



# The herpetofauna of Pu Luong Nature Reserve, Vietnam

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**Abstract.**—Based on our field surveys between 2016 and 2024, we herein provide a herpetofaunal list of the Pu Luong Nature Reserve, Vietnam, comprising 40 species of amphibians and 63 species of reptiles. Four species, *Occidozyga lingnanica*, *Vietnamophryne orlovi*, *Zhangixalus dennysi*, and *Pseudocalotes brevipes* are newly recorded in Thanh Hoa Province, and 30 species are recorded for the first time from Pu Luong Nature Reserve, comprising 12 species of amphibians (*Leptobranchella minima*, *L. namdongensis*, *Ophryophryne hanssi*, *O. microstoma*, *Limnonectes limborgi*, *Hylarana annamitica*, *H. maosonensis*, *Rana johnsi*, *Polypedates megacephalus*, *Theloderma corticale*, *T. gordonii*, *Tylototriton pasmansi*), four species of lizards (*Cyrtodactylus bobrovi*, *Draco maculatus*, *Sphenomorphus cryptotis*, and *Tropidophorus hainanus*), 11 species of snakes (*Python bivittatus*, *Xenopeltis unicolor*, *Boiga guangxiensis*, *Dendrelaphis pictus*, *Gonyosoma coeruleum*, *Lycodon futsingensis*, *L. meridionalis*, *Pareas margaritophorus*, *Ptyas korros*, *Bungarus fasciatus*, and *Ophiophagus hannah*), and three species of turtles (*Geoemyda spengleri*, *Manouria impressa*, and *Platysternon megacephalum*). This study also highlighted the conservation value of the herpetofauna of Pu Luong Nature Reserve with nine species listed in the CITES Appendices (2023), 20 species listed in the Vietnam Red Data Book (2024), 13 species listed in the IUCN Red List (2024), and nine species listed in the Governmental Decree No. 84/2021/NĐ-CP. Additional data on the natural history of amphibian and reptile species was also provided.

**Keywords.** Amphibians, reptiles, natural history, species composition, Thanh Hoa Province.

**Citation:** Dau VQ, Hoang TN, Do LT, Le PD, Trinh HT, Nguyen TQ, Pham AV. 2025. The herpetofauna of Pu Luong Nature Reserve, Vietnam. *Amphibian & Reptile Conservation* 19(1): 79–98 (e344).

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**Accepted:** 13 June 2025; **Published:** 18 October 2025

## Introduction

The Pu Luong Nature Reserve (PLNR) was established in 1999 by the People's Committee of Thanh Hoa Province with a total area of 17,662 hectares. The PLNR is located in the Ba Thuoc and Quan Hoa districts and is known as one of the five protected areas in Thanh Hoa Province, Vietnam (Thanh Hoa Provincial Forest Protection Department 2004).

The landscape of the PLNR is characterized by steep and mountainous terrain at elevations ranging from 60 to 1,650 m a.s.l (Thanh Hoa Provincial Forest Protection Department 2004). In terms of the herpetofaunal diversity, Nguyen et al. (2015) recorded 38 reptile species for the

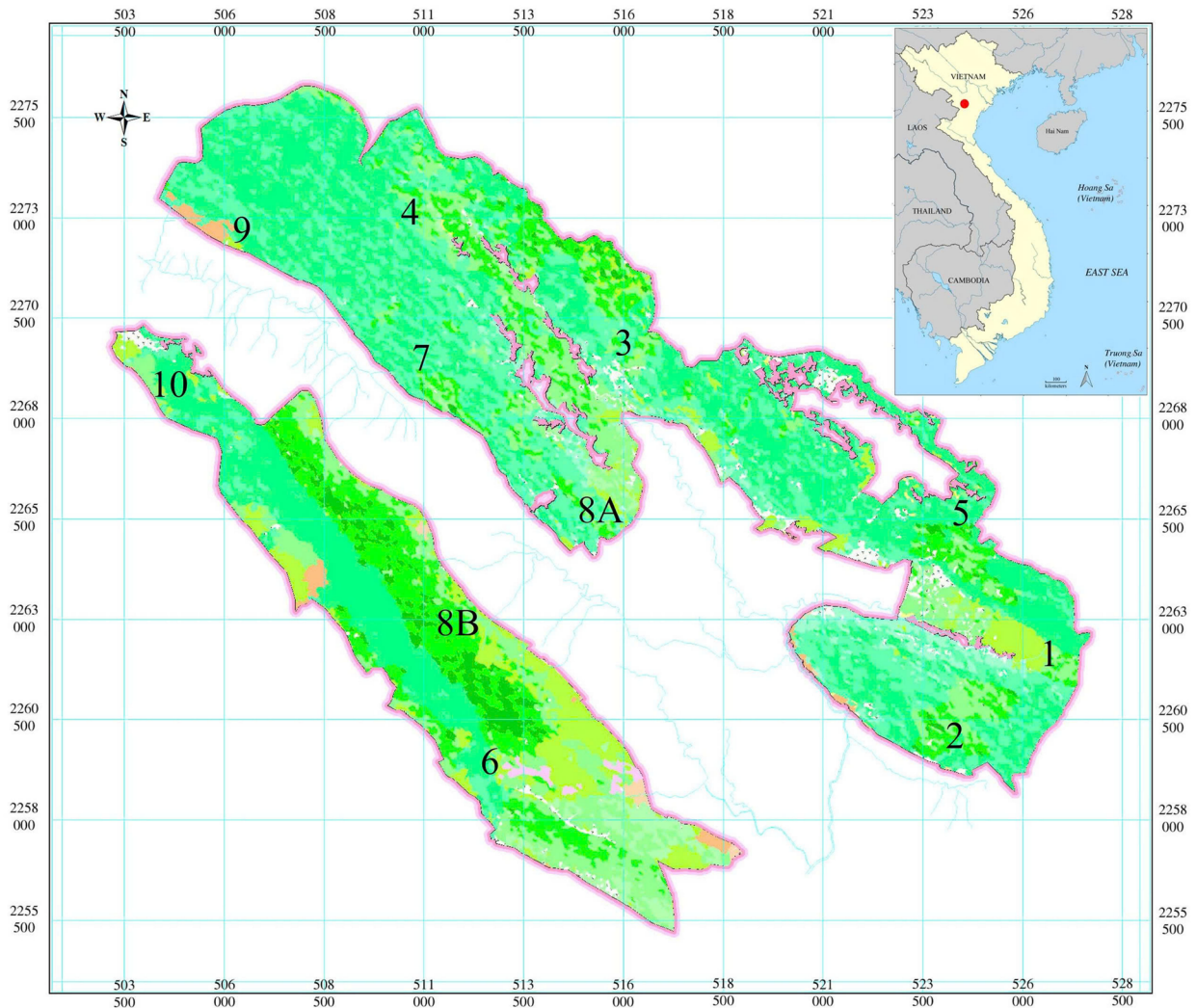
first time from PLNR. Dau et al. (2014) and Hoang et al. (2023) documented 29 new records of amphibians and reptiles from the nature reserve. Most recently, two new provincial records were reported from PLNR, namely *Megophrys parva* and *Pareas carinatus* (Dau et al. 2019, 2024).

This study reports an updated list of the herpetofauna from PLNR, including new information on their natural history and distribution.

## Materials and Methods

Field surveys were conducted by V.Q. Dau and T.N. Thao at 11 sites in PLNR, Thanh Hoa Province, Vietnam, with

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**Fig. 1.** Survey sites in Pu Luong Nature Reserve, Thanh Hoa Province, Vietnam: 1. Khuyn Village, Co Lung Commune, Ba Thuoc District; 2. Eo Dieu Village, Co Lung Commune, Ba Thuoc District; 3. Nua Village, Lung Cao Commune, Ba Thuoc District; 4. Kit Village, Lung Cao Commune, Ba Thuoc District; 5. Son Village, Lung Cao Commune, Ba Thuoc District; 6. Bam Village, Thanh Lam Commune, Ba Thuoc District; 7. Eo Ken Village, Thanh Son Commune, Ba Thuoc District; 8 (A, B). Pa Pan Village, Thanh Son Commune, Ba Thuoc District; 9. Tan Phuc Village, Phu Le Commune, Quan Hoa District; 10. Quang Vinh Village, Hoi Xuan Town, Quan Hoa District.

a total of 63 days. Additionally, four pitfall traps were deployed in this nature reserve for 9 months. The sampling sites were located near Khuyn and Eo Dieu villages of Co Lung Commune; Nua, Kit, and Son villages of Lung Cao Commune; Bam village of Thanh Lam Commune; Eo Ken and Pa Pan villages of Thanh Son Commune; Tan Phuc village of Phu Le Commune; and Quang Vinh village of Hoi Xuan Town (Fig. 1 and Table 1).

The habitat of PLNR is characterized by undisturbed evergreen forest, secondary forest, and agricultural area (Thanh Hoa Provincial Forest Protection Department 2004) (Fig. 2). We collected amphibians and reptiles by hand from 8:00 to 24:00. Pitfall traps were set up along streams, on the ground in evergreen and secondary forest, forest paths, and checked every day. After taking photos of life, individuals were measured and released at the site. For voucher specimens, few individuals were anaesthetized and euthanized in a closed vessel with a

piece of cotton wool containing ethyl acetate (Simmon 2002), fixed in 80% ethanol and then transferred to 70% ethanol for permanent storage. Some road-killed specimens were also collected for morphological examination. These specimens were deposited in the collection of the Zoological Laboratory, Hong Duc University (HDU), Thanh Hoa Province, Vietnam.

For taxonomic identification, we referred to the following documents: Bain et al. (2003), Fei et al. (2012), Hecht et al. (2013), Boulenger (1893), Smith (1935, 1943), Bourret (1942), Taylor (1962), Inger et al. (1999), Bernardes et al. (2020), Hoang et al. (2019), Luu (2022), Nguyen et al. (2018), Pham et al. (2018, 2020). For scientific names of species, we referred to Nguyen et al. (2009), Frost (2024), and Uetz et al. (2024).

Conservation status of species followed the Governmental Decree No 84/2021/ND-CP, the CITES (2023), IUCN (2024), and the Vietnam Red Data Book (Nguyen et al. 2024).

**Table 1.** The survey sites in Pu Luong Nature Reserve, Thanh Hoa Province, Vietnam

| No | Site                                                               | Date                                   | Latitude      | Longitude       | Elevation (m) |
|----|--------------------------------------------------------------------|----------------------------------------|---------------|-----------------|---------------|
| 1  | Forest near Khuyn Village, Co Lung Commune, Ba Thuoc District      | From 17 to 21 August 2020              | 20°26.680'N   | 105°15.526'E    | 196           |
|    |                                                                    | From 5 to 6 August 2021                |               |                 |               |
|    |                                                                    | From 13 to 14 March 2023               |               |                 |               |
|    |                                                                    | From 4 November to 4 January 2024      |               |                 |               |
|    |                                                                    | From 13 June to 13 July 2024           |               |                 |               |
| 2  | Forest near Eo Dieu Village, Co Lung Commune, Ba Thuoc District    | From 2 to 5 August 2021                | 20°25'24.17"N | 105°14'25.75"E  | 544           |
|    |                                                                    | From 3 November 2023 to 2 January 2024 |               |                 |               |
|    |                                                                    | From 13 June to 13 July 2024           |               |                 |               |
| 3  | Forest near Nua Village, Lung Cao Commune, Ba Thuoc District       | From 5 November to 5 December 2023     | 20°52'35.55"N | 105°13'78.46"E  | 254           |
|    |                                                                    | From 25 to 26 October 2021             |               |                 |               |
| 4  | Forest near Kit Village, Lung Cao Commune, Ba Thuoc District       | From 12 to 14 July 2022                | 20°55'34.5"N  | 105°10'44.77"E  | 525           |
|    |                                                                    | On 29 June 2023                        |               |                 |               |
|    |                                                                    | On 29 July 2023                        |               |                 |               |
| 5  | Forest near Son Village, Lung Cao Commune, Ba Thuoc District       | From 15 to 16 July 2022                | 20°50'8.78"N  | 105°19'6.55"E   | 948           |
|    |                                                                    | On 25 July 2023                        |               |                 |               |
| 6  | Forest near Bam Village, Thanh Lam Commune, Ba Thuoc District      | On 27 July 2023                        | 20°27'25.95"N | 105° 6'10.69" E | 1385          |
| 7  | Forest near Eo Ken Village, Thanh Son Commune, Ba Thuoc District   | From 20 to 25 July 2016                | 20.48433'N    | 105.11349'E     | 624           |
|    |                                                                    | From 10 to 14 July 2017                |               |                 |               |
| 8A | Forest near Pa Pan A Village, Thanh Son Commune, Ba Thuoc District | From 15 to 16 July 2017                | 20°48'600"N   | 105°11'162"E    | 597           |
|    |                                                                    | From 8 to 10 July 2018                 |               |                 |               |
|    |                                                                    | From 30 to 31 July 2020                |               |                 |               |
|    |                                                                    | From 29 to 30 October 2021             |               |                 |               |
|    |                                                                    | On July 2023                           |               |                 |               |
|    |                                                                    | On 25 June 2023                        |               |                 |               |
| 8B | Forest near Pa Pan B Village, Thanh Son Commune, Ba Thuoc District | On 26 July 2023                        | 20°48'33.5"N  | 105°09'96.4"E   | 1006          |
|    |                                                                    | From 11 to 13 July 2018                |               |                 |               |
|    |                                                                    | From 1 to 3 August 2020                |               |                 |               |
|    |                                                                    | From 22 to 24 August 2020              |               |                 |               |
|    |                                                                    | From 25 to 26 August 2020              |               |                 |               |
|    |                                                                    | From 26 to 27 March 2023               |               |                 |               |
| 9  | Forest near Tan Phuc Village, Phu Le Commune, Quan Hoa District    | On 30 July 2023                        | 20°32'9.70"N  | 105° 3'1.17"E   | 136           |
|    |                                                                    | From 2 November to 2 December 2023     |               |                 |               |
| 10 | Forest near Quang Vinh Village, Hoi Xuan Town, Quan Hoa District   | From 6 November to 6 December 2023     | 20°24'9.95"N  | 105° 8'47.63"E  | 380           |
|    |                                                                    | On 11 August 2023                      |               |                 |               |
|    |                                                                    | On 12 August 2023                      |               |                 |               |

## Results

In this study, we recorded a total of 40 species of amphibians (25 genera, 8 families) and 63 species of reptiles (43 genera, 14 families) from PLNR, Thanh Hoa Province (Table 2). Remarkably, four species, *Occidozyga lingnanica*, *Vietnamophryne orlovi*, *Zhangixalus dennysi*, and *Pseudocalotes brevipes* are new records in Thanh Hoa Province and 30 other species are new records in Pu Luong NR, including 12 species of amphibians (*Leptobranchella minima*, *L. namdongensis*, *Ophryophryne hansii*, *O. microstoma*,

*Limnonectes limborgi*, *Hylarana annamitica*, *H. maosonensis*, *Rana johnsi*, *Polypedates megacephalus*, *Theloderma corticale*, *T. gordonii*, *Tylototriton pasmansii*), and 18 species of reptiles (*Cyrtodactylus bobrovi*, *Draco maculatus*, *Sphenomorphus cryptotis*, *Tropidophorus hainanus*, *Python bivittatus*, *Xenopeltis unicolor*, *Boiga guangxiensis*, *Dendrelaphis pictus*, *Gonyosoma coeruleum*, *Lycodon futsingensis*, *L. meridionalis*, *Pareas margaritophorus*, *Ptyas korros*, *Bungarus fasciatus*, *Ophiophagus hannah*, *Geoemyda spengleri*, *Manouria impressa*, and *Platysternon megacephalum*).

## The herpetofauna of Pu Luong Nature Reserve

**Table 2.** List of reptile and amphibian species from Pu Luong NR, Vietnam: \*\* = new record for Thanh Hoa Province; \* = new record for Pu Luong NR; Site: we followed sites from 1 to 6 in table 1; Habitat: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas; RBVN = Red Data Book of Vietnam (Nguyen et al. 2024); IUCN = The IUCN Red List of Threatened Species (IUCN 2024); CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened, CITES = CITES appendices (2023): I, II = Appendix I and II; Decree No. 84 = The Governmental Decree No. 84/2021/ND-CP, dated on 22 September 2021, by the Government of Vietnam: IIB = Group IIB (limited exploitation and use for commercial purpose).

| Name                                  | Site                                  | Habitat | RBVN | IUCN | CITES | D. No. 84 |
|---------------------------------------|---------------------------------------|---------|------|------|-------|-----------|
| <b>AMPHIBIA</b>                       |                                       |         |      |      |       |           |
| <b>ANURA</b>                          |                                       |         |      |      |       |           |
| <b>Bufonidae</b>                      |                                       |         |      |      |       |           |
| <i>Duttaphrynus melanostictus</i>     | 1, 2, 3, 4, 5, 7, 8 (A), 8 (B), 9     | 1, 2, 3 |      |      |       |           |
| <b>Megophryidae</b>                   |                                       |         |      |      |       |           |
| <i>Boulenophrys palpebralespinosa</i> | 6, 8 (B)                              | 1       |      |      |       |           |
| <i>B. cf. parva</i>                   | 6, 8 (B)                              | 1       |      |      |       |           |
| <i>Leptobrachella minima</i> *        | 1, 9                                  | 1, 2    |      |      |       |           |
| <i>L. namdongensis</i> *              | 8 (B)                                 | 1       |      | EN   |       |           |
| <i>L. ventripunctata</i>              | 1, 2, 4, 7, 8 (A), 8 (B), 10          | 1, 2    |      |      |       |           |
| <i>Leptobrachium chapaense</i>        | 1, 3, 8 (A), 8 (B), 10                | 1, 2    |      |      |       |           |
| <i>Ophryophryne hansii</i> *          | 7, 8 (A), 8 (B)                       | 1, 2    |      |      |       |           |
| <i>O. microstoma</i> *                | 1, 2, 7, 8 (A)                        | 1, 2    |      |      |       |           |
| <i>Xenophrys lancangica</i>           | 7, 8 (A), 8 (B)                       | 1, 2    |      |      |       |           |
| <b>Microhylidae</b>                   |                                       |         |      |      |       |           |
| <i>Microhyla cf. hmongorum</i>        | 1, 2, 3, 4, 5, 7, 8 (A), 9, 10        | 2, 3    |      |      |       |           |
| <i>M. mukhlesuri</i>                  | 1, 2, 3, 4, 5, 7, 8 (A), 9, 10        | 2, 3    |      |      |       |           |
| <i>M. pulchra</i>                     | 1, 2, 7, 8 (A), 10                    | 3       |      |      |       |           |
| <i>Vietnamophryne orlovi</i> **       | 7, 8 (B)                              | 1       |      |      |       |           |
| <b>Dicroglossidae</b>                 |                                       |         |      |      |       |           |
| <i>Fejervarya limnocharis</i>         | 1, 2, 3, 4, 5, 7, 8 (A), 8 (B), 9, 10 | 1, 2, 3 |      |      |       |           |
| <i>Limnonectes bannaensis</i>         | 1, 2, 7, 8 (A), 8 (B), 10             | 1, 2    |      |      |       |           |
| <i>L. limborgi</i> *                  | 7, 8 (B)                              | 1       |      |      |       |           |
| <i>Occidozyga lingnanica</i> **       | 1, 2, 3, 4, 5, 7, 8 (A), 9, 10        | 2, 3    |      |      |       |           |
| <i>Quasipaa cf. verrucospinosa</i>    | 6                                     | 1       | VU   |      |       |           |
| <b>Ranidae</b>                        |                                       |         |      |      |       |           |
| <i>Amolops tanfuiianae</i>            | 1, 2, 7, 8 (A), 8 (B), 10             | 1, 2    |      |      |       |           |
| <i>Hylarana annamitica</i> *          | 1, 9                                  | 2       |      |      |       |           |
| <i>H. guentheri</i>                   | 1, 2, 3, 5, 7, 8 (A), 8 (B), 9        | 1, 2, 3 |      |      |       |           |
| <i>H. maosonensis</i> *               | 1                                     | 2       |      |      |       |           |
| <i>Odorrana chloronota</i>            | 8 (A)                                 | 2       |      |      |       |           |
| <i>Rana johnsi</i> *                  | 8 (B)                                 | 1       |      |      |       |           |
| <b>Rhacophoridae</b>                  |                                       |         |      |      |       |           |
| <i>Gracixalus quangi</i>              | 7, 8 (B)                              | 1       | NT   |      |       |           |
| <i>Kurixalus gryllus</i>              | 7, 8 (B)                              | 1       |      |      |       |           |
| <i>K. cf. bisacculus</i>              | 1, 2, 4, 5, 6, 7, 8 (A), 8 (B), 10    | 1, 2    |      |      |       |           |
| <i>Polypedates megacephalus</i> *     | 1, 2, 3, 4, 5, 7, 8 (A), 8 (B)        | 1, 2, 3 |      |      |       |           |
| <i>P. mutus</i>                       | 1, 2, 3, 5, 7, 8 (A), 8 (B)           | 1, 2, 3 |      |      |       |           |
| <i>Raorchestes parvulus</i>           | 7, 8 (B)                              | 1       |      |      |       |           |
| <i>Rhacophorus kio</i>                | 3, 4, 7                               | 1       |      |      |       |           |
| <i>R. orlovi</i>                      | 1, 2, 4, 5, 7, 8 (A), 8 (B)           | 1, 2    |      |      |       |           |
| <i>Theloderma albopunctatum</i>       | 5, 8 (A)                              | 3       |      |      |       |           |
| <i>T. corticale</i> *                 | 3, 5, 8 (A)                           | 1, 2    | VU   |      |       |           |
| <i>T. gordonii</i> *                  | 8 (A)                                 | 2       |      |      |       |           |
| <i>T. lateriticum</i>                 | 7                                     | 2       |      |      |       |           |
| <i>Zhangixalus demmyi</i> **          | 5                                     | 1       |      |      |       |           |



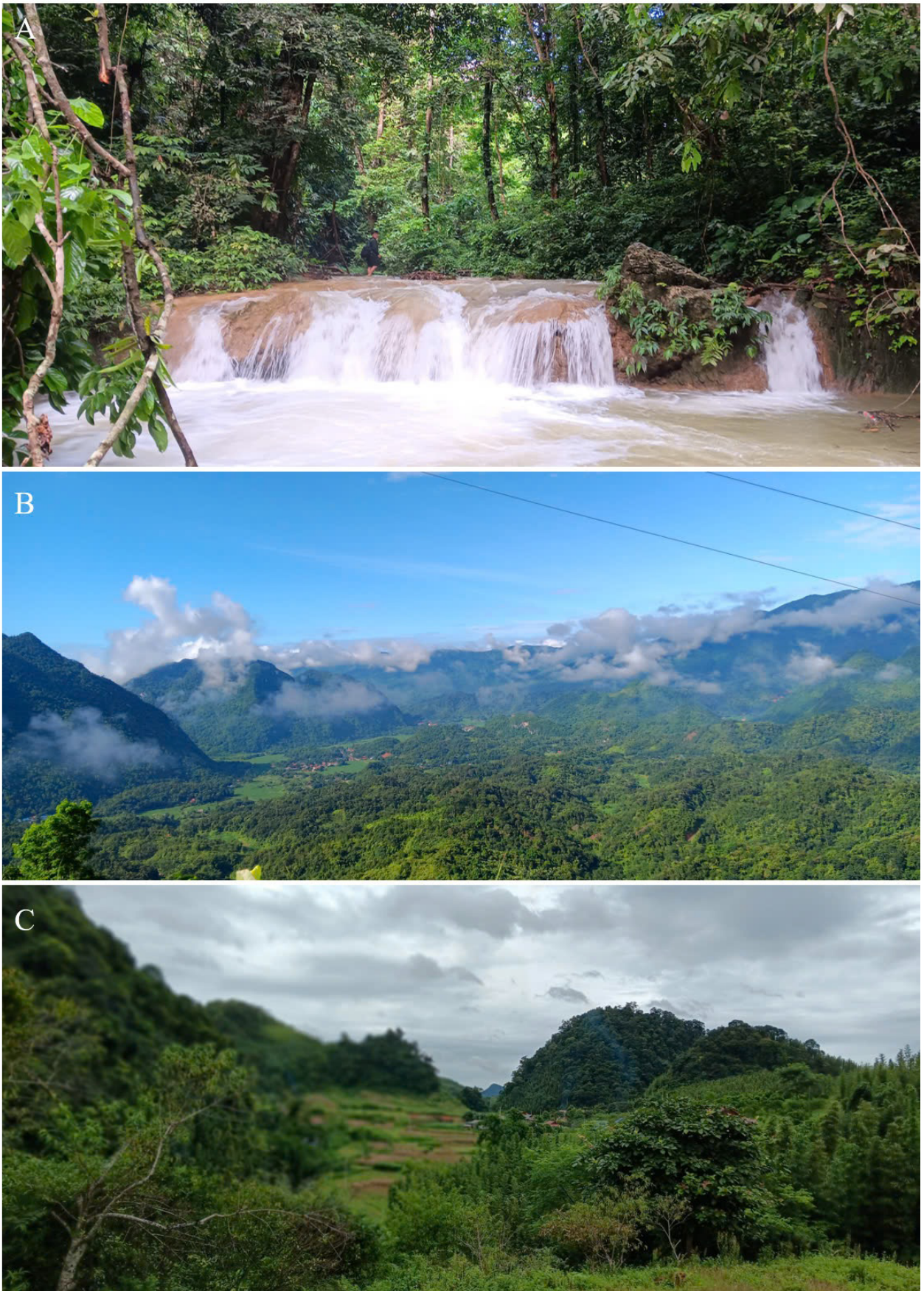
**Table 2(continued).** List of reptile and amphibian species from Pu Luong NR, Vietnam: \*\* = new record for Thanh Hoa Province; \* = new record for Pu Luong NR; Site: we followed sites from 1 to 6 in table 1; Habitat: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas; RBVN = Red Data Book of Vietnam (Nguyen et al. 2024); IUCN = The IUCN Red List of Threatened Species (IUCN 2024); CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/ Near Threatened, CITES = CITES appendices (2023): I, II = Appendix I and II; Decree No. 84 = The Governmental Decree No. 84/2021/ND-CP, dated on 22 September 2021, by the Government of Vietnam: IIB = Group IIB (limited exploitation and use for commercial purpose).

| Name                             | Site                                     | Habitat | RBVN | IUCN | CITES | D. No. 84 |
|----------------------------------|------------------------------------------|---------|------|------|-------|-----------|
| <b>GYMNOPHIDA</b>                |                                          |         |      |      |       |           |
| <b>Ichthyophiidae</b>            |                                          |         |      |      |       |           |
| <i>Ichthyophis kohtaoensis</i>   | 8 (A)                                    | 2       |      |      |       |           |
| <b>CAUDATA</b>                   |                                          |         |      |      |       |           |
| <b>Salamandridae</b>             |                                          |         |      |      |       |           |
| <i>Tylotriton pasmansi</i> *     | 6                                        | 1       | EN   |      | II    | IIB       |
| <b>REPTILIA</b>                  |                                          |         |      |      |       |           |
| <b>SQUAMATA</b>                  |                                          |         |      |      |       |           |
| <b>Agamidae</b>                  |                                          |         |      |      |       |           |
| <i>Acanthosaura lepidogaster</i> | 1, 2, 4, 7, 8 (A), 8 (B)                 | 1, 2    |      |      |       |           |
| <i>Calotes emma</i>              | 1, 2                                     | 1, 2    |      |      |       |           |
| <i>C. mystaceus</i>              |                                          |         |      |      |       |           |
| <i>C. versicolor</i>             | 1, 2                                     | 3       |      |      |       |           |
| <i>Draco maculatus</i> *         | 7                                        | 2       |      |      |       |           |
| <i>Pseudocalotes brevipes</i> ** | 2                                        | 1       |      |      |       |           |
| <i>Physignathus cocincinus</i>   | 8 (A)                                    | 2       | VU   | VU   | II    |           |
| <b>Gekkonidae</b>                |                                          |         |      |      |       |           |
| <i>Cyrtodactylus bobrovi</i> *   | 2                                        | 2       |      |      |       |           |
| <i>Gekko reevesii</i>            | 1, 2, 3, 4, 5, 6, 7, 8 (A), 8 (B), 9, 10 | 1, 2, 3 | VU   |      |       |           |
| <i>Hemidactylus frenatus</i>     | 1, 3                                     | 3       |      |      |       |           |
| <i>H. vietnamensis</i>           | 2, 5, 8 (A)                              | 3       |      |      |       |           |
| <b>Scincidae</b>                 |                                          |         |      |      |       |           |
| <i>Eutropis longicaudatus</i>    | 1, 2, 3, 5, 8 (A)                        | 2, 3    |      |      |       |           |
| <i>E. macularius</i>             | 2                                        | 2       |      |      |       |           |
| <i>E. multifasciatus</i>         | 1, 2                                     | 2       |      |      |       |           |
| <i>Plestiodon quadrilineatus</i> |                                          |         |      |      |       |           |
| <i>P. tamdaoensis</i>            | 6                                        | 1       |      |      |       |           |
| <i>Sphenomorphus cryptotis</i> * | 1                                        | 1       |      |      |       |           |
| <i>Tropidophorus hainanus</i> *  | 6, 8 (B)                                 | 1       |      |      |       |           |
| <b>Lacertidae</b>                |                                          |         |      |      |       |           |
| <i>Takydromus sexlineatus</i>    | 1                                        | 2       |      |      |       |           |
| <b>Pythonidae</b>                |                                          |         |      |      |       |           |
| <i>Python bivittatus</i> *       | 3                                        | 1       | CR   | VU   | II    | IIB       |
| <b>Xenopeltidae</b>              |                                          |         |      |      |       |           |
| <i>Xenopeltis unicolor</i> *     | 2, 8 (A)                                 | 2, 3    |      |      |       |           |
| <b>Colubridae</b>                |                                          |         |      |      |       |           |
| <i>Ahaetulla prasina</i>         | 7                                        | 2       |      |      |       |           |
| <i>Boiga guangxiensis</i> *      | 8 (A)                                    | 3       |      |      |       |           |
| <i>B. multomaculata</i>          | 2, 8 (A)                                 | 1       |      |      |       |           |
| <i>Calamaria pavementata</i>     |                                          |         |      |      |       |           |
| <i>Coelognathus radiatus</i>     | 7                                        | 2       | NT   |      |       |           |
| <i>Dendrelaphis pictus</i> *     | 1, 7                                     | 2       |      |      |       |           |
| <i>Elaphe moellendorffi</i>      | 3                                        | 1       | VU   | VU   |       |           |
| <i>E. taeniura</i>               | 3                                        | 1       | VU   | VU   |       |           |

# The herpetofauna of Pu Luong Nature Reserve

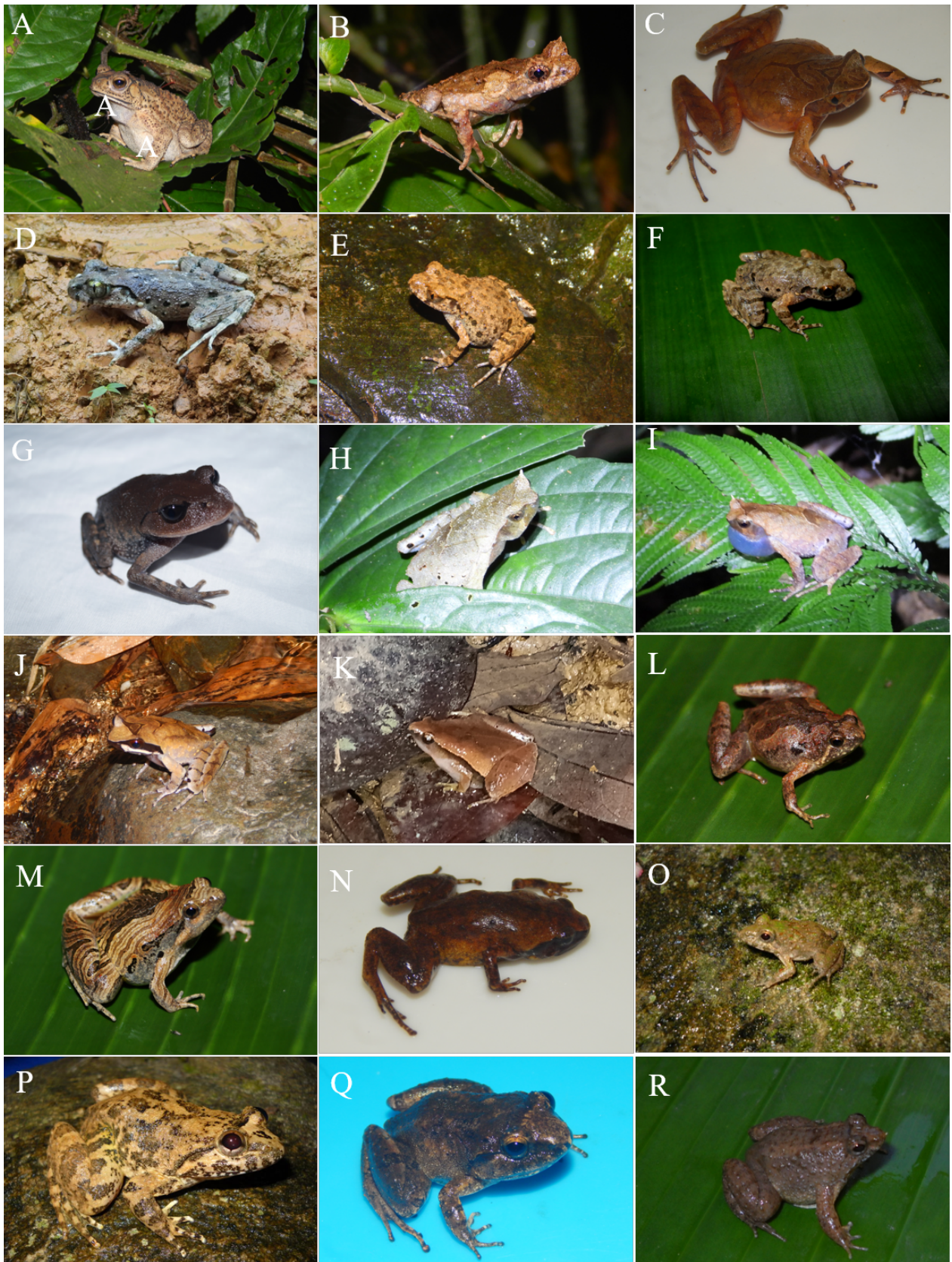
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| Name                                | Site                  | Habitat | RBVN | IUCN | CITES | D. No. 84 |
|-------------------------------------|-----------------------|---------|------|------|-------|-----------|
| <i>Fowlea flavipunctata</i>         | 1, 2, 8 (A)           | 1, 2, 3 |      |      |       |           |
| <i>Gonyosoma coeruleum</i> *        | 6                     | 1       |      |      |       |           |
| <i>Lycodon futsingensis</i> *       | 2                     | 1       |      |      |       |           |
| <i>L. meridionalis</i> *            | 1, 8 (B)              | 1, 2    |      |      |       |           |
| <i>L. ruhstrati</i>                 |                       |         |      |      |       |           |
| <i>L. subcinctus</i>                | 8 (A)                 | 2       |      |      |       |           |
| <i>Oligodon catenatus</i>           |                       |         |      |      |       |           |
| <i>O. fasciolatus</i>               | 2                     | 2       |      |      |       |           |
| <i>Pareas carinatus</i>             | 8 (A), 8 (B)          | 1, 2    |      |      |       |           |
| <i>P. hamptoni</i>                  | 1, 7, 8 (A), 8 (B)    | 1, 2    |      |      |       |           |
| <i>P. macularius</i>                | 2                     | 2       |      |      |       |           |
| <i>P. margaritophorus</i> *         | 1, 2, 8 (A)           | 1, 2    |      |      |       |           |
| <i>Pseudoxenodon bambusicola</i>    |                       |         |      |      |       |           |
| <i>P. macrops</i>                   | 8 (B)                 | 1       |      |      |       |           |
| <i>Ptyas korros</i> *               | 1, 2, 8 (A)           | 2, 3    | VU   | NT   |       |           |
| <i>P. multicincta</i>               | 1, 7, 8 (A)           | 1, 2    |      |      |       |           |
| <i>Rhabdophis helleri</i>           | 1, 2, 8 (A)           | 1, 2, 3 |      |      |       |           |
| <i>Trimerodytes percarinatus</i>    | 1, 8 (A)              | 1, 2    |      |      |       |           |
| <b>Elapidae</b>                     |                       |         |      |      |       |           |
| <i>Bungarus fasciatus</i> *         | 8 (A)                 | 3       | NT   |      |       |           |
| <i>B. multicinctus</i>              | 1, 2, 8 (A)           | 2, 3    | NT   |      |       |           |
| <i>Calliophis maclellandi</i>       |                       |         |      |      |       |           |
| <i>Naja atra</i>                    | 1, 8 (A)              | 2, 3    | VU   | VU   | II    | IIB       |
| <i>Ophiophagus hannah</i> *         | 1                     | 3       | CR   | VU   | II    | IB        |
| <b>Pseudaspidae</b>                 |                       |         |      |      |       |           |
| <i>Psammodynastes pulverulentus</i> | 8 (A)                 | 1       |      |      |       |           |
| <b>Typhlopidae</b>                  |                       |         |      |      |       |           |
| <i>Hypsiscopus plumbea</i>          | 1, 2                  | 3       |      |      |       |           |
| <b>Viperidae</b>                    |                       |         |      |      |       |           |
| <i>Protobothrops mucrosquamatus</i> | 2, 5, 8 (A), 8 (B)    | 1, 2    |      |      |       |           |
| <i>Trimeresurus albolabris</i>      |                       |         |      |      |       |           |
| <i>T. stejnegeri</i>                | 1, 2, 7, 8 (A), 8 (B) | 1, 2, 3 |      |      |       |           |
| <b>TESTUDINES</b>                   |                       |         |      |      |       |           |
| <b>Platysternidae</b>               |                       |         |      |      |       |           |
| <i>Platysternon megacephalum</i> *  | 1, 6, 8 (A), 8 (B)    | 1       | CR   | CR   | I     | IB        |
| <b>Geoemydidae</b>                  |                       |         |      |      |       |           |
| <i>Cuora galbinifrons</i>           |                       |         | CR   | CR   | I     | IB        |
| <i>C. mouhotii</i>                  | 1, 5, 8 (A)           | 1, 2    | EN   | EN   | II    | IIB       |
| <i>Geoemyda spengleri</i> *         | 1, 5, 8 (A), 8 (B)    | 1, 2    | EN   | EN   | II    | IIB       |
| <i>Manouria impressa</i> *          | 6, 8 (A), 8 (B)       | 1       | EN   | EN   | II    | IIB       |
| <b>Trionychidae</b>                 |                       |         |      |      |       |           |
| <i>Pelodiscus variegatus</i>        |                       |         | VU   |      |       |           |



**Fig. 2.** Habitat types in Pu Luong Nature Reserve, Vietnam: **(A)** Evergreen forest, **(B)** Disturbed secondary forest, and Agricultural area **(C)**.





**Fig. 3.** Amphibian species recorded in Pu Luong Nature Reserve, Vietnam: *Duttaphrynus melanostictus* (A), *Boulengerophrynus palpebralespinosa* (B), *B. parva* (C), *Leptobrachella minima* (D), *L. namdongensis* (E), *L. ventripunctata* (F), *Leptobrachium chapaense* (G), *Ophryophryne hansii* (H), *O. microstoma* (I), *Xenophrys lancangica* (J), *Microhyla cf. hmongorum* (K), *M. mukhlesuri* (L), *M. pulchra* (M), *Vietnamophryne orlovi* (N), *Fejervaria limnocharis* (O), *Limnonectes bannaensis* (P), *L. limborgi* (Q), *Occidozyga lingnanica* (R).

## Bufonidae

Doubtful Toad (*Duttaphrynus melanostictus*): Two specimens were collected, and many other individuals were observed on the ground from 19:00 to 24:00 in meadowlands, road edges, croplands, and gardens near residential areas (Fig. 3A).

## Megophryidae

Tonkin Spadefoot Toad (*Boulenophrys palpebralespinosa*): Two specimens were collected, and other toads were observed from 19:00 to 24:00 on leaves, ca. 0.2–1.0 m along streams in evergreen forest (Fig. 3B).

Small Spadefoot Toad (*Boulenophrys parva*): Two specimens were collected from 17:00 to 20:00 on the ground, along a stream in secondary forest (Fig. 3C).

Small Litter Toad (*Leptobrachella minima*): Two specimens were collected, and other toads were observed from 19:00 to 24:00, on leaves and rocks, ca. 20–30 cm above the ground, along streams, in evergreen and secondary forest (Fig. 3D).

Nam Dong Litter Frog (*Leptobrachella namdongensis*): Two specimens were collected at 20:45 on the ground, near a stream in an evergreen forest (Fig. 3E).

Yunnan Litter Toad (*Leptobrachella ventripunctata*): One specimen was collected, and other toads were observed from 19:00 to 23:00, on leaves and rocks along streams in evergreen forest (Fig. 3F).

Chapa Spadefoot Toad (*Leptobrachium chapaense*): Two specimens were collected, and other toads were observed from 19:00 to 24:00 on the ground along streams in the forest (Fig. 3G).

Han's Horned Frog (*Ophryophryne hansi*): Two specimens were collected, and many other frogs were observed at night on leaves, ca. 20–70 cm above the ground, near streams in the evergreen forest (Fig. 3H).

Asian Mountain Toad (*Ophryophryne microstoma*): Two specimens were collected, and many other individuals were observed from 20:40 to 24:00 on leaves, ca. 20–90 cm above the ground, near streams in the evergreen forest (Fig. 3I).

Lancang Horned Toad (*Xenophrys lancangica*): One specimen was collected, and many other frogs were observed from 19:30 to 24:00 on leaves, ca. 20–80 cm above the ground, near streams in the secondary forest and evergreen forest (Fig. 3J).

## Microhylidae

Hmong Narrow-mouth Frog (*Microhyla* cf. *hmongorum*): Two specimens were collected, and many others were observed from 20:00 to 21:00 on the ground, along the road, in agricultural fields, meadowlands, in a pond, and forest paths (Fig. 3K).

Mukhlesur's Narrow-mouthed Frog (*Microhyla*

*mukhlesuri*): Two specimens were collected, and many others were observed from 19:00 to 23:00 on the ground, in meadowlands, along the road, croplands, forest paths, and in a pond (Fig. 3L).

Yellow-legged Pigmy Frog (*Microhyla pulchra*): Two specimens were collected, and many others were observed from 17:00 to 24:00 on the ground, near a path, field edge, and pond (Fig. 3M).

Orlov's Dwarf Frog (*Vietnamophryne orlovi*): One juvenile was collected at 20:30 on the ground, near a small stream in the evergreen karst forest, and another adult female was collected at 17:30 on the ground in the evergreen forest (Fig. 3N).

## Dicroglossidae

Rice Frog (*Fejervarya limnocharis*): Numerous individuals were observed from 19:00 to 24:00 on the ground, in gardens, meadowlands, croplands, and along roads near residential areas (Fig. 3O).

Banna Large-headed Frog (*Limnonectes bannaensis*): Two specimens were collected, and many others were observed from 19:00 to 24:00 on water edges or rocky streams in disturbed secondary forest and evergreen forest (Fig. 3P).

Limborg's Frog (*Limnonectes limborgi*): Two specimens were collected, and many other individuals were observed from 19:00 to 24:00 on the ground near a stream in the evergreen forest (Fig. 3Q).

Lingnan Floating Frog (*Occidozyga lingnanica*): Two specimens were collected, and several others were observed from 19:00 to 24:00 on the ground near streams within secondary forest (Fig. 3R).

Verrucosa Spiny Frog (*Quasipaa* cf. *verrucospinosa*): One adult male was collected at 20:30 on a rock in a stream in the evergreen forest (Fig. 4A).

## Ranidae

Fui Lian's Lao Torrent Frog (*Amolops tanfuilianae*): Two specimens were collected, and many others were observed from 19:00 to 24:00 on rocks near waterfalls in streams or on the leaves near streams, in the evergreen forest (Fig. 4B).

Annam Stream Frog (*Hylarana annamitica*): Two specimens were collected from 19:00 to 20:00 on the ground near streams in disturbed secondary forest (Fig. 4C).

Guenther's Frog (*Hylarana guentheri*): Individuals were observed from 19:00 to 24:00 on the ground or tree branches in gardens, meadowlands, croplands, and verges close to residential areas, in impacted secondary forest, and in evergreen forest (Fig. 4D).

Mao-Son Frog (*Hylarana maosonensis*): Two specimens were collected, and many others were observed from 19:00 to 24:00 on the ground, near streams in disturbed secondary forest (Fig. 4E).



Chloronate Huia Frog (*Odorrana chloronota*): One adult male was collected at 21:00 on a rock in a stream, wide in the evergreen forest (Fig. 4F).

John's Frog (*Rana johnsi*): One specimen was collected, and many others were seen from 20:30 to 23:00 on the ground, more than 10 m away from the stream in evergreen forest (Fig. 4G).

## Rhacophoridae

Quang's Bushfrog (*Gracixalus quangi*): One specimen was collected, and three individuals were observed from 19:30 to 23:00 on leaves, near small streams, ca. 20 - 70 cm above the ground, in the evergreen forest (Fig. 4H).

Langbian Bubble-nest Frog (*Kurixalus gryllus*): Two specimens were collected from 20:00 to 22:00 near small streams, on the leaves, ca. 90 cm above the ground, in the evergreen forest (Fig. 4I).

Taylor's Tree Frog (*Kurixalus* cf. *bisacculus*): Two specimens were collected, and many others were observed from 19:00 to 24:00 near the puddles or ponds on the tree branches, ca. 20–70 cm above the ground, in disturbed secondary forest and evergreen forest (Fig. 4J).

Spot-legged Treefrog (*Polypedates megacephalus*): Two specimens were collected, and many others were observed from 19:00 to 24:00 on leaves near streams or tree branches, ca. 0.3–2.0 m above the ground, in the mixed evergreen forest (Fig. 4K).

Vocal Sacless Treefrog (*Polypedates mutus*): Two specimens were collected, and many others were observed from 19:00 to 24:00 on the ground, on the tree branches or leaves near puddles and streams, in mixed evergreen forest (Fig. 4L).

Tiny Bubble-nest Frog (*Raorchestes parvulus*): Two specimens were collected from 20:15 to 21:10 on leaves near streams, ca. 0.3–0.9 m above the ground, in evergreen forest (Fig. 4M).

Kio Flying Frog (*Rhacophorus kio*): One specimen was collected, and many others were observed from 19:00 to 21:00 on leaves near puddles or the rocks, ca. 0.5–2.5 m above the ground, in the evergreen forest (Fig. 4N).

Orlov Frog (*Rhacophorus orlovi*): One specimen was collected, and many others were observed at 20:00 to 24:00 on leaves near streams, ca. 1–3 m above the ground, in evergreen forest (Fig. 4O).

Warty Tree Frog (*Theloderma albopunctatum*): Two specimens were collected from 20:00 to 21:00 on the leaves in a water hole in the evergreen forest (Fig. 4P).

Tonkin Bug-eyed Frog (*Theloderma corticale*): Two specimens were collected from 20:30 to 21:10 in tree holes, ca. 1–1.5 m above the ground, in the evergreen forest (Fig. 4Q).

Gordon's Warty Frog (*Theloderma gordonii*): One specimen was collected at 21:30 in tree holes, in an evergreen forest (Fig. 4R).

Brick-red Bug-eyed Frog (*Theloderma lateriticum*):

One specimen was collected at 21:00 on the leave, ca. 50 cm above the ground, near a stream in disturbed secondary forest (Fig. 5A).

Denny's Whipping Frog (*Zhangixalus dennysi*): Two specimens were collected at 20:35 while sitting on tree branches, aca. 3–5 m above the ground, near a stream, in an evergreen forest (Fig. 5B).

## Ichthyophiidae

Koh Tao Snake Frog (*Ichthyophis kohtaoensis*): One specimen was collected at 20:20, underground, in the disturbed secondary forest (Fig. 5C).

## Salamandridae

Hoa Binh Crocodile Newt (*Tylototriton pasmansi*): One individual was observed 20:30 in a small pond in a bamboo forest (Fig. 5D).

## Agamidae

Brown Pricklenape (*Acanthosaura lepidogaster*): Several individuals were observed from 19:30 to 21:50 while sitting on trees, ca. 0.3–21.5 m above the ground, near streams in both evergreen and disturbed secondary forests (Fig. 6A).

Emma Gray's Forest Lizard (*Calotes emma*): One specimen was collected, and one adult female was observed from 13:30 to 16:15 on the rock, near the forest path in disturbed secondary forest (Fig. 6B).

Common Garden Lizard (*Calotes versicolor*): One specimen was collected, and many others were observed from 13:30 to 16:15 near bushes in gardens or cultivations (Fig. 6C).

Spotted Flying Dragon (*Draco maculatus*): One adult male was collected at 13:15 on a tree branch, ca. 5.0 m above the ground, in the secondary forest (Fig. 6D).

Vietnam False Bloodsucker (*Pseudocalotes brevipes*): One adult was observed at 21:35 on a tree branch, ca. 1.3 m above the ground, in an evergreen forest (Fig. 6E).

Green Water Dragon (*Physignathus cocincinus*): Two adult females were observed from 19:30 to 21:00 on a tree branch, ca. 5.0 m above the ground, in the secondary forest (Fig. 6F).

## Gekkonidae

Bobrov's Bent-toed Gecko (*Cyrtodactylus bobrovi*): One specimen was collected by a pitfall trap in the secondary forest (Fig. 6G).

Reeves' Tokay Gecko (*Gekko reevesii*): One specimen was collected by a pitfall trap in an evergreen forest. And many others were observed from 19:00 to 22:00 on the wall of the house or limestone cliffs, ca. 1.2–5 m above the ground, in a residential area, disturbed secondary, and evergreen forest (Fig. 6H).



**Fig. 4.** Amphibian species recorded in Pu Luong Nature Reserve, Vietnam: *Quasipaa* cf. *verrucospinosa* (A), *A. tanfuiianae* (B), *Hylarana annamitica* (C), *H. guentheri* (D), *H. maosonensis* (E), *Odorrana chloronota* (F), *Rana johnsi* (G), *Gracixalus quangui* (H), *Kurixalus gryllus* (I), *K. cf. bisacculus* (J), *Polypedates megacephalus* (K), *P. mutus* (L), *Raorchestes parvulus* (M), *Rhacophorus kio* (N), *R. orlovi* (O), *Theloderma albopunctatum* (P), *Theloderma corticale* (Q), *Theloderma gordonii* (R).





**Fig. 5.** Amphibian species recorded in Pu Luong Nature Reserve, Vietnam: *Theloderma lateriticum* (A), *Zhangixalus dennysi* (B), *Ichthyophis kohtaoensis* (C), *Tylototriton pasmansi* (D).

Common House Gecko (*Hemidactylus frenatus*): One specimen was collected, and many others were observed on the walls of houses in the residential areas both at night and during the day (Fig. 6I).

Vietnam House Gecko (*Hemidactylus vietnamensis*): One specimen was collected, and four individuals were observed from 19:00 to 23:00 on the house walls, ca. 1–3 m above the ground, in a residential area (Fig. 6J).

### Scincidae

Long-tailed Sun Skink (*Eutropis longicaudatus*): One specimen was collected, and many others were observed from 9:00 to 16:00 on the ground in agricultural land, residential areas, and secondary forest (Fig. 6K).

Grass Sun Skink (*Eutropis macularius*): One specimen was collected at 15:25 on the ground, in secondary forest (Fig. 6L).

Many-lined Sun Skink (*Eutropis multifasciatus*): One specimen was collected, and two others skinks were observed on the ground from 13:50 to 16:30, in the disturbed secondary forest (Fig. 6M).

Vietnam Skink (*Plestiodon tamdaoensis*): One specimen was collected at 9:10 on the ground, in a bamboo forest (Fig. 6N).

(*Sphenomorphus cryptotis*): One specimen was collected, and two individuals were observed from 15:00 to 16:30 on leaves, ca. 1.2–3 m above the ground, along streams in the evergreen forest (Fig. 6O).

Hainan water skink (*Tropidophorus hainanus*): One specimen was collected at 9:30 on the ground in a bamboo forest. And two other individuals were observed at 16:25

on the ground in the same bamboo forest (Fig. 6P).

### Lacertidae

Asian Grass Lizard (*Takydromus sexlineatus*): One specimen was collected by a pitfall trap in disturbed secondary forest (Fig. 6Q).

### Pythonidae

Burmese Python (*Python bivittatus*): One juvenile was observed at 16:10 in a cave, in the evergreen forest (Fig. 6R).

### Xenopeltidae

Sunbeam Snake (*Xenopeltis unicolor*): One specimen was collected by a pitfall trap in secondary forest, and another snake was found at 20:40 on the ground in a residential area (Fig. 7A).

### Colubridae

Asian vine snake (*Ahaetulla prasina*): One specimen was collected by a pitfall trap in secondary forest, and one individual was observed at 21:25 on tree branches, ca. 2.5 m above the ground, in secondary forest (Fig. 7B).

Guangxi Cat Snake (*Boiga guangxiensis*): One adult female was collected at 20:45 on tree branches, ca. 2.6 m above the ground, in a residential area (Fig. 7C).

Many-spotted Cat Snake (*Boiga multomaculata*): One specimen was collected, and another individual



was observed at 22:00 on a tree, ca. 1.5–2.2 m above the ground, in secondary forest (Fig. 7D).

Painted Bronzeback (*Dendrelaphis pictus*): One specimen was collected at 14:15 on the tree, ca. 2 m above the ground, in secondary forest. Another individual was observed at 9:05 on the tree, ca. 1 m above ground in the secondary forest (Fig. 7E).

Flower Snake (*Elaphe moellendorffi*): One adult male was observed at 9:00 on the ground in the evergreen forest (Fig. 7F).

Yellow-Spotted Keelback (*Fowlea flavipunctata*): One specimen was collected by a pitfall trap in secondary forest, and many others were observed from 19:00 to 23:00 on the ground, in disturbed secondary forest, residential area, and evergreen forest (Fig. 7G).

*Gonyosoma coeruleum*: One adult male was collected at 10:00 in a rotten bamboo trunk in a bamboo forest (Fig. 7H).

*Lycodon futsingensis*: One specimen was collected by a pitfall trap in an evergreen forest (Fig. 7I).

Yellow-Banded Big Tooth Snake (*Lycodon meridionalis*): One specimen was collected by a pitfall trap in the evergreen forest. Two snakes were observed from 19:25 to 20:25 in a disturbed secondary forest (Fig. 7J).

Malayan Banded Wolf Snake (*Lycodon subcinctus*): One individual was collected at 19:45 on the ground, in secondary forest (Fig. 7K).

Fasciolated Kukri Snake (*Oligodon fasciolatus*): One specimen was collected by a pitfall trap in a disturbed forest (Fig. 7L).

Keeled Slug Snake (*Pareas carinatus*): One specimen was collected at 20:10 and another individual was observed at 19:35 on the tree, ca. 1.5–2.5 m above the ground, near streams in evergreen forest (Fig. 7M).

Hampton's Slug Snake (*Pareas hamptoni*): One specimen was collected at 21:30 and five other snakes were observed from 20:00 to 22:00 on tree branches, ca. 0.3–1.6 m above the ground, near streams in the evergreen forest (Fig. 7N).

*Pareas macularius*: One specimen was collected by a pitfall trap in disturbed forest (Fig. 7O).

Mountain Slug Snake (*Pareas margaritophorus*): One specimen was collected by a pitfall trap in the evergreen forest (Fig. 7P).

Big-eyed Bamboo Snake (*Pseudoxenodon macrops*): Two specimens were collected by pitfall traps (Fig. 7Q).

Many-banded Green Snake (*Ptyas multicincta*): Three individuals were found from 19:00 to 22:00 on trees, near streams, ca. 1.3–3.6 m above the ground, in the evergreen forest (Fig. 7R).

Heller's Red-necked Keelback (*Rhabdophis helleri*): One specimen was collected at 13:45, in a residential area. Three other snakes were observed at 14:15 on the ground in the evergreen forest (Fig. 8A).

Olive Keelback (*Trimerodytes percarinatus*): One specimen was collected at 22:30 on a tree, near a stream in disturbed secondary forest. Three other snakes were observed from 19:30 to 22:25 on the tree, ca. 0.5–2 m above the ground, in evergreen forest (Fig. 8B).

## Elapidae

Banded Krait (*Bungarus fasciatus*): One adult male was observed at 23:00 on the ground in a residential area (Fig. 8C).

Many-banded Krait (*Bungarus multicinctus*): One specimen was collected by a pitfall trap in a disturbed secondary forest. Two other snakes were observed from 19:30 to 20:30 while moving in a residential area (Fig. 8D).

Chinese Cobra (*Naja atra*): Two snakes were observed from 13:00 to 16:00 on the ground in a residential area and disturbed secondary forest (Fig. 8E).

King Cobra (*Ophiophagus hannah*): One individual was observed at 21:30 on the ground in a residential area (Fig. 8F).

## Psammodynastidae

Common Mock Viper (*Psammodynastes pulverulentus*): One specimen was collected in the morning, on the ground, in the evergreen forest (Fig. 8G).

## Typhlopidae

Rice Paddy Snake (*Hypsiscopus plumbea*): One specimen was collected, and another snake was seen at night on the ground in a rice field (Fig. 8H).

## Viperidae

Brown spotted pitviper (*Protobothrops mucrosquamatus*): One specimen was collected at 22:30 on the tree, ca. 1.5 m above the ground, near a stream in the evergreen forest. Three pitvipers were observed from 19:30 to 22:30 on the tree, ca. 1.5–2 m above the ground, in the disturbed secondary forest (Fig. 8I).

Stejneger's Bamboo pitviper (*Trimeresurus stejnegeri*): Two specimens were collected from 19:00 to 20:15 on the tree, about 0.5–1 m above the ground, near streams in the evergreen forest. Three individuals were observed from 19:30 to 21:00 on the trees, ca. 0.5–1 m above the ground, in disturbed secondary forest (Fig. 8J).

## Platysternidae

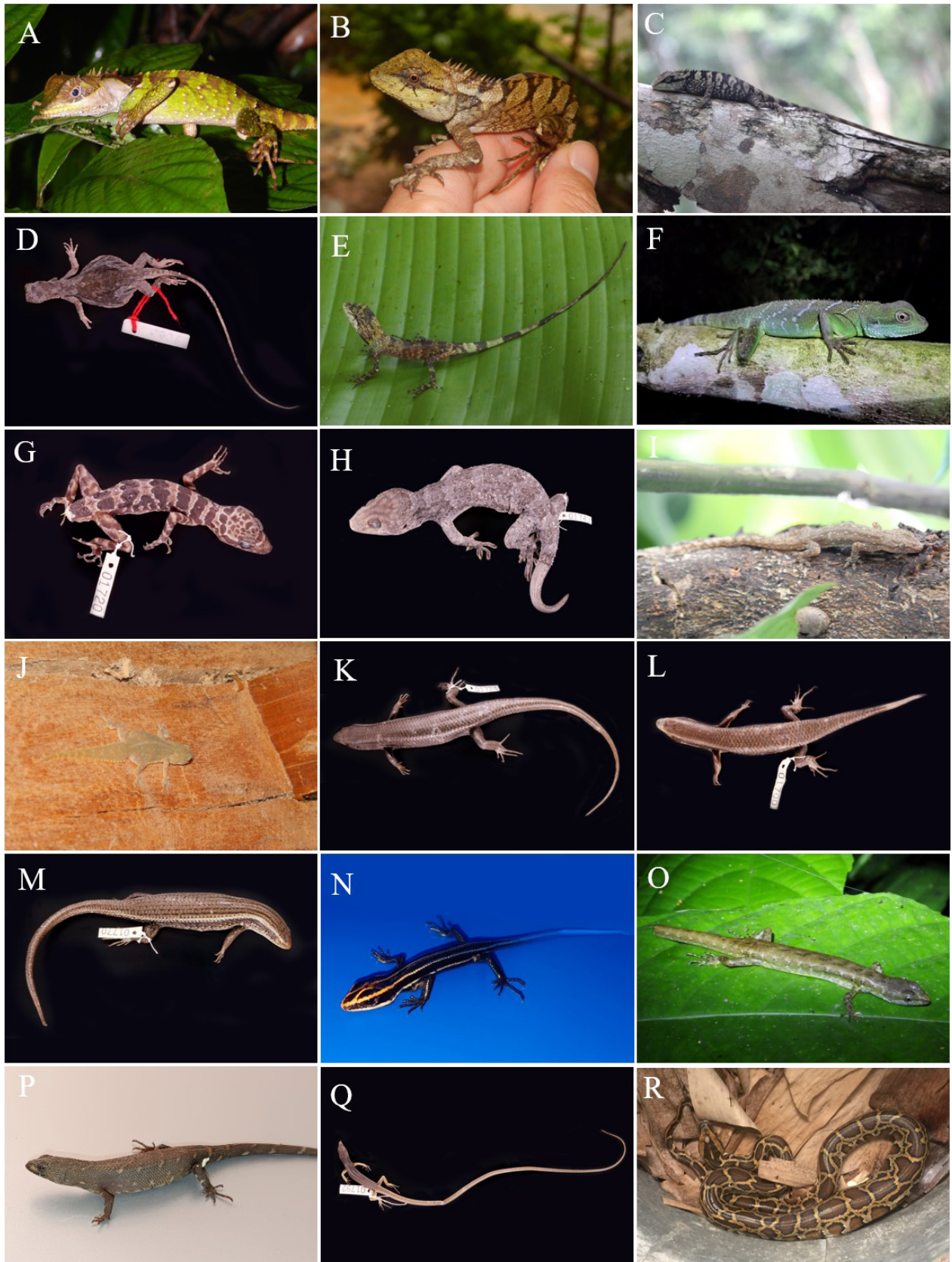
Big-headed Turtle (*Platysternon megacephalum*): One individual was observed in the morning, in streams in the evergreen forest (Fig. 8K).

## Geoemydidae

Keeled Box Turtle (*Cuora mouhotii*): Two individuals were observed from 13:30 to 14:50 in disturbed secondary forest, and three other individuals were observed from 19:30 to 21:30 in the evergreen forest (Fig. 8L).

Black-breasted Leaf Turtle (*Geoemyda spengleri*): Five individuals were observed from 8:30 to 10:30 in the evergreen forest and the disturbed forest (Fig. 8M).

Impressed Tortoise (*Manouria impressa*): Three individuals were observed from 8:30 to 10:00 in the evergreen forest (Fig. 8N).



**Fig. 6.** Lizard and snake species recorded in Pu Luong Nature Reserve, Vietnam *Acanthosaura lepidogaster* (A), *Calotes emma* (B), *C. versicolor* (C), *Draco maculatus* (D), *Pseudocalotes brevipes* (E), *Physignathus cocincinus* (F), *Cyrtodactylus bobrovi* (G), *Gekko reevesii* (H), *Hemidactylus frenatus* (I), *H. vietnamensis* (J), *Eutropis longicaudatus* (K), *E. macularius* (L), *E. multifasciatus* (M), *Plestiodon tamdaoensis* (N), *Sphenomorphus cryptotis* (O), *Tropidophorus hainanus* (P), *Takydromus sexlineatus* (Q), *Python bivittatus* (R).





**Fig. 7.** Snake species recorded in Pu Luong Nature Reserve, Vietnam: *Xenopeltis unicolor* (A), *Ahaetulla prasina* (B), *Boiga guangxiensis* (C), *B. multomaculata* (D), *Dendrelaphis pictus* (E), *Elaphe moellendorffi* (F), *Fowlea flavipunctatus* (G), *Gonyosoma coeruleum* (H), *Lycodon futsingensis* (I), *L. meridionalis* (J), *L. subcinctus* (K), *Oligodon fasciolatus* (L), *Pareas carinatus* (M), *P. hamptoni* (N), *P. macularius* (O), *P. margaritophorus* (P), *Pseudoxenodon macrops* (Q), *Ptyas multicincta* (R).





**Fig. 8.** Snake and turtle species recorded in Pu Luong Nature Reserve, Vietnam: *Rhabdophis helleri* (A), *Trimerodytes percarinatus* (B), *Bungarus fasciatus* (C), *B. multicinctus* (B), *Naja atra* (E), *Ophiophagus hannah* (F), *Psammodynastes pulverulentus* (G), *Hypsiscopus plumbea* (H), *Protobothrops mucrosquamatus* (I), *Trimeresurus stejnegeri* (J), *Platysternon megacephalum* (K), *Cuora mouhotii* (L), *Geoemyda spengleri* (M), *Manouria impressa* (N).

## Discussion

Our new findings bring the total number of reptile and amphibian species in PLNR to 103. Among these, 30 species are new records for PLNR, and 4 species are recorded for the first time in Thanh Hoa Province. Dau et al. (2020b) reported *Occidozyga lima* from PLNR. However, a morphological examination of the specimens collected from PLNR revealed the presence of another

taxon, *Occidozyga lingnanica*, which is a recently described species from China by Lyu et al. (2022).

Some records of amphibian species in previous studies (i.e. Hoang et al. 2023) were changed in this study, for example *Microhyla fissipes* was reidentified as *M. mukhlesuri*, *Leptobrachella petrops* as *L. namdongensis*, *Megohryx maosonensis* as *Xenophrys lancangica*, and *Amolops cremnobatus* as *A. tanfuiianae*.

Among 11 survey sites, forest near Pa Pan (8A) has



highest species diversity (50 recorded species), followed by Khuyn forest (46 recorded species), Eo Dieu (39 recorded species), Pa Pan (8B) (34 recorded species), Eo Ken (33 recorded species), Son (19 recorded species), Nua (16 recorded species), Kit (12 recorded species), Bam and Quang Vinh (11 recorded species each site), and Phu Le (9 recorded species) (Table 2).

The forests near Pa Pan A, B, Khuyn, Eo Dieu, and Eo Ken are situated in the core zone of the PLNR. These areas have high forest quality and large areas, which have a greater number of found species than other sites.

Most reptiles and amphibians inhabit evergreen forest and disturbed secondary forest (57 species or 62.64% of the total recorded species), and agricultural areas, where 26 species (36.36%) were recorded (Table 2).

In terms of conservation status, PLNR harbors a high number of threatened species: 21 species listed in the Red Data Book of Vietnam (Nguyen et al. 2024), with four species categorized as CR (*P. bivittatus*, *O. hannah*, *P. megacephalum*, and *C. galbinifrons*), four species as EN (*T. pasmansi*, *C. mouhotii*, *G. spengleri*, and *M. impressa*), and nine species as VU (*Q. verrucospinosa*, *T. corticale*, *P. cocincinus*, *G. reevesii*, *E. moellendorffi*, *E. taeniura*, *P. korros*, *N. atra*, and *P. variegatus*) four species as NT (*G. quangi*, *C. radiatus*, *B. fasciatus*, and *B. multicinctus*); 13 species listed in the IUCN Red List (IUCN 2024), with two species categorized as CR (*P. megacephalum* and *C. galbinifrons*), four species as EN (*L. namdongensis*, *C. mouhotii*, *G. spengleri*, and *M. impressa*), five species as VU (*P. cocincinus*, *E.*



**Fig. 9.** Threats to the herpetofauna in Pu Luong Nature Reserve, Thanh Hoa Province, Viet Nam: (A, B) Deforestation for agriculture, (C) Illegal timber logging, (D) Cattle grazing in the forest, (E) Tourism activities cause environmental pollution, (F) Wildlife collecting for food and trade

*moellendorffi*, *E. taeniura*, *N. atra*, and *O. hannah*), and one species as NT (*P. korros*); nine species listed in the Decree No. 84/2021/ND-CP (2021), included three species listed in the Group IB (*O. hannah*, *P. megacephalum*, and *Cuora galbinifrons*) and six species listed in the Group IIB (*T. pasmansi*, *P. cocincinus*, *P. bivittatus*, *N. atra*, *C. mouhotii*, *G. spengleri*, and *M. impressa*); and 10 species listed in CITES appendices, with two species included in the Appendix I (*P. megacephalum* and *C. galbinifrons*) and eight species listed in the Appendix II (*T. pasmansi*, *P. cocincinus*, *P. bivittatus*, *N. atra*, *O. hannah*, *C. mouhotii*, *G. spengleri*, and *M. impressa*) (Table 2).

Major threats to the habitat and populations of the herpetofauna in the Pu Luong NR are deforestation resulting from agricultural activities (Fig. 9A, B), illegal timber logging (Fig. 9C), free grazing of cattle in the forest (Fig. 9D), tourism activities cause environmental pollution (Fig. 9E), and wildlife collecting for food and trade (Fig. 9F).

**Acknowledgements.**—We are grateful to the directorates of the Forest Protection Department of Thanh Hoa Province and Pu Luong Nature Reserve for their support of our field work and for issuing relevant permits.

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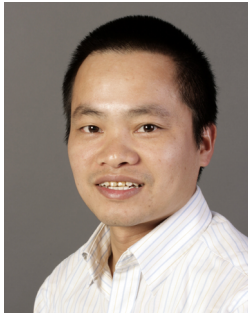
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