Zootaxa 5175 (1): 055–087
https://www.mapress.com/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5175.1.3
http://zoobank.org/urn:lsid:zoobank.org:pub:707F9BA8-81E2-4CF4-AEE8-AF2953BF1699

Appearances often deceive in racerunners: integrative approach reveals two new species of *Eremias* (Squamata: Lacertidae) from Pakistan

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Abstract

Based on newly provided morphological and previously published genetic data, we describe two new distinctive sympatric lacertid lizards of the genus *Eremias* (subgenus *Aspidorhinus*) from the arid mountains of northwestern Balochistan Province, Pakistan. The new species, *Eremias killasaifullahi* **sp. nov.** and *Eremias rafiqi* **sp. nov.** are distinguished from all other species of the subgenus *Aspidorhinus* (*E. afghanistanica, E. fahimii, E. isfahanica, E. kopetdaghica, E. lalezharica, E. montana, E. nikolskii, E. papenfussi, E. persica, E. regeli, E. roborowskii, E. strauchi*, *E. suphani,* and *E. velox*) by unique morphological characters and genetic differentiation. In the molecular phylogeny of *Aspidorhinus*, both new taxa are well-supported lineages differentiated from other species of this subgenus by uncorrected p distances from 8.5% to 21.6%, respectively. Both new species belong to *E. persica* complex where *E. rafiqi* **sp. nov.** is partly similar in dorsal color pattern to *E. persica* but can be distinguished from this species by unique meristic and morphometric characters. *Eremias rafiqi* **sp. nov.** is found in Pakistan, Afghanistan, and eastern Iran. *Eremias killasaifullahi* **sp. nov.** can be differentiated from *E. persica* by its distant distribution, dorsal color and pattern, smaller size, and less number of gulars and ventral scales. *Eremias killasaifullahi* **sp. nov.** is only known from the type locality and represents the local microendemism, along with other endemic species of reptiles reported from this part of Pakistan. We, however, expect that *E. killasaifullahi* **sp. nov.** could have a broader range in northwestern Pakistan and southeastern Afghanistan, which should be an object of following investigations. Our data show that remote areas between Hindu Kush Mountains and Indus River need attention as they most probably represent possible sources of genetic and species diversity in the region.

Key words: Afghanistan, *Aspidorhinus,* Balochistan, microendemism, molecular taxonomy, Palearctic region, Sulaiman Mountains

Introduction

The genus *Eremias* Fitzinger, 1834 belongs to the tribe Eremiadini (Arnold 1989, Pyron *et al.* 2013) and comprises 40 species that inhabit steppe, desert, and mountain habitats in the Eurasian region from Korean Peninsula, through China, Mongolia, Central, and South Asia, Middle East to Eastern Europe (Sindaco & Jeremčenko 2008, Rastegar-Pouyani *et al.* 2010, Guo *et al.* 2011, Orlova *et al.* 2017, Uetz *et al.* 2020). Based on morphological characters and hemipenial features, five subgenera are presently classified within *Eremias*: *Eremias* Fitzinger, 1834; *Rhabderemias* Lantz, 1928; *Aspidorhinus* Eichwald, 1841; *Scapteira* Fitzinger, 1834; *Pareremias* Szczerbak, 1973 (Ananjeva *et al.* 1998, Arnold 1986, Barabanov 2009, Chirikova 2004, Guo *et al.* 2010). Despite past efforts to ascertain the taxonomy and biogeography of the genus *Eremias* (Szczerbak 1971, 1974; Guo *et al.* 2011, Orlova *et al.* 2017),

Accepted by J. Smid: 16 Jul. 2022; published: 15 Aug. 2022

some populations and areas still remain understudied, especially in *E. persica* Blanford, 1874 and *E. velox* (Pallas, 1771) complexes (Rastegar-Pouyani *et al.* 2010, 2012; Guo *et al.* 2011).

In Pakistan, five to six currently recognized species of *Eremias* are reported, represented by the subgenera *Aspidorhinus*, *Rhabderemias*, and *Scapteira* (record of *E. fasciata* is dubious, for a review see Khan *et al.* 2021). Using a multiple gene approach, Khan *et al.* (2021) investigated six taxa of the genus and detected six, mostly well-supported and deeply divergent evolutionary clades with an unexpectedly high level of uncorrected *p* distances for mtDNA (in cytochrome *b* reaching up to 23.8%). The data confirmed the species status of recently described species that were defined based on morphological data and are endemic to the region, i.e. *E.* (*Rhabderemias*) *cholistanica* Baig & Masroor, 2006 and *E.* (*Rhabderemias*) *kakari* Masroor, Khisroon, Khan, Jablonski, 2020 (Masroor *et al.* 2020, Khan *et al.* 2021, Jablonski & Masroor 2021). On the other hand, the data showed that *E. aporosceles* Alcock and Finn, 1897 is a synonym of *E. acutirostris* (Boulenger, 1887), and *E. persica* represents hidden genetic diversity that needs to be better evaluated. These newly detected clades of the *E. persica* were named E and F (Khan *et al.* 2021) and were revealed based on both mitochondrial and nuclear data. The genetic distances between these two clades reveal more than 17% on mtDNA. Whereas clade E was detected to occur in Iran and Afghanistan, clade F is known only from the territory of Pakistan. Thus, Khan *et al.* (2021) concluded that the current taxonomy of *Eremias* in Pakistan does not reflect the observed genetic diversity.

Due to various reasons, the territory of Pakistan is one of the most complicated areas of the world for biodiversity research. Some areas are virtually unexplored and new finds are thus highly expected after comprehensive explorations. For the same reasons, the initial goals of this study were to explore the diversity of lacertid lizards in southwestern Balochistan. We collected 23 specimens of the genus *Eremias* from northwestern Balochistan during fieldwork surveys between 2017 and 2019. We also examined six additional formalin-preserved specimens, collected by our late colleague Khalid Javed Baig (Pakistan Museum of Natural History in Islamabad, 1956–2006) from Killa Saifullah during May 1997. Using identification keys (Minton 1966; Anderson 1999; Rastegar-Pouyani *et al.* 2016), our preliminary examination of the collected specimens revealed that these specimens belong to the subgenus *Aspidorhinus* with morphological characters not attributed to any known species which was later on confirmed by genetic data (Khan *et al.* 2021). Thus, we here bring a comprehensive morphological comparison of the subgenus *Aspidorhinus* supplemented by genetics that allowed us to describe two new species of *Eremias* from Pakistan.

Materials and methods

Morphological data

The collected specimens (see Table 1 and 2) stored in the Pakistan Museum of Natural History, Islamabad, Pakistan (PMNH) were examined for 39 morphological characters by recording their mesural, meristic and qualitative data, following Boulenger (1890, 1918, 1921), Lantz (1928), Szczerbak (1974), Rastegar-Pouyani *et al.* (2016), Orlova *et al.* (2017) and Masroor *et al.* (2020). All measurements were carried out to the nearest 0.01 mm by using a digital vernier caliper. The scales were counted with the use of a stereomicroscope. Measurements of arms, legs, and head as well as scale counts beneath the toes were principally taken on the right side of the specimens.

We took data of the following characters: SVL (snout-vent length, from the tip of snout to the anterior edge of the cloaca); TL (tail length, from the posterior edge of cloaca to the tip of the tail); TrL (trunk length, the distance from axilla to groin measured from posterior edge of forelimb insertion to anterior edge of hindlimb insertion); HL (head length, distance between snout-tip and retroarticular process of jaw); Lpil (length of pileus, from rostrum to the posterior border of parietals); NL (head length from snout tip to the anterior edge of collar, measured from ventral side); HW (head width, measuring widest part of the head); HH (head height, from occiput to underside of jaws); FrL (length of frontal scale); FrW (maximum width of frontal scale); SNL (length of supranasal suture); FNL (length of frontonasal); PFL (length of prefrontal); PFW (width of prefrontal); NSD (nostril to snout distance); HLL (hindlimb length, from hindlimb insertion to the tip of the longest toe); FLL (forelimb length, from forelimb insertion to the tip of the longest finger); HRL (length of humerus and radius, from forelimb insertion to palm, excluding the digits); FL (femur length, from hindlimb insertion to knee); CL (Crus length or tibia length, from the base of the heel to knee); LFPR (length of femoral pore row); LFPS (width of space between femoral pore rows); SL (supralabials, counted on both right and left sides); SLAS (number of supralabials anterior to subocular, counted on both right and left sides); IL (infralabials, counted on both right and left sides); G (gulars, from chin shields to the collar);

DS (number of scales on midbody); VL (maximum number of scales across mid-belly in a single row in the widest part); VT (number of ventral scales in a single row from posterior edge of collar to the vent); FP (number of femoral pores, counted on both right and left sides); FPS (number of scales separating femoral pore rows); SDLT 4th (subdigital lamellae under 4th toe); SAT 4th (number of scales around 4th toe at the penultimate phalanx); SDLF 4th (Subdigital lamellae under 4th finger); NCWS (scales around ninth and tenth caudal whorl posterior to the vent); FMIL (contact of fifth maxillary/chin shield with infralabial; in contact (+)/separated (-)); SOM (subocular in contact with mouth; present (+)/absent (-)); FSO (contact of frontal and supraoculars; in contact (+)/separated (-)), INTR (contact of infranasal with rostral; in contact (+)/separated (-)).

For morphological comparisons with species from subgenera *Aspidorhinus* and *Eremias*, we used morphological data from original descriptions as well as other relevant publications (Kessler 1878, Nikolsky 1896, Bedriaga in Nikolsky 1905, Nikolsky 1915, Lantz 1928, Minton 1966, Anderson & Leviton 1967, Başoğlu & Hellmich 1968, Szczerbak 1972, Bischoff & Böhme 1980, Szczerbak 1981, Böhme & Szczerbak 1991, Moravec 1994, Rastegar-Pouyani & Nilson 1997, Anderson 1999, Rastegar-Pouyani & Rastegar-Pouyani 2001, Baig & Masroor 2006, Mozaffari *et al*. 2011, Rastegar-Pouyani *et al*. 2016, Mozaffari *et al*. 2020).

Genetic data and analysis

For molecular phylogenetic reconstruction and relationships of the below-described species representing clades E and F (sensu Khan *et al.* 2021), we used sequence data set (cytochrome *b*; cyt *b*; 1143 bp) adopted from Rastegar-Pouyani *et al.* (2010, 2012, 2015, 2016), Liu *et al.* (2019), Mozaffari *et al.* (2020), and Khan *et al.* (2021) that represent the majority of currently described and valid species of the subgenus *Aspidorhinus* (Appendix 1). The genetic data of *Eremias isfahanica* and *E. papenfussi* (KP317957-KP317963) by Rastegar-Pouyani *et al.* (2016) were excluded as they are considered nuclear insertions of mtDNA (numts) (Khan *et al.* 2021). The following taxa in the family Lacertidae were selected as outgroup: *Mesalina guttulata* (JN828648), *M. watsonana* (MH040049), *Lacerta agilis* (CM020436), *Acanthodactylus boskianus* (KX528879), and *Ophisops elegans* (FJ416172). A Maximum likelihood (ML) analysis was implemented using IQ-TREE (Nguyen *et al.* 2015; Trifinopoulos *et al.* 2016) under the substitution model selected by the Bayesian Information Criterion (BIC) implemented in PartitionFinder 2 (Lanfear *et al.* 2017) which selected GTR+G for all codon positions. Using ultrafast bootstrap (UFB) with 1,000 pseudoreplicates we considered nodes having values 95 and above as strongly supported and nodes with values above 90 as well supported.

Moreover, we estimated genealogical relationships of mtDNA haplotypes (cyt *b*; 1143 bp) and nuclear alleles (Rag1; 922 bp; the dataset of Rastegar-Pouyani *et al*. 2015 and Khan *et al*. 2021) separately using a network approach (Appendix 1). For the purpose of allele network construction, sequences of the Rag1 with the heterozygous sites were resolved in PHASE 2.1.1 (Stephens *et al.* 2001) and input data were prepared in SeqPHASE (Flot, 2010). Haplotype networks of both analyzed markers were constructed and drawn using PopArt (http://popart.otago.ac.nz) and the implemented parsimony network algorithm of TSC (Clement *et al.* 2000), with a 95% connection limit. Well-defined networks are considered distinct evolutionarily significant units, following Fraser and Bernatchez (2001), thus this analysis was also used to infer genetic structure within the studied taxa. Uncorrected inter- and intraspecific *p* genetic distances and variability of the subgenus *Aspidorhinus* were estimated on cyt *b* using DnaSP 6 (Rozas *et al.* 2017).

Results

Molecular and morphological data showed that below described new species of *Eremias* from Pakistan are independent evolutionary lineages in the mitochondrial phylogeny of the *E. persica* complex in the subgenus *Aspidorhinus* (Khan *et al.* 2021 and this study). Both new species are well-supported through tree analysis (Fig. 1). The clade F is sister to all species represented in the phylogeny. The result obtained from the nuclear Rag1 marker also supports their species status with 1% of *p* distance between both new species (Fig. 2D). For details, see molecular diagnoses in the description part.

Both defined clades E and F are members of the genus *Eremias*, based on the following combination of morphological characters: head shields normal, but occipital often vestigial or absent; nostril between three or four nasals, not touching labial; lower eyelid scaly; collar complete or nearly so; dorsal scales small or granular, subimbricate or juxtaposed; ventral plates subquadrangular, imbricate, smooth in converging longitudinal rows; digits with or without lateral fringes; tail cylindrical; femoral pores present (all after Anderson 1999). Furthermore, the new taxa are assigned to the subgenus *Aspidorhinus* Eichwald, 1841 (type species: *E. velox*) based on the following combination of morphological characters sensu Lantz (1928: 36): subocular in contact with the edge of the mouth; row(s) of granular scales separating the frontal and supraoculars usually incomplete, thus supraoculars and frontal remain in contact; collars well-differentiated; striped dorsal pattern in young individuals drastically modified in adults in the form of ocelli, the lateralmost broader dark stripe may persist in the adults.

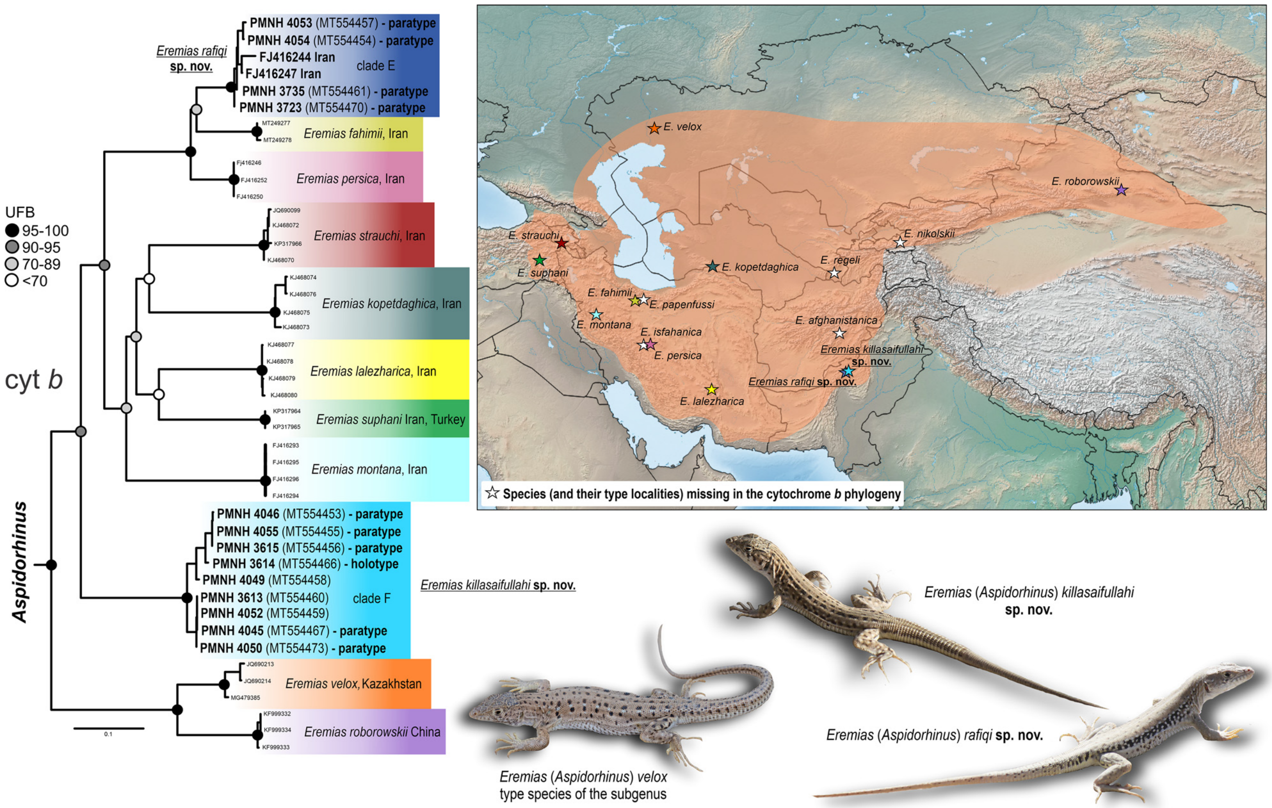

FIGURE 1. Maximum likelihood phylogeny of available species of the *Aspidorhinus* subgenus (*Eremias*) based on cytochrome *b* sequences. Black circles denote nodes with strongly supported UFB values. The distribution (orange layer) of the subgenus *Aspidorhinus* with type localities of currently recognized species is adopted and modified based on Mozaffari *et al.* (2020) and Khan *et al.* (2021).

Systematics

Family Lacertidae Oppel, 1811

Genus *Eremias* Fitzinger, 1834

Subgenus *Aspidorhinus* Eichwald, 1841

Type species: *Eremias velox* (Pallas, 1771)

***Eremias killasaifullahi* sp. nov.**
(Table 1, Figs. 3, 5, 6)
Suggested vernacular name: Killa Saifullah’s Racerunner
Pashto name: دا قلعه سیف الله سوسو مار

Holotype. PMNH 3613 (cyt *b*: MT554460; Rag1: MT554498), an adult male, collected from Kunder, Torghar Mountains, Killa Saifullah district, Balochistan (31.3247º N, 68.5452º E; Fig. 7D), elevation 1,920 m a. s. l., March 23, 2017, leg. Rafaqat Masroor (Fig. 3).

Paratypes. **Males:** PMNH 3614–3616 (cyt *b*: MT554466, MT554456, n/a; Rag1: MT554478, MT554482, n/a). **Females:** PMNH 4046 (cyt *b*: MT554453; Rag1: MT554479), PMNH 4050 (cyt *b*: MT554473; Rag1: MT554483), PMNH 4055 (cyt *b*: MT554455; Rag1: MT554481). **Juveniles:** PMNH 3673 (cyt *b*: n/a; Rag1: n/a), PMNH 4045 (cyt *b*: MT554467; Rag1: MT554486), PMNH 4052 (cyt *b*: MT554459; Rag1: MT554497). PMNH 3614–16, 3673 collected along with the holotype; PMNH 4045, 4052, September 5, 2018, Zamkai Nala, Tanishpa, Killa Saifullah district, leg. Rafaqat Masroor; PMNH 4046, 4055 August 31, 2018, Ashewat, Qamar Din Karez, Zhob district, leg. Rafaqat Masroor; PMNH 4050, September 1, 2018, Zamkai Nala, Tanishpa, Killa Saifullah district, leg. Rafaqat Masroor (Figs. 5, 6).

Morphological diagnosis. A medium-sized lacertid lizard, maximum snout-vent length (SVL) = 70.5 mm, tail 1.67 to 1.97 times longer than body length (SVL), hindlimbs relatively long (HLL/SVL ratio 0.6–0.8); subocular scale reaching to the edge of the mouth, 5–7 (mainly 6, rarely 5) anterior to subocular; dorsals 53–63; ventrals in 14–18 oblique longitudinal series; frontal separated from supraoculars; the height of the first two to three transverse rows of ventral scales in the pectoral region more than its breadth; 17–24 femoral pores on each side, separated medially by 1–5 scales (mainly 2–4, rarely 1), the space between the femoral pores less than one–fourth length of each row; toes without fringe, encircled by three scales in a single series of 21–25 unicarinate and bicarinate scales underneath; tip of the fourth toe reaches to the forelimb and extends to just behind the collar. The adult specimens are creamy beige in life with seven light stripes appearing on the neck which transforms into ocelli and vermiculation behind the neck. No dorsolateral broader dark stripes, an outer-most series of white and black ocelli starts behind the eyes on each side, onto the tympanum and flanks above the forelimb and hindlimb insertion.

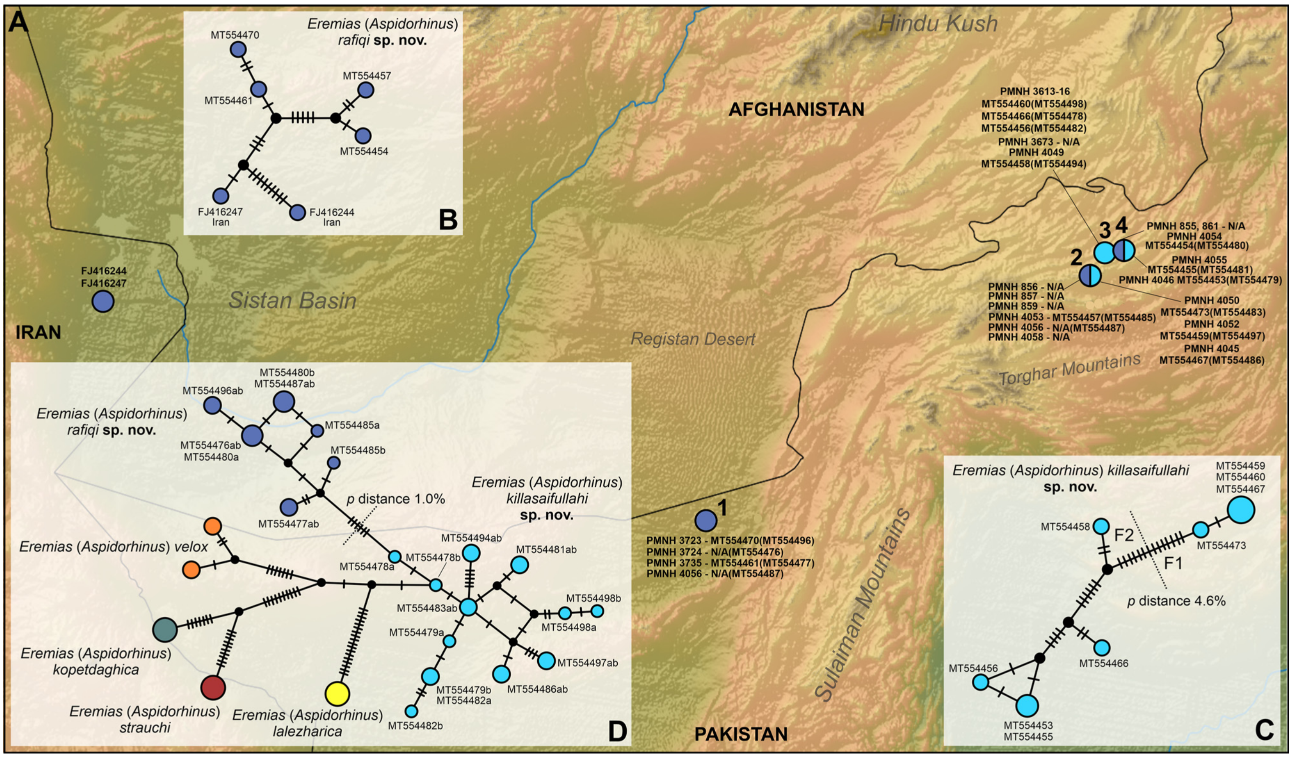

FIGURE 2. (A) The map of northern Balochistan in Pakistan, southern Afghanistan and eastern Iran with the localities from where morphologically examined specimens were collected: 1—Khar, Nushki district, 2—Tanishpa, Killa Saifullah district, 3—Kunder, Killa Saifullah district, 4—Ashewat, Zhob district. Their cytochrome *b* and Rag1 sequences (if available) are related to particular locality of the collection (GenBank accession numbers for Rag1 are in parentheses). (B, C) The network analyses of the intraspecific haplotype diversity based on cyt *b* and (D) relationships between available members of the subgenus *Aspidorhinus* on Rag1 sequences are presented on white backgrounds (see also Appendix 1). For the Rag1 network, different alleles of a single heterozygous specimen are coded as "a" and "b" variants, while "ab" indicates an allele of a homozygous specimen. Dashes on network branches represent number of mutation steps and black dots missing haplotypes. Coloration in networks corresponds with the tree presented in Fig. 1.

TABLE 1. Morphometric and meristic data of the type series of *Eremias* (*Aspidorhinus*) *killasaifullahi* **sp. nov.** including ratios of important characters. For abbreviation of characters, see material and methods (N/A = data not available, + = in contact, - = separated, R= regenerated).

PMNH	**3613**	**4050**	**4045**	**4052**	**3614**	**3615**	**3616**	**4046**	**4055**	**3673**	Min–Max (mean ±SD)
Types	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	
Sex	Male	Female	Female	Female	Male	Male	Male	Female	Female	Male	
Age	Adult	Adult	Juvenile	Juvenile	Adult	Adult	Adult	Adult	Adult	Juvenile	
Metric data											
SVL	65.3	58.5	37.1	32.8	67.9	70.5	59.4	58.1	56.4	36.7	32.8–70.5 (54.3 ±13.7)
TL	109.7	76.8 R	73.1	56.5	116.8	92.3 R	117.3	78.7 R	78.6 R	70.7	56.5–117.3 (90.7 ±26.9)
SVL/TL	0.6	N/A	0.5	0.6	0.6	N/A	0.5	N/A	N/A	0.5	0.5–0.6 (0.5 ±0.1)
HL	17.4	15.3	11.4	8.9	18.3	19.1	16.7	15.1	15.0	11.6	8.9–19.1 (14.9 ±3.3)
HW	10.2	8.6	6.2	5.0	11.1	11.2	9.3	8.0	9.0	6.0	5.0–11.2 (8.5 ±2.1)
HW/HL	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.5	0.6	0.5	0.5–0.6 (0.6 ±0.0)
HH	8.1	6.8	4.6	3.6	8.5	8.6	7.6	7.0	6.3	4.6	3.6–8.6 (6.6 ±1.7)
HL/SVL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3–0.3 (0.3 ±0.0)
HH//HW	0.8	0.8	0.7	0.7	0.8	0.8	0.8	0.9	0.7	0.8	0.7–0.9 (0.8 ±0.1)
TrL	28.3	24.0	15.5	13.7	28.1	29.1	27.1	26.8	26.9	15.4	13.7–29.1 (23.5 ±6.1)
TrL/SVL	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4–0.5 (0.4 ±0.1)
HLL	44.8	37.9	25.2	24.8	47.4	47.9	43.1	37.8	38.3	25.6	24.8–47.9 (37.3 ±9.1)
EL	4.9	4.5	3.2	3.1	5.1	5.5	4.5	4.5	4.1	2.9	2.9–5.5 (4.2 ±0.9)
EED	5.3	4.5	2.6	2.2	5.3	5.6	4.5	4.5	4.0	2.5	2.2–5.6 (4.1 ±1.2)
NL	8.1	6.3	4.3	4.3	8.2	9.9	6.7	6.3	5.7	4.1	4.1–9.9 (6.4 ±1.9)
TD	3.0	2.7	1.9	1.6	3.1	3.7	2.5	2.8	2.5	1.9	1.6–3.7 (2.6 ±0.6)
IOR	7.8	6.0	5.1	4.9	8.0	8.0	6.9	6.2	6.2	5.0	4.9–8.0 (6.4 ±1.2)
FL	12.2	10.5	7.2	6.3	13.1	13.5	11.1	12.8	10.4	6.9	6.3–13.5 (10.4 ±2.7)
CL	13.4	11.3	7.7	6.8	13.8	13.9	13.5	12.2	11.6	7.5	6.8–13.9 (11.1 ±2.8)
HLL/SVL	0.7	0.6	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.6–0.8 (0.7 ±0.0)
FLL	26.6	20.4	15.1	12.8	28.6	30.5	26.4	21.4	23.5	16.2	12.8–30.5 (22.1 ±6.0)
FLL/HLL	0.6	0.5	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5–0.6 (0.6 ±0.0)
HRL	16.2	13.1	9.3	7.0	17.9	19.0	15.5	12.2	13.8	10.2	7.0–19.0 (13.4 ±3.8)
LFPR	14.2	11.8	7.6	6.5	12.5	15.1	12.2	12.7	11.7	7.2	6.5–15.1 (11.1 ±3.0)
LFPS	0.8	1.7	1.6	0.7	1.6	1.4	1.6	1.2	0.3	0.7	0.3–1.7 (1.1 ±0.5)
FrL	4.6	4.2	3.3	2.9	5.3	5.2	4.3	4.1	4.2	3.2	2.9–5.3 (4.1 ±0.8)

......*continued on the next page*

TABLE 1. (Continued)

PMNH	**3613**	**4050**	**4045**	**4052**	**3614**	**3615**	**3616**	**4046**	**4055**	**3673**	Min–Max (mean ±SD)
Types	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	
Sex	Male	Female	Female	Female	Male	Male	Male	Female	Female	Male	
Age	Adult	Adult	Juvenile	Juvenile	Adult	Adult	Adult	Adult	Adult	Juvenile	
FrW	2.3	2.4	1.6	1.2	2.9	2.8	2.1	2.2	2.0	1.7	1.2–2.9 (2.1 ±0.5)
Lpil	15.9	13.5	10.2	8.7	16.6	16.5	14.5	13.7	13.0	10.2	8.7–16.6 (13.3 ±2.8)
NL	21.2	18.2	13.3	11.2	23.0	23.6	19.2	18.9	16.6	13.5	11.2–23.6 (17.9 ±4.2)
SNL	0.6	0.8	0.5	0.3	1.0	1.0	0.5	0.6	0.7	0.6	0.3–1.0 (0.7 ±0.2)
FNL	2.4	1.6	1.3	1.0	2.4	2.3	2.3	2.0	1.8	1.2	1.0–2.4 (1.8 ±0.5)
FNW	2.7	1.9	1.6	1.5	2.7	2.5	2.7	2.3	2.1	1.5	1.5–2.7 (2.1 ±0.5)
PFL	2.7	2.3	1.6	1.2	2.7	2.9	2.8	2.3	2.2	1.0	1.0–2.9 (2.1 ±0.7)
PFW	1.9	1.5	1.2	1.1	1.9	2.0	1.9	1.9	1.5	0.9	0.9–2.0 (1.6 ±0.4)
Meristic data											
SL (R/L)	8/8	9/8	9/8	9/8	10/11	9/9	9/9	11/11	8/9	9/10	8–11 (9 ±1.0)
IL (R/L)	6/6	7/6	7/7	7/7	7/7	7/7	8/7	7/8	7/7	7/7	6–8 (7 ±1.0)
DS	60	61	63	60	58	53	59	60	58	57	53.0–63.0 (58.9 ±2.7)
VT	25	27	27	26	29	28	29	26	29	28	25–29 (27.4 ±1.4)
VL	16	14	15	17	18	16	17	18	15	16	14–18 (16.2 ±1.3)
G	20	26	27	23	32	29	31	29	28	33	20–33 (27.8 ±4.0)
C	10	11	12	11	11	10	12	12	11	12	10–12 (11.2 ±0.8)
NCWS	26	22	26	23	24	25	25	24	22	27	22–27 (24.4 ±1.7)
SLAS (R/L)	5/5	6/5	6/5	6/5	6/7	6/6	6/6	6/6	5/6	6/6	5–7 (6 ±1.0)
FP (R/L)	17/N/A	19/N/A	19/N/A	18/N/A	20/N/A	22/N/A	20/N/A	22/N/A	21/N/A	24/N/A	17–24 (20.2 ±2.0)
FPS	2	4	4	2	5	4	3	2	1	2	1–5 (2.9 ±1.3)
SDLT 4th	21	23	23	22	25	23	24	24	25	23	21–25 (23.3 ±1.2)
SAT 4th	3	3	3	3	3	3	3	3	3	3	3–3 (3 ±0.0)
SDLF 4th	15	17	17	16	15	16	17	17	17	16	15–17 (16.3 ±0.8)
Qualitative data											
FMIL	+	+	+	+	+	+	+	+	+	-	
SOM	+	+	+	+	+	+	+	+	+	+	
FSO	+	+	+	+	+	+	+	+	+	+	
INTR	-	-	-	-	-	-	-	-	-	-	

TABLE 2. Morphometric and meristic data of the type series of *Eremias* (*Aspidorhinus*) *rafiqi* **sp. nov.** including ratios of important characters. For abbreviation of characters, see material and methods (N/A = data not available, + = in contact, - = separated, R= regenerated, TB= tail broken).

PMNH	**856**	**855**	**857**	**859**	**861**	**837**	**4058**
Types	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
Sex	Male	Male	Male	Male	Male	Male	Female
Age	Adult	Adult	Adult	Adult	Adult	Juvenile	Adult
Metric data							
SVL	99.3	92.2	78.5	80.0	84.5	44.8	98.1
TL	168.0	120.0 R	118.5 R	135.0	152.3	TB	121.4 R
SVL/TL	0.6	N/A	N/A	0.6	0.6	N/A	N/A
HL	26.9	25.5	22.1	21.6	23.3	13.1	28.8
HW	15.5	13.3	12.1	12.2	13.2	6.7	14.5
HW/HL	0.6	0.5	0.5	0.6	0.6	0.5	0.5
HH	13.8	12.0	10.0	10.4	10.3	5.4	11.5
HL/SVL	0.3	0.3	0.3	0.3	0.3	0.3	0.3
HH/HW	0.9	0.9	0.8	0.9	0.8	0.8	0.8
TrL	42.5	38.2	34.5	37.8	37.7	20.3	42.2
TrL/SVL	0.4	0.4	0.4	0.5	0.4	0.5	0.4
HLL	66.8	57.1	47.6	48.5	50.6	28.2	56.0
EL	6.7	6.5	6.1	6.4	6.3	4.4	6.6
EED	7.9	7.1	6.1	6.1	6.2	3.0	6.5
NL	12.4	11.3	9.4	10.2	10.7	5.4	13.8
TD	5.1	4.5	4.7	4.6	4.8	2.7	5.2
IOR	10.8	10.0	8.8	8.4	8.5	6.3	9.8
FL	20.3	19.0	15.7	15.4	15.8	7.2	17.0
CL	20.4	19.3	16.5	17.3	17.3	8.1	17.8
HLL/SVL	0.7	0.6	0.6	0.6	0.6	0.6	0.6
FLL	37.3	33.3	35.3	35.8	31.7	15.6	38.1
FLL/HLL	0.6	0.6	0.7	0.7	0.6	0.6	0.7
HRL	25.2	17.1	22.3	22.1	17.1	11.1	21.3
LFPR	19.3	19.6	15.9	15.3	15.8	8.4	18.5
LFPS	2.4	1.8	0.3	1.9	1.9	1.1	2.2
FrL	6.3	6.3	5.4	5.5	6.1	3.4	6.5

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TABLE 2. (Continued)

PMNH	**856**	**855**	**857**	**859**	**861**	**837**	**4058**
Types	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
Sex	Male	Male	Male	Male	Male	Male	Female
Age	Adult	Adult	Adult	Adult	Adult	Juvenile	Adult
FrW	3.4	3.6	3.0	2.9	3.0	1.9	3.3
Lpil	23.2	21.9	19.1	18.9	19.7	11.6	22.1
NL	31.6	30.4	26.4	25.3	27.1	14.4	31.7
SNL	1.0	0.9	1.0	0.9	1.1	0.5	1.2
FNL	3.7	3.4	3.1	2.6	2.8	1.9	3.4
FNW	4.0	4.0	3.2	2.9	3.4	2.0	3.9
PFL	4.1	4.1	3.4	3.3	3.4	1.7	3.9
PFW	2.5	2.5	2.3	2.0	2.0	1.5	2.3
Meristic data							
SL (R/L)	10/9	10/9	9/9	10/9	10/10	9/10	9/9
IL (R/L)	6/7	9/9	8/8	9/8	10/9	8/8	8/8
DS	62	60	62	64	62	63	66
VT	29	30	31	29	29	30	31
VL	16	15	16	14	14	14	15
G	32	31	34	30	32	32	33
C	10	9	11	9	8	10	11
NCWS	30	30	30	27	28	28	32
SLAS (R/L)	6/5	6/6	6/6	6/6	7/7	6/7	6/6
FP (R/L)	21/N/A	19/N/A	19/N/A	19/N/A	21/N/A	19/N/A	20/N/A
FPS	2	3	1	3	3	3	4
SDLT 4th	25	25	24	26	24	23	23
SAT 4th	3	3	3	3	3	3	3
SDLF 4th	17	18	17	17	16	17	18
Qualitative data							
FMIL	-	+	-	-	+	+	-
SOM	+	+	+	+	+	+	+
FSO	+	+	+	+	+	+	+
INTR	+	+	+	+	+	+	+

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TABLE 2. (Continued)

PMNH	**4056**	**3724**	**3735**	**3723**	**4053**	**4054**	Min–Max (mean ±SD)
Types	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	
Sex	Male	Female	Female	Male	Male	Female	
Age	Adult	Adult	Adult	Juvenile	Juvenile	Juvenile	
Metric data							
SVL	89.5	75.1	73.1	37.6	37.7	41.3	37.6–99.3 (71.6 ±23.2)
TL	149.8	135.7	125.8	68.4	71.3	77.2	68.4–168.0 (120.4 ±38.1)
SVL/TL	0.6	0.6	0.6	0.5	0.5	0.5	0.5–0.6 (0.6 ±0.0)
HL	25.2	20.2	19.5	11.3	11.5	12.6	11.3–28.8 (20.1 ±6.1)
HW	13.7	11.2	10.7	6.4	6.4	6.7	6.4–15.5 (10.9 ±3.3)
HW/HL	0.5	0.6	0.5	0.6	0.6	0.5	0.5–0.6 (0.5 ±0.0)
HH	10.3	8.6	8.4	4.4	4.7	5.1	4.4–13.8 (8.8 ±3.0)
HL/SVL	0.3	0.3	0.3	0.3	0.3	0.3	0.3–0.3 (0.3 ±0.0)
HH/HW	0.8	0.8	0.8	0.7	0.7	0.8	0.7–0.9 (0.8 ±0.1)
TrL	41.5	36.8	33.7	14.7	15.2	18.1	14.7–42.5 (31.8 ±10.6)
TrL/SVL	0.5	0.5	0.5	0.4	0.4	0.4	0.4–0.5 (0.4 ±0.0)
HLL	56.8	49.0	47.1	27.9	28.5	28.7	27.9–66.8 (45.6 ±13.1)
EL	6.6	5.6	5.5	3.4	3.6	3.9	3.4–6.7 (5.5 ±1.2)
EED	6.5	5.1	5.4	2.7	2.9	3.1	2.7–7.9 (5.2 ±1.8)
NL	11.6	9.8	9.8	5.4	5.7	6.7	5.4–13.8 (9.4 ±2.8)
TD	4.4	3.9	3.7	2.0	2.2	2.3	2.0–5.2 (3.8 ±1.1)
IOR	8.9	6.9	7.1	4.6	4.8	5.2	4.6–10.8 (7.7 ±2.0)
FL	16.3	15.0	13.7	7.3	7.7	8.2	7.2–20.3 (13.7 ±4.6)
CL	19.0	16.1	14.1	7.7	8.1	8.9	7.7–20.4 (14.6 ±4.7)
HLL/SVL	0.6	0.7	0.6	0.7	0.8	0.7	0.6–0.8 (0.6 ±0.1)
FLL	37.2	30.3	30.8	15.3	15.8	16.6	15.3–38.1 (28.7 ±9.2)
FLL/HLL	0.7	0.6	0.7	0.5	0.6	0.6	0.5–0.7 (0.6 ±0.1)
HRL	21.3	18.5	18.1	7.8	8.2	8.6	7.8–25.2 (16.8 ±6.0)
LFPR	15.8	14.9	15.1	6.5	6.7	8.1	6.5–19.6 (13.8 ±4.7)
LFPS	2.4	1.5	1.8	0.5	0.6	0.8	0.3–2.4 (1.5 ±0.7)
FrL	6.6	4.9	5.0	3.1	3.3	3.7	3.1–6.6 (5.0 ±1.3)
FrW	3.4	2.4	2.8	1.4	1.7	1.8	1.4–3.6 (2.6 ±0.7)

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TABLE 2. (Continued)

PMNH	**4056**	**3724**	**3735**	**3723**	**4053**	**4054**	Min–Max (mean ±SD)
Types	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	
Sex	Male	Female	Female	Male	Male	Female	
Age	Adult	Adult	Adult	Juvenile	Juvenile	Juvenile	
Lpil	22.0	16.3	16.5	9.8	10.3	11.0	9.8–23.2 (17.1 ±4.9)
NL	31.6	25.0	23.3	13.4	13.8	14.6	13.4–31.7 (23.7 ±7.2)
SNL	1.2	0.9	0.7	0.3	0.4	0.4	0.3–1.2 (0.8 ±0.3)
FNL	3.3	2.6	2.7	1.3	1.5	1.5	1.3–3.7 (2.6 ±0.8)
FNW	3.6	3.0	3.0	1.5	1.8	1.8	1.5–4.0 (2.9 ±0.9)
PFL	3.8	2.4	2.6	1.4	1.6	1.8	1.4–4.1 (2.9 ±1.0)
PFW	2.3	1.9	2.0	1.0	1.2	1.2	1.0–2.5 (1.9 ±0.5)
Meristic data							
SL (R/L)	10/8	9/11	10/9	9/9	10/10	10/10	8–11 (10 ±1.0)
IL (R/L)	8/7	9/9	8/8	8/8	8/8	8/8	6–10 (8 ±1.0)
DS	65	56	67	59	60	57	56–67 (61.8 ±3.3)
VT	29	33	32	30	29	31	29–33 (30.3 ±1.3)
VL	15	16	15	16	17	16	14–17 (15.3 ±0.9)
G	34	31	35	31	33	36	30–36 (32.6 ±1.7)
C	12	12	12	11	11	12	8–12 (10.6 ±1.3)
NCWS	33	26	24	26	28	24	24–33 (28.1 ±2.8)
SLAS (R/L)	6/5	5/7	6/6	6/6	6/7	6/6	5–7 (6 ±1.0)
FP (R/L)	22/N/A	18/N/A	17/N/A	19/N/A	20/N/A	19/N/A	17–22 (19.5 ±1.3)
FPS	3	2	3	3	3	3	1–4 (2.8 ±0.7)
SDLT 4th	26	25	22	25	27	23	22–27 (24.5 ±1.4)
SAT 4th	3	3	3	3	3	3	3–3 (3 ±0.0)
SDLF 4th	17	17	16	17	17	17	16–18 (17 ±0.6)
Qualitative data							
FMIL	-	-	+	+	-	+	
SOM	+	+	+	+	+	+	
FSO	+	+	+	+	+	+	
INTR	+	+	+	+	+	+	

Molecular data. *Eremias killasaifullahi* **sp. nov**. represents a newly detected evolutionary lineage (Fig. 1) of the genus *Eremias* (*Aspidorhinus*) that was firstly detected by Khan *et al*. (2021) as the clade F (with subclades F1, F2) based on four studied genetic markers (16S, COI, cyt *b*, Rag1). This lineage was detected occurring in NE Balochistan in Pakistan and represents local microendemism (Fig. 2). The lineage deeply diverges and is sister to all other lineages of such called *E. persica* complex (see Khan *et al*. 2021 and Fig. 1 in this study) and well differentiated in the Rag1 dataset (Fig. 2). The lineage genetically (uncorrected *p* distances) differs from 14.5% (*E. strauchi*) to 21.6% (*E. velox*) (Table 3) among species of the subgenus *Aspidorhinus*. Its average intraclade genetic variability (cyt *b*) is 3% (Fig. 2). Despite a very small known range of distribution, the distances between F1 and F2 subclades sensu Khan *et al*. (2021) reached 4.6% and the haplotype network based on cyt *b* dataset showed six different haplotypes. High allele diversity was also detected by analyzing the Rag1 marker (Fig. 2).

TABLE 3. Average uncorrected *p* distances (percentages) between currently recognized species of the subgenus *Aspidorhinus* (*Eremias*) on available sequences of mitochondrial DNA (cytochrome *b*). In diagonal (in italics) are the average intra-clade *p* distances.

species	*E. rafiqi* **sp. nov**.	*E. killasaifullahi* **sp. nov.**	*E. fahimii*	*E. kopetdaghica*	*E. lalezharica*	*E. montana*	*E. persica*, (type locality)	*E. roborowskii*	*E. strauchi*	*E. suphani*	*E. velox*, (type locality)
E. rafiqi **sp. nov**.	*2.0*										
E. killasaifullahi **sp. nov.**	15.1	*3.0*									
E. fahimii	8.5	15.1	*0.5*								
E. kopetdaghica	16.3	17.5	17.2	*1.7*							
E. lalezharica	15.9	18.3	18.4	16.4	*0.3*						
E. montana	17.6	18.7	16.4	17.7	16.1	*0*					
E. persica (type locality)	10.3	16.9	9.7	16.7	16.9	17.3	*0*				
E. roborowskii	17.9	20.8	18.7	19.5	18.5	17.7	18.8	*0.4*			
E. strauchi	20.7	14.5	16.1	15.5	14.8	14.6	15.1	15.9	*0.8*		
E. suphani	18.4	16.9	16.1	14.2	14.5	15.1	14.6	17.3	15.5	*0*	
E. velox (type locality)	19.8	21.6	16.9	18.8	19.2	18.1	16.9	11.9	14.6	16.0	*2.0*

Etymology. We derived the name of the new species from Killa Saifullah (Pashto: قلعہ سیف اللہ; also Qilla Saifullah), a city and district in northwestern Balochistan province, Pakistan that represents the area, from where this newly discovered endemic species of *Eremias* (subgenus *Aspidorhinus*) is currently known. The region plays an important role for producing fruits, nuts and vegetables in Pakistan. The discovery of this species of lizards thus highlights the importance of this region from the biodiversity point of view.

Description of the holotype. SVL: 65.3, TL: 109.7, HL: 17.4, HW: 10.2, HH: 8.1, TrL: 28.3, HLL: 44.8, FLL:

26.6, FrL: 4.6, FrW: 2.3. An adult male of *E. killasaifullahi* **sp**. **nov**. preserved in ethanol in a good state of preservation (Fig. 3); head and body moderately depressed; tail long, ca. 1.7 times longer than the body, cylindrical and depressed at the base. Head relativelylong (HL/SVL ratio 0.27) (Fig. 3), 1.7 times longer than wide (HW/HL ratio 0.59), head height less than head width (HH/HW, 0.79). Limbs strong, hindlimbs 1.6 times more than the length of forelimbs (FLL/HLL, 0.59), hindlimbs comprise 1.4 times the body length (HLL/SVL, 0.69).

Head broader than the neck; nasals, frontonasal, prefrontals, frontal, frontoparietals, interparietal and parietals are smooth and convex. Nasals are moderately swollen, three nasals, the lower in contact with three supralabials on the right and left side, its contact with the rostral lacking (Fig. 3D). Supranasals in contact with rostral and first supralabial, the suture between them is four times the length of frontonasal, whose breadth is ca. 1.1 times its length; length of prefrontals 1.4 times its width, joined by a median suture; frontal two times as long as broad, its length slightly less than its distance from the tip of the snout, narrow behind; parietals smooth, slightly longer than wide; interparietal smooth, more than half of the length of frontoparietals; no occipital. Two large supraoculars, about equal in size, the space anterior to supraoculars filled by few small and three to five larger granules; both supraoculars in contact with frontal of their sides while separated from supraciliaries by a series of granules (Fig. 3C), behind the two large spraoculars a single, comparatively medium-sized, granule exist; six supraciliaries, first longest, its length shorter than its distance from the first loreal. Rostral pentagonal, broader than high, narrower beneath than above; anterior loreal slightly higher than wide, shorter than the second loreal which is longer than high; supralabials 8; subocular keeled just below the eye, bordering the mouth, wedged between fifth and sixth supralabials (Fig. 3D). Temporals smooth, a large scale above ear; auricular denticulation indistinct or three small scales forming slight denticulation anteriorly. Lower eyelid covered with numerous small semi-transparent scales.

Six infralabials, gradually increasing in size posteriorly. Five pairs of chin shields; anterior three completely in contact, the fourth one separated by six smaller gulars, the fifth one is in contact with fifth and sixth infralabials on both sides. Collar curved, free, serrated and composed of 10 plates larger than adjacent gulars, the middle one slightly enlarged than others. Gular fold distinct, 20 gular scales in a straight line between the symphysis of the chin shields and the collar (Fig. 3B).

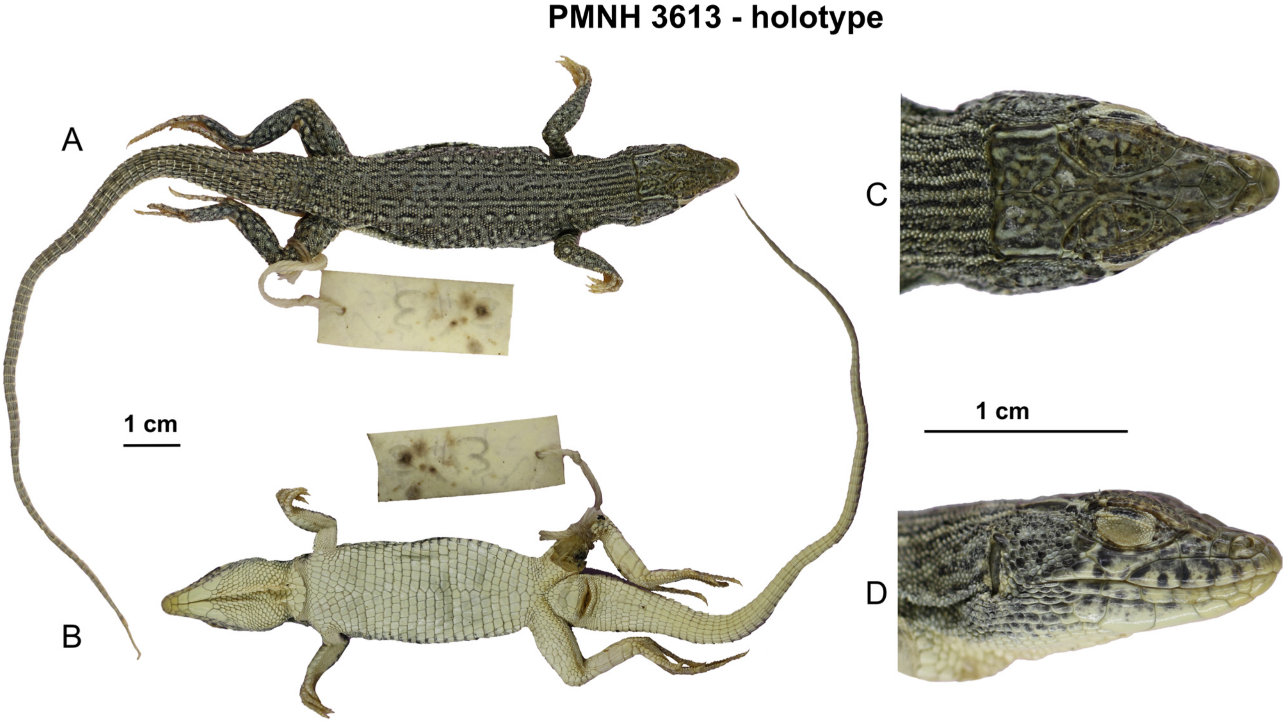


FIGURE 3. The holotype of *Eremias* (*Aspidorhinus*) *killasaifullahi* **sp. nov.** (PMNH 3613) from Kunder, Torghar Mountains, Killa Saifullah district, Balochistan, Pakistan.

Dorsal scales granular, smooth, 60 across the middle of the body. Ventral plates broader than long (except for outermost series), forming oblique longitudinal series of 16 plates across mid-belly and 25 transverse rows counted from behind collar to vent; first three rows of ventral scales in the pectoral region behind collar longer than broad, the first row is twice as long as broad. Precloacal region with an enlarged median plate just above the vent, surrounded by four large scales.

Forelimb ca. 1.5 times longer than the head, upper surface of the arm with rhombic, smooth scales. Scales on the upper surface of hindlimbs similar to dorsals, varying in size; ventral surface of hindlimbs covered by enlarged plates, the lower surface of the tibia with one row of very large and one comparatively smaller plates, the tip of the fourth toe reaches to the forelimb and extends to just behind the collar; 17 femoral pores on the right side, the left side damaged, the two series separated by two scales, length of the interfemoral space not greater than one-fourth length of each row. Toes slender, compressed, with no fringe. Subdigital lamellae unicarinate, in a single row of 21 scales under the 4th toe, a total of three scales around the 4th toe. Upper caudal scales oblique, truncate, strongly and diagonally keeled, 26 scales in the 9th –10th annulus behind the postcloacal granules.

Coloration in life. The adult specimens (Fig. 7E) are creamy beige with ocellate body pattern. Seven light stripes appear on the neck which transforms into ocelli and vermiculation behind the neck. Of the seven, the lateral-most light stripe originates from behind the eye and runs on the outer edge of the parietal, transforming into a disconnected series of white ocelli edged with black, running up to anterior one-third of the tail. Next to the lateral-most, the paravertebral light stripe originates from behind the parietal and transforms into closely-connected white ocelli edged with black and runs on the tail short of lateral-most ocelli. Next to paravertebral light stripe, there exists a light nuchal stripe on each side and the light vertebral stripe, the three joins behind the neck and transform into white ocelli edged with black in the pattern of vermiculation. In addition to seven light stripes on the neck, an outer-most series of white and black ocelli starts behind the eyes on each side, onto the tympanum and flanks above the forelimb and hindlimb insertion. The upper parts of both hindlimbs and forelimbs are provided with white and black ocelli. Head gray with black mottled markings or spots; supralabials white with black markings. Belly and underside of tail creamy white, tail dorsum grayish.

The juveniles and subadults (Fig. 6) are nearly similar in coloration to the adults except for the following details; seven longitudinal light stripes on the neck, the lateral-most originate from behind the eye, running on the outer parietals and continuing onto the dorsum in the form of connected small white ocelli, terminating on the one-third of the tail, the paravertebral light stripe originates from the posterior of parietals, and merge short of the lateral-most stripe on the tail, the nuchal of each side and vertebral light stripe merge after the neck to form light vermiculation up to the base of the tail. An additional outer-most light stripe originates from behind the tympanum and is produced in the form of disconnected white ocelli above the insertion of forelimbs and hindlimbs. The upper parts of hindlimbs and forelimbs are provided with white and black ocelli. Head gray with black mottled markings or spots; supralabials white with black markings. Belly and underside of tail creamy white, tail dorsum creamy grayish.

Variations in paratypes. Paratypes of *E. killasaifullahi* **sp**. **nov**. agree with the holotype with some differences given in Table 1 and Figs. 5, 6. Besides sex, the specimens differ in the arrangement of supralabials i.e. subocular wedged between 6th and 7th supralabials in all the type series except PMNH 4055 where it is wedged between 5th and 6th supralabials. The arrangement of postmentals has a similar pattern in the paratypes except PMNH 3673, where the fifth chins shield is not in contact with the infralabials. In all the type series including the holotype, the fifth chin shield is in contact with the infralabials. The scale count of dorsals, ventrals, gulars, collars, caudals at 9th –10th whorl and lamellae under 4th toe, however, show a unique value for every specimen within a certain range. The infranasal is not in contact with the rostral in all type specimens including the holotype (Figs. 3, 5, 6).

Sexual and age dimorphism. Apparently, males attain larger sizes than females in *E. killasaifullahi* **sp**. **nov**.: male SVL to 70.5 mm, female SVL 58.1 mm. Moreover, males have generally longer hindlimbs and shorter trunks as compared to females. For a larger female having SVL of 58.5 mm (PMNH 4050), the hindlimb is 37.9 mm against a same-sized male (PMNH 3616, SVL 59.4 mm) which has a hindlimb length of 43.1 mm. Similarly, the trunk length of a smaller female PMNH 4050 (SVL 58.5 mm) is 29.0 mm against a larger male (PMNH 3614, SVL 67.9 mm) which has a trunk length of 28.1 mm. The dorsal body color and pattern are, however, similar in juveniles and adults of both genders (Figs. 3, 5–7).

Comparison. The new species *Eremias killasaifullahi* **sp. nov.** is strikingly different from species exhibiting striped and ocellate pattern (*E. aria*; *E. kopetdaghica*; *E. lalezharica*; *E. papenfussi*; *Eremias persica*; *E. regeli*; *E. fahimii*; *E. isfahanica*; *E. montana*; *E. nikolskii*; *E. velox*) and ocellate pattern (*E. afghanistanica*; *E. nigrocellata*; *E. strauchi*; *E. suphani*; Table 1 and S1).

Eremias killasaifullahi **sp. nov.** can be distinguished from *E. afghanistanica* by a higher count of dorsals (53–63 *vs.* 44–46), caudal scales in the 9th–10th annulus (24–33 *vs.* 20–26) and a lower number of ventral scales in a single row from the posterior edge of collar to the vent (25–29 *vs.* 37–38).

From *E. persica*, *E. killasaifullahi* **sp. nov.** differs by its smaller size (SVL up to 70.5 mm *vs.* 98.0 mm), size of the second loreal scale to first loreal scale (more than two times *vs.* two times), supracaudals (strongly keeled *vs.* weakly keeled), the dorsal color and pattern in adults (ocellate without broader lateralmost stripe *vs.* striped and ocellate with broader lateralmost stripe) and tail coloration in the juveniles (creamy grayish *vs*. bluish).

Besides distant distribution, *Eremias killasaifullahi* **sp. nov.** differs from the recently described *E. fahimii* by its comparatively larger size (SVL up to 70.5 mm *vs.* 56.0 mm), more SDLT 4th (21–25 *vs.* 20–21), lower count of caudal scales in the 9th–10th annulus (22–27 *vs.* 31), the greater number of scales separating the femoral pores (1–5 *vs.* 1) and the dorsal color and pattern in adults (dorsal stripes broken into ocelli without broader lateralmost stripe *vs.* dorsal stripes persistent throughout life with broader lateralmost stripe).

From *E. isfahanica*, *E. killasaifullahi* **sp. nov.** differs in the following morphological characters apart from its distant distribution: higher count of supralabials (8–11 *vs.* 6–8), 5–7 of them (mainly 6, rarely 5) located anterior to subocular (*vs.* 5), lower count of collars (10–12 *vs.* 12–15), number of ventral scales in a single row from the posterior edge of collar to the vent (25–29 *vs.* 30–33) and the dorsal color pattern in adults (dorsal stripes broken into ocelli *vs.* dorsal stripes persistent throughout life).

Eremias killasaifullahi **sp. nov.** differs from *E. kopetdaghica* in having comparatively higher count of dorsals (53–63 *vs.* 48–59), collars (10–12 *vs.* 7) and the dorsal color and pattern in adults. *Eremias killasaifullahi* **sp. nov.** can be distinguished from *E. lalezharica* in having a lower number of ventral scales in a single row from posterior edge of collar to the vent (25–29 *vs.* 30–33), gulars (20–33 *vs.* 33–40), collars (10–12 *vs.* 13–15), generally higher count of femoral pores (17–24 *vs.* 15–19), pair of chin shields/ submaxillary shields (5 *vs.* 4), contact of gulars with second pair of submaxillary shields (none *vs.* 1-2 rows) and dorsal color and pattern (ocellate *vs.* ocellated and striped).

Apart from its peculiar distribution in the remote valley in Torghar Mountains, *E. killasaifullahi* **sp. nov.** can be differentiated from *E. montana* in the following set of characters: comparatively larger size (SVL up to 70.5 mm *vs.* 58.5 mm), lower count of dorsals (53–63 *vs.* 63–68), higher number of ventral scales in a row across mid-belly in the widest part (14–18 *vs.* 13–14), infralabials (6–10 *vs.* 4–6), number of supralabials anterior to the subocular (5–6 *vs.* 4–5), generally higher count of scales separating the femoral pores (1–5 *vs.* 2), three scales around the penultimate phalanx of 4th toe (*vs.* 4) and dorsal color and pattern (ocellated *vs.* striped and ocellate).

Besides having a subocular scale bordering mouth and ocellate dorsal pattern, *E. killasaifullahi* **sp. nov.** differs from *E. nigrocellata* by its smaller size (SVL up to 70.5 mm *vs.* 83.0 mm), higher count of dorsals (53–63 *vs.* 42–56) and the number of femoral pores on each side (17–24 *vs.* 11–13). *E. killasaifullahi* **sp. nov.** differs from *E. nikolskii* by having a higher count of ventral scales in a row across mid-belly in the widest part (14–18 *vs.* 14), lower number of ventral scales in a single row from the posterior edge of collar to the vent (25–29 *vs.* 28–32) and dorsal color and pattern (ocellate *vs.* striped and ocellate).

Besides the dorsal color and pattern, our new species stands distinguished from *E. papenfussi* by having a lower number of ventral scales in a single row from the posterior edge of the collar to the vent (25–29 *vs.* 30–33), 5–6 (mainly 6) number of scales anterior to subocular (*vs.* 5), generally higher count of scales separating the femoral pores (1–5 *vs.* 1–2).

From *E. regeli*, *E. killasaifullahi* **sp. nov.** differs in having three scales around the penultimate phalanx of 4th toe (*vs.* four scales), higher count of gulars (20–33 *vs.* 14–24), ventral scales in a row across mid-belly in the widest part (14–18 *vs.* 13), generally higher count of caudal scales in the 9th–10th annulus (22–27 *vs.* 17–25) and dorsal color and pattern (ocellate *vs.* striped and ocellate).

The new species *E. killasaifullahi* **sp. nov.** can be easily differentiated from *E. strauchi* by its distant distribution, lower number of ventral scales in a single row from the posterior edge of collar to the vent (25–29 *vs.* 28–33), and 5–6 (mainly 6) number of scales anterior to subocular (*vs.* 7). From *E. suphani*, *E. killasaifullahi* **sp. nov.** differs by its distant distribution, lower number of ventral scales in a single row from the posterior edge of collar to the vent (25–29 *vs.* 29–34) and arrangement of gulars (2 rows of gulars reaching to the second pair of chin shields *vs.* no such arrangement). The new species *E. killasaifullahi* **sp. nov.** can be easily differentiated from *E. velox* by its distant distribution, contact of infranasal to rostral (separated *vs.* in contact) and dorsal color and pattern.

From *E. rafiqi* **sp. nov.**, *E. killasaifullahi* **sp. nov.** differs in the following morphological characters: color pattern (ocellate *vs.* striped and ocellate), smaller size (SVL up to 70.5 mm *vs.* 99.3 mm), contact of infranasal with the rostral (separated *vs.* in contact), lower number of ventral scales in a single row from the posterior edge of collar to the vent (25–29 *vs.* 29–33) and generally lower count of gulars (20–33 *vs.* 29–33).

Distribution. *Eremias killasaifullahi* **sp. nov.** is a microendemic species with conspicuous intraspecies genetic diversity within an approximately 65 km^2 area. Currently, it is known only from the type locality and several other localities around Killa Saifullah (Kunder and Zimkai Nala, Tanishpa) and Zhob districts of northwestern Balochistan in Pakistan, approximately 60 km in aerial distance from the border with Afghanistan.

Habitat and natural history. *Eremias killasaifullahi* **sp. nov.** has a restricted distribution and is found in sympatry with *E. rafiqi* **sp. nov.** in the Torghar mountains including Kunder, Ashewat and Tanishpa. We did not find any partition of micro-habitats between *E. killasaifullahi* **sp. nov.** and *E. rafiqi* **sp. nov.** and both species thrive in the steppes or semi-deserts. The details of the ecology and sympatric flora and fauna is given in Masroor *et al*. (2020b). All the specimens were collected between 10:00 am to 12:00 pm. All the specimens were collected from the loamy habitat, dominated by the patches of the sand dunes at the foothills of Torghar mountains.

Eremias rafiqi sp. nov.

(Table 2, Figs. 4, 5, 6)
Suggested vernacular name: Rafiq's Racerunner
Pashto name: دا رفیق سوسو مار

Holotype. PMNH 856 (cyt *b*: n/a; Rag1: n/a), an adult male, collected from Tanishpa village, Torghar Mountains, Killa Saifullah district, Balochistan (31.1869º N, 68.4126º E; Fig. 1), elevation 2,506 m a. s. l., May 25, 1997, leg. Khalid Javed Baig (Fig. 4).

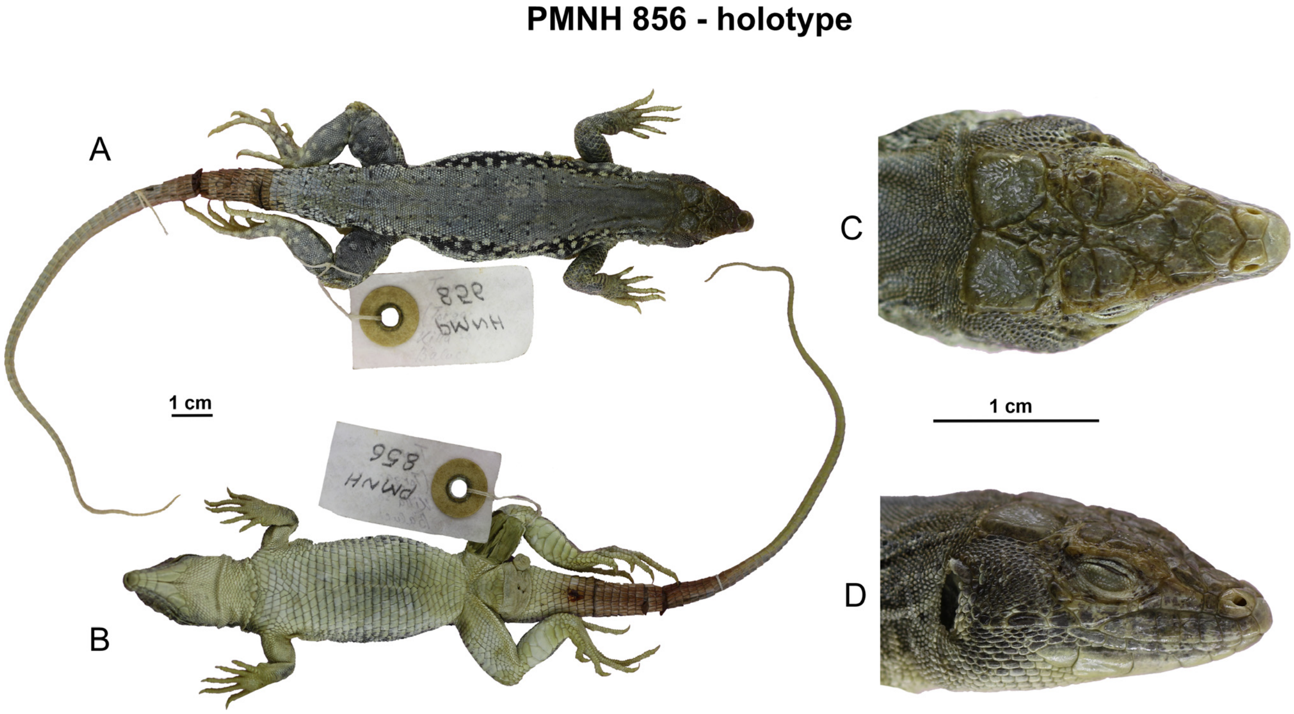


FIGURE 4. The holotype of *Eremias* (*Aspidorhinus*) *rafiqi* **sp. nov.** (PMNH 856) from Tanishpa village, Torghar Mountains, Killa Saifullah district, Balochistan, Pakistan.

Paratypes. **Males:** PMNH 855 (cyt *b*: n/a; Rag1: n/a), 857 (cyt *b*: n/a; Rag1: n/a), PMNH 859 (cyt *b*: n/a; Rag1: n/a), PMNH 861 (cyt *b*: n/a; Rag1: n/a), PMNH 4056 (cyt *b*: n/a; Rag1: MT554487). **Females:** PMNH 3724 (cyt *b*: n/a; Rag1: MT554476), PMNH 3735 (cyt *b*: MT554461; Rag1: MT554477), PMNH 4058 (cyt *b*: n/a; Rag1: n/a). **Juveniles:** PMNH 837 (cyt *b*: n/a; Rag1: n/a), PMNH 3723 (cyt *b*: MT554470; Rag1: MT554496), PMNH 4053 (cyt *b*: MT554457; Rag1: MT554485), PMNH 4054 (cyt *b*: MT554454; Rag1: MT554480). PMNH 857, collected along with the holotype; PMNH 855 and 861, May 26, 1997, Ashewat, Qamar Din Karez, Zhob district (31.3448ºN, 68.6307ºE), leg. Khalid Javed Baig; PMNH 859, May 24, 1997, Tanishpa village, Torghar, Killa Saifullah district, leg.

Khalid Javed Baig; PMNH 3723–24, October 09, 2017, Khar, Nushki district, Balochistan (29.5879ºN, 65.6609ºE), leg. Muazzam Ali Khan; PMNH 3735, October 21, 2017, Khar, Nushki district, leg. Muazzam Ali Khan; PMNH 4053, September 05, 2018, Zamkai Nala, Tanishpa village, Torghar, Killa Saifullah district (31.1930ºN, 68.4111ºE), leg. Rafaqat Masroor; PMNH 4054, September 01, 2018, Ashewat, Qamar Din Karez, Zhob district, leg. Rafaqat Masroor; PMNH 4056 and 4058, August 30, 2018, Kunder, Torghar, Killa Saifullah district, leg. Ibad ur Rehman (Figs. 5 & 6).

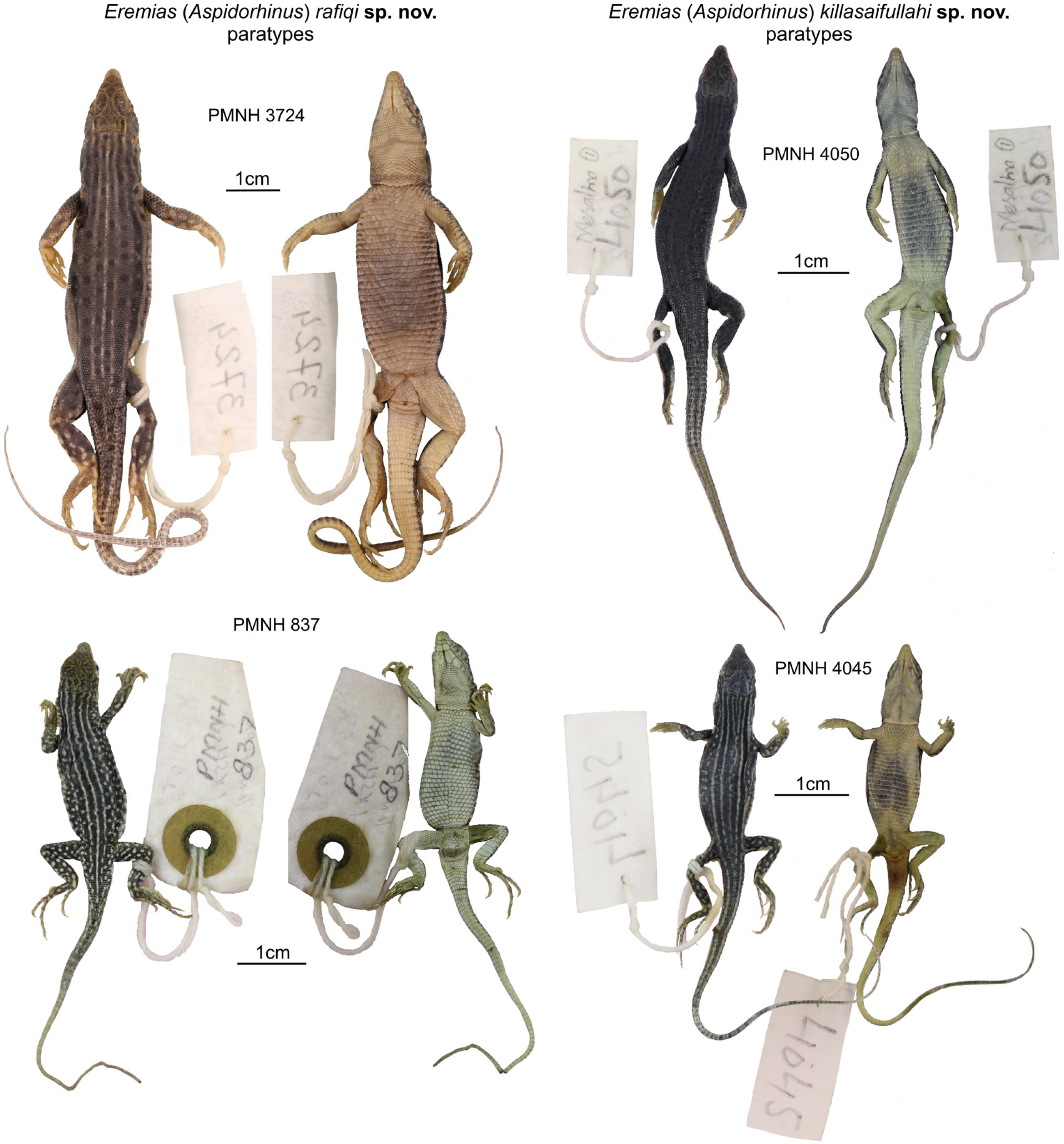
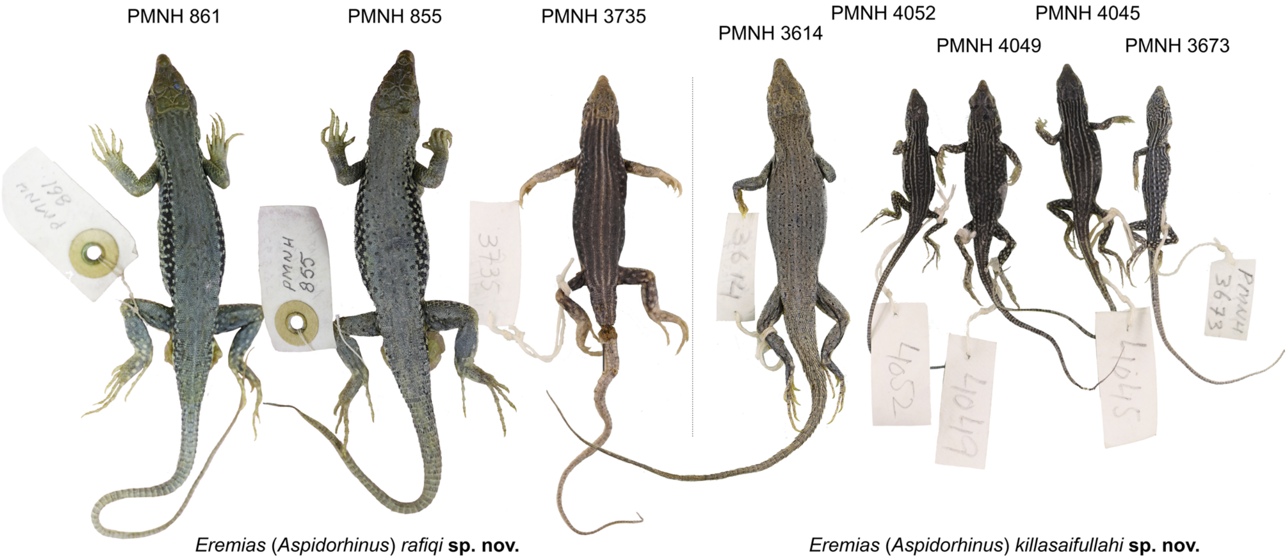


FIGURE 5. The dorsal and ventral views of selected paratypes of *Eremias* (*Aspidorhinus*) *rafiqi* **sp. nov**. and *E*. (*Aspidorhinus*) *killasaifullahi* **sp. nov**. from Pakistan at different age stages.

Morphological diagnosis. A large-sized lacertid lizard, maximum snout-vent length (SVL) = 99.3 mm, tail 1.67 to 1.89 times longer than body length (SVL), hindlimbs relatively long (HLL/SVL ratio 0.6–0.8); subocular scale reaching to the edge of the mouth, 5–7 (mainly 6, rarely 5) anterior to subocular; dorsals 56–67; ventrals in 14–17 oblique longitudinal series; frontal separated from supraoculars; the height of the first two to three transverse rows of ventral scales in the pectoral region more than its breadth; 17–21 femoral pores on each side, separated medially by 1–4 scales (mainly 3, rarely 1), the space between the femoral pores less than one–fourth length of each row; toes without fringe, encircled by three scales in a single series of 22–27 unicarinate and bicarinate scales underneath; the tip of the fourth toe reaches to the forelimb and extends to just behind the collar. The adult specimens are grayish in life with four series of longitudinal black ocelli on the dorsum originating from behind the parietals and extending onto the tail; on each lateral side, a broader dark stripe originates from behind the eye and continues onto the tail with disconnected white round ocelli at the margins as well as white ocelli inside the stripe.



Eremias (*Aspidorhinus*) *rafiqi* **sp. nov.** *Eremias* (*Aspidorhinus*) *killasaifullahi* **sp. nov.**

FIGURE 6. The variation of dorsal body color and pattern in different age stages of the newly described species, *Eremias* (*Aspidorhinus*) *rafiqi* **sp. nov**. and *E*. (*Aspidorhinus*) *killasaifullahi* **sp. nov**.

Molecular data. *Eremias rafiqi* **sp. nov.** represents the so-called Zabol clade sensu Rastegar-Pouyani *et al.* (2010) from eastern Iran and the clade E identified by Khan *et al.* (2021) from northeastern Balochistan, Pakistan. Whereas Rastegar-Pouyani *et al*. (2010) identified this clade solely on mtDNA (cyt *b*, 12S), Khan *et al.* (2021) used mitochondrial (16S, COI, cyt *b*) as well as nuclear data (Rag 1) that clearly showed deep differentiation of this new species from other available sequences of the genus. The distinction of *Eremias rafiqi* **sp. nov.** is supported by its phylogenetic position (monophyletic clade among other species of *E. persica* complex, sister to *E. fahimii* but with weak statistical support; Fig. 1), the differentiation on solely Rag1 dataset (Fig. 2), and the value of the uncorrected *p* distances reaching from 8.5% (*E. fahimii*) to 20.7% (*E. strauchi*) (Table 3). The intraclade genetic diversity (cyt *b*) is 2 % with six detected haplotypes found in Iran and Pakistan (Fig. 2, Table 3).

Etymology. The species epithet "*rafiqi*" is taken from the first name of late Rafique Ahmed Rajput (1968–2008) to whom the new species is dedicated. The deceased Rajput served in Sindh Wildlife Department from 1986 till his demise. With no formal education in wildlife research, conservation and management, his passion for the conservation of wildlife in Pakistan remain unparalleled. From collecting the first-ever data of *Ursus arctos isabellinus* in the high-altitude Deosai Plateau, Gilgit-Baltistan, to the faunistic studies in the Indus River Delta and desert areas, he was a symbol of hard work. He also has very sound techniques for the collection of lizards and snakes. Unfortunately, during one such endeavor for gathering faunistic data, he collected a juvenile venomous krait, *Bungarus* sp. (possibly *B. persicus*) from Jiwani town, Gwadar District, Balochistan and mistaken its identity with non-venomous *Lycodon* species. On the morning of October 13, 2008, when he was shifting the live snake from a container to permanently preserve it for research purposes, the snake bit him multiple times. After a couple of hours, Rajput felt severe pain, anxiety and dizziness. He was immediately taken to the hospital in Karachi, where the doctors told his relatives that anti-snake venom is not available and asked them to get it from the pharmacy market. By the time the anti-venom was arranged, Rajput breathed his last.

Description of the holotype. SVL: 99.3, TL: 168.0, HL: 26.9, HW: 14.5, HH: 15.5, TrL: 42.5, HLL: 66.8, FLL: 37.3, FrL: 6.3, FrW: 3.4. An adult male preserved in formalin in a good state of preservation (Fig. 4); head and body moderately depressed; tail long, ca. 1.7 times longer than the body, cylindrical and depressed at the base. Head relativelylong (HL/SVL, 0.27) (Fig. 4), ca. 1.7 times longer than wide (HW/HL, 0.58), head height slightly less than head width (HH/HW, 0.89). Limbs strong, hindlimbs ca. 1.8 times longer than the length of forelimbs (FLL/HLL, 0.56), hindlimbs comprise 1.4 times of the body length (HLL/SVL, 0.67).

Head slightly broader than the neck. Head shields including nasals, frontonasal, prefrontals, frontal, frontoparietals, interparietal and parietals are smooth and convex. Nasals moderately swollen, three nasals, the lower in contact with two supralabials on both right and left side and in contact with the rostral (Fig. 4D). Supranasals in contact with rostral but lack such contact with first supralabial, the suture between them is 3.7 times the length of frontonasal, whose breadth is slightly more than its length; length of prefrontals 1.6 times its width, forming a median suture; length of frontal ca. 1.8 times as long as broad, its length slightly less than its distance from the tip of the snout, narrow behind; parietals smooth, slightly longer than its width; interparietal smooth, more than half the length of frontoparietals, about equal to the suture of frontoparietal; no occipital. Two large supraoculars, about equal in size, the space anterior to supraoculars filled by few small and three to five larger granules; both supraoculars in contact with frontal of their sides while separated from supraciliaries by a series of granules (Fig. 4C); six supraciliaries, first longest, its length shorter than its distance from the first loreal. Rostral pentagonal, broader than high, narrower beneath than above; anterior loreal slightly higher than wide, shorter than the second loreal which is longer than high; supralabials 10 on the right side, 9 on the left side; subocular keeled just below the eye, bordering the mouth, wedged between sixth and seventh supralabials on the right side and fifth and sixth supralabials on the left side (Fig. 4D). Temporals smooth, a large scale above ear; auricular denticulation indistinct or three small scales forming slight denticulation anteriorly. Lower eyelid covered with numerous small semi-transparent scales.

Six infralabials on the right side, seven on the left side, gradually increasing in size posteriorly. Five pairs of chin shields; anterior three completely in contact, the fourth pair separated by 10 to 11 smaller gulars in a straight line, fifth not in contact with infralabials, separated by a single row of scales. Collar curved, free, serrated and composed of ten plates larger than adjacent gulars, the middle one quite enlarged than others. Gular fold distinct, 32 gular scales in a straight line between the symphysis of the chin shields and the collar (Fig. 4B).

Dorsal scales granular, smooth, 62 across the middle of the body. Ventral plates broader than long (except for outermost series), forming oblique longitudinal series of 16 plates across mid-belly and 29 transverse rows counted from behind collar to vent; first three rows of ventral scales in the pectoral region behind collar longer than broad, the first row is twice as long as broad. Precloacal region with a pair of the enlarged median plates just above the vent, surrounded by six large scales.

Forelimb ca. 1.4 times longer than the head, the upper surface of the arm with rhombic, smooth scales. Scales on the upper surface of hindlimbs similar to dorsals, equal in size; ventral surface of hindlimbs covered by enlarged plates, the ventral surface of the tibia with one row of very large and one comparatively smaller plates; the tip of the fourth toe reaches to the forelimb and extends to just behind the collar; 21 femoral pores on the right side, most of the left side damaged, the two femoral pore series separated by two scales, length of the interfemoral space not greater than one–fourth length of each row. Toes slender, compressed, with no fringe; subdigital lamellae unicarinate, in a single row of 25 scales under the 4th toe, a total of three scales around the 4th toe. Upper caudal scales oblique, truncate, strongly and diagonally keeled, 30 scales in the 9th –10th annulus behind the postcloacal granules.

Coloration in life. The adult specimens are grayish in life with four more or less regular rows of black spots on the light dorsum, originating from behind the parietals, smaller on the nape, larger on the middle of the dorsum, disappearing on proximal one-fourth of the tail. The middle two rows of black spots have white spots along each black spot of the rows. On each lateral side, a broader dorsolateral dark stripe originates from behind the eye and continues onto the tail with disconnected white ocelli at both margins as well as white ocelli inside the stripe; next to the broader dark stripe, a lateral-most stripe is composed of disconnected black ocelli, originating from behind tympanum and reaching to the hindlimb. Upper parts of both hindlimbs and forelimbs with white and black ocelli. Head gray without any markings or spots; labials white with black markings. Belly and underside of tail creamy white, tail dorsum sandy grayish.

The juveniles and subadults are nearly similar in coloration to the adults except for the following details; four longitudinal dark stripes on the body, the outermost originate from anterior parietals on the outer side and continue onto the tail, the innermost originate from the posterior of parietals and merge after running a while on the tail. A broader lateral stripe on each side originates from behind the eye and continues on the lateral side of the body and tail with interspersed white ocelli between the forelimb and hindlimb. The dorsal forelimb and hindlimb are dark gray with white ocelli.

Variations in paratypes. The paratypes of *E. rafiqi* **sp. nov.** agree with the holotype with some differences given in Table 2 (Figs. 5, 6). Besides sex, the specimens differ in the arrangement of supralabials i.e. subocular wedged between 6th and 7th in all the type series except PMNH 861 (between 7th and 8th) and PMNH 3724 (between 5th and 6th). The arrangement of postmentals has a similar pattern in the paratypes except PMNH 855, 861, 837, 3723, 3735 and 4054, where the fifth chin shield is in contact with the infralabials. The contact of postmental shield with the supralabials varies in the paratypes; PMNH 855 and 3724, the fifth postmental shield is in contact with 7th supralabial; PMNH 837 and 3735, the fifth postmental shield is in contact with sixth supralabial; PMNH 861, the fifth postmental shield is in contact with 7th and 8th supralabials. The infranasal scale in PMNH 837, 855, 859, 861, 3723, 3735, 4053–4054 and 4058 rests on first, second and third supralabials. The scale count of dorsals, ventrals, gulars, collars, caudals at 9th–10th annuli and lamellae under 4th toe, however, show a unique value for every specimen within a certain range.

Sexual and age dimorphism. Apparently, males attain larger sizes than females in *E. rafiqi* **sp. nov.**: male SVL to 99.3 mm, female SVL 82.1 mm. Moreover, males have generally longer hindlimbs and shorter trunks as compared to females. For a larger female having SVL of 98.1 mm (PMNH 4058), the hindlimb is 56.0 mm against a smaller-sized male (PMNH 855, SVL 92.2 mm) which has a hindlimb length of 57.1 mm. Similarly, the trunk length of a smaller female (PMNH 3724, SVL 75.1 mm) is 36.8 mm against a larger male (PMNH 857, SVL 78.5 mm) which has a trunk length of 34.5 mm. The dorsal body color and pattern, however, varies in juveniles and adults of both genders (Figs. 5, 6).

Comparison. The new species *Eremias rafiqi* **sp. nov.** is strikingly different from species exhibiting striped and ocellate patterns in the subgenus *Aspidorhinus* (*E. kopetdaghica* Szczerbak, 1972, *E. lalezharica* Moravec, 1994, *E. papenfussi* Mozaffari *et al*., 2011, *Eremias persica* Blanford, 1874, *E. regeli* Bedriaga, 1905, *E. fahimii* Mozaffari *et al*., 2020, *E. isfahanica* Rastegar-Pouyani *et al.*, 2016, *E. montana* Rastegar-Pouyani & Rastegar-Pouyani, 2001, *E. nikolskii* Bedriaga, 1905, *E. velox* Pallas, 1771) and ocellate pattern (*E. killasaifullahi* **sp. nov.**, *E. afghanistanica* Böhme & Szczerbak, 1991, *E. roborowskii* Bedriaga, 1912, *E. strauchi* Kessler, 1878, *E. suphani* Başoğlu & Hellmich, 1968). The new species *E. rafiqi* **sp. nov.** can also be differentiated from the geographically closely-distributed members of the subgenus *Eremias* having striped and ocellate pattern (*E. aria* Anderson & Leviton 1967) and ocellate pattern (*E. nigrocellata* Nikolsky 1896) by the arrangement of subocular scale which borders the mouth (Supplementary Tab. 1; see published data in Lantz 1928, Szczerbak 1974, Bischoff & Böhme 1980, Böhme & Szczerbak 1991, Anderson 1999). A brief of morphological differences is provided (the material used for a first-hand comparison is listed in parentheses at each species; see also Table 2 and S1).

Besides striped and ocellate body pattern (*vs.* ocellate), *E. rafiqi* **sp. nov.** can be distinguished from *E. afghanistanica* by its larger size (SVL up to 99.3 mm *vs.* 67.0 mm), higher count of dorsals (56–67 *vs.* 44–46), gulars (30–36 *vs.* 25–28), femoral pores (17–22 *vs.* 16–18), caudal scales in the 9th–10th annulus (24–33 *vs.* 22–25), 5–7 supralabials (mainly 6, rarely 5) located anterior to subocular (*vs.* 5) and lower number of ventral scales in a single row from the posterior edge of collar to the vent (29–33 *vs.* 37–38).

From *E. persica*, that is partly close in dorsal coloration, pattern and size, *E. rafiqi* **sp. nov.** differs in the length of interparietal to the length of suture of parietals (longer *vs.* shorter), length of frontonasal to its width (longer *vs.* as long as wide), size of the second loreal scale to first loreal scale (more than three times *vs.* two times), supracaudals (strongly keeled *vs.* weakly keeled) and tail coloration in the juveniles (sandy grayish *vs.* bluish).

Besides distant distribution, *Eremias rafiqi* **sp. nov.** differs from the recently described *E. fahimii* by its larger size (SVL up to 99.3 mm *vs.* 56.0 mm), more SDLT 4th (22–27 *vs.* 20–21), the greater number of scales separating the femoral pores (1–4 *vs.* 1) and the dorsal color and pattern in adults (dorsal stripes broken into ocelli *vs.* dorsal stripes persistent throughout life).

From *E. isfahanica*, *E. rafiqi* **sp. nov.** differs in the following morphological characters apart from its distant distribution: higher count of supralabials (8–10 *vs.* 6–8), 5–7 (mainly 6, rarely 5) of them located anterior to subocular (*vs.* 5), lower count of collars (8–12 *vs.* 12–15) and the dorsal color pattern in adults (dorsal stripes broken into ocelli *vs.* dorsal stripes persistent throughout life).

Eremias rafiqi **sp. nov.** differs from *E. kopetdaghica* in having a higher count of dorsals (56–67 *vs.* 48–59), gulars (30–36 *vs.* 19–28), caudal scales in the 9th–10th annulus (24–33 *vs.* 20–26) and collars (8–12 *vs.* 7) and the dorsal color and pattern in adults (presence of a broader dark stripe on each lateral side above flanks with disconnected white ocelli at the margins as well as white ocelli inside the stripe *vs.* no such lateral broader stripes).

Eremias rafiqi **sp. nov.** can be distinguished from *E. lalezharica* in having a higher count of dorsals (56–67 *vs.* 54–59), femoral pores (17–22 *vs.* 15–19), pair of chin shields/ submaxillary shields (5 *vs.* 4), lower number of collars (8–12 *vs*. 13–15), contact of gulars with second pair of submaxillary shields (none *vs*. 1-2 rows of gulars with the second pair of submaxillary shields) and dorsal color and pattern.

Apart from its peculiar distribution in the remote valley in Torghar Mountains, a part of the Palearctic region, *E. rafiqi* **sp. nov.** can be differentiated from *E. montana* in the following set of characters: larger size (SVL up to 99.3 mm *vs.* 58.5 mm), higher count of ventral scales in a row across mid-belly in the widest part (14–17 *vs.* 13–14), number of ventral scales in a single row from the posterior edge of collar to the vent (29–33 *vs.* 27–28), gulars (30–36 *vs.* 23–25), infralabials (6–10 *vs.* 4–6), number of supralabials anterior to the subocular (5–7 *vs.* 4–5), generally more SDLT 4th (22–27 *vs.* 18–25), generally higher count of scales separating the femoral pores (1–4 *vs.* 2) and dorsal color and pattern.

From *E. nigrocellata*, *E. rafiqi* **sp. nov.** differs in dorsal body pattern (striped and ocellate *vs.* ocellate), higher count of dorsals (56–67 *vs.* 42–56), lower number of ventral scales in a row across mid-belly in the widest part (14–17 *vs.* 18) and the number of femoral pores on each side (17–22 *vs.* 11–13).

E. rafiqi **sp. nov.** differs from *E. nikolskii* by having a higher count of gulars (30–36 *vs.* 20–28), ventral scales in a row across mid-belly in the widest part (14–17 *vs.* 14) and dorsal color and pattern.

Our new species stands distinguished from *E. papenfussi* by its larger size (SVL up to 99.3 mm *vs.* 62.0 mm), higher count of gulars (30–36 *vs.* 24–28), number of scales anterior to subocular (5–7, mainly 6 *vs.* 5), generally higher count of scales separating the femoral pores (1–4 *vs.* 2) and dorsal color and pattern.

From *E. regeli*, *E. rafiqi* **sp. nov.** differs in having three scales around the penultimate phalanx of 4th toe (*vs.* four scales), larger size (SVL up to 99.3 mm *vs.* 70.0 mm), higher count of gulars (30–36 *vs.* 14–24), caudal scales in the 9th–10th annulus (24–33 *vs.* 17–25), ventral scales in a row across mid-belly in the widest part (14–17 *vs.* 13), lower count of femoral pores (17–21 *vs.* 21–24) and dorsal color and pattern.

The new species *E. rafiqi* **sp. nov**. can be easily differentiated from *E. strauchi* by its distant distribution, color pattern (striped and ocellate *vs.* ocellate) and larger size (SVL up to 99.3 mm *vs.* 68.0 mm) besides several other characters. From *E. suphani*, *E. rafiqi* **sp. nov.** differs by its distant distribution, color pattern (striped and ocellate *vs.* ocellate), larger size (SVL up to 99.3 mm *vs.* 60.0 mm) and arrangement of gulars (2 rows of gulars reaching to the second pair of chin shields *vs.* no such arrangement). The new species *E. rafiqi* **sp. nov**. can be easily differentiated from *E. velox* by its distant distribution, larger size (SVL up to 99.3 mm *vs.* 77.0 mm), contact of infranasal to rostral (separated *vs.* in contact), generally higher count of gulars (30–36 *vs.* 19–33) and dorsal color and pattern.

From *E. killasaifullahi* **sp. nov.**, *E. rafiqi* **sp. nov.** differs in the following morphological characters: color pattern (striped and ocellate *vs.* ocellate), larger size (SVL up to 99.3 mm *vs.* 70.5 mm), contact of infranasal with the rostral (in contact *vs.* separated), a higher number of ventral scales in a single row from posterior edge of collar to the vent (29–33 *vs.* 25–29) and a generally higher count of gulars (29–33 *vs.* 20–33).

Distribution. The evolutionary clade corresponding with the new species *E. rafiqi* **sp**. **nov**. was genetically confirmed from the areas of SE Iran (Zabol in the Sistan Basin, Sistan and Balochistan Province; the Zabol clade sensu Rastegar-Pouyani *et al*. 2010), NW Balochistan in Pakistan and south-central Afghanistan (Rastegar-Pouyani *et al.* 2010, Khan *et al.* 2021). In Pakistan, the species is found in three Pakistani districts located along with the Afghan border including Torghar Mountains in the localities of Tanishpa village and Kunder area (Killa Saifullah district), Ashewat (Qamar Din Karez, Zhob district) and Khar in Nushki District.

Habitat and natural history. The type locality and the localities of paratypes (Tanishpa, Kunder and Ashewat) of *E. rafiqi* **sp. nov.** are located in the Torghar mountains (means "Black Mountains"), constituting the northern-most part of Toba Kakar Range which is a southern offshoot of the Sulaiman Mountains in the Hindu Kush Mountain system, lying ca. 60 km from the border with Afghanistan (Fig. 7A). The Torghar mountains are very rugged semi-arid sandstone ridges with an average elevation of 2,400 m and is approximately 90 km long and vary from 15 to 30 km in width. This region is characterized by having dry temperate ecology, with sparse vegetation. A great deal of information about the Torghar mountains including annual weather conditions, ecology, vegetation and sympatric fauna is provided in Masroor *et al.* (2020b). The species is also found in the Nushki district, ecological part of the Chagai desert (Registan desert, Afghanistan), lying ca. 340 km in aerial distance from the Torghar mountains.

All the specimens were collected between 11:00 am to 02:00 pm. Interestingly, specimens in the Tanishpa, Kunder and Ashewat were caught in the barren area of mixed loamy and sandy habitats at the foothills of Torghar mountains (Figs. 7B, C). On the other hand, specimens in the Khar (Nushki district) were collected mostly from the alluvial plain, with dominant vegetation of *Haloxylon persicum, Lyceum shawii, Saccharum griffithii, Chenopodium album, Periploca aphylla, Euphorbia prostrata* and others.

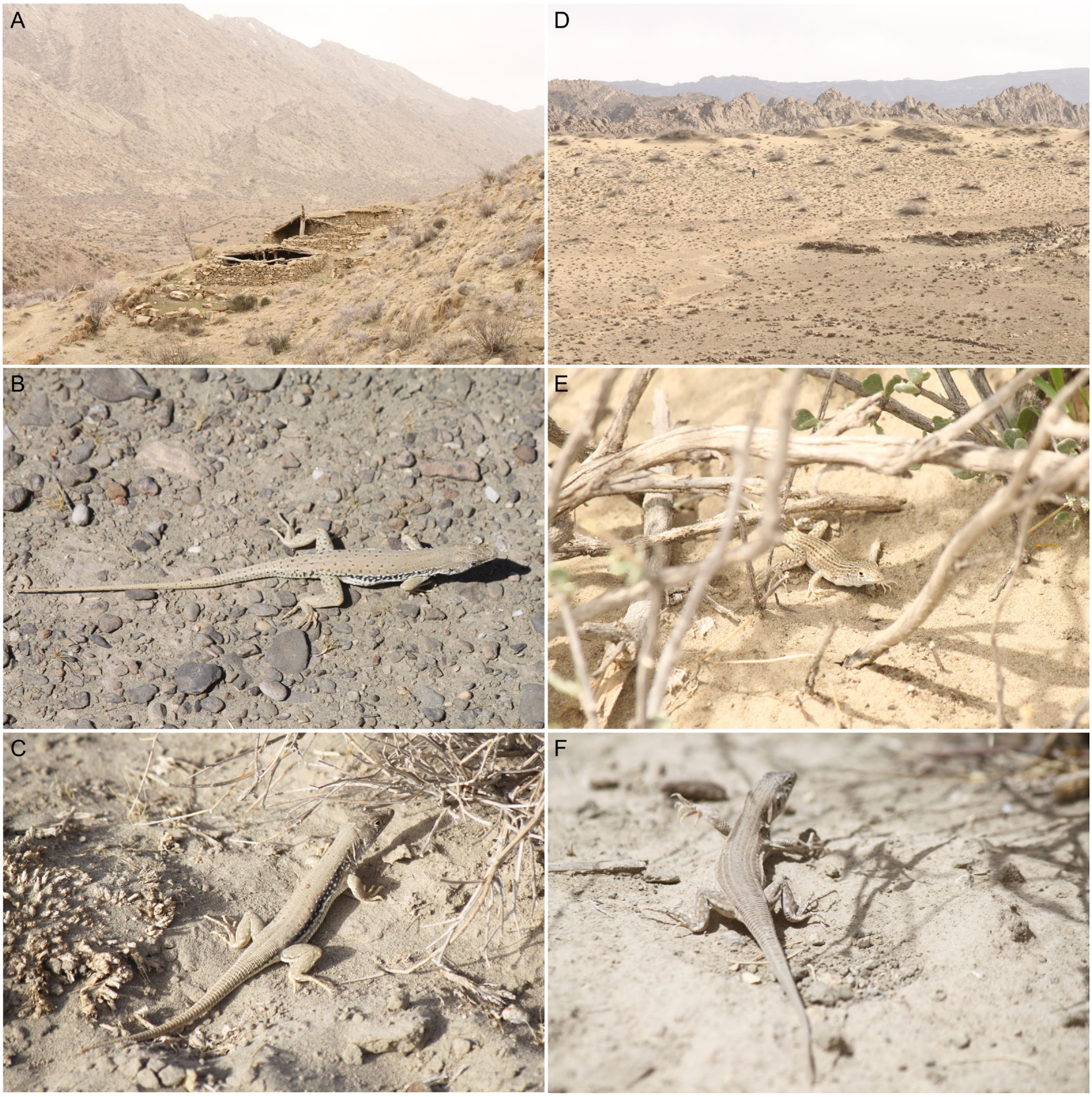


FIGURE 7. (A) The type locality of *Eremias rafiqi* **sp. nov.** near Tanishpa village, Torghar Mountains, Killa Saifullah district, Balochistan; (B) *Eremias rafiqi* **sp. nov.** from Kunder, Torghar Mountains, Killa Saifullah district, Balochistan; (C) The paratype of *E. rafiqi* **sp. nov.** (PMNH 4056) from under, Torghar Mountains, Killa Saifullah district, Balochistan; (D) The type locality of *Eremias killasaifullahi* **sp. nov.** near Kunder, Torghar Mountains, Killa Saifullah district, Balochistan; (E) The holotype of *E. killasaifullahi* **sp. nov.** (PMNH 3613) from Kunder, Torghar Mountains, Killa Saifullah district, Balochistan; (F) *Eremias killasaifullahi* **sp. nov.** from Tanishpa.

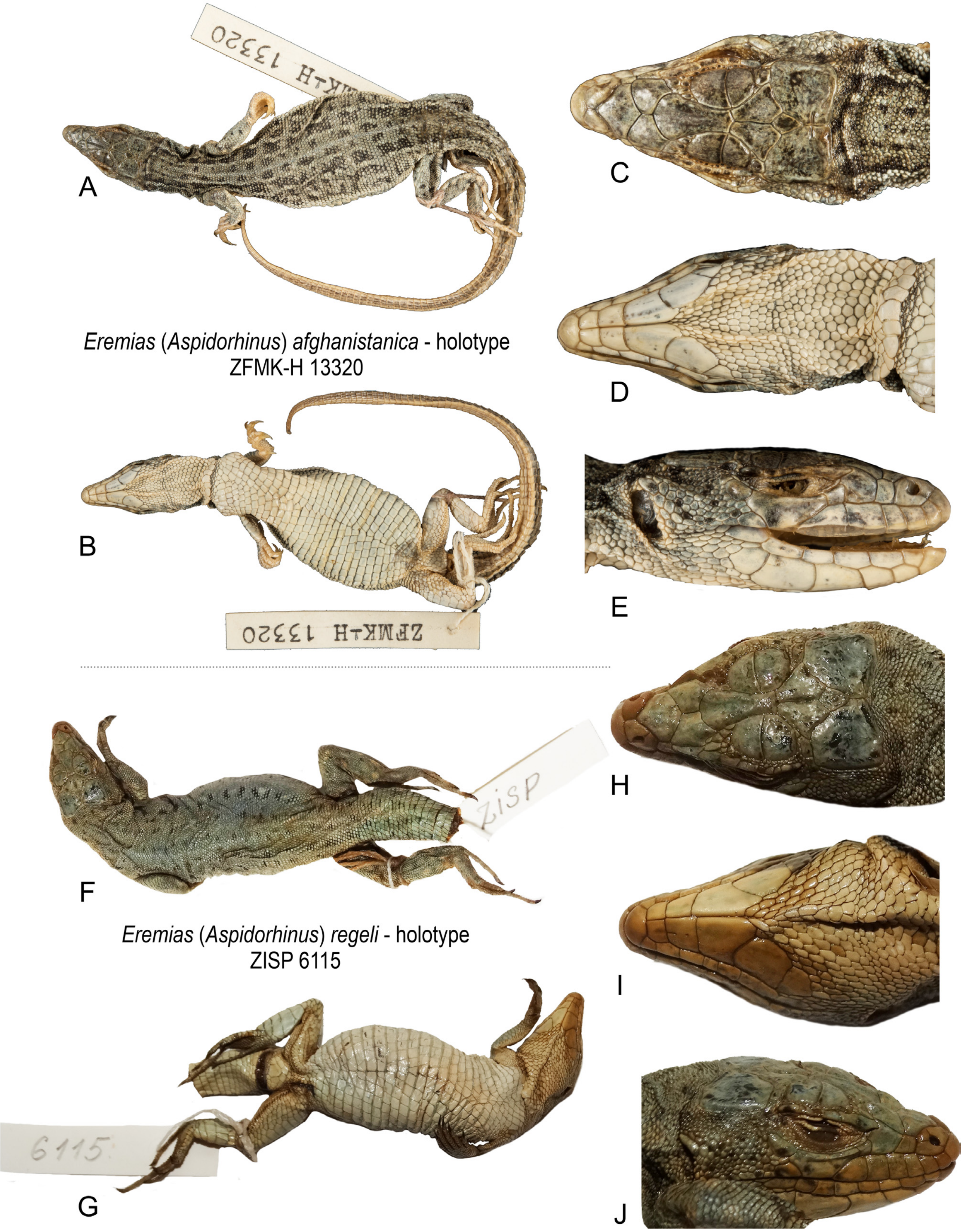


FIGURE 8. Two rare species of the subgenus *Aspidorhinus* (*Eremias*) from desert and semi-desert areas of Central Asia (Afghanistan, Uzbekistan) for which genetic data are missing so far: the holotype of *E. afghanistanica* from Afghanistan (ZFMK-H 13320) and the holotype of *E. regeli* from Uzbekistan (ZISP 6115).

Identification key to the Pakistani species of the genus *Eremias* (modified from Masroor *et al.* 2020a)

1. Subocular bordering mouth 2
- Subocular not bordering mouth . . . .*E. acutirostris*
2. A complete row of lateral scales of the 4th toe forming a distinct fringe or comb on its entire length. 3
- Lateral scales of 4th toe not forming distinct fringe 4
3. Row of femoral pores reaches well short of the knee; the median dark dorsal stripes interrupted and form reticulate pattern . . . . *E. scripta*
- Row of femoral pores reaches to knee; dorsal stripes without any sign of vermiculation. . . . . *E. cholistanica*
4. Back with 5–11 dark stripes, broader than interspaces, none of the stripes containing light ocelli or spots; stripes persistent in adults, but sometimes indistinct so that back appears almost uniform sandy; usually only single median collar scale distinctly larger than adjacent gulars 5
- Dark stripes on the dorsum of juvenile breaking up in adults to form spots or broken lines; usually, several collar scales distinctly larger than adjacent gulars. 6
5. 4th toe with two complete rows of subdigital scales and a complete row of sharply pointed lateral scales, i.e., a total of 4 scales counted around penultimate phalanx . . . .*Eremias fasciata*
- 4th toe with one complete row of subdigital scales and a complete row of lateral scales, i.e., total of three scales counted around penultimate phalanx . . . .*E. kakari*
6. Adults with four more or less regular rows of disconnected dark spots on dorsum between dorsolateral broader dark stripes, the latter with white ocelli at the edges and within each stripe; infranasal in contact with the rostral . . . .*E. rafiqi* **sp. nov.**
- Adults with seven light stripes on the neck, transforming into disconnected series of white ocelli edged with black; no dorsolateral dark stripes, an outer-most series of white and black ocelli starts behind the eyes on each side, onto tympanum and flanks above the forelimb and hindlimb insertion; infranasal not in contact with the rostral . . . . *E. killasaifullahi* **sp. nov.**

Discussion

Central Asia, especially areas between Hindu Kush Mountains and the Indus River belong to one of the most challenging areas for biodiversity research in the world (Jablonski *et al.* 2021). The present discovery of two new species from Balochistan province in Pakistan continues to highlight these dry, remote, and unexplored areas of the world as possible sources of genetic and species diversity (Masroor *et al.* 2020a,b, Jablonski & Masroor 2021, Jablonski *et al.* 2021, Khan *et al.* 2021). Apart from two earlier described endemic lizards *Laudakia melanura nasiri* Baig, 1999 and *Cyrtopodion rhodocauda* (Baig, 1998) from the same area, two species of lizards (*Eremias kakari* Masroor, Khisroon, Khan, Jablonski, 2020 and *Microgecko tanishpaensis* Masroor, Khisroon, Khan, Jablonski, 2020), representing local endemism, have been described recently from this part of Balochistan, and thus detection of such unexpected diversity raises interesting questions. Although *E. kakari* and *E. rafiqi* **sp**. **nov**. are currently known from wider areas of Pakistani Balochistan, Afghanistan, and Iran (Jablonski and Masroor 2021, Khan *et al*. 2021), *E. killasaifullahi* **sp**. **nov**., *M. tanishpaensis, L. melanura nasiri* and *C. rhodocauda* represent microendemic species known only from their type localities or areas around them. Such microendemism may reflect either our poor knowledge on the biodiversity in Central Asia or speciation event that occurred on a small geographic scale. The microendemism in Iran, Pakistan, or Afghanistan is, however, not uncommon and is apparent in different species of reptiles, especially from the families Lacertidae and Gekkonidae (Šmíd *et al.* 2014, Wagner *et al.* 2016). This endemism seems range-restricted within hilly regions in very hard environmental conditions and recalls that not only tropical biodiversity hotspots should be the focus of deeper herpetological research and species conservation. As shown in our genetic data in *E. killasaifullahi* **sp**. **nov**., high genetic diversity may be witnessed on a small geographic scale. Whereas we expect that our biodiversity knowledge is still partly known from here, the Sulaiman Mountains, the north-south extension of the southern Hindu Kush mountain system in Pakistan and Afghanistan and the Balochistan Plateau should be thus the focus of further research.

Although our morphological comparison with currently recognized taxa under the subgenus *Aspidorhinus* allowed us to find diagnostic data for our described species, we were not able to compare genetic data with all the representatives. The subgenus *Aspidorhinus* is currently formed of 14 species (Mozaffari *et al.* 2020, Khan *et al.* 2021), however, genetic data of cyt *b* marker are available only for nine species. Two species (*E. isfahanica*, *E. papenfussi*) were sequenced for this marker by Rastegar-Pouyani *et al.* (2016), however, their sequences include stop-codons and thus are not biologically informative. The remaining three species, *E. afghanistanica*, *E. nikolskii* and *E. regeli* (Fig. 8) were never sequenced on this widely used marker and molecularly analyzed (but see the position of *E. nikolskii* on cytochrome oxidase I in Khan *et al.* 2021). Especially the phylogenetic position of *E.*

afghanistanica (Fig. 8), which is known only from two specimens and two localities of Afghanistan (ZFMK 8584—holotype, ZFMK 13320—paratype; type locality: "Ost-Afghanistan [East Afghanistan], Prov. Ghazni, Dasht-e-Nawar, 3000 m N.N.") is worth of interest due to close geographic position to here described two species of the subgenus *Aspidorhinus*. However, as shown in our data, our described species show completely different external morphology compared to holotype of *E. afghanistanica* and *E. regeli* (Fig. 8).

Acknowledgements

We are grateful to the administration of the Society for Torghar Environmental Protection (STEP), especially Sardar Naseer Tareen (deceased), Sardar Sikandar, Sardar Payeend Khan, Khalis Khan and the protection guards of the Torghar Conservancy. To name a few protection guards who all the time accompanied and helped us in our endeavors to carry out our research on herpetofauna include Sattar Khan, Sadiq, Baran Khan, Hameed Ullah and Amir Muhammad. We are grateful to Muhammad Asif, Iqbal Sher, Riaz Ahmed, Ibad Ur Rehman, Muhammad Awais Leghari and Zafar Iqbal from Pakistan Museum of Natural History for extending their support during the fieldwork. We also thank Flecks Morris for providing photos of the holotype of *E. afghanistanica*, Natalia Ananjeva and Konstantin Milto for providing photos of the holotype of *E. regeli* and and one anonymous reviewer whose comments improved the first version of the manuscript. RM was supported by PSF-NSFC III/Bio/C-PMNH (13) and DJ was supported by the Slovak Research and Development Agency under contract no. APVV-19-0076.

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SUPPLEMENTARY TABLE S1. Comparison of morphological characters of *Eremias* (*Aspidorhinus*) *killasaifullahi* **sp. nov.** and *Eremias* (*Aspidorhinus*) *rafiqi* **sp. nov.** with other species of the subgenera *Aspidorhinus* and *Eremias*. See material and methods section for abbreviation of characters (N/A= data not available, + = in contact, - = separated). * and ** indicates the study in the particular line from where morphological data were taken.

Species	**Source**	**Max. SVL in mm**	**DS**	**VL**	**VT**	**G**	**C**	**SL**	**IL**	**SLAS**
Eremias (*Aspidorhinus*) *killasaifullahi* **sp. nov.**	This study	70.5	53–63	14–18	25–29	20–33	10–12	8–11	6–8	5–6
Eremias (*Aspidorhinus*) *rafiqi* **sp. nov.**	This study	99.3	56–67	14–17	29–33	30–36	8–12	8–10	6–10	5–7
Eremias (*Aspidorhinus*) *afghanistanica* Böhme & Szczerbak, 1991	Böhme & Szczerbak (1991)	67.0	44–46	N/A	37–38	25–28	N/A	8–9	6–7	5
Eremias (*Eremias*) *aria* Anderson & Leviton, 1967	Anderson & Leviton (1967)	61.0	55–59	12–14	28–29	23–25	12	8	N/A	5
Eremias (*Aspidorhinus*) *fahimii* Mozaffari, Ahmadzadeh, & Saberi-Pirooz, 2020	Mozaffari *et al*. (2020)	56.0	60–63	15	31–32	30–31	12	9–10	N/A	6–7
Eremias (*Aspidorhinus*) *isfahanica* Rastegar-Pouyani *et al*., 2016	Rastegar-Pouyani *et al*. (2016)	67.6	55–68	N/A	30–33	27–33	12–15	6–8	6–8	5
Eremias (*Aspidorhinus*) *kopetdaghica* Szczerbak, 1972	Szczerbak (1972)	76.1	48–59	N/A	26–31	19–28	7	8–10	6–9	N/A
Eremias (*Aspidorhinus*) *lalezharica* Moravec, 1994	Moravec (1994)	71.0	54–59	14–16	30–33	33–40	13–15	N/A	N/A	6–7
Eremias (*Aspidorhinus*) *montana* Rastegar-Pouyani and Rastegar-Pouyani, 2001	Rastegar-Pouyani & Rastegar-Pouyani (2001)	58.5	63–68	13–14	27–28	23–25	9–11	7–9	4–6	4–5
Eremias (*Eremias*) *nigrocellata* Nikolsky, 1896	Nikolsky (1896); Anderson, (1999)*; Baig & Masroor (2006)**	83.0*	42–56**	18	27–34**	23–33**	N/A	N/A	N/A	N/A

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SUPPLEMENTARY TABLE S1. (Continued)

Species	Source	Max. SVL in mm	DS	VL	VT	G	C	SL	IL	SLAS
Eremias (*Aspidorhinus*) *nikolskii* Bedriaga in Nikolsky, 1905	Nikolsky (1915)**; Bedriaga in Nikolsky (1905); Böhme & Szczerbak (1991)*	N/A	63	14	31; 28–32*	23; 20–28**	10	N/A	N/A	5–6
Eremias (*Aspidorhinus*) *papenfussi* Mozaffari *et al*., 2011	Mozaffari *et al*. (2011)	62.0	56–63	14–15	30–33	24–28	10–12	8	N/A	5
Eremias (*Aspidorhinus*) *persica* Blanford, 1874	Lantz (1928); Rastegar-Pouyani & Nilson (1997); Anderson (1999)	98.0	56–70	14–17	28–33	28–42	7–14	7–12	6–9	5–7
Eremias (*Aspidorhinus*) *regeli* Bedriaga in Nikolsky, 1905	Bedriaga in Nikolsky (1905); Böhme & Szczerbak (1991)*; Baig & Masroor (2006)**	70.0**	56; 43–61**	13	26; 25–31*	20; 14–24*	12	N/A	N/A	5–6
Eremias (*Aspidorhinus*) *strauchi* Kessler, 1878	Kessler (1878); Anderson, (1999)*	68.0*	58–62; 56–68*	16	30–32; 28–33*	26–27; 23–33*	8–11	8–9	6–7	7
Eremias (*Aspidorhinus*) *suphani* Başoğlu and Hellmich, 1968	Başoğlu & Hellmich (1968); Bischoff & Böhme (1980)*	60.0	50–64; 54–64*	N/A	29–34*	27–35*	N/A	N/A	N/A	5–6*
Eremias (*Aspidorhinus*) *velox* (Pallas, 1771)	Nikolsky (1915)**; Szczerbak, 1981; Anderson, (1999)*	77.0*	44–67; 46–56*; 50–65**	14–17**	26–34	19–33	10–11	7–12	5–9	N/A

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SUPPLEMENTARY TABLE S1. (Continued)

Species	NCWS	SDLT 4th	FP	SAT 4th	SOBM	FPS	Dorsal color pattern of adult	Distribution
Eremias (*Aspidorhinus*) *killasaifullahi* **sp. nov.**	22–27	21–25	17–24	3	+	1–5	ocellate	NW Balochistan, Pakistan—only the type locality
Eremias (*Aspidorhinus*) *rafiqi* **sp. nov.**	24–33	22–27	17–22	3	+	1–4	striped & ocellate	Afghanistan, SE Iran; NW Balochistan. Pakistan
Eremias (*Aspidorhinus*) *afghanistanica* Böhme & Szczerbak, 1991	22–25	22–25	16–18	N/A	+	2–3	ocellate	Afghanistan—only the type locality
Eremias (*Eremias*) *aria* Anderson & Leviton, 1967	28–29	25	17–18	3	–	1–3	striped & ocellate	Afghanistan—only the type locality
Eremias (*Aspidorhinus*) *fahimii* Mozaffari, Ahmadzadeh, & Saberi-Pirooz, 2020	31	20–21	19–21	N/A	+	1	striped & ocellate	Iran
Eremias (*Aspidorhinus*) *isfahanica* Rastegar-Pouyani *et al.*, 2016	N/A	22–26	18–23	N/A	+	3	striped & ocellate	Iran
Eremias (*Aspidorhinus*) *kopetdaghica* Szczerbak, 1972	20–26	N/A	15–21	N/A	+	N/A	striped & ocellate	Iran, Turkmenistan
Eremias (*Aspidorhinus*) *lalezharica* Moravec, 1994	25–32	N/A	15–19	N/A	+	3–5	striped & ocellate	Iran
Eremias (*Aspidorhinus*) *montana* Rastegar-Pouyani and Rastegar-Pouyani, 2001	23–28	18–25	18–20	4	+	2	striped & ocellate	W Iran
Eremias (*Eremias*) *nigrocellata* Nikolsky, 1896	19–31**	N/A	11–13	N/A	–	N/A	ocellate	SE Turkmenistan, S Uzbekistan, SW Tajikistan, NE Iran, NE Afghanistan

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SUPPLEMENTARY TABLE S1. (Continued)

Species	NCWS	SDLT 4th	FP	SAT 4th	SOBM	FPS	Dorsal color pattern of adult	Distribution
Eremias (*Aspidorhinus*) *nikolskii* Bedriaga in Nikolsky, 1905	N/A	N/A	17	N/A	+	N/A	striped & ocellate	Uzbekistan, N Tajikistan, Kyrgyzstan, SE Kazakhstan
Eremias (*Aspidorhinus*) *papenfussi* Mozaffari *et al*., 2011	23–28	N/A	19–26	N/A	+	1–2	striped & ocellate	Iran
Eremias (*Aspidorhinus*) *persica* Blanford, 1874	23–35	N/A	18–25	3*	+	N/A	striped & ocellate	Iran, Turkmenistan, S Afghanistan
Eremias (*Aspidorhinus*) *regeli* Bedriaga in Nikolsky, 1905	17–25	N/A	21–24	4	+	N/A	striped & ocellate	SE Turkmenistan, S Uzbekistan, SW Tajikistan, NE Afghanistan
Eremias (*Aspidorhinus*) *strauchi* Kessler, 1878	24–35*	N/A	18–20	N/A	+	N/A	ocellate	Armenia, Azerbaijan, Iran, Turkey
Eremias (*Aspidorhinus*) *suphani* Başoğlu and Hellmich, 1968	22–28*	N/A	16–26; 16–23*	N/A	+	0–4	ocellate	Iran, Turkey
Eremias (*Aspidorhinus*) *velox* (Pallas, 1771)	20–30**	N/A	15–24**	3*	+	2–4**	striped & ocellate	Afghanistan, Azerbaijan, China, Georgia, Iran, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan

APPENDIX 1. List of available, published cytochrome *b* (cyt *b*; mtDNA) and recombination activating gene 1 (Rag1; nDNA) sequences with their GenBank accession numbers of the subgenus *Aspidorhinus* examined in this study. The voucher specimen numbers of the Pakistan Museum of Natural History, Islamabad, Pakistan related to particular sequence of here described new species are in parentheses.

Cytochrome *b*:

Eremias (*Aspidorhinus*) *fahimii*: MT249277, MT249278.

Eremias (*Aspidorhinus*) *killasaifullahi* **sp. nov.**: MT554453 (PMNH 4046), MT554455 (PMNH 4055), MT554456 (PMNH 3615), MT554458 (PMNH 4049), MT554459 (PMNH 4052), MT554460 (PMNH 3613), MT554466 (PMNH 3614), MT554467 (PMNH 4045), MT554473 (PMNH 4050).

Eremias (*Aspidorhinus*) *kopetdaghica*: KJ468073, KJ468074, KJ468075, KJ468076.

Eremias (*Aspidorhinus*) *lalezharica*: KJ468077, KJ468078, KJ468079, KJ468080.

Eremias (*Aspidorhinus*) *montana*: FJ416293, FJ416294, FJ416295, FJ416296.

Eremias (*Aspidorhinus*) *persica* (Iran, type locality): FJ416246, FJ416250, FJ416252.

Eremias (*Aspidorhinus*) *rafiqi* **sp. nov.**: FJ416244, FJ416247, MT554454 (PMNH 4054), MT554457 (PMNH 4053), MT554461 (PMNH 3735), MT554470 (PMNH 3723).

Eremias (*Aspidorhinus*) *roborowskii*: KF999332, KF999333, KF999334.

Eremias (*Aspidorhinus*) *strauchi*: JQ690099.1, KJ468070, KJ468072, KP317966.

Eremias (*Aspidorhinus*) *suphani*: KP317964, KP317965.

Eremias (*Aspidorhinus*) *velox* (Kazakhstan, type locality): JQ690213, JQ690214, MG479385.

Recombination activating gene 1:

Eremias (*Aspidorhinus*) *killasaifullahi* **sp. nov.**: MT554478 (PMNH 3614), MT554479 (PMNH 4046),
MT554481 (PMNH 4055), MT554482 (PMNH 3615), MT554483 (PMNH 4050), MT554486 (PMNH 4045), MT554494 (PMNH 4049), MT554497 (PMNH 4052), MT554498 (PMNH 3613).

Eremias (*Aspidorhinus*) *kopetdaghica*: KJ486166, KJ486167, KJ486168, KJ486169.

Eremias (*Aspidorhinus*) *lalezharica*: KJ486170, KJ486171, KJ486172, KJ486173.

Eremias (*Aspidorhinus*) *rafiqi* **sp. nov.**: MT554476 (PMNH 3724), MT554477 (PMNH 3735), MT554480 (PMNH 4054), MT554485 (PMNH 4053), MT554487 (PMNH 4056), MT554496 (PMNH 3723).

Eremias (*Aspidorhinus*) *strauchi*: KJ486162, KJ486163, KJ486164, KJ486165.

Eremias (*Aspidorhinus*) *velox*: KJ486174, KJ486175, KJ486176, KJ486177.