

Compsobuthus lakkiansis sp. nov. (Scorpiones: Buthidae), New Species from Pakistan

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ABSTRACT

Members of the genus *Compsobuthus*, is distributed across the Arabian Peninsula, central Africa and the Indian subcontinent. The genus is represented in Pakistan by four documented species from the *weneri* group including *Compsobuthus atrostriatus* (Pocock, 1897), *C. pakistanus* Kovařík and Ahmed, 2007, *C. indicus* Kovařík and Ahmed, 2011, *C. rugosulus* (Pocock, 1900). In this study, we describe a new species within the *weneri* group, *Compsobuthus lakkiansis* sp. nov., collected from a semi-sandy area in Lakki Marwat District, northeast Pakistan. Morphometric data were recorded and compared with those of closely related congeners. This discovery establishes the first record of the genus *Compsobuthus* in Lakki Marwat and raises the number of its species in Pakistan to five. This work serves as a critical baseline for future research on scorpion biodiversity and aids in developing effective conservation strategies.

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Authors' Contribution

MI worked on the project and wrote the first draft. MA conceived the idea and supervised the project. SK and AA helped with the analysis and resources. HB collaborated and helped with the draft. All authors read and approved the final manuscript.

Key words

Compsobuthus, Fauna, Taxonomy, Lakki Marwat, Pakistan

INTRODUCTION

Limited information is available about the ecology, distribution and phylogeny of scorpion species of Pakistan; however, available records suggest the presence of at least 50 species belonging to 5 families and 17 genera (Tahir *et al.*, 2015).

The taxonomic classification of scorpions requires a detailed morphological study involving the study of key characteristics such as carination, pedipalp chela dentition and Trichobothrial patterns all serving as critical diagnostic tools (Vachon, 1974; Sissom, 1990). *Compsobuthus* Vachon, 1949 is a prime example of a group defined by such morphological features. The classification of the *Buthus acutecarinatus* leads to the genus *Compsobuthus* which is characterized by the fusion of posterior and central median carinae of carapace (Vachon, 1949).

Subsequent revisions more precisely characterized this genus by the presence of single continuous spiniform projection on the end of granular row of each tergites (Levy and Amitai, 1980) and divided it into two species groups: the *acutecarinatus* group (lacking external accessory granules on pedipalp chela fingers) and the *weneri* group (possessing these granules) (Vachon, 1952).

Members of the genus *Compsobuthus* is widely distributed across central Africa, the Middle East, the Arabian Peninsula and in the subcontinent including both India and Pakistan (Kovařík and Ojanguren, 2013). While only 12 to 15 species were recognized by the end of the 20th century (Fet *et al.*, 2000), extensive taxonomic work over the past two decades has clarified the genus status, leading to a current representation of 57 species (Kovařík and Ojanguren, 2013; Waghe *et al.*, 2022; Ythier and Lourenco, 2023; Kovařík, 2025; Ythier and Ullrich, 2025; Vahidinia *et al.*, 2025; Rein, 2026).

The genus *Compsobuthus* is represented by six documented species in the Indian subcontinent, specifically within Pakistan and India (Lourenço, 2004; Kovařík and Ahmed, 2011). The distribution of these

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Abbreviations

CL/CW, carapace length/width; MTL, metasomal telson length; ChL/ChW, chela length/width; PFL/PFW, pedipalp femur length/width; PPL/PPW, pedipalp patella length/width; MFL, movable finger length; FFL, fixed finger length; TL/TW, telson length/width; TBL, total body length.

species reveals a pattern of both endemism and shared presence, as for example; *C. pakistanus* (Kovařík and Ahmed, 2007) and *C. indicus* (Kovařík and Ahmed, 2011) are considered endemic to Pakistan while *C. Satpuraensis* (Waghe *et al.*, 2022) and *C. andresi* (Lourenço, 2004) have been reported only from India. The remaining two species: *C. rugosulus* (Pocock, 1900), with its type locality considered to be in Pakistan (Lourenço and Monod, 1998) has also been recorded in the Indian states of Madhya Pradesh, Rajasthan, and Gujarat; similarly, *C. atrostriatus* (Pocock, 1897) was initially reported from Pakistan (Pocock, 1897) and later formally described from specimens in Rajasthan, India (Tikader and Bastawade, 1983). Regarding species complexes, only *C. andresi* is a member of the *acutecarinatus* group while all other mentioned congeners are confirmed members of the *wernerii* group.

Specimens belonging to the genus *Compsobuthus* were obtained from Aba Khel, District Lakki Marwat, northeast Pakistan, during 2024 survey of the local scorpiofauna. A comprehensive morphological study which included detailed morphometry was conducted. The specimens were found to possess a unique combination of diagnostic features that do not correspond to any known species. Consequently, and based on this distinct morphology, we formally describe these specimens as *Compsobuthus lakkiansis* sp. nov.

MATERIALS AND METHODS

Scorpions were collected from the semi-sandy area in Aba Khel, Lakki Marwat District, northeast Pakistan during the day time randomly with the help of forceps in 2024. Google map was used to recorded exact location of the specimens. The collected specimens were killed by suffocating in a closed jar containing chloroform soaked-cotton swab. Specimens were preserved for three days in 8-10% formaldehyde; afterwards washed carefully thoroughly and kept in distilled water for 8-10 hours. Finally, they were preserved in 70% ethanol. The collected specimens were observed under the Labomed Luxeo 6z Stereo Zoom Microscope, and photographs of the specimens were taken. Vernier caliper was used for measurements and morphological identification was done for each of the specimen with the available identification keys of Polis (1990) and Kovařík and Ojanguren (2013).

Specimens were labeled with all the details such as species name, collector, location, date of collection and deposited in “Natural History Museum Institute of Zoological Sciences, University of Peshawar, Pakistan” where it was allotted the catalog numbers NHM IZS UOP 541-549.

Family Buthidae C. L. Koch, 1837

Compsobuthus Vachon, 1949

Compsobuthus lakkiansis sp. nov. (Figs. 1-3, Table I)

Holotype

1♀ (NHM IZS UOP 541) (Fig. 1), Pakistan, KPK Province, Lakki Marwat District, Aba-Khel, 32°33'58.9N, 70°49'52.7E, 22 August 2024, coll. M. Ishtiyag.

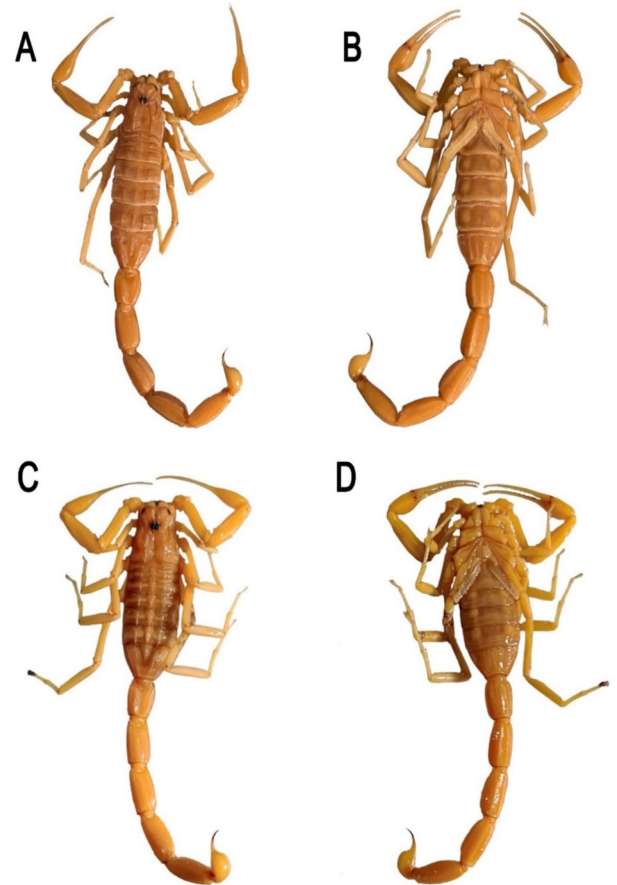


Fig. 1. Habitus of *Compsobuthus lakkiansis* sp. nov. from Pakistan. Male paratype: (A) Dorsal surface, (B) Ventral surface. Female holotype: (C) Dorsal surface, (D) Ventral surface.

Paratype

5♀♀ (NHM IZS UOP 542-546), 3♂♂ (NHM IZS UOP 547-549), 1juvenile, Pakistan, KPK Province, Lakki Marwat District, Aba Khel, 32°33'58.9N, 70°49'52.7E, 22 August 2024, coll. M. Ishtiyag.

Etymology

Named after the district of collection.

Table I. Morphometric measurements (in millimeters) of *Compsobuthus* species recorded from Pakistan.

Measurements	<i>C. lakkiansis</i> sp. nov. (this study)		<i>C. pakistanus</i> Kovařík and Ahmed, 2007	<i>C. indicus</i> Kovařík and Ahmad, 2011		<i>C. rugosulus</i> Lourenco and Monod, 1998		<i>C. humaae</i> Aamir <i>et al.</i> , 2005
	♂	♀	♀	♂	♀	♂	♀	♂
CL	7	8	2.9	3.3	3.5	3.0	4.3	6
CW	6	9	2.8	3.3	3.7	3.4	4.8	-
MTL	27	31	16.2	17.6	18.4	-	-	27
MIL	4	4	2.0	2.1	2.2	1.9	2.4	4.8
MIW	4	4	1.6	2.1	2.3	2.1	2.6	1.8
MIIIL	4.2	4.3	2.2	2.6	2.7	-	-	5.0
MIIW	3.5	3.5	1.4	1.9	2.1	-	-	2.0
MIIIL	5.0	5.0	2.5	2.7	2.8	-	-	5.5
MIIW	3.5	3.0	1.3	1.9	2.1	-	-	2.5
MIVL	6.0	6.2	3.0	3.0	3.1	-	-	5.8
MIVW	2.5	3.0	1.4	1.8	1.9	-	-	2.7
MVL	7.0	8.0	3.4	3.4	3.6	3.2	4.0	6
MVW	2.5	3.0	1.3	1.7	1.9	1.5	2.2	3
TL	6.0	7.0	2.6	3.3	3.7	-	-	5.5
TW	1.5	3.0	-	1.1	1.3	-	-	-
PFL	6.0	6.0	2.7	2.6	2.9	2.5	3.7	4.0
PFW	1.5	2.0	0.8	0.8	0.9	0.8	1.2	2.0
PPL	7.5	8.0	3.4	3.0	3.4	3.2	4.1	6.0
PPW	2.0	2.0	1.1	1.3	1.5	1.3	1.7	2.5
ChL	10	10	5.6	5.5	6.0	5.2	7.2	8.0
ChW	1.4	1.6	0.8	1.6	1.5	1.4	1.8	2.5
MFL	8.0	9.0	4.2	3.6	4.0	3.6	5.2	2.2
FFL	7.0	8.0	-	-	-	-	-	2.0
Pectines	29:30	25:26	18:19	18:18	16:16	14-19	14-17	29
TBL	53.5	56.3	27.5	35.8	33.5	30-50	30	43

CL, carapace length; CW, carapace width; MTL, metasomal telson length; TL, telson length; TW, telson width; PFL, pedipalp femur length; PFW, pedipalp femur width; PPL, pedipalp patella length/width; PPW, pedipalp patella width; ChL, chela length/width; ChW, chela width; MFL, movable finger length; FFL, fixed finger length; TBL, total body length; M1-VL/W, metasomal segment I-V length/width.

Diagnosis

It is a medium-sized scorpion, with its adult female measuring 56.3 mm and adult male 53mm in total length. It has its movable finger of the pedipalps with 12 oblique rows of granules, with both internal and external granules (characteristic of the *wernerii* group). The adults are having a long and slender patella and a narrow chela which differentiate them from their congeners. Sexual dimorphism is minor with no or slight difference between the lengths of pedipalps and metasomal segments. The sternum is triangular in shape. Metasomal segment I is having ten carinae, II-IV is having eight carinae while the metasomal segment V is pentacarinata. The tail is

slender and elongated while the metasomal segments I-V are longer than wide. The metasomal segments is sparsely covered with setae but densely packed with granules. Female have 25-26 while male have 29-30 pectinal teeth, and the 3rd and 4th legs with both tibial and pedal spurs.

Description

Meristic counts of the carapace, telson, metasomal segment, pedipalps segments along with pectinal teeth counts are mentioned in the [Table I](#).

Size

The female holotype has a total length 56.3 mm and

male 53 mm, general appearance is shown in Figure 1.

Colouration

The base colour is predominantly yellow (Fig. 1A-D). Carapace is slightly reddish having black pigments around the lateral eyes and between the median eyes. Tergites are orange yellow in colour and have no difference in coloration at the proximal and distal end of tergites (Fig. 2B, 3B). Metasomal segments I-V are uniformly yellowish in color including the telson (Figs. 2E-G, 3E-F). The vesicles are yellowish brown in colour, the aculeus is bicolor i.e. the radish brown base and a radish black tip (Fig. 2E, G). The pedipalps femur and patella are pale yellow in colour, while the chela is reddish brown with yellowish fingertips. Sternites I–VI are pale yellow in color (Figs. 2C, 3C, D). The coxa, trochanter, femur and patella of the legs are yellow, in contrast tarsomere and tibia are pale yellow in colour; tip of the tibial and pedal spurs and median and lateral claws are reddish in colour (Figs. 1, 2D).



Fig. 2. *Compsobuthus lakkiansis* sp. nov. from Pakistan. Female holotype: (A) Sternopectinal region and sternites. (B) Carapace and mesosoma, (C) Pedipalp, (D) Leg IV, (E) Metasomal segments and telson, (F) Metasomal segments III-IV, (G) Metasomal segments V and telson.

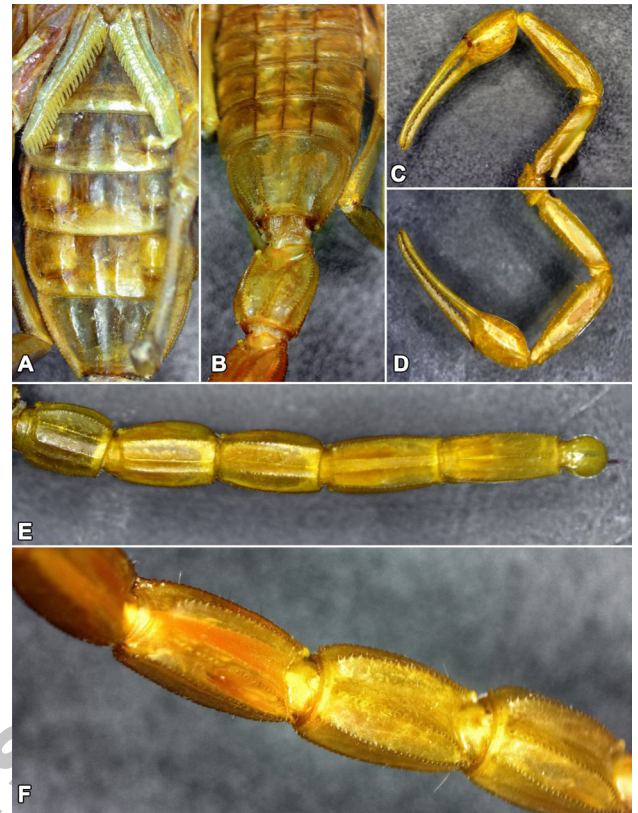


Fig. 3. *Compsobuthus lakkiansis* sp. nov. from Pakistan. Male paratype: (A) Sternopectinal region and sternites. (B) Mesosoma and metasomal segment I, (C) Pedipalp ventral view, (D) Pedipalp dorsal view, (E) Metasomal segments and telson ventral view, (F) Metasomal segments II-IV dorsal view.

Carapace and mesosoma

The surface of carapace and mesosoma are sparsely granulated. The surface of carapace is covered with small and weak granular. The proximal end of the carapace shows median granulation while the distal end shows weak granulation with single line of median granules interconnected with posterior granules of the carapace. The carinae are moderately developed. Median eyes are separated by less than one ocular diameter (Fig. 2B). Sternum is triangular in shape (Fig. 2A). Tergites I–III with median carinae showing single projection behind posterior margins as distinct spiniform processes (Figs. 2B, 3B). In female tergites IV–V showing group of three spiniform projection in median row of granules while tergite VI shows four spiniform projection in the median row of granules while the side lines show single spiniform projection on each tergites (Fig. 2B). In case of male all the tergites from I–VI showing single spiniform projection on the end of each granular row (Fig. 3B). Tergite VII possesses five

carinae (Figs. 2B, 3B). The number of pectinal teeth is 25-26 for females (Figs. 1D, 2A) and 29-30 for males (Figs. 1B, 3A). Genital operculum is divided longitudinally (Fig. 2A). The middle basal lamella is not dilated. The seventh sternite bears four strong and crenulate ventral carinae. All the sternites are smooth except sternite VI-VII bears four granulate carinae (Figs. 2A, 3A).

Table II. Overall body length (TBL) and carapace dimensions of *C. lakkiansis* sp. nov., which show that the female specimens are of larger size (Mean, Mean±SD).

Measurements	Male	Female	Combined
CL (mm)	7.00	8.00	7.50± 0.71
CW (mm)	6.00	9.00	7.50± 2.12
MTL (mm)	27.00	31.00	29.00± 2.83
ChL (mm)	10.00	10.00	10.00± 0.00
ChW (mm)	1.40	1.60	1.50± 0.14
TBL (mm)	53.50	56.30	54.90± 1.98

For abbreviation see, Table I.

Metasoma and telson

The metasomal segment I-V are longer than wide, segment I bearing 10 and segments II-V bears 8 carinae (Figs. 2E-G, 3E-F) of each with the intermediate carinae of the 2nd which is replaced by eight minute granules and isolated granular is found on the posterior end, the 3rd segment has only 2-3 posterior granules while the 4th segment has reduced granular so that the lateral surface has smooth appearance, segment V (Figs. 2E, G, 3E) is slender and long with five carinae and having reduced granules. Bristles are few in number while the telson is setaceous and less granular than metasomal segments with long aculeus while the subaculear tooth is absent.

Pedipalps

All the segments of the pedipalps (Figs. 2C, 3C, D)

are long and slender with particularly elongated fingers and slender patella, the dentate margin of the movable fingers of the pedipalps chela is with different granules divided into 12 linear rows with one accessory interior and one exterior granular with four terminal and one basal terminal granular is present. Patella is long, narrow and pentacarinata with developed carinae. Femur with 10/11 well developed keels. The chela is smooth with poorly defined carinae and its trichobothria is arranged in the beta pattern. The position and distribution of trichobothria on the chela is beta type.

Legs

The 3rd and 4th leg bears tibial and pedal spurs. Both retrolateral and prolateral pedal spurs are present on leg III and IV. On the ventral surface the tarsus bears the two rows of short fine microsetae and numerous macrosetae on the other side. Overall, the tibia, patella and Femur are sparsely setaceous while the basitarsus and tarsus are densely setaceous having no Bristle combs. The femur and patella both are densely granulated and bears only solitary macrosetae except for external lateral surfaces which are smooth in females and sparsely granulated in males. The femur has four carinae while the patella has four to six carinae (Fig. 2D).

Affinities

The combination of above-described features distinguish *C. lakkiansis* sp. nov. from all other congeners. The Key for each species is provided below. The key excludes the *C. humaae* (Amir et al., 2005), reported from Pakistan due to its uncertain taxonomic status, although it also is different from the species we are describing here i.e., *C. lakkiansis* sp. nov. in having total body length and metasomal segment IV and V (containing well developed carinae on its posterior portion), *C. lakkiansis* sp. nov. can be easily differentiated from *C. pakistanus* in having 18-19 pectinal teeth and its total body length. *C. lakkiansis* sp. nov.

Table III. Comparison of L/W ratios of *C. lakkiansis* sp. nov. with other species of *Compsobuthus* recorded from Pakistan.

Measurements	<i>C. lakkiansis</i> sp. nov.		<i>C. pakistanus</i>	<i>C. indicus</i>		<i>C. rugosulus</i>		<i>C. humaae</i>
	♂	♀	♀	♂	♀	♂	♀	♂
CL/CW	0.86	1.13	0.97	1.00	1.06	1.13	1.12	-
PFL/PFW	4.00	3.00	3.50	3.25	3.22	3.13	3.08	2.00
ChL/ChW	7.14	6.25	7.00	3.44	4.00	3.71	4.00	3.20
PPL/PPW	3.75	4.00	3.09	2.31	2.27	2.46	2.41	2.40
MIL/MIW	1.00	1.00	1.25	1.00	0.96	0.90	0.92	2.67
MVL/MVW	2.80	2.67	2.62	2.00	1.89	2.13	1.82	2.00

For abbreviation see, Table I.

has narrow and long pedipalps, its patella differs from *C. rugosulus* (reported from Sindh, district D I Khan of KPK Pakistan and India) and *C. indicus* (Pakistan, Sindh Province, Nagar Parkar); both these species have slightly robust patella, pectinal teeth numbers and body lengths as described in Table I. However, *C. lakkiansis* sp. nov. shows some similarities in patella of pedipalps to *C. williamsi* from Morocco (locality between Erfoud and Ouarzazate) but can be easily differentiated from *C. lakkiansis* sp. nov. in that *C. williamsi* is from *acutecarinatus* group having narrow and long metasomal segments and short chela. The known geographic range of *C. lakkiansis* sp. nov. overlaps with that of *C. rugosulus* (Pocock, 1900), *C. rugosulus* is recorded from D. I. Khan, a neighboring district with Lakki Marwat but is separated by the large mountains of Sheikh Badin hills which may have led to the speciation of *Compsobuthus*. Sheikh Badin hills are the part of local Marwat-Khisor range located in the southern part of Lakki Marwat which is the eastern extension of the of the Suleiman Mountain range. Also *C. rugosulus* can easily be distinguished from *C. lakkiansis* sp. nov. by its slightly robust patella of pedipalps, pectinal teeth number, metasomal segments especially segment IV and body length (Table I, Figs. 2, 3).

Key to the Species of *Compsobuthus* (Werneri Group) Recorded from Pakistan

1. Second segment of metasoma with 10 carinae 2
 - Second segment of metasoma with 8 carinae, some times with several accessory granules which do not form a complete carina 3
2. First metasomal segment of both sexes longer than wide; Total body length is 30-50 mm; slightly robust patella of pedipalps *C. rugosulus*
 - First metasomal segment of both sexes approximately as wide as long; total body length 27-38 mm; robust patella of pedipalps *C. indicus*
3. Pedipalp chela stocky; males with a recess and a lob at base of chela fingers *C. atrostriatus*
 - Pedipalp chela elongated 4
4. Total body length 27 mm (immature); short and narrow patella of pedipalps; Pectinal teeth number 18-19..... *C. pakistanus*
 - Total body length 49-57 mm; long and slender patella of pedipalps; Pectinal teeth number 25-30 *C. lakkiansis* sp. nov.

Morphometric analysis

Given the constraints of the dataset which is characterized by a small sample size, numerous missing values and some species represented by a single sex a

robust inferential statistical analysis was not feasible. Therefore, our approach is primarily descriptive and comparative, focusing on morphometric ratios to normalize for size and elucidate differences in shape and proportion. The analysis centers on *C. lakkiansis* sp. nov., for which both male and female data are available and thus allows for an intraspecific assessment of sexual dimorphism. The calculated key morphometric ratios infer to the functional morphology and ecological adaptation of the species in question.

Based on a comparative morphometric analysis, *C. lakkiansis* sp. nov. is definitively characterized as a lassiform or venom-centric scorpion, a functional morphotypes diametrically opposed to the burlyform crush-centric strategy of its congeners (*C. indicus*, *C. rugosulus*, and the extreme *C. humaae*). This fundamental divergence is most critically illustrated in chela morphology, where *C. lakkiansis* sp. nov. is having extremely slender grasping chelae (ChL/ChW ratio of 6.25-7.14) are over twice as slender as the robust, crushing chelae of the burly form species (ChL/ChW ratio of 3.20-4.00), a distinction that clearly separates their primary prey capture techniques i.e., venom injection for soft-bodied prey versus physical domination for hard-bodied prey. Ultimately, the morphometric data conclusively positions *C. lakkiansis* sp. nov. within its own functional category which is defined by a morphology built for precision envenomation rather than brute force.

The pedipalp patella length/width ratio (PPL/PPW) also is providing some critical insights, confirming both sexual dimorphism and the profound functional divide between morphotypes. In *C. lakkiansis* sp. nov., the male's more elongated patella (3.75) compared to the female's (4.00) reflects a common pattern of male pedipalp elongation for courtship and combat. More significantly, this ratio may also help to distinguish between the lassi form and burly form morphotypes, i.e., *C. lakkiansis* sp. nov. and *C. pakistanus* possess the most elongated patellae (3.75-4.00) thus maybe it is enhancing the reach and maneuverability for grasping agile prey, while *C. indicus*, *C. rugosulus* and *C. humaae* have drastically shorter but more robust patellae (2.27-2.46) which may be prioritizing power and structural integrity to anchor the massive muscles required for their crushing strategy. This demonstrates that the adaptive differences extend throughout the entire pedipalp, further underscoring that *C. lakkiansis* sp. nov. is built for a venom-centric, grasping ecology, fundamentally opposed to the more power-centric, crushing lifestyle of its burly form congeners.

Based on the interpretation of metasoma segment ratios, minimal sexual dimorphism in *C. lakkiansis* sp. nov. indicates the tail's structural importance for both sexes while

the interspecific comparisons reveal two distinct functional morphotypes, the lassi form species (*C. lakkiansis* sp. nov., *C. pakistanus*) possess a highly elongated and slender fifth segment (MVL/MVW: ~2.73), whereas the burlyform crushers (*C. indicus*, *C. rugosulus*) have a shorter, stouter fifth segment (MVL/MVW: 1.82-2.13), forming a robust structure that prioritizes strength and durability, secondary to their primary crushing pedipalps, with the hyper-burly form *C. humae* presenting a unique hybrid morphology that combines an elongated base for mobility with a stout terminal segment for powerful, penetrating stings against armored prey.

DISCUSSION

The compilation of *Compsobuthus* records from Pakistan reveals a complex and often unstable taxonomic history, underscoring the need for integrated systematic revisions. For instance, the status of *C. humae* (Amir *et al.*, 2005) has been questioned due to its original description lacking definitive diagnostic characters, leading some authorities to later consider it a nomen dubium (Kovářik and Ojanguren, 2013). Based on the literature, *C. atrostriatus* (Pocock, 1897) is reported from Pakistan (Kashmir and Sindh) and India (Jodhpur, Rajasthan) (Tikader and Bastawade, 1983), was initially placed in the genus *Vachonus*, and was finally transferred to the genus *Compsobuthus* by Navidpour *et al.* (2011). Pocock (1900) initially described *C. rugosulus* as a subspecies of *Buthus acutecarinatus* Simon, 1882, from specimens collected in Pakistan (Sindh and Khyber Pakhtunkhwa (KPK)) and India (Madhya Pradesh and Rajasthan), localities approximately 1000 km apart; later, Tikader and Bastawade (1983) also collected specimens from the Indian states of Gujarat and Rajasthan. *C. rugosulus* has also been reported from Afghanistan and Iran (Kovářik and Ojanguren, 2013), and was later redescribed from Hyderabad, Sindh, which was considered its type locality. While such broad distributions are not impossible, they often mask complexes of cryptic species, a hypothesis that should be tested with modern phylogenetic tools as seen in the studies on *C. matthiesseni* (Ali and Kachel, 2025). The redescription of *C. rugosulus* from Hyderabad, Sindh, helps to anchor the identity of this species, but the status of populations from other regions, including Dera Ismail Khan in KPK, requires further investigation. The discovery of *C. lakkiansis* sp. nov., a member of the *wernerii* group, represents the first report of the genus *Compsobuthus* from Lakki Marwat (Aba Khel), the second report from KPK, and the sixth for the genus from Pakistan. Additional field surveys targeting suitable areas in Punjab, Baluchistan, and the southern and northern parts of KPK are required to

further expand the known scorpion diversity and range of the genus *Compsobuthus* and may potentially lead to the discovery of new species.

The biogeographic context of this study is of particular interest. The specimen was collected in the Lakki Marwat district, a region situated at the confluence of mountainous terrain and sandy plains. This area is influenced by the Sheikh Badin hills, which form an eastern extension of the Sulaiman Mountain Range. Major mountain systems like the Sulaiman Range are known to act as both evolutionary hotspots and biogeographic barriers, promoting vicariance and allopatric speciation by isolating populations. The fact that *C. lakkiansis* sp. nov. is reported as sympatric with *C. rugosulus* in this region yet it is morphologically and functionally distinct which strongly suggests that the complex terrain and associated microhabitats may have played a key role in driving speciation within the genus. This pattern aligns with global biogeographic findings that identify mountainous regions like Borneo and Indochina for diversification.

The discovery of *Compsobuthus lakkiansis* sp. nov. from Lakki Marwat represents a significant addition to the scorpion fauna of the region, marking the second species of the genus reported from Khyber Pakhtunkhwa (KPK) and the fifth from Pakistan. This finding provides a crucial opportunity to re-evaluate the biogeography and evolutionary history of the genus in the region. The present study's morphometric analysis clearly differentiates *C. lakkiansis* sp. nov. from its congeners by placing it within the lassi form functional guild characterized by a venom-centric strategy involving slender chelae and a powerful metasoma. In contrast, other Pakistani species like *C. indicus* and *C. rugosulus* are confirmed as burlyform crushers. This profound morphological divergence suggests these taxa have undergone distinct evolutionary pathways which might likely have been driven by different ecological pressures. Such clear ecomorphological partitioning within a genus highlights the potential for cryptic diversification where similar-looking species are in fact adapted to very different niches, such phenomenon can be easily recognized through molecular systematics.

CONCLUSION

The description of *C. lakkiansis* sp. nov. expands the known distribution of the genus *Compsobuthus* in Pakistan and confirms the presence of a distinct form in the country. Its morphological disparity from other regional congeners underscores the importance of functional morphometric analyses in modern taxonomy. Additional targeted field surveys are required in the geologically complex areas of Pakistani Punjab, Balochistan, and the southern and

northern parts of KPK. These efforts will help to clarify species distributions and potentially might uncover further undescribed diversity.

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Ethical statement

The Study was approved by ASRB SC-1 on 13 Jan, 2025.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Statement of conflict of interest

The authors have declared no conflict of interest.

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