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On three endemic species of the linyphiid spider genus *Canariphantes* Wunderlich, 1992 (Araneae, Linyphiidae) from the Azores archipelago

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Abstract

We describe *Canariphantes junipericola* **n. sp.** and *C. relictus* **n. sp.,** new single-island endemic linyphiid spiders from the islands of Flores and Santa Maria (Azorean archipelago, Macaronesia), respectively. The female of the first species was incorrectly assigned to *Canariphantes acoreensis* (Wunderlich, 1992), a species occurring in four islands in the Central Group of Azores (Faial, Pico, São Jorge and Terceira). The latter species is transferred to *Canariphantes,* its male redescribed and the female genitalia described for the first time. We discuss the systematic affinities of these new species and comment on their conservation status..

Key words: Linyphiinae, *Canariphantes, Lepthyphantes*, Macaronesia, Azores, Taxonomy, Conservation, Endemics

Introduction

The archipelago of Azores is situated in the North Atlantic Ocean and is considered the most recently formed archipelago of Macaronesian islands; the oldest island, Santa Maria, has a geological age of 8.12 M.y. and the most recent island, Pico, of 0.3 M.y. (Serralheiro & Madeira 1993; França *et al.* 2003). The dominant natural habitat dominant in the Azorean islands, prior to human colonization about 600 years ago, was mainly composed of laurel forest and other native shrub vegetation (Frutuoso 1963). This particular type of relictual forest can nowadays be found only in Macaronesia. Currently, only about 2.5% of the total area of Azores is occupied by patches of native forest (Triantis *et al.* 2010), and it is thought that man-caused extinctions played a major role in shaping the current patterns in the archipelago's spider assemblages (Cardoso *et al.* 2010a). In addition, biological invasions are severely altering the original arthropod communities (Cardoso *et al.* 2013; Florencio *et al.* 2013), with invasive species replacing natives and the functions they perform in ecosystems (Cardoso *et al.* 2014). This loss of natural habitat and its respective communities has been most intensive in the smallest islands, Graciosa and Corvo, which have lost all primary native terrestrial forest habitat, but it is also massive in most of the other islands.

The Azorean spider fauna has received little attention before the 20th century. Brief reports were made by Simon (1883), Machado (1944, 1982) and Denis (1964), and it was only by the end of the 1980's that the endemic fauna of the Azorean archipelago attracted considerable attention. Joerg Wunderlich made the first intensive effort to describe Azorean spiders (1992), listing 10 new endemic species. More recently, the complementary work of Borges & Wunderlich (2008) containing the description of eight additional endemic species and a first checklist of Cardoso *et al.* (2010b) were published. These studies were possible due to the intensive sampling effort conducted by Borges and colleagues in the scope of several projects in both native (see Borges *et al.* 2005 and a review in Borges *et al.* 2011) and exotic (Cardoso *et al.* 2009, 2013, 2014; Florencio *et al.* 2013; Meijer *et al.* 2011) habitats.

The large genus *Lepthyphantes* Menge, 1866 has recently suffered large-scale splitting, mainly due to the

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works of Saaristo & Tanasevitch (1993, 1996, 1999, 2000, 2001, 2003), who performed detailed comparative analyses of the genitalic features of micronetine spiders, for both males and females, which resulted in the creation of many genera. These authors also revised the diagnoses of already described genera.

One Azorean endemic species described by Wunderlich (1992) was *Lepthyphantes acoreensis* Wunderlich, 1992. This micronetine species was originally placed in *Lepthyphantes* but with an uncertain status (Wunderlich 1992: 374). Since the original species description, specimens of both sexes have been captured in high abundance throughout the central group of islands, none from the eastern or western groups. The newly captured material also included specimens from two new, undescribed endemic species, closely related with *L. acoreensis*. These new species were found in the western and eastern groups of islands, complementing the distribution of the previously described related species (*L. acoreensis*) in the archipelago.

Methods

Most specimens were collected using pitfall traps spread through transects of roughly 150 m. Half of these traps were filled with monoethyleneglicol and half with an attractive solution composed of dark beer and some preservatives (Turquin 1973). Details of the sampling protocol can be found in Borges *et al.* (2005). In Santa Maria Island, additional specimens of *C. relictus* **n. sp.** were collected directly, with the use of an entomological aspirator. In the laboratory, specimens and their genitalia were studied using a Leica MZ 9.5, a Leica MZ 16 or a Zeiss Stemi 2000. The second was used for photography, with a ZVC KY–F1030 camera. Images were mounted with the software Auto–Montage Pro (Syncroscopy 1997).

Embolic divisions were dissected from the male palps with the aid of a small scalpel and hypodermic needles. These were observed in ethanol and in methyl salicylate, and stored in ethanol.

Epigyna were cleared using methyl salicylate, after being dissected from the specimen, and put back into ethanol. For simplicity, only one of the entrance grooves was drawn in the illustrations of the lateral view of cleared epigyna.

For illustrations, photos of the copulatory structures were taken and printed to A4 size. A drawing was made on a superimposed paper, through transparency.

Two males and two females of *L. junipericola* **n. sp.** and five males and five females of *L. acoreensis* and *L. relictus* **n. sp.** were used for measurements. These were taken with an ocular with a ruler imbedded in it. All measurements are in mm.

Coordinates are taken using the WGS 84 datum.

Terminology of male and female genital morphology follows Saaristo & Tanasevitch (1996) and species nomenclature follows Platnick (2014).

Abbreviations used for morphology:

AME—Anterior median eyes
ALE—Anterior lateral eyes
C—Column
EG—Entrance grooves
EP—Embolus proper
FG—Fertilization grooves
L—Lamella characteristica
LL—Lateral lobes of epigynum
L Sp Ti—Proportion of the length of tibial spine with the width of tibia
MM—Median membrane
P—Paracymbium
PLE—Posterior lateral eyes
PME—Posterior median eyes
PMP—Posterior median plate
PPS—Proximal part of scape

Ra—Radix
Re—Receptacula
SA—Suprategular apophysis
Su—Suprategulum
St—Stretcher
T—Tegulum
TA—Terminal apophysis
Th—Thumb

Collections:

SNM—Senckenberg Naturmuseum, Frankfurt, Germany
EDTP—Entomoteca Dalberto Teixeira Pombo, University of Azores, Angra do Heroísmo, Portugal
ULT—Universidad de La Laguna, Tenerife, Spain

Taxonomy

Canariphantes Wunderlich, 1992

Type species: *Canariphantes alpicola* Wunderlich, 1992

Composition. *C. alpicola* Wunderlich, 1992, *C. atlassahariensis* (Bosmans, 1991), *C. epigynatus* Tanasevitch, 2013, *C. homonymus* (Denis, 1934), *C. naili* (Bosmans & Bouragba, 1992), *C. nanus* (Kulczynski, 1898), *C. palmaensis* Wunderlich, 2011 and *C. zonatus* (Simon, 1884).

Distribution. *C. alpicola* and *C. palmaensis* from Canary Islands, *C. nanus* from Central, Eastern Europe to Israel, the remaining species from the Mediterranean.

Canariphantes acoreensis (Wunderlich, 1992) new combination
(Figs. 1–7; 23–24)

Lepthyphantes acoreensis Wunderlich, 1992: 378, figs. 399–402 (description of male, not female, misidentified).

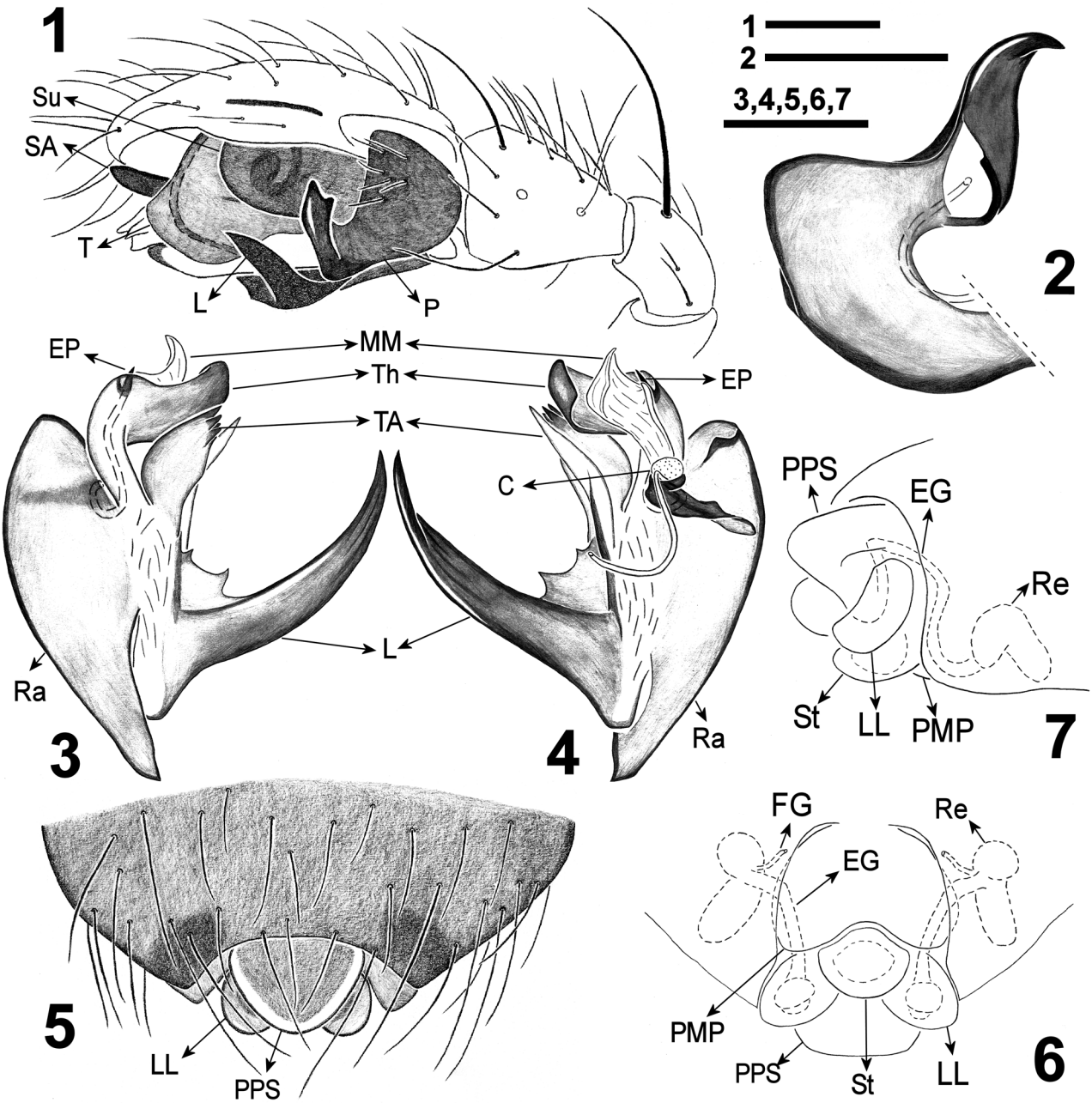
Type material. Holotype ♂ (right pedipalp missing) from Mistérios Negros, Terceira, 28.VII.1987, ULT; paratype ♀ from Mistérios Negros, Terceira, 30.VIII.1987, ULT; 1 paratype ♂ from Caldeira, Pico, VIII.1987, SNM 37603-124; 1 paratype ♀ from Mistérios Negros, Terceira, SNM 37610-124; 5 paratype ♂ and 3 paratype ♀ from Fonte da Faneca, Terceira, SNM 60151-124; 2 paratype ♂ from Fonte da Faneca, Terceira, SNM 60162-124.

Additional material examined. Terceira—Biscoito da Ferraria Natural Reserve, (UTM 26S 479370 4289985), VI.1999, 1 ♀; VII.2003, 1 ♂; VI.2011, 1 ♀. Terceira—Pico Galhardo Natural Reserve, (UTM 26S 479664 4287554), VII.2002, 1 ♂, 1 ♀; VI.2003, 3 ♂; VII.2003, 1 ♂, 1 ♀; IX.2003, 3 ♂, 2 ♀; VIII.2003, 1 ♀; V.2007, 1 ♂; VI.2010, 1 ♀. Terceira—Serra de Santa Bárbara Natural Reserve, (UTM 26S 472028 4288949), VII.2001, 2 ♂; VI.2003, 1 ♂; VII.2003, 3 ♂; VIII.2003, 5 ♂; IX.2003, 1 ♂; VII.2008, 1 ♂; IX.2010, 1 ♂, 5 ♀. Terceira—Terra Brava Natural Reserve, (UTM 26S 482438 4287412), V.1999, 1 ♂, 1 ♀; VIII.1999, 3 ♂, 1 ♀; VI.2002, 4 ♂, 1 ♀; VII.2002, 3 ♀; VI.2003, 1 ♂; IX.2003, 5 ♂, 2 ♀; VII.2007, 1 ♀; VII.2008, 3 ♂, 2 ♀; VIII.2010, 3 ♂, 1 ♀. Terceira—Caldeira Guilherme Moniz Natural Reserve, (UTM 26S 482285 4284477), IX.2003, 2 ♀. São Jorge—Pico Pinheiro Natural Reserve, (UTM 26S 408602 4277888), VII.2000, 4 ♂, 3 ♀; VII.2004, 2 ♂, 2 ♀; IX.2010, 2 ♂, 2 ♀. São Jorge—Topo Natural Reserve, (UTM 26S 421857 4272031), VIII.2000, 1 ♀; IX.2010, 2 ♀. Pico—Mistério da Prainha Natural Reserve, (UTM 26S 388683 4257957), IX.1999, 3 ♂, 3 ♀; VII.2000, 4 ♂, 1 ♀; VII.2010, 1 ♂, 1 ♀. Pico—Caveiro Natural Reserve, (UTM 26S 395274 4255409), VII.2000, 1 ♂, 1 ♀. Pico—Lagoa do Caiado Natural Reserve, (UTM 26S 390826 4257032), VII.2000, 1 ♂, 2 ♀. All specimens collected by pitfall trapping and deposited at EDTP.

Diagnosis. Males of *Canariphantes acoreensis* can be diagnosed from all other congeners by the combination

of the following palpal characters: absence of Fickert's gland, paracymbium with a bifurcated tip (Fig. 1) and terminal apophysis with several apical digitiform processes (Figs. 3–4). Females are more difficult to diagnose because the epigynum is very similar to that of *C. zonatus* (see Bosmans 2006), but it can be distinguished from it (and all other congeners) by the short and rounded proximal part of scape (Figs. 5–7).

Description. *Male* (from Terceira). Total length 2.4. Prosoma 1.0 long, 0.8 wide. All eyes except AME equal in size, large, AME small, posterior row slightly recurved, anterior row recurved. PME separated by half their diameter, separated from PLE by less than half their diameter. PLE touching ALE. ALE separated from AME by half the diameter of the former. AME separated by less than half their diameter. AME separated from PME by the diameter of the latter. Clypeus height ca. two AME diameters. Chelicerae with roughly 20 stridulatory striae, 3 promarginal teeth and 4 retromarginal denticles. Prosoma yellow. Sternum anteriorly truncated, roughly triangular, black. Opisthosoma whitish with a dorsal pattern of black chevrons (Fig. 23).



FIGURES 1–7. *Canariphantes acoreensis* (Wunderlich, 1992). 1, Male from Terceira, left palp, retrolateral. 2, Male from Pico, suprategular apophysis, ventral. 3, Same, embolic division, ventral. 4, Same, embolic division, dorsal. 5, Female from Pico, Epigynum, ventral. 6, Same, cleared epigynum, dorsal. 7, Same, cleared epigynum, lateral. Scale bars = 0.1 mm.

Legs with a prolateral spine in femur I; all patellae with 1 dorsal spine; tibiae I and IV with 2 dorsal, 1 prolateral and 1 retrolateral spine, tibiae II and III with 2 dorsal and 1 prolateral spine. Metatarsi with 1 dorsal spine. TmI 0.16. TmIV absent. L Sp Ti I 5, L Sp Ti IV 5.8. Legs uniformly dark yellow. Palp (Figs. 1–4). Patella with 1 dorsal spine, 3 times longer than diameter of patella. Tibia slightly longer than wide, with 1 dorsal spine, as long as diameter of tibia. Tibial spine roughly half the length of patellar spine. Three tibial trichobotria present, 2 retrolateral, 1 dorsal. Cymbium with a retrolateral keel. Paracymbium simple, with an incised tip, the inner tooth larger than the outer, with 6 to 7 hairs scattered from the basal to the median section. Suprategular apophysis hook-shaped in ventral view, directed anteriorly in retrolateral view, with a small sclerotized dorsal arch close to the column opening. Lamella characteristica simple, with an incised distal part. Embolic division with a terminal apophysis with several apical, small, digitiform processes. Lamella characteristica and terminal apophysis separated by a membranous area bearing two small teeth, which can be variable in size. Radix unsclerotized, with a short, pointed tailpiece. Median membrane laminar. Embolus with a lobed thumb extending retrolaterally and dorsally. Fickert's gland absent (*contra* Wunderlich 1992).

Female (from Terceira). Total length 2.8. Prosoma 1.3 long, 1.0 wide. Eyes same as in male. Clypeus height ca. three AME diameters. Chelicerae with roughly 20 stridulatory striae, 3 promarginal teeth and 5 retromarginal denticles. Prosoma same color as in male. Sternum as in male. Opisthosoma with a dorsal pattern of black chevrons, these are more diffuse than those of males and sometimes only interspersed white patches appear in a black opisthosoma (Fig. 24).

Leg spination and coloration as in male. L Sp Ti I 3.6, L Sp Ti IV 4.7. Epigynum (Figs. 5–7). Proximal part of scape short, wide and rounded, directly passing into distal part, with a total reduction or merging of the median part of scape; distal part of scape reduced, lateral lobes and stretcher very short (Figs. 5–7). Posterior median plate not visible in ventral view, heart-shaped in dorsal view. Entrance grooves not coiled, proceeding from the distal part of scape into the proximal part of scape and almost directly into the oval receptacula.

TABLE 1. Measurements of leg segments in male *Canariphantes acoreensis*: average (maximum–minimum) in mm.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.7 (1.5–1.8)	0.4 (0.3–0.4)	1.8 (1.8–1.9)	2.0 (1.9–2.1)	1.1 (1.1–1.2)	7.0 (6.8–7.3)
II	1.6 (1.5–1.8)	0.3 (0.3–0.4)	1.6 (1.4–1.7)	1.7 (1.6–1.8)	1.0 (0.9–1.0)	6.1 (5.6–6.3)
III	1.3 (1.2–1.5)	0.3 (0.3–0.3)	1.2 (1.2–1.4)	1.4 (1.3–1.4)	0.8 (0.8–0.8)	5.0 (4.8–5.3)
IV	1.6 (1.5–1.8)	0.3 (0.3–0.3)	1.7 (1.6–1.9)	1.7 (1.6–1.9)	0.9 (0.7–1.0)	6.0 (5.6–6.6)

TABLE 2. Measurements of leg segments in female *Canariphantes acoreensis*: average (maximum–minimum) in mm.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.0 (1.9–2.1)	0.4 (0.4–0.5)	2.0 (1.9–2.2)	2.1 (1.9–2.3)	1.2 (1.1–1.3)	7.7 (7.2–8.3)
II	1.9 (1.8–2.0)	0.4 (0.4–0.4)	1.9 (1.8–2.0)	1.9 (1.9–2.0)	1.1 (1.1–1.2)	7.4 (7.1–7.6)
III	1.6 (1.5–1.8)	0.4 (0.4–0.4)	1.4 (1.3–1.4)	1.5 (1.3–1.6)	0.8 (0.8–0.8)	5.6 (5.2–5.8)
IV	2.0 (1.8–2.1)	0.4 (0.4–0.4)	1.8 (1.7–1.8)	1.4 (1.3–1.5)	1.1 (1.0–1.1)	7.2 (6.6–7.2)

Variation. Total body size in male varies from 1.9 to 2.5, in female from 2.8 to 3.1. Prosoma length from 0.9 to 1.1 in male, from 1.2 to 1.4 in female. Prosoma width in female varies from 0.9 to 1.1. Some female specimens present 2 prolateral spines in Femur I.

Comments. In the original description of *C. acoreensis* by Wunderlich (1992: 567, Fig. 407) illustrated an epigynum with coiled entrance grooves and a wide stretcher. This morphology was not consistent with the genital structure of recently collected females together with males of *C. acoreensis* from nearly all the Azorean islands of the central group (Terceira, São Jorge and Pico). All collected females appeared to have an epigynum differing from Wunderlich's description, except for one single female from Flores. The first author studied the type material deposited by Wunderlich at ULT and SNM. All males and females of the central group of islands appeared to be identical to our specimens, but this could not be confirmed for a female from Flores islands with the missing epigynum. Since none of the females of the type series of *C. acoreensis* has an epigynum resembling Wunderlich's

figures, the female with the missing excised epigynum must be the one used by Wunderlich to describe the female of *C. acoreensis*. Both females from Flores belong in fact to a new species described below.

Distribution. The central group of islands with native forest patches (Terceira, São Jorge, Pico and Faial) (Fig. 8). Although *C. acoreensis* was cited from Faial (Wunderlich 1992), the referred material was not found at ULT, thus rendering the presence of *C. acoreensis* unconfirmed.

Natural history. This species builds small sheet-webs at ground level, exclusively in patches of native laurel forest. Adults were collected from May to September, but sampling outside this period was not performed.

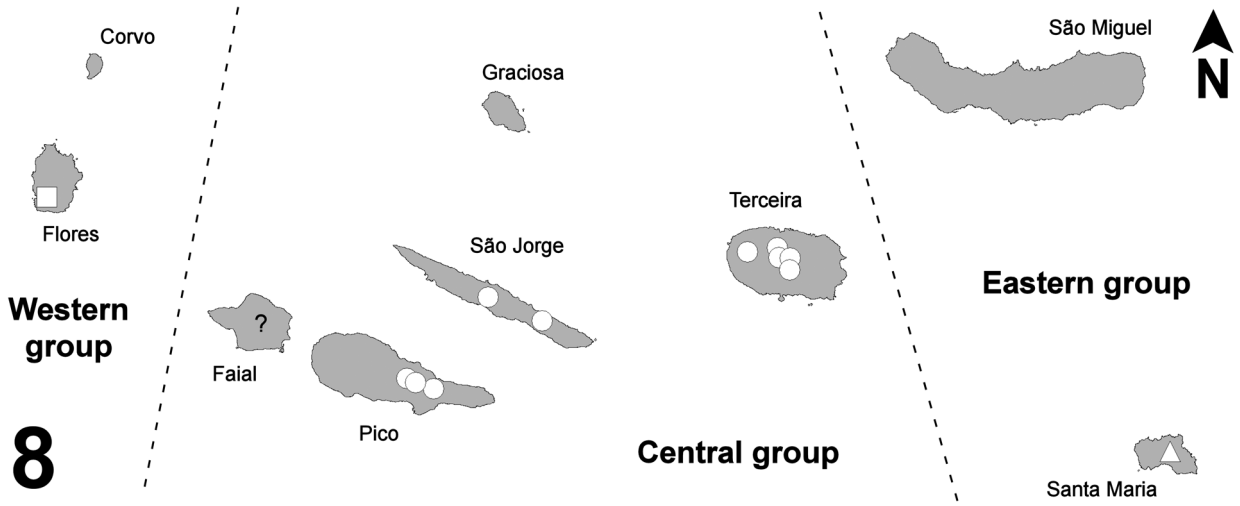


FIGURE 8. Map of the archipelago of Azores showing the collecting localities of the species described here (circles = *Canariphantes acoreensis* (Wunderlich, 1992); square = *C. junipericola* **n. sp.**; triangle = *C. relictus* **n. sp.**).

Canariphantes junipericola Crespo & Bosmans new species
(Figs. 9–15; 25–26)

Lepthyphantes acoreensis Wunderlich, 1992: 378, figs. 399–402 (descr. ♀, not ♂, misidentification).

Type material. Holotype ♂, Flores—Caldeira Funda e Rasa Nature Reserve (UTM 25S 136738 4370215), 28.VI-14.VII.2010, pitfall trapping, deposited at EDTP. Paratype ♀, same site and date as holotype, deposited at EDTP (most legs torn apart). Paratype ♂ (with a separated embolic division), same site and date as holotype, deposited at the SNM.

Additional material examined . Paratype ♀ of *Lepthyphantes acoreensis* Wunderlich, 1992 (misidentification), Flores, Lago do Seco (this should probably refer to Lagoa Seca, as there is no lagoon in Flores with that name), SNM 60150–124, epigynum missing.

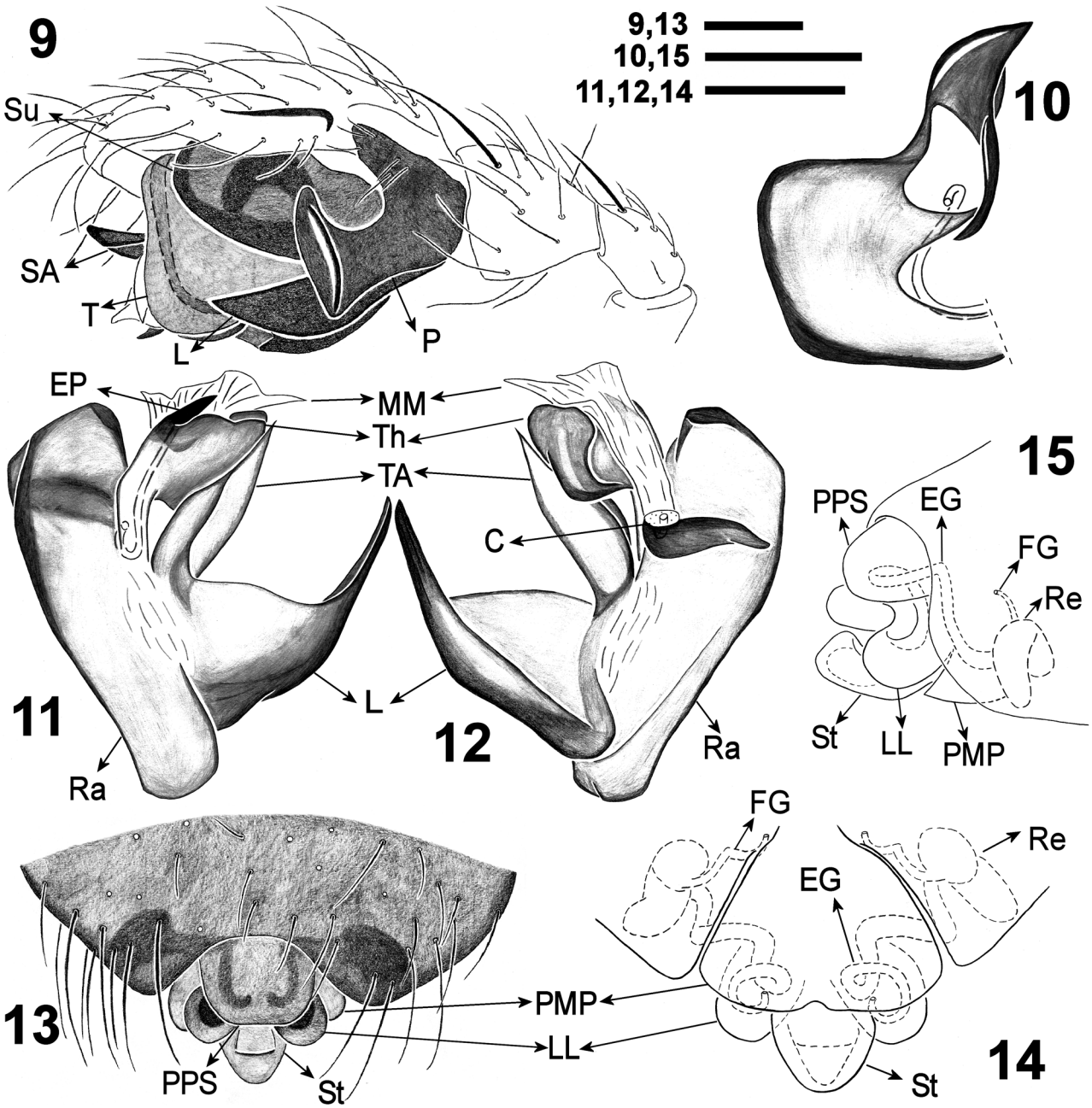
Etymology. The species name refers to the local dominant endemic tree, *Juniperus brevifolia* combined with the Latin verb *colo* (to live in).

Diagnosis. Males of *Canariphantes junipericola* **n. sp.** can be diagnosed from all other congeners by the combination of the following palp characters: absence of Fickert's gland, massive lamella characteristica, and paracymbium bearing a keel, resultant from the merged apical and anterior pockets (Fig. 9). Females are diagnosed by the protruding lateral lobes of scape (Fig. 13) and coiled entrance grooves (Figs. 14, 15).

Description. *Male holotype* (from Flores). Total length 2.7. Prosoma 1.3 long, 1.1 wide. All eyes except AME equal in size, large, AME small, posterior row slightly recurved, anterior row recurved. PME separated by less than half their diameter, separated from PLE by half their diameter. PLE touching ALE. ALE separated from AME by half the diameter of the former. AME separated by half their diameter. AME separated from PME by the diameter of the latter. Clypeus height ca. 2.5 times an AME diameter. Chelicerae with 40 to 50 stridulatory striae, 3 promarginal teeth and 6 retromarginal denticles. Prosoma yellow. Sternum anteriorly truncated, roughly triangular, darkened. Opisthosoma whitish with a black longitudinal band in the cardiac area and with posterior black chevrons (Fig. 25), ventrally black. Legs with a prolateral spine in femur I; all patellae with 1 dorsal spine; 2 dorsal,

1 prolateral and 1 retrolateral spine in tibia I, 2 dorsal and 1 retrolateral spine in tibia II and 2 dorsal spines in tibiae III and IV; 1 dorsal, 1 prolateral and 1 retrolateral spine in all metatarsi. TmI 0.2. TmIV absent. L Sp Ti I 2.7, L Sp Ti IV 3.8. Overall color yellow, with black annulations in femora and tibiae near the joints. Palp (Figs. 9–12). Patella with 1 dorsal spine, roughly as long as diameter of patella. Tibia as long as wide, with 1 dorsal spine, twice the diameter of tibia. Tibial spine roughly twice the length of patellar spine. Cymbium with a retrolateral keel. Paracymbium simple, with a distal keel, resultant from the merged anterior and apical pockets, with 4 to 6 hairs in its basal part. Suprategular apophysis a wide tooth, with a sclerotized dorsal arch above the large opening of the column. Lamella characteristica wide, terminally pointed. Terminal apophysis with a small ventral branch and a large dorsal branch, terminally pointed. Radix base widely rounded, without a pointed tail. Median membrane laminar. Embolus with a lobed thumb extending retrolaterally, anteriorly and dorsally. Fickert's gland absent.

Female (from Flores). Total length 4.0. Prosoma 1.8 long, 1.4 wide.



FIGURES 9–15. *Canariphantes junipericola* **n. sp.**, male and female from Flores. 9, Left male palp, retrolateral. 10, Suprategular apophysis, ventral. 11, Embolic division, ventral. 12. Embolic division, dorsal. 13, Epigynum, ventral; 14, Cleared epigynum, dorsal. 15, Cleared epigynum, lateral. Scale bars = 0.1 mm.

Eyes same as in males except the distance of PME, separated by half their diameter. Clypeus height ca. 3.5 times an AME diameter. Chelicerae with 30 to 40 stridulatory striae, 3 promarginal teeth and 7 retromarginal denticles. Prosoma yellowish to brown. Sternum as in male. Opisthosoma with a dorsal reticulate pattern of black patches interspersed with whitish areas, ventrally black (Fig. 26).

Leg spination same as in male. TmI 0.2. TmIV absent. Overall color yellowish to brown, with black annulations in femora and tibiae near the joints.

Epigynum (13–15). Scape sigmoid, with short proximal part, as long as wide, somewhat angular, with a total reduction or merging of the median part of the scape, distal part ending into rounded sclerotized lateral lobes on each side. Stretcher wide, with a large pit. Posterior median plate protruding in ventral view, heart-shaped in dorsal view. Entrance grooves coiled, ascending from the distal part of scape to the proximal part of scape into a coil, then proceeding in posterior direction to the oval receptacula.

TABLE 3. Measurements of leg segments in male *Canariphantes junipericola* **n. sp.**: average (minimum–maximum) in mm.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.6 (1.5–1.8)	0.4 (0.4–0.4)	1.5 (1.4–1.7)	1.8 (1.7–1.8)	1.0 (0.9–1.1)	6.3 (5.9–6.7)
II	1.5 (1.5–1.6)	0.3 (0.3–0.4)	1.4 (1.3–1.5)	1.6 (1.5–1.7)	1.0 (1.0–1.0)	5.9 (5.6–6.1)
III	1.2 (1.2–1.2)	0.3 (0.3–0.3)	1.1 (1.0–1.1)	1.2 (1.2–1.3)	0.7 (0.7–0.7)	4.4 (4.3–4.6)
IV	1.6 (1.5–1.7)	0.3 (0.3–0.3)	1.4 (1.3–1.5)	1.6 (1.5–1.7)	0.9 (0.9–0.9)	5.7 (5.5–6.0)

TABLE 4. Measurements of leg segments in female *Canariphantes junipericola* **n. sp.**: average (minimum–maximum) in mm.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.0 (1.8–2.2)	0.5 (0.4–0.5)	1.8 (1.6–2.1)	1.9 (1.8–2.1)	1.1 (1.1–1.2)	7.3 (6.7–8.0)
II	1.8 (1.6–2.0)	0.5 (0.4–0.5)	1.7 (1.5–1.9)	1.8 (1.6–2.0)	1.0 (1.0–1.1)	6.8 (6.1–7.5)
III	1.6 (1.4–1.7)	0.4 (0.4–0.4)	1.3 (1.1–1.4)	1.4 (1.3–1.6)	0.8 (0.8–0.8)	5.5 (4.9–6.0)
IV	2.0 (1.8–2.1)	0.4 (0.4–0.5)	1.8 (1.8–1.8)	2.0 (2.0–2.0)	0.8 (0.8–0.8)	7.1 (7.1–7.1)

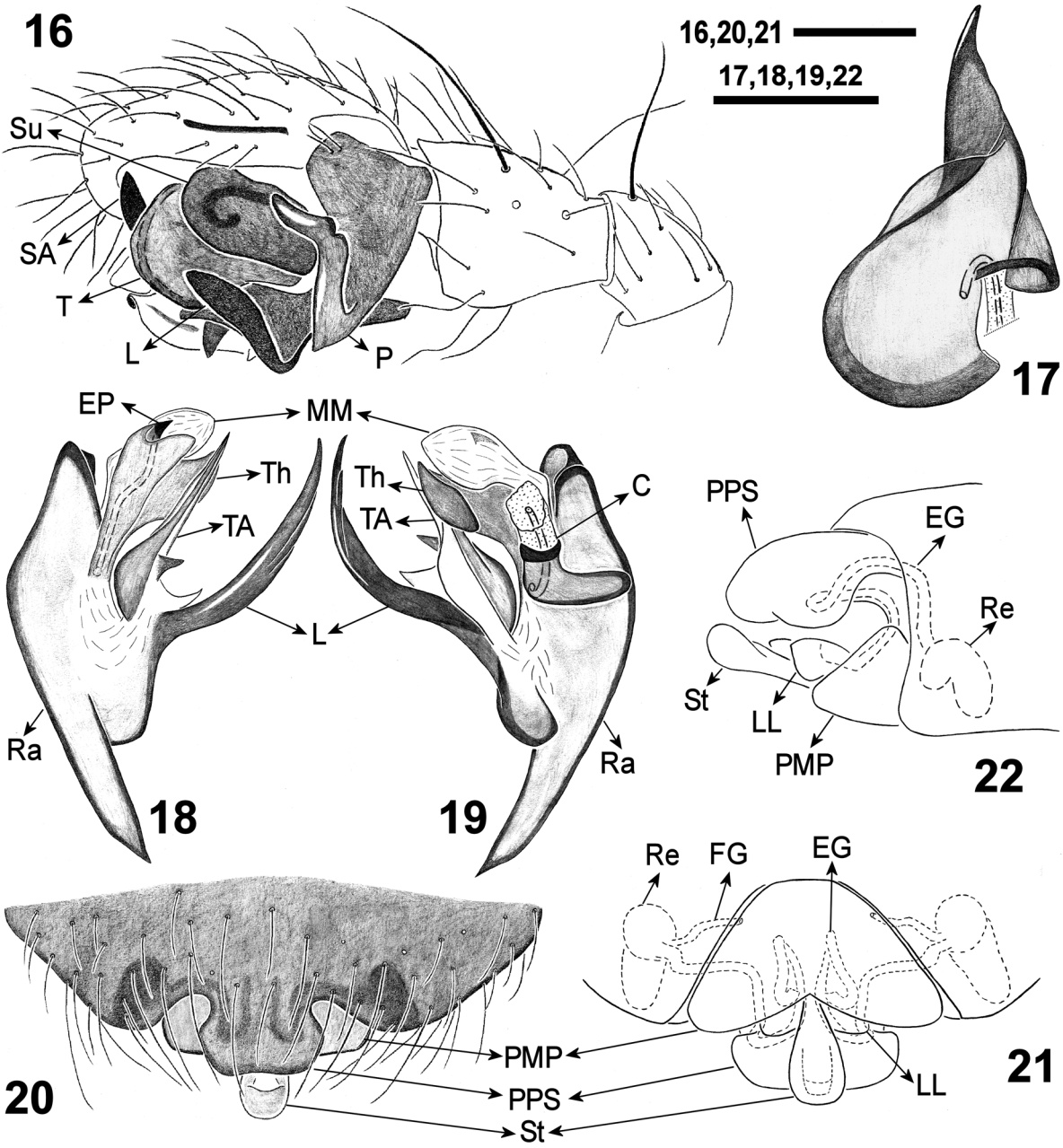
Variation. Total body size in male varies from 2.6 to 2.8, in female from 3.5 to 4.0. Prosoma length from 1.1 to 1.2 in male, from 1.3 to 1.6 in female. Prosoma width in male varies from 0.9 to 1.0, in female from 1.1 to 1.4.

Distribution. Endemic to the island of Flores (Fig. 8).

Natural history. This species is yet to be collected by direct hand sampling, having appeared solely through the use of pitfall trapping. Although several sites in Flores Island were sampled covering a wide area in the two main native forest areas and other habitat types spread through the island, the site where this species occurs is a small native forest fragment and the only one sampled in this island devoid of abundant *Sphagnum* mosses covering the ground. In this small patch of *Juniperus brevifolia* dominated forest, the ground has few or little herbaceous cover, due to a closed canopy. We can safely assume that *C. junipericola* builds its webs on the ground layer of the shady *J. brevifolia* forest. In other sites with *J. brevifolia* cover but no extensive shade or with abundant moss cover, *C. junipericola* is yet to be found. Adults were collected solely in June and July.

Canariphantes relictus Crespo & Bosmans new species
(Figs. 16–21; 27–28)

Type material. Holotype ♂, Santa Maria, Pico Alto Nature Reserve (UTM 26S 670284 4094208, datum WGS84), 10.VIII.2011, collected by hand, deposited at EDTP. 1 Paratype ♂ (in the course of the analyses, some of the genitalic structures of this specimen were lost or destroyed. Only the left embolic division, without the lamella characteristica, and the right pedipalp, with its components torn apart and without the embolus, remain) and 5 paratype ♀, same site and date as holotype, deposited at EDTP. 2 Paratype ♂ and 6 paratype ♀, same site and date as holotype, deposited at SNM.



FIGURES 16–22. *Canariphantes relictus* **n. sp.**, male and female from Santa Maria: 16, Male palp, retrolateral. 17, Suprategular apophysis, ventral. 18, Embolic division, ventral. 19, Embolic division, dorsal. 20, Epigynum, ventral. 21, Cleared epigynum, dorsal. 22 , Cleared epigynum, lateral. Scale bars = 0.1 mm.

Additional material examined. Santa Maria—Pico Alto Nature Reserve (UTM 26S 670284 4094208), VI.1997, 1 ♂ and 11 ♀; VI.2004, 2 ♂; 27.VII-10.VIII.2010, 20 ♂, collected by pitfall trapping, deposited at EDTP.

Etymology. The species name is derived from the Latin *relictum* and refers to the highly reduced area of native forest where this species lives, the disappearance of which threatens it with extinction.

Diagnosis. Males of *Canariphantes relictus* **n. sp.** can be diagnosed from all other congeners by the combination of the following palp characters: absence of the Fickert's gland and long and sharp tail of the radix (Figs. 18–19). Females are diagnosed by the shape of the scape (Fig. 20–22) and the highly coiled entrance grooves (Fig. 21–22).

Description. *Male holotype* (from Santa Maria). Total length 2.3. Prosoma 1.1 long, 0.9 wide. All eyes except AME equal in size, large, AME small, posterior row straight, anterior row recurved. PME separated by less than half their diameter, separated from PLE by less than half their diameter. PLE touching ALE. ALE separated from

AME by less than half their diameter. AME separated by half their diameter. AME separated from PME by the diameter of the latter. Clypeus heicht ca. 2.5 times an AME diameter. Chelicerae with 30 to 40 stridulatory striae, 3 promarginal teeth and 4 retromarginal denticles. Prosoma yellow, with a black band along the border of carapace. Sternum anteriorly truncated, roughly triangular, black. Opisthosoma with a dorsal pattern of black chevrons on a whitish background (Fig. 27), ventrally black.

Legs with 1 dorsal and 1 prolateral, sometimes 2 prolateral spines, in femur I; all patellae with 1 dorsal spine; 2 dorsal, 2 prolateral and 2 retrolateral spines in tibia I; 2 dorsal, 1 prolateral and 2 retrolateral spines in tibia II; tibia III and IV with 2 dorsal, 1 prolateral and 1 retrolateral spine, occasionally tibia III with 2 retrolateral spines. All metatarsi with 1 dorsal, 1 prolateral and 1 retrolateral spine. TmI 0.2. TmIV absent. L Sp Ti I 4.2, L Sp Ti IV 5.3. Legs generally the same colour as prosoma, but with darker annulations in femora and tibiae near the joints. Palp (Figs. 16–19). Patella with 1 dorsal spine, slightly longer than the diameter of patella. Tibia roughly as long as wide, with 1 dorsal spine, twice the diameter of tibia. Tibial spine twice the length of patellar spine. Three tibial trichobothria present, 2 retrolateral, 1 dorsal. Cymbium with a retrolateral keel. Paracymbium with a broad base with two basal hairs, gradually narrowing, distal part with a prolateral terminal lobe. Suprategular apophysis a tooth pointing dorsally in retrolateral view, with a small sclerotized dorsal arch encircling the opening of the column. Lamella characteristica long and thin. In ventral view, two teeth, the apical slightly sclerotized, and the basal, unsclerotized, separate the lamella characteristica and the long, thin and dorsolaterally folded lanceolate terminal apophysis. Radix unsclerotized, with a very long and thin tailpiece. Median membrane leaf-shaped, in close association with the embolus. Embolus with a thumb extending retrolaterally and dorsally. Fickert's gland absent.

Female (from Santa Maria). Total length 4.6. Prosoma 1.9 long, 1.6 wide. Eyes as in males. Clypeus height ca. three times an AME diameter. Chelicerae with 30 to 40 stridulatory striae, 3 promarginal teeth and 5 retromarginal denticles. Colour of prosoma dark yellow to brown. Sternum as in males. Opisthosoma with a dorsal reticulate pattern of black patches interspersed with non-pigmented areas (Fig. 28). Legs with 1 dorsal and 1 prolateral spine in femur I; 1 dorsal spine in all patellae; 2 dorsal, 2 prolateral and 2 retrolateral spines in tibia I; 2 dorsal, 1 prolateral and 2 retrolateral spines in tibia II; tibiae III and IV with 2 dorsal, 1 prolateral and 1 retrolateral spine. All metatarsi with 1 dorsal, 1 prolateral and 1 retrolateral spine. TmI 0.23. TmIV absent. Coloration as in males. Epigynum (Figs. 20–22). Scape sigmoid, with proximal part wider than long, distal part of scape not visible ventrally, except for the small stretcher. Posterior median plate much wider than scape. Entrance grooves coiled, ascending from distal part of scape along the median part into proximal part coiling anteriorly and then posteriorly into the oval receptacula.

TABLE 5. Measurements of leg segments in male *Canariphantes relictus* **n. sp.**: average (minimum–maximum) in mm.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.7 (1.7–1.8)	0.4 (0.4–0.4)	1.8 (1.7–1.8)	2.0 (1.9–2.1)	1.2 (1.2–1.3)	7.1 (6.7–7.5)
II	1.6 (1.5–1.7)	0.3 (0.3–0.4)	1.5 (1.4–1.7)	1.8 (1.7–1.9)	1.1 (1.0–1.1)	6.3 (5.9–6.7)
III	1.3 (1.2–1.4)	0.3 (0.3–0.3)	1.1 (1.0–1.2)	1.3 (1.2–1.4)	0.7 (0.7–0.8)	4.7 (4.4–5.1)
IV	1.6 (1.5–1.7)	0.3 (0.3–0.3)	1.4 (1.3–1.6)	1.7 (1.6–1.8)	1.0 (0.9–1.0)	6.0 (5.7–6.4)

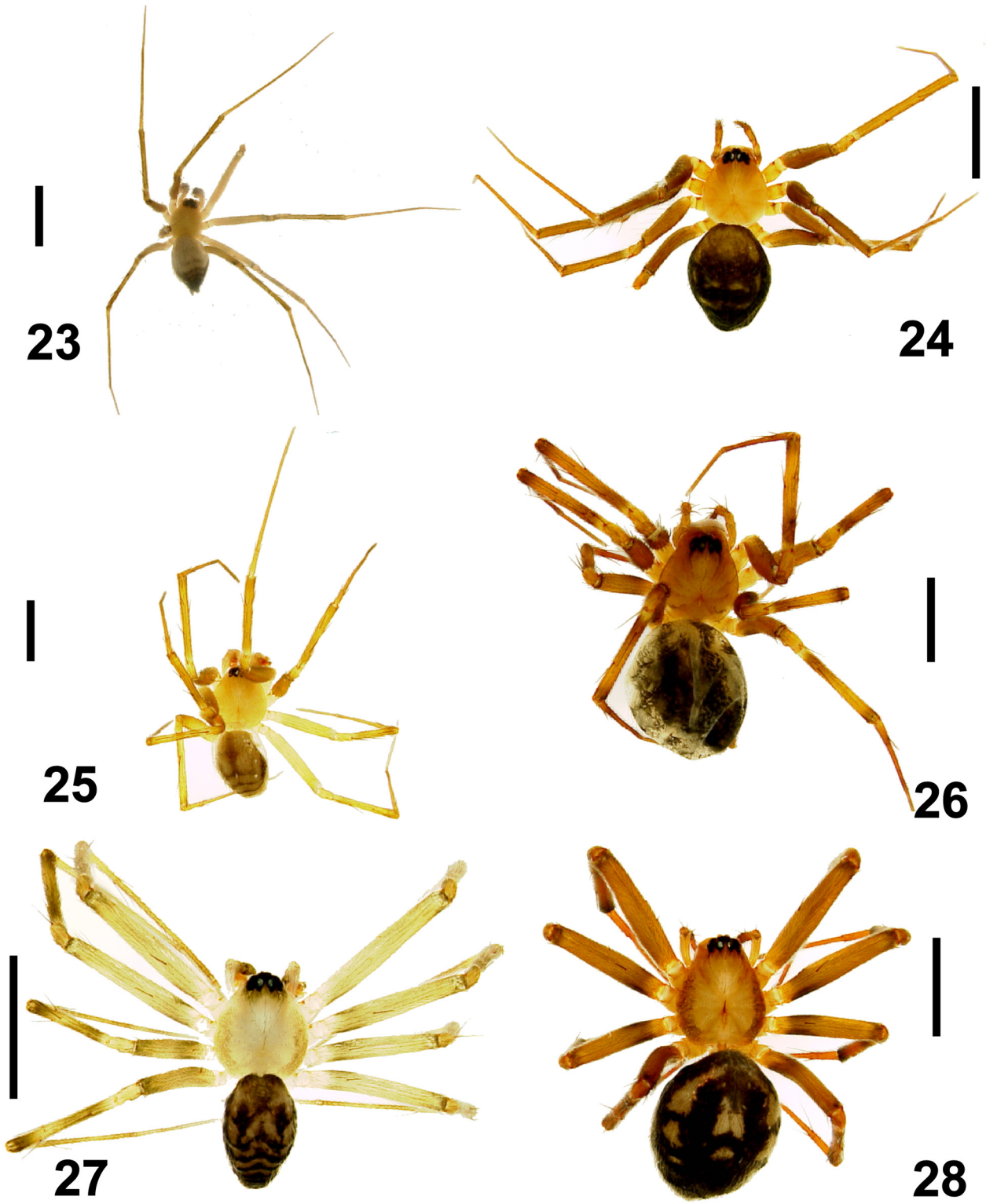
TABLE 6. Measurements of leg segments in female *Canariphantes relictus* **n. sp.**: average (minimum–maximum) in mm.

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.4 (2.2–2.5)	0.6 (0.5–0.6)	2.3 (2.1–2.5)	2.3 (2.2–2.4)	1.3 (1.3–1.4)	8.9 (8.3–9.3)
II	2.2 (1.8–2.4)	0.5 (0.5–0.6)	2.0 (1.8–2.1)	2.1 (2.0–2.3)	1.2 (1.1–1.2)	8.1 (7.4–8.4)
III	1.9 (1.8–2.0)	0.5 (0.4–0.5)	1.5 (1.4–1.6)	1.7 (1.6–1.8)	0.9 (0.9–0.9)	6.4 (6.0–6.7)
IV	2.3 (2.1–2.3)	0.5 (0.4–0.5)	1.9 (1.8–2.0)	2.1 (2.0–2.2)	1.1 (1.1–1.1)	7.8 (7.4–8.1)

Distribution. Endemic to the island of Santa Maria (Fig. 8).

Natural history. This species builds typical sheet-webs at ground level. The site where the majority of these spiders were caught is a marginal forest patch on Pico Alto Nature Reserve, and it was mainly composed of the

exotic *Cryptomeria japonica* and the invasive species *Acacia* sp. and *Pittosporum undulatum*, with a residual presence of native trees. Adults were collected from June to August, but the absence of sampling outside this period might obscure the complete phenology of this species.



FIGURES 23–28. 23–24. *Canariphantes acoreensis* (Wunderlich, 1992), male and female from Terceira, dorsal. Scale bars = 1.5 mm. **25–26.** *Canariphantes junipericola* **n. sp.**, male and female from Flores, dorsal. Scale bars = 1.5 mm. **27–28.** *Canariphantes relictus* **n.sp.**, male and female from Santa Maria, dorsal. Scale bars = 1.5 mm.

Discussion

Systematics. The problem of genus assignment whenever new micronetines are found can sometimes be puzzling, and this case is not an exception. Although some recent genera are now well known and distinct, due to the works of Saaristo & Tanasevitch (1993, 1996, 1999, 2000, 2001, 2003), others remain somewhat obscure, and the discovery of new species in these obscure genera tends to broaden their limits. While searching for affinities within the Micronetinae, the first two authors noticed some special features of these Azorean endemics. First, their embolic divisions lack a Fickert's gland. Wunderlich had illustrated a Fickert's gland in *C. acoreensis* (Wunderlich 1992: 566, Fig. 402) but, after many observations, the authors failed to find one in the three species accounted for; in all three species described here the sperm duct descends from the embolus and coils into the column and then into the suprategulum without any enlargement along its way. Second, the males of the species described here have an embolus with a terminal retrolateral thumb, and that does not fit into *Lepthyphantes sensu stricto*, because as defined by Saaristo & Tanasevitch (1996: 177), the embolus of *Lepthyphantes sensu stricto* is "massive and sickle-shaped with tight sulcus and large carina." Remarkable similarities are found with the embolus of the genera *Bolyphantes, Agnyphantes* and *Bolepthyphantes* (Saaristo & Tanasevitch 2000), but unlike the species of these genera, the new species do not present dorsal cymbial modifications. Third, all of the hereby described species show epigyna with short scapes, like that reported for the *Bolyphantes-Poeciloneta* division of the Micronetinae.
For these reasons we have decided to place the two new species in the genus *Canariphantes*. The genitalia of the type species, *C. alpicola*, is very similar to the species described here: the embolic division presents a lobed thumb, a simple lamella characteristica, a relatively simple terminal apophysis and no projections in the cymbium; and the epigyna have a very short scape. We also add that this genus has representatives on the Macaronesia and Mediterranean, which from a biogeographical standpoint, is congruent with this conjecture. Until large-scale cladistic studies are done within *Lepthyphantes sensu lato*, *Canariphantes* seems to be the closest to the natural placement of these endemic spiders of the Azores.

Conservation and protection measures. Both new species described here are restricted to single forest patches in single Azorean islands (Fig. 8), and were not found in disturbed habitats sampled for other projects, such as semi-natural grasslands or pastures (Meijer *et al.* 2011; Cardoso *et al.* 2013, 2014; Florencio *et al.* 2013). *C. junipericola* **n. sp.** is found in a single forest of 2.4 km^2, Caldeira Funda e Rasa Nature Reserve in Flores Island. This forest is highly disturbed, dominated by many invasive species (Cardoso *et al.* 2007; Gaspar *et al.* 2011). Nevertheless, it is extremely difficult to know the current population trend of the species (the Prestonian shortfall, see Cardoso *et al.* 2011b), since it was not found in several collecting trips made before 2010 or in the neighboring and more pristine forest of Morro Alto and Pico da Sé. We hypothesize that this could be explained by the fact that most of Morro Alto and Pico da Sé is composed of open *Sphagnum* peat bogs with the ground of forest patches being entirely covered by several meters depth of this moss, and these spiders might prefer secluded havens of shady *Juniperus brevifolia* forest with little moss cover. These two Nature Reserves are the only remaining native forest fragments of Flores. The absence of *C. junipericola* **n. sp.** in the dominant *Sphagnum* covered *Juniperus* forest in Flores and its restricted distribution to a small disturbed and isolated fragment makes its conservation a priority.

C. relictus **n. sp.** is found only in an equally highly disturbed, minute forest with 0.09 km^2, Pico Alto in Santa Maria Island (Cardoso *et al.* 2007; Gaspar *et al.* 2011; Meijer *et al.* 2011), the only remaining native forest patch of the island. As with the previous species, it is hard to know the current population trends since before 2010 most specimens found were juveniles in pitfall traps and few adult females or males.

Both islands were covered by forest before human settlement almost 600 years ago. Loss of native forest is a major cause of past and future extinctions of spiders (Cardoso *et al.* 2010a) and arthropods (Triantis *et al.* 2010) in this archipelago. However, in the view of the present data, we cannot suggest that any of these species is in decline, and possibly have populations elsewhere in undisturbed exotic forests (see Meijer *et al.* 2011).

The current knowledge allows us however to suggest a classification according to the IUCN criteria (IUCN 2001; Cardoso *et al.* 2011a). With an Area Of Occupancy < 20 km^2, and presence in a single location, a category of Vulnerable is currently suggested for both species. If continuing decline or extreme fluctuations are found then a status of Critically Endangered could eventually be suggested for both.

It should be noted that the Pico Alto Nature Reserve is an extremely small fragment of native habitat in the oldest island of the Azores, but can be considered a hotspot of diversity with 57 endemic species, *i.e.* 21% of the

Azorean endemic arthropods occur in less than 0.25% of the current area of native forest (Borges *et al.* 2011). Due to its age (8.12 M.y.), Santa Maria is home for a number of single-island endemic arthropod species (Borges & Hortal 2009) that survive in precarious situation either in this forest fragment or in surrounding, surrogate, habitat (Meijer *et al.* 2011). Yet, *C. relictus* **n. sp.** is the only spider considered as single island endemic in Santa Maria, as probably many species in this island were driven to extinction before description (Cardoso *et al.* 2010a). Concerning the widespread species *C. acoreensis,* most areas in Terceira and Pico are well preserved, but in São Jorge and Faial are very disturbed. The only way to guarantee the survival of the island's many endemic arthropod species would be to recover the native forest in a large area.

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