

The crab spider genus *Tarrocanus* Simon, 1895 with notes on the genera *Alcimochthes* Simon, 1895 and *Domatha* Simon, 1895 (Araneae:Thomisidae)

ILESHA S. ILEPERUMA ARACHCHI¹ & SURESH P. BENJAMIN^{1,2,3}

¹National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka.

E-mail: sandunikaileperuma@gmail.com; suresh.benjamin@gmail.com

²Zoological Research Museum Alexander Koenig, Adenauerallee 160, 53113 Bonn, Germany

³Corresponding author

Abstract

The crab spider genus *Tarrocanus* Simon, 1895 currently includes two species: *T. capra* Simon, 1895 and *T. viridis* Dyal, 1935. Recent field work revealed the presence of a new species, providing an opportunity to review the genus. The new species is described as *T. jaffnaensis* **sp. nov.** Furthermore, the male of *T. capra* is described for the first time, and taxonomic notes on *Alcimochthes* Simon, 1885 and *Domatha* Simon, 1895 are given, both presumably being close relatives of *Tarrocanus*. *Tarrocanus viridis* Dyal, 1935 is considered as *nomen dubium*.

Key words: Thomisinae, endemic species, Oriental region, India

Introduction

The crab spider genus *Tarrocanus* was established by E. Simon (1895) based on a female collected in Sri Lanka. Simon considered the genus related to *Alcimochthes* Simon, 1885, *Domatha* Simon, 1895 and *Peritarsus* Simon, 1895 and included them in the taxon Alcimochthae within the subfamily Misumeninae (currently Thomisinae). Probably he grouped these genera mainly based on similarities in eye morphology and arrangement. However, a recent molecular phylogenetic study on this group has shown that *Peritarsus* is a clade within *Tmarus* (Ileperuma Arachchi & Benjamin, in press) leaving only *Alcimochthes*, *Domatha* and *Tarrocanus* in Alcimochthae. These three genera share a single character, the partly jointed, enlarged lateral eye tubercles. All three genera are found in forests of tropical Asia (World Spider Catalog 2019).

Tarrocanus currently includes two species: *T. capra* Simon, 1895 and *T. viridis* Dyal, 1935. Both species descriptions are based on females. According to Simon (1895), members of this genus are characterised by peculiar triangular shaped tooth-like projections on posterior lateral eye tubercles. The Sri Lankan endemic *T. capra* was recently rediscovered in forest patches of the Ethagala mountains and Bowatenna Forest Reserve in Northwestern and Central Provinces of the island. Additionally, a new species of the genus was discovered from dry shrub forest of Mundathivu in the Jaffna peninsula. This new species *T. jaffnaensis* **sp. nov.** lacks the prominent characteristic tooth-like projections of *T. capra*, rendering it morphologically similar to species of *Alcimochthes*. Here, we describe both *Tarrocanus* species based on newly collected specimens and provide an updated diagnosis for the genus. In addition, we illustrate *Alcimochthes limbatus* Simon, 1885 and *Domatha vivida* Simon, 1895 based on type specimens. The former species is well known due to several publications (Ono 1988, 2009; Zhang *et al.* 2000; Tang & Li 2010; Yin *et al.* 2012) while the latter is known only from its original description (Simon, 1895).

Materials and methods

Spiders were collected by beating vegetation and hand collecting. The collected specimens were preserved in either 70% or 100% ethanol. Specimen preserved in 70% alcohol were examined using an Olympus SZX7 stereomicro-

scope. Male palps (left) were dissected and immersed in Methyl salicylate, slide mounted, observed and illustrated with the aid of an Olympus BX51 compound microscope attached with a drawing tube. Highly sclerotized or darker areas of palps and epigynum were shaded with a HB pencil. The female epigastric region was dissected and digested in a pancreatin solution (Álvarez-Padilla & Hormiga 2007) for about 3–7 days, slide mounted and illustrated using a microscope with a drawing tube. Digital images of the specimens were taken with a Leica MC170 HD camera mounted on a Leica M205C stereomicroscope using the software package Leica Application Suite, LAS version 4.6.2 (Leica Microsystems Limited, Germany). Acquired image stacks of different depths (15 to 50 images per stack) were assembled using Helicon Focus (version 6, Helicon soft Ltd.) to create a single image with the entire specimen in focus. Species descriptions were done according to Benjamin (2011). All measurements are in millimetres. Body length was measured as carapace length plus abdomen length (excluding spinnerets). All types and voucher specimens are deposited in NMSL. Non-type specimens are deposited in NIFS.

Abbreviations

Institutional abbreviations: NIFS—National Institute of Fundamental Studies, Kandy, Sri Lanka; NMSL—National Museum of Sri Lanka, Colombo; IZCAS—Institute of Zoology, Chinese Academy of Sciences, Beijing.

Character abbreviations: ALE—anterior lateral eyes; AME—anterior median eyes; E—embolus; LE—lateral eyes; MOA—median ocular area; PLE—posterior lateral eyes; PME—posterior median eyes; RTA—retro lateral tibial apophysis, RTS—retrolateral tibial spine; TR—tegular ridge; VTA—ventral tibial apophysis.

Taxonomy

Family Thomisidae Sundevall

Genus *Tarrocanus* Simon, 1895

Type species: *Tarrocanus capra* Simon, 1895: 979: fig. 1047.

Diagnosis. Species of *Tarrocanus* can be readily distinguished from other thomisid genera by the following characteristics: vertical and broad clypeus, elevated ocular area with slightly curved anterior row, enlarged prominent lateral eye tubercles (arrows in Figs 1, 2, 4, 5), tubercles of PLE larger than that of the other eyes and are either modified with prominent triangular shaped tooth-like projections (in *T. capra*) or without such modifications (*T. jaffnaensis* **sp. nov.**) and horseshoe shaped marking on the centre of prosoma starting from the base of PLE tubercles. *Tarrocanus* can be separated from *Alcimochthes* and *Domatha* by the strongly recurved anterior margin and posteriorly broader opisthosoma.

Description. Small spiders, body size 2.5–3.0. Prosoma brown, laterals dark brown, clypeus, ocular area, middle of prosoma light brown with whitish hue, widest at the centre, horseshoe-shaped markings on the centre, outlined by whitish yellow lines (Figs 1, 2), covered with sparsely distributed long setae and sub-erect weak setae. Opisthosoma lighter than prosoma, covered with numerous spots and patches of reddish brown, dark brown and greyish white, anterior half strongly recurved, bell-shaped, covered with sparsely distributed short setae. Eyes with enlarged, yellowish brown, partly jointed tubercles, both eye rows recurved. Eye formula: ALE>PLE>PME>AME, triangular shaped tooth-like projection on PLE (prominent only in *T. capra*). Clypeus vertical and broad, chelicerae yellowish brown, legs pale with sparsely distributed spines and setae. Palp: tegulum simple and round with no apophyses, VTA with long stem and hook-shaped, embolus either moderately long and slender or short, curved and stout. RTA rudimentary, ITA may or may not be present. Females are unknown.

Composition. Two species: *T. capra* and *T. jaffnaensis* **sp. nov.**

Distribution. Currently known only from Sri Lanka.

Remarks. Close relationship of *Tarrocanus* and *Alcimochthes* is confirmed by molecular data (Ileperuma Arachchi & Benjamin, in press). The extent of the relatedness of *Domatha* to *Tarrocanus* and *Alcimochthes* is yet unknown due to unavailability of molecular data for *Domatha*. A well represented sample, including species of the three genera (both sexes) is essential to evaluate their relationships and to corroborate their generic boundaries in morphological terms.

***Tarrocanus capra* Simon, 1895**

(Figs 1, 4, 6, 7, 10, 11)

Tarrocanus capra Simon, 1895: 979, fig. 1047. (♀ syntype from Sri Lanka, should be in MNHN; not found; species catalogue card not found).

Other material examined. SRI LANKA: North Western Province: 1♂, Kurunegala District, Ethagala FR, 07° 28' 17" N, 80° 22' 30" E, 190 m, hand collecting, 1–28 February 2007, leg. Z. Jaleel (IFS_Tho_233). **Central Province:** 1♂, Matale District, Bowatenna Forest Reserve, 07° 39' 37" N, 80° 41' 18" E, 252 m, beating vegetation, 10 February 2016, leg. S.P. Benjamin *et al.* (IFS_Tho_465).

Diagnosis. Males of *T. capra* can be unambiguously separated from *T. jaffnaensis* **sp. nov.** by the triangular shaped, tooth-like projections on the tubercles of PLEs (also present in females (Simon, 1985) and RTS present at the end of the rudimentary RTA (Figs 7, 11).

Description. Male: Total length 2.5; Prosoma length 1.2, width 1.3; Opisthosoma length 1.3, width 1.4. Overall body colour a mixture of dark and light brown. Prosoma, laterals dark brown, light in the middle, including ocular area and clypeus, steeply slanting towards lateral margin of prosoma. Clypeus vertical and broad. Opisthosoma covered with brown, dull red, and light yellow patches on a pale background and rounded anteriorly and broad and tapered posteriorly, sparsely covered with small setae. Eye tubercles yellowish brown, lateral tubercles enlarged, partly jointed with each other. PLE characteristic with prominent triangular shaped tooth-like projections. Eye measurements: AME 0.09; ALE 0.18; PME 0.11; PLE 0.18; AME-AME 0.19; AME-ALE 0.25; PME-PME 0.23; PME-PLE 0.39. MOA length 0.43, with front width 0.36 and back width 0.59. Legs pale yellow with dull red spots scattered throughout its length, covered with spines sparsely distributed proximally, densely arranged distally, setae on tarsi and meta tarsi. Leg measurements: I: 3.3 (1.1, 0.4, 0.7, 0.6, 0.4); II: 3.6 (1.2, 0.5, 0.8, 0.7, 0.4); III 2.3 (0.7, 0.3, 0.6, 0.4, 0.3); IV: 2.4 (0.9, 0.3, 0.6, 0.4, 0.2). Palp as in Figs 6, 7, 10, 11. VTA hook shaped with broad and short stem, RTA not prominent (rudimentary), broad and canoe shaped with a serrated margin dorsally, RTS at the retro lateral margin of the papal tibia next to the RTA. Tegulum oval, embolus long and filiform, running almost a circle around the tegulum.

Female: See Simon (1985); no additional material has been collected since.

Distribution and habitat. Known only from Sri Lanka.

Remarks. Our identification is based on Simon's (1895) description of the female syntype. Fortunately, he illustrates the characteristic triangular shaped or tooth-like projections on both tubercles of PLEs. This character is present in both males and females. Though we were unable to examine the type of *T. capra*, the description by Simon (1895) was clear enough for unambiguous identification of the species.

***Tarrocanus jaffnaensis* sp. nov.**

(Figs 2, 5, 8, 9, 12, 13)

Type material: Holotype: SRI LANKA: Northern Province: 1♂, Jaffna District, Mundaitivu, 09° 36' 26" N, 79° 59' 05" E, 3 m, beating vegetation, 20–22 September 2016, leg. S.P Benjamin *et al.* (IFS_Tho_581).

Other material examined: SRI LANKA: Uva Province: 1♂, Monaragala District, Katharagama Peak, 06° 23' 20" N, 81° 19' 52" E, 106 m, beating, 22–23 November 2017, S.P Benjamin *et al.* (IFS_Tho_660).

Etymology. The specific epithet refers to the type locality, Jaffna. Adjective.

Diagnosis. Males of *T. jaffnaensis* **sp. nov.** can be unambiguously separated from *T. capra* by the shape of embolus (prominent constriction, prominent bulge right after the constriction, ending with a hook shaped, upwardly curved tip).

Description. Male (holotype): Total length 2.7; Prosoma length 1.3, width 1.2; Opisthosoma length 1.4, width 1.1. Prosoma dark brown with brownish yellow irregular markings with sparsely distributed setae. Opisthosoma tapered posteriorly with curved anterior margin, mottled with grey, pale yellow, dark brown and maroon markings, covered with setae. Lateral eye tubercles large, continuous, coloured whitish grey mottled with brown and dull red patches. Eye measurements: AME 0.11; ALE 0.19; PME 0.11; PLE 0.16; AME-AME 0.22; AME-ALE 0.19; PME-PME 0.29; PME-PLE 0.43. MOA length 0.46, with front width 0.38 and back width 0.49. Legs pale yellowish white with scattered light reddish-brown markings. Leg measurements: I: 4.2 (1.2, 0.6, 1.0, 0.9, 0.5); II: 4.4 (1.3, 0.6, 1.1,

0.9, 0.5); III 3.0 (0.9, 0.5, 0.7, 0.6, 0.3); IV: 3.1 (1.0, 0.5, 0.7, 0.6, 0.3). Palp as in Figs (8, 9, 12, 13), VTA long stemmed with a blunt hook-shaped apex, RTA broad based, bifid proximally. Tegulum round, dark and sclerotized. Embolus long, running almost a circle around the tegulum, tip with a prominent constriction, prominent bulge right after the constriction, ending with a hook shaped, upwardly curved tip.

Female: Unknown.

Intraspecific variation. The specimen collected from Kataragama is brownish green while the one collected from Jaffna peninsula is reddish brown.

Distribution and habitat. Known only from Sri Lanka. This species occurs in dry shrublands close to the beach in Mundaitivu and in a low land forest patch in Kataragama.

Genus *Alcimochthes* Simon

Type species: Alcimochthes limbatus Simon, 1885: 448, pl. 10, fig 16.

Composition: *Alcimochthes limbatus* Simon, 1885, *A. melanophthalmus* Simon, 1903, *A. meridionalis* Tang & Li, 2009.

Diagnosis: Male *Alcimochthes* can be distinguished from *Tarrocanus* and *Domatha* by the enlarged continuous tubercles of lateral eyes (posterior lateral tubercles being the largest), the long and pointed RTA, VTA with a long stem. Females show a more or less sclerotized epigynal plate. For a detailed diagnosis see Tang & Li (2009) and Tang & Li (2010).

Alcimochthes limbatus Simon, 1885

(Figs 14, 15)

Alcimochthes limbatus Simon, 1885, 448, pl. 10, fig. 16 (♂, ♀)

Material examined. MALAYSIA: 2♂, 1♀ (MNHN 7856).

Remarks. The three specimens were fragile and not examined in detail.

Description. See Ono (1988, 2009) and Tang & Li (2010) for a detailed description. This species is well described in a number of publications since its first description.

Distribution. China, Vietnam, Singapore, Taiwan and Japan (World Spider Catalog 2019).

Genus *Domatha* Simon

Type species: Domatha vivida Simon, 1895: 979, fig. 1048 (♂, ♀).

Composition. *Domatha vivida* Simon, 1895, *Domatha celeris* Kulczyński, 1911

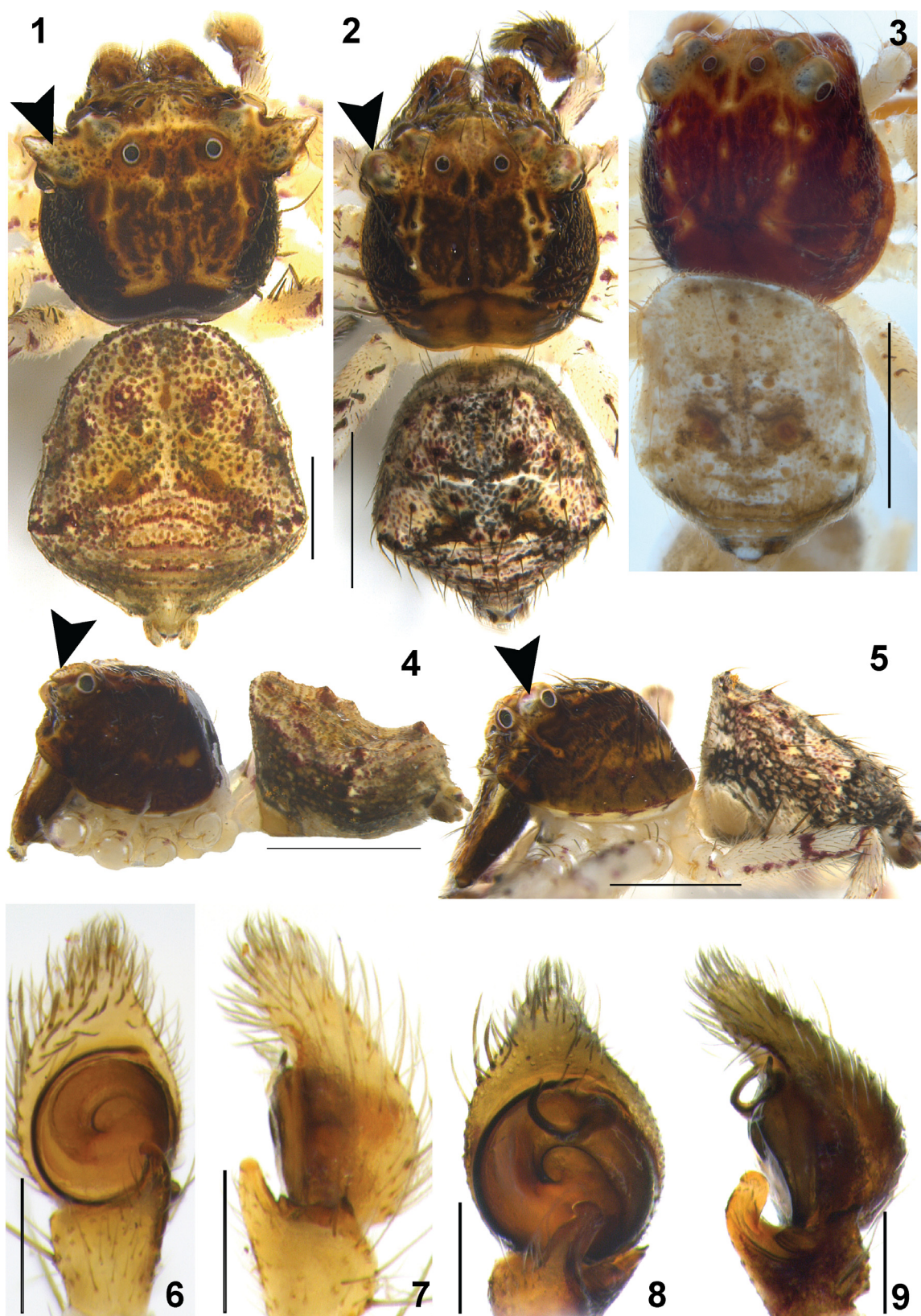
Domatha vivida Simon, 1895

(Figs 3, 16, 17)

Domatha vivida Simon, 1895: 979, fig. 1048 (♂, ♀).

Material examined. PHILIPPINES: 6♂, several juveniles, Manila (MNHN11376).

Description. Male (MNHN11376, based on alcohol preserved type series): Prosoma brown and a bit darker on sides, wider in the centre, covered with weak sub-erected setae and some long setae, the marking on the middle not clear in the alcohol preserved specimen but a light-yellow outline visible. Both eye rows recurved. Lateral eyes bear enlarged yellowish grey eye tubercles. Opisthosoma lighter in colour than prosoma, anterior half more or less square shaped and posterior half truncated, two muscle spots present in the centre. Legs yellowish white, covered with

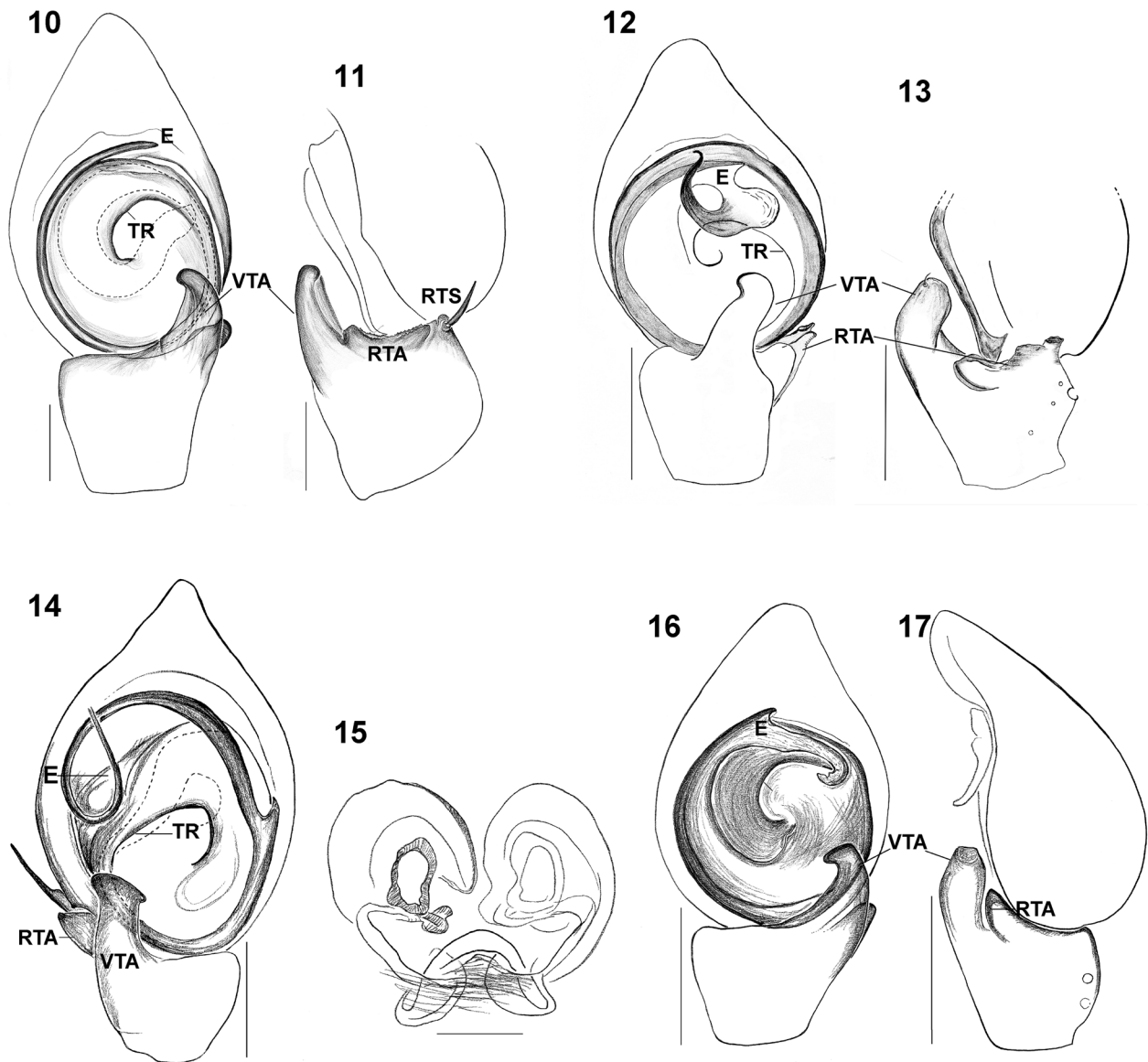


FIGURES 1–9. 1 *Tarrocanus capra* (male), Bowatenna Forest Reserve, dorsal view; 2 *Tarrocanus jaffnaensis* **sp. nov.** (male), Mundathivu, Jaffna, dorsal view; 3 *Domatha vivida* (male), type specimen (MNHN 11376), dorsal view; 4 *Tarrocanus capra* (male), lateral view; 5 *Tarrocanus jaffnaensis* **sp. nov.** (male), lateral view; 6–7 *T. capra*, left male palp (6 ventral, 7 retrolateral). 8–9 *T. jaffnaensis* **sp. nov.**, left male palp (8 ventral, 9 retrolateral). Arrows point to the lateral eye tubercles. Scale bars: 0.2 mm (6–9), 1 mm (1–5).

short setae and sparsely distributed short spines. Palp as in Figs 16, 17. VTA hook-shaped with a flat tip. RTA short, with a blunt tip slanted towards VTA. Simple round tegulum, embolus short and circles around $\frac{3}{4}$ of tegulum, distal $\frac{1}{4}$ part with a dent-like process followed by a curved, hook-like tip directed inwards.

Female: Unknown.

Distribution. Only known from the Philippines (World Spider Catalog 2019).



FIGURES 10–17. 10–11 *Tarrocanus capra*, left male palp (10 ventral, 11 retrolateral); 12–13 *Tarrocanus jaffnaensis* **sp. nov.**, left male palp (12 ventral, 13 retrolateral); 14–15 *Alcimochthes limbatus* (14 right male palp, ventral, 15 epigynum, ventral); 16–17 *Domatha vivida* (MNHN 11376), right male palp (16 ventral, 17 retrolateral). Scale bars: 0.2 mm (10–11, 15–17), 0.3 mm (14), 0.4 mm (12–13).

Species inquirenda

Tarrocanus viridis Dyal, 1935: 200.

The enigmatic *T. viridis* Dyal, 1935 was described on the basis of a female (Dyal 1935). No illustrations are provided in the description. Depository of the syntype is unknown; currently no specimens from S. Dyal are found in the University of the Punjab. We strongly suspect that *T. viridis* is misplaced in *Tarrocanus* and that its description might refer to a common species of the genus *Thomisus*. Thus, we declare this species name a *nomen dubium*.

Acknowledgements

This study was mainly funded by National Science Foundation (NSF) of Sri Lanka (grant No: RG/2015/EB/04 to SPB). Additional funding came from the NIFS, ZFMK and the Alexander von Humboldt foundation. Thanks to N. Athukorala for support in the field. We also thank Z. Jaleel, S. Ranasinghe, N. Kanesharatnam, D. Bopearachchi for collecting part of the material. Thanks to Christine Rollard and Elise-Anne Leguin (MNHN) for granting access to collections under their care. We are grateful for Department of Forest Conservation and the Department of Wildlife Conservation for granting permission for field work. Two anonymous reviewers and Christoph Muster read and improved the manuscript; we are extremely grateful to all of them.

References

- Álvarez-Padilla, F. & Hormiga, G. (2007) A protocol for digesting internal soft tissues and mounting spiders for scanning electron microscopy. *Journal of Arachnology*, 35, 538–542.
<https://doi.org/10.1636/Sh06-55.1>
- Benjamin, S.P. (2011) Phylogenetics and comparative morphology of crab spiders (Araneae: Dionycha, Thomisidae). *Zootaxa*, 3080 (1), 1–108.
<https://doi.org/10.11646/zootaxa.3080.1.1>
- Dyal, S. (1935) Fauna of Lahore. 4. Spiders of Lahore. *Bulletin of the Department of Zoology of the Panjab University*, 1, i–ii + 119–252.
- Ileperuma Arachchi, I.S. & Benjamin, S.P. (2019) Twigs that are not twigs: phylogenetic placement of crab spiders of the genus *Tmarus* of Sri Lanka with comments on the higher level phylogeny of Thomisidae. *Invertebrate Systematics*. [in press]
- Kulczyński, W. (1911) Spinnen aus Nord-Neu-Guinea. In: Wichmann, A. & van der Sande, G.J. (Eds.), *Résultats de l'expédition scientifique néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann*. Nova Guinea 5 (Zoologie, Lief. 4). E. J. Brill, Leiden, pp. 423–518, pls. 19–20.
- Ono, H. (1988) *A revisional study of the spider family Thomisidae (Arachnida, Araneae) of Japan*. National Science Museum, Tokyo, ii + 252 pp.
- Ono, H. (2009) *The spiders of Japan with keys to the families and genera and illustrations of the species*. Tokai University Press, Kanagawa, 739 pp.
- Simon, E. (1885) Matériaux pour servir à la faune arachnologiques de l'Asie méridionale. III. Arachnides recueillis en 1884 dans la presqu'île de Malacca, par M. J. Morgan. IV. Arachnides recueillis à Collegal, district de Coimbatore, par M. A. Theobald G. R. *Bulletin de la Société Zoologique de France*, 10, 436–462.
- Simon, E. (1895) *Histoire naturelle des araignées. Vol. I*. Roret, Paris, 324 pp. [pp. 761–1084]
- Simon, E. (1903) Etudes arachnologiques. 33e Mémoire. LIII. Arachnides recueillis à Phuc-Son (Annam) par M. H. Fruhstorfer (nov-déc. 1899). *Annales de la Société Entomologique de France*, 71, 725–736.
- Tang, G. & Li, S.Q. (2009) Three new crab spiders from Xishuangbanna rainforest, southwestern China (Araneae: Thomisidae). *Zootaxa*, 2109, 45–58.
- Tang, G. & Li, S.Q. (2010) Crab spiders from Hainan Island, China (Araneae, Thomisidae). *Zootaxa*, 2369 (1), 1–68.
<https://doi.org/10.11646/zootaxa.2369.1.1>
- World Spider Catalog (2019) *World Spider Catalog. Version 19.0*. Natural History Museum, Bern. Available from: <http://wsc.nmbe.ch> (accessed February 2019)
- Yin, C.M., Peng, X.J., Yan, H.M., Bao, Y.H., Xu, X., Tang, G., Zhou, Q.S. & Liu, P. (2012) *Fauna Hunan: Araneae in Hunan, China*. Hunan Science and Technology Press, Changsha, 1590 pp.
- Zhang, Y.J., Pan, Z.C., Tong, L.J. & Zhu, S.H. (2000) The spiders of family Thomisidae in Ningbo Tiantong Forest Park. *Journal of Ningbo University, Natural Science Edition*, 13, 35–38.