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THE SNAKE FAUNA OF LAOS WITH NEW PROVINCIAL RECORDS

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Nathanaël Maury[1], Patrick David[2*] & Somchit Sudavanh[3]

[1] *Chelonian Conservation Center Laos, World Encyclopedia of Herpetofauna, Vientiane, LAOS PDR; E-mail: nathanael.maury@gmail.com*
[2] *Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, Sorbonne Université, École Pratique des Hautes Études, Université des Antilles, CNRS, CP 30, 57 rue Cuvier, F-75005 Paris, France; E-mail: patrick.david@mnhn.fr*
[3] *Chelonian Conservation Center Laos, World Encyclopedia of Herpetofauna, Faculty of Natural Sciences of Laos University, Vientiane, LAOS PDR; E-mail: somchit.soudavanh@gmail.com*
**Corresponding author. E-mail: patrick.david@mnhn.fr*

Abstract
We add seventeen new provincial records for fifteen snake species of Laos with precise localities and elevations. These new records result from 45 independent surveys conducted at different times between the years 2016 and 2021 in all Laotian provinces except Attapu. In all field trips, we took a series of photographs that allowed us to prepare high-resolution photographic plates that then allowed us to identify all individuals down to species level. No specimen was killed and preserved. Here we provide the list of all new localities of snakes photographed during our surveys. We discuss potential systematic problems and the biogeographic implications of these new provincial records.

Key words: Distribution, Indochinese Region, geography, Southeast Asia, Sundaland, taxonomy

Introduction

The Lao People's Democratic Republic, here referred to simply as "Laos", is entirely landlocked between five other sovereign states, namely, from clockwise, Myanmar, the People's Republic of China, Vietnam, Cambodia, and Thailand. With the exception of the long, lowland area through which the Mekong River flows, the country's landscape consists mostly of rugged highlands, dissected by steep, narrow valleys. About 90 % of the country consists of thickly forested hills and mountains. The northern part of the country comprises a series of high plateaus, mainly covered with shallow lateritic soils and dissected by numerous valleys and karst formations. The physiogeography and the various climates present in the country are the basis of a rich biodiversity (Stuart 1999).

According to our unpublished data, currently 126 species of snakes are known from Laos. This number excludes several species mentioned from this country by Uetz *et al*. (2022; last accessed on 1 September 2022), such as *Asthenodipsas laevis* (H. Boie *in* F. Boie, 1827),

Boiga kraepelini Stejneger, 1902, *Naja atra* Cantor, 1842, and others. These mentions either result from misidentifications or are not supported by voucher specimens. Long neglected, the natural heritage of Laos has been the subject of numerous sustained and growing investigations for more than two decades. Stuart (1999) proposed an initial list of 58 species of amphibians and 108 species of reptiles. Eleven years later, Teynié & David (2010) compiled a list of 180 reptile species known to be present in Laos, including 104 species of snakes. Since then, the number of species recorded in Laos has continued to grow. The major recent publications dealing with the reptile or snake fauna of Laos are (in chronological order) Stuart (1999), Teynié *et al*. (2004), Bain *et al*. (2007a–b), Teynié & David (2007), Stuart & Heatwole (2008), Teynié & David (2010), David *et al*. (2012), Teynié & David (2014), Teynié *et al*. (2014), Luu *et al*. (2015), Teynié *et al*. (2017), Luu *et al*. (2018), Brakels & Nguyen (2020), Fukuyama *et al*. (2020), Nguyen *et al*. (2020a–c), Brakels *et al*. (2021a–j), Lee (2021), David *et al*. (2022) and Lottier & David (2022). We also took into account numerous unpublished data obtained by Alexandre Teynié, here cited as personal communications, during his numerous trips after those conducted between 2003 and 2014 which were described in Teynié *et al*. (2014).

Despite these numerous publications based on extensive surveys, the reptile fauna of Laos remains poorly known compared with that of adjacent countries like Vietnam and Thailand. In this paper, we present seventeen new provincial records of snake species, mainly in the north and west of the country. In each province, we surveyed areas comprising various types of habitats such as evergreen primary forest, secondary forest, limestone or karst forest, and wetland forest. We released all specimens immediately after having taken the pictures at the places where they were collected.

Material and Methods

Field surveys were conducted from 2016 to 2021 in seventeen out of the eighteen Laotian provinces, including Vientiane Prefecture. The exception was the province of Attapu. Geographic coordinates and elevations were obtained using a Garmin GPSMAP 64s GPS receiver (USA). The names of provinces (Fig. 1) follow the spellings used in McCoy (2003). Since the transcription of Laotian names into the Roman alphabet is not standardized, the geographic names of villages are phonetically transcribed.

Figure 1. Administrative divisions of Laos (provinces and Vientiane Prefecture): **1** Phôngsali; **2** Louangnamtha; **3** Oudômxay; **4** Louangphrabang; **5** Houaphan; **6** Bokèo; **7** Xaignabouli; **8** Xiangkhoang; **9** Vientiane (Province); **10** Xaisomboun; **11** Bolikhamxai; **12** Vientiane Prefecture; **13** Khammouan; **14** Savannakhét; **15** Salavan; **16** Xékong; **17** Champasak; **18** Attapu

The specimens were observed during field trips conducted by Nathanaël Maury and Somchit Sudavanh on both sunny and rainy days, mostly at night but also during daytime. For identification purposes, specimens were photographed in situ using a digital camera (Canon 5DRS, Sony Alpha 7 RIII or Sony Alpha 7R 4I). Using the raw pictures, we created Identification Plates (ID Plates) which regrouped all pictures of the same species on one plate. The full size of an ID plate, expressed in number of pixels varies from 150 to 400 megapixels. This very high definition is useful for recording scale counts, especially the numbers of ventral and subcaudal scales of the individual, and any detail of its morphology.

Shortly after capture, all specimens were photographed using the same protocol. The living snake was placed on a white background. We took pictures from different angles to show the head from face on, side on and from the top; for the body, we photographed the complete dorsal and ventral surfaces. Besides these five pictures, when necessary, we took additional pictures of some behavioral characteristics.

The new provincial records are described in detail. For each of them, we mention: (1) the new record, then the name of the province, followed by the locality and its geographic coordinates; (2) The ecological data on the photographed specimen, if recorded; (3) Geographic comments on the distributional range of the species in Laos; and (4) Systematic comments, when appropriate.

Abbreviations. NPA, National Protected Area; a.s.l., above sea level.

Results

TYPHLOPIDAE

Argyrophis diardii (Schlegel, 1839)
(Figs. 2A–D)

New record. Bolikhamxai Province. Phou Khao Khouay NPA (18°15.889'N, 103°04.558'E).

Ecology. The specimen was found at night while it was moving in the leaf litter on the floor of a secondary forest at an elevation of 400 m a.s.l.

Distribution. Previously, based on Deuve (1970) and Teynié & David (2010), this species was known from the provinces of Champasak, Houaphan and Xiangkhoang. Our new record fills a wide gap in adding a locality in central Laos. This species is probably present throughout Laos.

Systematics. This species, widely known as *Typhlops diardii* in the literature, was referred to the new genus *Asiatyphlops* by Hedges *et al*. (2014: 35) along with twelve other species. However, Pyron & Wallach (2014) showed that the genus *Asiatyphlops* was an objective junior synonym of *Argyrophis* Gray, 1845. *A. diardii* has long been confused with *Typhlops muelleri* Schlegel, 1839. Taylor (1965) restricted *Argyrophis muelleri* to the regions of southern Thailand and the Sundaland. *Argyrophis diardii* is monotypic.

XENOPELTIDAE

Xenopeltis unicolor F. Boie, 1827
(Figs. 2E–H)

New record. Salavan Province. Phou Xiang Thong NPA (15°27.459'N, 105°44.463'E).

Ecology. The specimen was found at night, in the riverbed of a half-dried river. The area was composed of large rocks on a substrate made of gravels and sand at an elevation of 220 m a.s.l.

Distribution. This wide-ranging species is present throughout Laos. Based on Deuve (1970), Stuart (1999), Teynié *et al*. (2004), Teynié & David (2010) and unpublished observations, this species was previously known from the provinces of Bolikhamxai, Champasak, Louangphrabang, Phôngsali, Vientiane, Vientiane Prefecture, Xaignabouli, Xékong and Xiangkhoang. Our new record fills a gap in southern Laos.

Systematics. This species is currently monotypic. Orlov *et al*. (2022) described a new species, *Xenopeltis intermedia* (as *X. intermedius*), from the highlands of central Vietnam. The occurrence of this species in south-eastern Laos is possible.

COLUBRIDAE

Boiga cyanea (Duméril, Bibron & Duméril, 1854)
(Figs. 3A–D)

New record. Bokèo Province. Nam Kan Protected Area (20°29.008'N, 100°45.251'E).

Ecology. The specimen was found at night perched in a low tree 1.5 meter above the ground in primary forest at an elevation of 530 m a.s.l.

Distribution. This wide-ranging species is present throughout Laos. Based on Deuve (1970), Stuart (1999), Teynié & David (2010), Nguyen *et al*. (2020a) and unpublished observations, this species was previously known from the provinces of Champasak, Khammouan,

Oudômxay, Savannakhét Vientiane, Vientiane Prefecture, Xaignabouli and Xékong. Our new record fills a gap in western Laos.

Systematics. This species is currently monotypic.

Lycodon capucinus F. Boie, 1827
(Figs. 3E–H)

New record. Vientiane Prefecture. Turtle Farm, Ban Khok Hae, near Ban Phialad (18°11.415'N, 102°12.800'E).

Ecology. The specimen was found on the ground at night near habitations, in a highly disturbed area with some bushy patches, at an elevation of 230 m a.s.l.

Distribution. In Laos, this wide-ranging species was previously known only from Bolikhamxai Province (Luu *et al*. 2018) in which a specimen was recorded from Phou Khao Khouay NPA. Our new record extends the Laotian range of this species westward.

Systematics. *Lycodon capucinus* has long been considered either a synonym of *Lycodon aulicus* Linnaeus, 1758 or a subspecies of this latter species. Taylor & Elbel (1958) raised the taxon *capucinus* to full species status because the taxa *aulicus* and *capucinus* are sympatric in a part of their range, for example in Myanmar. They were followed by the great majority of recent authors. We refer to Vogel & Harikrishnan (2013), Wallach *et al*. (2014) and Ganesh & Vogel (2018) for discussions about its status as a valid species distinct from *L. aulicus*.

Systematics. *Lycodon capucinus* is currently monotypic.

Ptyas carinata (Günther, 1864)
(Figs. 4A–E)

New record. Oudomxay Province. Nam Kat Yorla Pa Resort, near Nam Nga River (20°42.529'N, 102° 06.759'E).

Ecology. The specimen was found at night sleeping on a thin branch of a tree four meters above the ground. The environment was a secondary forest at an elevation of 800 m a.s.l.

Distribution. Deuve (1970) did not mention this species from Laos, even as a possible occurrence. Its presence in this country was mentioned by Nguyen *et al*. (2009) but without a specified locality. The first confirmed record of *Ptyas carinata* from Laos, based on a specimen from Bokèo Province, was published by Nguyen *et al*. (2020b). This species has also been recorded from Xaignabouli Province. It may also occur in other parts of the Mekong valley. Our new record extends the range of this species in western Laos and makes a connection with the populations of eastern Thailand, a country in which this large species is widespread. *Ptyas carinata* is the largest Asian colubrid snake as its maximum total length is 399 centimeters (Das 2012).

Systematics. The description of this species has constantly been credited to Günther (1858) but as shown by Dubois & David (2020), the nomen created by this author, although widely used, is not valid as it is an invalid objective junior synonym of *Coluber dhumnades* Cantor, 1842. The first valid description appeared in Günther (1864). *Ptyas carinata* is monotypic.

Ptyas mucosa (Linnaeus, 1758)
(Figs. 4F–I)

New record. Vientiane Prefecture. The Turtle Farm, Ban Khok Hae, near Ban Phialad (18°11.415'N, 102° 12.800'E).

Ecology. The specimen was found at night while it was sleeping 1.5 meters above the ground in a patch of bush near human habitations, at an elevation of 230 m a.s.l. Previously, the same animal had been spotted moving on the floor countless times during the day.

Distribution. This species has been recorded from the north, centre and south of the country. Based on the data given by Deuve (1970), Stuart (1999), Teynié *et al*. (2004) and Teynié & David (2010), *Ptyas mucosa* was previously known from the provinces of Bolikhamxai, Champasak, Khammouan, Louangphrabang, Vientiane and Xiangkhoang. Our new record adds a locality in the valley of the Mekong River.

Systematics. *Ptyas mucosa* is monotypic.

ELAPIDAE

Bungarus candidus (Linnaeus, 1758)
(Figs. 5A–D)

New record. Vientiane Prefecture. The Turtle Farm, Ban Khok Hae, near Ban Phialad (18°11.415'N, 102°12.800'E).

Ecology. The specimen was found at night foraging on a concrete path in an enclosure of secondary forest at an elevation of 230 m a.s.l.

Distribution. This species was previously known only from the provinces of Champasak and Salavan in the south of the country (Stuart 1999; Teynié & David 2010; Nguyen *et al*. 2020a). We present here the first unambiguous record from Vientiane Prefecture, in northern

Laos. Based on Chen *et al*. (2021) and examined specimens, records of *Bungarus candidus* from other parts of Laos refer to *Bungarus wanghaotingi* Pope, 1928, including the specimen cited by Nguyen *et al*. (2020a) from Vientiane Province.

Systematics. Chen *et al*. (2021) revised the complex of *Bungarus candidus* / *B. multicinctus* / *B. wanghaotingi* based on both morphology and molecular phylogenies. They confirmed the validity of these three taxa at species level and that the records of *B. candidus* from China, central and northern Vietnam and northern Laos should be referred to *B. wanghaotingi*. Nevertheless, we here confirm that *Bungarus candidus* also occurs in northern Laos. This species is monotypic.

NATRICIDAE

Hebius chapaensis (Bourret, 1934)
(Figs. 5E–I)

New record. Vientiane Province. In the hills in the north-west of Vang Vieng, 19°00.561'N-102°17.446'E.

Ecology. The specimen was found at night in the steep rocky riverbed of a small stream surrounded by secondary forest at an elevation of 890 m a.s.l.

Distribution. Teynié *et al.* (2014b) published the first record of this species in Laos. Based on this latter reference, on Ren *et al*. (2018), Nguyen *et al*. (2020a) and David *et al*. (2021), *Hebius chapaensis* is currently known from five localities spread over four provinces in the north of the country, namely Houaphan, Louangphrabang, Vientiane and Xaisomboun.

Systematics. This species was described as *Pararhabdophis chapaensis* Bourret, 1934. Subsequently, based on molecular data, Kizirian *et al*. (2018) showed that the genus *Pararhabdophis* Bourret, 1934 is a synonym of *Hebius* Thompson, 1913. For a long time, this rare species has been known from its sole holotype, collected in north-western Vietnam. Following Teynié *et al.* (2014b), David *et al*. (2021) examined ten preserved specimens, of which three originated from Laos.

Hebius khasiensis (Boulenger, 1890)
(Figs. 6A–D)

New record. Oudômxay Province. Nam Kat Yorla Pa Resort, near Nam Nga River (20°42.597'N, 102°06.594'E).

Ecology. The specimen was found at dusk in a grassy area that is used as pasture by sheep, not far from secondary forest at an elevation of 770 m a.s.l.

Distribution. This species was previously known only from Phôngsali Province (Teynié & David 2010). The new record constitutes a range extension of about 125 kilometers southward.

Systematics. David *et al*. (2013) showed that many authors since Smith (1943) had confused *H. khasiensis* and *H. boulengeri* (Gressitt, 1937). Records of "*Amphiesma khasiense*" from eastern and southern Laos found in the literature (Smith 1943; Deuve 1970) refer to *Hebius boulengeri*. *Hebius khasiensis* is monotypic.

PAREIDAE

Pareas formosensis (Van Denburgh, 1909)
(Figs. 6E–H)

New record. Xékong Province. Ban Dakchung (15°28.760'N, 107°09.291'E).

Ecology. The specimen was found at night in the low branches of a shrub half a meter above the ground in a secondary montane forest at an elevation of 1,410 m a.s.l.

Distribution. Based on Ding *et al*. (2020), Wang *et al*. (2020) and our material, *Pareas formosensis* was previously known only from the provinces of Champasak and Khammouan. Our new record fills, in part, a wide gap in eastern Laos, along the Truongson Mountain Range.

Systematics. You *et al*. (2015) and Bhosale *et al*. (2020) showed that most populations of south-eastern China and Vietnam, and implicitly northern Laos, referred to as *Pareas hamptoni* (Boulenger, 1905) in the literature, are not conspecific with the holotype, originating from "the neighbourhood of Mogok, Upper Burma", namely Mogok, Mandalay Region, Myanmar, and other populations of *P. hamptoni* inhabiting Myanmar but are indeed referable to *Pareas formosensis* (Van Denburgh, 1909), previously considered endemic to Taiwan. Ding *et al*. (2020) revised the *Pareas hamptoni*-complex. They confirmed that *Pareas hamptoni* inhabits only Myanmar and the province of Lao Cai in north-western Vietnam and stated that it might also be present in Yunnan Province, People's Republic of China. These authors described another species from Yunnan Province, *Pareas geminatus* Ding *et al.* (2020). This new species has also been recorded from Houaphan Province in northern Laos by Ding *et al*. (2020). As a consequence of these revisions and our unpublished materials, populations of *Pareas*

hamptoni (Boulenger, 1905), cited from Laos by Deuve (1970), Stuart (1999), Teynié *et al*. (2014b) and Nguyen *et al.* (2020a), should now be identified either as *P. formosensis* or as *P. geminatus*. *Pareas formosensis* is monotypic.

Pareas macularius Theobald, 1868
(Figs. 7A–D)
New record. Oudômxay Province. Nam Kat Yorla Pa Resort, near Nam Nga River (20°40.610'N, 102°06.180'E).

Ecology. The specimen was found at night in the low branches of a shrub only 10 centimeters above the ground in a secondary forest at an elevation of 1,070m a.s.l.

Distribution. This species has been recorded from scattered localities across the whole of Laos. It was previously first mentioned from "Xieng-Khouang Province" by Deuve (1970), under the name *Amblycephalus andersonii* (Boulenger, 1888), now a valid, distinct species. Based on Hauser (2017), Nguyen *et al*. (2020a), Vogel *et al*. (2020) and our material, *Pareas macularius* was previously known from the provinces of Champasak, Houaphan, Louangphrabang, Phôngsali, Xaisomboun and Xiangkhoang. Our new record fills a gap in northern Laos.

Systematics. Hauser (2017), Vogel *et al*. (2020) and Wang *et al*. (2020) confirmed the validity of this species that has sometimes been considered a synonym of *Pareas margaritophorus* (Jan *in* Bocourt, 1866). *Pareas macularius* is monotypic.

PSEUDASPIDIDAE

Psammodynastes pulverulentus (H. Boie *in* F. Boie, 1827)
(Figs. 7E–H)
New record. Vientiane Province. Fifteen km north of Vang Vieng (18°58.344'N, 102°24.916'E).

Ecology. The specimen was found at night perched on a small tree 5 meters above the ground in the middle of a fast-flowing stream surrounded by secondary forest at an attitude of 430 m a.s.l.

Distribution. This common species is widespread throughout Laos. Based on Deuve (1970), Stuart (1999), Teynié & David (2010, 2014) and of our material and observations, *Psammodynastes pulverulentus* was previously known from the provinces of Attapu, Champasak, Khammouan, Louangphrabang, Savannakhét and Xiangkhoang, and of Vientiane Prefecture, in the vicinity of Vientiane City.

Systematics. The familial position of this genus is far from being consensual. It has variously been considered a member of Natricinae or Lamprophiidae *incertae sedis*. Eventually, Zaher *et al*. (2019) confirmed the validity of the family Pseudaspididae and included in it the genus *Psammodynastes* Günther, 1858. *Psammodynastes pulverulentus* is currently divided into two subspecies of which only the nominative one occurs in Laos and the Indochinese Region.

VIPERIDAE

Ovophis makazayazaya (Takahashi, 1922)
(Figs. 8A–H)
New records. Louangphrabang Province. Near Phoukoune (19°25.008'N, 102°25.036'E); Oudômxay Province. Nam Kat Yorla Pa Resort, near Nam Nga River (20°40.654'N, 102°05.935'E).

Ecology. The first specimen was found on the ground in the leaf litter of a secondary forest. The second specimen was obtained by a villager in a secondary forest at an elevation between 1,000 and 1,200 m a.s.l.

Distribution. This species is widespread throughout eastern, southeastern and central China and reaches just into northern Vietnam. It was first mentioned from Laos by Teynié *et al*. (2014b) based on three specimens from Houaphan Province. This locality was at the time outside of the recognized range of *O. makazayazaya* (Malhotra *et al*. 2011a: Suppl., Fig. G1). However, the paired subcaudals, the presence of 9 or 10 supralabials, of which the 4th one is the largest, and the number of ventrals, were indeed typical of *O. makazayazaya*. Our new records of this species greatly extend westward its range in Laos. It is obviously widespread in the highlands of the north of the country.

Systematics. We refer to Malhotra *et al*. (2011a) and David & Vogel (2012) for the systematics of the complex of the brown mountain pitvipers related to the *Ovophis monticola* species complex that is now divided into five species, as follows: *Ovophis monticola* (Günther, 1864), *Ovophis convictus* (Stoliczka, 1870), *Ovophis makazayazaya* (Takahashi, 1922), *Ovophis zayuensis* Jiang *in* Djao & Jiang, 1977, and *Ovophis tonkinensis* (Bourret, 1934). *Ovophis monticola* is known from Champasak Province, in southern Laos (Teynié & David

Plate 23

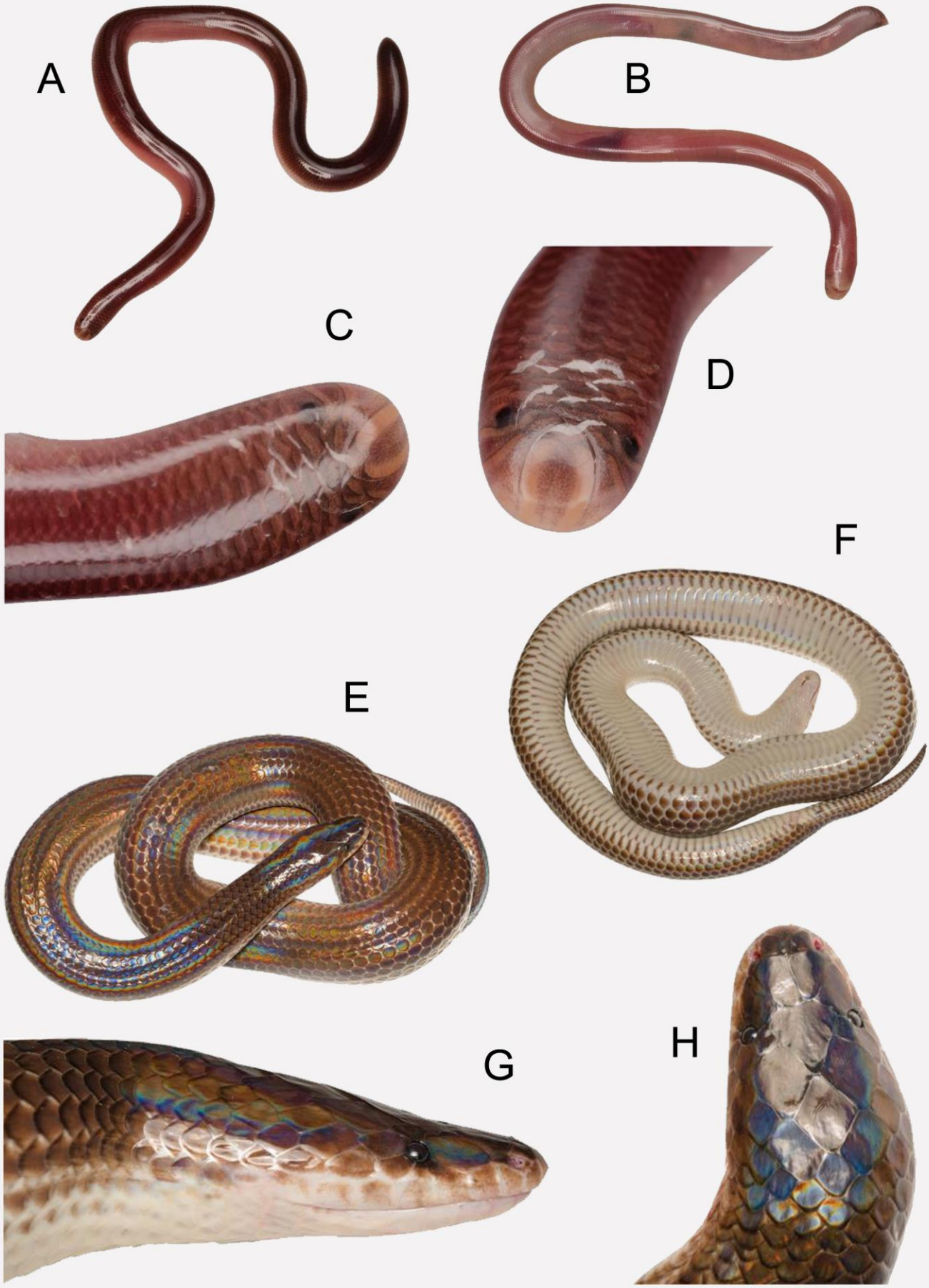

Figure 2. *Argyrophis diardii*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** dorsal, **(D)** frontal views of the head; *Xenopeltis unicolor* **(E)** dorsal, **(F)** ventral views of the full body and **(G)** lateral (right side), **(H)** dorsal views of the head © Photo: Nathanaël Maury

Plate 24

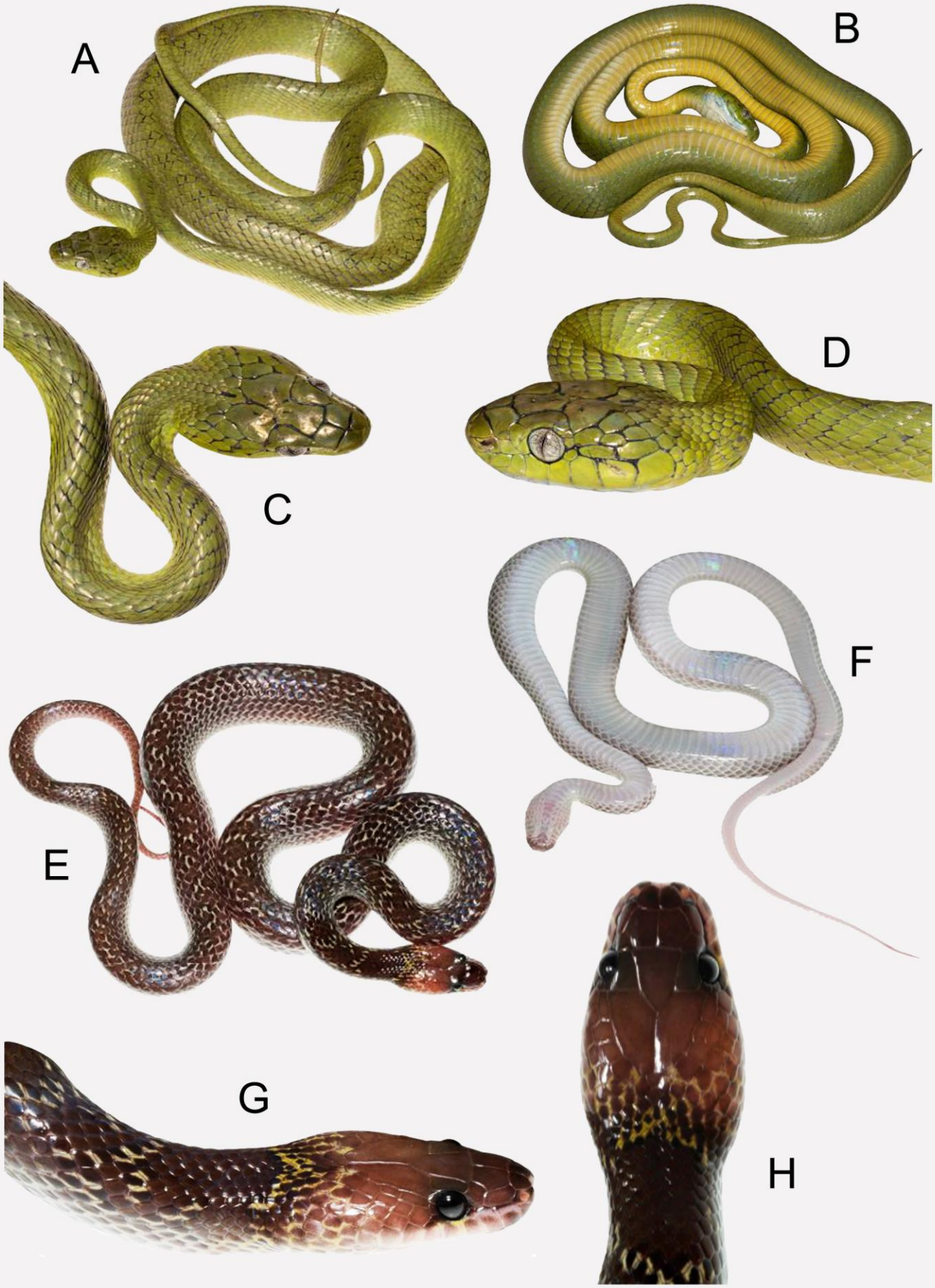

Figure 3. *Boiga cyanea*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** dorsal, **(D)** lateral (left side) views of the head; *Lycodon capucinus* **(E)** dorsal, **(F)** ventral views of the full body and **(G)** lateral (right side) **(H)** dorsal views of the head © Photo: Nathanaël Maury

Plate 25

Figure 4. *Ptyas carinata*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** lateral (right side), **(D)** frontal, **(E)** dorsal views of the head; *Ptyas mucosus* **(F)** dorsal, **(G)** ventral views of the full body and **(H)** lateral (right side), **(I)** dorsal views of the head © Photo: Nathanaël Maury

Plate 26

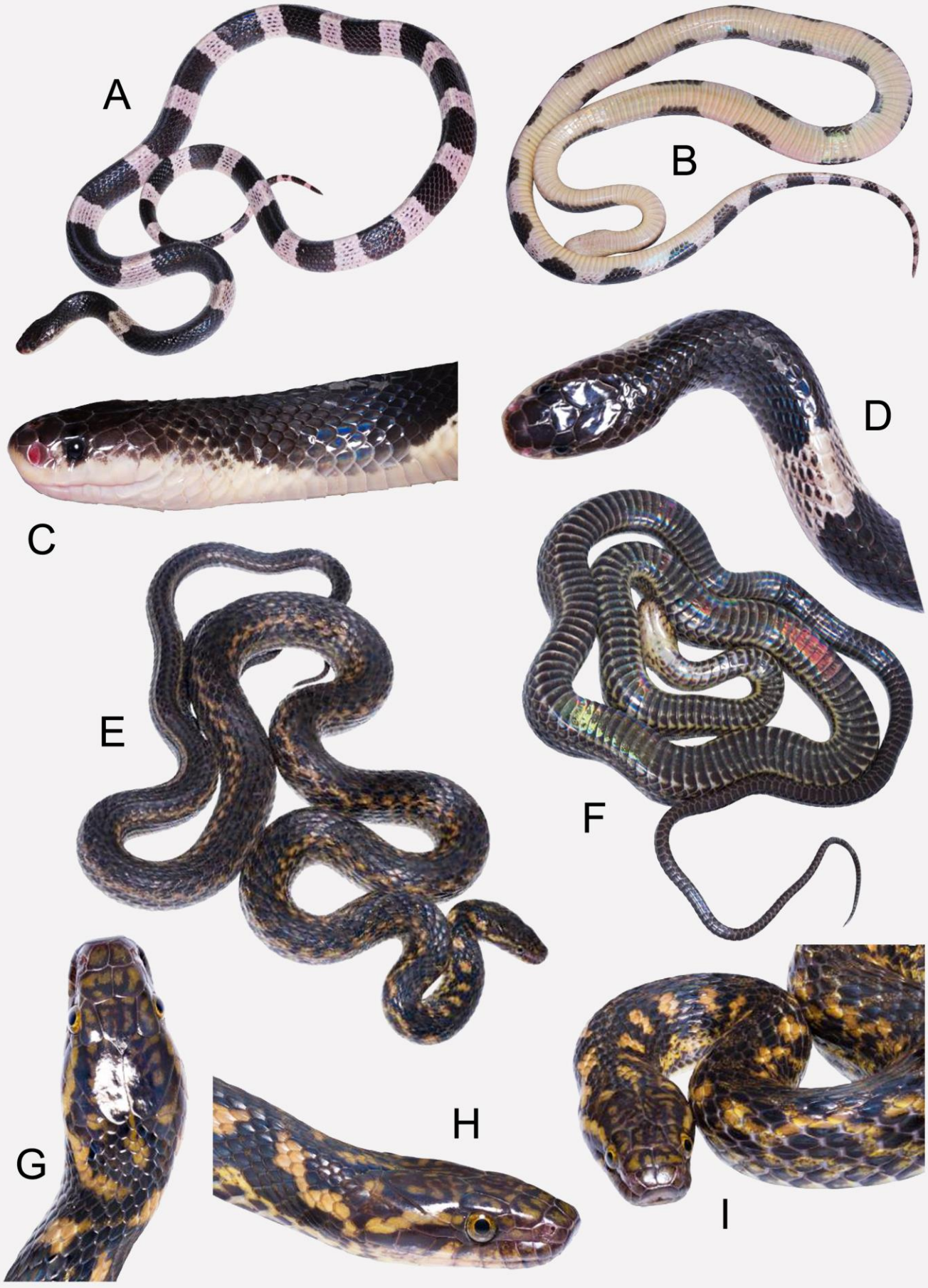

Figure 5. *Bungarus candidus*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** lateral (left side), **(D)** dorsal views of the head; *Hebius chapaensis* **(E)** dorsal, **(F)** ventral views of the full body and **(G)** dorsal, **(H)** lateral (right side), **(I)** frontal views of the head © Photo: Nathanaël Maury

Plate 27

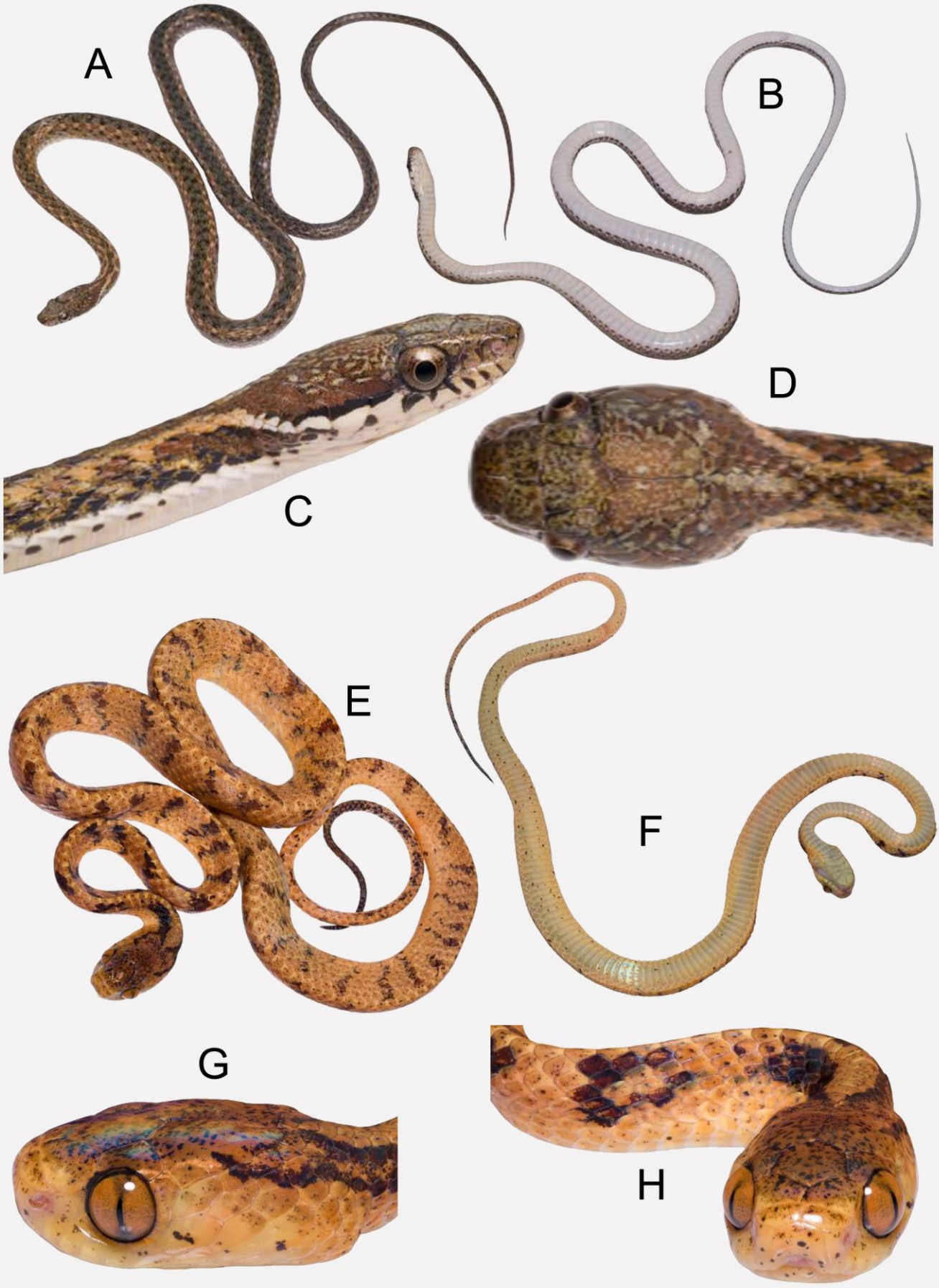

Figure 6. *Hebius khasiensis*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** lateral (right side), **(D)** dorsal views of the head; *Pareas formosensis* **(E)** dorsal, **(F)** ventral views of the full body and **(G)** lateral (leftside), **(H)** frontal views of the head © Photo: Nathanaël Maury

Plate 28

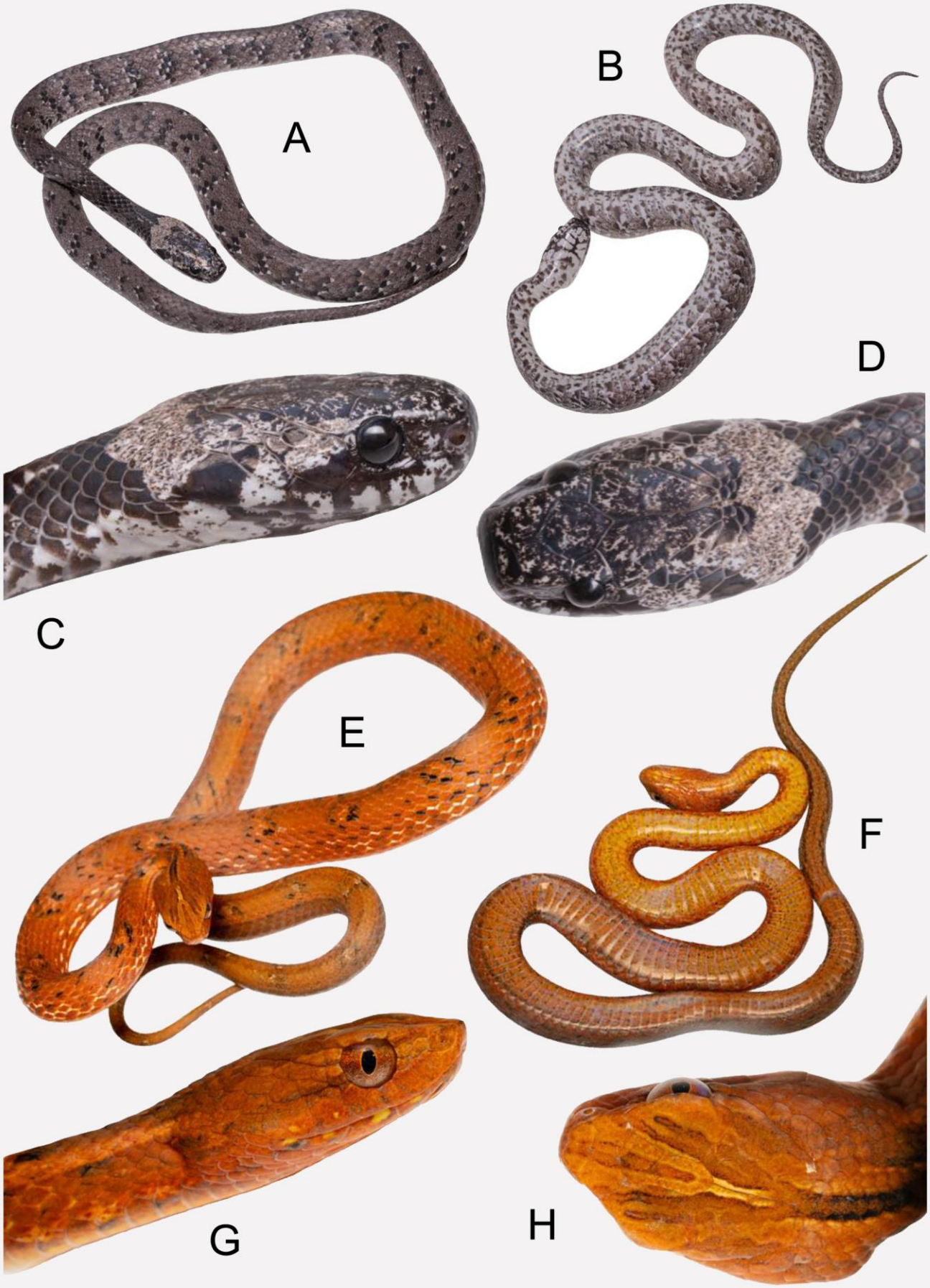

Figure 7. *Pareas macularius*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** lateral (right side), **(D)** dorsal views of the head; *Psammodynastes pulverulentus* **(E)** dorsal, **(F)** ventral views of the full body and **(G)** lateral (right side), **(H)** dorsal views of the head © Photo: Nathanaël Maury

Plate 29

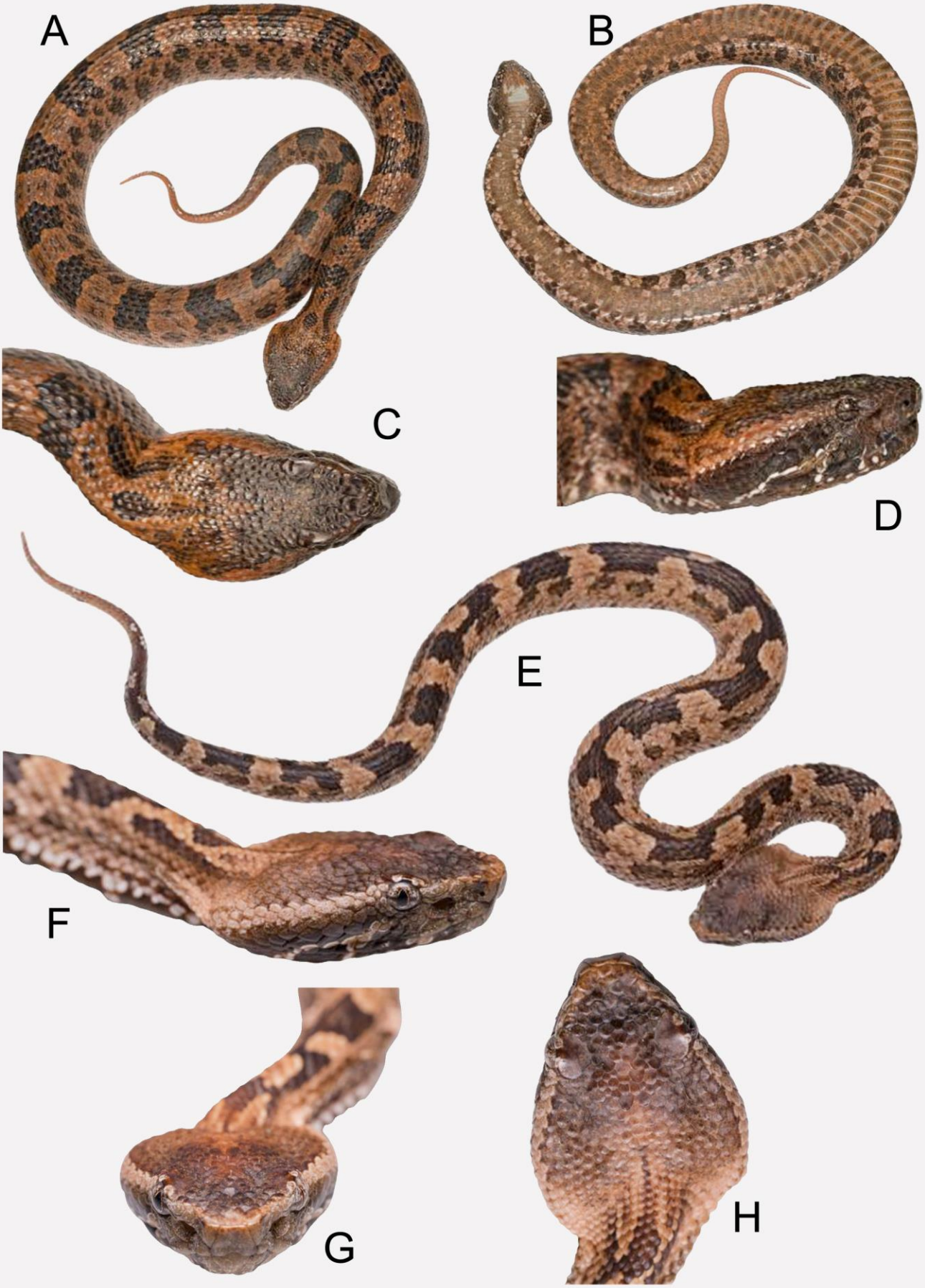

Figure 8. *Ovophis makazayazaya*: from Louangphrabang Province **(A)** dorsal, **(B)** ventral views of the full body and **(C)** dorsal, **(D)** lateral (right side) views of the head; from Oudômxay Province **(E)** dorsal view of the full body and **(F)** lateral (right side), **(G)** frontal, **(H)** dorsal views of the head © Photo: Nathanaël Maury

Plate 30

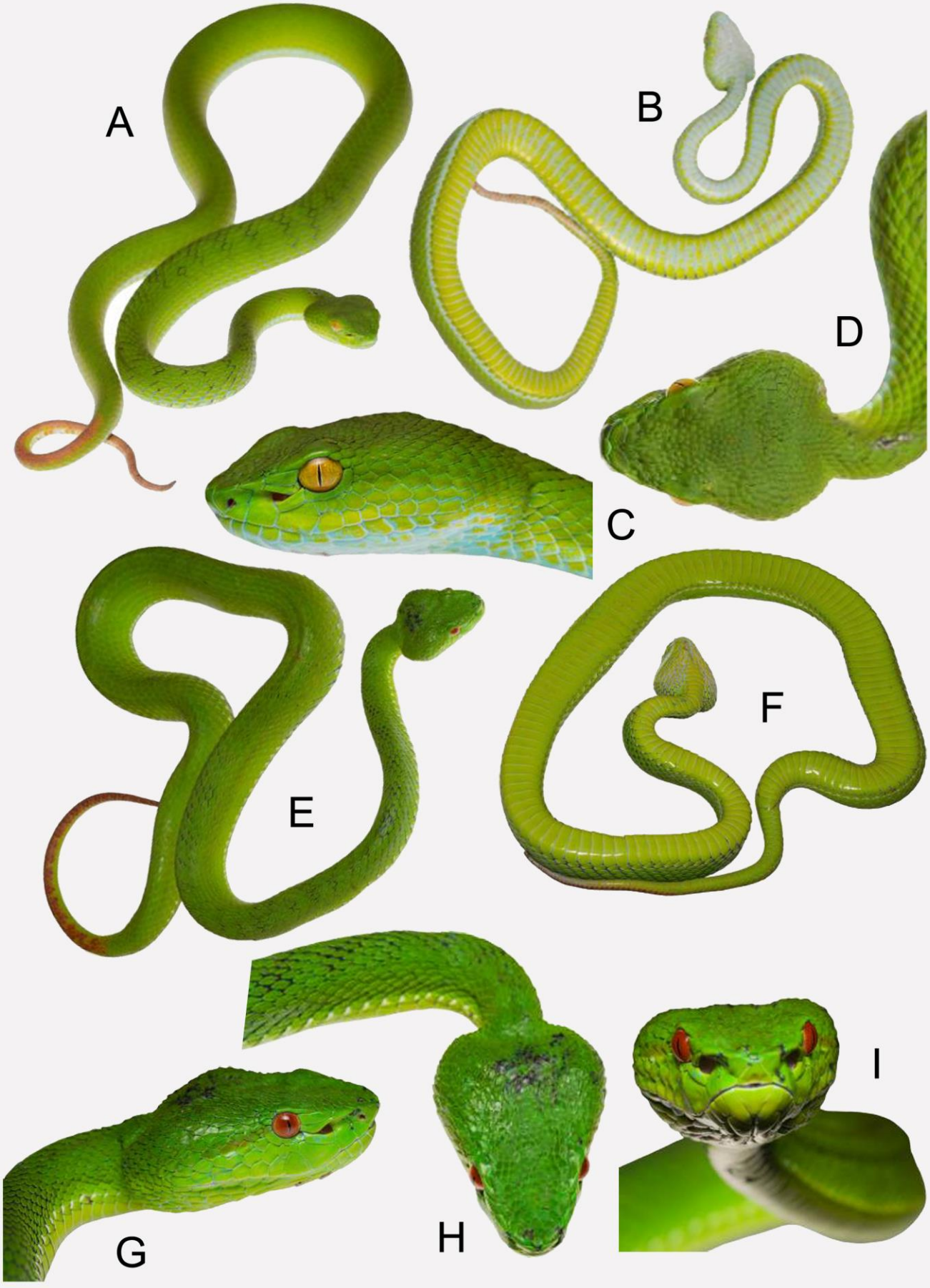

Figure 9. *Trimeresurus macrops*: **(A)** dorsal, **(B)** ventral views of the full body and **(C)** lateral (left side), **(D)** dorsal views of the head; *Trimeresurus popeiorum* **(E)** dorsal, **(F)** ventral views of the full body and **(G)** lateral (right side), **(H)** dorsal, **(I)** frontal views of the head © Photo: Nathanaël Maury

2010) while *O. tonkinensis* might also be present on the western slopes of the Truongson Mountain Range in eastern Laos. All these species are dangerously venomous; see, for example, Pandey *et al*. (2021). *Ovophis makazayazaya* is monotypic.

Trimeresurus macrops Kramer, 1977
(Figs. 9A–D)
New record. Xaignabouli Province. Near Nam Phauy (18°56.557'N, 101°29.990'E).

Ecology. A few specimens were found at night perched in trees at heights from 0.5 to 8 meters along small rivers in secondary forest at elevations between 400 to 550 m a.s.l.

Distribution. Teynié *et al*. (2004) published the first record of *Trimeresurus macrops* from Laos, a species previously known from Thailand, Cambodia and Vietnam. Vietnamese populations were subsequently referred to another species, *Trimeresurus rubeus* (Malhotra *et al.* 2011). In Laos, *T. macrops* seems to be widespread in the basin of the Mekong River. Following Teynié & David (2004, 2010, 2014) and Malhotra *et al.* (2011b), *Trimeresurus macrops* was previously known from the following provinces in southern and central Laos: Bolikhamxai, Champasak, Khammouan, Vientiane and Xékong. Our new record from Xaignabouli Province expands northward by about 150 kilometers the range of this species in this country.

Trimeresurus popeiorum Smith, 1937
(Figs. 9E–I)
New records. Oudômxay Province. A locality in Muang Xay District (20°39.598'N, 102°04.241'E); Xaignabouli Province. Nam Phouy NPA (18°56.559'N, 101°29.843'E); Nam Hong (Hong Stream) (19°04.764'N, 101°24.281'E).

Ecology. Many specimens were found during the day and at night between 450 m to 1,300 m a.s.l. The density may be very high as we found up to 25 individuals in a single evening. It is common to find over 15 individuals at the same place in secondary forest but the species is more abundant near streams and water bodies. Snakes are perched high in trees, between about 2 and 10 meters during dry days, where they are probably resting. At night, especially during the rainy nights, specimens are found much closer to the ground, at heights between 10 cm and 2 meters.

Distribution. Previously, based on Vogel *et al*. (2004), Anonymous (2013), Nguyen *et al*. (2020a) and our material, *Trimeresurus popeiorum* was only known from the provinces of Louangphrabang, Phôngsali and Vientiane. Our new records fill two gaps in its distribution range. This venomous species seems to be present throughout the north and north-west of Laos.

Discussion

Our observations reported here add seventeen new provincial records covering fifteen snake species. Nevertheless, the poor knowledge of the Laotian herpetofauna remains obvious. According to our unpublished data, only nine snake species have been recorded from Attapu Province, ten in Bokèo and only five in Salavan Province. These low numbers obviously result from a lack of surveys. In contrast, the fauna of some provinces, especially Champasak (63 species), Khammouan (56) and Xiangkhoang (51) are much better known. Despite that we cannot yet consider their snake faunas as completely known.

Here we significantly increased the distribution ranges in Laos of two venomous species, *Bungarus candidus* and *Ovophis makazayazaya*. *B. candidus* was previously known only from the provinces of Champasak and Salavan in the south of the country. Its discovery in Vientiane Prefecture suggests that it may be present in the lowlands of the valley of the Mekong River and use this corridor to reach northern Laos. It should be searched for in this valley.

As far as *O. makazayazaya* is concerned, its wide range in the highlands of northern Laos suggests that Laotian populations are connected with populations of this species inhabiting Yunnan Province in southwestern China.

Laos has very diverse types of habitats, and they are currently not all researched properly. With more surveys, especially in remote areas like parts of the Phôngsali and Xiangkhoang provinces, we expect to find new records, not only at provincial level but also new for the country, and, possibly, species new to science.

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