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Taxonomy/Taxinomie

A new iridescent tarantula of the genus *Thrigmopoeus* Pocock, 1899 from Western Ghats, India

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Abbreviations :
ALE, anterior lateral eyes
AME, anterior median eyes
NHM, Natural History Museum, London
BNHS, Bombay Natural History Society, Mumbai
CES, Center for Ecological Sciences
d, dorsal
fe, femur
mt, metatarsus
MOQ, median ocular quadrate
p, prolateral
pa, patella
PLE, posterior lateral eyes
PLS, posterior lateral spinnerets
PME, posterior median eyes
PMS, posterior median spinnerets
r, retrolateral
RS, Rajesh Sanap
ta, tarsus
ti, tibia
v, ventral
ZM, Zeeshan Mirza
ZSI, Zoological Survey of India

ABSTRACT

A distinctive new species of ground burrowing tarantula from Western Ghats endemic genus *Thrigmopoeus* is described from Kerala State, India. *Thrigmopoeus psychedelicus* sp. nov. differs from putative species of the genus in the adults being black overall with a metallic blue lustre on the carapace and abdomen. Females of *Thrigmopoeus psychedelicus* sp. nov. exhibit polychromatism. Juveniles and sub-adults are paler with vibrant maroon colouration on its abdomen whereas adult females are much darker and lack vibrant colouration as sub-adults.

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1. Introduction

Theraphosidae Thorell, 1870 is one of the most species rich family of Mygalomorphae spiders, with nearly 60 species in thirteen genera reported from India [1,2]. Of the six subfamilies of tarantulas reported from India [1], Thrigmopoeinae is the only subfamily of tarantulas endemic to the Western Ghats, represented by three genera and seven species [2]. All members of this subfamily have received little attention except for a generic revision by Raven [3] and redescription of two species [4,5]. The distribution of these three genera as presently known is as follows: *Phlogiodes* Pocock, 1899 from Northern Western Ghats of Maharashtra [4], *Thrigmopoeus* Pocock, 1899 from Centre Western Ghats and *Haploclastus* Simon, 1892 from Southern Western Ghats and Nilgiri hills [2,5].

Western Ghats is a known biodiversity hotspot and supports a great diversity of theraphosid spiders. However, these largely remain poorly documented, which is evident from recent description of two new genera and eight new species [1,6]. In the course of an arachnological expedition to the Western Ghats, specimens with vibrant colours and iridescent sheen on the carapace and abdomen were collected. These tarantulas were collected from burrows along the road with a clear tubular extension made up of soil and leaves as seen in members of the genus *Thrigmopoeus* [5]. However, known members of the genus Thrigmopoeus are in a shade of brown lacking vibrant colours or iridescent sheen on its dorsum. The collected specimens on the other hand show vibrant colours highlighting the distinctness of the collected specimens, which warrants their description as a new species.

2. Materials and methods

Specimens were collected during the surveys conducted in Kerala in December 2013 and additional material was found in the collection of Centre for Ecological Sciences, Bangalore. Specimens have been stored in 70% ethanol and the type series is housed in the collection of the Bombay Natural History Society (BNHS), Mumbai, Maharashtra and non-type material are housed in the collection of Centre for Ecological Sciences (CES) at the Indian Institute of Science, Bangalore. Comparative material for the study was examined from the collection of the Natural History Museum (NHM), London. Measurements of body parts were taken with a Mitutoyo™ Dial Calliper. Measurements of the chelicerae were taken of the lateral aspect after dissection. All measurements are in millimetres and total length excludes chelicerae. Spermathecae were dissected and cleaned in clove oil using needles. Specimens were examined using a Leica MZ12S stereobinocular microscope. Photographs of the specimens were taken with a Canon 70D mounted with a Canon Mp-E 65 mm illuminated with two external Canon 430EX-II flashes. Descriptive style follows Mirza et al. [1].

List of comparative material examined:

Annandaliella travancorica (Hirst, 1909) holotype female (NHM 16.5.2.13) Travancore, Kerala, India

Chilobrachyus furmosus (Pocock 1895) holotype female (NHM 09.10.7.17), North India

Haploclastus kayi (Gravely, 1915) female holotype from ZSI and topotypic material CES 131004, CES 131005, CES 131006

Haploclastus nilgirinus (Pocock, 1899) NHM 94.8.21.9, female holotype

Haploclastus tenebrosus (Gravely, 1935) Diagrams of male holotype from ZSI (specimen missing)

Heterophrictus milleti (Pocock 1900) female, Nashik District, Maharashtra, India

Plesiophrictuss blatteri (Gravely 1935) female (NHM 16.5.2.15) Satara district, Maharashtra, India

Phlogiodes robustus (Pocock, 1899) female holotype NHM, registration number not available

Phlogiodes validus (Pocock, 1899) 1 male, Matheran, Raighad District, Maharashtra WILD-10- ARA-1102; 1 female, Matheran, Raighad District, Maharashtra WILD-10-ARA-1103; 1 male, Aarey Milk Colony, Mumbai, Maharashtra WILD-10-ARA-543; 1 female, Aarey Milk Colony, Mumbai, Maharashtra, WILD-10-ARA-544.

Plesiophrictus millardi (Pocock 1900) male (NHM 99.11 2.234) Matheran, Raighad District, Maharashtra, India; topotype male BNHS SP-62, Matheran, Raighad District, Maharashtra, India; BNHS SP-64 female, Aarey Milk Colony, Mumbai, Maharashtra, India.

Plesiophrictus sataraensis Gravely 1915, holotype male (NHM 22.05.17), Medha, Yenna Valley, Satara District, Maharashtra, India

Poeciloteria formosa (Pocock 1899) female holotype (NHM 98.10.31.1), Salem, Tamil Nadu.

Thrigmopoeus insignis (Pocock, 1899) NHM 1899.7.10.13, female holotype

Thrigmopoeus truculentus (Pocock, 1899) NHM 98.12.92, female holotype

Plesiophrictus raja (Gravely 1915) female type (NHM 16.5.2.17), Kavalai, Cochin state, Kerala.

3. Taxonomy treatment

Family: THERAPHOSIDAE Thorell, 1870
Genus: ***Thrigmopoeus*** Pocock, 1899
Thrigmopoeus psychedelicus sp. nov.
Figs. 1–6, Table 1

Fig. 1. (Colour online.) *Thrigmopoeus psychedelicus* sp. nov. holotype female BNHS SP115 in life. Photo by Rajesh Sanap.

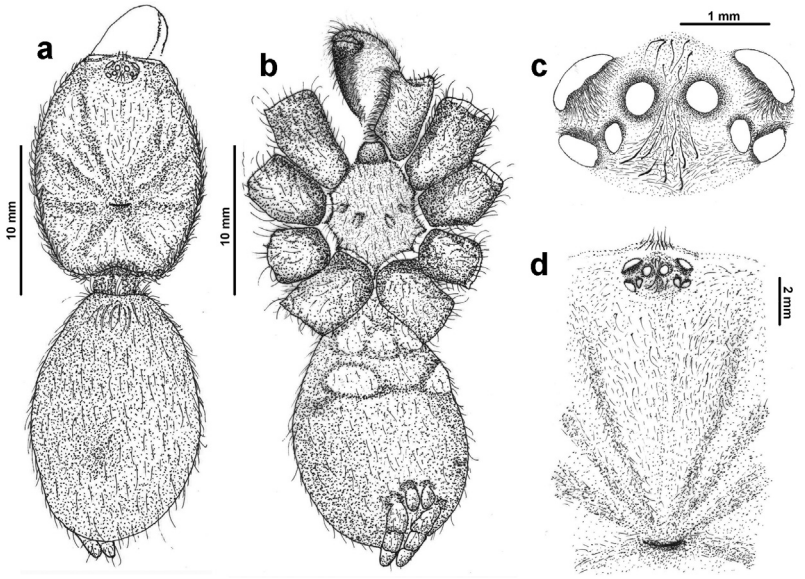

Fig. 2. *Thrigmopoeus psychedelicus* sp. nov. (a) dorsal view, (b) ventral view, (c) eyes, (d) caput.

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Holotype: female BNHS SP115, Ambanad Tea Estate, near Thenmala, Kollam district, Kerala state, India (9.038439°, 77.089325°, elevation 561 m), collected by Rajesh Sanap, Zeeshan Mirza & Karthik Prabhu on 22 December 2013.

Paratype: 1 female BNHS SP116, same data as holotype.

Other material: 1 female CES 10/2028, Sabarimala, Pathanamthitta district, Kerala state, India (9.433844°, 77.080063°, elevation 475 m). Collected by N.P.K. Das on 6 April 2010; 4 juveniles CES 131018, CES 131019, CES 131020 & BNHS SP117 and 1 adult female CES 131042, same data as holotype.

Etymology: The specific epithet '*psychedelicus*' refers to the vibrant metallic sheen and multiple colours of adults and juveniles of the new species.

3.1. Diagnosis

Adult in a shade of dark brown to black with blue lustre on carapace and abdomen (Fig. 1 & 4). Thoracic fovea smaller than ocular width (Fig. 1d). Maxillary stridulatory setae scattered on the prolateral face and not present in a defined "C" shaped band (Fig. 3c). Spermathecae in shape of two small mounds.

Comparison: *Thrigmopoeus psychedelicus* sp. nov. differs from putative species of the genus in bearing maxillary

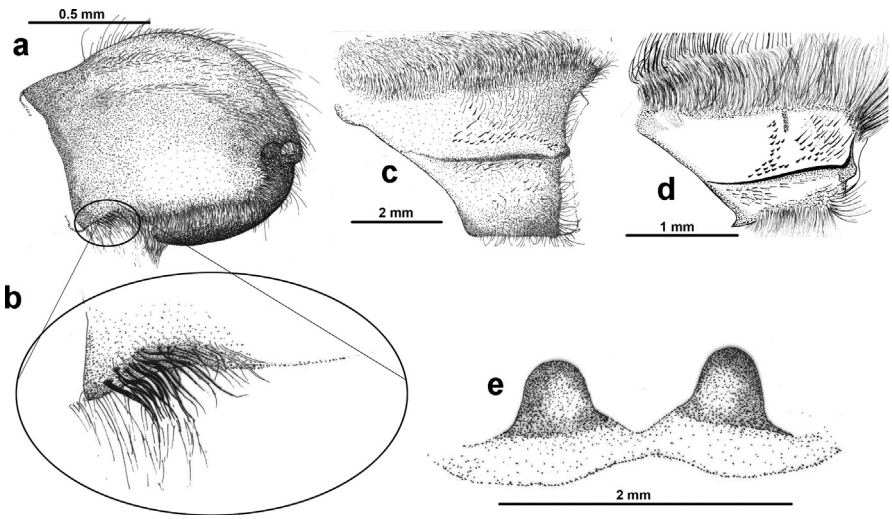

Fig. 3. *Thrigmopoeus psychedelicus* sp. nov. (a) chelicerae retrolateral view, (b) detailed view of cheliceral lyra (setae excluded to highlight character), (c) prolateral face of maxilla of *T. psychedelicus* sp. nov., (d) prolateral face of maxilla of *T. insignis*, (e) spermathecae.

Fig. 4. (Colour online.) *Thrigmopoeus psychedelicus* sp. nov. female paratype BNHS SP116 in life. Photo by Rajesh Sanap.

stridulatory setae being scattered on the prolateral face (Fig. 3c) as opposed to being aligned in a "C" shaped manner as seen in *T. insignis* Pocock 1899 and *T. truculentus* Pocock 1899 (Fig. 3d). Furthermore the new species differs from *T. insignis* and *T. truculentus* in the adult colouration being dark black to brown with a blue metallic sheen on its carapace and abdomen (Fig. 1 & 4) vs. overall dark or light brown colouration in *T. insignis* and *T. truculentus* (Fig. 7a & b).

3.2. Description of holotype female BNHS SP115 (Fig. 1)

carapace 18.26 long, 14.18 wide, chelicerae 9.79 long. Sternum 7.22 long, 6.63 wide. Abdomen 19.38 long, 14.15 wide. Spinnerets: PMS, 1.64 long, 0.99 wide, 0.65 apart; PLS, 1.96 basal, 1.56 middle, 2.19 distal; midwidths 1.59, 1.42, 1.14 respectively. Leg and palp morphometry given in Table 1.

Colouration (Fig. 1)**:** overall in a shade of black to dark brown, with extremities of leg with a tinge of light brown. Carapace greyish, abdomen dark brownish to black, each with blue lustre overall. Colouration in preservative is more faded and is in a shade of brown to reddish brown. The metallic blue lustre is reduced.

Fig. 5. (Colour online.) *Thrigmopoeus psychedelicus* sp. nov. juvenile at the burrow entrance (uncollected individual). Photo by Rajesh Sanap.

Fig. 6. (Colour online.) Image depicting the mosaic landscape at the type locality. Photo by Rutuja Dhamale.

Carapace (Fig. 2a, d)**:** covered with short silvery grey hair, dense on caput and carapace edges. Fovea procurved, slightly shorter than ocular width. Vestigial thick black bands radiating from the fovea running along the interstitial ridges. A few long bristles present on the ocular tubercle. A band of spinules present posterior to the fovea scattered in a fairly longitudinal manner.

Eyes (Fig. 2c)**:** ratio of group width to length 1.4. PLE smaller than ALE but perceptibly bigger than PME, ALE clearly larger than the rest. Eye diameter: ALE, 0.58; AME, 0.38; PLE, 0.24; PME, 0.22. Distance between the eyes: AME-AME, 0.26; PME-PLE, 0.08; AME-ALE, 0.29; PME-PME, 1.09. Ocular quadrate, 1.26 long, 2.91 wide. MOQ: length, 0.73; front width, 1.10; back width, 2.91.

Maxilla: posterior ventral edge gently rounded and long; retrolateral face yellowish-red, smooth, glabrous. Cuspules: over 130 in anterior corner in roughly triangular region. Posterior edge almost straight, concave near heel.

Maxillary lyra (Fig. 3c)**:** thick spike setae in 2–3 rows present above the maxillary suture aligned along the suture; bellow the suture with thick long spike setae scattered in distal half of the prolateral face, not in a defined 'C' pattern.

Labium: nearly 120 cuspules in band for one-fourths of anterior length; cuspules ca. similar in size to maxillary. Basal groove shallow, distinct with two distinct mounds.

Chelicera: inter-cheliceral peg setae absent. Basal oral fringe of chelicerae with a clustre of thick long curved setae in 4–5 curved (parallel) lines (Fig. 3a & b). Promarginal teeth 15, many small granules at basal cheliceral groove (Fig. 3a).

Sternum (Fig. 2b)**:** longer than wide, high in centre, slopping gradually, covered with a mat of short brown and long, black setae. Posterior edge pointed but not separating coxae IV. Pedicel not clearly seen.

Sigilla: 3 pairs, posterior 1.30 diameter, ca. 1.70 lengths apart; ca.1.40 dist. from margin; middle 0.80 diameter, ca. 4.34 lengths apart; ca.0.50dist.from the margin; anterior very small, marginal.

Table 1
Leg morphometry of *Thrigmopoeus psychedelica* sp. nov. holotype BNHS SP115 and paratype BNHS SP116. All measurements in mm.

	Leg I		Leg II		Leg III		Leg IV		Palp	
	BNHS SP115	BNHS SP116	BNHS SP115	BNHS SP116	BNHS SP115	BNHS SP116	BNHS SP115	BNHS SP116	BNHS SP115	BNHS SP116
Femur	12.88	8.87	11.91	6.30	10.07	6.25	13.12	7.85	10	5.26
Pattela	7.65	5.39	6.18	3.46	5.60	3.40	6.60	3.59	5.99	2.40
Tibia	9.70	4.59	8.11	4.11	5.62	3.30	9.18	7.11	6.26	3.33
Metatarsi	6.86	4.09	5.49	3.45	5.05	3.45	9.56	6.63	–	–
Tarsi	5.44	3.90	4.86	3.30	4.49	3.64	4.86	4.04	7.46	3.60
Total	42.53	26.84	36.55	20.62	30.83	20.04	42.32	29.22	29.71	14.59
Mid-widths										
Femur	3.64	2.20	3.44	2.07	3.56	2.07	3.20	1.70	2.32	1.51
Tibia	3.15	1.99	2.87	1.53	2.96	1.53	2.56	1.80	3.20	1.50

Leg: formula 1423. Coxae-Prolateral face of coxa with thin, long horizontally aligned setae above the coxal suture, bellow suture with numerous short, thick spike setae scattered in the distal half of the coxa. Retrolateral face with thick, long bristles in anterior distal region. Spines-spines present on metatarsi of leg III & IV. Leg III mt, p 1, r 1, v 3, d 1; leg IV mt, p 1, r 1, v 3, d 1.

Scopulae: entire, dense on tarsi I-III; tarsi II entire, long hair in the centre but not divided; on tarsi II entire divided at base with few long hairs; tarsi IV divided by a band of 3–4 spike setae for its entire length. Scopula well developed on ventrolateral tarsus I-II. Absent on prolateral tibia. Metatarsi I-II entire; metatarsi III for ⅔ length, not divided; on metatarsi IV for ¼ of length, divided by 3–4 rows of setae

Tricobothria: tarsi I, 35 clavate and 15–16 long and short filiform in basal half in two rows; tarsi II, 30 clavate and 17–18 long and short filiform in distal half in two rows; tarsi III, 25 clavate and 12–13 long and short filiform in distal half in two rows; tarsi IV, 16 clavate and 7–8 long and short filiform in distal half in two rows; palp tarsi with 5–6 clavate and 10–11 long and short filiform.

Claws: inferior tarsal claw present only on tarsi IV. Superior tarsal claws on all legs without dentition; single bare claw on palp.

Abdomen pilosity (Fig. 2a, b)**:** cuticle not exposed dorsally and ventrally; dorsally covered with fine layer of brown long hair and bristles, many pallid; ventrally black with fine layer of many long black hair bristles.

Spinnerets: 2 pairs, blackish brown, covered with black hair.

Spermethecae (Fig. 3f)**:** Hillock shaped pair of lobes, broader at base and gradually narrowing towards apex.

3.3. Details of paratype female BNHS SP 116 (Fig. 4)

Carapace 11.57 long, 9.30 wide, chelicerae 6.39 long after dissection. Abdomen 16.40 long, 11.39 wide. Spinnerets: PMS, 1.10 long, 0.70 wide, 0.51 apart; PLS, 2.00 basal, 1.22 middle, 1.66 distal; midwidths 1.05, 0.94, 0.74 respectively; apart 0.99. Eyes: Ratio of group width to length 1.4. PLE smaller than ALE but perceptibly larger than PME, ALE clearly larger than the rest. Eye diameter: ALE, 0.45; AME, 0.42; PLE, 0.25; PME, 0.15. Distance between the eyes: AME-AME, 0.17; PME-PLE, 0.07; AME-ALE, 0.15; PME-PME, 0.90. Ocular quadrate, 0.98 long, 2.14 wide. Maxilla: front length 4.09, back length 1.97, mid-width 2.89; Labium: Long 1.21, width 1.37; Chelicera: 12 promarginal teeth and 32–33 basomesal teeth; Sternum: long 5.28, wide 5.19; Sigilla: 3 pairs, posterior 0.73 diameter, ca. 1.07 lengths apart; ca.0.97 dist. from margin; middle 0.20 diameter, ca. 3.24 lengths apart; ca. 0.10 dist. from the margin; anterior very small, marginal.

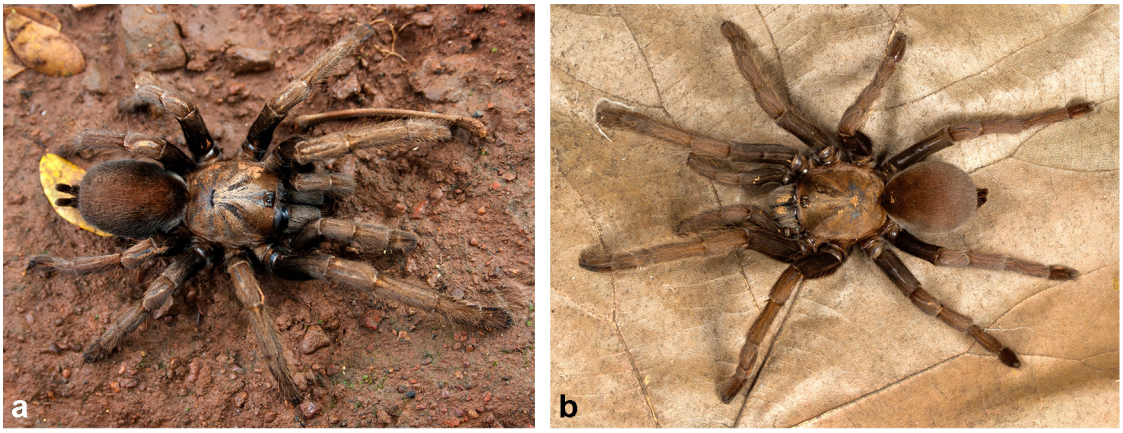

Fig. 7. (Colour online.) Image depicting life coloration of *Thrigmopoeus insignis* (a), *Thrigmopoeus truculentus* (b). Photo by Zeeshan Mirza.

Colouration in life (Fig. 4)**:** Carapace and femur of all legs in a shade of black with a deep blue metallic sheen. Abdomen in a shade of pale metallic pink with a silvery lustre to it throughout. Anterior legs with dense mat of light brown to pale setae on their metatarsi and tarsi; patella and tibia of leg I whitish and that of leg II-III browner. Leg IV tibia and patella with a light mat of brown setae on its dorsum, lateral portion blackish with blue sheen throughout.

Distribution and natural history: the new species lives in burrows ca. 0.609 meters deep with a tubular extension made up of soil and leaves. Horizontal burrows of juveniles were mostly seen along roadside mud embankments (Fig. 5), whereas adults were found mostly in deep and vertical burrows. The female holotype was found in a burrow along a road. The female occupied a cavity in a rock crevice. The female paratype BNHS SP116 was dug out from its burrows along a road. Based on reports from locals residents, researchers and our own observation, *T. psychedelicus* sp. nov. appears to be distributed in West Coast Tropical Evergreen Forest in the vicinity of the type locality (Fig. 8) [7]. Dominant floral elements in the immediate vicinity include *Dipterocarpus bourdillonii, Kingiodendron pinnatum, Polyalthhia* sp. and *Vitex altissima* among tea and rubber plantations (Fig. 6). The habitat at the type locality is contiguous with Shendurney Wildlife Sanctuary and the new species likely occurs throughout this landscape. The specimen CES 10/1028 was collected from Sabarimala which lies ca. 40 km north of the type locality (Fig. 7) and is situated in Periyar Tiger Reserve. Based on the present available data, the new species likely inhibits low elevation evergreen forest, rubber as well as Tea plantations.

4. Discussion and conclusion

Theraphosid taxonomy in India has received little attention from Indian researchers in the past. However, there have been some notable additions in the recent past [1,6,8]. *Thrigmopoeus psychedelicus* sp. nov. is yet another contribution towards documentation of theraphosid spiders of India. The new species is the second known species of tarantula from India, with a metallic lustre; in addition to this, the species exhibits polychromatism in the same sex with respect to age class. The juveniles and sub-adults have a dark brown to black carapace, a femur of all appendages; an abdomen in a shade of metallic pink with the brown legs in colour, whereas the large females are entirely dark blackish brown. Both these forms exhibit a blue sheen on the carapace, abdomen and femur of all legs. Males of the species were not found during our survey and more dedicated efforts in different seasons will perhaps yield males of the species. The new species is perhaps one of the most distinctly coloured species of tarantula from India and hence will be sought after by pet trades, which will severely affect the wild population. The new species is presently known only from a few localities in the vicinity of the type locality and is likely that it is narrowly distributed in the Southern Western Ghats (south of Palghat gap). Rampant habitat destruction and collection by pet traders for illegal trade has had severe effect on local populations of some large Indian tarantulas (Mirza personal observation). Inclusion of tarantulas in the Indian wildlife schedule under the Wildlife Protection Act 1972 will ensure protection to the new species and others of the family Theraphosidae.

The Western Ghats run parallel to the western coast of India to about 1600 km in length and to about 30 km wide

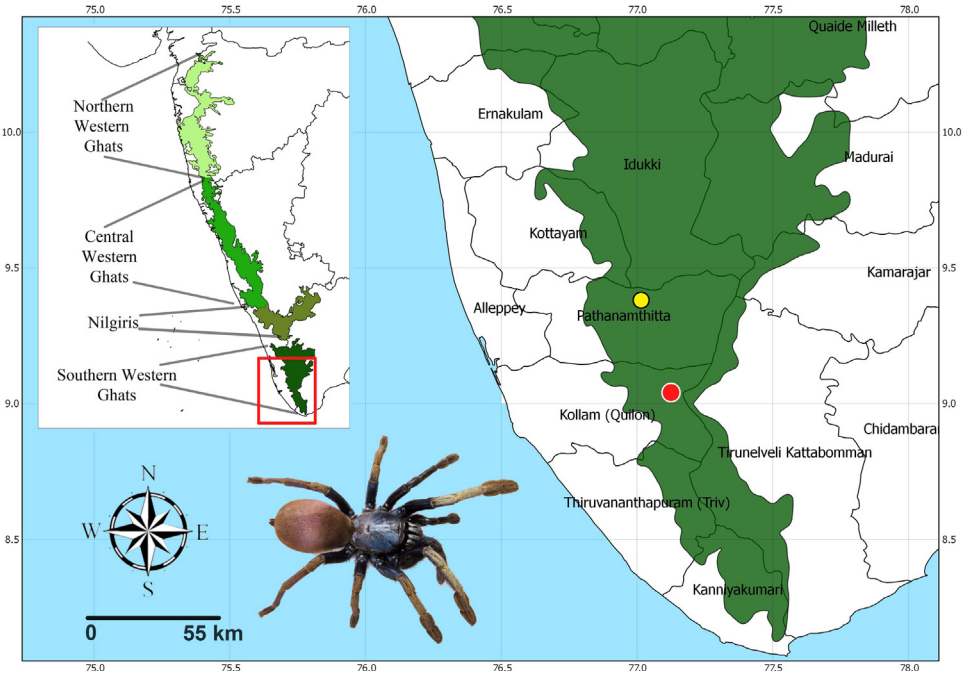

Fig. 8. (Colour online.) Map showing type locality 'Amdanad Tea Estate' highlighted by a red solid circle and Sabrimala by a yellow solid circle.

with three prominent geographical breaks in the chain of hills namely: Goa gap, Palghat Gap and Shencottah Gap [9]. These gaps have been shown to have tremendous effect on biodiversity as these gaps act as barriers for gene flow in many taxa [9]. The Palghat gap is the widest break in the chain of hills that isolates the southern part of the Western Ghats from the rest of the ghats. Due to the Palghat gap, many taxa are believed to be restricted to the southern Western Ghats, which perhaps resulted in the southern Western Ghats supporting a higher degree of endemic species as opposed to central and northern Western Ghats [9,10]. Despite this, the diversity of tarantulas and other mygalomorph spiders in this region remains poorly documented. Description of *T. psychedelicus* sp. nov., a distinct and unique species, highlights the need for dedicated surveys of the mygalomorph spider diversity of the Western Ghats.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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