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Research article

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Resurrection of *Pareas yunnanensis* (Vogt, 1922) with description of a new species of *Pareas* from Yunnan Province, China (Squamata, Pareidae)

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Abstract. Based on molecular and morphological data of four specimens of *Pareas* Wagler, 1830 collected from the type locality of *P. yunnanensis* (Vogt, 1922), along with examination of the type specimens of *P. yunnanensis*, we revalidate this poorly known, secretive species. Furthermore, based on molecular

and morphological lines of evidence we also describe a new species of *Pareas* from Xishuangbanna Prefecture, Yunnan Province, China. Morphologically, the new species closely resembles its sister species *P. nigriceps* Guo & Deng, 2009. However, the new species is divergent from the latter in cytochrome b mtDNA gene sequences, and can be distinguished from all congeners by the following combination of morphological characteristics: single preocular, postocular fused with subocular, loreal not bordering orbit, vertebral scales enlarged, 3–5 rows of mid-dorsal scales keeled at the middle of the body, ventral scales 160–171; subcaudals 62–64, dorsal surface of head solid black or reddish-brown, dark nuchal band present, iris brownish-black or reddish-brown.

Keywords. Dali, Menghai, slug-eating snakes, synonymy, taxonomy.

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Introduction

Pareas Wagler, 1830 is a genus of small and slender arboreal nocturnal snakes with a blunt snout, missing mental groove, and no teeth on the anterior part of maxillary, as they feed on snails or slugs; they are also known as snail-eating or slug-eating snakes (Hoso *et al.* 2007; Wallach *et al.* 2014; You *et al.* 2015; Poyarkov *et al.* 2022). The genus *Pareas* now contains 26 recognized species (Le *et al.* 2021; Liu & Rao 2021; Vogel *et al.* 2021; Poyarkov *et al.* 2022; Uetz *et al.* 2022), of which 20 species are distributed in China (Bhosale *et al.* 2020; Ding *et al.* 2020; Liu & Rao 2021; Vogel *et al.* 2020, 2021; Yang *et al.* 2021; Poyarkov *et al.* 2022). Two subgenera are at present recognized within the genus: the subgenus *Pareas* includes six species distributed mostly in Indochina and Sundaland, whereas the subgenus *Eberhardtia* Angel, 1920 includes the remaining species and has a wider distribution, covering northeastern India, Myanmar, southern and eastern China, and southwards to Sumatra (Poyarkov *et al.* 2022).

Pareas yunnanensis (Vogt, 1922) was originally described as *Amblycephalus yunnanensis* Vogt, 1922. Mell (1922) gave the type locality of this species as "Talifu" (corresponding presently to Dali City and parts of its adjacent areas), Yunnan Province, China, and was then considered a synonym of *P. chinensis* (Barbour, 1912) (Anonymous 1977; Zhao & Adler 1993; Zhao 2006; Yang & Rao 2008; Wallach *et al.* 2014; Uetz *et al.* 2022). While several scholars, including Rao & Yang (1992), Ding *et al.* (2020), Guo *et al.* (2020), Wang *et al.* (2020), Liu & Rao (2021), and Poyarkov *et al.* (2022), have suggested that *P. yunnanensis* may represent a valid taxon, none of them have given clear evidence for clarification of its status.

During our recent fieldwork in the northwestern part of Yunnan Province, China, in 2022, four specimens of the genus *Pareas* were collected from Dali City, the type locality of *P. yunnanensis*. Morphologically these specimens agree well with the type specimens of *P. yunnanensis*, and phylogenetically form a distinct group separating from all other known species of *Pareas*. Therefore, we resurrect *P. yunnanensis* as a valid species. In addition, during our fieldwork in the southern part of Yunnan Province, China, in 2021, three specimens of the genus *Pareas* which superficially resemble *P. nigriceps* Guo & Deng, 2009 in morphology were collected from the western part of Xishuangbanna Prefecture. Morphological comparison and molecular analysis indicated that these specimens belong to a separate taxon and are distinguished from all nominal species of *Pareas*. Therefore, we describe the taxon as a new species herein.

Material and methods

Specimens were collected by hand at night. Photographs in life were taken to document the colour pattern prior to euthanasia. Snakes were stored in 75% ethanol. Liver tissues were collected for molecular

analyses and stored in 99% ethanol. All specimens were deposited at Kunming Natural History Museum of Zoology, Kunming Institute of Zoology, Chinese Academy of Sciences.

Molecular data were generated for seven newly collected specimens of *Pareas*. Total genomic DNA was extracted from liver tissues using the OMEGA DNA Kit (Omega Bio-Tek, Inc., Norcross, GA, USA). Partial sequences of cytochrome b mitochondrial DNA gene (cyt b), were amplified using the primers L14910/H16064 (Lawson *et al.* 2005). DNA amplification and sequencing conditions followed Poyarkov *et al.* (2022). The amplification products were purified and sequenced at Tsingke Biotechnology Co., Ltd. Sequences were edited and manually adjusted using SeqMan in Lasergene ver. 7.1 (DNASTAR Inc., Madison, WI, USA) and MEGA ver. 11 (Tamura *et al.* 2021). All new sequences have been deposited to GenBank. Homologous sequences included in phylogenetic analyses were obtained from GenBank; all GenBank accession numbers for taxa used in this study are listed in Table 1. *Aplopeltura boa* (Boie, 1828), *Asthenodipsas laevis* (H. Boie in F. Boie, 1827), and *Xylophis captaini* Gower & Winkler, 2007 were selected as outgroups, based on phylogenetic results of Liu & Rao (2021) and Poyarkov *et al.* (2022).

Sequences were automatically aligned using ClustalW (Thompson *et al.* 1994) in MEGA ver. 11. Bayesian inference (BI) was performed in MrBayes ver. 3.2.7 (Ronquist *et al.* 2012), based on the GTR+F+I+G4 model. Four Markov chains were run for 1 000 000 generations sampled every 100 generations. The first 25% of the sampled trees were discarded as burn-in and the remaining trees were used to estimate Bayesian posterior probabilities (BPP). Maximum likelihood (ML) phylogenetic analysis was performed in IQ-TREE ver. 1.6.12 (Nguyen *et al.* 2015) based on the GTR+F+R4 model. Nodal support was estimated by 1000 ultrafast bootstrap replicates (UFB). The best substitution models were selected using ModelFinder (Kalyaanamoorthy *et al.* 2017) in IQ-TREE ver. 1.6.12 under the Akaike Information Criterion (AIC) for BI and ML, respectively. The values of uncorrected pairwise genetic divergence (p-distance) were calculated in MEGA ver. 11.

We measured the body and tail lengths with a measuring tape (to the nearest of 1 mm). Paired meristic characters are given as left/right (following Liu & Rao 2021). Abbreviations used were as follows:

ATem = anterior temporals
DNB = dark nuchal band
DS = dorsal scale rows (counted at one head length behind head-mid-body-one head length before vent)
InfL = infralabials
LoBO = loreal bordering orbit
Max = maxillary teeth
NED = number of enlarged dorsal scale rows at mid-body
NKD = number of keeled dorsal scale rows (counted at one head length behind head-mid-body-one head length before vent)
PosO = postoculars
Prec = precloacal plate
PreO = preoculars
PrFBO = prefrontal bordering orbit
PTem = posterior temporals
Sc = subcaudals
SPOF = subocular-postocular fused
SubO = suboculars
SupL = supralabials

Table 1 (continued on the next page). Sequences (cyt b) used in phylogenetic analysis of this study. Abbreviations: Hw. = highway; Is. = island; Mt. = mountain.

Species	Locality	Voucher no.	GenBank no.	Source
Pareas abros	Vietnam, Quang Nam, Song Thanh	ZMMU R-16393	MZ712235	Poyarkov *et al*. 2022
Pareas andersonii	Myanmar, Chin, Mt. Natmataung	CAS 235359	MT968772	Vogel *et al*. 2020
Pareas atayal	China, Taiwan, N. Cross Is. Hw.	NMNS 05594	KJ642122	You *et al*. 2015
Pareas berdmorei	Myanmar, Mon, Kin Pon Chaung	CAS 240362	MZ712219	Poyarkov *et al*. 2022
Pareas boulengeri	China, Guizhou, Jiangkou	GP 2923	MK135090	Wang *et al*. 2020
Pareas carinatus	Malaysia, Kedah, Sungai Sedim	LSUHC10604	KC916748	Loredo *et al*. 2013
Pareas chinensis	China, Sichuan, Hongya	GP 2383	MK135089	Wang *et al*. 2020
Pareas formosensis	China, Taiwan, N. Cross Is. Hw.	NMNS 05632	KJ642130	You *et al*. 2015
Pareas geminatus	China, Yunnan, Jiangcheng	CIB 118021	MW287068	Ding *et al*. 2020
Pareas geminatus	China, Yunnan, Jiangcheng	KIZ L2020020	MW436707	Liu & Rao 2021
Pareas geminatus	China, Yunnan, Jiangcheng	KIZ L2020024	MW436708	Liu & Rao 2021
Pareas hamptoni	Myanmar, Kachin	YPX 18219	MK135077	Wang *et al.* 2020
Pareas iwasakii	Japan, S. Ryukyu, Ishigaki Is.	I03-ISG1	KJ642158	You *et al*. 2015
Pareas kaduri	India, Arunachal, Lohit	BNHS 3574	MT188734	Bhosale *et al*. 2020
Pareas komaii	China, Taiwan, Taitung, Lijia	HC 000669	JF827687	Guo *et al*. 2011
Pareas kuznetsovorum	Vietnam, Phu Yen, Song Hinh	ZMMU R-16802	MZ712232	Poyarkov *et al*. 2022
Pareas macularius	Myanmar, Bago	CAS 206620	AF471082	Guo *et al*. 2011
Pareas margaritophorus	China, Guangxi, Cangwu	YBU 16061	MK135097	Wang *et al*. 2020
Pareas modestus	India, Mizoram, Aizawl, Tanhril	MZMU 1293	MT968773	Vogel *et al*. 2020
Pareas monticola	China, Tibet, Medog	GP 2027	MK135107	Wang *et al*. 2020

Table 1 (continued).

Species	Locality	Voucher no.	GenBank no.	Source
Pareas niger	China, Yunnan, Kunming	KIZ 059339	MW436706	Liu & Rao 2021
Pareas nigriceps	China, Yunnan, Mt. Gaoligong	SYSr001222	MK201455	Li *et al*. 2020
Pareas nuchalis	Brunei, Belait	FK 2626	MZ603794	Le *et al*. 2020
Pareas stanleyi	China, Guangxi, Guilin	HM 2007-S001	JN230704	Guo *et al*. 2011
Pareas temporalis	Vietnam, Lam Dong, Da Huoai	UNS 09992	MZ603793	Le *et al*. 2020
Pareas victorianus	Myanmar, Chin, Mt. Natmataung	CAS 235254	MW438300	Vogel *et al*. 2021
Pareas vindumi	Myanmar, Kachin, Lukpwir	CAS 248147	MT968776	Vogel *et al*. 2020
Pareas xuelinensis	China, Yunnan, Lancang	KIZ XL1	MW436709	Liu & Rao 2021
Pareas xuelinensis	China, Yunnan, Lancang	KIZ XL2	MW436710	Liu & Rao 2021
Pareas yunnanensis	China, Yunnan, Dali	KIZ 2022033	OP752146	This study
Pareas yunnanensis	China, Yunnan, Dali	KIZ 2022034	OP752147	This study
Pareas yunnanensis	China, Yunnan, Dali	KIZ 2022035	OP752148	This study
Pareas yunnanensis	China, Yunnan, Dali	KIZ 2022036	OP752149	This study
Pareas tigerinus sp. nov.	China, Yunnan, Menghai	KIZ 20210703	OP752143	This study
Pareas tigerinus sp. nov.	China, Yunnan, Menghai	KIZ 20210704	OP752144	This study
Pareas tigerinus sp. nov.	China, Yunnan, Menghai	KIZ 20210705	OP752145	This study
Aplopeltura boa	Malaysia	LSUHC 7248	KC916746	Loredo *et al*. 2013
Asthenodipsas laevis	Malaysia	LSUHC 10346	KC916749	Loredo *et al*. 2013
Xylophis captaini	India, Kerala, Kottayam	BNHS 3376	MK340914	Deepak *et al*. 2018

SVL = snout-vent length (from tip of snout to posterior margin of cloacal plate)
TL = tail length (from posterior margin of cloacal plate to tip of tail)
VBTa = vertical dark bars on tail
VBTr = vertical dark bars on trunk
Vs = ventrals

For comparison, we examined the type specimens of *Pareas yunnanensis*, data for other species of *Pareas* were taken from the original and subsequent descriptions (Boulenger 1900, 1905; Vogt 1922; Pope 1935; Zhao *et al.* 1998; Grossmann & Tillack 2003; Guo & Deng 2009; Guo *et al.* 2011; Loredo *et al.* 2013; Vogel 2015; You *et al.* 2015; Hauser 2017; Bhosale *et al.* 2020; Ding *et al.* 2020; Vogel *et al.* 2020, 2021; Wang *et al.* 2020; Le *et al.* 2021; Liu & Rao 2021; Yang *et al.* 2021; Poyarkov *et al.* 2022).

Museum abbreviations are as follows:

KIZ = Kunming Natural History Museum of Zoology, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, China
ZMB = Zoologisches Museum für Naturkunde der Humboldt-Universität zu Berlin, Berlin, Germany.

Results

Phylogenetically, BI and ML analyses showed essentially consistent results (Fig. 1) and largely concordant with previously published phylogenetic analyses of the genus *Pareas* (e.g., Le *et al.* 2021; Liu & Rao 2021; Poyarkov *et al.* 2022). The specimens collected from the type locality of *P. yunnanensis* formed a distinct lineage sister to *P. geminatus* Ding, Chen, Suwannapoom, Nguyen, Poyarkov & Vogel, 2020 with strong support (BPP/UFB 1/99), and the specimens collected from the western part of Xishuangbanna formed a distinct lineage sister to *P. nigriceps* with strong support (BPP/UFB 1/100). The genetic divergence in cyt b sequences between the specimens collected from the type locality of *P. yunnanensis* and *P. geminatus* was 4.1%, while between the specimens collected from the western part of Xishuangbanna and *P. nigriceps* it comprised 4.3% (see Table 2).

Morphologically, the specimens from the type locality of *Pareas yunnanensis* agree well with the type specimens of *P. yunnanensis*, except for a few minor variations (see Table 3). Therefore, we consider that these specimens are conspecific with the type specimens of *P. yunnanensis*. Phylogenetically, *P. yunnanensis* is not close to *P. chinensis* with which it was previously confused (Anonymous 1977), it belongs to a different species group within the subgenus *Eberhardtia* (see Fig. 1). Moreover, when compared with *P. chinensis*, *P. yunnanensis* has a significantly shorter tail and lower number subcaudals (see Table 4). Therefore, we formally remove *P. yunnanensis* from the synonymy of *P. chinensis*.

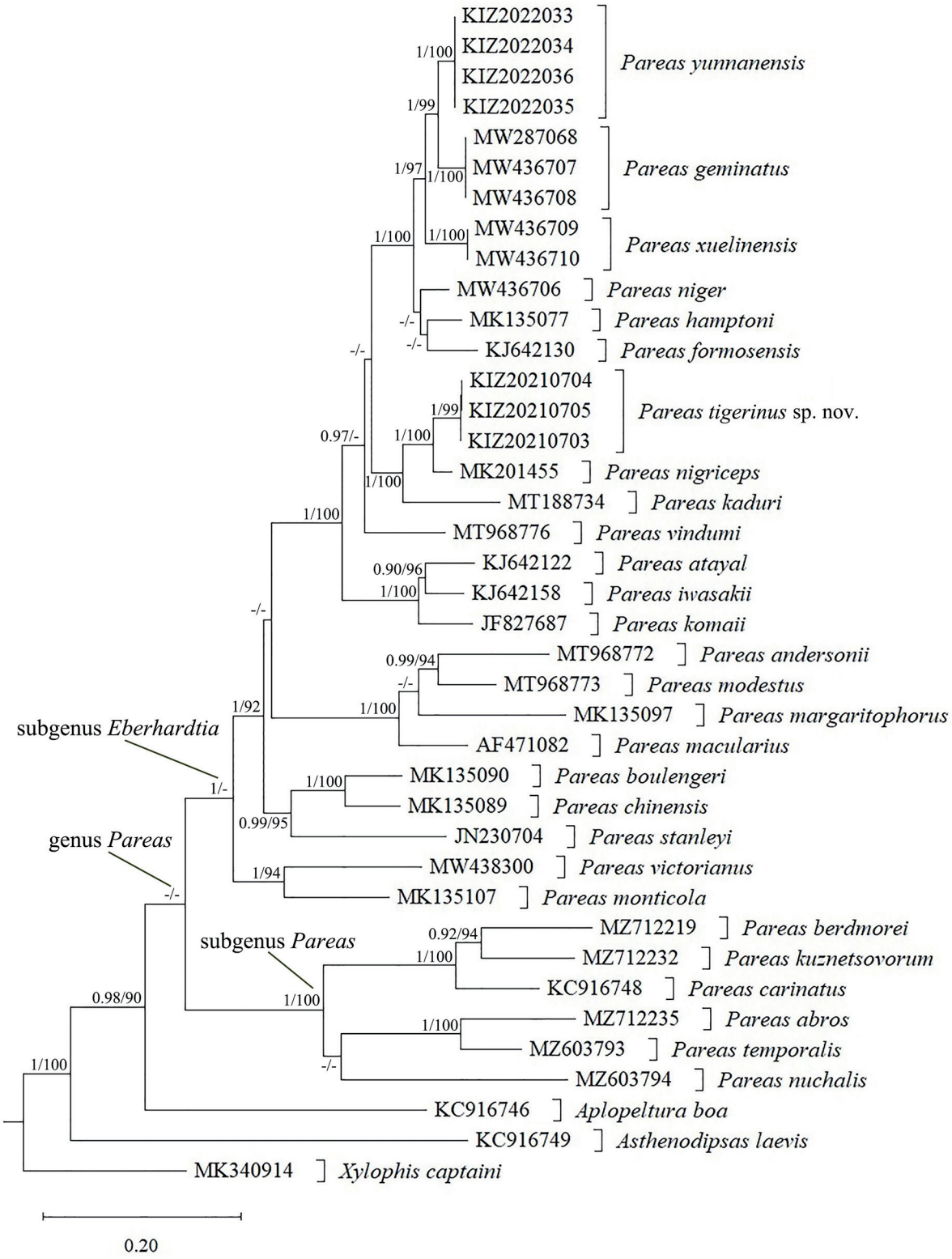

Fig. 1. Bayesian phylogeny tree of *Pareas* Wagler, 1830 inferred from cyt b sequences. Node numbers before slashes indicate BPP (values below 0.90 are not shown) and numbers after slashes indicate UFB (values below 90 are not shown).

Table 2. Uncorrected p-distances (%) amongst the members of *Pareas* Wagler, 1830, calculated from cyt b gene sequences.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1 *Pareas abros*																											
2 *Pareas andersonii*	23.5																										
3 *Pareas atayal*	22.8	20.2																									
4 *Pareas berdmorei*	21.3	23.8	23.5																								
5 *Pareas boulengeri*	23.2	19.7	18.3	23.7																							
6 *Pareas carinatus*	21.8	22.9	22.6	13.8	22.2																						
7 *Pareas chinensis*	23.7	19.1	18.4	24.7	9.0	22.6																					
8 *Pareas formosensis*	22.9	21.7	15.1	24.9	17.2	23.9	17.4																				
9 *Pareas geminatus*	22.8	22.3	14.6	23.5	17.5	23.5	19.1	8.8																			
10 *Pareas hamptoni*	23.6	21.5	14.2	23.7	17.2	23.6	18.3	7.2	7.4																		
11 *Pareas iwasakii*	23.4	20.4	7.2	23.7	16.8	23.3	17.9	14.4	14.6	13.5																	
12 *Pareas kaduri*	25.4	21.2	16.3	24.9	20.2	22.8	19.9	13.6	14.2	13.4	15.6																
13 *Pareas komaii*	23.3	19.5	8.5	23.9	18.1	23.9	18.3	14.7	15.1	14.5	7.9	16.6															
14 *Pareas kuznetsovorum*	20.9	23.8	22.9	13.0	22.6	13.0	23.0	23.7	23.4	23.3	23.9	23.3	24.2														
15 *Pareas macularius*	23.0	13.9	19.2	22.7	17.8	22.1	17.4	19.0	20.6	19.7	18.9	19.7	18.3	22.8													
16 *Pareas margaritophorus*	25.8	15.3	19.1	24.7	19.2	23.5	18.3	20.5	22.2	20.5	18.8	21.0	19.5	23.7	14.8												
17 *Pareas modestus*	23.5	12.0	18.7	24.4	19.2	24.0	18.7	20.7	20.3	19.6	19.3	19.5	17.8	24.4	11.0	13.9											
18 *Pareas monticola*	22.6	18.9	17.3	22.0	18.7	22.8	18.1	18.9	19.9	19.0	17.8	19.2	17.9	22.5	18.1	19.7	18.2										
19 *Pareas niger*	22.7	20.4	14.3	23.8	17.5	23.0	17.8	7.2	7.0	5.6	13.7	13.1	14.9	22.7	18.9	20.1	18.9	18.5									
20 *Pareas nigriceps*	23.6	18.8	16.2	22.9	16.9	22.6	16.2	12.6	13.4	12.6	16.1	10.4	16.2	23.9	17.8	17.9	16.4	19.1	12.5								
21 *Pareas nuchalis*	21.1	24.3	23.7	21.5	24.3	21.6	24.0	24.4	25.1	24.8	24.5	26.1	23.5	20.4	23.1	26.1	24.5	21.4	25.2	23.8							
22 *Pareas stanleyi*	25.7	20.4	19.2	25.0	15.7	24.9	15.4	19.6	19.8	18.7	18.2	20.8	17.4	24.9	19.9	19.5	19.4	19.2	19.5	19.0	24.0						
23 *Pareas temporalis*	12.3	23.6	23.1	20.6	22.1	19.9	21.5	24.3	23.8	23.4	23.1	25.0	23.8	20.1	24.4	24.0	23.2	21.3	23.3	23.8	19.8	23.4					
24 *Pareas victorianus*	24.3	20.6	19.6	22.8	19.1	22.8	17.4	17.8	18.7	18.6	19.7	19.3	19.4	22.9	19.1	21.5	19.3	15.1	17.9	19.1	24.7	19.0	24.2				
25 *Pareas vindumi*	24.5	20.8	14.9	24.7	18.4	23.8	17.5	12.1	12.5	11.4	14.7	13.5	15.2	23.7	19.3	20.5	19.9	18.3	10.8	12.3	24.7	19.4	24.9	17.8			
26 *Pareas xuelinensis*	23.1	21.3	13.8	25.1	16.9	24.3	18.7	8.0	6.1	8.1	13.7	14.1	14.9	24.6	19.2	21.3	20.2	19.8	7.3	12.5	25.9	19.5	24.4	18.8	12.6		
27 *Pareas yunnanensis*	23.2	22.1	14.7	24.6	16.7	23.4	18.0	7.9	4.1	6.1	14.0	13.4	14.7	23.7	19.8	21.5	20.6	20.0	6.3	12.8	24.9	19.5	23.6	18.7	11.5	6.2	
28 *Pareas tigerinus* sp. nov.	23.1	19.4	14.7	24.2	19.0	23.3	18.6	12.3	12.3	11.8	14.1	11.6	14.0	24.3	18.6	20.4	18.1	18.9	11.4	4.3	25.2	19.4	24.6	18.1	12.0	12.2	11.7

Taxonomic accounts

Class Reptilia Laurenti, 1768
Order Squamata Oppel, 1811
Suborder Serpentes Linnaeus, 1758
Family Pareidae Romer, 1956
Subfamily Pareinae Romer, 1956
Genus *Pareas* Wagler, 1830
Subgenus *Eberhardtia* Angel, 1920

Pareas* (*Eberhardtia*) *yunnanensis (Vogt, 1922)
Figs 2–4; Tables 3–4

Amblycephalus yunnanensis Vogt, 1922: 142.

Amblycephalus yunnanensis — Mell 1922. — Pope 1935. — Ding *et al*. 2020.
Amblycephalus monticola yunnanensis — Mell 1931.
Pareas yunnanensis — Rao & Yang 1992. — Guo *et al*. 2020 — Wang *et al*. 2020. — Liu & Rao 2021.
Pareas chinensis (in part) — Zhao & Adler 1993. — Zhao 2006. — Yang & Rao 2008. — Wallach *et al*. 2014.
Pareas cf. *yunnanensis* — Poyarkov *et al*. 2022.

Revised diagnosis

This species differs from *Pareas geminatus* by having fewer subcaudals, relatively more rows of keeled mid-dorsal scales, relatively fewer ventral scales, solid black dorsal surface of head, and no distinct large black spots or stripe on each side of head; it differs from *P. xuelinensis* Liu & Rao, 2021 by infralabials not fused with chin-shields, vertebral scales enlarged, having fewer ventral scales, fewer subcaudals, relatively more rows of keeled mid-dorsal scales, and solid black dorsal surface of head.

SVL 387–482 mm in adults, TL 94–110 mm in adults, TL/SVL 0.22–0.25; preoculars mostly single, rarely two; postoculars and suboculars mostly fused, rarely separated; loreal bordering orbit in most individuals; prefrontal bordering orbit; supralabials 6–8, infralabials 6–8; infralabials not fused with chin-shields; dorsal scales in 15 rows throughout the body; vertebral scales enlarged; 5–7 rows of mid-dorsal scales keeled on the middle part of the body; precloacal plate undivided; ventral scales 169–175; subcaudals 59–65, all paired. Dorsal surface of head black; no or 1–2 indistinct large black spots on each side of head, no stripe on each side of head; two wide black stripes pass from parietals to the vertical black bars on neck; dark nuchal band absent; vertical black bars distinct on trunk and indistinct on tail; iris brownish-yellow or brownish-orange.

Etymology

The specific epithet is a toponymic adjective given in reference to Yunnan Province, China. We propose "Yunnan slug-eating snake" for the common English name and "云南钝头蛇" (Yún Nán Dùn Tóu Shé) for the common Chinese name of this species.

Type material

Syntypes

CHINA • 2 ♀♀ (adults); Dali Prefecture, Yunnan Province; ZMB 27660, 65431.

Additional material examined

CHINA – **Yunnan Province** • 2 ♀♀ adults; Dali Prefecture, Dali City, Xiaguan Town; 25°36′17″ N, 100°11′33″ E; elev. 2250 m; 12 Jun. 2022; S. Liu leg.; KIZ 2022033, 2022034 • 1 ♀ adult; Dali Prefecture,

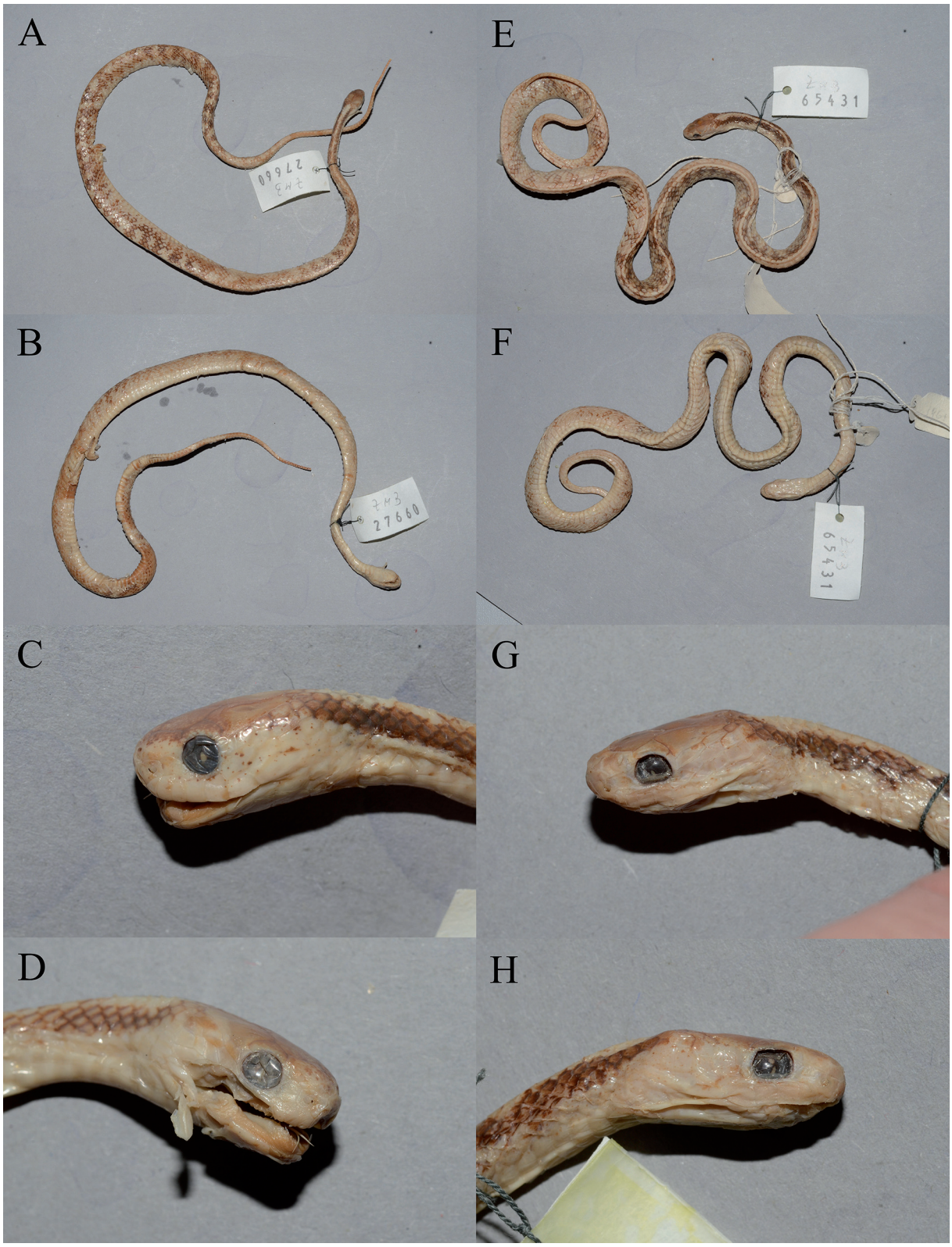

Fig. 2. *Pareas yunnanensis* (Vogt, 1922), syntypes in preservative. **A–D**. ZMB 27660. **A**. Dorsal view. **B**. Ventral view. **C–D**. Close up views of the head. **E–H**. ZMB 65431. **E**. Dorsal view. **F**. Ventral view. **G–H**. Close up views of the head. Photos by G. Vogel.

Table 3. Morphological characters of *Pareas yunnanensis* (Vogt, 1922). For abbreviations, see Material and methods section. Measurements in mm, paired meristic characters given as left/right, "?" = not available, data in parentheses from Vogt (1922).

	ZMB 27660 Syntype	ZMB 65431 Syntype	KIZ 2022033	KIZ 2022034	KIZ 2022035	KIZ 2022036
SEX	♀	♀	♀	♀	♀	Juvenile
SVL	387 (385)	405 (410)	482	395	445	163
TL	? (95)	? (100)	105	94	110	39
TL/SVL	? (0.25)	? (0.24)	0.22	0.24	0.25	0.24
PrFBO	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
PreO	1/1	1/1	1/1	1/1	2/1	1/1
PosO	Fused	Fused	Fused	Fused	2/2	Fused
SubO	Fused	Fused	Fused	Fused	1/1	Fused
SPOF	Yes	Yes	Yes	Yes	No	Yes
ATem	2/2	2/2	1/1	1/1	2/2	1/1
PTem	3/2	3/3	2/2	2/2	2/3	2/2
SupL	?	7/6	7/8	7/7	7/7	6/6
InfL	?	7/7	7/8	8/6	8/8	7/6
LoBO	Yes/Yes	No/Yes	Yes/No	No/No	Yes/Yes	Yes/Yes
Vs	172	175	173	174	169	173
Prec	Single	Single	Single	Single	Single	Single
Sc	65	64	59	60	64	61
Ds	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
NED	1	1	1	1	1	1
NKD	7	5	7	7	7	5
Max	?	?	4/4	5/5	4/4	5/4
DNB	Absent	Absent	Absent	Absent	Absent	Absent

Dali City, Dali Town; 25°41′56″ N, 100°8′2″ E; elev. 2230 m; 13 Jun. 2022; S. Liu leg.; KIZ 2022035 • 1 juv.; Dali Prefecture, Dali City, Xiaguan Town; 25°37′52″ N, 100°11′44″ E; elev. 2140 m; 15 Jun. 2022; S. Liu leg.; KIZ 2022036.

Distribution

This species is currently known only from Dali City and its adjacent areas, Dali Prefecture, Yunnan Province, China (Fig. 8).

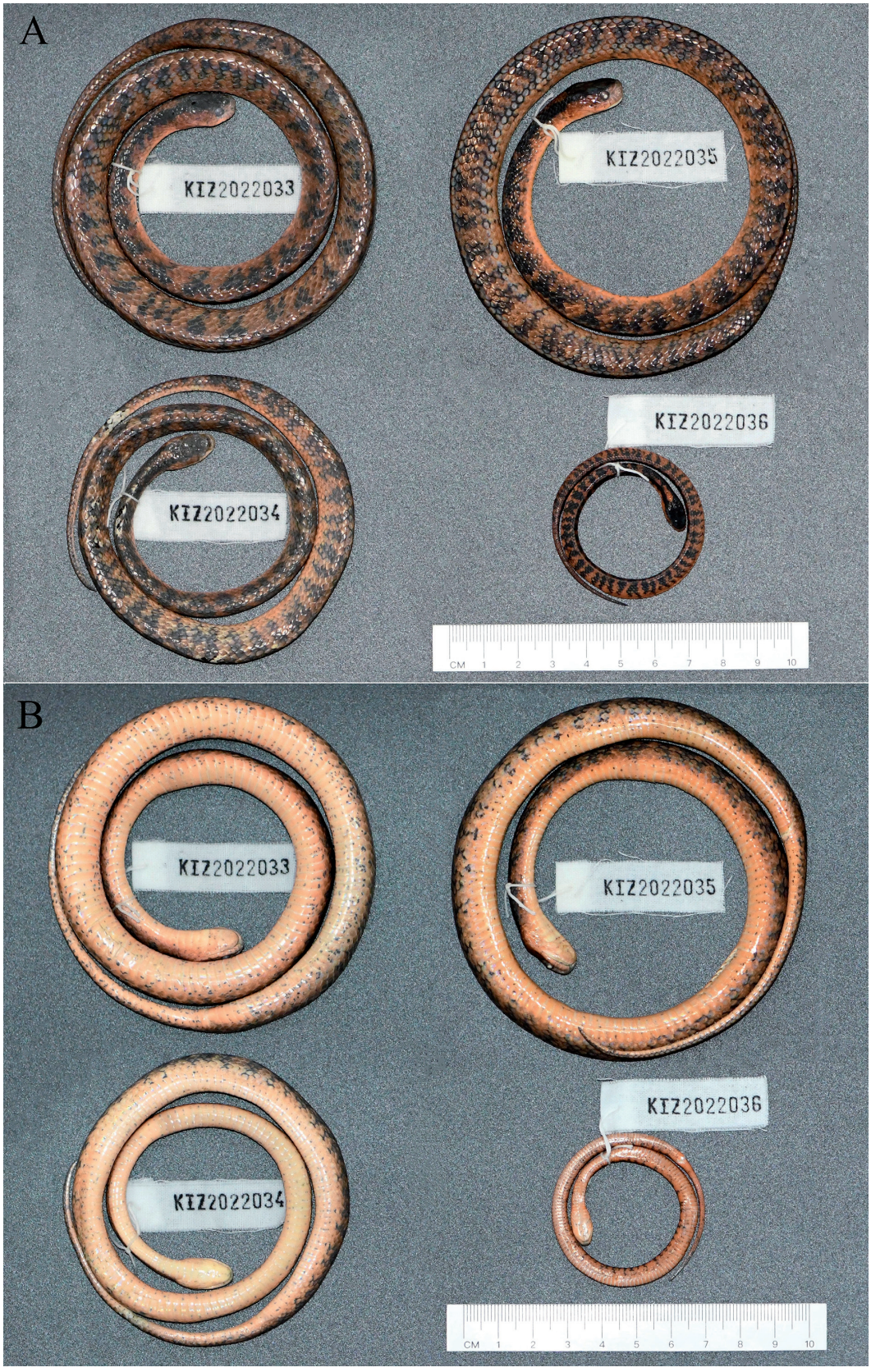

Fig. 3. *Pareas yunnanensis* (Vogt, 1922), specimens from its type locality in preservative. **A**. Dorsal views. **B**. Ventral views. Photos by S. Liu.

Fig. 4. *Pareas yunnanensis* (Vogt, 1922), specimens from its type locality in life. **A–C**. ♀, KIZ 2022033. **D–F**. ♀, KIZ 2022034. **G–I**. ♀, KIZ 2022035. Photos by S. Liu.

Table 4. Comparisons of morphometric and scalation data for *Pareas yunnanensis* (Vogt, 1922) and *P. chinensis* (Barbour, 1912). Measurements in mm, data for *P. chinensis* (restricted to Sichuan Province, China) from Poyarkov *et al*. (2022).

	Pareas yunnanensis	***Pareas chinensis***
SVL	385–482	309–427
TL	95–110	99–128
TL/SVL	0.22–0.25	0.26–0.33
PrFBO	Yes	Yes
PreO	1–2	1–2
PosO	Fused or 2	Fused or 1
SubO	Fused or 1	Fused or 1
SPOF	Yes or No	Yes or No
ATem	1–2	2
PTem	2–3	3–4
SupL	6–8	6–8
InfL	6–8	7–9
LoBO	Yes or No	No
Vs	169–175	169–178
Sc	59–65	69–76
Ds	15-15-15	15-15-15
NED	1	0 or 3
NKD	5–7	0 or 5
Max	4–5	5–6
DNB	Absent	Absent

Phylogenetic position

Pareas yunnanensis belongs to the subgenus *Eberhardtia* and is a member of the *P. hamptoni* (Boulenger, 1905) species group (Poyarkov *et al*. 2022). Phylogenetically it is reconstructed as a sister species of *P. geminatus* (see Fig. 1).

Pareas* (*Eberhardtia*) *tigerinus sp. nov.
urn:lsid:zoobank.org:act:6538EBDF-DB82-47C7-8EB1-9E9BD178B414
Figs 5–7; Tables 5–6

Diagnosis

This species differs from *Pareas nigriceps* by having a relatively shorter tail, more infralabials, fewer ventral scales, fewer subcaudals, and fewer maxillary teeth; it differs from *P. kaduri* Bhosale, Phansalkar, Sawant, Gowande, Patel & Mirza, 2020 by having relatively smaller body size, keeled mid-dorsal scales in females, fewer temporals, and fewer maxillary teeth.

Single preocular; postocular fused with subocular; loreal not bordering orbit; prefrontal bordering orbit; infralabials not fused with chin-shields; three chin-shield pairs, the first pair triangular, the second pair and the third pair elongate; dorsal scales in 15 rows throughout; vertebral scales enlarged; scales not keeled on the anterior part of the body, 3–5 rows of mid-dorsal scales keeled on the middle part of the body, 5–9 rows of mid-dorsal scales keeled on the posterior part of the body; seven supralabials; eight infralabials; precloacal plate undivided; ventral scales 160–171; subcaudals 62–64, paired. Dorsal surface of head solid black or reddish-brown; dark nuchal band present; vertical dark bars on trunk and tail distinct; iris brownish-black or reddish-brown.

Etymology

The species epithet "*tigerinus*" is attributed to this species due to the similarity of the species colour pattern to the prominent lateral stripes in tigers. We propose "Tiger slug-eating snake" for the common English name and "虎纹钝头蛇" (Hǔ Wén Dùn Tóu Shé) for the common Chinese name.

Type material

Holotype

CHINA • ♀ adult; Yunnan Province, Xishuangbanna Prefecture, Menghai County, Xiding Township; 21°49′54″ N, 100°7′21″ E; elev. 1920 m; 21 Jul. 2021; S. Liu leg.; KIZ 20210705.

Paratypes

CHINA • 1 ♂ adult; same collection data as for preceding; 20 Jul. 2021; KIZ 20210703 • 1 ♀ adult; same collection data as for preceding; 20 Jul. 2021; KIZ 20210704.

Description of holotype

Adult female, SVL 434 mm, TL 109 mm, TL/SVL 0.25, TL/total length 0.20; body elongated; head distinct from neck; snout wide and blunt, projecting beyond lower jaw; body slightly compressed laterally, vertebral ridge developed. Rostral approximately as wide as high, slightly visible from above; nasals undivided; internasals wider than long; prefrontals pentagonal, bordering orbits; frontal hexagonal, longer than wide; parietals large, much longer than wide, median suture longer than frontal; single loreal, not entering orbit; single preocular; one supraocular, longer than wide; subocular and postocular fused into one thin elongated crescent-shaped scale; one anterior temporal and two posterior temporals on each side; seven supralabials on each side, not touching orbit; eight infralabials on each side, anteriormost in contact with its opposite between mental and anterior chin-shields; infralabials not fused with chin-shield; three chin-shield pairs, the first pair triangular, the second pair and the third pair elongate, the first pair slightly larger than other two; ventral scales 169; precloacal plate undivided; subcaudals 62, paired; dorsal scales in 15 rows throughout, vertebral scales enlarged, scales not keeled at anterior of body, five rows of mid-dorsal scales keeled at middle of body, seven rows of mid-dorsal scales keeled at posterior of body.

Coloration of holotype in life

Dorsal surface of head solid black; occipitalia yellow; dorsal surface of body yellow, a large black band on neck and not connect with the black patch on top of head; sides of head yellow; two black spots on the left side of head, one on the lower rear part of eye and one on the angle of mouth; three black spots on the right side of head, two on the lower rear part of eye and a large elongate one on the angle of mouth; ventral surface of head light yellow, a few black spots on the outer margins of the third chin-shield and the first preventral; approximately 59 vertical, slightly billowing dark bars on trunk and approximately 22 vertical, slightly billowing dark bars on tail; belly and ventral surface of tail pale yellow with sparse small black spots; iris brownish black, pupil black.

Colouration of holotype in preservative

The dorsal surface of the head and body became darker in alcohol; the belly and ventral surface of head and tail faded to yellowish-white; the iris changed to greyish-black and the pupil changed to white.

Variation

The male paratype KIZ 20210703 has a slightly darker body colour, a smaller SVL, an incomplete tail, fewer ventral scales, fewer vertical dark bars on trunk, two large black spots on each side of head, no black spots on ventral side of head, and nine rows of mid-dorsal scales keeled on the posterior part of

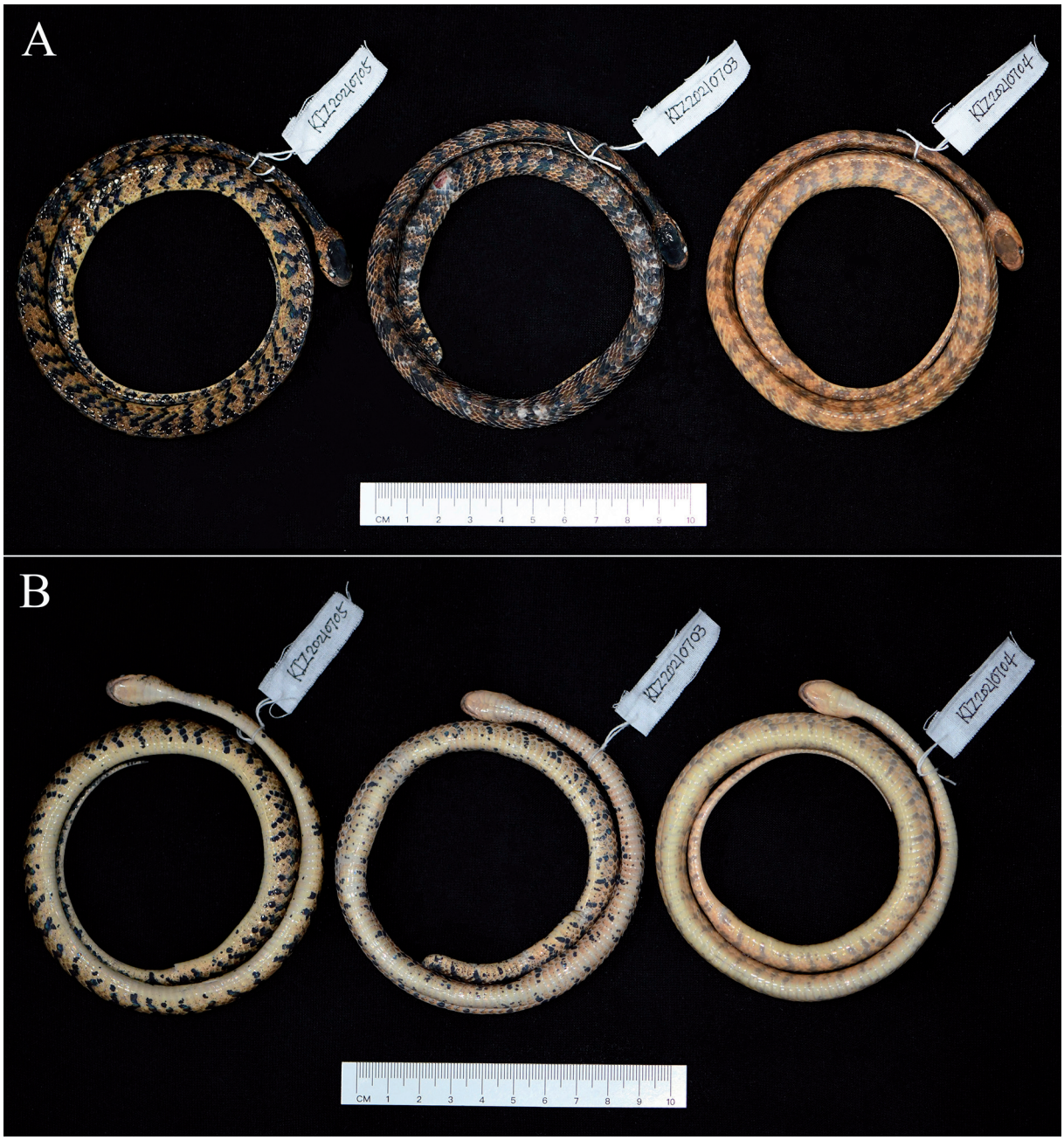

Fig. 5. *Pareas tigerinus* sp. nov., type specimens in preservative. **A**. Dorsal views. **B**. Ventral views. Photos by S. Liu.

the body. The female paratype KIZ 20210704 has a much paler body colour: the dorsal surface of head, nuchal band, vertical bars on trunk and tail, and iris are reddish-brown; and there is only one reddish-brown spot at the angle of mouth on each side of head, only one posterior temporal on each side, no spots on ventral side of head, three rows of mid-dorsal scales keeled on the middle part of the body, and five rows of mid-dorsal scales keeled on the posterior part of the body.

Natural history notes

The specimens were found in the forest (Fig. 7D) at night perching on bushes growing along a small stream at elevation 1920 m a.s.l. Other species of amphibians and reptiles observed at the type locality of the new species include *Diploderma menghaiense* Liu, Hou, Wang, Ananjeva & Rao, 2020; *Pareas*

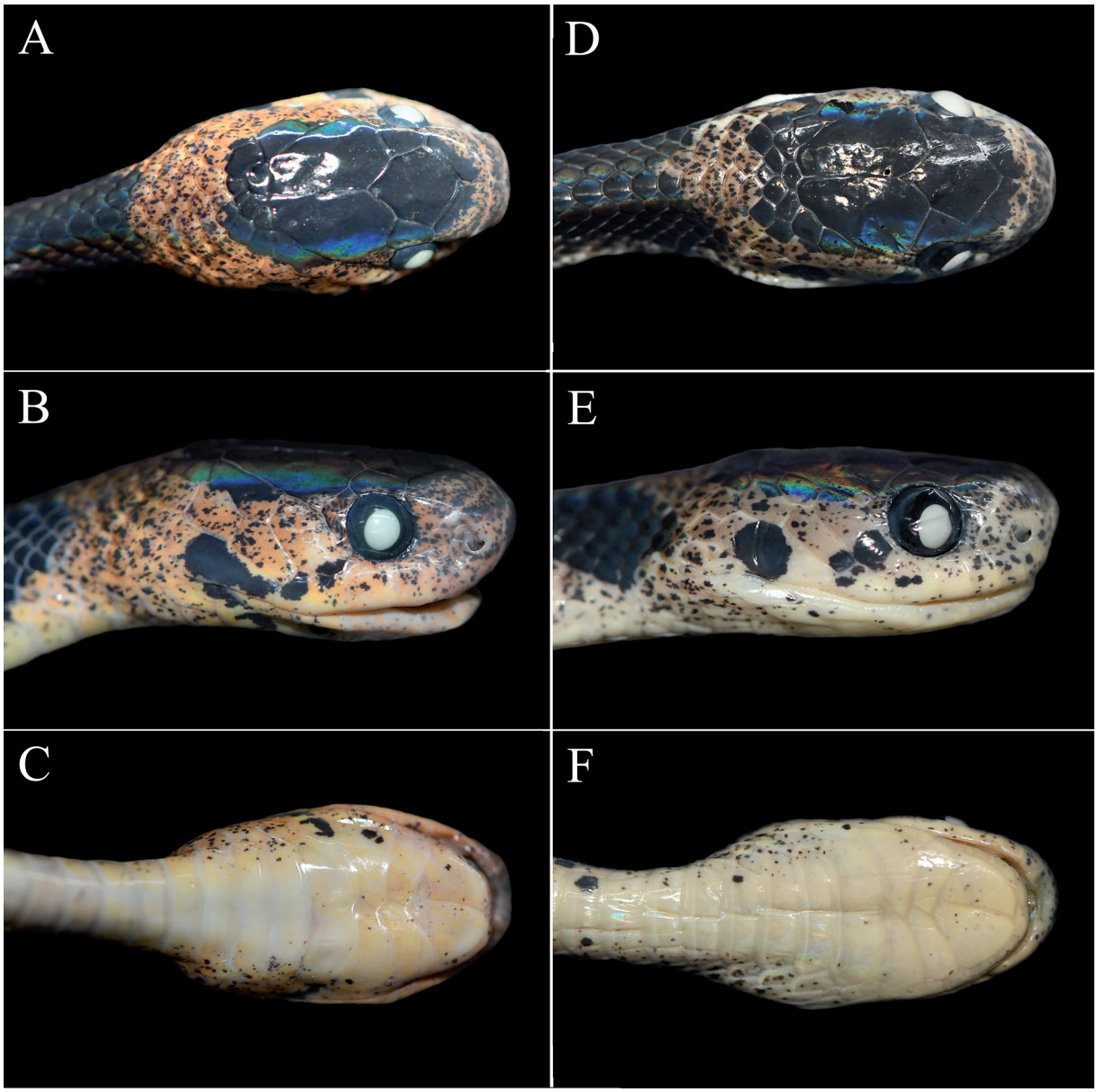

Fig. 6. *Pareas tigerinus* sp. nov. in preservative, head. **A–C**. Holotype, ♀ (KIZ 20210705). **A**. Dorsal view. **B**. Lateral view. **C**. Ventral view. **D–F**. Paratype, ♂ (KIZ 20210703). **D**. Dorsal view. **E**. Lateral view. **F**. Ventral view. Photos by S. Liu.

xuelinensis, and *Raorchestes hillisi* Jiang, Ren, Guo, Wang & Li, 2020. The sympatric occurrence of the new species with congeneric *P. xuelinensis* is remarkable, since both are members of the *P. hamptoni* species group. *Pareas xuelinensis* is usually smaller than *Pareas tigerinus* sp. nov. in body size, however, *P. xuelinensis* is more dominant than *Pareas tigerinus* in the population size at the type locality of the new species. Relatively, *P. xuelinensis* is more arboreal and *Pareas tigerinus* is more terrestrial through our brief observation, but the specific feeding habits of these two species are currently unknown.

Distribution

The new species is currently known only from its type locality in Xiding Township, Menghai County, Xishuangbanna Prefecture, Yunnan Province, China (Fig. 8). This new species likely occurs in Myanmar and northwestern Laos.

Phylogenetic position

Pareas tigerinus sp. nov. belongs to the subgenus *Eberhardtia* and is a member of the *P. hamptoni* species group. Phylogenetically, it is reconstructed as a sister species of *P. nigriceps* (see Fig. 1).

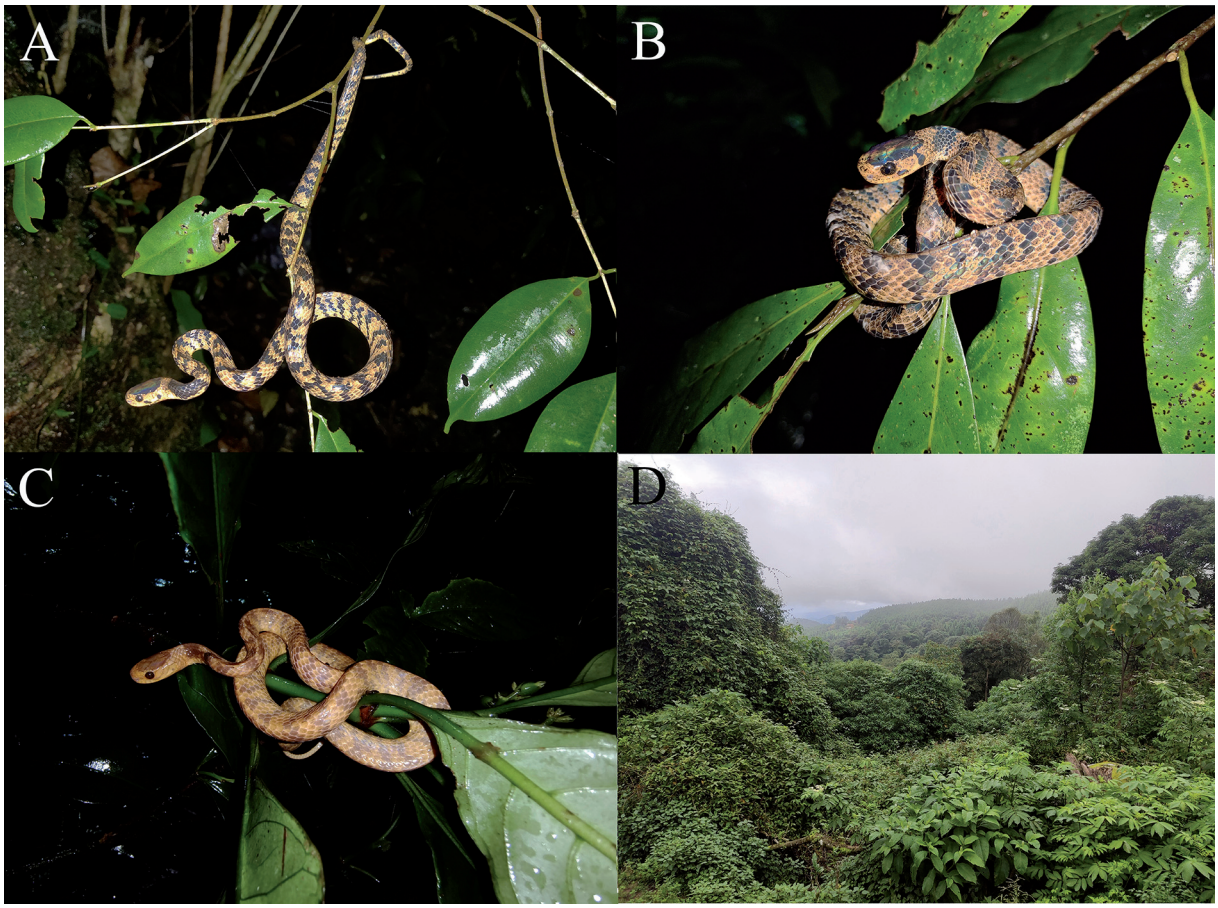

Fig. 7. *Pareas tigerinus* sp. nov. in life. **A**. Holotype, ♀ (KIZ 20210705). **B**. Paratype, ♂ (KIZ 20210703) **C**. Paratype, ♀ (KIZ 20210704) . **D**. Habitat at the type locality. Photos by S. Liu.

Table 5. Morphological characters of the type series of *Pareas tigerinus* sp. nov. For abbreviations, see Material and methods section. Measurements in mm, paired meristic characters given as left/right.

	KIZ 20210705 Holotype	**KIZ 20210703** Paratype	**KIZ 20210704** Paratype
SEX	♀	♂	♀
SVL	434	392	431
TL	109	35+	111
TL/SVL	0.25	0.09+	0.26
PrFBO	Yes/Yes	Yes/Yes	Yes/Yes
PreO	1/1	1/1	1/1
PosO	Fused	Fused	Fused
SubO	Fused	Fused	Fused
SPOF	Yes	Yes	Yes
ATem	1/1	1/1	1/1
PTem	2/2	2/2	1/1
SupL	7/7	7/7	7/7
InfL	8/8	8/8	8/8
LoBO	No/No	No/No	No/No
Vs	169	160	171
Prec	Single	Single	Single
Sc	62	19+	64
Ds	15-15-15	15-15-15	15-15-15
NED	1	1	1
NKD	5	5	3
Max	5/4	5/4	4/4
DNB	Present	Present	Present
VBTr	59	53	61
VBTa	22	5+	24

Comparison

Pareas tigerinus sp. nov. can be distinguished from *P. andersonii* (Boulenger, 1888), *P. modestus* Theobald, 1868, *P. macularius* Theobald, 1868, and *P. margaritophorus* (Jan, 1866) by its yellow body background colour (vs body background colours of grey, dark grey, brownish grey, or completely black).

Pareas tigerinus sp. nov. can be distinguished from *P. abros* Poyarkov, Nguyen, Vogel & Orlov, 2022, *P. atayal* You, Poyarkov & Lin, 2015, *P. berdmorei* Theobald, 1868, *P. carinatus* Wagler, 1830, *P. formosensis* (Van Denburgh, 1909), *P. iwasakii* (Maki, 1937), *P. komaii* (Maki, 1931), *P. kuznetsovorum* Poyarkov, Yushchenko & Nguyen, 2022, *P. nuchalis* (Boulenger, 1900), and *P. temporalis* Le, Tran, Hoang & Stuart, 2021 by subocular and postocular fused into one thin elongated crescent-shaped scale (vs subocular and postocular not fused).

Pareas tigerinus sp. nov. can be distinguished from *P. boulengeri* (Angel, 1920) and *P. monticola* (Cantor, 1839) by 3–5 rows of mid-dorsal scales keeled at middle of the body, 5–9 rows of mid-dorsal scales keeled on the posterior part of the body (vs all dorsal scales smooth), and having fewer ventral scales (160–171 vs 176–199).

Pareas tigerinus sp. nov. can be distinguished from *P. chinensis* by one row of vertebral scales enlarged (vs vertebral scales not enlarged or three rows of vertebral scales enlarged), having fewer temporals (1+1 or 1+2 vs 2+3 or 2+4), and fewer subcaudals (62–64 vs 69–76).

Pareas tigerinus sp. nov. can be distinguished from *P. geminatus* by having fewer subcaudals (62–64 vs 73–91) and relatively shorter tail (TL/SVL 0.25–0.26 vs 0.27–0.35).

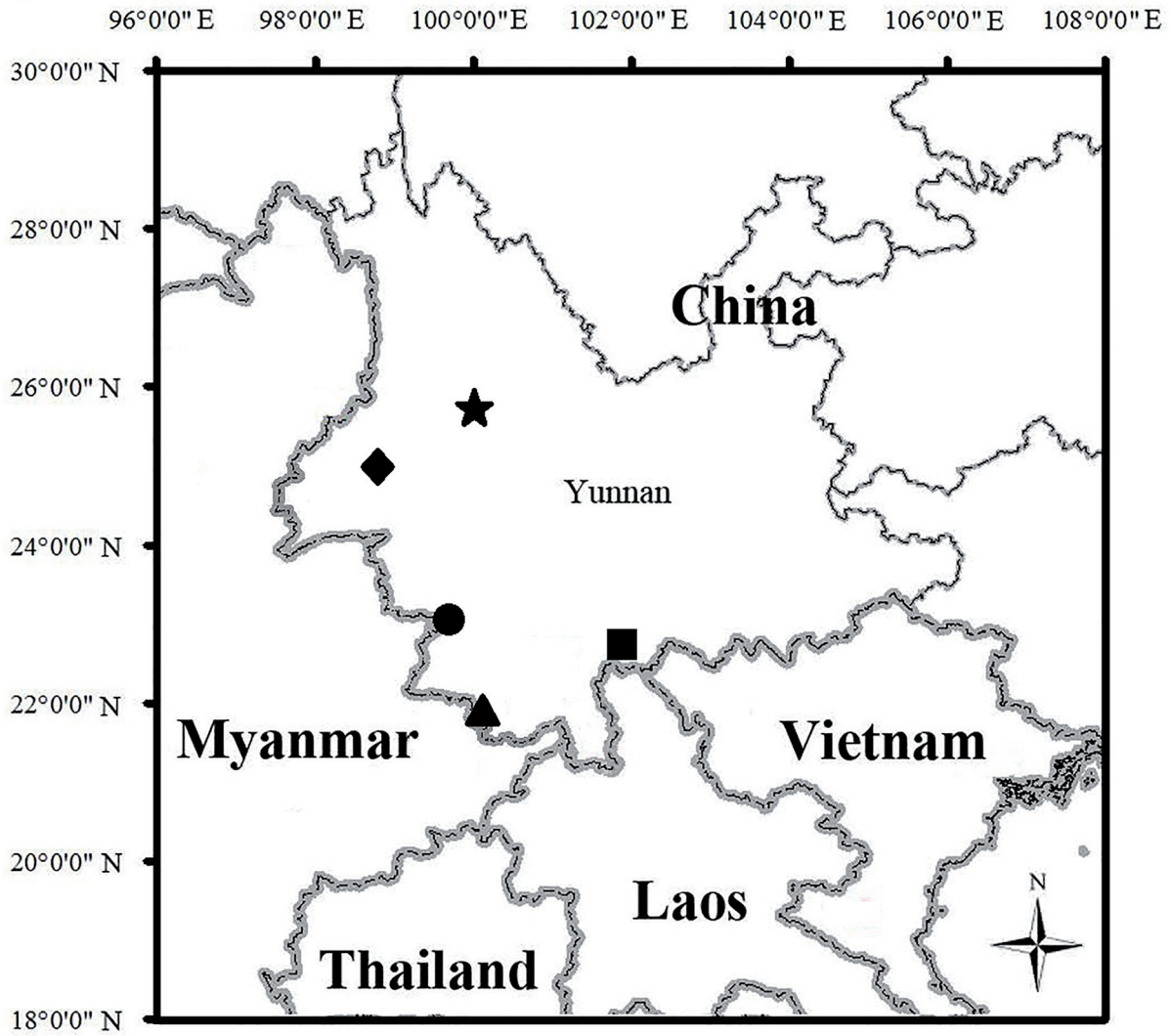

Fig. 8. Map showing the type locality of *Pareas yunnanensis* (Vogt, 1922) (black star), the type locality of *P. geminatus* Ding, Chen, Suwannapoom, Nguyen, Poyarkov & Vogel, 2020 (black square), the type locality of *P. xuelinensis* Liu & Rao, 2021 (black circle), the type locality of *P. nigriceps* Guo & Deng, 2009 (black diamond), and the type locality of *P. tigerinus* sp. nov. (black triangle).

Pareas tigerinus sp. nov. can be distinguished from *P. hamptoni* by having one preocular (vs two preoculars), fewer ventral scales (160–171 vs 195–202), fewer subcaudals (62–64 vs 96), relatively shorter tail (TL/SVL 0.25–0.26 vs 0.37), and infralabials not fused with the chin-shield (vs fourth or fifth infralabial fused with second chin-shield).

Pareas tigerinus sp. nov. can be distinguished from *P. kaduri* by having relatively smaller body size (SVL 392–434 vs 455–550), 3–5 rows of mid-dorsal scales keeled on the middle part of the body, 5–7 rows of mid-dorsal scales keeled on the posterior part of the body in females (vs all dorsal scales smooth in females), fewer temporals (1+1 or 1+2 vs 2+3), and fewer maxillary teeth (4 or 5 vs 6 or 7).

Pareas tigerinus sp. nov. can be distinguished from *P. niger* (Pope, 1928) by yellow colouration of dorsum with dark crossbars (vs solid black marking on dorsum), ventral surface of tail with no or sparse spots (vs ventral surface of tail with dense black spots or ventral surface of tail completely black), and having fewer maxillary teeth (4 or 5 vs 6–8).

Pareas tigerinus sp. nov. can be distinguished from *P. stanleyi* (Boulenger, 1914), *P. victorianus* Vogel, Nguyen & Poyarkov, 2021, and *P. vindumi* Vogel, 2015 by preocular present (vs preocular absent), loreal not entering the orbit (vs loreal entering orbit).

Pareas tigerinus sp. nov. can be distinguished from *P. xuelinensis* by having enlarged vertebral scales (vs vertebral scales not enlarged), infralabials not fused with chin-shield (vs fourth or fifth infralabial fused with second chin-shield), having fewer ventral scales (160–171 vs 182–188), fewer subcaudals (62–64 vs 87–93), and relatively shorter tail (TL/SVL 0.25–0.26 vs 0.33–0.34).

Pareas tigerinus sp. nov. can be distinguished from *P. yunnanensis* by no black stripes on the neck (vs two wide black stripes pass from parietals to the vertical black bars on the neck), having dark nuchal band (vs dark nuchal band absent), having distinct dark spots on each side of the head (vs no or indistinct spots on each side of head), and iris brownish black or reddish brown (vs iris brownish yellow or brownish orange).

Pareas tigerinus sp. nov. is superficially most similar to *P. nigriceps* in morphology characteristic and coloration. However, the new species can be distinguished from *P. nigriceps* (Table 6) by having a relatively shorter tail (TL/SVL 0.25–0.26 vs 0.32), eight infralabials (vs seven infralabials), fewer ventral scales (160–171 vs 175), fewer subcaudals (62–64 vs 76), and fewer maxillary teeth (4 or 5 vs 6 or 7).

Discussion

In this study, we resolved the long-standing systematic controversy of *Pareas yunnanensis*. Based on four newly collected specimens from its type locality, we revalidated this species and reported the re-discovery of this secretive snake exactly 100 years after its original description. We also provided the first molecular data and photographs in life of this rare species of *Pareas*.

Amblycephalus yunnanesis was described simultaneously in two different papers published in the same issue of *Archiv für Naturgeschichte* by Mell (1922: 125) and by Vogt (1922: 142), respectively. As Mell (1922: 125) indicated the species authority: *Amblycephalus yunnanensis* Vogt (sp. n.), so it is clear that Vogt is the author of this species, however, according to the requirements of the Code (ICZN 1999: Art. 24.2), a formal nomenclatural act is needed in this case. Herein, we therefore follow the current usage in the literature (i.e., Pope 1935; Rao & Yang 1992; Zhao & Adler 1993; Zhao 2006; Yang & Rao 2008; Ding *et al*. 2020; Guo *et al*. 2020; Wang *et al*. 2020) and the original indication of the species authority by Mell (1922: 125), formally select Vogt as the correct author of this taxon, to which we presently refer as *Pareas yunnanensis* (Vogt, 1922).

Table 6. Comparisons of morphometric and meristic data for *Pareas tigerinus* sp. nov. and *P. nigriceps* Guo & Deng, 2009. Measurements in mm, data for *P. nigriceps* from Guo & Deng (2009).

	***Pareas tigerinus* sp. nov.**	***Pareas nigriceps***
SVL	392–434	396
TL	109–111	125
TL/SVL	0.25–0.26	0.32
PrFBO	Yes	Yes or No
PreO	1	1
PosO	Fused	Fused
SubO	Fused	Fused
SPOF	Yes	Yes
ATem	1	1
PTem	1–2	2–3
SupL	7	7
InfL	8	7
LoBO	No	No
Vs	160–171	175
Sc	62–64	76
Ds	15-15-15	15-15-15
NED	1	1
NKD	3–5	9
Max	4–5	6–7
DNB	Present	Present
VBTr	53–61	60–66
VBTa	22–24	18

Based on the original description of *Pareas yunnanensis* by Vogt (1922), this species has two preoculars, one subocular, 1–2 postoculars, and loreal bordering the orbit in this species. However, after the examination of the syntypes of *P. yunnanensis* by G. Vogel, we found that these characters are somewhat ambiguous such as: preocular is single, suboculars and postoculars are fused, and loreal is not always bordering orbit in the syntypes of *P. yunnanensis*. In addtion, based on the newly collected specimens of *P. yunnanensis*, we found a few more morphological variation. Therefore, we expanded upon what is known of morphological variation and revised the morphological diagnosis of the species.

Previously, there were 26 recognized species within the genus *Pareas* (Poyarkov *et al.* 2022; Uetz *et al.* 2022). By resurrecting *P. yunnanensis* and describing a new species of *Pareas* from Yunnan, we increased the number of recognized species of this genus to 28 and increased the number of recognized species of this genus in China to 22. Compared with other countries, China has the largest number of species of *Pareas*. Species diversity of *Pareas* is especially rich in Yunnan Province of China, which has more than half of the species number of this genus in China. Our data therefore also underline the importance of tropical and montane areas of Yunnan Province for herpetological conservation in

China. Further herpetological surveys in remote montane areas of Yunnan Province will likely result in discovery of more new lineages and species of slug-eating snakes of the genus *Pareas*.

Acknowledgements

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