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A new species of Dwarf *Japalura sensu lato* (Reptilia: Squamata: Agamidae) from the upper Mekong River in Eastern Tibet, China, with notes on morphological variation, distribution, and conservation of two congeners along the same river

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Abstract

Despite being recognized as ecologically and biogeographically important, the biodiversity of the Hengduan Mountain Region, particularly along the upper Mekong River, remains poorly understood. Here we describe a new species of Mountain Dragon of the genus *Japalura sensu lato* Gray, 1853 from the headwater region of the Mekong River in Chamdo, Tibet Autonomous Region, China. The species is recognized as a member of the *Japalura flaviceps* Barbour & Dunn 1919 complex, and it can be distinguished readily from all congeners by a suite of morphological characteristics, including its dwarf appearance (small body size and disproportionally short tails and short hind limbs), smooth or weakly keeled ventral scales, feebly developed vertebral crests in males, and by the absence of distinct gular spots in males and females. In addition to the description of the new species, we also report morphological variations and range extensions of two recently described congeners along the same river, namely *J. iadina* and *J. vela*. We discuss the distribution patterns of the genus in the Hengduan Mountain Region and the urgent conservation priorities for protecting *Japalura* species along the Mekong River. According to our best available data, we provided IUCN assessments of the three species and propos to list them as nationally protected under the Chinese Wildlife Protection Act.

Key words: cryptic diversity, habitat destruction, lizard, new record, Three Parallel Rivers, Yunnan

Introduction

The historical continental collision between India and Asia resulted in dramatic changes to the landscape of southwest China, including the formation of the Hengduan Mountain Region (HMR) on the eastern edge of the Tibetan Plateau (Yang *et al*. 1982). Not only have studies highlighted the unique nature and ecological importance of biodiversity across this region (Myers *et al.* 2000; Lei *et al*. 2015), but also, recent work has suggested that the HMR may have served as a source for refugial habitats during historical glacial periods, possibly contributing significantly to diversification for many lineages across the region (Fu *et al*. 2005; Che *et al.* 2010; López-Pujol *et al.* 2011; Lei *et al*. 2015).

Unfortunately, the general paucity of modern organismal studies across HMR has impeded efforts to better understand the biogeographic history of regions in Southwest China. To date, vertebrate diversity, particularly amphibians and reptiles, remains understudied throughout the HMR—partly as the result of a general belief that the high elevation environments are unsuitable for many amphibians and reptiles (Hu *et al*. 1987; Zhao & Yang 1997;

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Li *et al*. 2010). Historically, only a few reptile species have been documented from the northern ranges of the HMR, including a single species of *Japalura* Gray, 1853, *Japalura flaviceps* Barbour & Dunn, 1919 (Hu *et al.* 1987; Zhao & Yang 1997; Yang & Rao 2008). However, renewed herpetological survey efforts in the HMR have revealed surprising endemic, cryptic diversity present within populations previously identified *J. flavicpes* along major river valleys in the Tibet Autonomous Region (herein abbreviated as Tibet) and Yunnan Province of China (Manthey *et al*. 2012; Wang *et al.* 2015, 2016). Yet despite recent biodiversity survey efforts in of the region, many reaches of major rivers in the HMR have remained unexamined for a long period of time, including the upper reach of Mekong River (=Lancang River) in Tibet (Hu *et al.* 1977). As species of *Japalura* across the HMR are recognized to be restricted and endemic to river valleys in this region (Zhao & Yang 1997; Manthey *et al*. 2012; Wang *et al.* 2016), it is likely that cryptic diversity still exists in the upper reach of Mekong River in Tibet, and the diversity of *Japalura* across the HMR remains underestimated (Wang *et al*. 2015, 2016).

In addition to the possible cryptic diversity, most of the recently described congeners from the HMR lack basic natural history data (Manthey *et al.* 2012; Wang *et al.* 2015, 2016). In particular, no study has been published regarding the morphological variation, distribution ranges, and conservation status of *Japalura iadina* and *J. vela* along the upper Mekong River, ever since their original descriptions. Such lack of basic biological data not only limits ecological and evolutionary studies of the group, but it also prevents effective conservation assessments and environmental policy reforms. With the rapid, ongoing developments along major rivers in the northern HMR, particularly along the upper Mekong River (Gu *et al*. 2016), understanding of species diversity and the basic biological data of endemic species across this region are of critical importance for effective conservation.

During herpetofaunal surveys of the upper Mekong River in 2015 and 2016, we collected specimens of *Japalura* along the upper Mekong River in Tibet and Yunnan Province, China. Comparisons of morphological characters with recognized lineages revealed that *Japalura* populations from the upper reaches of Mekong River in Tibet and lower reaches in Yunnan Province match the morphological diagnosis of *J. vela*. In addition, a new population of *J. iadina* was discovered 17 km downstream from its type locality along the Mekong River. Furthermore, *Japalura* populations from the headwaters of the Mekong River further north in Chamdo, Tibet, possess a suite of distinct morphological characteristics that could not be assigned to any known species of the genus. In this study, we describe the Chamdo population of *Japalura* as a new species and comment on natural history observations and conservation implications of this new discovery. Additionally, we discuss morphological variation observed for the newly discovered populations of *J. iadina* and *J. vela*, and extend their recognized ranges along the upper Mekong River in Tibet and Yunnan Province of China.

Methods

Field work, sample collection, and specimen preservation. Collections of all animals used for this present study obey the Wildlife Protection Act of China. Collection permit was 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 R17-019) 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 five and 18 specimens of *J. iadina* and *J. vela* were collected from five new sites along the Mekong River Valley (Appendices I and III). In addition, eight specimens of the new species were collected from the river valley near the headwaters of the Mekong River in Chamdo, Tibet, including one female from Karuo, Chamdo, Tibet in 2015 and two males and five females from Chaya, Chamdo, Tibet in 2016 (Fig. 1; Appendix I).

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 slide calipers by KW to the nearest 0.01 mm. Focal characters and character definitions follow Wang *et al.* (2016), including: 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); supralabial count (SL); infralabial count (IL); count of scales between nasal and first supralabials (NSL); and count of scale rows between supralabials and orbit circle (SOR); enlarged post-occipital scale count (POS); enlarged post-tympanic scale count (PTY); enlarged post-rictal scale count (PRS); Finger IV subdigital lamellae count (F4S); Toe IV subdigital lamellae count (T4S); and middorsal scale count (MD). In addition, texture of ventral scales (TVS; distinctively keeled vs. feebly keeled or smooth), presence or absence of skin fold under nuchal crest (SNC), skin fold under dorsal crest (SDC), and gular spot (GS), and status of crest scales (SCS; erect and serrated vs. not erect or serrated) were also examined. Additionally, to remove the co-variance of different morphometric measurements and compare different measurements fairly, the following relative ratios were calculated and compared, including HL/SVL, TAL/SVL, TRL/SVL, FLL/SVL, HLL/SVL, HW/HL, and SEL/HL. Values for paired characters (SL, IL, NSL, SOR) were recorded from both sides of the body, with counts provided in left/right order. Comparisons of coloration in life were based on photographs of live specimens and type descriptions (Zhao *et al.* 1999; Manthey 2010; Wang *et al.* 2016).

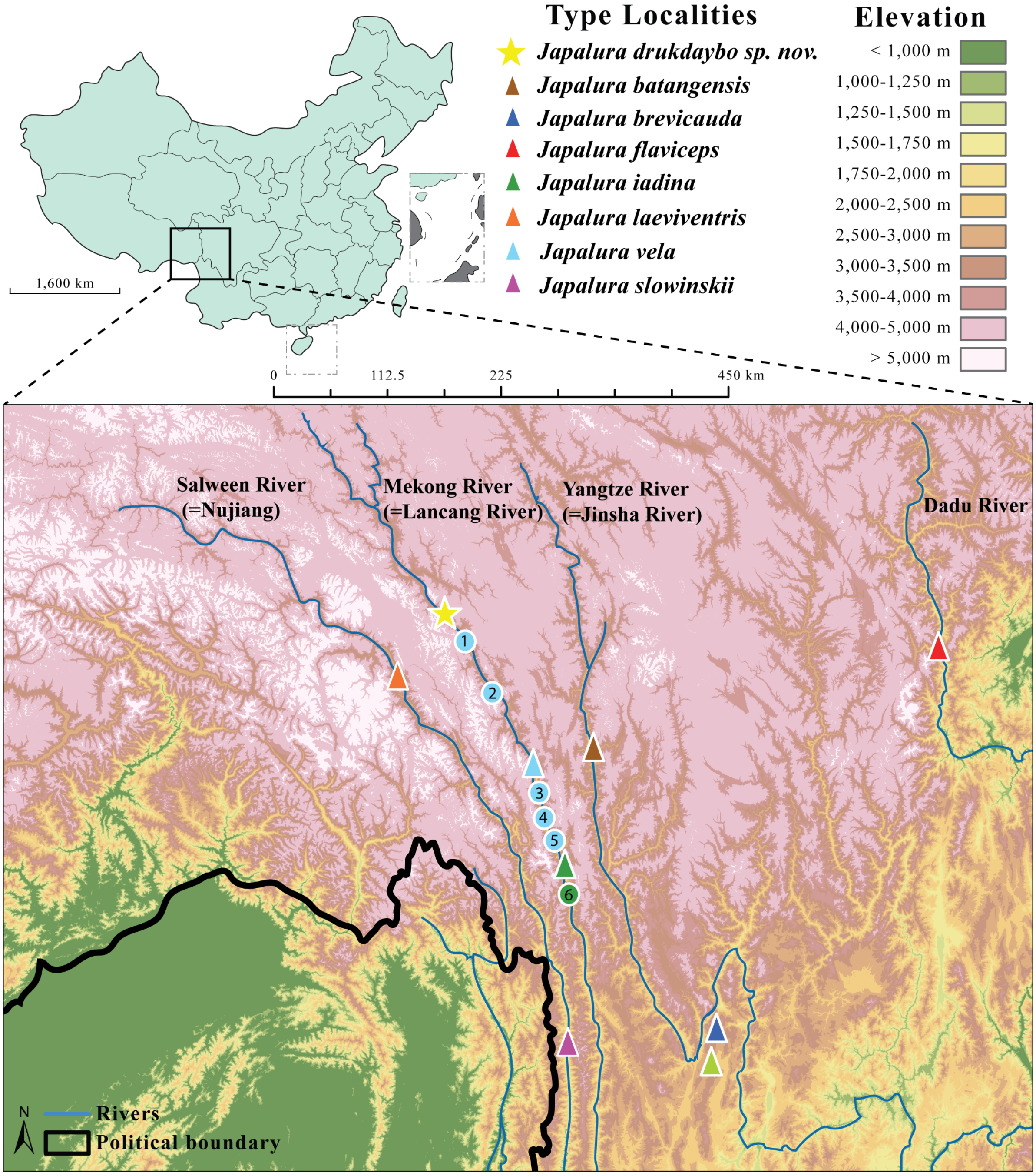

FIGURE 1. Distribution of *Japalura sensu lato* in the Hengduan Mountain Region in Southwest China. Numbers represent new localities for *Japalura vela* (1–5) and *J. iadina* (6), which are: (1) Tongsha, Markam, Tibet; (2) Rumei Township, Markam Prefecture, Tibet; (3) Xilu, Deqin County, Yunnan Province; (4) Foshan, Deqin County, Yunnan Province; (5) Xidang, Deqin County, Yunnan Province; and (6) Yunling, Deqin County, Yunnan Province.

Whenever possible, morphological data for congener species were taken from type specimens or topotypic material, or secondarily from specimens collected within close proximity to the type localities. 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 (Manthey *et al.* 2012). For maximum comparability and consistency, terminology in color descriptions follows Köhler (2012). Museum abbreviations for specimens examined follow Sabaj (2016) and include: Chengdu Institute of Biology, Chinese Academy of Sciences (CIB); Kunming Institute of Zoology, Chinese Academy of Sciences (KIZ); Museum für Naturkunde Berlin, Brilin, Germany (ZMB); and National Museum of Natural History (NMNH), Washington D.C., USA.

Results

Morphological variation of *Japalura vela* and *Japalura iadina*. Detailed morphometric data of the newly collected specimens of *J. iadina* and *J. vela* are summarized in Appendix III. For *J. iadina*, the newly collected specimens resemble the type series closely, although males (KIZ 027702 and 027704) possess distinct skin folds beneath crest scales, which differ from the type series.

For *J. vela*, although morphological characteristics of the southern populations in Yunnan Province match the morphological data of the type series, the northern populations of the species, which are in higher elevation habitats in the upper reaches of the Mekong River, possess noticeable morphological variation from the type series (Table 2; Appendix III). Specifically, the most northern populations have relatively shorter tails (TAL 174.58–175.11% SVL in males, 159.82–161.62% in females) and shorter hind limbs (HLL 72.47–73.56% SVL in males, 65.67–67.67% in females) when compared to type specimens and other newly discovered southern populations (TAL 180.64–238.11% SVL in males, 177.37–202.17% in females; HLL 67.53–85.64% SVL in males, 71.45–81.62% in females). In addition, the toe IV subdigital lamellae count of newly discovered populations show a greater variation than the type series (20–25 vs. 24 or 25).

With respect to color and ornamentation variation, males of both newly discovered *J. vela* populations are largely consistent with the original description. However, the northern populations of *J. vela* from Rumei and Tongsha are observed to have more faint, dark vermiculate stripes on the ventral surfaces of the head (or the stripes are absent) and a lighter dorsal body coloration.

New species description

Japalura drukdaypo sp. nov. Wang, Ren, Jiang, Zou, Wu, Che, Siler, 2016

(Fig. 2–6)

Synonyms:
Japalura flaviceps Hu *et al*. 1987; Zhao & Yang 1997; Li *et al*. 2010
Japalura cf. *flaviceps* Wang *et al*. 2015, 2016

Holotype. KIZ 027616, adult male from Chaya County, Chamdo, Tibet, China (30.7294° N, 97.3808° E, elevation 3,310 m; WGS 84), collected by Kai WANG on 19 June 2016 (Figs. 1, 2).

Paratypes. KIZ 027617–19, 027629–30, adult females collected by Kai WANG and Gadeng NIMA on 19 June 2016; KIZ 027628, adult male collected by Kai WANG and Gadeng NIMA on 21 June 2016. KIZ 016486, adult female from Kanuo, Chamdo, Tibet, China (31.0433° N, 97.2239° E, elevation 3,245 m; WGS 84), collected by Dahu ZOU and Fang YAN on 13 May 2015.

Diagnosis. *Japalura drukdaypo* **sp. nov.** can be distinguished from all congeners by a combination of the following morphological characteristics: (1) adult body size small, SVL 49.85–58.93 mm; (2) head moderate, HW 65.94–75.16% HL; (3) limbs relatively short, FLL 37.52–45.40% SVL, HLL 58.18–63.75% SVL; (4) tail relatively short, TAL 153.01–154.40% SVL in males, 132.84–143.95% SVL in females; (5) transverse gular fold present, well developed; (6) tympanum concealed; (7) MD 43–56; (8) T4S 18–25; (9) ventral head and body scales feebly keeled or smooth; (10) nuchal and dorsal crest scales feebly developed, not distinctively erected or raised on skin folds; (11) dorsal enlarged scales relatively flat; (12) gular spots absent in both sexes; and (13) dorsolateral stripes present in both sexes, jagged, bright sulphur yellow in males, medium chrome orange in females.

Description of holotype. Adult male. Body size small, SVL 49.85 mm, moderately compressed dorsally, dwarf looking; tail relatively short, TAL 154.40% SVL; hind limbs short, HLL 63.75% SVL. Head moderate in length and width, HL 33.16% SVL, HW 65.94% HL. Rostral rectangular, four times wider than long; nasal oval in shape, separated from rostral and first supralabial by single small scale; supralabials 9/10 (Left/Right), weakly keeled; suborbital scale rows 4/4, scales roughly equal in size, keeled; infralabials 10/9, smooth; post-rictal scales roughly homogeneous in size, except single moderately enlarged, keeled, post-rictal scale present on each side of head; enlarged scales scattered between posterior orbit and dorsal anterior tympanum, 6/7; tympanum concealed beneath small scales; single enlarged, conical scale post-superior to tympanum. Supraciliaries 6/6, overlapping more than one third of lengths with succeeding ones posteriorly. Dorsal head scales heterogeneous in size, distinctively keeled; dorsal snout surface with raised, keeled ridge, Y-shaped, running from snout tip to point in line with anterior edge of orbit on dorsal side; interparietal sub-rectangular, with distinct pineal eyespot; enlarged, conical scales present on occipital region, 4/4.

Ground scales of dorsal body small, keeled, intermixed with enlarged, keeled scales; enlarged, keeled scales mostly flat, not protruding or giving spiky appearance; two paravertebral ridges present on each side of vertebral crest dorsolaterally, composed of enlarged scales, spanning distance from neck to pelvis; scales of medial dorsolateral ridge smaller than distal ridge, more widely spaced longitudinally along ridge, less regularly aligned; nuchal and dorsal crest feebly developed, nuchal crest scales slightly raised compared to dorsals, not erect; skin folds along crest absent; antehumeral fold present, distinct; axillary fold present. Scales of dorsal limbs keeled, generally homogeneous in size on fore-limbs, heterogeneous in size on hind limbs, with enlarged scales scattered on posterior femoral surface; ventral scales of fore-limbs and lower hind limbs distinctively keeled, ventral femoral scales feebly keeled. Tail slender and short, covered with keeled scales.

Ventral head scales smooth or feebly keeled, largely homogeneous in size, except chin shields and scales near transverse gular fold, which enlarged and lessened; mental triangular, in contact with single pair of enlarged chin shields; gular pouch present in life, well developed, indistinct after preservation; transverse gular fold present, distinct; scales under gular fold smaller than other ventral scales. Ventral body scales smooth or weakly keeled, mostly homogeneous in size and shape.

Coloration of holotype in life. Color name and code conventions follow Köhler (2012). The dorsal surface of the head is Smoke Gray (Code 264), with a single, distinct Raw Umber (Code 280) transverse band present between the eyes. The band forms a "V-shaped" point medially, with the tip pointing posteriorly. Lateral surface of head is Pale Buff (Code 1). Distinct, Sepia (Code 286) radial stripes are present around the eyes, with the posterior stripes on each side of the head the broadest. These broad posterior stripes extend posteriorly to about two scales above the corner of the mouth. Oral cavity is uniform Light Flesh Color (Code 250).

Background coloration of the dorsal surface of the body is Raw Umber (Code 280) to Jet Black (Code 300). A Sulphur Yellow (Code 80) dorsolateral longitudinal stripe is present on each side of the vertebral crest from the occipital region of the head to the pelvis, both of which are strongly jagged. Nine Sulphur Yellow (Code 80), narrow transverse bands are distributed evenly between the two dorsolateral stripes from the neck to the base of the tail, separating the background coloration of the dorsal surfaces of the body into nine rectangular-shaped patches of pigmentation. Irregularly scattered, enlarged, Sulphur Yellow (Code 80) scales are distributed along the lateral surface of the body, ventral to the dorsolateral stripes. The background coloration of the dorsal surfaces of the forelimbs is Jet Black (Code 300), where it is Drab (Color 19) to Olive Brown (Code 278) on the hind limbs. Numerous narrow, Pale Buff (Code 1), transverse bands are present on the dorsal surfaces of the limbs, with fore-limb bands more distinct than hind limb bands. Coloration and ornamentation patterns gradually fade posteriorly towards the base of the tail, and the coloration of the tail eventually becomes Beige (Code 254).

Background coloration of the ventral surface of head is Pale Buff (Code 1). Distinct Jet Black (Code 300) vermiculate stripes are present, but they do not reach the center of the gular pouch, resulting in a triangular empty space in background coloration. The anterior and medial part of the ventral surface of the body is Pale Sulphur Yellow (Code 92), with no distinct ornamentation patterns. The posterior part of the ventral body is white (Figs. 2).

Coloration of holotype in preservative. In preservation, most color, pigmentation, and ornamentation patterns remain consistent with those in life, with only a few exceptions. First, Sulphur Yellow (Code 80) coloration of dorsolateral stripes, transverse bands across dorsal body, and irregular spots of lateral surfaces of body fade into Pale Buff (Code 1) or white in preservation. Second, the Pale Sulphur Yellow (Code 92) of ventral surfaces of the body fade to Pale Buff (Code 1) (Fig. 3).

FIGURE 2. Holotype male (left; KIZ 027619) and paratopotype female (right, KIZ 027617) of *Japalura drukdaypo* **sp. nov.** in life. Photos by Kai WANG.

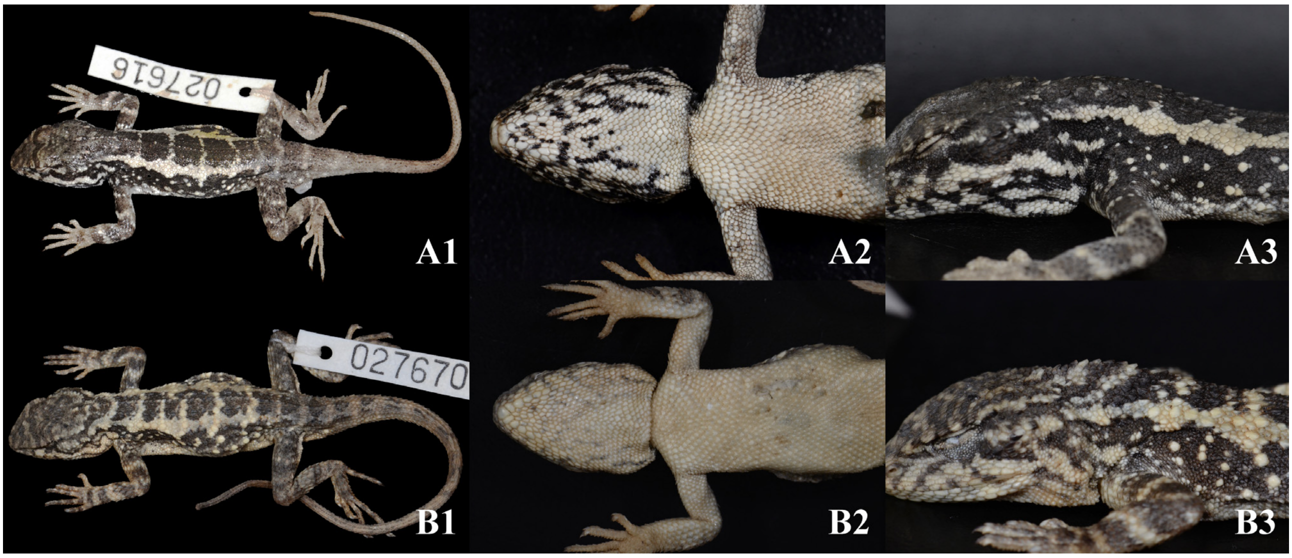

FIGURE 3. Dorsal (1), ventral (2), and lateral close-up (3) comparisons of male *Japalura drukdaypo* **sp. nov.** (holotype KIZ 027619) and *J. vela* (KIZ 027670), showing the relatively shorter tail, shorter hind limbs, smoother ventral scales, and feeble and non-erecting crest of *J. drukdaypo* **sp. nov.** compared with the closely distributed population of *J. vela* from Tongsha, Markam Prefecture, Tibet, China. Images are not to scale. Photos by Kai WANG.

Variation. Morphological variation among the type series is summarized in Table 1. Even though our sample size is small, sexual dimorphism is evident in the new species, with males possessing a smaller adult body size (SVL 49.85–51.48 mm in males vs. 51.05–58.01 mm in females), relatively longer tails (TAL 153.01–154.40% SVL in males vs. 132.84–143.95% in females), and relatively shorter trunk length (TRL 40.4–45.3% SVL in males vs. 51.7–52.4% in females). Furthermore, males have distinct coloration patterns from females, including the background body coloration (Raw Umber [Code 280] to Jet Black [Code 300] in males vs. Olive Horn Color [Code 16] or Drab [Code 19] in females), dorsal ornamentation patterns (solid, Jet Black [Code 300] rectangular patches separated by Sulphur Yellow [Code 80] bands along body midline in males vs. triangular, Olive Horn Color [Code 16] or Drab [Code 19] patches or zigzag stripes separated by Pale Buff [Code 1] transverse bands in females), throat patterns (conspicuous vermiculate stripes in males vs. more faded stripes in females), and shapes and coloration of dorsolateral stripes (distinct, Sulphur Yellow [Code 80] stripes in males vs. somewhat faded, Medium Chrome Orange [Code 75] stripes in females) (Figs. 2–5). In one male individual (KIZ 016486), the center of the throat is Pale Sulphur Yellow (Code 92), but nevertheless the coloration has faded edges and does not form a clear gular spot.

TABLE 1. Morphological and pholidosis characteristics of the type series of *Japalura drukdaypo* **sp. nov.**. Abbreviations are listed in methods. Paired characteristics such as supralabial scale counts are presented in left/right order; "—" indicates missing data (KIZ 016486 has an incomplete tail).

Museum Number	KIZ 027616	KIZ 027628	KIZ 026729	KIZ 027619	KIZ 027630	KIZ 027018	KIZ 027617	KIZ 016486
Type Status	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
Sex	M	M	F	F	F	F	F	F
SVL	49.85	51.48	58.93	51.79	51.05	55.91	58.01	50.24
TAL	76.97	78.77	78.28	71.23	71.57	80.48	78.46	—
HL	16.53	13.98	17.57	14.63	14.20	16.22	16.38	15.16
HW	10.90	9.33	11.66	10.10	10.24	11.59	11.81	10.91
SEL	6.26	5.43	6.64	5.56	5.12	6.46	5.72	5.36
FLL	22.63	19.49	24.84	19.52	19.45	20.98	24.69	19.32
HLL	31.78	29.95	37.02	31.74	31.75	33.37	33.84	30.31
T4L	8.24	8.17	7.59	8.41	6.99	7.85	8.63	7.63
TRL	22.59	20.81	30.46	26.83	26.73	29.08	30.44	25.01
TAL/SVL	154.40%	153.01%	132.84%	137.54%	140.20%	143.95%	135.25%	—
HL/SVL	33.16%	27.16%	29.82%	28.25%	27.82%	29.01%	28.24%	30.18%
HW/HL	65.94%	66.74%	66.36%	69.04%	72.11%	71.45%	72.10%	71.97%
SEL/HL	37.87%	38.84%	37.79%	38.00%	36.06%	39.83%	34.92%	35.36%
FLL/SVL	45.40%	37.86%	42.15%	37.69%	38.10%	37.52%	42.56%	38.46%
HLL/SVL	63.75%	58.18%	62.82%	61.29%	62.19%	59.69%	58.33%	60.33%
TRL/SVL	45.32%	40.42%	51.69%	51.81%	52.36%	52.01%	52.47%	49.78%
SL	9/10	10/10	9/10	10/9	9/9	8/7	9/10	10/9
IL	10/9	11/11	10/11	10/10	11/11	9/9	10/12	12/10
NSL	1/1	1/1	1/2	2/2	1/2	1/1	2/1	1/1
MD	47	50	49	45	46	43	49	56
F4S	15/16	16/17	16/15	15/16	16/15	15/13	14/16	15/15
T4S	18/19	21/23	22/23	22/21	18/19	18/22	21/22	19/19
SOR	4/4	4/4	4/3	4/4	4/4	4/4	4/4	3/3
PTS	3/3	3/2	2/2	4/5	3/3	2/1	5/5	1/2
PTY	1/2	1/1	3/3	4/4	3/2	2/3	2/1	2/2
PRS	2/0	1/0	2/2	2/3	1/0	3/2	1/1	2/2

Comparisons. Previous phylogenetic study found that the Himalayan species of the genus *Japalura* are paraphyletic with respect to the East Asian species (Macey *et al.* 2000). In addition to the different zoogeography between the Himalaya region and the HMR (Zhang 1999), we exclude the comparisons between the new species and Himalayan species (including *J. andersoniana*, *J. dasi*, *J. kumaonensis*, *J. major*, *J. otai*, *J. planidorsata*, *J. sagittifera*, *J. tricarinata*, and *J. variegata*).

Although populations of *Japalura drukdaypo* **sp. nov.** have been confused historically with *J. flaviceps*, the new species can be distinguished readily from the latter by having a smaller adult body size (SVL 49.85–58.93 mm vs. 64.35–75.35 mm), shorter hind limbs (HLL 58.18–63.75% SVL in males, 59.69–62.82% in females vs. 64.93–70.86% SVL in males, 61.61–74.09% in females), shorter tails (TAL 153.01–154.40% SVL in males, 132.84–143.95% SVL in females vs. 170.08–191.26% SVL in males, 167.18–181.98% SVL in females), less distinctive crests in males (slightly raised nuchal crest scales, flat dorsal crest scales, with no skin fold underneath vs. distinctively erected crest scales along skin fold), distinct gular pigmentation patterns (vermiculated stripes not reaching the center of the throat vs. highly reticulated, mosaic patterns occupying the center of the throat), as well as by the absence of strongly differentiated conical, post-rictal scales (vs. presence), absence of dark rhomboidshaped patterns with yellow centers along the midline of the body (vs. presence), and presence of distinct radial stripes around the eyes (vs. absence or faded and indistinct) (Fig. 5; Table 2).

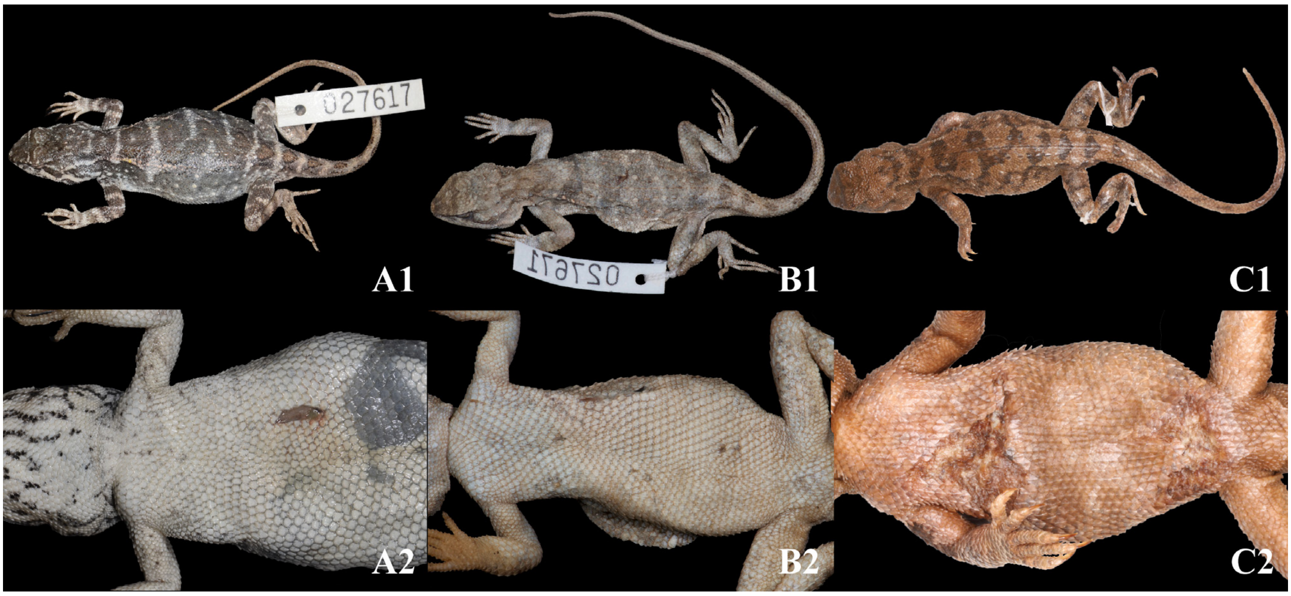

FIGURE 4. Dorsal (1) and ventral (2) comparisons of females among *Japalura drukdaypo* **sp. nov.** (paratopotype KIZ 027617), *J. brevicauda* (paratype ZMB 28932), and *J. vela* (KIZ 027671), showing the differences in relative tail length, relative limb length, and texture of ventral body scales. Individual images are not to scale. Dorsal view of *J. vela* (B1) was horizontally rotated 180° to align with other figures. Photos by Kai WANG and Frank TILLACK.

The new species is phenotypically most similar to *Japalura laeviventris* and *J. brevicauda*, from the upper Salween and middle Jinsha River Valleys, respectfully. However, *Japalura drukdaypo* **sp. nov.** can be differentiated from *J. laeviventris* by having a smaller adult body size (SVL 49.85–58.93 mm vs. 64.00–71.60 mm), shorter hind limbs (HLL 58.18–63.75% SVL in males, 59.69–62.82% in females vs. 70.42%–74.33% SVL in males, 64.43%–74.06% in females), shorter tails (TAL 153.01–154.40% SVL in males, 132.84–143.95% SVL in females vs. 197.22–198.51% SVL in males, 168.57–184.38% SVL in females), fewer MD (43–56 vs. 57–59), feebly developed nuchal crest in males without strongly erected crest scales or skin fold (vs. distinctively erected crest scales on skin fold), and by the absence of distinct gular spots in both sexes (vs. presence), absence of M-shaped pigmentation patterns along body midline in males (vs. presence), and absence of distinct, dense dark speckles on all surfaces of head and dorsal and lateral surfaces of body (vs. presence) (Fig. 5); and from *J. brevicauda* by having relatively longer tails in males (TAL 153.01–154.40% SVL in males, 132.84–143.95% SVL in females vs. 140% in males, 125–145% in females), a greater number of MD (43–56 vs. 34–40), and smooth or weakly keeled ventral scales (vs. distinctively keeled) (Fig. 4).

Japalura drukdaypo **sp. nov.** can be differentiated from *J. vela* by having shorter hind limbs (HLL 58.18–63.75% SVL vs. 65.67–85.64% SVL), shorter tails (TAL 153.01–154.40% SVL in males, 132.84–143.95% SVL in females vs. 174.58–238.11% SVL in males, 159.8–202.17% SVL in females), feebly developed crests in males without strongly erected crest scales or skin fold (vs. distinctively erected crest scales on continuous, well developed skin fold), weakly keeled or smooth ventral scales of head and body (vs. strongly keeled), flat and relatively less enlarged scales on dorsal body (vs. distinctly keeled, raised, and relatively large), and faint yellowish ventral coloration in live males (vs. uniform white) (Figs. 3–5).

The new species differs from all remaining congeners in Tibet and adjacent areas (*J. batangensis*, *J. dymondi*, *J. iadina*, *J. micangshanensis*, *J. splendida*, *J. yulongensis*, *J. varcoae*, and *J. zhaoermii*) by having a shorter tail (TAL 153.01–154.40% SVL in males, 132.84–143.95% SVL in females vs. >160.00% SVL in males, >150.00% SVL in females), shorter hind limbs (HLL 58.18–63.75% SVL in males, 59.69–62.82% in females vs. >64.00% SVL), and smooth or feebly keeled ventral scales (vs. distinctively keeled). Furthermore, from *J. batangensis*, *J. iadina*, and *J. yulongensis*, the new species differs by the absence of gular spots in both sexes (vs. presence); from *J. batangensis*, *J. dymondi*, *J. iadina*, *J. micangshanensis*, *J. splendida*, *J. yulongensis*, and *J. zhaoermii* by the presence of narrow, orange dorsolateral stripes in females (vs. absence); from *J. batangensis*, *J. iadina*, *J.*

micangshanensis, *J. yulongensis*, and *J. zhaoermii* by having feebly developed crests in males without strongly erected crest scales or skin fold (vs. distinctively erected crest scales on well developed skin fold); and from *J. dymondi* and *J. varcoae* by having concealed tympana (vs. exposed). For remaining congeners from the mainland Asia, the new species differs from *J. bapoensis*, *J. chapaensis*, *J. hamptoni*, *J. fasciata*, and *J. yunnanensis* by feebly developed nuchal crest scales (vs. well developed in triangular shape), from *J. chapaensis* and *J. yunnanensis* by differential oral coloration (Light Flesh Color [Code 250] vs. Light Chrome Orange [Color 76] to Dark Spectrum Yellow [Color 78]); and from *J. fasciata* by differential dorsal ornamentation (jagged dorsolateral stripes vs. hourglass-shaped transverse bands across midbody). Lastly, the new species differ from all island congeners (*J. brevipes*, *J. luei*, *J. makii*, *J. polygonata*, *J. swinhonis*) by the presence of distinct transverse gular fold (vs. absent), feebly developed nuchal crest (vs. well developed), and by the differential ecology (terrestrial vs. arboreal).

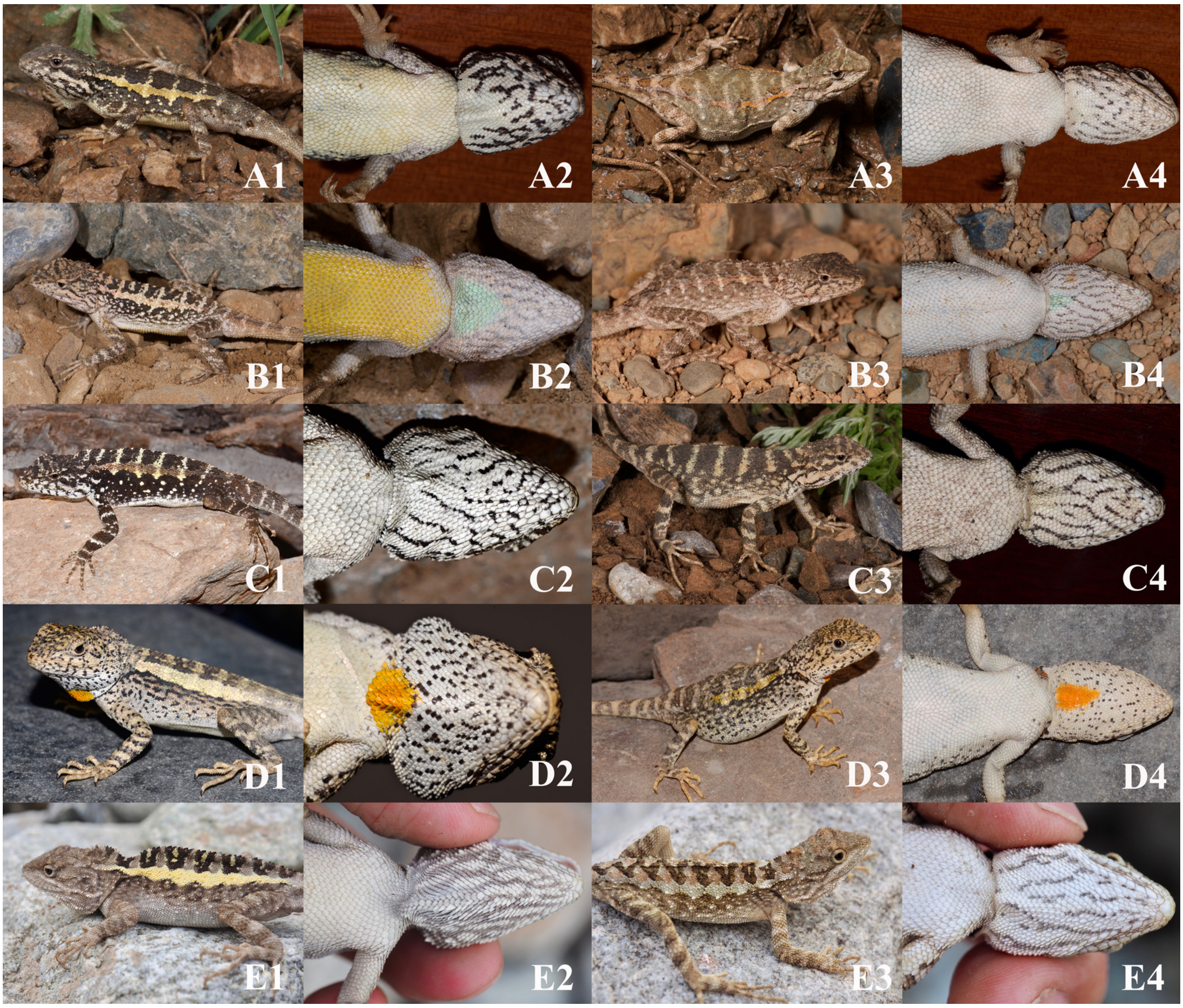

FIGURE 5. Comparisons of live males (columns 1, 2) and females (columns 3, 4) among *Japalura drukdaypo* **sp. nov.** (row A), *J. batangensis* (row B), *J. vela* (row C), *J. laeviventris* (row D), and *J. flaviceps* (row E). Photos by Kai WANG and Xu ZHANG.

Etymology. The species name, *drukdaypo*, was derived from the pronunciation of the Kham Tibetan word that means "dwarf dragon", which describes the diagnostic dwarf-morphology of the new species. We name the new species using Kham Tibetan in honor of the local culture and people, as well as their positive impacts on wildlife conservation. Suggested English common name is: Dwarf Mountain Dragon, and the suggested Chinese common name is 侏攀蜥 (Pinying: Zhu Pan Xi).

TABLE 2. Ranges and averages of morphological and pholidosis comparisons among *Japalura drukdaypo* **sp. nov.**, *J. brevicauda*, *J. flaviceps*, *J. laeviventris*, and *J. vela*. Abbreviations are listed in methods. Data of *J. brevicauda* was taken from Manthey *et al*. (2012) thus have different significant figures. Average values for each characteristic are given in parentheses. For the pholidosis characteristics (SL, IL, MD, T4S), data of males and females are grouped together for each species, as sexual dimorphism in those characteristics is not evident. "—" indicates missing data (either the actual head length or the HL/SVL ratio was not reported in the original description of *J. brevicauda*); "+": presence; "-": absence; "W": weak or feeble; "S": strong or distinct.

Species	Sex	Sample size	SVL	HL/SVL	TAL/SVL	FLL/SVL	HLL/SVL
Japalura drukdaypo **sp. nov.**	M	2	49.85–51.48 (50.67)	27.16–33.16% (30.16%)	153.01–154.40% (153.71%)	37.86–45.40% (41.63%)	58.18–63.75% (60.96%)
	F	6	50.24–58.93 (54.32)	27.82–30.18% (28.88%)	132.84–143.95% (137.95%)	37.52–42.56% (39.41%)	59.69–62.82% (60.78%)
J. brevicauda	M	1	48 (–)	—	140% (–)	39%	60%
	F	3	60–64 (62)	—	125–145% (135%)	33–40% (36.5%)	60–64% (62%)
J. vela	M	10	51.62–64.52 (58.23)	30.48–32.84% (31.43%)	174.58–238.11% (199.26%)	43.52–53.09% (47.92%)	67.53–85.64% (75.60%)
	F	10	54.07–64.24 (59.32)	28.19–30.41% (29.66%)	159.82–202.17% (179.99%)	43.35–51.76% (46.95%)	65.67–81.62% (72.87%)
J. flaviceps	M	5	71.65–75.35 (74.01)	30.43%–31.95% (31.21%)	170.08%–191.26% (182.58%)	39.02–43.95% (41.07%)	64.93%–70.86% (68.36%)
	F	3	64.35–73.25 (68.86)	28.00%–30.26% (28.86%)	167.18%–181.98% (176.08%)	39.00%–41.20% (40.47%)	61.61%–74.09% (67.60%)
J. laeviventris	M	2	66.70–71.60 (69.15)	31.53%–31.79% (31.66%)	197.22%–198.51% (197.86%)	44.44%–45.67% (45.06%)	70.42%–74.33% (72.37%)
	F	3	64.00–70.00 (68.00)	28.43%–28.86% (28.91%)	168.57–184.38% (178.60%)	43.29%–47.34% (44.97%)	64.43%–74.06% (69.69%)
J. batangensis	M	6	55.48–62.81 (59.31)	28.77–32.18% (30.93%)	187.34–206.54% (194.63%)	45.98–49.80% (47.93%)	74.71–79.83% (76.36%)
	F	5	54.66–63.11 (59.98)	28.51–31.69% (30.16%)	171.77–203.07% (186.88%)	46.21–51.18% (48.37%)	73.42–79.22% (76.94%)

……*continued on the next page*

TABLE 2. (Continued)

Species	Sex	Sample Size	TVS	GS	SNC	SDC	SCS	SL	IL	T4S	MD	SL
Japalura drukdaypo **sp. nov.**	M	2	W	-	-	-	-	7–10 (9.21)	9–12 (10.28)	18–23 (20.44)	43–56 (48.13)	7–10 (9.21)
	F	6	W	-	-	-	-					
J. brevicauda	M	1	S	-	-	-	+	6–9 (7.8)	7–10 (8.5)	16–20 (18.4)	34–40 (37.3)	6–9 (7.8)
	F	3	S	-	-	-	+					
J. vela	M	10	S	-	+	+	+	7–10 (8.88)	9–12 (10.15)	20–25 (21.9)	40–50 (44.47)	7–10 (8.88)
	F	10	S	-	-	-	+					
J. flaviceps	M	5	S	-	+	+	+	9–11 (9.63)	10–11 (10.64)	22–24 (23.50)	43–48 (44.75)	9–11 (9.63)
	F	3	S	-	+	-	+					
J. laeviventris	M	2	W	+	+	-	+	7–9 (8.10)	7–11 (8.80)	23–25 (23.80)	57–59 (58.20)	7–9 (8.10)
	F	3	W	+	-	-	+					
J. batangensis	M	6	S	+	+	+	+	7–11 (9.27)	9–13 (10.55)	18–24 (21.14)	41–53 (43.91)	7–11 (9.27)
	F	5	S	+	-	-	+					

Natural history. *Japalura drukdaypo* **sp. nov.** is terrestrial and inhabits high-elevation hills (> 3,130m) in warm-and-dry valleys near the headwaters of the Mekong River in Chamdo, Tibet (Figs. 1, 6). Habitat throughout the areas or observation includes mostly spiky shrubs (e.g. *Caragana* sp. and *Selaginella* sp.). The new species was observed to be most active in the morning and at dusk in the summer, and with individuals appearing to stay around the entrances to shelters (rock crevices and rodent/insect borrows) or in the shade of vegetation during hot afternoons. Currently, *J. drukdaypo* **sp. nov.** is known only from the valleys near the headwaters of the Mekong River in Karuo and Chaya Counties of Chamdo, Tibet, China. We believe the species may be a micro-endemic to this area based on our extensive field surveys of the surrounding region.

FIGURE 6. Habitat at the type localities of *Japalura drukdaypo* **sp. nov.** in Kanuo (A and B) and Chaya (C and D), Chamdo, Tibet, China. Photos by Kai WANG.

Discussion

Distribution of *Japalura sensu lato* in the HMR. Previous authors have suggested that records of *Japalura* cf. *flaviceps* in the unsurveyed river valleys in the HMR may represent cryptic diversity within the genus (Manthey *et al.* 2012; Wang *et al.* 2015, 2016), including populations from the headwaters of the Mekong River and much of the upper Jinsha River (Hu *et al*. 1977; Zhao *et al.* 1999; Yang & Rao 2008). Our discovery of *J. drunkdaypo* within the *J. flaviceps* complex in the upper reaches of the Mekong River Valley further supports this hypothesis and indicates that the diversity of the genus in the HMR may still be underestimated. Currently, four species are reported from the Mekong River Valley (*J. drukdaypo*, *J. iadina*, *J. vela*, and *J. yunnanensis*) and three species are reported from the adjacent upper Jinsha River Valleys (*J. batangensis*, *J. brevicauda*, and *J. yulongensis*) in China. Given the large gaps of unsurveyed habitat between the known ranges of many of these species, particularly the three species along the Jinsha River, it is likely that additional lineages await discovery.

Most recently, Rao *et al.* (2017) stated that *J. laeviventris* and *J. vela* occur in Yunnan Province; however, no reference to vouchered material or new data was provided. In the original description of *J. laeviventris*, the species was reported only from the type locality in Basu, Markam County, Tibet, which is about 224 km from the Yunnan border along the Salween River (Wang *et al*. 2016), and to date there are no other published studies about the distribution of *J. laeviventris*. Furthermore, given the fact that we did not observe the species during our extensive field surveys along the Salween River Valley in northwest Yunnan Province in 2016, even at the Yunnan-Tibet border in Gongshan County of Yunnan Province, we feel it is unlikely that the distribution of *J. laeviventris* extends into Yunnan Province. As for *J. vela*, Wang *et al*. (2015) noted that the species might also occur in the adjacent reaches of the Mekong River; however, no other vouchered information has been presented to re-evaluate the species' geographic distribution prior to the present study. Near the northern range limits of *J. vela*, we discovered two new localities along the Mekong River close to Chamdo, in the Tongsha Village and the Rumei Township, which expand the distribution range of the species northward by 114 km in linear distance (type locality at Quzika, Markam, Tibet; Wang *et al.* 2015). Additionally, at the southern limits of the range of *J. vela*, we observed the species at three new localities in Yunnan Province: Foshan, Xilu, and Xidang villages, which expand the known distribution of the species southward by 78 km in linear distance (Fig. 1). Those three southern localities fall between the type locality of *J. vela* and the type locality of *J. iadina* (Wang *et al.* 2015, 2016). With no observations of *J. vela* at the type locality of *J. iadina* in Ninong, Deqin County based on the previous study and our recent surveys (Wang *et al.* 2016), we suspect that the southern range limit of *J. vela* does not extend beyond Ninong, Deqin County in Yunnan Province. Furthermore, Xidang Village in Deqin County may represent the southern range limit for *J. vela*. Therefore, we conclude that *J. vela* is distributed along the upper Mekong River Valley from Markam County, Tibet to Deqin County, Yunnan, with a total of about 192 km linear distance between the northern and southern distributional limits, and provide the first vouchered confirmation of *J. vela* in Yunnan Province.

Finally, concerning *J. iadina*, the results of our survey efforts indicate the species may possess a much more restricted range than its neighboring species, *J. vela*. Although we did discover a more southern population of *J. iadina* in Yunling, Deqin County, the linear distance between the northern and southern range limits of the species remains less than 20 km (Fig.1). Interestingly, the newly observed population of *J. iadina* extends the species' range into more forested habitats that are quite different from the arid bushy habitats present at the type locality. Future studies on the life history and ecology of *J. iadina* are needed to better understand the species' microhabitat preferences and ecological requirements.

At present, a total of 10 species of *Japalura sensu lato* are recorded from Yunnan Province, including *J. bapoensis* (Yang & Rao 2008; although generic affiliation of the species is questionable, see Mahony 2010), *J. brevicauda* (Manthey *et al.* 2012), *J. dymondi* (Zhao *et al.* 1999; Yang & Rao 2008), *J. fasciata* (Yang & Rao 2008), *J. iadina* (Wang *et al.* 2016), *J. slowinskii* (Rao *et al.* 2017), *J. varcoae* (Zhao *et al.* 1999; Yang & Rao 2008), *J. vela* (present study), *J. yulongensis* (Manthey *et al.* 2012; Wang *et al*. 2017), and *J. yunnanensis* (Zhao *et al.* 1999; Yang & Rao 2008).

Conservation of *Japalura sensu lato* along the Upper Mekong River. Like most congeners from the HMR, *Japalura drukdaypo*, *J. iadina*, and *J. vela* are restricted to valley habitats below 3,400m of elevation along the upper Mekong River. Unfortunately, these valley habitats overlap greatly with human developments, and habitat destruction poses the greatest threats to the conservation of these endemic lizards. During our two-year survey efforts, large-scale construction projects were observed along these valley habitats along the upper Mekong River in both Yunnan and Tibet, including expansion of local townships and agricultural lands, construction of tourist sites, development of National Highway G214, and construction of hydropower stations (Fig. 7). Sadly, limited attention is paid to the impact of these landscape modifications on the conservation of terrestrial vertebrate species inhabiting the Mekong River Valley, and current proposed conservation actions are far from effective (Northwest Engineering Corporation Lt. 2013; Shanshui Conservation Center 2016). Furthermore, many construction activities do not comply with approved environmental regulations or abide by environmental protection laws. During our field surveys, construction waste stemming from the development of National Highway G214 was being disposed of into the valleys directly adjacent to the construction activities, instead of being transported to the designated disposal areas. This resulted in significant damage to native plant communities and physical structures in these important valley habitats (Fig. 7). Similar kinds of illegal activities have impacted endemic *Japalura* species in the region already. For example, road construction destroyed much of the type locality of *J. iadina* at Ninong, Deqin County within just a few months of the original description. Furthermore, expansions of agricultural land and tourism-associated construction activities at the type locality of *J. vela* have reduced the available habitat dramatically since 2015 (Fig. 7).

FIGURE 7. Destructive habitat alteration resulting from construction activities along the upper Mekong River. (A) Construction at the type localities of *Japalura vela*; (B) agricultural plantations near the type locality of *J. vela* in Markam County, Tibet; and (C) road construction close to the type locality of *J. vela* in Markam, Tibet. Photos by Kai WANG.

Therefore, according to the IUCN criteria (IUCN, 2012), we recommend *Japalura vela* be considered Vulnerable (VU) based on the following criteria: VU B2 a and b (area of occupancy estimated less than 2,000 km^2, and continuing decline of area and quality of habitat), *Japalura drukdaypo* as Vulnerable (VU) based on the following criteria: VU B2 a and b (Area of occupancy estimated less than 500 km^2; continue decline observed in quality of habitats), and *Japalura iadina* as Endangered (EN) based on the following criteria: EN B2 a and b (Area of occupancy estimated less than 500 km^2; continued decline observed in the area, extent and quality of habitat; known to exist at no more than five locations). Additionally, due to their status as regional endemic vertebrate species, and close geographic association with the iconic world-heritage sites, The Three Parallel Rivers and Meili Snow Mountains, we recommend listing *Japalura vela* and *J. drukdaypo* as Class II nationally protected species, and *J. iadina* as a Class I nationally protected species in China. Lastly, we urge the regional ministry of environment to re-evaluate the impact of road construction activities on all endemic species in China and apply conservation actions accordingly. Furthermore, we recommend greater legal enforcement of environmental laws to ensure that all such activities comply with approved environmental guidelines and regulations.

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APPENDIX I. Newly collected specimens for the present study (all coordinates are in WGS 84 datum format).

Japalura vela (n=20): KIZ 027641, 027645–49, Rumei, Markam, Tibet, China (29.6817˚ N, 98.3821˚ E, elevation 3,000 m); KIZ 027668, 027670–73, Tongsha, Markam, Tibet, China (29.9852˚ N, 98.0763˚ E, elevation 3,300 m); KIZ 027667, 027693–695, Foshan, Deqin, Yunnan, China (28.7906˚ N, 98.6652˚ E, elevation 2,200 m); KIZ 027680, 027681, Xilu, Deqin, Yunnan, China (28.9533˚ N, 98.6402˚ E, elevation 2,430 m); KIZ 027682, 027684, Xidang, Deqin, Yunnan, China (29.9852˚ N, 98.0763˚ E, elevation 2,260 m).

Japalura iadina (n=4): KIZ 027702–05, Yunling, Deqin, Yunnan, China (28.2312˚ N, 98.8578˚ E, 2,045 m).

Japalura drukdaypo (n=8): KIZ 027616 (holotype), KIZ 027618, 027619, 027628–027630 (paratopotypes), Chaya, Chamdo, Tibet, China; KIZ 016486 (paratype), Karuo, Chamdo, Tibet, China (31.0433˚ N, 97.2239˚ E, elevation 3,245 m).

APPENDIX II. Additional specimens examined.

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

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

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

Japalura iadina (n=12): KIZ 019321 (holotype), 09398 (allotype), 09401– 03, 019322, 019325–019328 (paratypes), Ninong, Deqin, Yunnan, China.

Japalura laeviventris (n=5): KIZ 014038 (holotype), 014037, 014041–014043 (paratypes), Markam, Tibet, China.

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

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

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

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

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

Japalura yulongensis (n=15): KIZ 09399, 09400, 028291–028293, 028294, 028296–028298, 028299, 028300, 028303, 028342–028344, Xianggelila County, Yunnan, China.

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

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

APPENDIX III. Morphological measurements of newly collected *Japalura vela* and *J. iadina*. Abbreviations are listed in methods. Locality codes are the followings: (1) Tongsha, Markam, Tibet Autonomous Region; (2) Rumei Township, Markam Prefecture, Tibet Autonomous Region; (3) Xilu, Deqin County, Yunnan Province; (4) Foshan, Deqin County, Yunnan Province; (5) Xidang, Deqin County, Yunnan Province; and (6) Yunling, Deqin County, Yunnan Province. "—" indicates missing data due to incomplete specimen (i.e. incomplete tail).

Species	Catalog number	Sex	Locality code	SVL	TAL	HL	HW	SEL	FLL	HLL	F4L	T4L	TRL
Japalura vela	027693	M	4	61.68	135.83	20.21	13.18	7.67	31.24	50.29	6.75	12.16	28.13
	027667	M	4	58.99	—	18.09	12.38	7.05	28.88	44.39	6.96	11.57	25.55
	027680	M	3	57.17	136.13	18.06	11.66	6.76	30.35	48.96	7.77	11.64	25.54
	027682	M	5	62.27	126.46	18.98	13.15	7.22	30.69	50.37	7.93	12.44	30.08
	027647	M	2	64.52	—	20.30	13.81	7.71	28.08	43.57	7.17	10.35	29.69
	027646	M	2	59.44	120.72	18.21	12.02	6.63	28.32	44.74	6.93	11.28	28.03
	027645	M	2	61.66	111.38	18.89	12.83	6.74	28.24	44.46	7.06	11.33	27.70
	027668	M	1	52.92	92.67	17.38	11.35	6.37	26.35	38.35	7.01	9.05	23.16
	027670	M	1	51.62	90.12	16.30	11.25	6.15	23.59	37.97	5.70	9.99	23.82
	027669	M	1	52.07	—	16.48	11.38	6.26	23.30	37.35	6.02	8.96	27.38
	027694	F	4	61.80	114.25	18.28	12.58	7.14	29.23	45.08	6.78	12.19	28.10
	027695	F	4	58.50	118.27	16.79	11.69	6.35	26.78	41.80	6.76	10.58	29.08
	027681	F	3	60.43	121.55	18.32	11.95	6.95	31.28	49.32	7.10	10.99	27.13
	027684	F	5	64.24	114.10	18.11	12.35	6.90	31.94	49.62	6.41	10.86	32.22
	027641	F	2	61.21	106.74	18.25	12.02	6.81	26.92	43.92	6.74	10.45	29.95
	027649	F	2	59.00	106.72	17.54	11.58	6.41	28.44	44.95	7.16	10.76	27.71
	027648	F	2	59.66	105.82	18.14	12.66	6.91	28.56	44.21	7.35	9.52	30.05
	027671	F	1	60.18	96.18	18.29	12.51	6.76	26.09	39.52	6.25	8.73	28.19
	027672	F	1	54.07	87.39	16.13	11.04	6.06	24.09	36.53	5.40	9.10	25.50
	027673	F	1	54.14	—	15.30	11.36	5.91	24.63	37.98	5.13	9.52	28.99
Japalura iadina	027703	M	6	52.79	105.48	16.76	11.26	6.48	24.92	39.47	6.24	10.08	27.33
	027702	M	6	58.70	113.63	19.17	12.43	7.04	29.32	45.31	7.15	11.01	29.20
	027704	M	6	53.28	110.00	17.64	11.52	6.59	27.78	43.41	6.94	11.72	27.31
	027705	F	6	54.46	95.91	16.42	10.37	6.23	26.68	40.91	6.41	9.14	28.77

……*continued on the next page*

APPENDIX III. (Continued)

Species	Catalog number	Sex	Locality code	SVL	TAL	HL	HW	SEL	FLL	HLL	F4L	T4L	TRL
Japalura vela	027693	M	4	9/8	10/10	1/1	3/4	44	17/16	21/24	4/3	2/3	3/2
	027667	M	4	9/10	9/10	1/1	3/3	45	16/16	23/23	4/2	5/4	3/2
	027680	M	3	10/9	11/11	1/1	3/3	44	17/18	23/23	5/5	4/4	3/3
	027682	M	5	10/9	11/12	1/1	3/4	50	17/16	24/24	3/3	3/3	3/3
	027647	M	2	9/8	10/10	1/1	4/4	45	17/18	21/21	3/5	4/4	3/3
	027646	M	2	8/8	10/11	1/1	3/3	43	15/16	21/22	4/3	4/4	6/6
	027645	M	2	9/8	9/9	2/2	3/3	44	18/18	24/23	4/3	3/3	3/2
	027668	M	1	10/9	9/10	2/1	3/3	41	17/17	21/21	4/4	2/1	4/4
	027670	M	1	9/8	10/10	1/1	3/3	48	16/15	21/22	2/3	1/2	3/3
	027669	M	1	10/9	11/10	2/1	3/4	43	17/16	21/22	3/2	4/2	3/2
	027694	F	4	9/9	10/9	2/2	4/4	44	15/15	20/20	3/3	3/4	4/2
	027695	F	4	9/9	11/10	1/1	3/3	45	17/16	24/23	3/3	1/2	3/4
	027681	F	3	9/9	11/9	2/2	3/3	44	15/15	20/21	4/3	2/2	1/0
	027684	F	5	8/9	11/10	2/1	4/3	47	15/15	22/21	4/4	3/2	3/4
	027641	F	2	9/9	11/10	1/1	4/4	47	17/16	25/25	4/4	3/2	2/4
	027649	F	2	9/8	11/11	2/2	3/3	42	15/17	22/23	4/4	3/4	5/5
	027648	F	2	9/8	10/10	2/2	4/4	40	16/16	22/21	4/4	4/4	3/3
	027671	F	1	9/7	10/10	1/1	3/3	42	14/15	20/20	4/2	2/2	3/3
	027672	F	1	9/9	9/10	2/2	4/4	48	15/15	20/22	4/5	4/2	5/3
	027673	F	1	9/10	10/10	1/1	3/3	44	16/15	20/20	1/3	2/2	3/2
Japalura iadina	027703	M	6	9/9	10/10	1/1	4/3	39	16/16	20/22	3/3	6/8	4/6
	027702	M	6	8/8	9/9	1/1	3/3	38	14/17	21/21	2/3	6/7	7/6
	027704	M	6	8/7	9/8	1/0	3/3	40	—	—	3/2	5/3	4/6
	027705	F	6	7/8	9/9	0/1	3/3	39	17/17	21/21	4/3	5/5	5/6