

The herpetofauna of Xuan Nha Nature Reserve, Vietnam

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Abstract.—This article presents the results of a herpetofaunal inventory of Xuan Nha Nature Reserve, Vietnam conducted between April 2016 and May 2021, comprising 41 species of amphibians and 66 species of reptiles, and 82 of the 107 species were recorded directly in this study. One species, *Hemiphyllodactylus bonkowskii*, represents a new record for Son La Province and 20 species of amphibians and reptiles are new records for the Xuan Nha Nature Reserve, comprising 10 species of frogs (*Boulenophrys palpebralespinosa*, *B. cf. parva*, *Leptobranchella eos*, *L. ventripunctata*, *Nanohyla marmorata*, *Kurixalus bisacculus*, *Rhacophorus orlovi*, *R. rhodopus*, *Zhangixalus feae*, and *Z. pachyproctus*), two species of lizards (*Hemidactylus garnotii* and *Sphenomorphus indicus*), and eight species of snakes (*Boiga cyanea*, *Dendrelaphis pictus*, *Elaphe taeniura*, *Gonyosoma frenatum*, *Oligodon fasciolatus*, *Hebius chapaensis*, *Rhabdophis nigrocinctus*, and *Pareas hamptoni*). Remarkably, *Gonyosoma coeruleum*, a recently described species from southern China, is recorded for the first time in Vietnam based on a single specimen from Son La Province. The herpetofauna of Xuan Nha Nature Reserve contains a high number of species of conservation concern, including 12 species listed in the Governmental Decree No. 84/2021/ND-CP, 19 species listed in the Vietnam Red Data Book, 18 species listed in the IUCN Red List, and 12 species listed in CITES Appendices. In addition, data on the distribution and natural history of the amphibian and reptile species in Xuan Nha Nature Reserve are provided.

Keywords. Amphibians, biodiversity, distribution, natural history, new records, reptiles

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Introduction

Son La Province is located in northwestern Vietnam, bordering Lao PDR in the southwest, and it is covered by 599,000 hectares of natural forest (The People’s Committee of Son La Province 2019). Xuan Nha is one of the five nature reserves in Son La Province, located in Moc Chau and Van Ho districts. This nature reserve was established in November 2002 with an area of 18,268 hectares (The People’s Committee of Son La Province 2019). The landscape of the nature reserve is characterized by steep and mountainous topography with elevations ranging from 400 to 1,800 m asl.

In terms of the herpetofaunal diversity, Nguyen et al. (2010) provided the first list which included 27 amphibian species and 50 reptile species from Xuan Nha Nature

Reserve (NR). Additional new records of reptiles and amphibians from this nature reserve were documented by Nguyen et al. (2017) and Pham et al. (2018, 2020). Most recently, a new species and subspecies of salamander was described from Xuan Nha NR, namely *Tylototriton pasmansii obsti* Bernardes, Le, Nguyen, Pham, Pham, Nguyen, and Ziegler, 2020 (Bernardes et al. 2020). As a result of our ongoing research in the past five years, this article provides an updated list of amphibians and reptiles from Xuan Nha NR, with new data on their distributions and natural history.

Material and Methods

Four field surveys were conducted at eight sites in Xuan Nha NR, Son La Province, Vietnam over a total of 51

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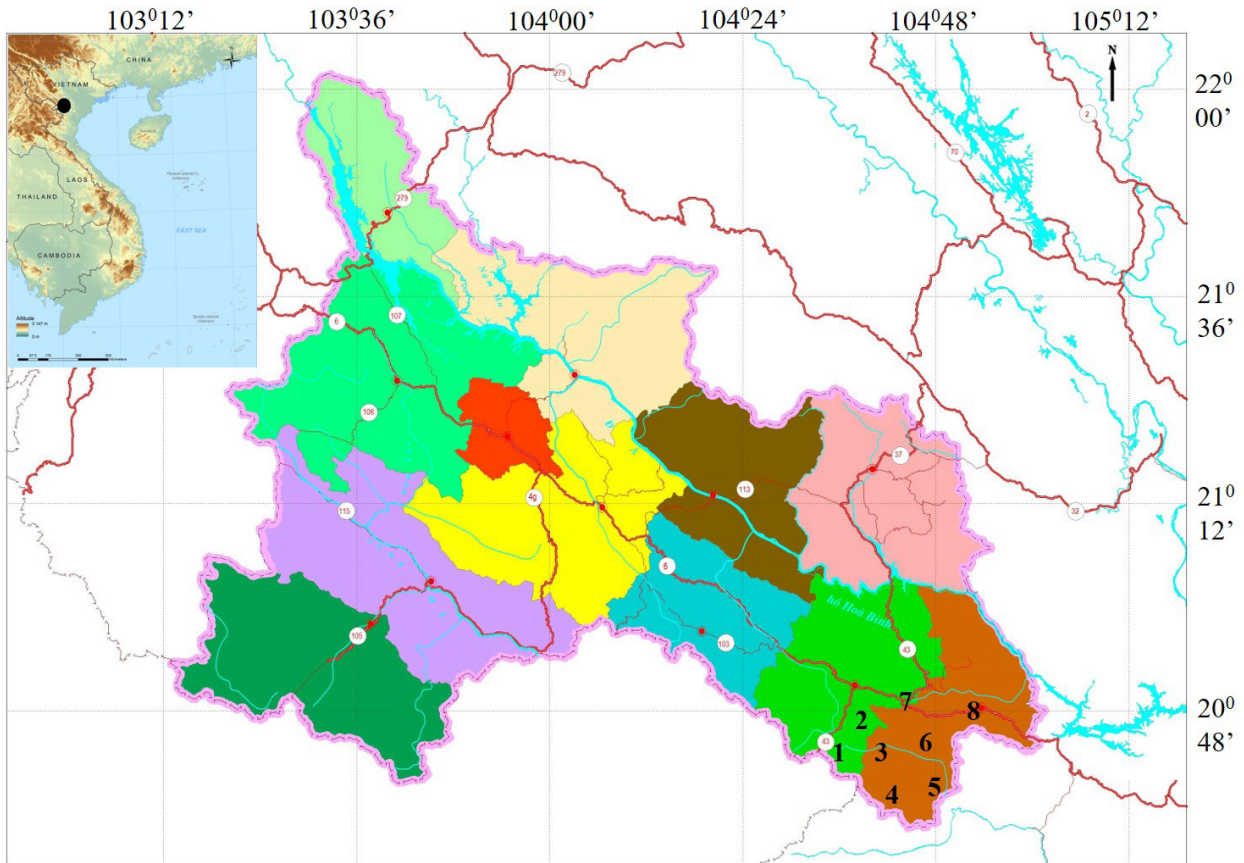


Fig. 1. Survey sites in Xuan Nha Nature Reserve, Son La Province, Viet Nam: 1. Hin Pen Village, Chieng Son Commune; 2. Cong Troi Village, Chieng Son Commune; 3. Kho Hong Village, Chieng Xuan Commune; 4. Lay Village, Tan Xuan Commune; 5. Nga Village, Tan Xuan Commune; 6. Muong An Village, Xuan Nha Commune; 7. Sao Do Village, Van Ho Commune; and 8. So Linh Village, Van Ho Commune.

days. The sites and dates are: **Van Ho District:** from 24 to 27 June 2016 in Kho Hong Village, Chieng Xuan Commune, from 28 June to 2 July 2016 in Muong An Village, Xuan Nha Commune, and from 3 to 6 July 2016 in Sao Do Village, Van Ho Commune, by A.V. Pham and N.B. Sung; from 15 to 20 October 2020 in Kho Hong Village, Chieng Xuan Commune by A.V. Pham, C.V. Hoang, T.Q. Phan, and N.B. Sung; from 20 to 24 April in Sao Do Village, from 25 to 27 April in So Linh Village, Van Ho Commune; from 28 to 30 April 2021 in Muong An Village, Xuan Nha Commune; from 1 April to 3 May 2021 in Lay Village, from 4 to 7 May 2021 in Nga Village, Tan Xuan Commune by A.V. Pham, T. Vaxenh, T.A. Sung, C.A. Sung, and L.A. Sun; **Moc**

Chau District: from 15 to 18 June 2017 and from 12 to 14 October 2020 in Hin Pen Village, and from 19 to 24 June 2017 in Cong Troi Village, Chieng Son Commune by A.V. Pham and N.B. Sung (Fig. 1 and Table 1).

The typical habitats at the study sites were undisturbed evergreen forest, disturbed secondary forest, and agricultural areas (Fig. 2). The geographic coordinates (WGS84) were recorded by using a Garmin GPSMAP 62s. Specimens were collected by hand between 0800 and 2300 h. After taking photographs in life, animals were identified to the species level, measured, sexed, and released at the site. For voucher specimens, a few individuals were anaesthetized and euthanized in a closed vessel with a piece of cotton wool containing

Table 1. Information for the survey sites in Xuan Nha Nature Reserve, Vietnam.

No	Site	Latitude	Longitude	Elevation (m)
1	Forest near Hin Pen Village, Chieng Son Commune	20°44.115'N	104°34.113'E	940
2	Forest near Cong Troi Village, Chieng Son Commune	20°45.418'N	104°37.156'E	1,144
3	Forest near Kho Hong Village, Chieng Xuan Commune	20°43.185'N	104°40.267'E	739
4	Forest near Lay Village, Tan Xuan Commune	20°38.015'N	104°40.175'E	850
5	Forest near Nga Village, Tan Xuan Commune	20°37.416'N	104°47.039'E	412
6	Forest near Muong An Village, Xuan Nha Commune	20°44.012'N	104°47.022'E	576
7	Forest near Sao Do Village, Van Ho Commune	20°49.002'N	104°46.132'E	626
8	Forest near So Linh Village, Van Ho Commune	20°46.550'N	104°55.415'E	677



Fig. 2. Habitat types in Xuan Nha Nature Reserve, Vietnam: (A, A1, A2) Evergreen forest, (B) Agricultural areas, and (C) Disturbed secondary forest.

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 subsequently deposited in the collection of the Tay Bac University (TBU), Son La Province, Vietnam.

Taxonomic identifications referred to the descriptions in Bain et al. (2003), Boulenger (1893), Bourret (1942), Fei et al. (2012), Hecht et al. (2013), Inger et al. (1999), Smith (1935, 1943), and Taylor (1962). Species names followed Frost (2021) for amphibians and Uetz et al. (2021) for reptiles.

Conservation status levels of amphibian and reptile species followed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Red List of International Union for Conservation of Nature and Natural Resources (IUCN), Vietnam Red Data Book (Dang et al. 2007), and The Governmental Decree No. 84/2021/ND-CP, dated on 22 September 2021 by the Government of Vietnam on the management of endangered wild flora and fauna.

Results

A total of 107 species belonging to 75 genera and 26 families were recorded from Xuan Nha NR, comprising 41 species of amphibians (24 genera, seven families) and 66 species of reptiles (51 genera, 19 families) (Table 2). Remarkably, one species of lizard is reported for the first time from Son La Province and 20 additional species are documented for the first time from Xuan Nha NR,

comprising 10 species of anurans, two species of lizards, and eight species of snakes. Based on a single snake specimen from Son La Province of Vietnam, we also report the first record of *Gonyosoma coeruleum* outside of its type locality in Yunnan Province, China.

Amphibia

Anura

Bufonidae

Duttaphrynus melanostictus (Schneider, 1799) (Fig. 3A):

Individuals were observed at night on the ground in meadowlands, croplands, gardens, and road edges near residential areas.

Megophryidae

Boulenophrys palpebralespinosa (Bourret, 1937) (Fig. 3B): Two specimens were found at night on leaves, 20–50 cm above the ground, near a stream in evergreen forest. This is a new record for Xuan Nha NR.

Boulenophrys cf. *parva* (Boulenger, 1893) (Fig. 3C):

One specimen was found at night on the ground, near a stream in evergreen forest. *Boulenophrys parva* seems to be restricted in Myanmar and records of this species in northern Vietnam should be assigned to other named and unnamed species (Manhony et al. 2020).

Leptobranchella eos (Ohler, Wollenberg, Grosjean, Hendrix, Vences, Ziegler, and Dubois, 2011) (Fig. 3D): One specimen was found at night on the ground

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Table 2. List of amphibian and reptile species recorded from Xuan Nha NR, Vietnam. New record types: ***= new record for Vietnam; ** = new record for Son La Province; * = new record for Xuan Nha NR. **Site:** Descriptions of the sites numbered from 1 to 8 are provided in Table 1. **Habitat** codes: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas. **Red Data Book** refers to *Red Data Book of Vietnam* (Dang et al. 2007), and **IUCN** refers to *The IUCN Red List of Threatened Species* (IUCN 2021) with the following conservation status codes: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened. **CITES** refers to CITES appendices (2021): I, II = Appendix I and II. **Decree No. 84** refers to *The Governmental Decree No. 84/2021/ND-CP*, dated on 22 September 2021 (The Government of Vietnam 2021), with the following codes: IB = Group IB (Prohibited exploitation and use for commercial purpose); IIB = Group IIB (limited exploitation and use for commercial purpose). **Record evidence:** The types of observations made for each species in the field surveys of this study. **Previous record** codes indicate literature references: 1 = Nguyen et al. (2010), 2 = Nguyen et al. (2017), 3 = Pham et al. (2018), 4 = Bernardes et al. (2020), 5 = Pham et al. (2020), and 6 = Pham et al. (2022).

No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
ANURA									
Bufoinae Gray, 1825									
1	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)	1–8	2, 3					Photos	1
Megophryidae Bonaparte, 1850									
2	<i>Boulenophrys palpebralespinosa</i> (Bourret, 1937)*	4	1	CR				Specimens (2)	
3	<i>Boulenophrys cf. parva</i> (Boulenger, 1893)*	4	1					Specimen (1)	
4	<i>Leptobranchella eos</i> (Ohler, Wollenberg, Grosjean, Hendrix, Vences, Ziegler, and Dubois, 2011)*	4	1					Specimen (1)	
5	<i>Leptobranchella namdongensis</i> Hoang, Nguyen, Luu, Nguyen, and Jiang, 2019	4	1		EN			Specimens (4)	6
6	<i>Leptobranchella ventripunctata</i> (Fei, Ye, and Li, 1990)*	3	1					Specimens (3)	
7	<i>Leptobranchium masatakasatoi</i> Matsui, 2013	5	1					Specimens (2)	1
8	<i>Xenophrys maosonensis</i> (Bourret, 1937)	5	1					Specimens (2)	1
Microhylidae Günther, 1858 (1843)									
9	<i>Kaloula pulchra</i> Gray, 1831	1	3					Photos	1
10	<i>Microhyla berdmorei</i> (Blyth, 1856)								1
11	<i>Microhyla butleri</i> Boulenger, 1900	2, 3, 6	3					Specimen (1) Photos	1
12	<i>Microhyla heymonsi</i> Vogt, 1911	3, 4, 5, 7, 8	2, 3					Specimens (2) Photos	1
13	<i>Microhyla mukhlesuri</i> Hasan, Islam, Kuramoto, Kurabayashi, and Sumida, 2014	2, 5–8	3					Specimen (1) Photos	1
14	<i>Microhyla pulchra</i> (Hallowell, 1861)	1, 4, 5, 7, 8	3					Specimens (2) Photos	1
15	<i>Nanohyla marmorata</i> (Bain and Nguyen, 2004)*	3	1					Specimens (2)	
Dicroglossidae Anderson, 1871									
16	<i>Fejervarya limnocharis</i> (Gravenhost, 1829)	1–8	2, 3					Photos	1

Table 2 (continued). List of amphibian and reptile species recorded from Xuan Nha NR, Vietnam. New record types: ***= new record for Vietnam; ** = new record for Son La Province; * = new record for Xuan Nha NR. **Site:** Descriptions of the sites numbered from 1 to 8 are provided in Table 1. **Habitat** codes: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas. **Red Data Book** refers to *Red Data Book of Vietnam* (Dang et al. 2007), and **IUCN** refers to *The IUCN Red List of Threatened Species* (IUCN 2021) with the following conservation status codes: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened. **CITES** refers to CITES appendices (2021): I, II = Appendix I and II. **Decree No. 84** refers to *The Governmental Decree No. 84/2021/ND-CP*, dated on 22 September 2021 (The Government of Vietnam 2021), with the following codes: IB = Group IB (Prohibited exploitation and use for commercial purpose); IIB = Group IIB (limited exploitation and use for commercial purpose). **Record evidence:** The types of observations made for each species in the field surveys of this study. **Previous record** codes indicate literature references: 1 = Nguyen et al. (2010), 2 = Nguyen et al. (2017), 3 = Pham et al. (2018), 4 = Bernardes et al. (2020), 5 = Pham et al. (2020), and 6 = Pham et al. (2022).

No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
17	<i>Hoplobatrachus rugulosus</i> (Wiegmann, 1834)	1, 3, 5–7	3					Photos	1
18	<i>Limnonectes bannaensis</i> Ye, Fei, Xie, and Jiang, 2007	1, 3, 4, 6, 8	1, 2					Photos	1
19	<i>Occidozyga lima</i> (Gravenhorst, 1829)								1
20	<i>Occidozyga martensii</i> (Peters, 1867)								1
21	<i>Quasipaa verrucospinosa</i> (Bourret, 1937)	1, 3, 4	1					Photos	1
Ranidae Batsch, 1796									
22	<i>Amolops cremnobatus</i> Inger and Kottelat, 1998	4	1					Specimens (2)	6
23	<i>Hylarana macrodactyla</i> Gunther, 1858								1
24	<i>Hylarana taipehensis</i> (Van Denburgh, 1909)								1
25	<i>Nidirana chapaensis</i> (Bourret, 1937)	3	1					Specimen (1) Photos	6
26	<i>Odorrana chloronota</i> (Günther, 1876)								1
27	<i>Odorrana nasica</i> (Boulenger, 1903)	5	1					Specimen (1)	1
28	<i>Odorrana tiannanensis</i> (Yang and Li, 1980)	3	1					Specimens (2)	6
29	<i>Rana johnsi</i> Smith, 1921	1	2					Specimen (1)	1
30	<i>Sylvirana guentheri</i> (Boulenger, 1882)	1, 3, 4, 6, 7	3					Photos	1
31	<i>Sylvirana maosonensis</i> (Bourret, 1937)	5	1					Specimen (1)	1
32	<i>Sylvirana nigrovittata</i> (Blyth, 1856)	1, 3, 5	1, 2					Specimen (1) Photos	1
Rhacophoridae Hoffman, 1932 (1858)									
33	<i>Kurixalus bisacculus</i> (Taylor, 1962)*	1–5	1, 2					Specimen (1) Photos	
34	<i>Polypedates megacephalus</i> Hallowell, 1861	1–8	1–3					Specimens (2) Photos	1
35	<i>Raorchestes parvulus</i> (Boulenger, 1893)	3, 4, 6	1					Specimens (2) Photos	6
36	<i>Rhacophorus kio</i> Ohler and Delorme, 2006	3, 4	1	EN				Photos	1
37	<i>Rhacophorus orlovi</i> Ziegler and Köhler, 2001*	3, 4, 8	1					Specimens (3) Photos	

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Table 2 (continued). List of amphibian and reptile species recorded from Xuan Nha NR, Vietnam. New record types: ***= new record for Vietnam; ** = new record for Son La Province; * = new record for Xuan Nha NR. **Site:** Descriptions of the sites numbered from 1 to 8 are provided in Table 1. **Habitat** codes: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas. **Red Data Book** refers to *Red Data Book of Vietnam* (Dang et al. 2007), and **IUCN** refers to *The IUCN Red List of Threatened Species* (IUCN 2021) with the following conservation status codes: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened. **CITES** refers to CITES appendices (2021): I, II = Appendix I and II. **Decree No. 84** refers to *The Governmental Decree No. 84/2021/ND-CP*, dated on 22 September 2021 (The Government of Vietnam 2021), with the following codes: IB = Group IB (Prohibited exploitation and use for commercial purpose); IIB = Group IIB (limited exploitation and use for commercial purpose). **Record evidence:** The types of observations made for each species in the field surveys of this study. **Previous record** codes indicate literature references: 1 = Nguyen et al. (2010), 2 = Nguyen et al. (2017), 3 = Pham et al. (2018), 4 = Bernardes et al. (2020), 5 = Pham et al. (2020), and 6 = Pham et al. (2022).

No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
38	<i>Rhacophorus rhodopus</i> Liu and Hu, 1960*	3, 4	1					Photos	
39	<i>Zhangixalus feae</i> (Boulenger, 1893)*	3	1	EN				Photos	
40	<i>Zhangixalus pachyproctus</i> Yu, Hui, Hou, Wu, Rao, and Yang, 2019*	3, 5	1					Photos	
CAUDATA									
Salamandridae Goldfuss, 1820									
41	<i>Tylototriton pasmansi obsti</i> Bernardes, Le, Nguyen, Pham, Pham, Nguyen, and Ziegler, 2020	3, 8	1			II	IIB	Photos	4
SQUAMATA									
Agamidae									
42	<i>Acanthosaura lepidogaster</i> (Cuvier, 1829)	1, 2, 8	1					Photos	1
43	<i>Calotes emma</i> Gray, 1845	8	1					Specimen (1)	1
44	<i>Calotes versicolor</i> (Daudin, 1802)	1–8	3					Specimen (1) Photos	1
45	<i>Draco maculatus</i> (Gray, 1845)								1
46	<i>Physignathus cocincinus</i> Cuvier, 1829			VU	VU				1
Gekkonidae									
47	<i>Cyrtodactylus otai</i> Nguyen, Le, Pham, Ngo, Hoang, Pham, and Ziegler, 2015	7, 8	2		EN			Photos	2
48	<i>Gekko palmatus</i> Boulenger, 1907	3, 8	2					Specimen (1) Photos	3
49	<i>Gekko reevesii</i> (Gray, 1831)	7, 8	2					Photos	1
50	<i>Hemidactylus frenatus</i> Duméril and Bibron, 1836	1–8	3					Photos	1
51	<i>Hemidactylus garnotii</i> Duméril and Bibron, 1836*	6	2					Specimen (1) Photos	
52	<i>Hemiphyllodactylus bonkowskii</i> Nguyen, Do, Ngo, Pham, Pham, Le, and Ziegler, 2020**	8	2					Specimens (2)	

Table 2 (continued). List of amphibian and reptile species recorded from Xuan Nha NR, Vietnam. New record types: ***= new record for Vietnam; ** = new record for Son La Province; * = new record for Xuan Nha NR. **Site:** Descriptions of the sites numbered from 1 to 8 are provided in Table 1. **Habitat** codes: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas. **Red Data Book** refers to *Red Data Book of Vietnam* (Dang et al. 2007), and **IUCN** refers to *The IUCN Red List of Threatened Species* (IUCN 2021) with the following conservation status codes: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened. **CITES** refers to CITES appendices (2021): I, II = Appendix I and II. **Decree No. 84** refers to *The Governmental Decree No. 84/2021/ND-CP*, dated on 22 September 2021 (The Government of Vietnam 2021), with the following codes: IB = Group IB (Prohibited exploitation and use for commercial purpose); IIB = Group IIB (limited exploitation and use for commercial purpose). **Record evidence:** The types of observations made for each species in the field surveys of this study. **Previous record** codes indicate literature references: 1 = Nguyen et al. (2010), 2 = Nguyen et al. (2017), 3 = Pham et al. (2018), 4 = Bernardes et al. (2020), 5 = Pham et al. (2020), and 6 = Pham et al. (2022).

No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
Lacertidae									
53	<i>Takydromus sexlineatus</i> Daudin, 1802	2	2					Specimen (1)	1
Scincidae									
54	<i>Eutropis chapaensis</i> (Bourret, 1937)								1
55	<i>Eutropis longicaudatus</i> (Hallowell, 1857)	1, 2, 6	3					Photos	1
56	<i>Eutropis multifasciatus</i> (Kuhl, 1820)	4, 5, 7	3					Photos	1
57	<i>Sphenomorphus indicus</i> (Gray, 1853)*	8	1					Specimen (1)	
58	<i>Tropidophorus baviensis</i> Bourret, 1939	7	2					Specimen (1)	1
Varanidae									
59	<i>Varanus salvator</i> (Laurenti, 1768)			EN		II	IIB		1
Typhlopidae									
60	<i>Indotyphlops braminus</i> (Daudin, 1803)	6	2					Specimen (1)	1
Pythonidae									
61	<i>Python molurus</i> (Linnaeus, 1758)			CR	NT	II	IIB		1
Xenopeltidae									
62	<i>Xenopeltis unicolor</i> Reinwardt, 1827	1, 6	3					Specimen (1) Photos	1
Colubridae									
63	<i>Ahaetulla prasina</i> (Boie, 1827)	2	2					Photos	1
64	<i>Boiga cyanea</i> (Duméril, Bibron, and Duméril, 1854)*	7	1					Specimen (1)	
65	<i>Boiga guangxiensis</i> Wen, 1998	4	1					Photos	5
66	<i>Boiga multomaculata</i> (Boie, 1827)	3	2					Photos	1
67	<i>Calamaria pavementata</i> Duméril, Bibron, and Duméril, 1854	1	2					Specimen (1)	1
68	<i>Coelognathus radiatus</i> (Boie, 1827)	7	3	EN				Photos	1

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No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
69	<i>Dendrelaphis pictus</i> (Gmelin, 1789)*	1, 8	2					Specimens (2) Photos	
70	<i>Elaphe moellendorffi</i> (Boettger, 1886)	8	2	VU	VU			Photos	1
71	<i>Elaphe taeniura</i> (Cope, 1861)*	1, 2	2, 3		VU			Photos	
72	<i>Euprepiophis mandarinus</i> (Cantor, 1842)	3	1	VU				Specimen (1)	1
73	<i>Gonyosoma coeruleum</i> Liu, Hou, Lwin, Wang, and Rao, 2021***	5	2					Specimen (1)	
74	<i>Gonyosoma frenatum</i> (Gray, 1853)*	8	1					Specimen (1)	
75	<i>Lycodon futsingensis</i> (Pope, 1928)	5	1					Specimen (1)	1
76	<i>Lycodon meridionalis</i> (Bourret, 1935)	7	2					Specimen (1)	5
77	<i>Oligodon fasciolatus</i> (Günther, 1864)*	2, 6	2					Specimen (1) Photos	
78	<i>Oreocryptophis porphyraceus</i> (Cantor, 1839)	7	2	VU				Photos	1
79	<i>Ptyas korros</i> (Schlegel, 1837)	1, 5, 6	2, 3	EN	NT			Photos	1
80	<i>Ptyas mucosa</i> (Linnaeus, 1758)			EN		II	IIB		1
Elapidae									
81	<i>Bungarus fasciatus</i> (Schneider, 1801)	5	2	EN				Photos	1
82	<i>Bungarus wanghaotingi</i> Pope, 1928	1, 6	2					Photos	1
83	<i>Naja atra</i> Cantor, 1842	7	2	EN	VU	II	IIB	Photos	1
84	<i>Ophiophagus hannah</i> (Cantor, 1836)			CR	VU	II	IB		1
85	<i>Sinomicrurus maclellandi</i> (Reinhardt, 1844)	3	1					Specimen (1)	1
Homalopsidae									
86	<i>Hypsiscopus plumbea</i> (Boie, 1827)								1
Pseudaspidae									
87	<i>Psammodynastes pulverulentus</i> (Boie, 1827)	7	2					Photos	1

Table 2 (continued). List of amphibian and reptile species recorded from Xuan Nha NR, Vietnam. New record types: ***= new record for Vietnam; ** = new record for Son La Province; * = new record for Xuan Nha NR. **Site:** Descriptions of the sites numbered from 1 to 8 are provided in Table 1. **Habitat** codes: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas. **Red Data Book** refers to *Red Data Book of Vietnam* (Dang et al. 2007), and **IUCN** refers to *The IUCN Red List of Threatened Species* (IUCN 2021) with the following conservation status codes: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened. **CITES** refers to CITES appendices (2021): I, II = Appendix I and II. **Decree No. 84** refers to *The Governmental Decree No. 84/2021/ND-CP*, dated on 22 September 2021 (The Government of Vietnam 2021), with the following codes: IB = Group IB (Prohibited exploitation and use for commercial purpose); IIB = Group IIB (limited exploitation and use for commercial purpose). **Record evidence:** The types of observations made for each species in the field surveys of this study. **Previous record** codes indicate literature references: 1 = Nguyen et al. (2010), 2 = Nguyen et al. (2017), 3 = Pham et al. (2018), 4 = Bernardes et al. (2020), 5 = Pham et al. (2020), and 6 = Pham et al. (2022).

No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
Natricidae									
88	<i>Amphiesma stolatum</i> (Linnaeus, 1758)								1
89	<i>Fowlea flavipunctatus</i> (Hallwell, 1861)								1
90	<i>Hebius chapaensis</i> (Bourret, 1934)*	4	1					Specimen (1)	
91	<i>Rhabdophis chrysargos</i> (Schlegel, 1837)								1
92	<i>Rhabdophis nigrocinctus</i> (Blyth, 1856)*	6	1					Specimen (1)	
93	<i>Rhabdophis helleri</i> (Schmidt, 1925)	1, 2, 6, 7	2, 3					Photos	1
94	<i>Trimerodytes percarinatus</i> (Boulenger, 1899)	3	1					Photos	1
Pareidae									
95	<i>Pareas hamptoni</i> (Boulenger, 1905)*	7	1					Specimen (1)	
Viperidae									
96	<i>Ovophis monticola</i> (Günther, 1864)	4	1					Specimen (1)	1
97	<i>Trimeresurus albolabris</i> Gray, 1842	4, 6, 7	2					Specimen (1) Photos	1
98	<i>Trimeresurus stejnegeri</i> Schmidt, 1925								1
TESTUDINES									
Platysternidae									
99	<i>Platysternon megacephalum</i> Gray, 1831	4	1	EN	CR	I	IB	Photos	1
Geoemydidae									
100	<i>Cuora galbinifrons</i> Bourret, 1939			EN	CR	II	IB		1
101	<i>Cuora mouhotii</i> (Gray, 1862)				EN	II	IIB		1
102	<i>Geoemyda spengleri</i> (Gmelin, 1789)				EN	II	IIB		1
103	<i>Mauremys sinensis</i> (Gray, 1834)				CR				1
104	<i>Sacalia quadriocellata</i> (Siebenrock, 1903)				CR	II	IIB		1

Table 2 (continued). List of amphibian and reptile species recorded from Xuan Nha NR, Vietnam. New record types: ***= new record for Vietnam; ** = new record for Son La Province; * = new record for Xuan Nha NR. **Site:** Descriptions of the sites numbered from 1 to 8 are provided in Table 1. **Habitat** codes: 1 = Evergreen forest, 2 = Disturbed secondary forest, and 3 = Agricultural areas. **Red Data Book** refers to *Red Data Book of Vietnam* (Dang et al. 2007), and **IUCN** refers to *The IUCN Red List of Threatened Species* (IUCN 2021) with the following conservation status codes: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Lower Risk/Near Threatened. **CITES** refers to CITES appendices (2021): I, II = Appendix I and II. **Decree No. 84** refers to *The Governmental Decree No. 84/2021/ND-CP*, dated on 22 September 2021 (The Government of Vietnam 2021), with the following codes: IB = Group IB (Prohibited exploitation and use for commercial purpose); IIB = Group IIB (limited exploitation and use for commercial purpose). **Record evidence:** The types of observations made for each species in the field surveys of this study. **Previous record** codes indicate literature references: 1 = Nguyen et al. (2010), 2 = Nguyen et al. (2017), 3 = Pham et al. (2018), 4 = Bernardes et al. (2020), 5 = Pham et al. (2020), and 6 = Pham et al. (2022).

No.	Name	Site	Habitat	Red Data Book	IUCN	CITES	Decree No. 84	Record evidence (this study)	Previous record
Testudinidae									
105	<i>Indotestudo elongata</i> (Blyth, 1853)			EN	CR	II	IIB		1
106	<i>Manouria impressa</i> (Guenther, 1882)	3	1	VU	EN	II	IIB	Photos	1
Trionychidae									
107	<i>Palea steindachneri</i> (Siebenrock, 1906)			VU	CR	II	IIB		1

near a stream in evergreen forest. This is a new record for Xuan Nha NR.

Leptobranchella namdongensis Hoang, Nguyen, Luu, Nguyen, and Jiang, 2019 (Fig. 3E): Four specimens were found at night on the ground or on stones near a stream. The surrounding habitat was evergreen forest, composed of small hardwoods, liane, and shrub.

Leptobranchella ventripunctata (Fei, Ye, and Li, 1990) (Fig. 3F): One specimen was found on a stone near a stream and two other specimens were observed along a forest path at night. This is a new record for Xuan Nha NR.

Leptobranchium masatakasatoi Matsui, 2013 (Fig. 3G): Two specimens were found at night on the ground near a stream in evergreen forest.

Xenophrys maosonensis (Bourret, 1937) (Fig. 3H): Two specimens were found at night on the ground, near a stream in evergreen forest.

Microhylidae

Kaloula pulchra Gray, 1831 (Fig. 3I): An individual was observed at night on a bonsai pot in a household garden.

Microhyla butleri Boulenger, 1900 (Fig. 3J): One specimen was found at night on the ground in meadowlands and other individuals were observed at night in croplands, and at small puddle edges near the rice fields and forest edges.

Microhyla heymonsi Vogt, 1911 (Fig. 3K): Two specimens were found at night on the ground along road edges and other individuals were observed at night on the ground in croplands, in meadowlands, croplands, and forest trails near forest edges, and inside the forest.

Microhyla mukhlesuri Hasan, Islam, Kuramoto, Kurabayashi, and Sumida, 2014 (Fig. 3L): One

specimen was found at night on the ground near small puddle edges in rice fields, and other individuals were observed at night on the ground near small puddle edges in rice fields, meadowlands, and croplands.

Microhyla pulchra (Hallowell, 1861) (Fig. 3M): Two specimens were found at night on the ground in meadowlands near rice fields, and other individuals were observed at night on the ground in croplands, around small puddle edges.

Nanohyla marmorata (Bain and Nguyen, 2004) (Fig. 3N): Two specimens were found in the morning on the forest path. The surrounding habitat was evergreen forest. This is a new record for Xuan Nha NR.

Dicroglossidae

Fejervarya limnocharis (Gravenhost, 1829) (Fig. 3O): Many individuals were observed at night on the ground, in meadowlands near rice fields, croplands, and small puddles at road edges.

Hoplobatrachus rugulosus (Wiegmann, 1834) (Fig. 3P): Individuals were observed at night on the ground, at pond edges, and in rice fields.

Limnonectes bannaensis Ye, Fei, Xie, and Jiang, 2007 (Fig. 3Q): Individuals were observed at night on the ground near streams or water edges in streams in evergreen forest.

Quasipaa verrucospinosa (Bourret, 1937) (Fig. 3R): Individuals were observed at night on rocks in streams or near waterfalls. The surrounding habitat was evergreen forest.

Ranidae

Amolops cremnobatus Inger and Kottelat, 1998 (Fig.



Fig. 3. Amphibian species recorded in Xuan Nha Nature Reserve, Vietnam: (A) *Duttaphrynus melanostictus*, (B) *Boulenophrys palpebralespinosa*, (C) *Boulenophrys* cf. *parva*, (D) *Leptobranchella eos*, (E) *L. namdongensis*, (F) *L. ventripunctata*, (G) *Leptobranchium masatakasatoi*, (H) *Xenophrys maosonensis*, (I) *Kaloula pulchra*, (J) *Microhyla butleri*, (K) *M. heymonsi*, (L) *M. mukhlesuri*, (M) *M. pulchra*, (N) *Nanohyla marmorata*, (O) *Fejervarya limnocharis*, (P) *Hoplobatrachus rugulosus*, (Q) *Limnonectes bannaensis*, and (R) *Quasipaa verrucospinosa*.



Fig. 4. Additional amphibian species recorded in Xuan Nha Nature Reserve, Vietnam: (A) *Amolops cremnobatus*, (B) *Nidirana chapaensis*, (C) *Odorrana nasica*, (D) *O. tiannanensis*, (E) *Rana johnsi*, (F) *Sylvirana guentheri*, (G) *S. maosonensis*, (H) *S. nigrovittata*, (I) *Kurixalus bisacculus*, (J) *Polypedates megacephalus*, (K) *Raorchestes parvulus*, (L) *Rhacophorus kio*, (M) *R. orlovi*, (N) *Rhacophorus rhodopus*, (O) *Zhangixalus feae*, (P) *Z. pachyproctus*, and (Q) *Tylototriton pasmansi obsti*.

4A): Two specimens were found at night on rocks in streams with strong currents. The surrounding habitat was evergreen forest, composed of small hardwoods, liane, and shrub.

Nidirana chapaensis (Bourret, 1937) (Fig. 4B): One specimen was found at night on tree leaves, 30 cm above the ground, near a stream. Two other individuals were observed on the ground at a small puddle edge in evergreen forest.

Odorrana nasica (Boulenger, 1903) (Fig. 4C): One specimen was found at night on a rock near a waterfall in evergreen forest.

Odorrana tiannanensis (Yang and Li, 1980) (Fig. 4D): Two specimens were found at night on the ground near a stream in evergreen forest.

Rana johnsi Smith, 1921 (Fig. 4E): One specimen was found at night on the ground near a stream at the forest edge.

Sylvirana guentheri (Boulenger, 1882) (Fig. 4F): Individuals were observed at night on the ground or on leaves, ca. 30–50 cm above the ground near pond edges and streams. The surrounding habitat was rice field.

Sylvirana maosonensis (Bourret, 1937) (Fig. 4G): One specimen was found at night on the ground near a stream in evergreen forest.

Sylvirana nigrovittata (Blyth, 1856) (Fig. 4H): One specimen was found at night on the ground near a stream, and other individuals were observed at night on the ground, on stones near a stream or at the water edges in streams. The surrounding habitat was evergreen forest. The call concerts were regularly heard in the evening.

Rhacophoridae

Kurixalus bisacculus (Taylor, 1962) (Fig. 4I): One specimen was found at night on a tree branch near a stream, and other individuals were observed at night while sitting on leaves near a stream or near puddles, ca. 1–2 m above the ground. The surrounding habitat was mixed evergreen forest of small hardwoods, bamboo, and shrubs. This is a new record for Xuan Nha NR.

Polypedates megacephalus Hallowell, 1861 (Fig. 4J): Two specimens were found at night on the tree branches near puddles, and other individuals were observed at night while sitting on leaves or branches near streams, puddles, and ponds, ca. 0.3–2 m above the ground. The surrounding habitat was cultivated land, mixed evergreen forest of small hardwoods, bamboo, and shrubs.

Raorchestes parvulus (Boulenger, 1893) (Fig. 4K): Two specimens were found at night sitting on leaves near streams, ca. 1–3 m above the ground in evergreen forest.

Rhacophorus kio Ohler and Delorme, 2006 (Fig. 4L): Individuals were observed at night while sitting on

leaves near puddles, ca. 2–5 m above the ground in evergreen forest.

Rhacophorus orlovi Ziegler and Köhler, 2001 (Fig. 4M): Three specimens were found at night while sitting on leaves near streams, 2–3 m above the ground in evergreen forest. This is a new record for Xuan Nha NR.

Rhacophorus rhodopus Liu and Hu, 1960 (Fig. 4N): Individuals were observed at night while sitting on leaves near puddles, ca. 2–5 m above the ground in evergreen forest. This is a new record for Xuan Nha NR.

Zhangixalus feae (Boulenger, 1893) (Fig. 4O): Individuals were observed at night while sitting on leaves, 0.5–3 m above the ground; some individuals found on the ground near streams in evergreen forest.

Zhangixalus pachyproctus Yu, Hui, Hou, Wu, Rao, and Yang, 2019 (Fig. 4P): Individuals were observed at night while sitting on leaves, ca. 1–6 m above the ground, near large puddles in evergreen forest. This is a new record for Xuan Nha NR.

Caudata

Salamandridae

Tylototriton pasmansi obsti Bernardes, Le, Nguyen, Pham, Pham, Nguyen, and Ziegler, 2020 (Fig. 4Q): Individuals were observed during the daytime in small streams in evergreen forest. Surrounding habitat was small hardwoods, bamboo, and shrub.

Reptilia

Squamata

Agamidae

Acanthosaura lepidogaster (Cuvier, 1829) (Fig. 5A): An individual was observed while sitting on a tree, about 2 m above the ground, and another individual was seen while crossing a forest path.

Calotes emma Gray, 1845 (Fig. 5B): One specimen was found in the morning on a forest path in evergreen forest.

Calotes versicolor (Daudin, 1802) (Fig. 5C): Individuals were observed during the daytime near cultivated areas and another road-killed individual was found on Road 102. Some individuals were seen on the ground near bushes in a garden.

Gekkonidae

Cyrtodactylus otai Nguyen, Le, Pham, Ngo, Hoang, Pham, and Ziegler, 2015 (Fig. 5D): Three individuals were observed at night, on tree branches, near limestone cliffs at the forest edges.

Gekko palmatus Boulenger, 1907 (Fig. 5E): One specimen was found and other individuals were observed at night on limestone cliffs at the forest edges.

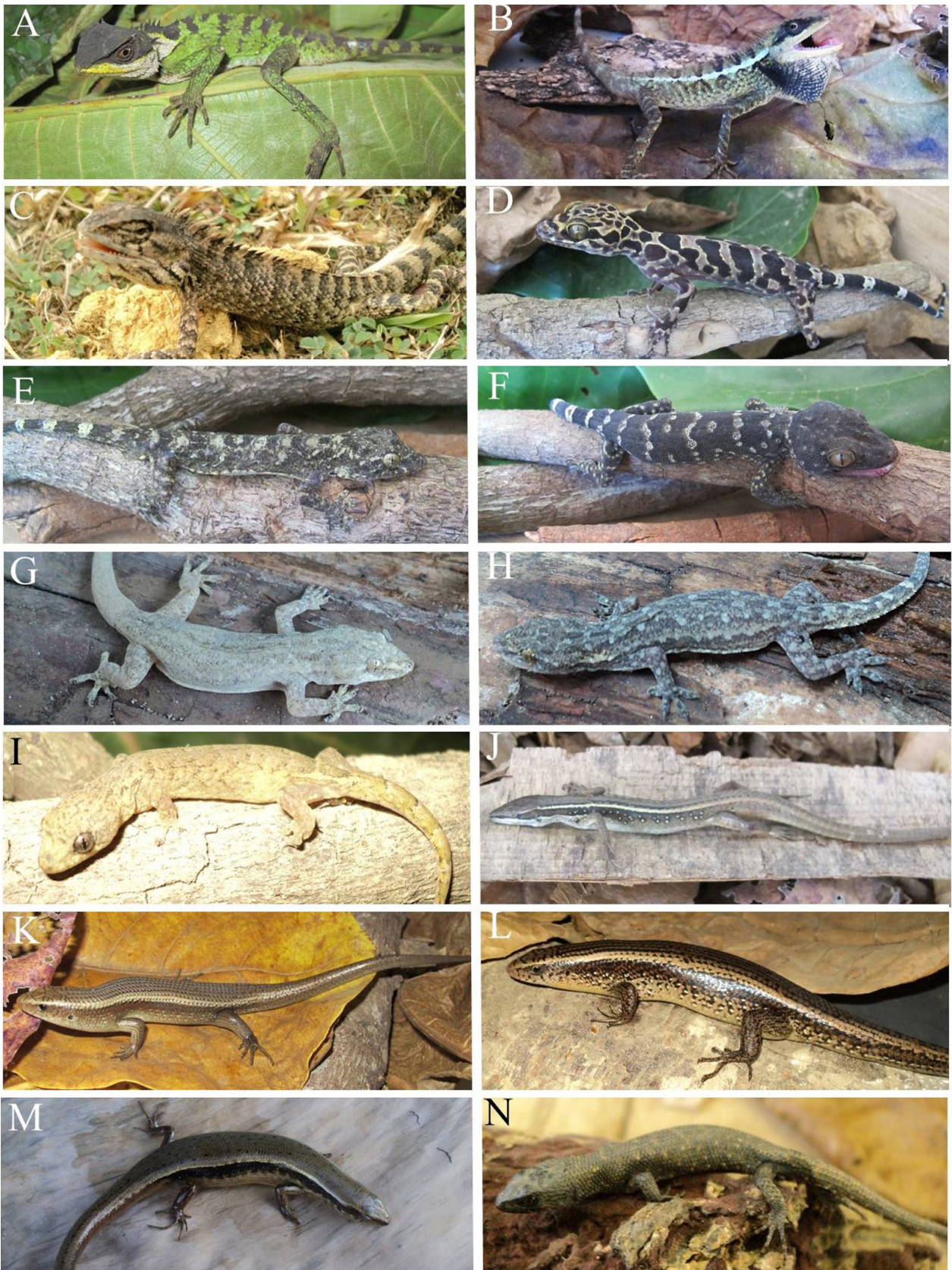


Fig. 5. Lizard species recorded in Xuan Nha Nature Reserve, Vietnam: (A) *Acanthosaura lepidogaster*, (B) *Calotes emma*, (C) *C. versicolor*, (D) *Cyrtodactylus otai*, (E) *Gekko palmatus*, (F) *G. reevesii*, (G) *Hemidactylus frenatus*, (H) *H. garnotii*, (I) *Hemiphyllodactylus bonkowski*, (J) *Takydromus sexlineatus*, (K) *Eutropis longicaudatus*, (L) *E. multifasciatus*, (M) *Sphenomorphus indicus*, and (N) *Tropidophorus baviensis*.

Gekko reevesii (Gray, 1831) (Fig. 5F): An individual was observed at night on limestone cliffs, and another individual was observed on a big tree, about 5 m above the ground.

Hemidactylus frenatus Duméril and Bibron, 1836 (Fig. 5G): Individuals were observed at night on the wall near a light in a residential area.

Hemidactylus garnotii Duméril and Bibron, 1836 (Fig. 5H): One specimen was found and other individuals were observed at night on limestone karst outcrops, 2–3 m above the ground. The surrounding habitat was secondary forest. This is a new record for Xuan Nha NR.

Hemiphyllodactylus bonkowskii Nguyen, Do, Ngo, Pham, Pham, Le, and Ziegler, 2020 (Fig. 5I): Two specimens were found at night on tree branches near limestone cliffs at forest edges. This is a new record for Xuan Nha NR and Son La Province.

Lacertidae

Takydromus sexlineatus Daudin, 1802 (Fig. 5J): One specimen was found during the daytime, on the ground near bamboo trees in secondary forest.

Scincidae

Eutropis longicaudatus (Hallowell, 1857) (Fig. 5K): Individuals were found during the daytime on the ground, garden fences, road edges, and shrubs near cultivated areas.

Eutropis multifasciatus (Kuhl, 1820) (Fig. 5L): Three individuals were found during the daytime on the ground, along road edges near cultivated areas.

Sphenomorphus indicus (Gray, 1853) (Fig. 5M): One specimen was found in the afternoon on a forest path in evergreen forest. This is a new record for Xuan Nha NR.

Tropidophorus baviensis Bourret, 1939 (Fig. 5N): One specimen was found under a carpet of fallen leaves at the forest edge.

Typhlopidae

Indotyphlops braminus (Daudin, 1803) (Fig. 6A): One specimen was found in the morning under a rotten bamboo tree at the forest edge.

Xenopeltidae

Xenopeltis unicolor Reinwardt, 1827 (Fig. 6B): An individual was observed in the afternoon under a rotten plank in a garden and another road-killed specimen was found on Road 102.

Colubridae

Ahaetulla prasina (Boie, 1827) (Fig. 6C): An individual

was found at night on the thick grass in secondary forest.

Boiga cyanea (Duméril, Bibron, and Duméril, 1854) (Fig. 6D): A road-killed specimen was found in the afternoon on Road 102. The surrounding habitat was evergreen forest.

Boiga guangxiensis Wen, 1998 (Fig. 6E): An individual was observed at night on a tree branch near a stream in evergreen forest.

Boiga multomaculata (Boie, 1827) (Fig. 6F): An individual was observed at night while moving on the grass near a stream at the forest edge.

Calamaria pavementata Duméril, Bibron, and Duméril, 1854 (Fig. 6G): A road-killed individual was found in the morning on Road 102. The surrounding habitat was secondary forest.

Coelognathus radiatus (Boie, 1827) (Fig. 6H): An individual was observed in the afternoon while moving across Road 102.

Dendrelaphis pictus (Gmelin, 1789) (Fig. 6I): Two specimens were found in the afternoon near Road 102, an individual crawling on a tree branch and a road-killed individual on Highway 6. This is a new record for Xuan Nha NR.

Elaphe moellendorffi (Boettger, 1886) (Fig. 6J): An individual was observed in the afternoon near the entrance of a cave at the forest edge.

Elaphe taeniura (Cope, 1861) (Fig. 6K): An individual was observed in the morning near a large rock at the forest edge, and another individual was detected in an agricultural area. This is a new record for Xuan Nha NR.

Euprepiophis mandarinus (Cantor, 1842) (Fig. 6L): A road-killed individual was found in the morning on Highway 6. The surrounding habitat was evergreen forest.

Gonyosoma coeruleum Liu, Hou, Lwin, Wang, and Rao 2021 (Fig. 6M): A road-killed specimen (adult male) was found in the morning on Highway 6. The surrounding habitat was evergreen forest. This is the first record of this species in Vietnam. *Gonyosoma coeruleum* was recently described by Liu et al. (2021) from Yunnan Province, China. The new species closely resembles *G. prasinum* (Blyth), but it is differentiated from the latter species by having the precloacal plate divided, iris blue and inside of mouth greyish-white in life. Morphological characteristics of the specimen from Son La Province are as follows: Snout-vent length: 662 mm; tail length: 242 mm; head distinguished from neck; pupil rounded; rostral broader than high; internasals as wide as long; prefrontal shorter than length of frontal; frontal pentagonal; parietals longer than wide; nasal paired; loreal 1/1; supralabials 9/9, fourth to sixth entering orbit; infralabials 10/10, first to fifth bordering chin shields; preocular 1/1; postoculars 2/2; anterior temporals 2/2, posterior temporals 2/2; dorsal scale



Fig. 6. Snake species recorded in Xuan Nha Nature Reserve, Vietnam: (A) *Indotyphlops braminus*, (B) *Xenopeltis unicolor*, (C) *Ahaetulla prasina*, (D) *Boiga cyanea*, (E) *B. guangxiensis*, (F) *B. multomaculata*, (G) *Calamaria pavementata*, (H) *Coelognathus radiatus*, (I) *Dendrelaphis pictus*, (J) *Elaphe moellendorffi*, (K) *Elaphe taeniura*, (L) *Euprepiophis mandarinus*, (M) *Gonyosoma coeruleum*, (N) *G. frenatum*, (O) *Lycodon futsingensis*, (P) *L. meridionalis*, (Q) *Oligodon fasciolatus*, and (R) *Oreocryptophis porphyraceus*.



Fig. 7. Snake and turtle species recorded in Xuan Nha Nature Reserve, Vietnam: (A) *Ptyas korros*, (B) *Bungarus fasciatus*, (C) *Bungarus wanghaotingi*, (D) *Naja atra*, (E) *Sinomicrurus maccllellandi*, (F) *Psammodynastes pulverulentus*, (G) *Hebius chapaensis*, (H) *Rhabdophis nigrocinctus*, (I) *Rhabdophis helleri*, (J) *Trimerodytes percarinatus*, (K) *Pareas hamptoni*, (L) *Ovophis monticola*, (M) *Trimeresurus albolabris*, (N) *Platysternon megacephalum*, and (O) *Manouria impressa*.

rows 19–19–15; ventrals 198; cloacal scale paired; subcaudals 100, paired. Coloration in preservative: dorsal surface green; belly greenish (determination after Liu et al. 2021).

Gonyosoma frenatum (Gray, 1853) (Fig. 6N): A road-killed specimen was found in the afternoon on

Highway 6. The surrounding habitat was evergreen forest.

Lycodon futsingensis (Pope, 1928) (Fig. 6O): One specimen was found at night on the ground while moving near a stream in evergreen forest.

Lycodon meridionalis (Bourret, 1935) (Fig. 6P): A

road-killed specimen was found in the afternoon on Highway 6. The surrounding habitat was evergreen forest.

Oligodon fasciolatus (Günther, 1864) (Fig. 6Q): An individual was observed at night on the ground while moving across a forest trail, and a road-killed specimen was found on Highway 6. This is a new record for Xuan Nha NR.

Oreocryptophis porphyraceus (Cantor, 1839) (Fig. 6R): An individual was observed at night while moving on the roadside. The surrounding habitat was evergreen forest.

Ptyas korros (Schlegel, 1837) (Fig. 7A): Five individuals were found during the daytime on the ground or on tree branches near bamboo bushes, abandoned fields, and at the roadside near forest edge.

Elapidae

Bungarus fasciatus (Schneider, 1801) (Fig. 7B): An individual was observed at night near the ground by a stream at the forest edge.

Bungarus wanghaotingi Pope, 1928 (Fig. 7C): An individual was observed near a stream and another individual was observed in a rice field. The surrounding habitat was secondary forest. Previous records of *B. multicinctus* in Xuan Nha NR by Nguyen et al. (2010) and in Vietnam by Nguyen et al. (2009) should be re-identified as *Bungarus wanghaotingi* after Chen et al. (2021).

Naja atra Cantor, 1842 (Fig. 7D): An individual was observed in the afternoon on the ground, in a bamboo bush near Road 102. The surrounding habitat was the secondary forest.

Sinomicrurus macclellandi (Reinhardt, 1844) (Fig. 7E): A road-killed specimen was found in the morning on Highway 6. The surrounding habitat was evergreen forest.

Lamprophiidae

Psammodynastes pulverulentus (Boie, 1827) (Fig. 7F): An individual was observed at night on a tree branch near the forest edge.

Natricidae

Hebius chapaensis (Bourret, 1934) (Fig. G): One specimen was found at night in a stream in evergreen forest. This is a new record for Xuan Nha NR.

Rhabdophis nigrocinctus (Blyth, 1856) (Fig. 7H): One specimen was found in the afternoon while moving on the grass near a stream in secondary forest. This is a new record for Xuan Nha NR.

Rhabdophis helleri (Schmidt, 1925) (Fig. 7I): Individuals were found during the daytime on the ground or on grass near the roadside, and in rice fields. The

surrounding habitat was secondary forest and agricultural cultivation areas.

Trimerodytes percarinatus (Boulenger, 1899) (Fig. 7J): An individual was observed in the afternoon near a stream. The surrounding habitat was evergreen forest.

Pareatidae

Pareas hamptoni (Boulenger, 1905) (Fig. 7K): One specimen was found at night sitting on a tree branch in evergreen forest. This is a new record for Xuan Nha NR.

Viperidae

Ovophis monticola (Günther, 1864) (Fig. 7L): One specimen was found at night while moving across a forest trail in evergreen forest.

Trimeresurus albolabris Gray, 1842 (Fig. 7M): Specimens were observed during the daytime on tree branches at forest edges. The surrounding habitat was secondary forest and agricultural cultivation areas.

Testudines

Platysternidae

Platysternon megacephalum Gray, 1831 (Fig. 7N): An individual was observed at night under a rock in a stream. The surrounding habitat was evergreen forest.

Testudinidae

Manouria impressa (Guenther, 1882) (Fig. 7O): An individual was observed in the afternoon under a wet carpet of leaves in evergreen forest.

Discussion

The new findings in this study bring the number of amphibian and reptile species in Xuan Nha NR to 107, comprising 41 amphibian and 66 reptile species, of which 21 species are new records for Xuan Nha NR, one species is a new record for Son La Province, and one is recorded for the first time from Vietnam. *Gonyosoma coeruleum* was recorded for the first time from outside of China based on a single specimen collected from Son La Province, Vietnam. This species was recently described by Liu et al. (2021) from Yunnan Province, China. Because of morphological ambiguity between *G. coeruleum* and *G. prasinum*, previous records of *G. prasinum* in Vietnam should be re-examined to determine whether they are referable to *G. coeruleum* or are, in fact, true *G. prasinum*. *Hemiphyllodactylus bonkowskii* was recently described by Nguyen et al. (2020). Its original description was based on specimens found in Hoa Binh Province, with the type locality approximately 20 km from the new records in Xuan Nha NR.



Fig. 8. Threats to the herpetofauna in Xuan Nha Nature Reserve, Son La Province, Vietnam: (A) Slash and burn forest, (B) Illegal timber logging, (C) Domestic animal production in the forest, (D, E) Road-killed reptiles and amphibians on the road, and (F) Wildlife collection for food and trade.

Several of the records provided by Nguyen et al. (2010) were excluded from the list of Xuan Nha NR in this study, either because they were based on misidentifications or due to changes in taxonomy and/or nomenclature. For example, *Leptobranchella pelodytoides* was formerly reported from the nature reserve, but has since been assigned to a different taxon, and *L. pelodytoides* is considered to be restricted to Myanmar, southern China, and Thailand (Frost

2021). Previous records of *Leptobranchium chapaense*, *Amolops ricketti*, *Calotes mystaceus*, and *Bungarus multicinctus* in Xuan Nha NR, as reported by Nguyen et al. (2010), could be reidentified as *Leptobranchium masatakasatoi*, *Amolops cremnobatus*, *Calotes emma*, and *Bungarus wanghaotingi*, respectively. Some species were documented from Xuan Nha NR based on interview information only, viz. *Hylarana macrodactyla*, *Odorrana*

chloronota, *Physignathus cocincinus*, *Varanus salvator*, *Python molurus*, *Ptyas mucosa*, *Ophiophagus hannah*, *Hypsiscopus plumbea*, *Fowlea flavipunctatus*, *Cuora mouhotii*, *Geoemyda spengleri*, *Mauremys sinensis*, *Indotestudo elongata*, and *Palea steindachneri*. Nine other species (*Occidozyga lima*, *O. martensii*, *Hylarana taipehensis*, *Eutropis chapaensis*, *Amphiesma stolatum*, *Rhabdophis chrysargos*, *Trimeresurus stejnegeri*, *Cuora galbinifrons*, and *Sacalia quadriocellata*) were included in the list here based on the previous records of Nguyen et al. (2010).

In terms of habitat preferences, most of the amphibians and reptiles in this survey inhabit the evergreen forest (41 species, or 50% of the total recorded species), followed by disturbed secondary forest with 33 recorded species (40.24%), and agricultural areas with 19 recorded species (23.17%; Table 2).

Among the eight survey sites, Kho Hong has the highest level of species richness with 29 recorded species; followed by Lay forest with 26 species; the Hen Pin and Sao Do sites with 23 species; the Nga, Muong An and So Linh sites with 21 species; and Cong Troi with 15 species (Table 2). Both of the Kho Hong and Lay sites are located in the core zone of the Xuan Nha NR with a large area of evergreen forest (>3,000 hectares) and the habitat quality is relatively good. Therefore, the numbers of recorded species are higher than those of the other sites.

Concerning its herpetofaunal conservation status, the Xuan Nha NR harbors a high number of threatened species. Among the 107 species, 19 are listed in the Red Data Book of Vietnam (Dang et al. 2007), including three species categorized as CR, 10 as EN, and six as VU; 18 species are listed in the IUCN Red List (IUCN 2022), including six species categorized as CR, five as EN, five as VU, and two as NT; 14 species are listed in the Vietnam Governmental Decree No. 84/2021/ND-CP (2021), including three species in Group IB and 11 species in Group IIB; and 14 species are listed in the CITES appendices, including one species in Appendix I and 13 in Appendix II (Table 2). The major threats to the habitat and populations of amphibians and reptiles in the Xuan Nha NR are deforestation resulting from agricultural activities (Fig. 8A), illegal timber logging (Fig. 8B), free grazing of cattle in the forest (Fig. 8C), road construction (Fig. 8D–E), and wildlife poaching for food and trade (Fig. 8F).

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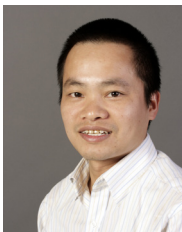
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Herpetofauna of Xuan Nha Nature Reserve, Vietnam



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