thailand (Nguyen, Ho and Nguyen, 2009). This is the first record of *B. chapaensis* from Thuong Tien NR as well as from Hoa Binh Province.

**Natural history notes.** Specimens were collected between 21:00 and 21:30 while sitting on a stone in a rocky stream. The surrounding habitat was evergreen forest at an elevation of ca. 680 m a.s.l.

### Rhacophoridae

**Kurixalus bisacculus** (Taylor 1962)

Taylor’s Treefrog / *Ech cay tay-lo* (Fig. 2C)

Specimens examined. Two adult males (VFU A.2009.14-15) collected on 27 April 2009 by VQL et al. in Doi Thung 1 forest, Quy Hoa Commune, Tan Lac District (N 20°36.360', E 105°29.353', at an elevation of ca. 750 m a.s.l).

Morphological characters. SVL 32.7-33.7 mm; head as long as wide (HL 10.9-11.3 mm, HW 11.9-12.2 mm); snout pointed at tip; loreal region concave; tympanum enlarged, rounded; supratympanic fold distinct; vomerine teeth present; tongue notched posteriorly; vocal sacs present in males. Forelimbs: relative length of fingers: I<II<IV<III; tip of fingers enlarged into large discs; webbing basal; dermal fringe along outer finger and palmar tubercles present; nuptial pad enlarged. Hindlimbs: toes with enlarged discs; relative length of toes: I<II<III=V<IV; toes three-fourths webbed, first and second toes less than half webbed; dermal fringe along outer toe present; subarticular tubercles visible; inner metatarsal tubercle present; outer metatarsal tubercle absent. Skin: dorsal surface of head, occiput, eyelids, and dorsum with several tubercles; flanks with bigger tubercles; ventral skin, upper part of thigh, and cloacal region granular. Coloration in life: dorsal surface of head, body and limbs smooth; ventral surface of belly and thighs granular. Coloration in life: dorsal surface of head, body, and limbs green; lateral head with a yellow stripe on each side, from nostril through above orbit and tympanum to axilla; webbing greenish yellow; belly and lower thighs purplish brown; lower lip, throat, chest, and ventral surface of limbs white (determination after Boulenger, 1893; Orlov, Nguyen and Ho, 2008).

Distribution. In Vietnam, *R. feae* has been recorded from Lai Chau, Lao Cai, Kon Tum, Dak Lak, Lam Dong, and Dong Nai provinces. Elsewhere, this species is known from China, Myanmar, Laos, and Thailand (Nguyen, Ho and Nguyen, 2009; Frost, 2013). Our finding represents the first record for Thuong Tien NR as well as for Hoa Binh Province.

**Natural history notes.** The specimen was collected at 22:00 on a banana leaf, ca. 1 m above a stream in evergreen forest, at an elevation of ca. 650 m a.s.l.

### Rhacophorus feae Boulenger 1893

Thao Whipping Frog / *Ech cay phe* (Figs. 2D)

Specimen examined. One adult male VFU A.2009.1 collected by VQL et al. on 25 April 2009 in evergreen forest near Doi Thung 1 area, Quy Hoa Commune, Lac Son District (N 20°35.702', E 105°29.619'), at an elevation of ca. 650 m a.s.l.

Morphological characters. SVL 75.4 mm; head longer than wide (HL 10.9-11.3 mm, HW 11.9-12.2 mm); canthus rostralis distinct; loreal region concave; tympanum visible, supratympanic fold distinct; vomerine teeth present; tongue rounded posteriorly; vocal sac present in the male. Forelimbs: relative length of fingers: I<II<IV<III; tip of fingers enlarged into large discs, rounded; webbing completed; dermal fringe along outer finger well developed; palmar tubercles present; nuptial pad present. Hindlimbs: toes with enlarged discs; relative length of toes: I<II<III=V<IV; toes fully webbed; dermal fringe along outer toe present; subarticular tubercles indistinct; inner metatarsal tubercle present. Skin: dorsal surface of head, body and limbs smooth; ventral surface of belly and thighs granular. Coloration in life: dorsal surface of head, body, and limbs green; lateral head with a yellow stripe on each side, from nostril through above orbit and tympanum to axilla; webbing greenish yellow; belly and lower thighs purplish brown; lower lip, throat, chest, and ventral surface of limbs white (determination after Boulenger, 1893; Orlov, Nguyen and Ho, 2008).

Distribution. In Vietnam, *R. feae* has been recorded from Lai Chau, Lao Cai, Kon Tum, Dak Lak, Lam Dong, and Dong Nai provinces. Elsewhere, this species is known from China, Myanmar, Laos, and Thailand (Nguyen, Ho and Nguyen, 2009; Frost, 2013). Our finding represents the first record for Thuong Tien NR as well as for Hoa Binh Province.

**Natural history notes.** Specimens were found between 21:20 and 21:30 on tree leaves, approximately 1 m above the forest floor, at an elevation of ca. 750 m a.s.l.

### Rhacophorus kio Ohler and Delorme 2006

Black-webbed Treefrog / *Ech cay ki-o* (Fig. 2E)

Specimens examined. One adult male and one adult female (VFU A.2009.2 and VFU 2009.3) collected by VQL et al. on 27 April 2009 in evergreen forest near Doi Thung 1 area, Quy Hoa Commune, Lac Son District (N 20°36.360', E 105°29.353', at an elevation of ca. 750 m a.s.l).
New records of amphibians from Thuong Tien Nature Reserve, Vietnam

20°41.230’, E 105°28.812’), at an elevation of 580 m a.s.l.

**Morphological characters.** SVL 68.7-74.3 mm; head longer than wide (HL 24.7-25.2 mm, HW 21.4-24.5 mm); snout acute; canthus rostralis circular; loreal region moderately convex; nostrils rounded, closer to the tip of snout than to the orbit (SN 4.1-5.0 mm, EN 5.4-6.6 mm); tympanum rounded, visible; vomerine teeth present; tongue rounded posteriorly; vocal sac present in the male. Forelimbs: relative length of fingers: I < II < IV < III; tips of fingers enlarged into rounded discs; webbing well developed; dermal fringe along outer finger present; palmar tubercles indistinct; nuptial pad present. Hindlimbs: tibia longer than femur and foot length; relative length of toes: I < II < III < V < IV; toes fully webbed; dermal fringe along outer toe well developed; subarticular tubercles present, rounded; inner metatarsal tubercle indistinct. Skin: dorsal and ventral skin smooth. Coloration in life: Dorsal surface of head, body and upper zone of flank green with white dots, lower lateral part dark brown with yellow spots; forearm proximately green and yellowish with small white dots; thigh orange yellow posteriorly; dermal fringes on toes and fingers yellowish white; ventral surface yellow, webbing orange with an ink black spot at base; nuptial pad yellow (determination after Ohler and Delorme, 2006).

**Distribution.** In Vietnam, *R. kio* has been known from Lao Cai and Ca Bang in the North southwards to Kon Tum and Gia Lai provinces. Elsewhere, this species has been recorded from eastern India, China, Laos, Thailand, and Cambodia (Nguyen, Ho and Nguyen, 2009). This is the first record for Thuong Tien NR as well as for Hoa Binh Province. **Natural history notes.** The specimen was collected at 22:00 while jumping on the forest floor in evergreen forest at an elevation of 720 m a.s.l.

**Salamandridae**

*Theloderma asperum* (Boulenger 1886)

Hill Garden Bug-eyed Frog / Ech cay san a-x-po (Fig. 2F)

**Specimens examined.** One adult male (VFU A.2009.25) and one adult female (VFU A.2009.8) collected on 24 July 2009 in Cot Ca forest, Quy Hoa Commune, Lac Son District (N 20°37.059’, E 105°29.300‘), at an elevation of 720 m a.s.l.

**Morphological characters.** SVL 61.2-71.3 mm, tail length TaL 67.7-71.7 mm; head wider than long (HL 14.3-17.0 mm, HW 16.9-20.4 mm); snout short, blunt, projecting anteriorly beyond lower jaw; glandular ridge on midline of crown from above anterior edge of eye to middle of head; glandular ridge on outer margin of crown from above eye to base of parotoid gland; parotoid glands enlarged, projecting posteriorly; vertebral tubercular ridge well-developed, from posterior end of crown to base of tail; a dorsolateral row of 15-17 large glandular warts present on each side from axilla to
base of tail, smaller posteriorly; dorsal skin with small tubercles; throat and chest granular; belly with striations perpendicular to body axis; fingers free of webbing; toes with a web-remnant at base; tail laterally compressed, tail tip pointed. Coloration in life: Body dark brown; dorsal margin of tail, outer margin of upper and lower surface of finger and toe tips, upper surface of fingers and toes, cloacal region continuing to ventral ridge of tail yellowish orange (determination after Nguyen et al., 2009; Nishikawa, Matsui and Nguyen, 2013).

**Distribution.** Nishikawa, Matsui and Nguyen (2013) referred the populations of *Tylototriton* from Cao Bang and Ha Giang in northern Vietnam to a newly described species, namely *T. ziegleri*. Elsewhere, this species is known only from China (Nguyen, Ho and Nguyen, 2009). This is the first record of the species for Thuong Tien NR and for Hoa Binh Province.

**Natural history notes.** The specimens were found between 15:00 and 17:00 in a pond (ca. 3-4 m in diameter and water level about 0.3 m in depth) in evergreen forest. Several juveniles were seen in the pond in July, at an elevation of 720 m a.s.l.

**Discussion**

The new records bring the total number of amphibian species to 33 in Thuong Tien NR, comprising 5 species of Megophryidae, 3 species of Bufonidae, 1 species of Hylidae, 9 species of Microhylidae, 8 species of Dicroglossidae, 9 species of Ranidae, and 15 species Rhacophoridae (Fig. 4). Nguyen, Ho and Nguyen (2009) reported 27 anuran species from Hoa Binh Province, including *Microhyla berdmorei* (Blyth 1856) from Thuong Tien NR and *Odorrana andersonii* Boulenger 1882 and *Chiromantis vittatus* Boulenger 1887 from adjacent areas. However, voucher specimens of these species have not been found during our field surveys in Thuong Tien NR in 2008 and 2009. Statistic analyses showed that the species composition of the amphibian fauna of Thuong Tien NR is most similar to that of Hang Kia – Pa Co NR (djk = 0.750) with 21 species recorded in both areas whereas it is only 0.593 between Cuc Phuong NP and Ngoc Son – Ngo Luong NR (see Table 1). It is expected that additional new records and even new species will be discovered from Hoa Binh Province in future. Sterling, Hurley and Le (2006) indicated that a wild range of elevations and the complexity of landforms have given the northwestern region of Vietnam a great diversity of natural habitats and a high level of biodiversity potential. For instance, north of the Hoa Binh Province, the Hoang Lien National Park (Lao Cai Province) harbours a total of 63 species of amphibians, including one newly recorded genus and five new species have been described since 2000 (Nguyen, Ho and Nguyen, 2009; Nguyen et al., 2013).

![Figure 3. Granular Newt *Tylototriton asperrimus* A) dorsal view and B) ventral view. Photos: V. Q. Luu.](image-url)

Table 1. Similarity (Sorensen coefficient index) of the species composition of the amphibian fauna between Thuong Tien NR and nearby protected areas in northwestern Vietnam.

<table>
<thead>
<tr>
<th>Protected area</th>
<th>Thuong Tien (Hoang and Luu, 2009; this study)</th>
<th>Cuc Phuong (Nguyen et al., 2003)</th>
<th>Hang Kia - Pa Co (Nguyen et al., 2000)</th>
<th>Ngoc Son - Ngo Luong (Le et al., 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thuong Tien</td>
<td>1</td>
<td>0.688</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cuc Phuong</td>
<td></td>
<td></td>
<td>0.593</td>
<td>0.632</td>
</tr>
<tr>
<td>Hang Kia - Pa Co</td>
<td>0.750</td>
<td>0.738</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ngoc Son - Ngo Luong</td>
<td>0.746</td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
Acknowledgements. We are grateful to the directorates and staffs of Thuong Tien NR for support of our field work. We thank L. D. Phan, L. X. Tran, H. K. Can, T. Bui, T. H. Nguyen, T. V. Ninh, and C. H. Nguyen (Hanoi) for their assistance in the field. Many thanks to A. Ohler (Paris) for commenting on our manuscript, and E. Sterling (New York) and K. Koy (Berkeley) for providing the map. Field work in Thuong Tien NR was funded by IDEAWILD for V. Q. Luu. Research of V. Q. Luu in Germany is funded by the Ministry of Education and Training of Vietnam (MOET, Project 911) and the German Academic Exchange Service (DAAD). Research of T.Q. Nguyen in Germany is funded by the Alexander von Humboldt Stiftung/Foundation (VIE 114344).

References

Figure 4. Species richness of amphibian families from Thuong Tien Nature Reserve (new records marked in red).


