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Rediscovery of the enigmatic Mountain Dragon, *Japalura yulongensis* (Reptilia: Sauria: Agamidae), with notes on its natural history and conservation

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Abstract

Mountain Dragons of the genus *Japalura* Gray 1853 have gained increasing systematic attention recently as a result of the availability of new, vouchered collections and a resurgence of interest in Indochinese agamid diversity. This is particularly true for the *J. flaviceps* Barbour, Dunn 1919 complex from southwest China. However, many species of the complex are still known from few historical specimens only, and little is known about their general biology and conservation status. As one of such understudied members of the complex, *Japalura yulongensis* Manthey, Denzer, Hou, and Wang 2012 was described on the basis of seven historical specimens from the type locality in northwest Yunnan, PR China in 1914. Little was known at the time of the general biology and conservation status of the species, and the species has not been documented in the wild since the original description. Herein, we report the re-discovery of this secretive species based on a series of newly collected specimens from the vicinity of the type locality. We provide the first accounts of body coloration in life and microhabitat preferences, expand upon what is known of the species' morphological variation and ecology, revise the morphological diagnosis of the species, and offer suggestions on its IUCN conservation status and protection status in China.

Key words: conservation, endemism, Hengduan Mountains, *Japalura flaviceps*

Introduction

Mountain Dragons of the genus *Japalura* Gray, 1853 include 34 recognized species (Cai *et al*. 2015; Wang *et al*. 2016a; Rao *et al*. 2017), representing one of the most speciose agamid genera in Asia. Despite this rich diversity, no comprehensive phylogenetic study of the genus has been conducted to date (Macey *et al*. 2000; Pyron *et al.* 2013), largely due to the lack of vouchered individuals and tissue samples. With limited morphological data available from congeners, and hypothesized relationships and species boundaries based on morphological data only, lineage diversity within the genus remains poorly understood (Wang *et al*. 2015, 2016a). As body coloration has been suggested to play a role in mate recognition among species of *Japalura* (Bastiaans *et al*. 2014; LeBas & Marshall 2000; Stuart-Fox & Ord 2004; Wang *et al*. 2016a), data on coloration in life are of great importance for defining species boundaries and understanding the role sexual selection has played in species-level diversification.

The paucity of such datasets is exemplified by members of the *Japalura flaviceps* Barbour, Dunn 1919 complex from southwest China (Manthey *et al*. 2012; Wang *et al*. 2016a; Zhao *et al*. 1999). Currently, the *J. flaviceps* complex contains 10 recognized species, including: *J. batangensis* Li, Deng, Wu, Wang 2001; *J. brevicauda* Manthey, Denzer, Hou, Wang 2012; *J. flaviceps, J. iadina* Wang, Jiang, Siler, Che 2016; *J. laeviventris* Wang, Jiang, Siler, Che 2016; *J. micangshanensis* Song 1987; *J. splendida* Barbour, Dunn 1919; *J. vela* Wang, Jiang, Pan, Hou, Siler, Che 2015; *J. yulongensis* Manthey, Denzer, Hou, Wang 2012; and *J. zhaoermii* Gao, Hou 2002. Among the recognized species of the complex, *Japalura yulongensis* remains one of the most secretive and

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poorly studied species. Although it was described in 2012, *J. yulongensis* is known from seven historical type specimens only, all collected by Camilo Schneider in 1914 from the Ulukay Village (or Vulukay), approximately 20 km north of Lijiang, northwest Yunnan, China (Fig. 1; Manthey *et al.* 2012). To date, virtually nothing is known about the species geographic distribution, ecology, and coloration in life, and what little information is available on morphological variation is based on seven specimens collected more than a century ago.

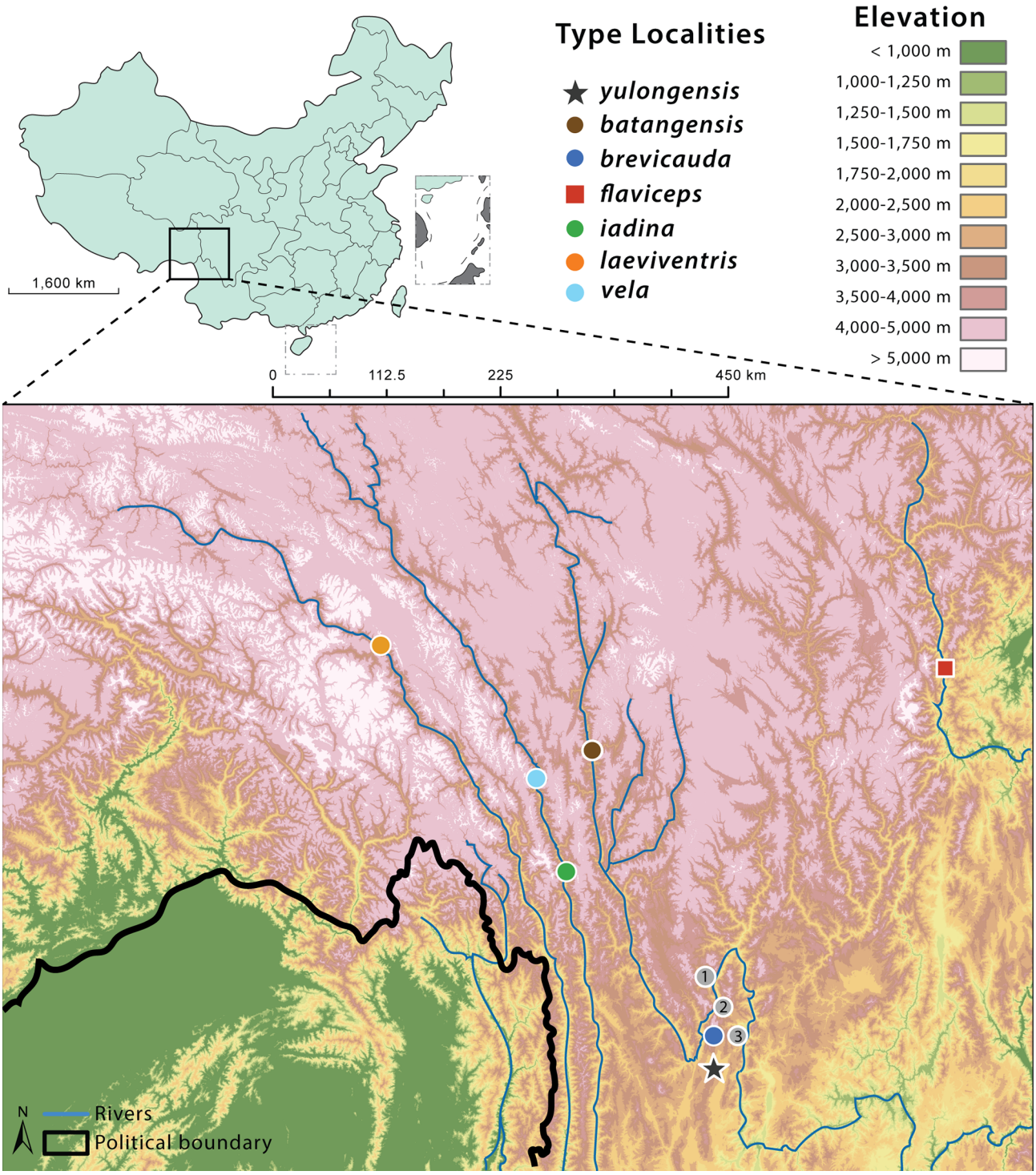

FIGURE 1. Distribution of *Japalura yulongensis* and other members of the *Japalura flaviceps* complex in northeast Yunnan, PR China. Numbers represent newly discovered localities of *J. yulongensis* from northwest Yunnan Province reported in this study, including 1. Baishuitai, 2. Hutiaoxia, and 3. Dadong Village. Detailed locality information seen methods.

During biodiversity surveys of the regional herpetofauna in 2015 and 2016, 16 specimens of *Japalura* were collected from the upper Jinsha Valley in Xianggelila (=Shangri-La) and Lijiang Counties in northwest Yunnan, PR China, close to the type locality of *Japalura yulongensis*. After detailed morphological comparisons with congeners, these specimens were identified as *J. yulongensis* and represent the first observation of the species in the wild in more than a century. Herein, we provide the first detailed, robust account of the species based on the new, vouchered materials, summarize morphological variation among populations, and provide the first descriptions of its coloration in life, microhabitat preferences, general ecology, and distribution. Given the rapid rate of habitat destruction that has occurred near the type locality of the species in northwest Yunnan Province (Ren *et al.* 2015; Sun 2010; Wang *et al*. 2016b), and what is known of the species to date, we assess the conservation status of *J. yulongensis* and provide conservation suggestions accordingly.

Methods

Field work, sample collection, and specimen preservation. Collections of all animals used for this present study obey the Wildlife Protection Act of PR China. Collection permit were issued by Kunming Institute of Zoology, Chinese Academy of Sciences (BBCJ-2014-001), and permissions for collections and surveys were granted by Forestry Department and National Reserves of China. IACUC protocols (IACUC R13-11) and relevant protocols of the Animal Care and Ethics Committee at the Kunming Institute of Zoology were followed for the proper treatments of animals in the field.

A total of 16 specimens were collected from Baishuitai (locality 1, 27° 30' 7" N, 100° 2' 3" E, 2,600 m elevation, WGS 84), Dadong Village (locality 3, 27° 9' 41.76" N, 100° 26' 42" E, 1,465 m elevation, WGS 84), and Hutiaoxia (locality 2, 27° 14' 40" N, 100° 8' 42" E, 1,990 m elevation, WGS 84), in northwest Yunnan Province, PR China, in the vicinity of the type locality of *Japalura yulongensis* (26° 53' N, 100° 11' E, > 2500 m elevation, WGS 84) (Fig. 1, Appendix I). The specimens included nine adult males, six adult females, and one juvenile female. Following euthanasia, tissue samples were taken from livers and preserved in 95% ethanol, and voucher specimens were fixed in 10% buffered formalin and later transferred to 70% ethanol for long-term preservation. All specimens were deposited in the Museum of Kunming Institute of Zoology, Chinese Academy of Sciences (KIZ).

Morphological data. Measurements were made with digital calipers by KW and JK to the nearest 0.1 mm, except for the tail length (TAL), which was made with a ruler to the nearest 1 mm. Focal characters and character definitions follow Wang *et al*. (2016a): snout–vent length (SVL); tail length (TAL); head width (HW); snout–eye length (SEL); fore-limb length (FLL); hind limb length (HLL); Finger IV length (F4L); Toe IV length (T4L); trunk length (TRL); interorbital distance (IOD); supralabial count (SL); infralabial count (IL); number of scales between nasal and first supralabial (NSL); and number of scale rows between supralabials and orbit circle (SOR); enlarged, conical, post-occipital scale count (POS); enlarged, conical, post-tympanic scale count (PTY); enlarged, conical, post-rictal scale count (PRS); Finger IV subdigital lamellae count (F4S); and Toe IV subdigital lamellae count (T4S). Values for paired characters (SL, IL, NSL, SOR) were recorded from both sides of the body, with counts provided in left/right order. To avoid taxonomic confusion, morphological data of congeners were taken from type specimens or topotypic material, or from specimens collected within close proximity to the type locality whenever possible. Summaries of specimens examined are presented in Appendix II.

In addition to vouchered specimens examined, morphological data of congeners were also obtained from the literature (Li *et al*. 2001; Manthey *et al.* 2012). Comparisons of coloration in life were based on type descriptions and available color photographs (Manthey 2010; Wang *et al*. 2016a; Zhao *et al*. 1999). Museum abbreviations for specimens examined follow Sabaj (2016), and include: Chengdu Institute of Biology, Chinese Academy of Sciences (CIB), Chengdu, China; Kunming Institute of Zoology, Chinese Academy of Sciences (KIZ), Kunming, China; Museum of Comparative Zoology at Harvard University (MCZ), Boston, MA, USA; and National Museum of Natural History (NMNH), Washington D.C., USA; Museum für Naturkunde Berlin (ZMB), Berlin, Germany.

Description of coloration in life followed Köhler (2012) for maximum consistency: terminologies of different colors were taken from the book (noted in capital forms) and their corresponding reference numbers were also given.

Results

Description of additional specimens (Appendix I). Medium sized *Japalura*, SVL 56.2–70.7 mm in males, 56.2–69.2 mm in females. Tail long, TAL 210.2–247.6% SVL in males, 182.1–227.3% in females. Head moderate, HL 28.5–31.6% SVL; HW 62.1–72.6% HL; SEL 35.9–38.5% HL. Rostral rectangular, four times longer than high, bordering six or seven small scales excluding first labials; nasals flat, somewhat oval, separated from first supralabial by one or two small scales; supralabials 8–10, keeled; 3–5 rows of scales between ventral margin of orbit and sixth supralabial; tympanum concealed with small scales; 3–7 distinctively keeled, enlarged scales present between posterior edge of orbit and tympanum; numerous distinct, enlarged, conical scales present in post-tympatic, postrictal, and occipital regions of head. Scales of dorsal head distinctively keeled, heterogeneous in size; supraciliaries seven, overlapping one half to one third of its length with subsequent ones; two or three distinctively enlarged scales forming weak ridge along snout midline from two or three scales posterior to rostral to point in line with anterior corner of eyes; two large scales symmetric to snout midline posterior to last scale of weak snout ridge; remaining dorsal head scales irregularly arranged; parietal somewhat oval, pineal eye present. Ventral head scales mostly homogeneous in size, strongly keeled; infralabials 7–11, keeled; gular pouch present, well developed; gular fold present, distinct.

FIGURE 2. *Japalura yulongensis* in life. A, B: adult male (KIZ 028296); C, D: adult female (KIZ 028342); both from Baishuitai, Xianggelila County, Yunnan, PR China. Photographs by Kai WANG.

Dorsal body scale heterogeneous in size, distinctively keeled, with enlarged scales randomly scattered; middorsal crest scale 35–44, slightly larger than neighboring scales, imbricated along body midline; nuchal and dorsal crest raised on skin fold, with distinct break in between, posteriorly above forelimb insertion; single row of enlarged scale forming paravertebral ridge on each side of middorsal crest from neck to vent, one to three scales away from middorsal crest. Dorsal limb scales distinctively keeled; scales mostly homogeneous in size on fore-limbs, heterogeneous on hind limbs, with numerous enlarged, conical scales distributed on posterior thigh; F4S 15–18, F4L 6.0–8.2 mm; T4S 20–26, T4L 10.0–13.4 mm. All scales of tail distinctively keeled.

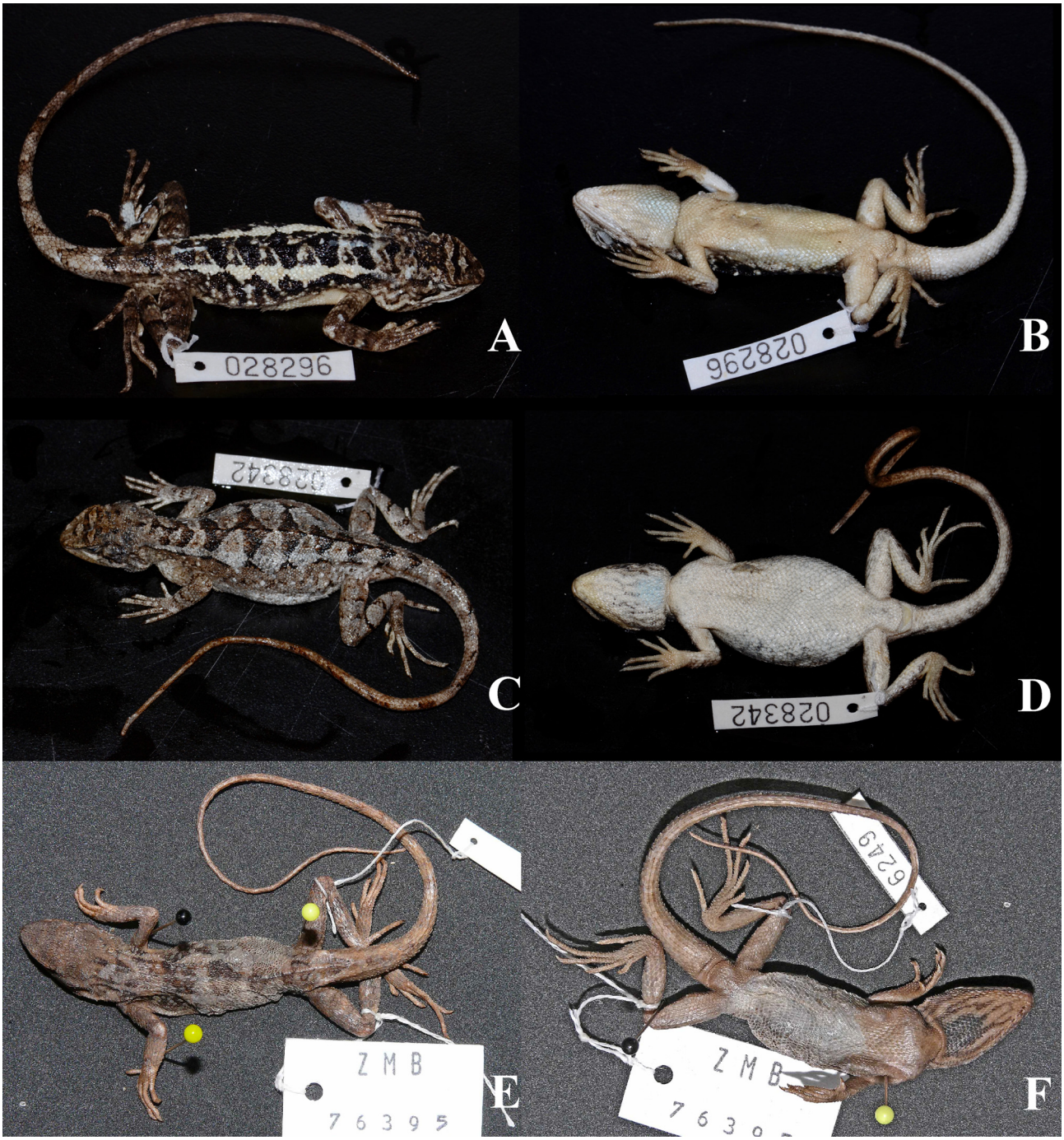

FIGURE 3. *Japalura yulongensis* in preservation. A, B: adult male (KIZ 028296); C, D: adult female (KIZ 028342); both from Baishuitai, Xianggelila County, Yunnan, PR China. Photographs by Kai WANG. E, F: holotype of *Japalura yulongensis* (ZMB 76395), from Manthey *et al*. (2012).

Coloration in life. *Japalura yulongensis* is sexually dichromatic. For males, the dorsal surface of the head is mottled Drab (Color 18) to Raw Umber (Color 22), with two or three Jet Black (Color 300) to Olive-Brown (Color 278) bands running between the eyes and another band running across the internasal region of the snout. The lateral surface of the head is predominately Pale Neutral Gray (Color 296) to Cream White (Color 52). Distinct, radial, Jet Black (Color 300) eye-stripes are present posterior to each eye, with the largest running from the posterior corner of the eye posteroventrally towards the labial scale series, terminating near the corner of the mouth. The inferior or sub-ocular stripes are indistinct or entirely absent. A Cream White (Color 52) labial stripe is present beneath each eye. The ground coloration of the dorsal and lateral surfaces of the body is Raw Umber (Color 22) to Jet Black (Color 300). A distinct, Pale Greenish Yellow (Color 86), strongly jagged dorsolateral stripe is present on each side

of the body from the occipital region of the head to the pelvic region of the body in males. Narrow, Light Greenish Yellow (Color 87) transverse bands are present along the body midline between the dorsolateral stripes, separating the dark ground coloration into numerous rectangular patches. Sometimes these lighter transverse bands are incomplete, resulting in a zigzag-shaped Jet Black (Color 300) stripe along the dorsal midline in-between the dorsolateral stripes in males. Irregularly shaped clusters of enlarged scales are present on the lateral surfaces of the body, ventral to the dorsolateral stripes in males. These clusters vary in lighter coloration from Light Greenish Yellow (Color 87) to Chartreuse (Color 89). The ground coloration on the dorsal surfaces of the limbs is Brownish Olive (Color 292), with irregular, lighter, Cream White (Color 52) transverse bands. The tail is Hair Brown (Color 277) with narrow, light, Cream White (Color 52) transverse bands. The ventral surface of the head is Smoky White (Color 52), sometimes with a few, indistinct Dark Neutral Gray (Color 299) vermiculated stripes. A large, Chartreuse (Color 89) to Opaline Green (Color 106) gular spot is present across the gular pouch. Ground coloration of the ventral surface of the body is Smoky White (Color 52). Two Medium Greenish Yellow (Color 88) ventrolateral patches of coloration are present on the venter, running from the pectoral to pelvic regions, and at times fusing anteriorly to cover most of the anterior half of the ventral surface of the body (Fig. 2, A, B; Fig. 6, A1, A2).

Females of this species differ from males in coloration and pigmentation patterns in the following ways: (1) the dorsal surface of the body is speckled Drab (Color 18) and Raw Umber (Color 22); (2) the dorsolateral stripes are absent or significantly more narrow; (3) a series of triangular Vandyke Brown (Color 282) patches are present along the dorsal midline; (4) the gular spot is much smaller; (5) the Dark Neutral Gray (Color 299) vermiculated stripes on the ventral surface of the head are more distinct; and (6) the lateral and ventrolateral surfaces of the body are Pale Neutral Gray (Color 296)or Smoky White (Color 52), with no green-colored patches (Fig. 2, C, D; Fig. 4, A3, A4).

Coloration in preservation. For specimens recently preserved with formalin, the coloration and pigmentation patterns are similar to the ones recorded in life, except for the following: (1) the yellowish green coloration of the ventrolateral surfaces of body fades significantly; and (2) the green coloration of the gular region either fades or turns to a bluish coloration. Compared with historical collections (Appendix 2) preserved in ethanol, the coloration and pigmentation patterns of newly preserved material differ in the following ways: (1) the yellow coloration of the dorsolateral stripes fades into brownish; (2) the yellowish green coloration of the ventrolateral surfaces of body disappears; (3) the green coloration of the gular region turns to blackish in males and disappears in females (Fig. 3; Manthey *et al*. 2012).

Discussion

Morphological variation. In the original description, *Japalura yulongensis* was described based on the seven type specimens (Manthey *et al*. 2012). Subsequently, morphological data of four additional, non-type specimens was included in the data table without explanations or referenced voucher numbers (Table 1 in Manthey *et al.* 2012). Although Manthey *et al.* (2012) provided ranges and summary statistics of the morphological data, the small sample size and absence of information on individual character states precluded a more comprehensive understanding of phenotypic variation within the species and between sexes. Our results are largely consistent with the ranges of morphological variables reported in the original description, including supralabial scale count, relative head width (HW/SVL, 20–24%), relative fore-limb length (FLL/SVL, 43–52%), and hind limb length (HLL/SVL, 72–82%) (Manthey *et al*. 2012). However, morphometric data collected for the newly discovered population increase the range of character states for several characters (ranges from Manthey *et al.* [2012] are given in parentheses): (1) IL 7–11 (vs. 9–10); (2) T4S 21–26 (vs. 20–24); (3) MD 36–44 (vs. 35–42); (4) TAL/SVL 210.2–247.6% in males, 182.1–227.3% in females (vs. 223–230% in males, 224% in females); and (5) dark radial stripes present anterior, posterior, and superior to eyes (vs. absence entirely) (Table 1). This increased variation may represent inter-population differences, as all individuals from Baishuitai are observed to have shorter mean tail lengths on average than other localities (Table 1). With the rediscovery of this species in the wild, future studies should be conducted in the region to explore the full extent of phenotypic and population genetic diversity of *J. yulongensis* in northwest Yunnan, PR China.

TABLE 1. Morphometric data of examined *Japalura yulongensis*. Full terms of abbreviated morphological characteristics and codes of localities are listed in the section of Methods in the manuscript. The sign, "—", indicates missing data (KIZ 028297, 028303, 028343, 028291 have incomplete tails).

Catolog Number	KIZ 09400	KIZ 09399	KIZ 028292	KIZ 028294	KIZ 028296	KIZ 028297	KIZ 028298	KIZ 028303	KIZ 028343	KIZ 028291	KIZ 028293	KIZ 028299	KIZ 028300	KIZ 028302	KIZ 028342	KIZ 028344
Sex	M	M	M	M	M	M	M	M	M	F	F	F	F	F, subadult	F	F
Locality Code	2	2	2	2	1	1	1	2	2	2	2	2	1	3	1	2
SVL	57.58	64.88	64.92	56.22	64.74	70.70	65.50	60.51	57.58	62.61	60.76	65.09	61.34	46.68	69.24	56.20
TAL	141	136	155	139	139	—	139	—	—	—	123	123	115	106	126	119
TAL/SVL	2.443	2.102	2.390	2.476	2.146	—	2.115	—	—	—	2.026	1.885	1.874	2.273	1.821	2.113
HL	16.95	19.77	19.05	17.77	19.93	22.14	21.16	18.94	17.20	17.42	17.44	19.11	18.42	14.16	19.74	16.99
HL/SVL	0.294	0.305	0.293	0.316	0.308	0.313	0.323	0.313	0.299	0.278	0.287	0.294	0.300	0.303	0.285	0.302
HW	12.28	13.30	12.71	11.04	13.38	15.41	14.29	12.01	11.76	11.93	11.10	12.93	12.25	10.28	13.37	10.90
HW/SVL	0.213	0.205	0.196	0.196	0.207	0.218	0.218	0.198	0.204	0.191	0.183	0.199	0.200	0.220	0.193	0.194
HW/HL	0.724	0.673	0.667	0.621	0.671	0.696	0.675	0.634	0.684	0.685	0.636	0.677	0.665	0.726	0.677	0.642
SEL	6.40	7.35	7.33	6.54	7.78	8.50	8.00	7.04	6.36	6.75	6.67	7.01	7.07	5.08	7.54	6.28
SEL/HL	0.378	0.372	0.385	0.368	0.390	0.384	0.378	0.372	0.370	0.387	0.382	0.367	0.384	0.359	0.382	0.370
IOD	6.54	7.25	8.54	8.72	9.65	11.00	10.39	8.94	7.89	7.80	8.69	9.01	9.05	6.96	9.40	7.82
FLL	27.04	27.83	28.53	24.36	29.74	31.89	31.40	27.34	25.76	27.53	25.52	29.51	27.81	23.53	30.17	24.77
FLL/SVL	0.470	0.429	0.439	0.433	0.459	0.451	0.479	0.452	0.447	0.440	0.420	0.453	0.453	0.504	0.436	0.441
HLL	44.94	48.65	47.79	40.88	48.62	48.84	49.53	46.50	42.34	45.94	41.93	46.27	42.85	36.88	47.66	42.11
HLL/SVL	0.780	0.750	0.736	0.727	0.751	0.691	0.756	0.768	0.735	0.734	0.690	0.711	0.699	0.790	0.688	0.749
F4L	—	—	7.14	5.88	8.23	8.00	8.23	7.41	6.39	6.91	7.17	7.57	7.04	5.63	8.19	6.00
T4L	11.18	12.24	12.04	11.53	12.81	12.34	13.39	11.46	10.19	11.64	10.94	11.41	11.52	9.17	12.31	10.04
TRL	25.21	28.59	31.25	26.43	29.87	32.32	27.45	27.35	26.65	31.95	32.61	32.81	29.56	21.55	34.78	26.82
TRL/SVL	0.438	0.441	0.481	0.470	0.461	0.457	0.419	0.452	0.463	0.510	0.537	0.504	0.482	0.462	0.502	0.477
SL	9/9	8/8	9/9	8/9	8/9	9/9	8/8	8/9	9/9	9/9	8/9	9/9	9/8	9/8	9/9	10/9
IL	11/10	9/10	10/11	10/9	7/8	8/8	8/8	9/9	9/9	10/10	10/9	10/10	9/10	9/11	8/7	10/11
NSL	1	2	2	2	1	2	1/2	2/1	1/2	1	2	1	1	2	1	1
MD	39	40	44	38	40	41	40	43	36	40	41	40	42	38	41	42
F4S	18/19	16/16	18/18	17/15	18/18	18/18	18/17	17/18	16/18	—	17/18	18/19	17/17	16/17	19/18	17/18
T4S	25/25	24/25	24/25	24/25	23/24	24/26	24/23	24/23	23/24	—	25/23	26/26	22/22	22/21	26/26	25/26
SOR	3/3	4/4	4/3	5/5	3/3	4/4	3/3	3/3	4/4	5/5	5/5	4/4	3/3	5/5	4/4	4/4
PTS	1/1	4/4	3/3	3/2	3/3	3/3	3/4	2/3	5/5	2/3	3/3	4/4	4/4	3/3	4/2	3/4
PTY	2/2	2/2	1/2	2/1	2/3	1/1	2/2	2/2	3/2	2/2	2/2	1/1	3/2	2/2	1/2	1/3

Comparisons. With the absence of data available previously on the coloration in life of *Japalura yulongensis*, comparisons of the species with congeners relied primarily on mensural and pholidosis data. As coloration patterns of *Japalura* in life are diagnostic and easy to apply in the field (Wang *et al.* 2016a), adding such information to morphological comparisons not only is relevant to taxonomists, but also to local government units and the general public with limited systematic backgrounds. Furthermore, our recent observations allow for us to revise morphological comparisons of the species accordingly.

Based on our results and data from the original description, *Japalura yulongensis* is most similar morphologically to *J. batangensis* and *J. zhaoermii*, with all three species possessing jagged dorsolateral stripes and greenish gular spots in males (Fig. 4). However, *J. yulongensis* can be distinguished readily from *J. batangensis* and *J. zhaoermii* by having a longer tail (TAL/SVL 210.2–247.8% in males, 182.1–227.3% in females vs. 164.4–194.7% and 163.8–166.5% [for males and females of *J. batangensis*] or 181.1–220.2% and 151.7–174.9% [for males and females of *J. zhaoermii*]), distinct coloration of the ventrolateral body in males in life (yellowish green vs. gray [*J. batangensis*] or uniform white [*J. zhaoermii*]), as well as by the absence of distinct, long radial stripes below eyes (vs. presence), and the presence of light lip stripes below eyes (vs. absence). Furthermore, *J. yulongensis* can be distinguished from *J. batangensis* by gular spot coloration (lime green vs. greenish blue), and from *J. zhaoermii* by having a smaller adult body size (SVL 56.2–70.7 mm vs. 64.3–81.7 mm), smaller gular spots in males (vs. large), and by the presence of gular spots in females (vs. absence).

Japalura yulongensis has been confused with *J. flaviceps* historically, but it can be distinguished from the latter by having a relatively longer tail (TAL/SVL 210.2–247.6% in males, 182.1–227.3% in females vs. 170.1–191.3% in males, 167.2–182.0% in females), a tendency toward fewer MD (35–44 vs. 43–54), distinct ventro-lateral coloration in males (yellowish green vs. grayish brown), and by the presence of green gular spots in both sexes (vs. absence in both sexes) (Fig. 4).

Based on the results of our study, we provide a revised diagnosis of *Japalura yulongensis* as the following: (1) body length moderate in adults (SVL 56.2–70.7 mm); (2) tail long (TAL/SVL 211.3–247.6% in males, 182.1–227.3% in females); (3) MD 35–44; (4) T4S 20–26; (5) tympanum concealed; (6) transverse gular fold present; (7) lip stripe white, present below eyes; (8) radial stripes distinct, present anterior, superior, and posterior of eyes, but absent or indistinct inferior to eyes; (9) dorso-lateral stripes always present in males, sometimes in females, jagged, greenish yellow; (10) ventro-lateral and anterior ventral body yellowish green in males; and (11) gular spots lime green or dark green in life, present in both sexes.

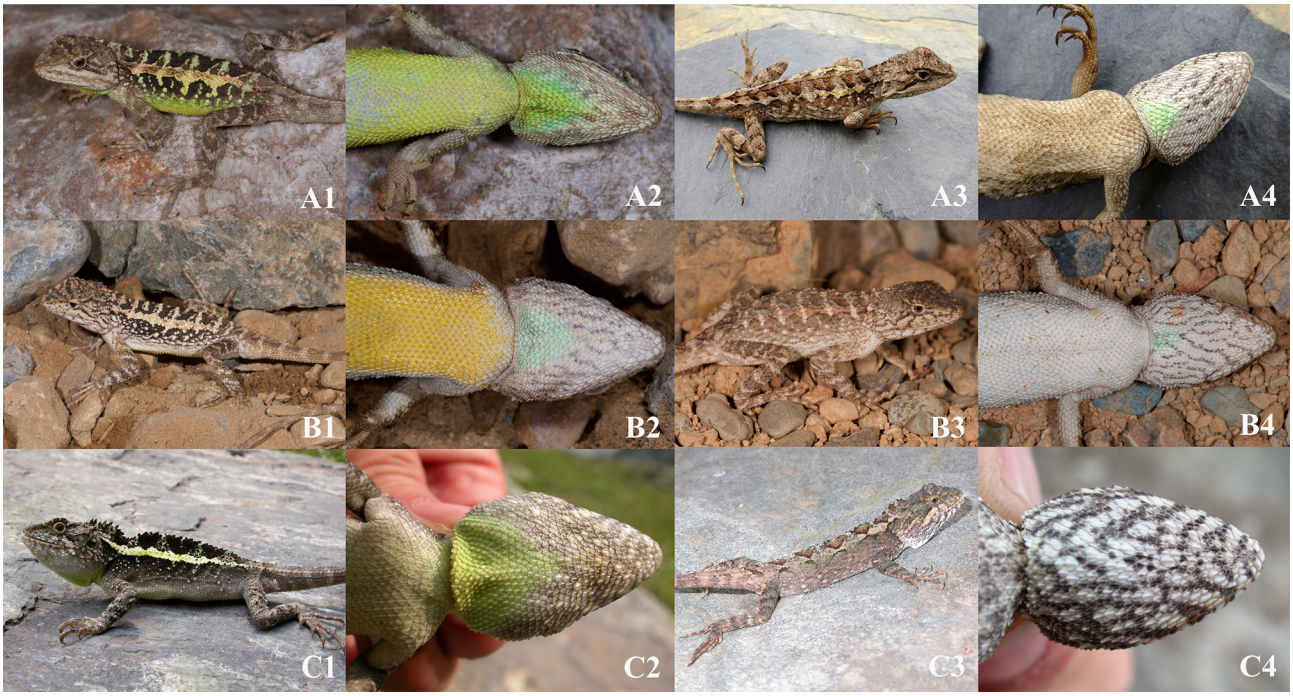

FIGURE 4. Comparisons of males (column 1 and 2) and females (column 3 and 4) among *Japalura yulongensis* (top row A), *J. batangensis* (middle row B), *J. zhaoermii* (bottom row C). Photographs by Kai WANG, Jiawei WU, and Christian WEINERT.

FIGURE 5. General habitat of *Japalura yulongensis* from the upper Jinsha Valley at Hutiaoxia, Xiangelila County, Yunnan, PR China (A and B), Dadong Village, Lijiang, Yunnan, PR China (C), and Baishuitai, Xiangelila County, Yunnan, PR China (D). Photographs by Kai WANG.

FIGURE 6. *Japalura yulongensis* in situ and its microhabitats from Baishuitai, Xianggelila, Yunnan, PR China. Photographs by Kai WANG.

FIGURE 7. Habitat destructions observed at Baishuitai Scenic Area, Xianggelila, Yunna, PR China in July 2016. Photographs by Jin SAN.

Ecology and natural history. At the time of the original description, only locality data was available for the vouchered museum specimens collected in 1914 (Manthey *et al.* 2012), with no information ever recorded on the species' microhabitat preferences, life history characteristics, or ecology. The rediscovery of *Japalura yulongensis* in the wild after 102 years reveals interesting characteristics of the species' ecology that further distinguishes it from its congeners in the Hengduan Mountain Region. Although being terrestrial, *J. yulongensis* appears to occupy moist, mixed forest habitat (Fig. 5), unlike other congeners that inhabit arid, shrubby environments in hot-dry valleys of the region (e.g., *J. batangensis*, *J. flaviceps*, *J. laeviventris*, and *J. vela*; Wang *et al*. 2015, 2016a). The presences of sufficient physical shelters, such as rock crevices or dense vegetation, appear to be an important aspect of preferred microhabitat for *J. yulongensis*. We observed most individuals among rock piles and shrubby open ground along the edge of forests or plantations (Fig. 6). However, a few individuals were found under dense canopy coverage. Individuals were observed to be most active from 09:00–14:00 hr during our summer surveys, and were seen basking on rocks or tree trunks, actively foraging, or defending territories. During rains, individuals were observed seeking shelters or remaining near shelter entrances. Adults feed mainly on large insects, including grasshoppers and crickets; however, juveniles were observed eating considerable numbers of ants. During the same survey periods, we observed three species of amphibians (*Bufo gargaarizans*, *Rana chaochiaoensis*, and *Ordorrana* sp.) and two species of reptiles (*Elaphe carinata* and *Ptyas nigromariginata*) occurring sympatrically with *J. yulongensis*. Pressure from predation may come from larger snakes in the region, birds, or mammals. Finally, during capture, tail autotomy was observed often, and many wild individuals were observed to possess incomplete tails.

Distribution. Currently, the species is known from the Jinsha Valleys and adjacent forest areas under 3,400 m elevation on both the west and east sides of the Yulong Snow Mountain in Lijiang and Xianggelila counties, northwest Yunnan Province, PR China (Fig. 1). It is possible that the species is also found in the Jinsha Valley at the Yunnan-Sichuan border in the north, including the adjacent southwest corner of Sichuan Province (Fig. 1).

Conservation. Although the species appears locally abundant, *Japalura yulongensis* continues to possess a restricted range along the Jinsha River, despite the newly discovered populations. Information to date suggests that the species is endemic to the upper Jinsha Valley in Xianggelila and Lijiang Counties. Habitat degradation is the major conservation threat to the species, stemming largely from infrastructure development in the region. The known range of the species overlaps greatly with several major centers for tourism in Yunnan Province, including the Yulong Snow Mountain Scenic Area, Tiger Leaping Gorge Scenic Area, and Lugu Lake Scenic Area. With the rapid development of the tourism industry in the region (Sun 2010), the paucity of environmental impact reports for construction plans or robust conservation assessments, and the overall deforestation in northwest Yunnan Province (Ren *et al.* 2015; Wang *et al*. 2016b), the preferred habitat of *J. yulongensis* remains highly vulnerable. Taking the example of the Baishuitai Scenic Area, we observed significant habitat deteriorations during the survey in 2016 (Fig. 7). Furthermore, such high overlap with human activities may increase the chance of illegal collections for the pet trade and traditional medicine, as numerous collection attempts from tourists were observed during our surveys, and more adults possess incomplete tails in the tourist heavy site (eg. Baishuitai). Therefore, following the IUCN classification criteria (Extent of occupancy estimated less than 2,000 km^2, continuing decline of area, extent, and quality of habitats; IUCN 2013), we recommend *J. yulongensis* be classified as Near Threatened, pending further information provided by population-level studies of the micro-endemic species. Furthermore, we recommend generally that all major scenic areas in the region increase conservation education and awareness campaigns, as well as place greater conservation efforts on preserving the remaining forest and valley habitat. Finally, given its restricted distribution, and documented decline in available habitats in the region, we recommend *J. yulongensis* be listed as a class II protected species in the new Wildlife Protection Act of China.

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APPENDIX I. Referred specimens of *Japalura yulongensis*.

Historical type specimens: ZMB 76395 (holotype), adult male, ZMB 76396–76399 (paratypes), adult males, ZMB 76400 and 76401 (paratypes), adult females; all collected by Camilo Schneider from Ulukay Village, eastern slopes of the Yulong Snow Mountains near Lijiang, northwestern Yunnan, PR China (26° 53' N, 100° 11' E, > 2500 m in elevation, WGS 84) sometime between July and September, 1914.

Newly collected specimens from current study: KIZ 09399, 09400, adult males, collected by KW and KJ from Zhonghutiao (=Middle Tiger Leaping Gorge), Xianggelila County, northwest Yunnan, PR China (27° 14' 40" N, 100° 8' 42" E, 1,990 m elevation, WGS 84) on 10 May 2015; KIZ 028292, 028294, 028303, adult males; KIZ 028293, 028291, adult females, collected by KW and JR from the same locality on 11 July 2016.

KIZ 028344, adult female, KIZ 028343, adult male, collected by KW and JR from Yongke Village, Xianggelila County, northwest Yunnan, PR China, close to Hutiaoxia (27° 18' 59 " N, 100° 13' 1" E, 1,884 m elevation, WGS 84) on 11 July 2016.

KIZ 028296–028298, adult males, KIZ 028299, 028300, 028342, adult females, collected by KW, JR, and Gadeng Nima from Baishuitai, Xianggelila County, northwest Yunnan, PR China (27° 30' 7" N, 100° 2' 3" E, 2,600 m elevation, WGS 84) on 12 July 2016.

KIZ 028302, juvenile of female, collected by KW from Dadong Village, Lijiang County, northwest Yunnan, PR China (27° 9' 41.76" N, 100° 26' 42" E, 1,465 m elevation, WGS 84) on 14 July 2016.

APPENDIX II. Additional material examined.

Japalura batangensis (n=16): CIB 1902–1908, 2227, 2233, 2243, KIZ 84011, 801081, Batang, Sichuan, PR China; KIZ 09404, 019311, 019312, KIZ 019314, Mangkang, Tibet, PR China.

Japalura dymondi (n=7): CIB 1869, 87234, Panzhihua, Sichuan, PR China; KIZ 95I1001, 1002, 1016, 1018, 1022, Dayao, Yunnan, PR China.

Japalura grahami (n=1): USMN 65500 (holotype), Yibin, Sichuan, PR China.

Japalura micangshanensis (n=9): CIB 86348, 86351, Xianyang, Shaanxi, PR China; CIB 86356, 86357, 86360, 86361, Luonan, Shaanxi, PR China; CIB 2572, 2578, 2582, Wenxian, Gansu, PR China.

Japalura flaviceps (n=13): CIB 2234, 2332, 2333, 2341, 2354, 2355, 2549, 2554, 2556, 2561, 2567; KIZ 05181, 05182; Luding, Sichuan, PR China.

Japalura splendida (n=6): USNM 35522 (holotype), Yichang, Hubei, PR China; CIB 2588, 2591, 2596, 72468, 72469, Chongqing, PR China.

Japalura varcoae (n=3): CIB 2650, 2651, KIZ 85II0006, Kunming, Yunnan, PR China.

Japalura vela (n=11): KIZ 013801 (holotype), KIZ 013802, 013813, 013800, 013805–013811 (paratopotypes), Jerkalo, Tibet, PR China.

Japalura yunnanensis (n=8): CIB 2684, 2686, 2687, 2689, KIZ 82081, Longling, Yunnan, PR China; KIZ 74II0240, 0248, 79I469, Tengchong, Yunnan, PR China.

Japalura zhaoermii (n=14): CIB 2690 (holotype), 86432, 86435, 85721, 85722, 86433, 86434, 86436, Wenchuan, Sichuan, PR China; CIB 2232, 2244, 2240, KIZ 84032, 85030, Lixian, Sichuan, PR China.