taxonomy

Article

A New Species of *Pareas* Wagler, 1830 (Squamata, Pareidae) from Northwestern Yunnan, China †

Shuo Liu [1], Mingjing Yang [2], Jingqiu Rao [3], Yuhong Guo [4,*] and Dingqi Rao [5,*]

[1] Kunming Natural History Museum of Zoology, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming 650223, China
[2] Agricultural Service Center of the People's Government of Lurong Township, Zhenfeng 562203, China
[3] Key Laboratory for Conserving Wildlife with Small Populations in Yunnan, Southwest Forestry University, Kunming 650233, China
[4] College of Life Science, Leshan Normal University, Leshan 614000, China
[5] Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming 650201, China
* Correspondence: gyhharry@126.com (Y.G.); raodq@mail.kiz.ac.cn (D.R.)

† urn:lsid:zoobank.org:act:8EEA5A22-7041-424A-A931-FCD465E1203A;
urn:lsid:zoobank.org:pub:22483816-AC27-41FF-81E9-A0CB378BFA31.

Abstract: A new species of *Pareas* Wagler, 1830 is described from Dulongjiang Township, Gongshan County, Yunnan Province, China. Phylogenetically, the new species is most closely related to *Pareas kaduri* Bhosale, Phansalkar, Sawant, Gowande, Patel and Mirza, 2020; however, the genetic divergence (uncorrected p-distance) of the cyt b gene between the new species and *P. kaduri* reached 9.4%. Morphologically, the new species can be distinguished from *P. kaduri* by the absence of preoculars, loreal bordering the orbit, the fusion of subocular and postocular, three rows enlarged vertebral scales, five rows keeled mid-dorsal scales at the middle of the body, having more subcaudals, and having a relatively longer tail. In addition, the new species can be distinguished from all other congeners by a combination of morphological characteristics. Our work brings the total number of recognized species of the genus *Pareas* to 29, of which 23 occur in China.

Keywords: cyt b; Dulongjiang; Gongshan; systematics; taxonomy

Citation: Liu, S.; Yang, M.; Rao, J.; Guo, Y.; Rao, D. A New Species of *Pareas* Wagler, 1830 (Squamata, Pareidae) from Northwestern Yunnan, China. *Taxonomy* **2023**, *3*, 169–182. https://doi.org/10.3390/taxonomy3020013

Academic Editor: Edgar Lehr

Received: 20 February 2023
Revised: 21 March 2023
Accepted: 24 March 2023
Published: 31 March 2023

1. Introduction

The family Pareidae Romer, 1956 was once considered a subfamily (Pareatinae Romer, 1956) of Colubridae Oppel, 1811 [1–3], which encompasses two subfamilies (Pareinae and Xylophiinae Deepak, Ruane and Gower, 2019) and four genera (*Aplopeltura* Duméril, 1853; *Asthenodipsas* Peters, 1864; *Pareas* Wagler, 1830 [4]; and *Xylophis* Beddome, 1878) [5–7]. Poyarkov et al. [8] partitioned the genus *Pareas* into two subgenera (*Pareas* and *Eberhardtia* Angel, 1920).

Evolutionarily, although there is practically no fossil record for Pareinae [9], based on the calibration priors from Deepak et al. [5], Poyarkov et al. [8] inferred that Pareinae originated in Sundaland during the middle Eocene and the most recent common ancestor of Pareinae originated in late Eocene. Pareinae colonized mainland Asia in the early Oligocene, when the genera *Asthenodipsas* and *Pareas* started to diversify [8].

The snail-eating or slug-eating snake genus *Pareas* is a group of snakes that has undergone fast taxonomic changes which is mainly distributed in northeastern India, Myanmar, southern and eastern China, Indochina, and Sundaland [7,8]. Before 2000, there were only 11 recognized species in this genus, namely *Pareas boulengeri* (Angel, 1920), *Pareas carinatus* Wagler, 1830; *Pareas chinensis* (Barbour, 1912); *Pareas formosensis* (Van Denburgh, 1909); *Pareas hamptoni* (Boulenger, 1905); *Pareas iwasakii* (Maki, 1937); *Pareas macularius* Theobald, 1868; *Pareas margaritophorus* (Jan, 1866); *Pareas monticola* (Cantor, 1839); *Pareas nuchalis* (Boulenger, 1900); and *Pareas stanleyi* (Boulenger, 1914). There-after, *P. macularius* was synonymized with *P. margaritophorus* by Huang [10] but was revalidated by Hauser [11]; Guo and Deng [12] described *Pareas nigriceps* Guo and Deng, 2009 from western Yunnan, China; Vogel [13] described *Pareas vindumi* Vogel, 2015 from northern Myanmar; You et al. [14] described *Pareas atayal* You, Poyarkov and Lin, 2015 from Taiwan, China, and resurrected *Pareas komaii* (Maki, 1931); Ding et al. [15] described *Pareas geminatus* Ding, Chen, Suwannapoom, Nguyen, Poyarkov and Vogel, 2020 from southern Yunnan, China; Bhosale et al. [16] described *Pareas kaduri* Bhosale, Phansalkar, Sawant, Gowande, Patel and Mirza, 2020 from northeastern India; Vogel et al. [17] resurrected *Pareas andersonii* Boulenger, 1888 and *Pareas modestus* Theobald, 1868; Wang et al. [6] described *Pareas menglaensis* Wang, Che, Liu, Ki, Jin, Jiang, Shi and Guo, 2020 and *Pareas mengziensis* Wang, Che, Liu, Ki, Jin, Jiang, Shi and Guo, 2020 from southern and central Yunnan, China, respectively; Liu and Rao [18] described *Pareas xuelinensis* Liu and Rao, 2021 from western Yunnan, China, resurrected *Pareas niger* (Pope, 1928), and synonymized *P. mengziensis* with *P. niger*; Vogel et al. [19] described *Pareas victorianus* Vogel, Nguyen and Poyarkov, 2021 from western Chin State, Myanmar; Le et al. [20] described *Pareas temporalis* Le, Tran, Hoang and Stuart, 2021 from southern Vietnam; Poyarkov et al. [8] described *Pareas abros* Poyarkov, Nguyen, Pawangkhanant, Yushchenko, Brakels, Nguyen, Nguyen, Suwannapoom, Orlov and Vogel, 2022 and *Pareas kuznetsovorum* Poyarkov, Yushchenko and Nguyen, 2022 from Vietnam, resurrected *Pareas berdmorei* Theobald, 1868, and synonymized *P. menglaensis* with *P. berdmorei*; and Liu et al. [21] resurrected *Pareas yunnanensis* (Vogt, 1922) and described *Pareas tigerinus* Liu, Zhang, Poyarkov, Hou, Wu, Rao, Nguyen and Vogel, 2023 from southwestern Yunnan, China. To date, this genus contains 28 recognized species [21], of which more than one third were described in the past decade [7,21]. However, there are still undiscovered new species and unresolved taxonomic problems in this genus [8,21].

Dulongjiang, a township in Gongshan County, Yunnan Province, China, located in the China–Myanmar border area, which constitutes a long-acknowledged biodiversity hotspot [22,23]. However, previously there were few surveys in Dulongjiang because of its very inconvenient transportation conditions [24]. It was not until recent years that driveways were available there that more surveys were conducted there. However, there are still a lot of new species in Dulongjiang to be discovered.

During our fieldwork in northwestern Yunnan Province, China, in 2015, one specimen of the genus *Pareas* was collected from Dulongjiang Township, Gongshan County. Morphological comparison and molecular analysis indicate that the specimen belongs to a distinctive taxon and is separated from all other named species of the genus *Pareas*. Therefore, we describe this specimen as a new species herein.

2. Materials and Methods

The specimen of the new species was collected by hand at night and was euthanized using isoflurane, injected intraperitoneally with 95% ethanol, and then preserved in 75% ethanol. Liver tissue was collected for molecular analysis and stored in 99% ethanol. The specimen was deposited at Kunming Natural History Museum of Zoology, Kunming Institute of Zoology, Chinese Academy of Sciences (KIZ).

Measurements of the body and tail were taken to the nearest 1 mm with a measuring tape and measurements of the head were taken to the nearest 0.1 mm with a digital caliper. Paired meristic characters are given as left/right. The methodology of measurements and meristic counts followed those of Bhosale et al. [16] and Liu et al. [21]. Abbreviations used were as follows: ATem, number of anterior temporals; CL, cephalic length (measured from tip of snout to constriction of neck); DNB, dark nuchal band; DS, dorsal scale rows (counted at one head length behind the head, mid-body, and one head length before the vent); ED, eye diameter (widest diameter of the eye); El, eye to labial height (measured from lowest border of the eye to lower border of the labial); EN, eye to nares distance; ES, eye to snout length; HL, head length (measured from snout tip to the angle of the jaw); HW, head width (measured at the widest part of the head); InfL, infralabials; LoBO, loreal bordering orbit;

Max, maxillary teeth; NED, number of enlarged dorsal scale rows at midbody; NKD, number of keeled dorsal scale rows at the middle of the body; NW, neck width (measured at the constriction of the neck); PosO, postoculars; Prec, precloacal plate; PreO, preoculars; PrFBO, prefrontal bordering orbit; PTem, number of posterior temporals; Sc, subcaudals; SPOF, subocular-postocular fused or not; SubO, suboculars; SupL, supralabials; SVL, snout-vent length (measured from tip of snout to posterior margin of cloacal plate); TaL, tail length (measured from posterior margin of cloacal plate to tip of tail); TL, total length; VBTr, vertical dark bars on trunk; Vs, ventrals. For comparison, data for other species were taken from the original and subsequent descriptions [2,6,8,11–21,25–33].

The sequence of the mitochondrial gene fragment cytochrome b (cyt b) was generated for the newly collected specimen. Homologous sequences were obtained from GenBank. The new sequence has been deposited in GenBank. *Aplopeltura boa* (Boie, 1828) was selected as the outgroup, based on the work of Liu et al. [21]. All the GenBank accession numbers for the taxa used in this study are listed in Table 1. Genomic DNA was extracted from liver tissue; the primers L14910/H16064 [34] were used for DNA sequencing. DNA extraction and amplification conditions followed those of Poyarkov et al. [8]. The amplification products were purified and sequenced by Tsingke Biotechnology Co., Ltd., Beijing, China. The sequence was edited and managed using SeqMan in Lasergene 7.1 (DNASTAR Inc., Madison, WI, USA) and MEGA 11 [35].

Table 1. Sequences (cyt b) used in phylogenetic analysis of this study. "Mt." = mountain, "Is." = island, "Hw." = highway.

Species	Locality	Voucher No.	GenBank No.
Pareas abros	Song Thanh, Quang Nam, Vietnam	ZMMU R-16393	MZ712235
Pareas andersonii	Mt. Natmataung, Chin, Myanmar	CAS 235359	MT968772
Pareas atayal	N. Cross Is. Hw., Taiwan, China	NMNS 05594	KJ642122
Pareas berdmorei	Kin Pon Chaung, Mon, Myanmar	CAS 240362	MZ712219
Pareas boulengeri	Jiangkou, Guizhou, China	GP 2923	MK135090
Pareas carinatus	Sungai Sedim, Kedah, Malaysia	LSUHC10604	KC916748
Pareas chinensis	Hongya, Sichuan, China	GP 2383	MK135089
Pareas formosensis	N. Cross Is. Hw., Taiwan, China	NMNS 05632	KJ642130
Pareas geminatus	Jiangcheng, Yunnan, China	CIB 118021	MW287068
Pareas hamptoni	Kachin, Myanmar	YPX 18219	MK135077
Pareas iwasakii	Ishigaki Is., S. Ryukyu, Japan	I03-ISG1	KJ642158
Pareas kaduri	Lohit, Arunachal, India	BNHS 3574	MT188734
Pareas kaduri	Lohit, Arunachal, India	BNHS 3575	MW026190
Pareas komaii	Taitung, Taiwan, China	HC 000669	JF827687
Pareas kuznetsovorum	Song Hinh, Phu Yen, Vietnam	ZMMU R-16802	MZ712232
Pareas macularius	Bago, Myanmar	CAS 206620	AF471082
Pareas margaritophorus	Cangwu, Guangxi, China	YBU 16061	MK135097
Pareas modestus	Aizawl, Mizoram, India	MZMU 1293	MT968773
Pareas monticola	Medog, Tibet, China	GP 2027	MK135107
Pareas niger	Kunming, Yunnan, China	KIZ 059339	MW436706
Pareas nigriceps	Mt. Gaoligong, Yunnan, China	SYSr001222	MK201455
Pareas nuchalis	Belait, Brunei	FK 2626	MZ603794
Pareas stanleyi	Guilin, Guangxi, China	HM 2007-S001	JN230704
Pareas temporalis	Da Huoai, Lam Dong, Vietnam	UNS 09992	MZ603793
Pareas tigerinus	Menghai, Yunnan, China	KIZ 20210703	OP752143
Pareas tigerinus	Menghai, Yunnan, China	KIZ 20210704	OP752144
Pareas tigerinus	Menghai, Yunnan, China	KIZ 20210705	OP752145
Pareas victorianus	Mt. Natmataung, Chin, Myanmar	CAS 235254	MW438300
Pareas vindumi	Lukpwir, Kachin, Myanmar	CAS 248147	MT968776
Pareas xuelinensis	Lancang, Yunnan, China	KIZ XL1	MW436709
Pareas yunnanensis	Dali, Yunnan, China	KIZ 2022036	OP752149
Pareas dulongjiangensis sp. nov.	Gongshan, Yunnan, China	KIZ R201607	OQ718498
Aplopeltura boa	Malaysia	LSUHC 7248	KC916746

Sequences were aligned using ClustalW [36] integrated in MEGA 11 [35] with default parameters. Uncorrected pairwise genetic divergences (p-distance) were estimated using MEGA 11 [35]. The best substitution model (GTR + F + I + G4) for Bayesian inference and the best substitution model (GTR + F + R4) for maximum likelihood were selected using ModelFinder [37] in IQ-TREE 1.6.12 [38] under the Akaike Information Criterion (AIC). Bayesian inference was performed in MrBayes 3.2.7 [39]. Four Markov chains were run for 10,000,000 generations sampled every 1000 generations. The first 25% of the sampled trees were discarded as burn-in and the remaining trees were used to calculate Bayesian posterior probabilities. Maximum likelihood analysis was performed using IQ-TREE 1.6.12 [38]. Nodal support was estimated by 1000 ultrafast bootstrap replicates. Nodes with Bayesian posterior probabilities of 0.95 and above were considered strongly supported [40–42] and nodes with ultrafast bootstrap values of 95 and above were considered strongly supported [43].

3. Results

Maximum likelihood analyses and Bayesian inference showed identical topology; the newly collected specimen formed a distinct lineage which is sister to *Pareas kaduri* with strong support, which means that the newly collected specimen belongs to the subgenus *Eberhardtia* and is a member of the *P. hamptoni* species group [8] (Figure 1). The genetic divergence (uncorrected p-distance) between the newly collected specimen and *P. kaduri* was 9.4%, the genetic divergence (uncorrected p-distance) between the newly collected specimen and other congeners ranged from 10.3% to 25.0% (Table 2).

Table 2. Uncorrected p-distances (%) amongst the members of *Pareas*, calculated from cyt b gene sequences. (1) *Pareas abros*, (2) *P. andersonii*, (3) *P. atayal*, (4) *P. berdmorei*, (5) *P. boulengeri*, (6) *P. carinatus*, (7) *P. chinensis*, (8) *P. formosensis*, (9) *P. geminatus*, (10) *P. hamptoni*, (11) *P. iwasakii*, (12) *P. kaduri*, (13) *P. komaii*, (14) *P. kuznetsovorum*, (15) *P. macularius*, (16) *P. margaritophorus*, (17) *P. modestus*, (18) *P. monticola*, (19) *P. niger*, (20) *P. nigriceps*, (21) *P. nuchalis*, (22) *P. stanleyi*, (23) *P. temporalis*, (24) *P. tigerinus*, (25) *P. victorianus*, (26) *P. vindumi*, (27) *P. xuelinensis*, (28) *P. yunnanensis*, (29) *Pareas dulongjiangensis* sp. nov.

	(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)	(28)
(1)																												
(2)	23.5																											
(3)	22.8	20.2																										
(4)	21.3	23.8	23.5																									
(5)	23.2	19.7	18.3	23.7																								
(6)	21.8	22.9	22.6	13.8	22.2																							
(7)	23.7	19.1	18.4	24.7	9.0	22.6																						
(8)	22.9	21.7	15.1	24.9	17.2	23.9	17.4																					
(9)	22.9	22.2	14.2	23.0	17.4	23.1	18.8	8.3																				
(10)	23.6	21.5	14.2	23.7	17.2	23.6	18.3	7.2	7.3																			
(11)	23.4	20.4	7.2	23.7	16.8	23.3	17.9	14.4	14.4	13.5																		
(12)	25.0	20.7	15.6	24.9	19.8	22.6	19.3	13.3	13.7	13.0	15.2																	
(13)	23.3	19.5	8.5	23.9	18.1	23.9	18.3	14.7	14.9	14.5	7.9	16.1																
(14)	20.9	23.8	22.9	13.0	22.6	13.0	23.0	23.7	22.8	23.3	23.9	23.1	24.2															
(15)	23.0	13.9	19.2	22.7	17.8	22.1	17.4	19.0	20.4	19.7	18.9	19.8	18.3	22.8														
(16)	25.8	15.3	19.1	24.7	19.2	23.5	18.3	20.5	21.8	20.5	18.8	20.8	19.5	23.7	14.8													
(17)	23.5	12.0	18.7	24.4	19.2	24.0	18.7	20.7	19.9	19.6	19.3	19.4	17.8	24.4	11.0	13.9												
(18)	22.6	18.9	17.3	22.0	18.7	22.8	18.1	18.9	19.7	19.0	17.8	19.0	17.9	22.5	18.1	19.7	18.2											
(19)	22.7	20.4	14.3	23.8	17.5	23.0	17.8	7.2	6.8	5.6	13.7	12.5	14.9	22.7	18.9	20.1	18.9	18.5										
(20)	23.6	18.8	16.2	22.9	16.9	22.6	16.2	12.6	13.5	12.6	16.1	10.1	16.2	23.9	17.8	17.9	16.4	19.1	12.5									
(21)	21.1	24.3	23.7	21.5	24.3	21.6	24.0	24.4	25.1	24.8	24.5	25.6	23.5	20.4	23.1	26.1	24.5	21.4	25.2	23.8								
(22)	25.7	20.4	19.2	25.0	15.7	24.9	15.4	19.6	19.4	18.7	18.2	20.6	17.4	24.9	19.9	19.5	19.4	19.2	19.5	19.0	24.0							
(23)	12.3	23.6	23.1	20.6	22.1	19.9	21.5	24.3	23.6	23.4	23.1	24.8	23.8	20.1	24.4	24.0	23.2	21.3	23.3	23.8	19.8	23.4						
(24)	23.1	19.4	14.7	24.2	19.0	23.3	18.6	12.3	12.3	11.8	14.1	11.2	14.0	24.3	18.6	20.4	18.1	18.9	11.4	4.3	25.2	19.4	24.6					
(25)	24.3	20.6	19.6	22.8	19.1	22.8	17.4	17.8	18.4	18.6	19.7	18.9	19.4	22.9	19.1	21.5	19.3	15.1	17.9	19.1	24.7	19.0	24.2	18.1				
(26)	24.5	20.8	14.9	24.7	18.4	23.8	17.5	12.1	12.4	11.4	14.7	12.9	15.2	23.7	19.3	20.5	19.9	18.3	10.8	12.3	24.7	19.4	24.9	12.0	17.8			
(27)	23.1	21.2	13.8	25.1	16.9	24.3	18.6	8.0	5.9	8.1	13.7	13.6	14.8	24.5	19.2	21.3	20.2	19.8	7.2	12.5	25.9	19.4	24.4	12.1	18.8	12.6		
(28)	23.2	22.1	14.6	24.6	16.7	23.4	18.0	7.9	4.0	6.1	14.0	12.9	14.7	23.7	19.7	21.5	20.7	20.0	6.3	12.8	24.8	19.5	23.7	11.7	18.7	11.4	6.1	
(29)	24.0	19.6	14.0	24.4	18.0	23.3	17.6	12.9	12.7	12.4	13.9	9.4	13.8	24.2	19.4	18.4	18.6	16.5	12.3	10.3	24.6	19.2	25.0	10.3	18.0	12.6	13.2	12.9

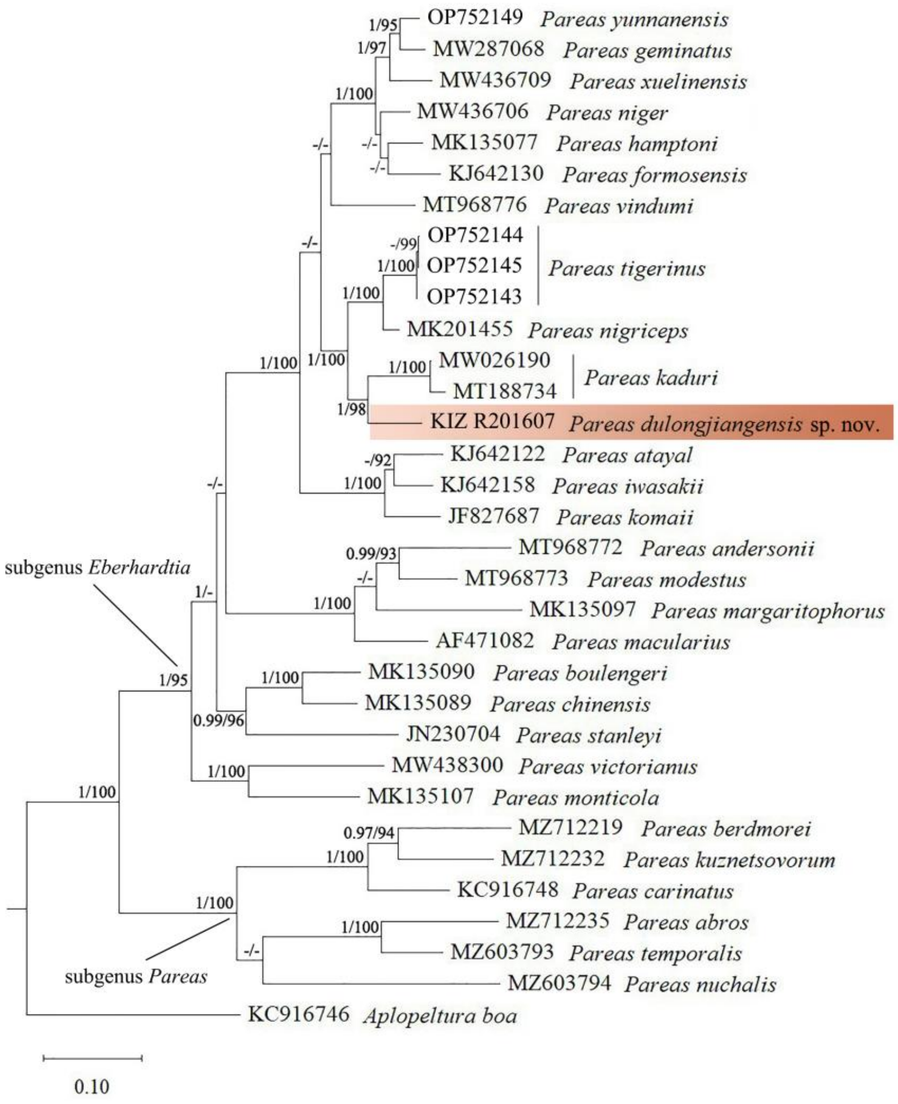

Figure 1. Phylogenetic tree of *Pareas* inferred from cyt b gene. The new species is highlighted in brown. Numbers before slashes indicate values (>0.9) of Bayesian posterior probabilities and numbers after slashes indicate values (>90) of bootstrap support for maximum likelihood analyses.

Class Reptilia Laurenti, 1768
Order Squamata Oppel, 1811
Suborder Serpentes Linnaeus, 1758
Infraorder Caenophidia Hoffstetter, 1939
Family Pareidae Romer, 1956
Subfamily Pareinae Romer, 1956
Genus *Pareas* Wagler, 1830
Subgenus *Eberhardtia* Angel, 1920
Pareas dulongjiangensis sp. nov.
urn:lsid:zoobank.org:act:8EEA5A22-7041-424A-A931-FCD465E1203A
(Figures 2 and 3)

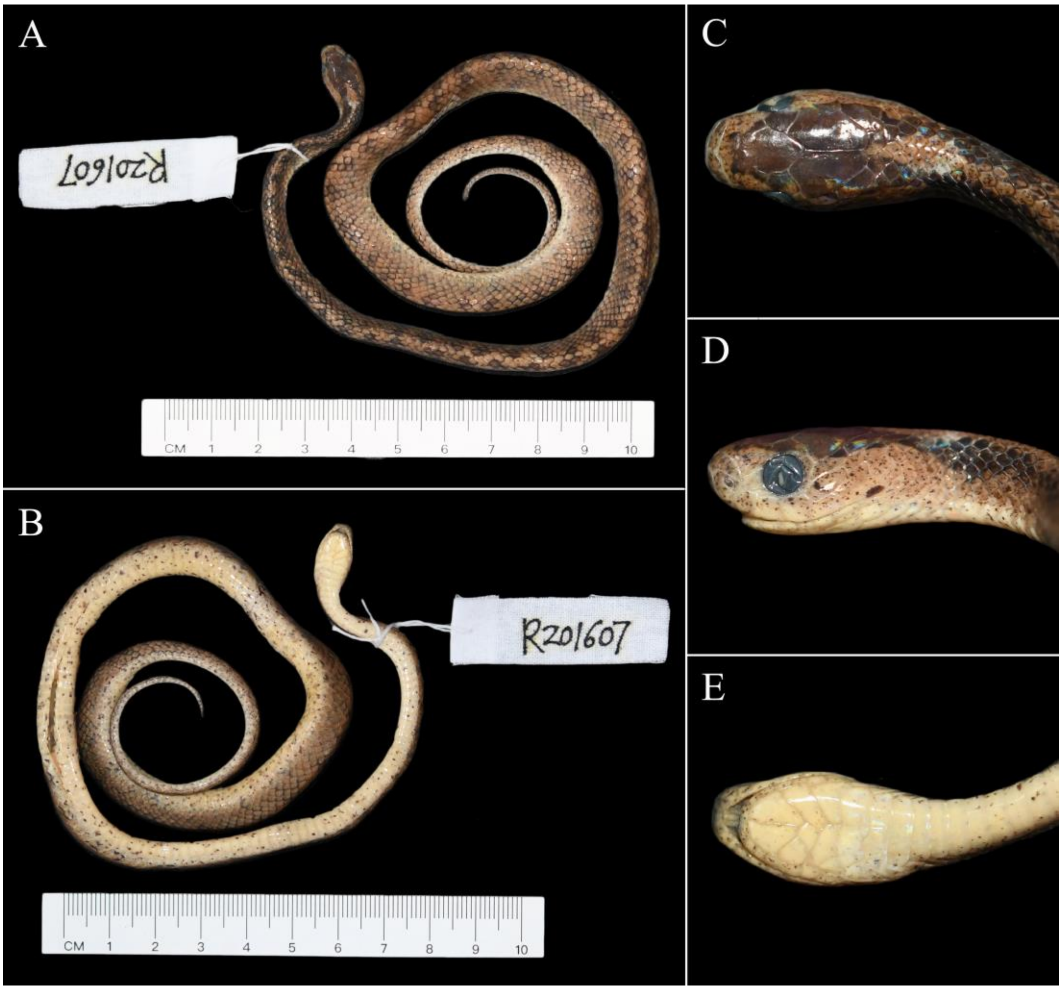

Figure 2. *Pareas dulongjiangensis* sp. nov., holotype in preservative. (**A**) Dorsal view of the body; (**B**) ventral view of the body; (**C**) close-up view of the dorsal side of the head; (**D**) close-up view of the left side of the head; (**E**) close-up view of the ventral side of the head.

Holotype. KIZ R201607, adult female, collected from Kongdang Village, Dulongjiang Township, Gongshan County, Nujiang Prefecture; Yunnan Province, China, on 9 September 2015 by Dingqi Rao (27°50′16″ N, 98°19′30″ E; 1460 m).

Diagnosis. Preocular absent; postocular fused with subocular; loreal bordering orbit; prefrontal bordering orbit; infralabials not fused with chin-shield; chin-shields three pairs, first pair triangular, second pair and third pair elongate; dorsal scales 15 rows throughout without apical pits; three rows vertebral scales enlarged; five rows mid-dorsal scales keeled at middle of body; supralabials6–7; infralabials7–9; precloacal plate undivided; ventral scales182; and subcaudals 76, paired. In preservative, dorsal surface of head chocolate brown, from which two brownish-black longitudinal stripes run on each side of the neck, leaving a pale central portion; lateral surface of head dense with brownish black dusting and two short brownish-black streaks, one on lower anterior temporal and another on last supralabial; almost no mottling on ventral surface of head; sparse brown mottling on ventral surfaces of body and tail; and indistinct vertical dark bars on trunk and tail.

Figure 3. Close-up views of the dorsal scales at the middle of the body of the holotype (KIZ R201607) in preservative. (**A**) Dorsal side; (**B**) left side; (**C**) right side.

Description. Adult female, SVL 373 mm, TL 115 mm, TaL/SVL 0.308, TaL/TL 0.236; body elongated, slightly compressed laterally; body vertebral ridge developed; head distinct from neck; snout wide and blunt, projecting beyond lower jaw. Rostral approximately as wide as high, not visible from above; nasals undivided; internasals wider than long; prefrontals bordering orbits; frontal anteriorly fused with prefrontals; parietals large, much longer than wide; loreal, single, large, approximately rectangular, broadly bordering orbit; preocular absent; supraocular single, slightly longer than wide; subocular and postocular fused into one thin elongated crescent-shaped scale; anterior temporals two on each side, posterior temporals three on left side and two on right side; supralabials six on left side and seven on right side, all separated from eye; infralabials seven on left side and nine on right side, anterior-most in contact with its opposite between mental and anterior chin-shields;

infralabials not fused with chin-shield; chin-shields three pairs, first pair triangular, second pair and third pair elongate, and first pair larger than other two; ventral scales182; precloacal plate undivided; subcaudals 76, paired; dorsal scales 15 rows throughout without apical pits, three rows vertebral scales enlarged, and five rows mid-dorsal scales keeled at middle of body.

Coloration. In preservative over seven years, dorsal surface of head chocolate brown, from which two brownish-black longitudinal stripes run on each side of neck leaving a pale central portion; dorsal surface of body brownish-yellow, and approximately 52 indistinct, vertical, slightly billowing dark bars on trunk, and dark bars on tail more indistinct or invisible; lateral surface of head dense with brownish-black dusting and two short brownish-black streaks, one on lower anterior temporal and another on last supralabial; ventral surface of head light yellow with almost no mottling; and ventral surfaces of body and tail light yellow with sparse brown mottling. Coloration in life unknown.

Comparison. *Pareas dulongjiangensis* sp. nov. can be distinguished from *P. andersonii*, *P. modestus*, *P. macularius*, and *P. margaritophorus* by the yellow body background color (vs. body background colors being grey, dark grey, brownish-grey, or completely black).

Pareas dulongjiangensis sp. nov. can be distinguished from *P. abros*, *P. atayal*, *P. berdmorei*, *P. carinatus*, *P. iwasakii*, *P. komaii*, *P. kuznetsovorum*, *P. nuchalis*, and *P. temporalis* by the fusion of subocular and postocular into one thin elongated crescent-shaped scale (vs. subocular and postocular not being fused).

Pareas dulongjiangensis sp. nov. can be distinguished from *P. boulengeri* and *P. stanleyi* by the three rows enlarged vertebral scales (vs. vertebral scales not being enlarged).

Pareas dulongjiangensis sp. nov. can be distinguished from *P. chinensis*, *P. formosensis*, *P. geminatus*, *P. hamptoni*, *P. monticola*, *P. niger*, *P. vindumi*, *P. xuelinensis*, and *P. yunnanensis* by the absence of preoculars (vs. preoculars being present).

Pareas dulongjiangensis sp. nov. can be distinguished from *P. victorianus* by the three rows enlarged vertebral scales (vs. one row vertebral scales being enlarged), having more ventral scales (182 vs. 164), more subcaudals (76 vs. 58), and a relatively longer tail (TaL/SVL 0.308 vs. 0.265).

Pareas dulongjiangensis sp. nov. can be distinguished from *P. nigriceps* by the absence of preoculars (vs. preoculars being present), loreal bordering the orbit (vs. not bordering), three rows enlarged vertebral scales (vs. one row vertebral scales being enlarged), and having more ventral scales (182 vs. 175).

Pareas dulongjiangensis sp. nov. can be distinguished from *P. tigerinus* by the absence of preoculars (vs. preoculars being present), loreal bordering the orbit (vs. not bordering), three rows enlarged vertebral scales (vs. one row vertebral scales being enlarged), having more ventral scales (182 vs. 160–171), more subcaudals (76 vs. 62–64), and a relatively longer tail (TaL/SVL 0.308 vs. 0.25–0.26).

Pareas dulongjiangensis sp. nov. is most similar to *P. kaduri* in morphological characteristics and coloration; however, the new species can be distinguished from *P. kaduri* by the absence of preoculars (vs. preoculars being present), loreal bordering the orbit (vs. not bordering), the fusion of subocular and postocular (vs. the presence of one subocular and two postoculars), three rows enlarged vertebral scales (vs. one row vertebral scales being enlarged), five rows keeled mid-dorsal scales at the middle of the body in the single female (vs. mid-dorsal scales at the middle of the body being smooth in the single female), having more subcaudals (76 vs. 52–70), and having a relatively longer tail (TaL/SVL 0.308 vs. 0.226–0.262) (see Table 3).

Table 3. Comparison of morphometric and meristic data for *Pareas dulongjiangensis* sp. nov. and *P. kaduri*. The data for *P. kaduri* were obtained from Bhosale et al. [16].

	***Pareas dulongjiangensis* sp. nov.**	***Pareas kaduri***
	Holotype KIZ R201607	***n* = 4**
	♀	**3♂, 1♀**
SVL	373	455–550
TaL	115	113–144
TL	488	571–694
TaL/SVL	0.308	0.226–0.262
TaL/TL	0.236	0.184–0.207
HL	14.0	10.4–14.6
CL	15.4	14.3–18.8
HW	8.1	7.1–8.8
ED	2.6	2.7–3.6
El	1.7	1.5–1.8
ES	4.1	3.7–4.3
EN	1.8	2.3–2.7
NW	3.6	3.5–5.8
PrFBO	Yes	Yes
PreO	0	1
PosO	Fused	2
SubO	Fused	1
SPOF	Yes	No
ATem	2/2	2
PTem	3/2	3
SupL	6/7	7
InfL	7/9	7
LoBO	Yes	No
Vs	182	160–183
Prec	Undivided	Undivided
Sc	76	52–70
Ds	15-15-15	15-15-15
NED	3	1
NKD	5	8 in ♂, 0 in ♀
Max	5/4	6–7
DNB	Yes	Yes
VBTr	52	56

Etymology. The specific epithet *dulongjiangensis* refers to the Dulongjiang Township, where the new species was discovered. We propose “Dulongjiang Slug-eating Snake” for the common English name and “ 独龙江钝头蛇” (Pinyin: dú lóng jiāng dùn tóu shé) for the common Chinese name of this species.

Distribution. The new species is currently known only from its type locality in Dulongjiang Township, Gongshan County, Nujiang Prefecture, Yunnan Province, China.

Natural history notes. The specimen of the new species was found at night on the road near a small village by the Dandangluo River, which is a tributary of the Dulongjiang River; there are some rocks, grass, and plantains along the road (Figure 4). More ecological information about this species is unknown. Other herpetological species observed near the type locality of the new species include *Elaphe carinata* (Günther, 1864); *Nanorana chayuensis* (Ye, 1977); *Odorrana dulongensis* Liu, Che & Yuan, 2021; *Ovophis zayuensis* (Jiang, 1977); *Raorchestes dulongensis* Wu, Liu, Gao, Wang, Li, Zhou, Yuan & Che, 2021; *Rhabdophis leonardi* (Wall, 1923); and *Zhangixalus burmanus* (Andersson, 1939).

Figure 4. The habitat of *Pareas dulongjiangensis* sp. nov. at the type locality.

4. Discussion

Vogel et al. [19] indicated a potential new species of *Pareas* from Putao District, Kachin State, northern Myanmar, which lies just between the type localities of *P. kaduri* and *Pareas dulongjiangensis* sp. nov. (Figure 5); however, due to the lack of available molecular data for this potential new species, it was not formally described. In terms of morphology, this potential new species also resembles *P. kaduri* and *Pareas dulongjiangensis* sp. nov.; nevertheless, it differs from *P. kaduri* as the loreal contacts the eye (vs. not touching the eye) (see Figure 6), the dorsal scales are keeled in the single female (vs. smooth dorsal scales in the single female), it has slightly more subcaudals (71 vs. 65–70), and has a slightly, relatively longer tail (TaL/TL 0.210 vs. 0.184–0.207); it differs from *Pareas dulongjiangensis* sp. nov. by the presence of preoculars (vs. preoculars being absent), having one postocular (vs. postocular being fused with subocular), having one row enlarged median vertebral scales (vs. three rows), having fewer subcaudals (71 vs. 76), having a relatively shorter tail (TaL/TL 0.210 vs. 0.236), and having more vertical dark bars on the trunk (60 vs. 52). Although *P. kaduri* and *Pareas dulongjiangensis* sp. nov. have the closest phylogenetic relationship, the genetic distance between them is still relatively large (9.4%). We speculate that this potential new species is probably a species sandwiched between *P. kaduri* and *Pareas dulongjiangensis* sp. nov. As there is still no molecular data available for this potential new species, this speculation needs to be verified.

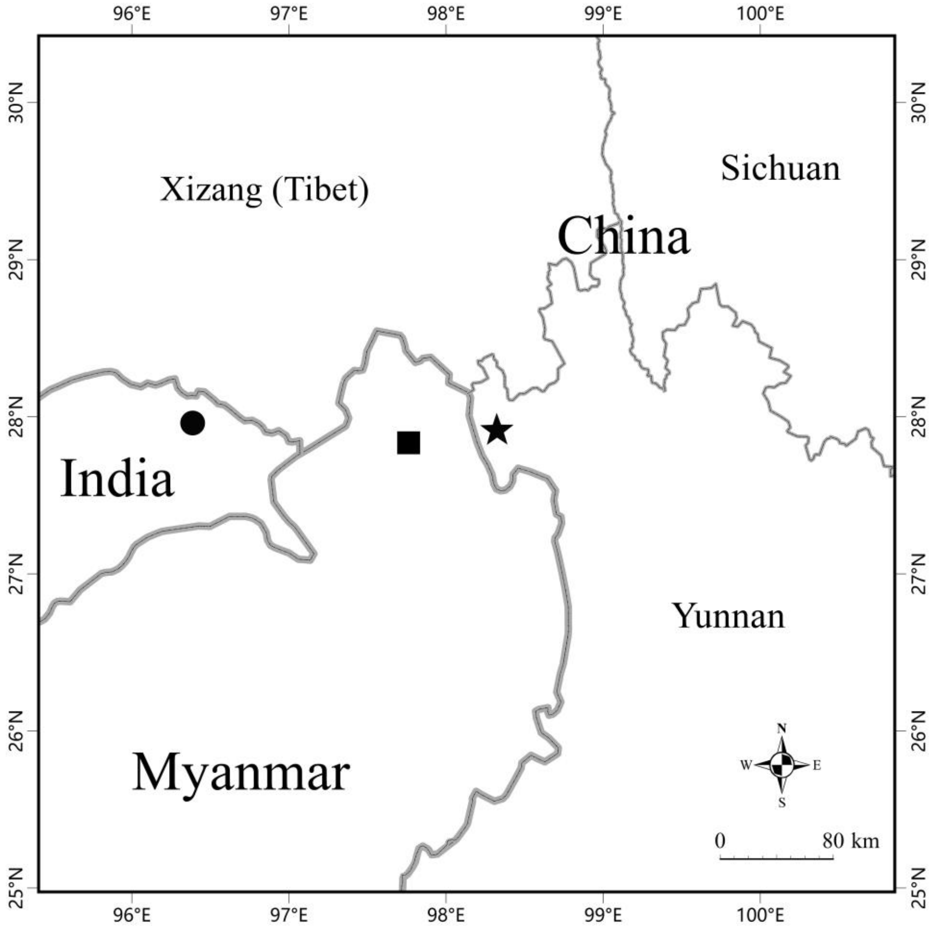

Figure 5. Map showing the type locality (black star) of *Pareas dulongjaingensis* sp. nov., the type locality (black dot) of *P. kaduri*, and the locality (black square) of the potential new species in Vogel et al. [19].

Pareas dulongjiangensis sp. nov. is phylogenetically closely related to *P. kaduri*. *Pareas kaduri* is distributed near the Lohit River bank, which belongs to the Brahmaputra River system, whereas *Pareas dulongjiangensis* sp. nov. is distributed near the Dulongjiang River bank, which belongs to the Irrawaddy River system. There are many high mountains between the two river systems [44], which would lead to geographical isolation. Therefore, biogeography also supports that *Pareas dulongjiangensis* sp. nov. and *P. kaduri* belong to two different species.

At present, *Pareas dulongjiangensis* sp. nov. is known only from a single specimen, and nothing is known about the actual distribution range and ecological data of this species. Further research is required to clarify the extent of its distribution, population trends, and conservation status. Moreover, investigation of species diversity in the China–Myanmar border region is far from complete due to the relatively inconvenient traffic conditions; more survey efforts are required to achieve a better understanding of the diversity of *Pareas* in this region.

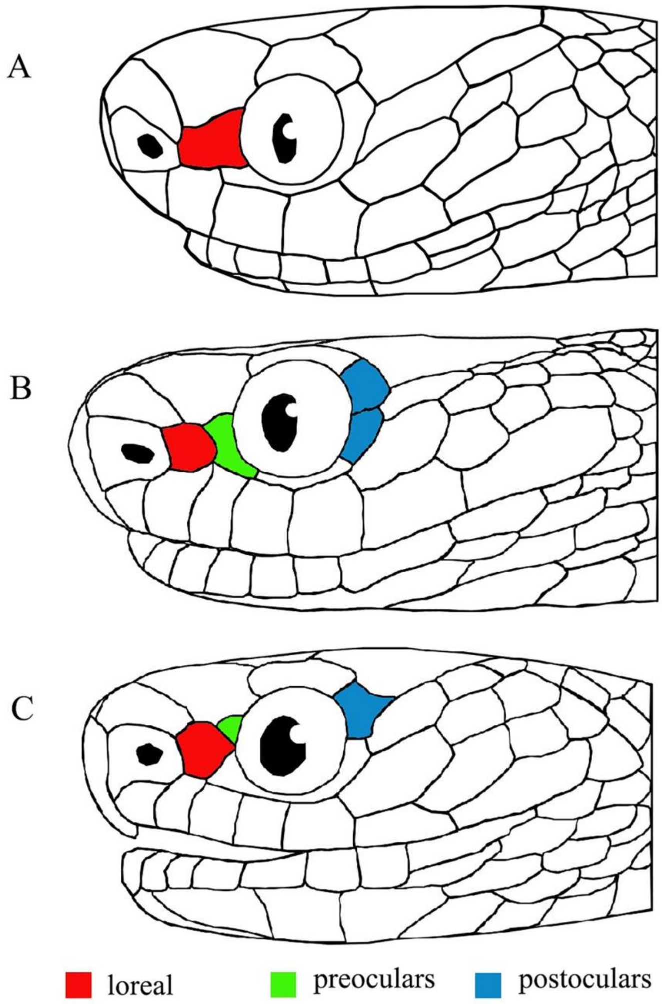

Figure 6. Comparison of head scalation. (**A**) Holotype of *Pareas dulongjiangensis* sp. nov. (KIZ R201607); (**B**) holotype of *P. kaduri* (BNHS 3574); (**C**) the potential new species (CAS 235254) in Vogel et al. [19].

Author Contributions: Investigation, D.R.; experiment, M.Y. and J.R.; writing, S.L.; review, Y.G. and D.R. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the Science-Technology Basic Condition Platform from the Ministry of Science and Technology of the People's Republic of China (grant no. 2005DKA21402), the National Natural Science Foundation Project: Systematic Taxonomy and Biogeographic Study of Pareidae (grant no. 31460558), the National Key Laboratory of Genetic Resources and Evolution and Open Project (grant no. GREKF17-08), and the National Important Research and Development Project: Biodiversity Conservation and Restoration Technology in High Mountain and Valley Regions of Southwestern China (grant no. 2017YFC0505202).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: All data are presented in this article and in GenBank (https://www.ncbi.nlm.nih.gov).

Acknowledgments: The curator and deputy curator of the Kunming Natural History Museum of Zoology, Kunming Institute of Zoology, Chinese Academy of Sciences, are gratefully acknowledged for their support in the taxonomic study. We would like to thank Xiaoyu Zhu for his assistance in the field, Guangyi Lu for providing information about specimen collection, and our workmates for their help and advice. We are also grateful to the reviewers for their valuable comments on the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Smith, M.A. *The Fauna of British India, Ceylon and Burma, including the Whole of the Indo-Chinese Subregion. Reptilia and Amphibia. Vol. III. Serpentes*; Taylor and Francis: London, UK, 1943.
2. Zhao, E.M.; Huang, M.H.; Zong, Y.; Jiang, Y.M.; Huang, Q.Y.; Zhao, H.; Ma, J.F.; Huang, Z.J.; Wei, G.; Yang, D.T.; et al. *Fauna Sinica, Reptilia, Squamata. Serpentes*; Science Press: Beijing, China, 1998.
3. Zhao, E.M. *Snakes of China*; Anhui Science Technology Publishing House: Hefei, China, 2006; Volume 1.
4. Wagler, J.G. *Natürliches System der Amphibien, mit Vorangehender Classification der Säugthiere und Vogel: Ein Neitrag zur Vergleichenden Zoologie*; J.G. Cottasche Buchhandlung Nachfolger: Stuttgart, Germany, 1830.
5. Deepak, V.; Ruane, S.; Gower, D.J. A New Subfamily of Fossorial Colubroid Snakes from the Western Ghats of Peninsular India. *J. Nat. Hist.* **2019**, *52*, 2919–2934. [CrossRef]
6. Wang, P.; Che, J.; Liu, Q.; Li, K.; Jin, J.Q.; Jiang, K.; Shi, L.; Guo, P. A Revised Taxonomy of Asian Snail-Eating Snakes Pareas (Squamata, Pareidae): Evidence from Morphological Comparison and Molecular Phylogeny. *ZooKeys* **2020**, *939*, 45–64. [CrossRef] [PubMed]
7. Uetz, P.; Freed, P.; Aguilar, R.; Hošek, J. (Eds.) The Reptile Database. Available online: http://www.reptile-database.org (accessed on 16 January 2023).
8. Poyarkov, N.A.; Nguyen, T.V.; Pawangkhanant, P.; Yushchenko, P.V.; Brakels, P.; Nguyen, L.H.; Nguyen, H.N.; Suwannapoom, C.; Orlov, N.; Vogel, G. An Integrative Taxonomic Revision of Slug-Eating Snakes (Squamata: Pareidae: Pareineae) Reveals Unprecedented Diversity in Indochina. *PeerJ* **2022**, *10*, e12713. [CrossRef] [PubMed]
9. Smith, K.T.; Georgalis, G.L. The Diversity and Distribution of Palaeogene Snakes—A Review, with Comments on Vertebral Sufficiency. In *The Origin and Early Evolution of Snakes*; Gower, D., Zaher, H., Eds.; Cambridge University Press: Cambridge, UK, 2022.
10. Huang, Q.Y. Pareas macularius Theobald, 1868 should be a Junior Synonym of Pareas margaritophorus (Jan, 1866). *Sichuan J. Zool.* **2004**, *23*, 207–208.
11. Hauser, S. On the Validity of Pareas macularius Theobald, 1868 (Squamata: Pareidae) as a Species Distinct from Pareas margaritophorus (Jan in Bocourt, 1866). *Trop. Nat. Hist.* **2017**, *17*, 25–52.
12. Guo, K.J.; Deng, X.J. A New Species of Pareas (Serpentes: Colubridae: Pareatinae) from the Gaoligong Mountains, Southwestern China. *Zootaxa* **2009**, *2008*, 53–60. [CrossRef]
13. Vogel, G. A New Montane Species of the Genus Pareas Wagler, 1830 (Squamata: Pareatidae) from Northern Myanmar. *Taprobanica* **2015**, *7*, 1–7. [CrossRef]
14. You, C.W.; Poyarkov, N.A.; Lin, S.M. Diversity of the Snail-Eating Snakes Pareas (Serpentes, Pareatidae) from Taiwan. *Zool. Scr.* **2015**, *44*, 349–361. [CrossRef]
15. Ding, L.; Chen, Z.N.; Suwannapoom, C.; Nguyen, T.V.; Poyarkov, N.A.; Vogel, G. A New Species of the Pareas hamptoni Complex (Squamata: Serpentes: Pareidae) from the Golden Triangle. *Taprobanica* **2020**, *9*, 174–193. [CrossRef]
16. Bhosale, H.; Phansalkar, P.; Sawant, M.; Gowande, G.; Patel, H.; Mirza, Z.A. A New Species of Snail-Eating Snakes of the Genus Pareas Wagler, 1830 (Reptilia: Serpentes) from Eastern Himalayas, India. *Eur. J. Taxon.* **2020**, *729*, 54–73. [CrossRef]
17. Vogel, G.; Nguyen, T.V.; Lalremsanga, H.T.; Biakzuala, L.; Hrima, V.; Poyarkov, N.A. Taxonomic Reassessment of the Pareas margaritophorus-macularius Species Complex (Squamata, Pareidae). *Vertebr. Zool.* **2020**, *70*, 547–569. [CrossRef]
18. Liu, S.; Rao, D.Q. A New Species of the Genus Pareas (Squamata, Pareidae) from Yunnan, China. *Zookeys* **2021**, *1011*, 121–138. [CrossRef] [PubMed]
19. Vogel, G.; Nguyen, T.V.; Zaw, T.; Poyarkov, N.A. A New Species of the Pareas monticola Complex (Squamata: Serpentes: Pareidae) from Chin Mountains with Additions to the Pareas Fauna of Myanmar. *J. Nat. Hist.* **2021**, *54*, 2577–2612. [CrossRef]
20. Le, D.T.T.; Tran, T.G.; Hoang, H.D.; Stuart, B.L. A New Species of Pareas (Squamata, Pareidae) from Southern Vietnam. *Vertebr. Zool.* **2021**, *71*, 439–451. [CrossRef]
21. Liu, S.; Zhang, D.R.; Poyarkov, N.A.; Hou, M.; Wu, L.; Rao, D.Q.; Nguyen, T.V.; Vogel, G. Resurrection of Pareas yunnanensis (Vogt, 1922) with Description of a New Species of Pareas from Yunnan Province, China (Squamata, Pareidae). *Eur. J. Taxon.* **2023**, *860*, 1–26. [CrossRef]
22. Myers, N.; Mittermeier, R.A.; Mittermeier, C.G.; Da Fonseca, G.A.; Kent, J. Biodiversity Hotspots for Conservation Priorities. *Nature* **2000**, *403*, 853–858. [CrossRef] [PubMed]
23. Marchese, C. Biodiversity hotspots: A Shortcut for a More Complicated Concept. *Glob. Ecol. Conserv.* **2015**, *3*, 297–309. [CrossRef]
24. Xue, J.R.; Tang, J.S.; Xu, Z.H.; Yang, Y.M.; Chen, Y.S.; Wang, J.H. *Goligongshan National Nature Reserve*; China Forestry Press: Beijing, China, 1995.
25. Boulenger, G.A. Descriptions of New Reptiles and Batrachians from Borneo. *Proc. Zool. Soc. London* **1900**, *69*, 182–187. [CrossRef]
26. Boulenger, G.A. Descriptions of Two New Snakes from Upper Burma. *Bombay Nat. Hist. Soc.* **1905**, *16*, 235–236. [CrossRef]
27. Vogt, T. Zur Reptilien-und Amphibienfauna Südchinas. *Arch. Für Nat.* **1992**, *88*, 135–146.

28. Pope, C.H. *The Reptiles of China. Turtles, Crocodilians, Snakes, Lizards, Natural History of Central Asia*; The American Museum of Natural History: New York, NY, USA, 1935; Volume X.
29. Grossmann, W.; Tillack, F. On the Taxonomic Status of Asthenodipsas tropidonotus (Van Lidth de Jeude, 1923) and Pareas vertebralis (Boulenger, 1900) (Serpentes: Colubridae: Pareatinae). *Russ. J. Herpetol.* **2003**, *10*, 175–190.
30. Guo, Y.H.; Wu, Y.K.; He, S.P.; Shi, H.T.; Zhao, E.M. Systematics and Molecular Phylogenetics of Asian Snail-Eating Snakes (Pareatidae). *Zootaxa* **2011**, *3001*, 57–64. [CrossRef]
31. Loredo, A.I.; Wood, P.L., Jr.; Quah, E.S.; Anuar, S.; Greer, L.; Norhayati, A.; Grismer, L.L. Cryptic Speciation within Asthenodipsas vertebralis (Boulenger, 1900) (Squamata: Pareatidae), the Description of a New Species from Peninsular Malaysia, and the Resurrection of A. tropidonotus (Lidth de Jude, 1923) from Sumatra: An Integrative Taxonomic Analysis. *Zootaxa* **2013**, *3664*, 505–524. [CrossRef]
32. Yang, J.H.; Yeung, H.Y.; Huang, X.Y.; Yang, S.P. First Record of Pareas vindumi Vogel, 2015 (Reptilia: Pareidae) from China with a Revision to Morphology. *Taprobanica* **2021**, *10*, 39–46. [CrossRef]
33. David, P.; Deuti, K. On the Type Specimens of Pareas macularius Theobald, 1868 and Pareas berdmorei Theobald, 1868 with the Designation of a Lectotype for Pareas macularius (Squamata: Serpentes: Pareidae). *Zootaxa* **2022**, *5105*, 490–500. [CrossRef] [PubMed]
34. Lawson, R.; Slowinski, J.B.; Crother, B.I.; Burbrink, F.T. Phylogeny of the Colubroidea (Serpentes): New evidence from Mitochondrial and Nuclear Genes. *Mol. Phylogenetics Evol.* **2005**, *37*, 581–601. [CrossRef]
35. Tamura, K.; Stecher, G.; Kumar, S. MEGA11: Molecular Evolutionary Genetics Analysis Version 11. *Mol. Biol. Evol.* **2021**, *38*, 3022–3027. [CrossRef]
36. Thompson, J.D.; Higgins, D.G.; Gibson, T.J. CLUSTAL W: Improving the Sensitivity of Progressive Multiple Sequence Alignment Through Sequence Weighting, Position-Specific Gap Penalties and Weight Matrix Choice. *Nucleic Acids Res.* **1994**, *22*, 4673–4680. [CrossRef]
37. Kalyaanamoorthy, S.; Minh, B.Q.; Wong, T.K.; Von Haeseler, A.; Jermiin, L.S. ModelFinder: Fast Model Selection for Accurate Phylogenetic Estimates. *Nat. Methods* **2017**, *14*, 587–589. [CrossRef]
38. Nguyen, L.T.; Schmidt, H.A.; Von Haeseler, A.; Minh, B.Q. IQ-TREE: A Fast and Effective Stochastic Algorithm for Estimating Maximum-Likelihood Phylogenies. *Mol. Biol. Evol.* **2015**, *32*, 268–274. [CrossRef]
39. Ronquist, F.; Teslenko, M.; Van Der Mark, P.; Ayres, D.L.; Darling, A.; Höhna, S.; Larget, B.; Liu, L.; Suchard, M.A.; Huelsenbeck, J.P. MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space. *Syst. Biol.* **2012**, *61*, 539–542. [CrossRef] [PubMed]
40. Huelsenbeck, J.P.; Ronquist, F.; Nielsen, R.; Bollback, J.P. Bayesian Inference of Phylogeny and its Impact on Evolutionary Biology. *Science* **2001**, *294*, 2310–2314. [CrossRef]
41. Wilcox, T.P.; Zwickl, D.J.; Heath, T.A.; Hillis, D.M. Phylogenetic Relationships of the Dwarf Boas and a Comparison of Bayesian and Bootstrap Measures of Phylogenetic Support. *Mol. Phylogenetics Evol.* **2002**, *25*, 361–371. [CrossRef] [PubMed]
42. Alfaro, M.E.; Zoller, S.; Lutzoni, F. Bayes or Bootstrap? A Simulation Study Comparing the Performance of Bayesian Markov chain Monte Carlo Sampling and Bootstrapping in Assessing Phylogenetic Confidence. *Mol. Biol. Evol.* **2003**, *20*, 255–266. [CrossRef] [PubMed]
43. Minh, B.Q.; Nguyen, M.A.T.; von Haeseler, A. Ultrafast Approximation for Phylogenetic Bootstrap. *Mol. Biol. Evol.* **2013**, *30*, 1188–1195. [CrossRef]
44. Che, J.; Jiang, K.; Yan, F.; Zhang, Y.P. *Amphibians and Reptiles in Tibet-Diversity and Evolution*; Science Press: Beijing, China, 2020.