*Zootaxa* 3709 (2): 185–199
www.mapress.com/zootaxa/


**Article**

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

http://dx.doi.org/10.11646/zootaxa.3709.2.6
http://zoobank.org/urn:lsid:zoobank.org:pub:70103854-8349-42A0-8973-95D22B504F36

# The male of *Tengella perfuga* Dahl, 1901 with re-description of the female and comparisons with *T. radiata* (Kulczynski, 1909) (Araneae: Tengellidae)

MATTHEW LEISTER, RACHAEL MALLIS & KELLY MILLER

*Museum of Southwestern Biology, Division of Arthropods, MSC03 2020, University of New Mexico, Albuquerque, NM, USA 87131-0001. E-mail: mleister@unm.edu, mallis@unm.edu, kbmiller@unm.edu*

## Abstract

*Tengella perfuga* Dahl, 1901, is the type species for *Tengella*, the type genus for the family Tengellidae Dahl, 1908. Here, the males are described for the first time and females re-described based on new specimens collected in Nicaragua. We confirm the species status of *T. perfuga* (instead of previously suggested synonymy with *Tengella radiata* (Kulczynski, 1909)), since the colour pattern and genitalia of both sexes, particularly the palp RTA and the epigynal median septum, are unique in the genus. Important diagnostic features are illustrated for both males and females. Also new distribution records are reported for *T. perfuga* from Nicaragua and *T. radiata* from Honduras, Nicaragua and Panama.

**Key words:** Taxonomy, lectotype, palp morphology, cribellate, Central America

## Introduction

The family Tengellidae (Dahl 1908) is currently represented by 9 genera and 57 species with a worldwide distribution (Platnick 2013). Of these nine, three are cribellate genera comprising six species (Lehtinen 1967; Raven & Stumkat 2003; Platnick 2013). Currently six genera are recognised in the New World and of these only *Tengella* Dahl, 1901, is found south of Mexico. *Tengella* also represents the only cribellate tengellid genus in the Western Hemisphere (Lehtinen 1967; Platnick, 2013). A majority of tengellids are medium to large ecribellate wandering hunters, but members of a few genera, including *Tengella*, make web structures using cribellate silk. One unifying morphological feature of this family is the presence of a third tarsal claw, despite heavy tarsal scopulae or claw tufts in some cases (Wolff 1977; Platnick 1999; Platnick & Ubick 2005, 2007).

The type species of *Tengella* is *T. perfuga* Dahl, 1901, described from two female specimens labelled only "Süd Amerika?" which has been thought to mean Brazil or Colombia (Platnick 2009). Originally *T. perfuga* was placed in the family Zoropsidae Bertkau (Dahl 1901), but later used as the basis of the family Tengellidae Dahl, 1908. The genus now includes four species: *T. perfuga*, *T. radiata*, *T. albolineata* (F. O. Pickard-Cambridge, 1902), and *T. thaleri* Platnick, 2009.

During a field trip in 2010 to Nicaragua five spiders were collected, one immature female, three mature females and a single mature male. While curating these, they were identified as *Tengella*, and after further investigation, were later determined to be *Tengella perfuga*, previously known only from the original type series. After this exciting discovery, during a second trip to Nicaragua in 2012, additional specimens were recovered from the same locality in Departamento Matagalpa and another in Departamento Jinotega (Fig. 1). An examination of the spider collection of Nicaraguan entomologist Jean-Michel Maes revealed two additional mature males from Departamento Matagalpa. These represent the first examples of *T. perfuga* known to have been collected since Dahl's (1901) original description. Here we redescribe the species, including the male for the first time. Our rediscovery is important, not only because this represents the first description of a male *T. perfuga*, but also because these specimens are the first examples of this species to be recorded in over a century, as well as the first ones from a precise locality. The validity of the species has been questioned (Lehtinen 1967; Wolff 1977 but see Platnick 2009), and we re-examine its specific status in light of the new specimens.

*Accepted by C. Vink: 20 Aug. 2013; published: 4 Sept. 2013*

In addition, in 2012 *Tengella radiata* was collected for the first time from southern Nicaragua representing the first record of the species outside of Costa Rica (Fig. 1; Wolff 1977, Santana *et al*. 1990; Eberhard *et al*. 1993, Barrantes 2008, Barrantes & Madrigal-Brenes 2008, Platnick 2009). These specimens were used here to compare with *T. perfuga.*

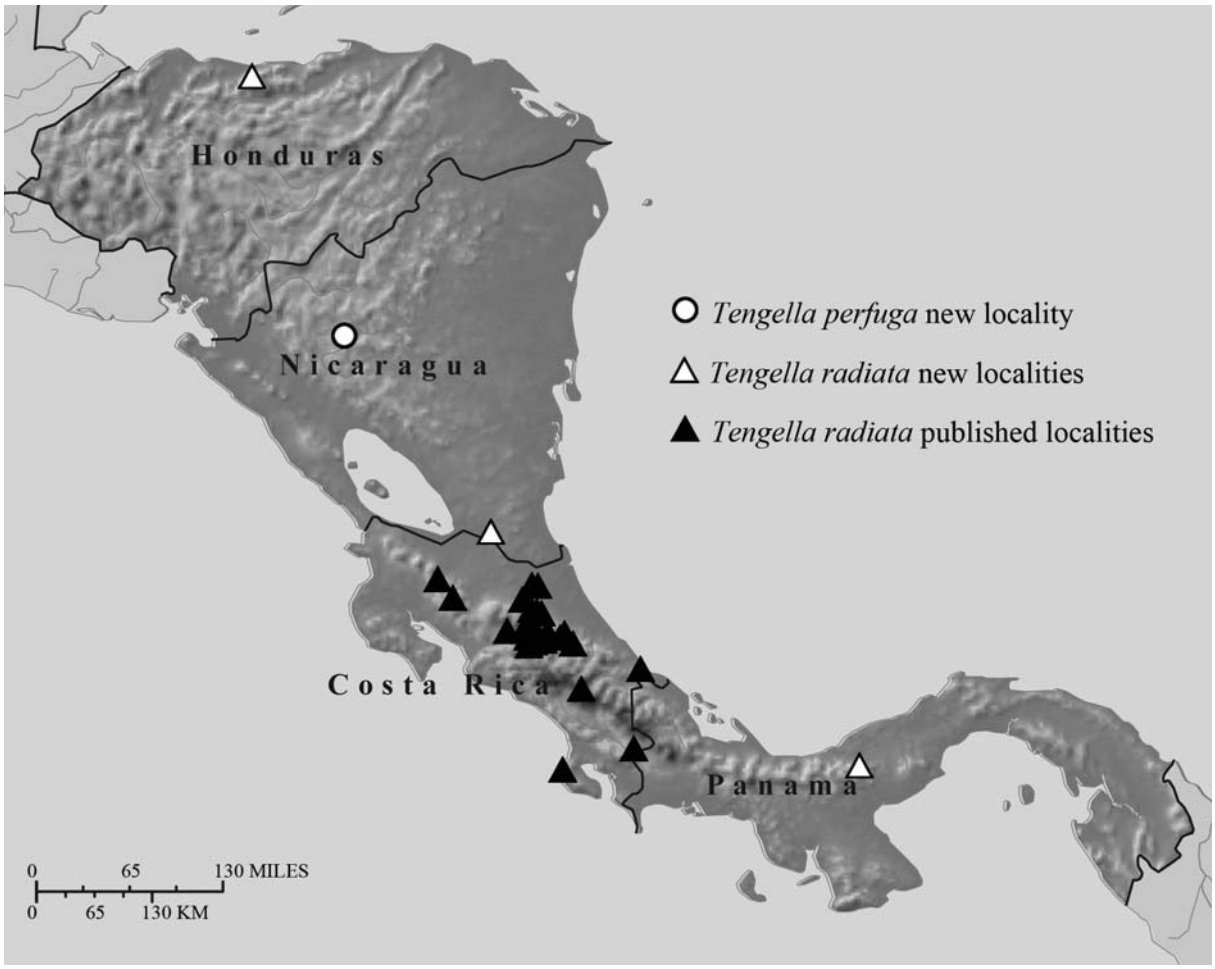



**FIGURE 1.** Map of published localities for *Tengella radiata* and new localities for *Tengella perfuga* and *T. radiata*.

## Material and methods

Specimens were examined, measured and drawn using Olympus SZ60 binocular dissecting scopes equipped with an ocular micrometer, calibrated to 10×. Images were taken in the field using a Canon digital camera. Photo images of morphological structures were taken using a Visionary Digital BK Plus system (www.visionarydigital.com). Epigyna were dissected from the abdomen along with the epigastric furrow from several of the adult female specimens with a scalpel using a #11 blade. The sclerotised mating plugs, as well as other tissues, were cleared using lactic acid at room temperature over a 48 hour period. All remaining soft tissue was dissected with mounting pins. This successfully cleared the plugs and internal structures, such as the spermathecae, were readily visible.

### Abbreviations used

ALE—Anterior lateral eyes
ALS—Anterior lateral spinnerets
AME—Anterior median eyes

D—Dorsal
OQL—Ocular quadrangle length
OQW—Ocular quadrangle width
P—Prolateral
PER—Posterior eye row
PLE—Posterior lateral eyes
PLS—Posterior lateral spinnerets
PME—Posterior median eyes
PMS—Posterior median spinnerets
R—Retrolateral
RTA—Retrolateral tibial apophysis
V—Ventral

## Tengellidae Dahl, 1908

### *Tengella* Dahl, 1901

*Tengella* Dahl, 1901; type species = *Tengella perfuga* Dahl, 1901.
*Metafecenia* F.O. Pickard-Cambridge, 1902; type species = *Metafecenia albolineata* F.O. Pickard-Cambridge, synonymy by Lehtinen, 1967. Type species: *Tengella perfuga* Dahl, 1901, by original designation.

**Diagnosis.** *Tengella* differ from other New World Tengellidae, as well as the Old World genus *Austrotengella* Raven, 2012, in having (1) a bipartite cribellum and calamistrum (Figs. 2A, C), (2) four pairs of ventral spines on tibiae I and II, and (3) three prolateral and four retrolateral teeth on the chelicerae (Wolff 1977; Platnick 2009). Two additional Old World tengellids are cribellate, but easily distinguished from *Tengella* for the same characters as above. *Wiltona* Koçak & Kemal, 2008, differs due to the presence of a small, whole cribellum, as well as heavily reduced use of cribellate silk due to active foraging as adults (Forster & Wilton 1973, Forster & Forster 1999). *Calamistrula* Dahl, 1901, differs by the loss of the cribellum and calamistrum in adulthood (Lehtinen 1967).

### *Tengella perfuga* Dahl, 1901
Figs. (2, 3, 4A, C–F 5, 6A–C, G, H, 7A, B)

**Diagnosis.** *Tengella perfuga* can best be distinguished from other *Tengella* species by genitalic characters in both males and females. *T. perfuga* can be distinguished from *T. thaleri* by smaller overall body size (*T. thaleri* male = 6.0mm, female 8.1mm, *T. perfuga* see Description), as well as the lack of an inner lobe in the male palpal RTA, the presence of a denticulate median apophysis, the presence of thick ventral tarsal scopulae and different septum shape and size in the female epigynum (Platnick 2009). Whereas only the male is known from *T. albolineata,* it differs from other *Tengella* species in carapace colour pattern and palpal structure, particularly the sclerotised portion of the embolus which appears to have a terminal apophysis (Wolff 1977; Platnick 2009). Both of these species have been collected in or associated with caves in Mexico, whereas *T. perfuga* and *T. radiata* are not known from caves.

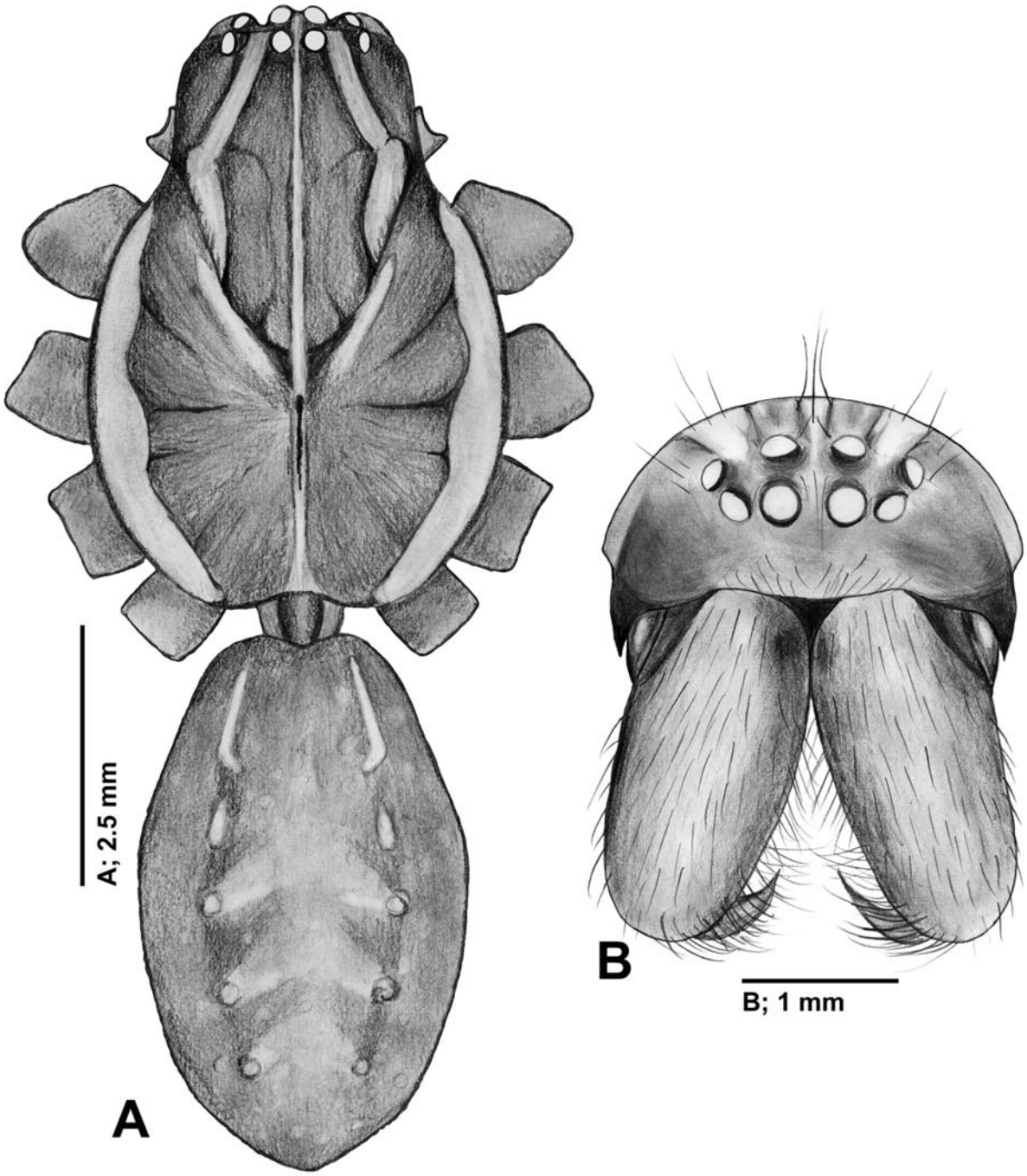
Whereas *Tengella perfuga* and *T. radiata* have similar morphology, spin highly similar webs (pers. obs.), and occupy similar habitats, they can still readily be distinguished from each other. Colour and patterning is more defined in *T. radiata* (Figs. 3A, 4). The male palp of *T. perfuga* has three prolateral tibial spines, whereas *T. radiata* has two (Figs. 5A, B, 6A, B, D, E). *T. perfuga* has a large cylindrical RTA bearing terminal denticles, whereas the RTA of *T. radiata* is slender and bears a three-lobed anterior projection (Figs. 6G–J). The sclerotised median apophysis has a large prominent basal tooth along with numerous small serrations in *T. perfuga*, whereas *T. radiata* lacks the basal tooth (Figs. 5B, C, 6B, C, E, F) (Wolff 1977; Platnick 2009). The female epigyna are even more distinguishable, with the septum of *T. perfuga* being more rounded and narrowed abruptly anteriorly, and the septum broader and more angular in *T. radiata* (Figs. 5D–E, 7).


**FIGURES 2A–C.** *Tengella perfuga*. A, B. Posterior tip of abdomen showing cribellum, ventral view; A. male; B, female; C. Metatarsus IV showing calamistrum, lateral view; male top; female bottom.

**Lectotype designation.** The type series of *Tengella perfuga* Dahl, 1901 includes two female syntypes from "Süd Amerika?", deposited in the Museum für Naturkunde at Humboldt-Universität, Berlin, each of which were examined for this study. One female specimen (ZMB 34656) was used by Dahl (1901) for internal dissection and due to its poor condition, serves little diagnostic or morphologic use. The second specimen (ZMB 34657) is mostly intact with the exception of a dissected epigynum that has since been lost. This specimen, *Tengella perfuga* ("Süd Amerika?") (ZMB 34657), is designated as the lectotype.

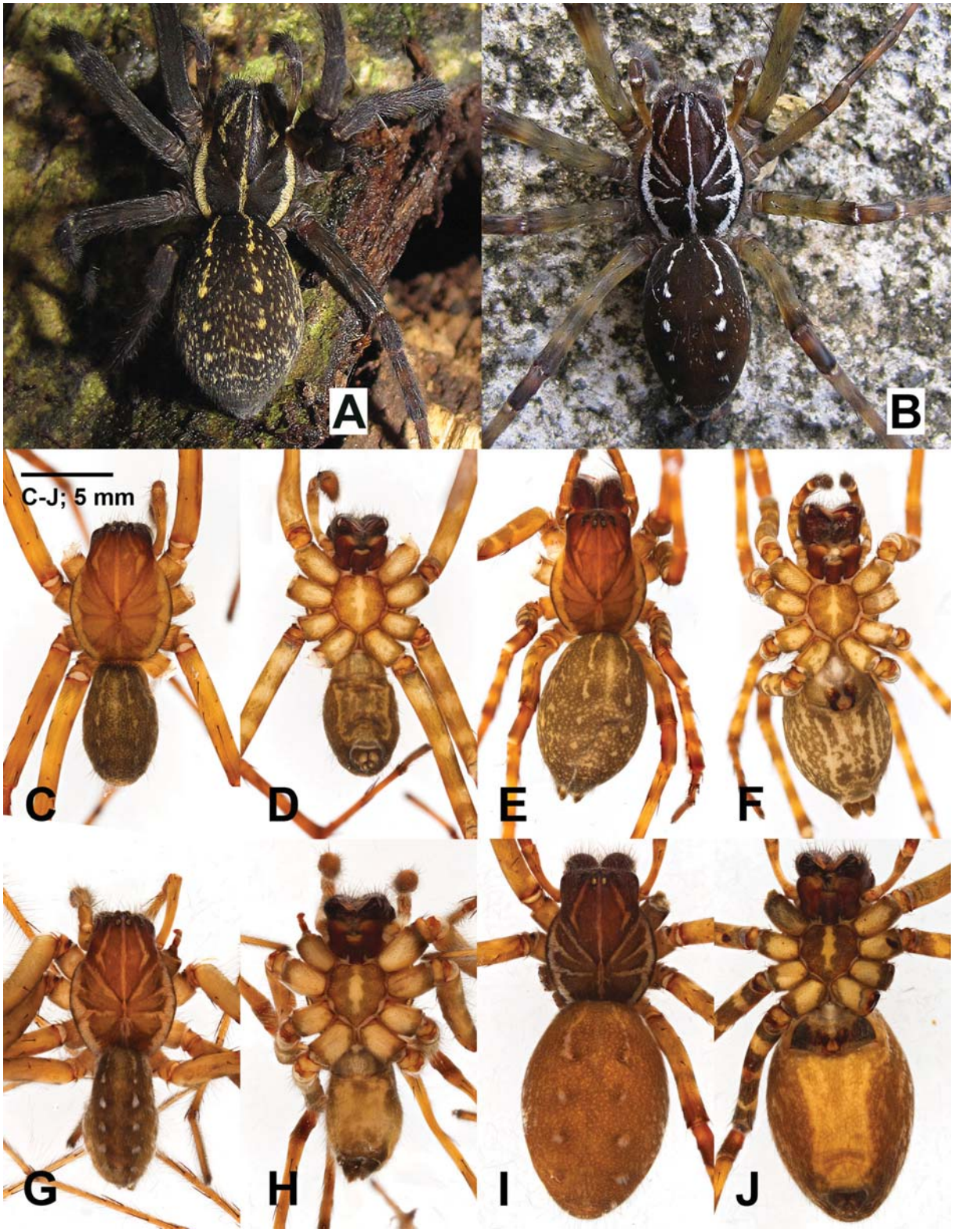
**Other material examined. Nicaragua**: Matagalpa Dpto: Selva Negra, near Matagalpa, (12.9836°N, 85.9002°W), 1251m 09 November 2010, K.B. Miller, J. Smith coll., 1 male (MSBA 023929), 3 females (MSBA 24989, 24990, 24991); same locality, 25–30 May 2012, K.B. Miller, R. Mallis, M. Leister coll., 3 males (MSBA 24980, 24981, 24982), 2 females (MSBA 24985, 24986); Fuente Pura, 17 August 1994, J. M. Maes coll., 1 male (MSBA 24983, 29083).

**Description of male.** Body length (excluding chelicerae and spinnerets) = 11.15–15.50mm (N = 5, mean = 13.85mm); carapace light brown with thin black marginal line, thick white sub-marginal lines, thin white medial line, pair of angled white lines anteriorly, and faint black lines radiate from thoracic groove; abdomen dark brown with white mottling that increases posteriorly, discontinuous white longitudinal lines present anteriorly, three pairs of white spots extending posteriorly, and faint chevron pattern on the posterior portion of the abdomen (Figs. 3A, 4C); legs pale yellow, darker distally, femora with four dark annulations, tibia with three to four dark annulations; metatarsi IV with reduced calamistrum, scopula extending half length of all metatarsi; tarsi with thick scopula, two primary toothed tarsal claws and a small third claw lacking teeth. Carapace pyriform in shape, length = 5.80–7.80mm (mean = 6.92mm), width at anterior coxae II = 4.21–5.71mm (mean = 5.14mm) (Fig. 3A, 4C, Table 1), abruptly narrowed at anterior half of coxae I, thoracic groove in middle of carapace, deep, longitudinal; surface

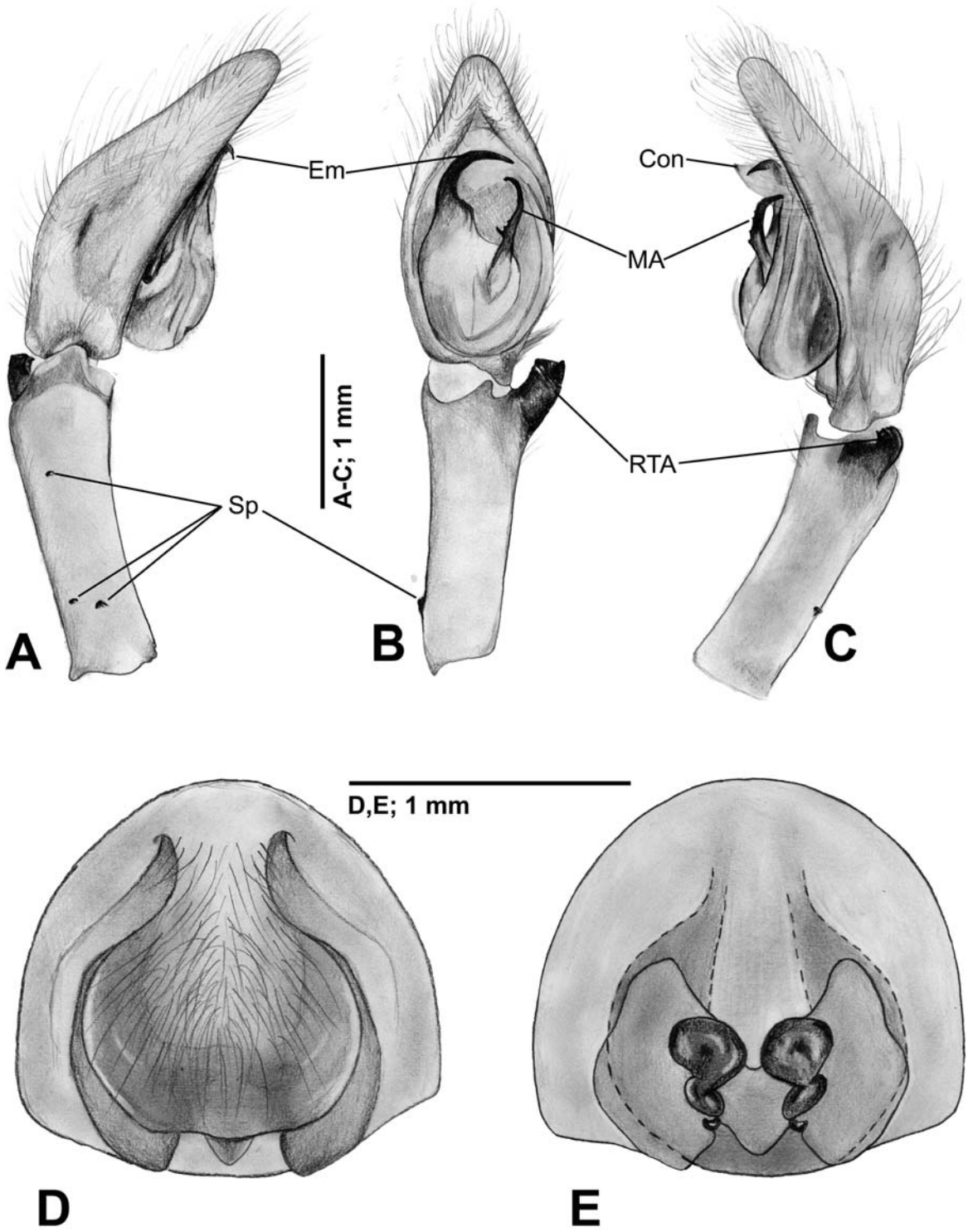



**FIGURES 3A–B.** *Tengella perfuga*; male. A. Carapace and abdomen, dorsal view; B. Carapace and chelicerae, anterior view. (Original illustrations by Matthew Leister).

covered in short black setae, sparse longer black setae surrounding thoracic groove, carapace margins, and ocular area; eight eyes in two straight rows (Fig. 3A, 4C), anteriorly, PER slightly procurved (Fig. 3B); all eyes round and subequal in size, AME slightly larger, spacing and measurements as in Table 1; corners of clypeus enclose prominent cheliceral boss (Fig. 3B); chilum divided; chelicerae vertical and setose; promargin with three equally spaced teeth, median tooth largest, retromargin with four larger, equally sized and spaced teeth, retromarginal teeth more distally placed on the chelicerae than promarginal teeth; endites rectangular, longer than wide, lateral margin narrowed at approximately one third of length, broader distally, diverging, laterodistal portion rounded with a distinct angle at level of palp coxae, slightly darkened at proximal medial edge near labium, surface covered with




**FIGURES 4A–J.** *Tengella* spp., habitus. A. *T. perfuga* female, alive, in field, Nicaragua; B. *T. radiata* female, alive, in field, Nicaragua; C, D. *T. perfuga* male, preserved; E, F. *T. perfuga* female, preserved; G, H. *T. radiata* male, preserved; I, J. *T. radiata* female, preserved.




**FIGURES 5A–E.** *Tengella perfuga* genitalia. A–C. Left male palp; A. prolateral view; B. ventral view; C. retrolateral view; D–E. Epigynum; D. ventral view; E. dorsal view. Con—conductor, Em—embolus, MA—median apophysis, RTA—retrolateral tibial apophysis, Sp—spine attachments. (Original illustrations by Matthew Leister).

dense setae on distomedial margin, long erect setae covering lateral portion of endites; labium rectangular, approximately two thirds length of endites, proximal margins angled, with shallow notch at base, dense setae covering anterior margin; sternum shield-shaped, narrowing at level of coxae III, forming a point, divided medially

by pale longitudinal stripe with radiating darker lines extending towards coxae; pedicel long, thin, and sclerotised (Fig. 4D).

Cribellum bipartite; ALS conical and two-segmented, PLS cylindrical and two-segmented, PLS more slender and slightly shorter than ALS, PMS small, cylindrical.

Leg formula 1 4 2 3 (Table 1). Leg spination as follows, with only spine-bearing surfaces lised: Femora: I d1-1-1, p1-2-1, r1-2-1; II d1-1-1, p1-2-1, r1-2-1; III d1-1-1, p1-2-1, r1-2-1; IV d1-1-1, p1-1-1, r0-2-1; Palp d0-1-2, p0-0-1; Tibiae: I p0-2-0, v2-4-2; II p1-0-1, v2-4-2, r1-0-1; III d1-0-0, p1-1-1, v2-2-2, r1-1-1; IV d1-0-1, p1-0-1, v2-2-2, r1-1-1; Palp d0-1-0, p2-0-1; Metatarsi: I p0-0-1, v2-2-1, r0-0-1; II d0-0-1, p1-1-1, v2-2-1, r0-1-1; III d0-1-2, p1-1-1, v2-2-2, r1-1-1; IV d2-0-2, p0-1-1, v2-2-1, r0-2-1.

**TABLE 1.** Mean and range of five male *Tengella perfuga* in mm.

| | Mean(range) | | Mean(range) |
|---|---|---|---|
| **Body** | | **Leg II** | |
| Clypeus height | 0.56(0.49–0.71) | Coxa II | 2.18(1.86–2.50) |
| Carapace length | 6.92(5.80–7.80) | Trochanter II | 1.02(0.75–1.15) |
| Carapace width | 5.14(4.21–5.71) | Femur II | 8.42(7.18–9.32) |
| Abdomen length | 6.93(5.35–7.89) | Patella II | 2.73(1.90–3.30) |
| **Body length** | **13.85(11.15–15.50)** | Tibia II | 7.81(6.67–9.48) |
| **Eyes** | | Metatarsus II | 11.26(7.18–9.15) |
| PME width | 0.26(0.21–0.32) | Tarsus II | 3.57(3.25–3.80) |
| AME width | 0.35(0.30–0.41) | **Total leg II** | **33.80 (28.79–38.65)** |
| PLE width | 0.30(0.30–0.31) | **Leg III** | |
| ALE width | 0.31(0.30–0.31) | Coxa III | 1.93(1.78–2.10) |
| PME-PME | 0.18(0.08–0.21) | Trochanter III | 0.91(0.69–1.05) |
| PME-PLE | 0.33(0.30–0.35) | Femur III | 7.29(5.58–8.30) |
| PLE-ALE | 0.10(0.08–0.11) | Patella III | 2.38(1.85–2.61) |
| AME-ALE | 0.09(0.08–0.11) | Tibia III | 5.83(4.90–6.90) |
| AME-AME | 0.09(0.07–0.11) | Metatarsus III | 6.95(6.08–7.51) |
| OQL | 0.87(0.70–0.95) | Tarsus III | 2.90(2.45–3.35) |
| OQW | 1.87(1.60–2.15) | **Total leg III** | **28.18(23.61–30.85)** |
| **Leg I** | | **Leg IV** | |
| Coxa I | 2.47(2.13–2.70) | Coxa IV | 2.09(1.83–2.30) |
| Trochanter I | 1.14(0.95–1.20) | Trochanter IV | 1.09(0.88–1.20) |
| Femur I | 10.29(9.20–10.90) | Femur IV | 9.44(8.00–10.23) |
| Patella I | 3.07(2.61–3.40) | Patella IV | 2.49(2.00–2.89) |
| Tibia I | 11.19(9.72–13.18) | Tibia IV | 8.09(7.55–8.89) |
| Metatarsus I | 11.26(9.93–12.70) | Metatarsus IV | 10.48(8.20–11.55) |
| Tarsus I | 4.76(4.48–5.10) | Tarsus IV | 3.63(3.25–4.19) |
| **Total leg I** | **44.17(39.02–48.89)** | **Total leg IV** | **37.30(31.71–41.25)** |
| | | **Pedipalp** | |
| | | Palp trochanter | 0.60(0.38–0.70) |
| | | Palp femur | 3.28(2.45–3.70) |
| | | Palp patella | 1.38(1.05–1.60) |
| | | Palp tibia | 1.81(1.47–2.00) |
| | | Palp tarsus | 2.36(1.85–2.70) |
| | | **Total palp** | **9.43(7.20–10.41)** |

Palp tibia widened distally; RTA large, heavily sclerotised, distally darkened, bearing large denticles on distal portion (Figs. 5A–C, 6A–C, G, H); cymbium densely setose with hooked setae; tegulum with large median apophysis, sclerotised, curved dorsomedially, with prominent basal tooth followed by row of small serrated denticles which begin at middle and extend along medial edge; embolus broadened at base, strongly curving distally above median apophysis; hyaline conductor extending medially between embolus and median apophysis, dorsally cupping the embolus distally (Figs. 5C, 6C).

**Female.** Total body length (excluding chelicerae and spinnerets) = 13.76–18.05 (N= 5, mean = 15.72mm, Table 2); colour and pattern of carapace, abdomen and legs as in male, but patterning more distinct (Fig. 4A, E); calamistrum more prominent than in male, beginning at one-fourth and terminating at one-half length of metatarsus IV (Fig. 2C), scopula extending half length of metatarsi; tarsi scopulate with two primary toothed tarsal claws and a single small claw lacking denticles as in male. Carapace pyriform in shape as in male, length = 5.81–7.55mm (mean = 6.85mm), width = 4.55–5.55mm (mean = 5.07mm, Table 2); thoracic groove as in male; surface setae and eight eyes in two rows as in male (eye measurements in Table 2); clypeus enclosing cheliceral boss as in male; chilum, cheliceral setae and shape, marginal teeth, endites, labium and sternum as in male (Fig. 4A, E, F).

Cribellum bipartite (Fig. 2B), more prominent than in male; ALS and PLS as in male.

Leg formula 1 4 2 3 (Table 2). Leg spination as follows, with only spine-bearing surfaces lised: Femora: I d1-1-1, p0-2-1, r0-2-2; II d1-1-1, p1-1-1, r1-1-2; III d1-1-1, p1-2-1, r1-2-1; IV d1-1-1, p0-1-1, r0-1-1; Palp d0-0-4, p0-0-1; Tibiae: I v2-4-2; II p0-1-1, v2-4-2; III d1-1-0, p0-1-1, v2-2-2, r0-1-1; IV d1-0-0, p0-1-1, v2-2-2, r0-1-1; Palp d0-1-1, p2-0-1; Metatarsi: I v2-2-3; II p0-1-2, v2-2-1, r0-0-1; III d1-1-0, p1-1-2, v2-2-1, r1-1-2; IV d0-1-2, p1-1-1, v2-3-1, r1-1-1; Palp tarsus: p2-1-0, r0-1-0.

Epigynum with median septum round, narrowed abruptly anteriorly, with sclerotised mating plugs present on all examined females; dorsally, spermathecae short, oval structures with a single twist (Figs. 5D, E, 7A, B).

**Colour in life.** Since some of the specimens used for this description have been preserved in 70% EtOH, the pigmentation in the setae and the exoskeleton is faded. This makes the specimens lighter in colour than they appear in life, with degradation of patterning. In life, the overall colouration is dark brown, with all lines and accessory patterning yellow (Fig. 4A). In the male, sclerotised portions of the RTA, cymbium, and portions of the chelicerae and clypeus also have subtle blue green iridescence. This iridescence is present on the chelicerae and clypeus in females, but less distinctly.

**Sexually dimorphic features.** Males have longer legs than females, most notably leg I, and the abdomen in females is markedly larger than in males (Table 1, Table 2), and both leg I and abdomen are used in courtship behaviour (pers. obs. of the authors). Spination also varies between the sexes.

**Intrasexual variation.** Within the sexes, there is little variation in colour pattern and spination; however body size and leg lengths vary. For adult males, body length = 11.15–15.50mm, whereas in adult females body length = 13.76–18.05mm (Table 1, Table 2).

**Natural history.** These are medium to large cribellate spiders that build sheet webs with a funnel retreat and significant cribellate tangle structure above the web. Webs in the field were typically along stream embankments, tree trunks and between stones on a stone bridge and builidngs. These were comprised of a broad more round sheet with a funnel retreat below the web either in a rear corner or in the center of the web. The main sheet and retreat were surrounded by a scaffolding of tangle lines above, and some anchor lines below the sheet. Cribellate silk was integrated throughout all parts of the funnel web. The spider spends most of its time in the retreat or just at the retreat opening and runs out on top of the sheet to capture prey and back to the retreat. *Tengella perfuga* is found in Nicaraguan high elevation cloud forests (1251m), often associated with coffee plantations, in close proximity to conspecifics along banks of streams, tree trunks, sides of bridges and other manmade structures. Specimens were collected by hand from webs.

**Distribution.** Nicaragua, high elevation regions in Departamento Matagalpa and Jinotega (Fig. 1).

### *Tengella radiata* (Kulczynski, 1909)

Figs. (4B, G–J, 6D–F, I, J, 7C, D)

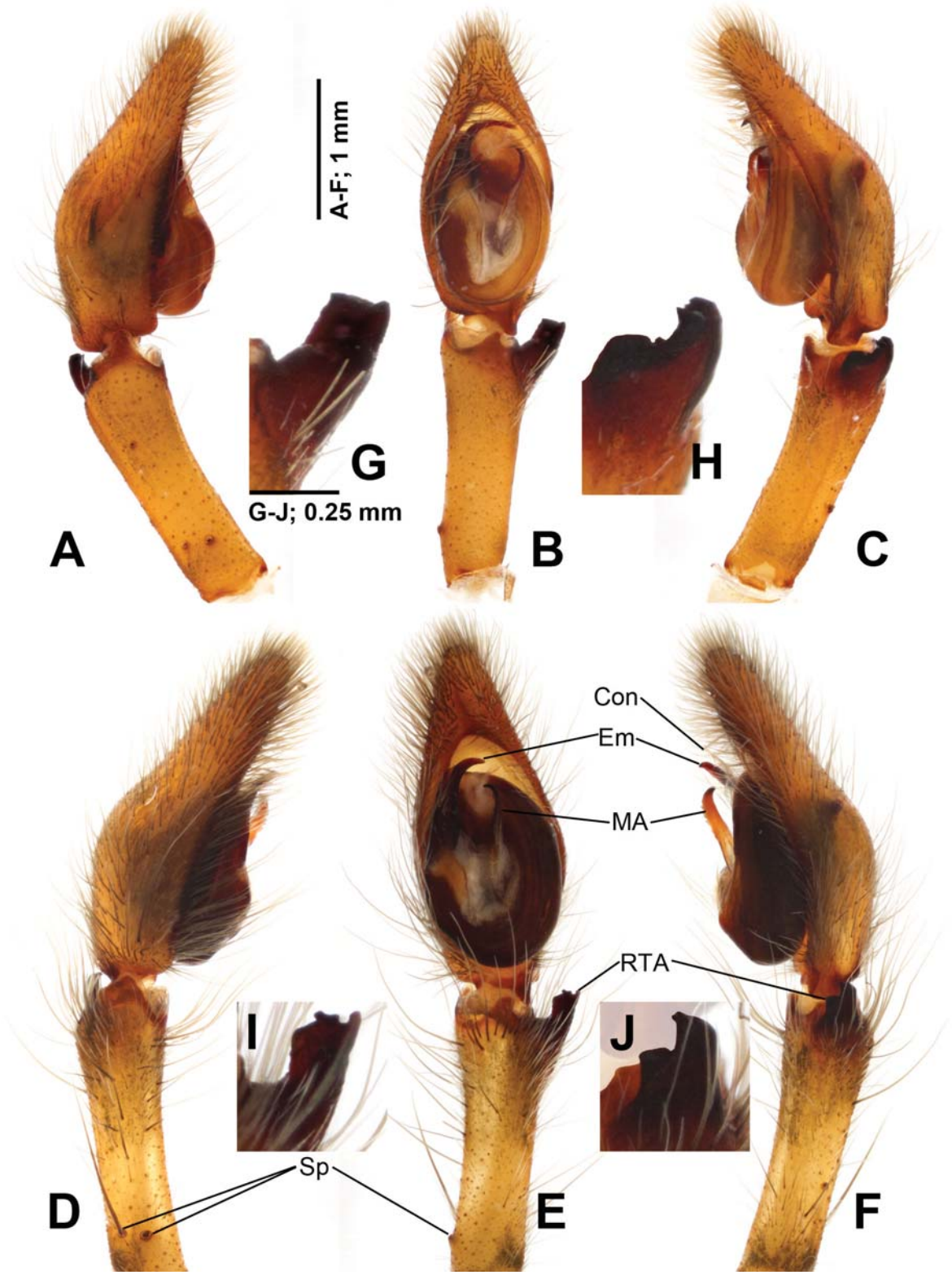
*Metafecenia radiata* Kulczynski, 1909 synonymised with *T. perfuga*, Lehtinen, 1967; synonymy rejected and reinstated as *Tengella radiata*, Wolff, 1977

**Material examined. Nicaragua**: Rio San Juan Dpto: Refugio Bartola, (10.97254°N, 84.33899°W), 36m, 18–23 May 2012, K.B. Miller, R. Mallis, M. Leister. coll. 2 male (MSBA 29077, 29078), 2 females, (MSBA 29079, 29080). (NEW RECORD).

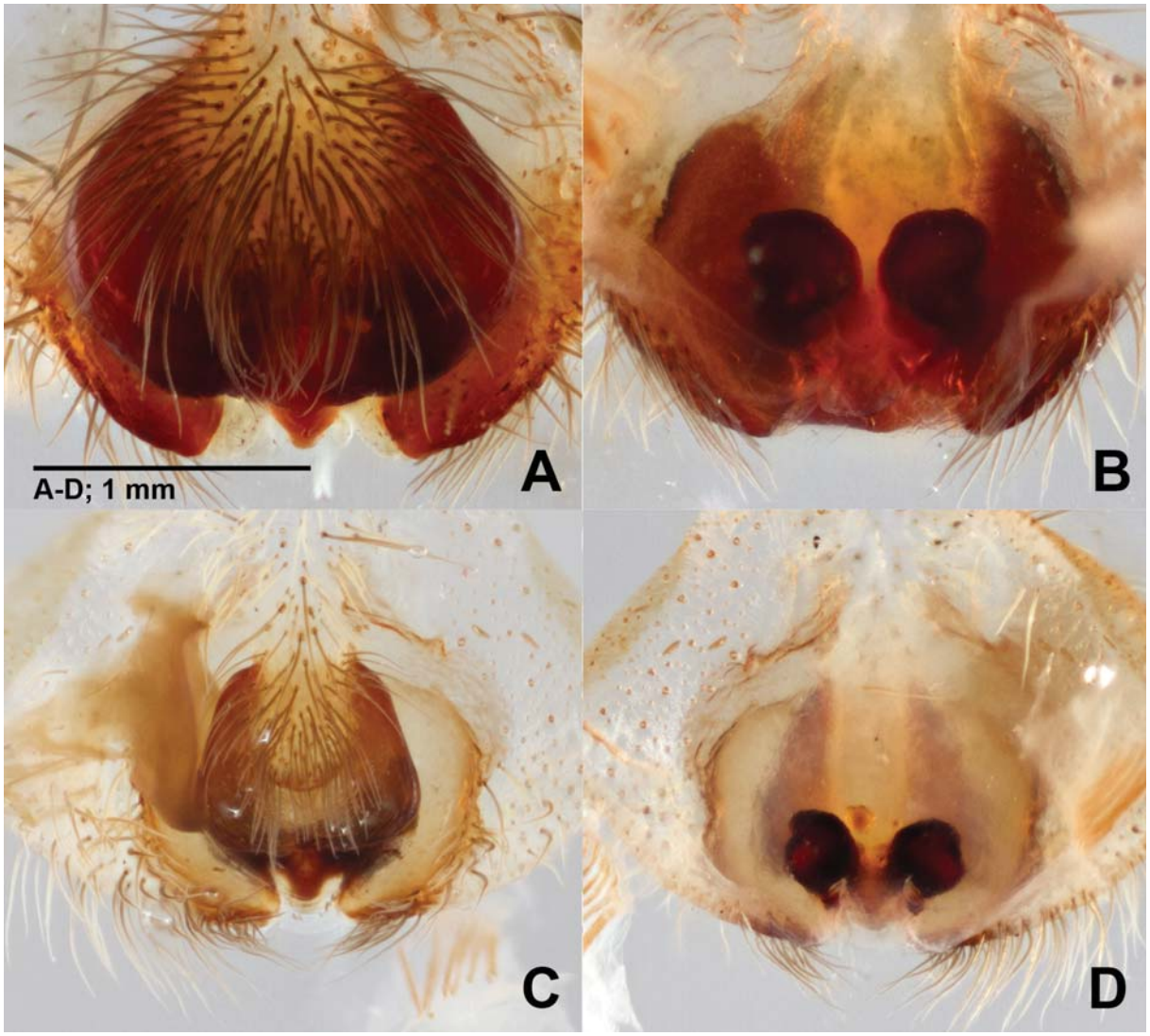
**TABLE 2.** Mean and range of five female *Tengella perfuga* in mm.

| | Mean(range) | | Mean(range) |
|---|---|---|---|
| **Body** | | **Leg II** | |
| Clypeus height | 0.55(0.50–0.75) | Coxa II | 2.04(1.70–2.25) |
| Carapace length | 6.85(5.81–7.55) | Trochanter II | 0.95(0.85–1.10) |
| Carapace width | 5.07(4.55–5.55) | Femur II | 6.36(5.57–7.20) |
| Abdomen length | 8.87(7.50–10.60) | Patella II | 2.53(2.25–2.90) |
| **Body length** | **15.72(13.76–18.05)** | Tibia II | 5.61(5.10–6.15) |
| **Eyes** | | Metatarsus II | 4.81(4.37–5.45) |
| PME width | 0.26(0.21–0.30) | Tarsus II | 2.44(2.20–2.65) |
| AME width | 0.32(0.25–0.35) | **Total leg II** | **24.74(22.79–27.70)** |
| PLE width | 0.30(0.30–0.30) | **Leg III** | |
| ALE width | 0.30(0.25–0.31) | Coxa III | 1.88(1.60–2.10) |
| PME-PME | 0.20(0.19–0.22) | Trochanter III | 0.79(0.70–0.95) |
| PME-PLE | 0.44(0.40–0.49) | Femur III | 5.49(4.75–6.35) |
| PLE-ALE | 0.11(0.10–0.13) | Patella III | 2.18(1.85–2.45) |
| AME-ALE | 0.11(0.10–0.16) | Tibia III | 4.16(3.69–4.55) |
| AME-AME | 0.16(0.15–0.19) | Metatarsus III | 4.53(4.10–5.05) |
| OQL | 0.85(0.80–0.90) | Tarsus III | 2.18(1.93–2.30) |
| OQW | 1.96(1.75–2.25) | **Total leg III** | **21.21(19.43–23.75)** |
| **Leg I** | | **Leg IV** | |
| Coxa I | 2.27(2.10–2.45) | Coxa IV | 2.08(1.80–2.30) |
| Trochanter I | 1.08(0.93–1.20) | Trochanter IV | 1.10(1.00–1.120) |
| Femur I | 7.46(6.67–8.25) | Femur IV | 7.18(6.27–7.95) |
| Patella I | 2.91(2.55–3.30) | Patella IV | 2.42(2.10–2.65) |
| Tibia I | 7.63(7.18–8.50) | Tibia IV | 6.05(5.60–6.55) |
| Metatarsus I | 6.55(5.95–7.30) | Metatarsus IV | 6.99(6.48–7.25) |
| Tarsus I | 3.21(2.95–3.45) | Tarsus IV | 2.67(2.30–3.20) |
| **Total leg I** | **31.10(28.48–34.40)** | **Total leg IV** | **28.50(26.02–30.70)** |
| | | **Pedipalp** | |
| | | Palp Trochanter | 0.55(0.25–0.75) |
| | | Palp femur | 2.80(2.60–3.19) |
| | | Palp patella | 1.36(1.12–1.55) |
| | | Palp tibia | 1.90(1.78–1.97) |
| | | Palp tarsus | 2.35(2.25–2.45) |
| | | **Total palp** | **8.97(8.40–9.84)** |

**Description of male.** Carapace brown, thick white sub-marginal lines, thin white medial line, paired of angled pale lines emerge anterior, three to four paired pale lines radiate from thoracic groove; abdomen dark brown, broken white longitudinal lines anteriorly, four pairs white spots extend posteriorly; patterning as in Fig. 4G; legs pale yellow, darker distally, femora, tibia with dark annulations; metatarsi IV with reduced calamistrum, scopula extending half the length of all metatarsi; tarsi with thick scopula, two primary toothed tarsal claws and a small




**FIGURES 6A–F.** Comparison of male genitalia, left palp. G–J. Comparison of male RTA. A–C, G, H. *Tengella perfuga*; D–F, I, J. *T. radiata* ; A, D. Prolateral view; B, E, G, I. Ventral view; C, F, H, J. Retrolateral view. Con—conductor, Em—embolus, MA—median apophysis, RTA—retrolateral tibial apophysis, Sp—spines and spine attachments.




**FIGURES 7A–D.** Comparison of female genitalia. A, B. *Tengella perfuga*; C, D. *T. radiata*; A, C. Epigynum, ventral view; B, D. Epigynum, dorsal view.

third claw lacking denticles. Carapace pyriform in shape, thoracic groove in middle of carapace, deep, longitudinal; sternum shield-shaped, narrowing at level of coxae III, forming a point, divided medially by light longitudinal stripe; pedicel long, thin, and sclerotised (Fig. 4G, H).

Cribellum bipartite.

Leg formula 1 4 2 3. Leg spination described in Wolff (1977).

Palp tibia widened distally; RTA large, heavily sclerotised, distally darkened, bearing three lobes on distal portion (Figs. 6I, J); cymbium densely setose with hooked setae; tegulum with large median apophysis, sclerotised, curved dorsomedially, with row of small serrated denticles along distal third of medial edge; embolus broadened at base, strongly curving distally above median apophysis; hyaline conductor club shaped (Figs. 6D–F).

**Female.** Colour and pattern of carapace, abdomen and legs as in male, patterning more distinct than in male (Fig. 4B, I, J); calamistrum more prominent than in male; tarsi scopulate with two primary toothed tarsal claws and a single small claw lacking denticles as in male. Carapace pyriform in shape as in male; thoracic groove as in male; eyes as in male.

Cribellum bipartite, more prominent than in male.

Leg formula 1 4 2 3. Leg spination follows Wolff (1977).

Epigynum with broad trapezoidal median septum, dorsally spermathecae with a single twist situated posteromedially; genitalia as in Figs. 7C, D.

**Colour in life.** In both sexes, overall colour is dark brown, legs annulate, with patterning comprised of white setae on both the carapace, as well as the abdomen (Fig. 4B). Iridescence similar to that seen in *T. perfuga*.

**Sexually dimorphic features.** Males have longer legs than females, most notably leg I.

**Intrasexual variation.** Within the sexes, there is little variation in colour pattern and spination.

**Natural history.** These are medium to large cribellate spiders that build sheet webs with a funnel retreat and significant cribellate tangle structure above the web. Webs in the field were typically found along tree trunks or within root structures. These were typically comprised of a more rectangular sheet, with a retreat at the rear edge, and tangle lines above the sheet. Spiders would be at the retreat or mouth of the retreat. Cribellate silk was integrated in the sheet and retreat (pers. obs., Santana *et al*. 1990, Eberhard *et al*. 1993, Barrantes 2008, Barrantes & Madrigal-Brenes 2008). They can be found in a variety of habitats, including lowland tropical rainforests, as well as higher elevation cloud forests and are also associated with shade coffee plantations (Santana *et al*. 1990; Eberhard *et al*. 1993; Barrantes 2008). They harbour a number of kleptoparasites and web symbionts as well (Eberhard *et al*. 1993). Specimens were collected by hand from the web.

**Distribution.** Central America. The localities in northern Honduras, southern Nicaragua and central Panama (Fig. 1) represent new records.

**Additional Records: Panama**: Coclé Province, (8.6681°N, 80.5926°W), 760m, 04–09 June 2008, M. Arnedo, L. Benavides, G. Hormiga, F. Labarque, M. Ramírez coll. (Labarque 2012). **Honduras**: La Ceiba, Pico Bonito Lodge, Mermaid Falls Trail (15.68786°N, 86.90323°W), 150m, 13 January 2013, J. Warfel coll.(pers. comm.); Deposited in Museum of Southwestern Biology; 1 male (MSBA 24987), 1 subadult male (MSBA 24988).

## Discussion

The rediscovery of *Tengella perfuga* provides specific and accurate locality information for this species, which is found in northern Nicaragua in high altitude regions. Further efforts to collect from a variety of locations and habitats, as well as a thorough examination of museum specimens from Central America, will give better insight into potential variation within the species and a better understanding of its distribution. *Tengella radiata* was previously only known from Costa Rica (Santana *et al*. 1990; Eberhard *et al*. 1993; Barrantes 2008). Specimens of this species from Honduras (Warfel, pers. comm.), southern Nicaragua and Panama (Labarque 2012) extend the known northern and southern range limits considerably for this species.

*Tengella radiata* has been observed in similar habitats as we found for *T. perfuga* (Santana *et al*. 1990; Eberhard *et al*. 1993; Barrantes 2008), and it is possible that some Costa Rican specimens of the latter have been misidentified as *T. radiata*. Nothing is known about the natural history of *T. perfuga*, so further studies of web ontology, feeding and courtship behaviour, both in the laboratory and in nature will provide a better understanding of the natural history of this spider. These studies are currently in progress.

*Tengella* spiders use cribellate silk and are the only cribellate genus in the family Tengellidae in the New World, and the only one to use cribellate silk in adulthood to construct a web (Lehtinen 1967, Forster & Forster 1999, Platnick 1999, Platnick & Ubick 2005, Platnick & Ubick 2007, Raven 2012, Platnick 2013). The monophyly of Tengellidae, as well as placement of the family within the phylogeny of spiders, especially cribellate entelegynes, is ambiguous (Griswold *et al*. 1999, 2005; Raven & Stumkat 2005; Spagna & Gillespie 2008). Tengellidae, represented by *T. radiata* in morphological and some molecular phylogenies, has been placed sister to or within the lycosoids and Zorocratidae (*Zorocrates*) (Griswold *et al*. 1999, 2005; Silva Dávila 2003; Raven & Stumkat 2005; Spagna & Gillespie 2008). Whether the use of cribellate silk in *Tengella* is a retained plesiomorphy or a novel evolutionary innovation is unclear (Spagna & Gillespie 2008; Blackledge *et al*. 2009). A phylogenetic analysis with the purpose of placing *Tengella* and examining relationships within Tengellidae and between these spiders and other families is currently underway.

**Acknowledgements**

We thank Jean-Michel Maes for coordinating the collecting trips to Nicaragua and aiding in specimen recovery, as well as the generous donation of his spider collection from Nicaragua to the Museum of Southwestern Biology. We acknowledge the generous loan by Jason Dunlop of the *Tengella perfuga* types from the Museum für Naturkunde at the Humboldt-Universität in Berlin, Germany. We are appreciative of the correspondence with Norman Platnick about *T. perfuga* and his experience with the dissection of type materials. We thank Facundo Labarque for providing additional locality information on *T. radiata*, which stemmed from his PhD dissertation**.** We also thank Joe Warfel for sharing specimens of *T. radiata* and locality information from his recent trip to Honduras, and allowing us to publish this information. We also thank Sandra Brantley for her time and expertise in editing our manuscript, as well as help in specimen dissection and curation. Finally, we thank members of the 2012 Field Class to Nicaragua for their help and enthusiasm in collecting and observing *Tengella*. Specimens were collected in Nicaragua under Autorización Especial DGPN / DB-9-2012 from Carlos Ramiro Mejía, Director of Biodiversity, MARENA of Nicaragua. Thanks also to Robert Raven, an anonymous reviewer and Cor Vink for their invaluable suggestions and comments. Portions of this project were supported by NSF grant DEB-0845984 (K.B. Miller, PI).

## References

Barrantes, G. (2008) Courtship behavior and copulation in *Tengella radiata* (Araneae, Tengellidae). *The Journal of Arachnology,* 36, 606–608.
http://dx.doi.org/10.1636/st07-13.1

Blackledge, T.A., Scharff, N., Coddington, J.A., Szüts, T., Wenzel, J.W., Hayashi, C.Y., Agnarsson, I. & Schoener, T.W. (2009) Reconstructing web evolution and spider diversification in the molecular era. *Proceedings of the National Academy of Sciences of the United States of America,* 106, 5229–5234.
http://dx.doi.org/10.1073/pnas.0901377106

Dahl, F. (1901) Nachtrag zur Uebersicht der Zoropsiden. *Sitzungs-berichte Gesellschaft naturforschender Freunde zu Berlin,* 1901, 244–255.

Dahl, F. (1908) Die Lycosiden oder Wolfspinnen Deutschlands und ihre Stellung im Haushalte der Natur. *Nova Acta Abhandlungen der Kaiserlich-Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher,* 88, 175–678.

Eberhard, W.G., Platnick, N.I. & Schuh, R.T. (1993) Natural history and systematics of arthropod symbionts (Araneae; Hemiptera; Diptera) inhabiting webs of the spider *Tengella radiata* (Araneae, Tengellidae). *American Museum Novitates,* 3065, 1–17.

Forster, R.R. & Forster, L. (1999) *Spiders of New Zealand and their Worldwide Kin*. University of Otago Press, in association with Otago Museum, Dunedin, New Zealand, vi + 270 pp.

Forster, R.R. & Wilton, C.L. (1973) The spiders of New Zealand. Part IV. *Otago Museum Bulletin*, 4, 1–309.

Griswold, C.E., Coddington, J.A., Platnick, N.I. & Forster, R.R. (1999) Towards a phylogeny of entelegyne spiders (Araneae, Araneomorphae, Entelegynae). *The Journal of Arachnology*, 27, 53–63.

Griswold, C.E., Ramírez, M.J., Coddington, J.A. & Platnick, N.I. (2005) Atlas of phylogenetic data for entelegyne spiders (Araneae: Araneomorphae: Entelegynae) with comments on their phylogeny. *Proceedings of the California Academy of Sciences,* 56, 1–324.

Koçak, A.Ö & Kemal, M. (2008) New synonyms and replacement names in the genus group taxa of Araneida. *Center for Entomological Studies Ankara, Miscellaneous Papers,* 139–140, 1–4.

Kulczynski, W. (1909) Fragmenta arachnologica, XI-XIII. *Bulletin International de l'Académie des Sciences da Cracovie*, 1909, 427–472.

Labarque, F. (2012) *Evaluación de identificaciones taxonómicas mediante código de barras del ADN en un grupo tropical megadiverso.* Facultad de Ciencias Exactas y Naturales (FCEyN), Universidad de Buenos Aires (UBA), Argentina, 250 pp.

Lehtinen, P.T. (1967) Classification of the cribellate spiders and some allied families, with notes on the evolution of the suborder Araneomorpha. *Annales zoologici fennici,* 4, 199–468.

Pickard-Cambridge, F.O. (1902) Arachnida - Araneida and Opiliones. *In: Biologia Centrali-Americana,* Zoology, London, 2, 313–424.

Platnick, N.I. (1999) A revision of the Appalachian spider genus *Liocranoides* (Araneae: Tengellidae). *American Museum Novitates,* 3285, 1–13.
http://dx.doi.org/10.1206/0003-0082(2008)3608[1:arotec]2.0.co;2

Platnick, N.I. (2009) A review of the spider genus *Tengella* (Araneae: Tengellidae). *Contributions to Natural History,* 12, 1071–1080.

Platnick, N.I. (2013) The World Spider Catalog, version 13.5. American Museum of Natural History. Available from: http://research.amnh.org/iz/spiders/catalog (Accessed 28 May 2013)
http://dx.doi.org/10.5531/db.iz.0001

Platnick, N.I. & Ubick, D. (2005) A revision of the North American spider genus *Anachemmis* Chamberlin (Araneae, Tengellidae). *American Museum Novitates,* 3477, 1–20.
http://dx.doi.org/10.1206/0003-0082(2005)477[0001:arotna]2.0.co;2

Platnick, N.I. & Ubick, D. (2007) A revision of the spider genus *Zorocrates* Simon (Araneae, Zorocratidae). *American Museum Novitates,* 3579, 1–44.
http://dx.doi.org/10.1206/0003-0082(2007)3579[1:arotsg]2.0.co;2

Raven, R.J. (2012) Revisions of Australian ground-hunting spiders. V. A new lycosoid genus from eastern Australia (Araneae: Tengellidae). *Zootaxa*, 3305, 28–52.

Raven, R.J. & Stumkat, K. (2003) Problem solving in the spider families Miturgidae, Ctenidae and Psechridae (Araneae) in Australia and New Zealand. *The Journal of Arachnology,* 31, 105–121.
http://dx.doi.org/10.1636/0161-8202(2003)031[0105:psitsf]2.0.co;2

Raven, R.J. & Stumkat, K. (2005) Revisions of Australian ground-hunting spiders: II: Zoropsidae (Lycosoidea: Araneae). *Memoirs of the Queensland Museum,* 50, 347–423.

Santana, M., Eberhard, W.G., Bassey, G., Prestwich, K.N. & Briceño, R.D. (1990) Low predation rates in the field by the tropical spider *Tengella radiata* (Araneae: Tengellidae). *Biotropica,* 22, 305–309.
http://dx.doi.org/10.2307/2388542

Silva Dávila, D. (2003) Higher level relationships of the spider family Ctenidae (Araneae: Ctenoidea). *Bulletin of the American Museum of Natural History,* 274, 1–86.
http://dx.doi.org/10.1206/0003-0090(2003)274<0001:hlrots>2.0.co;2

Spagna, J.C. & Gillespie, R.G. (2008) More data, fewer shifts: Molecular insights into the evolution of the spinning apparatus in non-orb-weaving spiders. *Molecular Phylogenetics and Evolution,* 46, 347–368.
http://dx.doi.org/10.1016/j.ympev.2007.08.008

Wolff, R.J. (1977) The cribellate genus *Tengella* (Araneae: Tengellidae?). *The Journal of Arachnology,* 5, 139–144.