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Taxonomy/Taxinomie

A new high-elevation scorpion species of the genus *Scorpiops* Peters, 1861 (Scorpiones: Euscorpidae: Scorpiopinae) from the Himalayas, India

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ABSTRACT

A new high-elevation scorpion species of the genus *Scorpiops* is described from the Indian state of Himachal Pradesh. *Scorpiops spitiensis* sp. nov. is the second highest-elevation scorpion species in Asia and the first one from India occurring at elevations above 4200 m. The new species closely resembles *Scorpiops petersii*, but it can be distinguished from it based on a suit of characters, one of which is the presence of 16 trichobothria on the external aspect of the patella, which is unique to the new species.

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1. Introduction

Family Euscorpidae Laurie, 1896 is globally distributed and is represented by ten genera and ninety-nine species [1]. Of these, three genera, viz. *Euscorplops* Vachon, 1980, *Scorpiops* Peters, 1892 and *Neoscorplops* Vachon, 1980, have been reported from India. In India, *Euscorplops* and *Scorpiops* are primarily distributed across the western Himalayas and in northeast India (a single *Scorpiops* species has been reported from central India), while *Neoscorplops* is restricted to the northern Western Ghats [2,3]. Among the Indian Euscorpids, the genus *Scorpiops* is most well represented, with at least nine species viz. *Scorpiops braunwalderi* Kovařík 2000, *S. dastychi* Kovařík 2000, *S. demise* Kovařík 2005, *S. feti* Kovařík 2000, *S. hardwickei* Gervais 1843, *S. leptochirus* Pocock 1893, *S. pachmarhicus* Bastawade 1992, *S. petersii* Pocock 1893 and *S. rohtangensis* Mani 1959 currently

reported from India [3–5]. A majority of these species typically occur at high-elevations (< 1000 m) with some species occurring at elevations greater than 3700 m.

Recently, individuals from one such high-elevation (4000–4200 m) *Scorpiops* population from Spiti Valley in Himachal Pradesh were collected. Morphologically, these individuals show affinity to *S. petersii*. Detailed comparisons of the collected individuals with the lectotype of *S. petersii* however indicate significant differences between the two, which warrant the individuals from Spiti Valley to be considered a distinct taxon. In this paper, we present a detailed description of the collected types and provide diagnostic characters and notes on its natural history.

2. Methods

Specimens of the new species are stored in 70% ethanol in the collection of the Bombay Natural History Society (BNHS, Mumbai). Measurements were taken with a Mitutoyo™ digital calliper with an error of 0.1, and

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morphological details were recorded using an Olympus™ SZ40. Measurements were taken following Stahnke [6] and are provided in millimetres (mm). Trichobothrial nomenclature follows Vachon [7] and morphological terminologies follow Hjelle [8]. Acronyms used in the manuscript are as follows: BNHS – Bombay Natural History Society, Mumbai; NHM – Natural History Museum, London.

In addition to the classical diagnostic characters, we propose a new method to quantify cuticular granulation that is an important diagnostic character in scorpion taxonomy. Granulation has until now been presented largely descriptively, e.g., dense, sparse, moderately dense, etc. This method, though informative, is prone to personal subjectivity and bias. Moreover, it fails to provide an absolute measure of granulation, making comparisons between closely related species complicated, especially when types cannot be accessed. To counter this issue, we propose a novel yet highly simplistic technique that allows quantitative assessment of granulation. To quantify granulation, photographs (with scale) of the types of the new species and the closely related *S. petersii* were taken and resized to 300 dpi. Grids of 10 pixel² were overlaid on the image in Adobe Photoshop CS3 and percent area coverage of granules was calculated by counting the total number of grids required to cover the focal body part and the number grids among them that showed the presence of granules.

3. Taxonomic treatment

Family EUSCORPIIDAE Laurie, 1896

Subfamily SCORPIOPINAE Kraepelin, 1905

Scorpiops spitiensis sp. nov. (Figs. 1–4)

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Holotype. BNHS Sc-67, adult male collected by Mayank Kohli and Ashwin Viswanathan from Kibber village, Spiti Valley, Himachal Pradesh, India (32.3309N, 78.0072E, altitude 4200 m).

Paratypes. One female BNHS Sc-68 and one male BNHS Sc-69 by Kulbhushansingh Suryawanshi; 1 female BNHS Sc-70 by Mayank Kohli and Ashwin Viswanathan. Collection locality same as the holotype.

Etymology. The specific epithet refers to the type locality “Spiti” where the types were collected.

3.1. Diagnosis

A medium-sized species in relation to members of the genus *Scorpiops* (39.51 mm maximum). Carapace anterior margin raised upwards. Median eyes situated anteriorly in the ratio 1:3. Patella with 7 ventral trichobothria and 16 external trichobothria, single em present. Manus flexed in males. Mesosomal tergites I–VI with median carinae, posterior and laterally portion of tergites with depressed granulation. Telson moderately bulbous. Pectines 5 in number.

3.2. Description of holotype BNHS Sc-67

Colouration (Fig. 1a & 1b, Table 1). Overall in a shade of brownish black with the chelicerae being yellowish brown

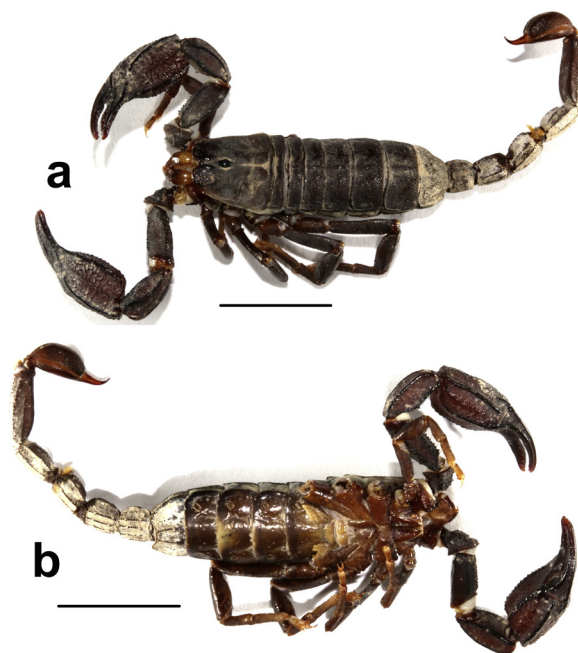


Fig. 1. (Colour online.) *Scorpiops spitiensis* sp. nov. holotype male Bombay Natural History Society Sc-67, (a) dorsal view, (b) ventral view. Scale bar: 10 mm.

with dark brown reticulations. Manus and telson with a slight reddish ting. Pectines and genital operculum pale yellowish. Sternites dark brown.

Morphology. Carapace anterior margin with a moderately deep ‘U’ shaped indentation with its edges along the lateral eyes and anterior margin raised upwards. Surface with coarse granulation throughout. Carapacial carinae indistinct. Median eyes situated anteriorly in the ratio of 1:3. Median and lateral ocular tubercle glossy black (Fig. 2a). Three pairs of lateral eyes. Mesosoma (Figs. 1a, 1b & 2b) – Tergites coarsely granular throughout with large depressed granules concentrated on the lateral and posterior region of each segment. Median carinae fairly distinct on segments I–VI, lateral carine indistinct, merely represented by concentrated granules. Pectines 5 in number with fulcra present. All sternites smooth and glossy lacking carinae except sternite VII, which bears two pairs of lateral carinae. **Metasoma** – First metasomal segment with 10 keels (dorso-median vestigial, merely represented by a few granules), II–IV segment with 8 keels (latero-median absent), segment V with 7 keels. Keels on segment V serrated. Vesicle sparsely granular with a clear smooth band on its lateral aspect (Fig. 2c). Pedipalp (Figs. 3a–f & 4a–f) – Trichobothrial pattern C, neobothriotoxic [7]. Patella with 16 trichobothria on its external (5 eb, 2 esb, 1 em, 4 est, 4 et; Figs. 3e, 4e) and 7 on its ventral aspect (Figs. 3f, 4f). Patella with a large tooth and a few small ones on its internal aspect. Movable finger with a single row of granules. Manus length to width ratio 1:2.5. Chelicerae – Fixed finger with one large tooth at distal end and a small bifid tooth. Movable finger with two rows of teeth, from 4–6.

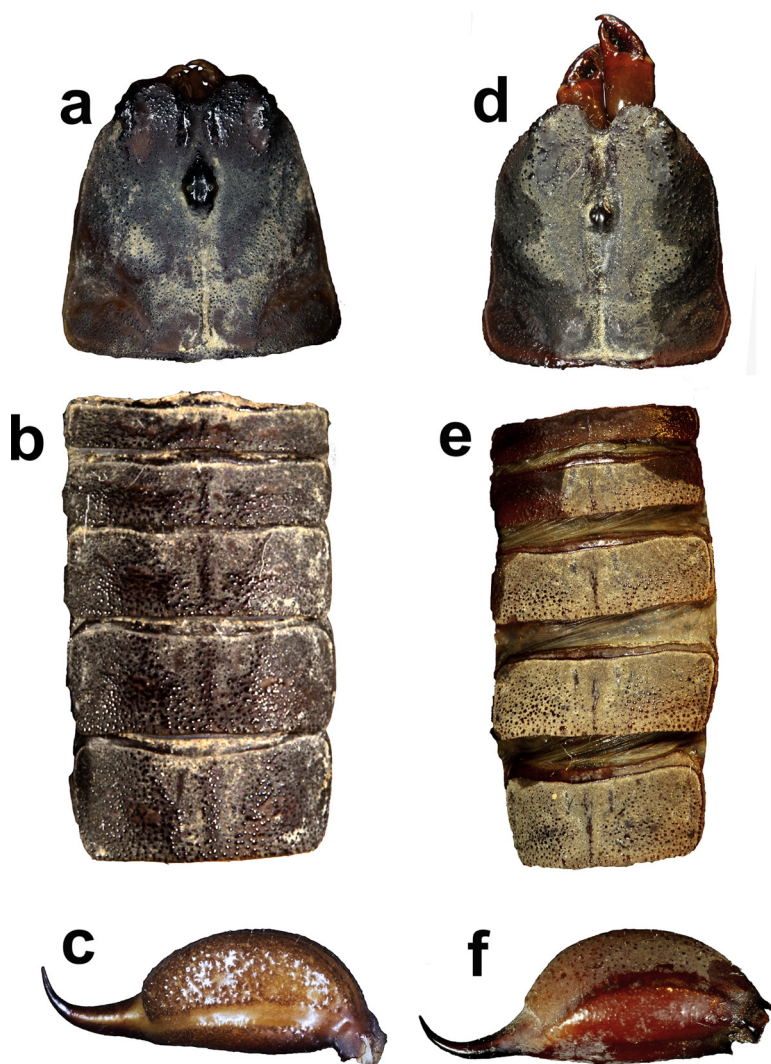


Fig. 2. (Colour online.) *Scorpiops spitiensis* sp. nov. holotype male Bombay Natural History Society Sc-67 (a–c), (a) carapace, (b) mesosoma, (c) telson. *Scorpiops petersii* lectotype male British Museum of Natural History (BMNH) (c–e), (c) carapace, (d) mesosoma, (e) telson.

Distribution and natural history notes. The type locality, Spiti Valley, is located in western Himachal Pradesh in northern India (Fig. 5). Spiti Valley is a cold, high-altitude desert characterized by a mosaic of rolling hills, rocky cliffs and outcrops with altitudes varying from 3000 to 5000 m. Mean summer temperature is around 25 °C, but however can drop to –35 °C during winters. Precipitation is in the form of snow during months of December to March. The vegetation of the area is classified as dry alpine steppe and is dominated by several shrub species [9]. The types were found while ground was being dug for the construction of houses at 4000–4200 m (Fig. 6), but however might occur at higher elevation, but dedicated surveys need to be conducted to ascertain the higher limits of distribution of the new species. Local residents report this species to be common while digging during summer months

indicated fossorial habits. Given that the type locality remains covered with snow for more than 4 months, it is likely that this species hibernates during the cold months of the year and surfaces only during the hotter months of the year.

3.3. Relationship

The new species closely resembles *S. petersii*, but however differs from it as follows:

- maximum length 39.51 mm (average length 69.3 mm in *S. petersii*);
- 16 trichobothria on external aspect of patella (17 in *S. petersii*);
- carapace anterior margin with a moderately deep ‘U’ shaped indentation with its edges along the lateral eyes

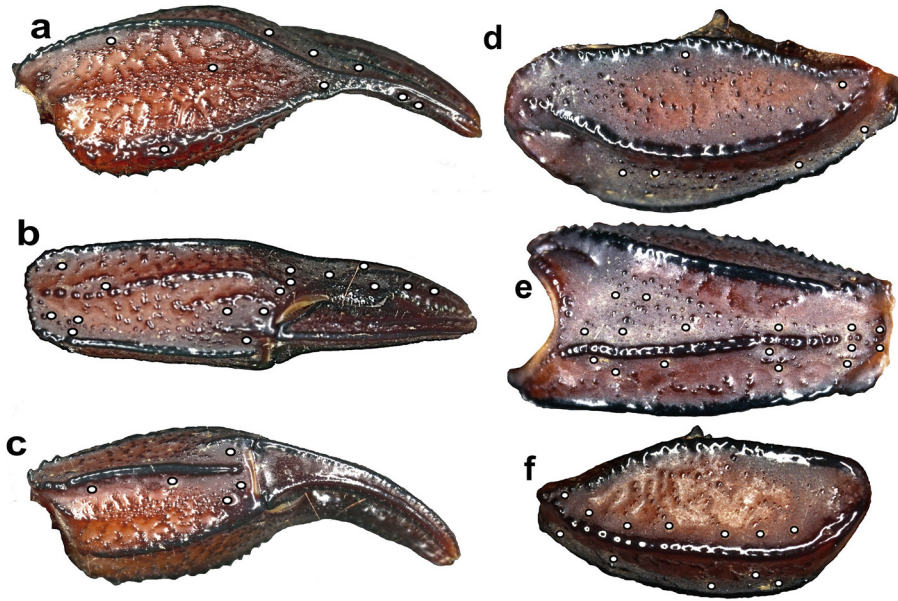


Fig. 3. (Colour online.) *Scorpiops spitiensis* sp. nov. holotype male Bombay Natural History Society Sc-67 manus (a) dorsal view, (b) external view, (c) ventral view, patella (d) dorsal view, (e) external view, (f) ventral view.

and anterior margin raised upwards ('U' shaped indentation deep with anterior margin not raised in *S. petersii*, Fig. 2);

- anterior eyes situated medially in the ratio of 1:3 (1:2.6 in *S. petersii*, Fig. 2);
- mesosomal tergites coarsely granular throughout with large depressed granules concentrated on the lateral and posterior region of each segment. Percent granulation on mesosomal segment IV: 70%, V: 87% and VII: 92% (granulation sparse and restricted to the posterior

portion. Percent granulation on mesosomal segment IV: 50%, V: 55% and VII: 45% in *S. petersii*, Fig. 2);

- telson moderately bulbous, vesicle with 51% granulation 2.5 times that of the aculeus (telson bulbous, vesicle with 25% granulation 3 times that of the aculeus in *S. petersii*, Fig. 2).

Variation: Paratypes resemble the holotype in all aspects except for the females, which do not have a flexed manus.

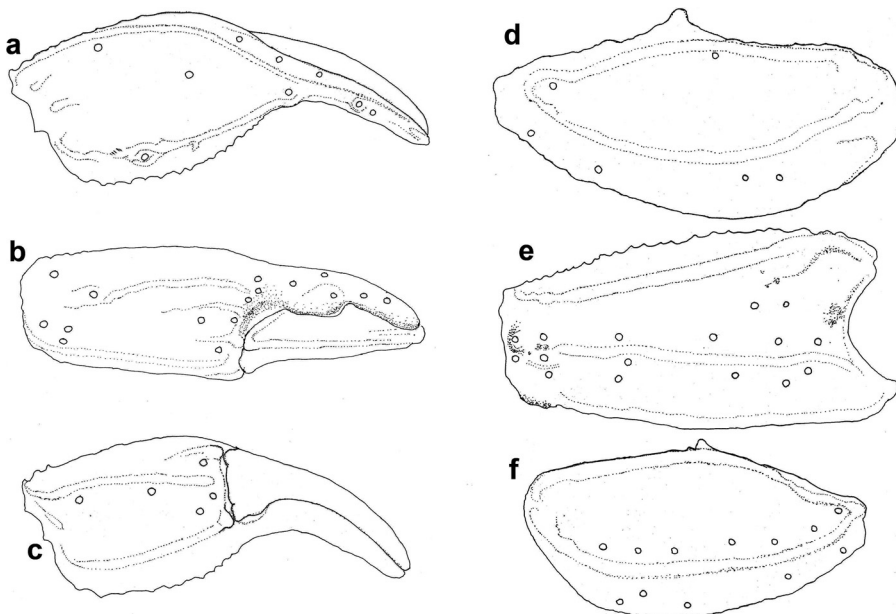


Fig. 4. *Scorpiops spitiensis* sp. nov. holotype male Bombay Natural History Society Sc-67 showing trichobothrial pattern on manus (a) dorsal view, (b) external view, (c) ventral view, patella (d) dorsal view, (e) external view, (f) ventral view.

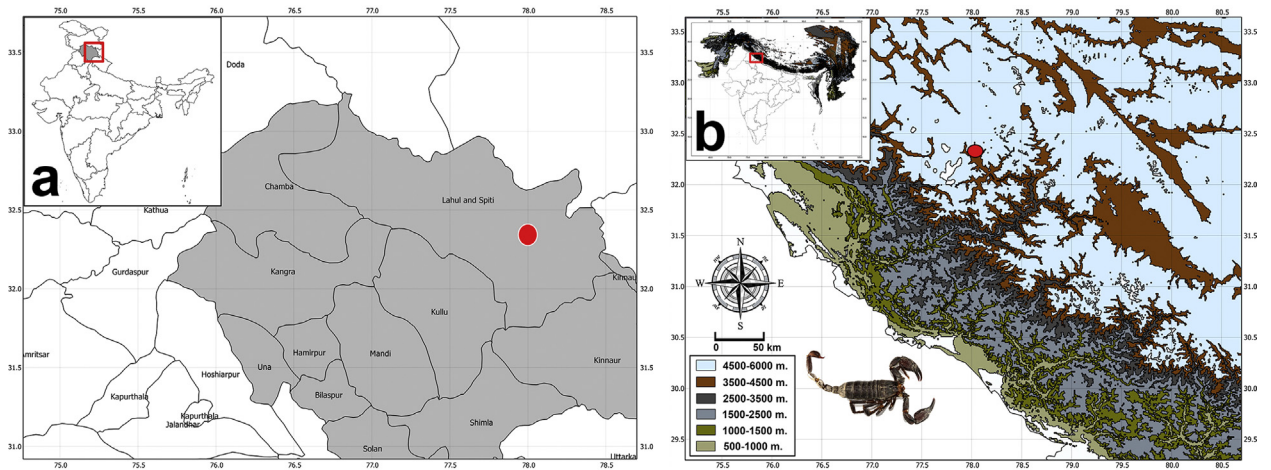


Fig. 5. (Colour online.) Map showing the type locality of *Scorpiops spitiensis* sp. nov. (a) type locality indicated by a solid red circle in the Indian state of Himachal Pradesh in a political map, (b) type locality highlighted by a solid red circle in a map showing elevational gradient in the Himalayas. The inset map shows the location of Himachal Pradesh in India in a shade of grey and in a red box.

Table 1
Morphometric details of the type series of *Scorpiops spitiensis* sp. nov.

Characters	BNHS Sc-67 Holotype	BNHS Sc-68 Paratype	BNHS Sc-69 Paratype	BNHS Sc-70 Paratype	<i>Scorpiops petersii</i> Lectotype
Total length	39.51	33.13	31.08	26.56	69.3
Carapace length	6.91	5.59	5.55	4.67	8.8
Carapace anterior width	3.99	4.11	3.2	2.62	NA
Carapace posterior width	6.56	5.68	5.75	4.38	8
Mesosomal length	15.24	10.52	9.68	10.63	NA
Metasoma total length	17.36	17.02	15.9	11.26	34.7
Metasomal seg I length	1.84	2.26	2.16	1.35	3.5
Metasomal seg I width	2.81	2.54	1.91	1.72	3.5
Metasomal seg II length	2.58	3.34	2.8	1.89	4.1
Metasomal seg II width	2.41	2.36	1.33	1.35	3
Metasomal seg III length	3.38	2.87	2.56	2.06	4.4
Metasomal seg III width	2.3	2.15	1.71	1.37	2.8
Metasomal seg IV length	3.7	3.25	3.33	2.47	5
Metasomal seg IV width	2.28	2.04	1.75	1.4	2.6
Metasomal seg V length	5.86	5.3	5.05	3.49	8.2
Metasomal seg V width	2.13	1.9	1.57	1.36	2.3
Telson length	6.29	4.74	4.12	3.81	8.7
Femur length	4.65	4.54	4.06	3.29	7.2
Femur width	2.13	1.96	1.82	1.31	3.3
Patella length	5.47	4.34	4.07	3.36	7.2
Patella width	2.27	1.84	1.8	1.49	3.4
Chela length	10.94	9.02	8.45	7.36	15.1
Chela width	4.34	3.09	2.92	2.1	5.8
Movable finger length	6.06	5.12	4.42	4.04	7.5
Pectines L/R	5/5	6/6	6/6	5/5	5/5

BNHS: Bombay Natural History Society; L: left; R: right.

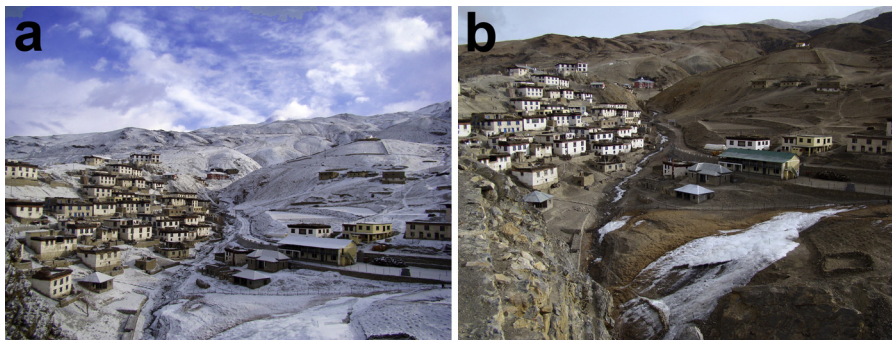


Fig. 6. (Colour online.) Images depicting the type locality of *Scorpiops spitiensis* sp. nov. in two different seasons (a) winter, (b) summer. Types were collected from under such houses while digging to renovate the houses. Photo by Kulbhushansingh Suryawanshi.

4. Discussion

The occurrence of the new species at 4200 m represents the highest-elevation record of any scorpion in India and the second highest to the best of our knowledge in the whole of Asia. The highest record for a scorpion species reported from Asia is ~ 4600 m by *Tibetiomachus himalayensis* Lourenço and Qi 2006 [10], followed by *Scorpiops rohtangensis* Mani 1959 [3], the holotype of which is missing from the collection of the Zoological Survey of India, Kolkata. Few other species are known to inhabit elevations higher than *S. spitiensis* sp. nov. with the exception of *Orobothriurus crassimanus* Maury, 1975 from the Andes, which have been reported from altitudes of up to 5500 m [11].

S. spitiensis sp. nov. shows close affinities to *S. petersii*, which is likely a species complex comprised of multiple cryptic species. *S. spitiensis* is possibly one of the cryptic species of this complex, has only 16 trichobothria on the external surface of the patella – one of strongest diagnostic character that separates it from *S. petersii*. The members of the genus *Scorpiops* show large variation in the number of trichobothria (17–21) on the external aspect of the patella. The presence of only 16 trichobothria in the new species sets it apart from all known *Scorpiops* species, with it being the only species exhibiting this unique character. Whether this character alone warrants the erection of a new genus to accommodate the new species as yet remains unclear. Though similar differences have been used in the past to separate Euscorpidae genera, we prefer to be conservative in our approach, acknowledging a potential need to do so if more species exhibiting the unique character are revealed in the future.

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