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Philodromus splendens spec. nov., a mysterious new spider species from pine trees in Bulgaria (Araneae: Philodromidae)

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Abstract. *Philodromus splendens* **spec. nov.** is described from both sexes and tentatively placed in *Philodromus* Walckenaer, 1826. Its relationships are briefly discussed. The number of reported spider species from Bulgaria is thus raised to 1046.

Keywords: Arachnida, Europe, taxonomy

Zusammenfassung. *Philodromus splendens* spec. nov., eine rätselhafte neue Spinne auf Kiefer in Bulgarien (Araneae: Philodromidae). *Philodromus splendens* **spec. nov.** wird nach beiden Geschlechtern beschrieben und provisorisch zu *Philodromus* Walckenaer, 1826 gestellt. Ihre systematischen Beziehungen werden kurz diskutiert. Die Anzahl der für Bulgarien gemeldeten Spinnenarten erhöht sich somit auf 1046.

The spider fauna of Bulgaria currently includes 1045 species (Dimitrov et al. 2019, Lazarov & Dimitrov 2018, Naumova 2018, 2019, Naumova et al. 2017, 2019a, 2019b), of which 17 species belong to *Philodromus* Walckenaer, 1826, one to *Pulchellodromus* Wunderlich, 2012 and two to *Rhysodromus* Schick, 1965 (Deltshev 2011, Deltshev & Blagoev 2001, Deltshev et al. 2012, Drensky 1936, Jäger 1995, Lazarov 2007). However, a series of collecting efforts undertaken by the author and collaborators showed that the number of species of *Philodromus* occurring in the country is actually higher. One paper focuses on novelties in the *Philodromus aureolus* group (Indzhov in prep.), while the current paper focuses on a peculiar outsider of unclear relationships.

Materials and methods

Spiders were collected by hand or by beating. Unless otherwise stated, the material was collected by the author. If no method was stated, then hand collection is assumed. The immatures were kept until maturity in plastic boxes (either 1 × 3.5 × 5.5 cm or 2 × 5 × 8 cm) and fed diverse insects from the orders Diptera and Lepidoptera. Once dead, the specimens were fixed in 70–90% ethanol and stored in Eppendorff vials. Specimens were examined under a Carl Zeiss Jena Citoplast with a grid for measurement, MBS-8 and Bresser Advance ICD stereomicroscopes. Drawings were made using 5MP smartphone camera photographs taken through the ocular as templates (smartphone model Lenovo A536) on rice paper using pencil and an ink pen. Digital images of the habitus were taken using a Canon EOS 400D DSLR camera with a SIGMA 105mm macro lens. Digital images of genitalia were taken with a Canon EOS 1100D digital camera, attached to a Carl Zeiss Amplival microscope. The vulva was made translucent in concentrated lactic acid at room temperature. Hairs on the prolateral margin of the cymbium were removed in some cases to uncover the embolus. Left male pedipalp is always depicted.

Terminology is based on Lecigne et al. (2019), Muster et al. (2007) and Muster & Thaler (2004) for the male and Muster et al. (2007) for the female.

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In the Material examined section, lack of maturity date means the specimen was collected as an adult. Conversely, presence of two dates means the specimen was collected immature and subsequently raised to maturity.

Types are deposited at National Museum of Natural History, Sofia (NMNHS). The additional material listed in the Material examined section is deposited in the author's collection, unless otherwise stated.

Abbreviations. ALE, anterior lateral eyes; AME, anterior median eyes; CD, copulatory ducts; Cy, cymbium; dis, distal; juv, juvenile(s); mat, matured (on); med, medial; Mt, metatarsus; PLE, posterior lateral eyes; PME, posterior median eyes; pr, proximal; Pt, patella; RTA, retrolateral tibial apophysis; Ta, tarsus; Ti, tibia; VTA, ventral tibial apophysis.

Results

Philodromidae Thorell, 1870

Philodromus Walckenaer, 1826

splendens group

General remarks. Due to unclear relationships with existing genera like *Celerrimus* Lecigne, Cornic, Oger & Van Keer, 2019, the *Philodromus* species in the *rufus* group in a broad sense as treated by Dondale & Redner (1968), *Pulchellodromus* Wunderlich, 2012, and *Rhysodromus* Schick, 1965, a new genus group taxon to accommodate the present species is not formally described.

Diagnosis. The only member known so far of this group is characterised by the following traits: lacking apical spines on Mt I & II; densely scopulate Mt and Ta as well as palpal Ta in females and juveniles; large distance between PME; a long cymbium with an indistinct retrobasal process, presence of a thick hook-shaped conductor process, a capital-Gamma-shaped soft conductor originating behind the anterior tegular margin in the male; a sclerotised epigyne with a subtriangular median plate, globular receptacula lacking glandular mounds, and small glandular heads in the female. The greatest affinities are with *Philodromus* from the *rufus* group as characterised by Dondale & Redner (1968) (= *Tibellomimus* Gertsch, 1933, as characterised by Schick 1965). The differences are mainly in the size of the conductor process which is significantly larger in *Philodromus splendens* **spec. nov.**, the embolus which is more robust and more distally originating in the new species, the additional functional conductor (Fig. 1a-b, see also

discussion for affinities towards paraembolar apophysis); also, the copulatory ducts are either long, parallel and sclerotised, with anteriorly situated glandular heads (Dondale & Redner 1968: Figs 115-122), long and transparent, revolving around the spermathecae and with basally situated glandular heads (Dondale & Redner 1968: Figs 124, 126, 133) or very short (Dondale & Redner 1968: Fig. 153-156, 168, 171, 201 – list of figures incomplete) but never anteriorly converging, with a wide lumen and basally-medially situated glandular heads (Figs 1c-e, 2d-e). Furthermore, glandular mounds (= torus in Schick 1965) are absent in *Philodromus splendens* **spec. nov.** Another morphologically similar taxon is *Pulchellodromus* Wunderlich, 2012, as characterised by Muster et al. (2007). It has a similar configuration to the *rufus* group of the above mentioned genital and chaetotaxy traits (but see discussion for its established relationships) so this part will not be repeated. Also, it differs from the *splendens* group in the more developed cymbial process (Muster et al. 2007). From *Rhysodromus* as diagnosed by Szita & Logunov (2008) the new species group differs significantly in some aspects of genital morphology, especially shape of the embolus, the female epigyne (e.g. septum not continuous, character 60 in Muster 2009), and length of the copulatory ducts (corresponding to the length of embolus). There is also some resemblance in the habitus, chaetotaxy, size of conductor process and form of the embolus to *Celerrimus duffeyi* Lecigne, 2019, but the orientation of the embolus, shape of the conductor, the configuration of the tibial apophyses and the epigyne are different (Lecigne et al. 2019: plate 6).

***Philodromus splendens* spec. nov.**

Material examined. BULGARIA: Holotype: ♂, Sofia, The South park, isolated pine tree on a meadow (42.66326°N, 23.30366°E, 600 m a.s.l.), 2. May 2018, *Pinus nigra/sylvestris* branch; Paratypes: 1 ♀, Sofia, The South park, same locality as holotype, 7. Apr. 2018, mat. 28. Apr. 2018, beaten off a *Pinus nigra/sylvestris* branch; 1 ♀, Sofia, The South park, same locality as holotype, 28. Apr. 2018, mat 10. May 2018, *Pinus nigra/sylvestris* branch; 2 ♂♂, Sofia, The South park (42.66851°N, 23.31040°E, 623 m a.s.l.), 19. May 2019, pine monoculture, beaten off *Pinus nigra/sylvestris* branches. All types are deposited at NMNHS.

Additional material examined. BULGARIA: 1♂, Sofia, Borisova gradina park near "Vishneva" (42.67865°N, 23.33535°E, 610 m a.s.l.), 6. Nov. 2019, mat 25. Dec. 2019, under *Pinus nigra/sylvestris* bark; 1♂, Sofia, Borisova gradina park near Seminary (42.67595°N, 23.33801°E, 617 m a.s.l.), 27. Nov. 2019, mat 19. Jan. 2020, mixed forest, under *Pinus nigra/sylvestris* bark; 1♀, Sofia, Borisova gradina park near Seminary (42.67595°N, 23.33801°E, 617 m a.s.l.), 18. Dec. 2019, mat 12. Feb. 2020, mixed forest, under *Pinus* bark; 1♀, Sofia, Borisova gradina park near Balgarska Armia Stadium (42.68287°N, 23.33923°E, 570 m a.s.l.), 2. Feb. 2020, mat 28. Mar. 2020, mixed forest, under *Pinus nigra/sylvestris* bark; 1♂, Sofia, Borisova gradina park, 42.67°N, 23.34°E, ca. 600 m a.s.l., 10. Feb. 2020, mat 28. Mar. 2020, mixed forest, under *Pinus nigra/sylvestris* bark, NMNHS (stuck in its last moult; transferred in 96% ethanol); 1♀, Sofia, The South park (42.66851°N, 23.31040°E, 623 m a.s.l.), 6. Mar. 2020. mat 23.

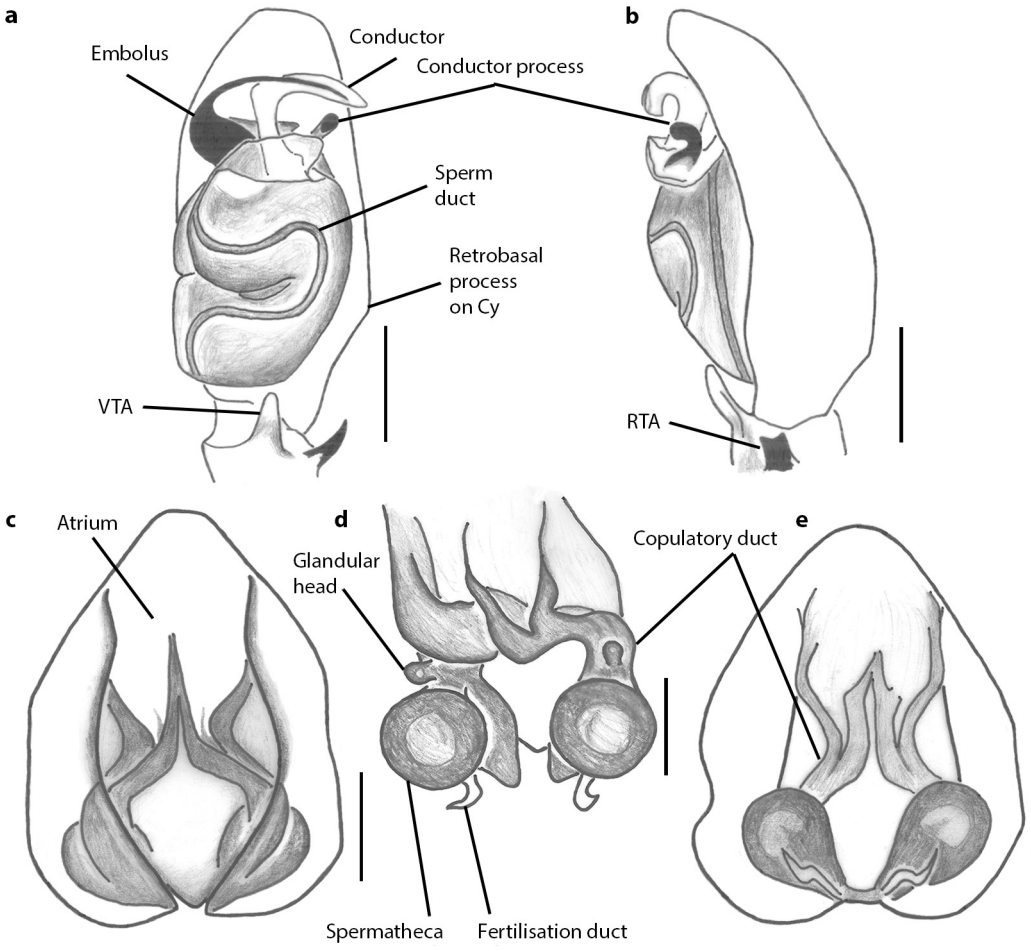

Fig. 1: *Philodromus splendens* **spec. nov. a.** male pedipalp, ventral view (holotype); **b.** male pedipalp, retrolateral view; **c.** female epigyne/vulva, ventral view (paratype); **d.** female vulva, antero-dorsal view; **e.** female vulva, dorsal view. Scale bar of a-b 0.4 mm; of c-e 0.2 mm

Mar. 2020, pine monoculture, beaten off *Pinus nigra/sylvestris* branches; 2 juv, Sandanski, no exact coordinates, prior to 4. Aug. 2019, in a *Sceliphron* Klug, 1801 nest, leg. Irina Paparo (identification tentative), NMNHS.

Etymology. Latin adjective, meaning "bright", "shining", referring to the distinctive colouration.

Distribution. Known with certainty only from the type locality, with juveniles possibly belonging to this species found at a second location. Both places are situated in Western Bulgaria.

Diagnosis. To complement the group diagnosis above, following traits are added: transverse sperm duct loop, tegular margin with an oblique lamellous extension, curved bifid RTA in male (Fig. 1a-b) as well as remotely U-shaped excavated median septum, wedge-shaped structure dividing the atrium posteriorly, X-shaped sclerotized copulatory ducts, globular spermathecae without glandular mounds in female (Fig. 1c-e).

Description

Male

Measurements. (n = 1, holotype): Carapace length 3.0 mm, width 2.9 mm. Opisthosoma length 2.6 mm. Distance between PME 0.46 mm. Distance between AME 0.19 mm. Distance AME–ALE 0.19 mm. Distance PME–PLE 0.23 mm. Distance PME–AME 0.23 mm. Distance PME–ALE 0.19 mm. Distance PLE–AME 0.56 mm. Distance PLE–ALE 0.28 mm. Fe I 3.0 mm. Pt I 0.93 mm. Ti I 2.3 mm. Mt I 1.6 mm. Ta I 1.6 mm. Fe II 3.26 mm. Pt 1.2 II mm. Ti II 2.8 mm. Mt II 3.0 mm. Ta II 1.6 mm. Fe III 2.56 mm. Pt III 0.7 mm. Ti III 2.1 mm. Mt III 1.86 mm. Ta III 1.4 mm. Fe IV 3.26 mm. Pt IV 1.2 mm. Ti IV 2.56 mm. Mt IV 2.33 mm. Ta IV 1.4 mm. Palp Fe 1.2 mm. Palp Pt 0.56 mm. Palp Ti 0.7 mm. Palp Cy length 1.4 mm. Palp Cy width (at tip of cymbial process) 0.7 mm. Spination in Tab. 1. Size variability (n = 2): prosoma length 2.9-3.0 mm, opisthosoma length 2.6–3.1 mm.

Habitus. Same markings as female (see below), but darker and duller, rather brownish. Legs brownish, femora proximally paler. Terminal segments of legs (Ta, Mt) covered by scarce scopulae.

Pedipalp. Cymbium large and elongated, with a very short, flattened tip covered in short, dense setae (omitted in Fig. 1a-b). Tegulum trapezoid (distal and proximal margins parallel to each other, prolateral margin orthogonal to them, retrolateral margin oblique), with a low transparent tooth-like projection distally, covering the base of conductor when viewed ventrally. Loop of sperm duct transverse (opening at a ca. 9 o'clock position, Figs 1a, 2a-b), nearly reaching the retrolateral margin. Embolus, originating distally, embolic base thick, situated more distally than the distal margin at its prolateral side. A retrolaterally pointing tooth originates on the retrolateral side of the base, partly or completely hidden behind the base of conductor, when viewed ventrally. Embolus abruptly curved above the base, its main part transverse to cymbium and reaching past its retrolateral margin. Conductor not sclerotised, originating from the middle of the distal tegular margin just next to the projection, curved in the middle and then strictly following the distal part of the embolus until both end. A thick hook-shaped conductor process originates retrolaterally (at a ca. 2 o'clock position) behind the distal margin of the tegulum. Tibia with two apophyses, VTA narrow, lamellous, its prolateral margin oblique and its apex blunt. RTA short, sclerotised, hook shaped from ventral view, more or less bifid and with a slightly thickened base from retrolateral view.

Female

Measurements. (n = 1, paratype from 7. Apr. 2018): Carapace length 3.7 mm. Carapace width 3.7 mm. Opisthosoma length 5.1 mm. Distance between PME 0.65 mm. Distance between AME 0.28 mm. Distance AME–ALE 0.23 mm. Distance PME–PLE 0.23 mm. Distance PME–AME 0.28 mm. Distance PME–ALE 0.1mm. Distance PLE–AME 0.6 mm. Distance PLE–ALE 0.23 mm. Fe I 3.72 mm. Pt I 1.63 mm. Ti I 2.8 mm. Mt I 2.56 mm. Ta I 1.63mm. Fe II 4.2 mm. Pt II 1.85 mm. Ti II 3.72 mm. Mt II 2.56 mm. Ta II 1.63 mm. Fe III 3.25mm. Pt III 1.63 mm. Ti III 3.25mm. Mt III 2.56 mm. Ta III 1.4 mm. Fe IV 3.25 mm. Pt IV 1.4 mm. Ti IV 2.8 mm. Mt IV 2.56 mm. Ta IV 1.5 mm. Palp Fe 1.4 mm. Palp Pt 0.45 mm. Palp Ti 0.7 mm. Palp Ta 1.4 mm. Spination in Tab. 1. Size variability (n = 2): Carapace length 3.2–3.7 mm, opisthosoma length 3.8–5.1 mm.

Habitus. Cephalothorax, reddish brown, margin covered with white hairs. Opisthosoma at its widest at the level of the cardiac mark apex, posteriorly tapering, cardiac mark large, broad, red. Two white transverse lines present dorsally – one going through the posterior tip of the cardiac mark, one further anteriorly, roughly mid cardiac mark and interrupted by latter. A broad bronze coloured folium surrounded in white is situated posteriorly of the cardiac mark. Sides of opisthosoma lighter, reddish or orangish. Hairs on opisthosoma very slightly shining. Legs orangish, with some annulations (Fig. 4). Terminal segments of legs (Ta, Mt) and pedipalps (Ta, Ti) covered in dense black scopulae.

Epigyne and vulva. Epigyne, a concave median part (septum?) surrounded by two folds that converge posteriorly. Posterior section of median part nearly triangular, with a slightly convex anterior side. Anteriorly of it sclerotised ridges (marking the underlying copulatory ducts) present. These delimit the posterior side of two triangular sclerites covering the atrial openings. Atrium V-shaped, with a median ridge formed by the distal part of the inner walls of the copulatory ducts. Epigynal plate, longer than wide, nearly pentagonal (Figs 1c, 2d). Receptacula, situated laterally of the posterior part of the epigyne, globular but with conical extensions leading towards the fertilisation ducts. Copulatory ducts, sclerotised, converging strongly towards the posterior atrial margin and touching there. Glandular heads, situated anteriorly of the receptacula on the dorsal side of the copulatory ducts, visible from an antero-dorsal view of the vulva (Figs 1d, 2e), slightly elongated and with widened, globular tips.

Tab. 1: *Philodromus splendens* **spec. nov.** spines on leg I (based on several specimens in order to avoid omitting broken off spines and to cover variability. Additional spines present in males are put in brackets)

Spines leg I	Femur I	Patella I	Tibia I	Metatarsus I
Dorsal	1 pr, 1 med, 1 dis	1 pr, 1 med	1 pr, 1 med, 1 dis	1 pr
Prolateral	1 pr, 1 med, 1 dis	– (1 pr, 1 med)	1 pr, 1 med, 1 dis	1 pr, 1 med
Ventral	–	–	2 pr, 2 med, 2 dis	2 pr, 2 med
Retrolateral	(1-2 pr), 1 med, 1 dis	–	1 pr, 1 med, 1 dis	1 pr, 1 med, (1 dis)

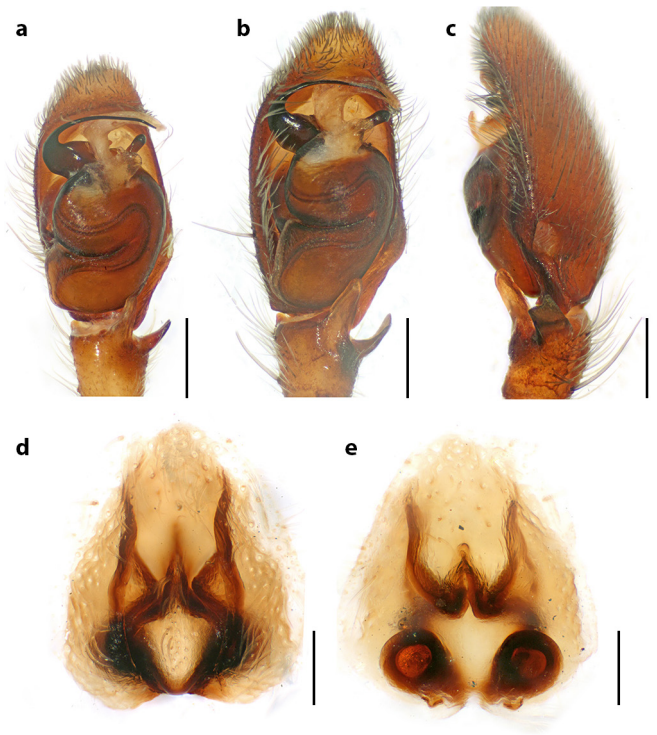

Fig. 2: *Philodromus splendens* **spec. nov. a.** male pedipalp, ventral view (holotype); **b.** same (one paratype from 19. May 2019, same scale); **c.** male pedipalp, retrolateral view (same paratype as b); **d.** female epigyne, ventral view (paratype from 28. Apr. 2018); **e.** female vulva, antero-dorsal view (same paratype as d). Scale of a-c 0.4 mm, scale of d-e 0.2 mm. (photos: Dragomir Dimitrov)

Discussion

This species could not be found anywhere in the literature on the family Philodromidae Thorell, 1870 available in the World Spider Catalog (2020). Its origins and distribution are as yet unclear, but given its suggested affinities it could be an introduction from the New World, although other possibilities including an Old World origin cannot be excluded. Adult specimens are so far known only from two parks in Sofia, Bulgaria, where the species seems to be established, and two juveniles with a similar habitus and chaetotaxy tentatively assigned to this species were collected in Sandanski (south-western Bulgaria) from a *Sceliphron* nest kindly sent to the author by Irina Paparo. Apart from the fact it matures in May – like several other *Philodromus* species in the region (personal observation by the author) – much of its biology is unknown. The species is almost certainly a habitat specialist on pine crowns, and the inaccessibility of the pine crowns might mean that this species is more widely distributed on the Balkan Peninsula – just rarely recorded. This view is supported by finding overwintering juveniles two moults before reaching maturity under pine bark in Borisova Gradina park in Sofia, Bulgaria, in late autumn and early winter (November–December). The species has not yet been found on any other type of tree in either park.

Its morphology is also unique, most notably featuring a long, soft functional conductor originating behind the anterior tegular margin. In some other *Philodromus* species, like those from the *aureolus* or the *rufus* groups, the conductor is a broad extension of the anterior tegular margin and thus not homologous with *Philodromus splendens'* **spec. nov.** conductor. The latter could be an oversized homolog to the paraembolar apophysis/process in the *rufus* or *pulchellus* groups (Dondale & Redner 1968, Muster et al. 2007) as its base is pressed against the robust sclerotised base of the embolus. Other similarities between *Philodromus splendens* **spec. nov.** and the *rufus* group (= *Tibellomimus* Gertsch, 1933) are in the configuration of Ti and Mt I spines in both sexes (Dondale & Redner 1968, Gertsch 1934, concerning *Philodromus floridensis* Banks, 1904). Genital similarities are the presence of two tibial apophyses including an elongated lamellous VTA (Schick 1965), a bifid RTA (Dondale & Redner 1968: Figs 40, 88) and a retrodistally originating, curved conductor process on the bulbus (PCA in Schick 1965) in the male, presence of glandular heads (= spermathecal organ in Schick 1965) and similarities in the epigynes of *Philodromus splendens* **spec. nov.** to those of *Philodromus bilineatus* Bryant, 1933 and *Philodromus floridensis* Banks, 1904 (Dondale & Redner 1968: Figs 200, 202), the former being the type species of *Tibellomimus* Gertsch, 1933. *Pulchellodromus* Wunderlich, 2012, while appearing morphologically similar to some members of the *rufus* group, especially *Philodromus rufus* (Walckenaer, 1802) and allies like *Philodromus exilis* Banks, 1892, in the configuration of the tibial apophyses, the shape of the paraembolar apophysis where present in *Pulchellodromus* (Muster et al. 2007: Figs 12-14) and the female vulva, lands surprisingly far from *Philodromus rufus* in the phylogenetic trees of Muster (2009: Fig. 1). However, the basic morphological traits used in the diagnosis of *Philodromus splendens* **spec. nov.** – tibial apophyses, paraembolar apophysis where present, conductor process in *Pulchellodromus simoni* (Mello-Leitão, 1929) and *Pulchellodromus wunderlichi* (Muster, Bosmans & Thaler, 2007) (Muster et al. 2007: Figs 16-17), *Philodromus rufus*-like vulva type – are nearly the same. Other similarities include the transverse sperm duct loop, the prolaterally visible subtegulum and the distally originating embolus. Due to the fact that *Pulchellodromus* resembles it only in the male sex, the present author considers *Pulchellodromus* to be more distant than the *rufus* group to *Philodromus splendens* **spec. nov.** Seemingly more distant, but nevertheless potentially relevant taxa are *Rhysodromus* Schick, 1965 as diagnosed in Szita & Logunov (2008) and *Celerrimus* Lecigne, Cornic, Oger & Van Keer, 2019. The former shares some somatic similarities with *Philodromus splendens* **spec. nov.** like having PME closer to PLE than to AME, densely scopulated Mt and Ta, and in lacking apical spines on Mt I. Form and approximate position of the glandular heads (Szita & Logunov 2008, character 52 in Muster 2009), the same as in its type species *Rhysodromus histrio*, are also similar to those in *Philodromus splendens* **spec. nov.** *Celerrimus duffeyi* Lecigne, 2019, being another pine-associated West Palaearctic species, is of some interest, featuring several somatic (ventral Ti I and Mt I spines, also habitus) and genital (shape and position of conductor process, thickened base of embolus) similarities. However, its markedly different female genitalia, tibial apophysis configuration and most notably the unique inverted embolus likely warrant a distant position. A unifying role in the taxa used in the diagnosis played the conductor process. It is likely homologous in *Celerrimus*, the *Philodromus rufus* group, the *Philodromus splendens* group and *Pulchellodromus*, originating retrodistally on the bulbus on a membranous area, just behind the tegular margin and close to the conductor and being usually hook-shaped (Figs 1a-b, 2a-c; Lecigne et al. 2019, Muster et al. 2007, Schick, 1965).

Fig. 3: *Philodromus splendens* **spec. nov.** female, live specimen

Fig. 4: Known and suspected (question mark) distribution of *Philodromus splendens* **spec. nov. 1.** Sofia; **2.** Sandanski (map source: d-maps 2019)

Other possible homologies include the philodromid tegular apophysis in *Rhysodromus* Schick, 1965 (Schick 1965, Szita & Logunov 2008) or even the sclerite called the conductor in the *Philodromus infuscatus* group although the latter seems to originate from the tegular margin (Dondale & Redner 1969). Identifying homologies in Philodromidae is, however, problematic according to Muster (2009) so until a proper phylogenetic analysis is conducted some of these statements will contain a degree of uncertainty. However, this is beyond the current capabilities of the author and represents a future goal. For that reason, *Philodromus splendens* **spec. nov.** is retained in the type genus *Philodromus* until further revisions, with the latter being possibly in need for revision or even further splitting, according to some authors (this has been addressed in Lecigne et al. 2019).

Anyway, the finding itself is a peculiar addition to the Bulgarian as well as to the European spider fauna, with the number of recorded Araneae species for Bulgaria reaching 1046 (Dimitrov et al. 2019, Lazarov & Dimitrov 2018, Naumova 2018, 2019, Naumova et al. 2017, 2019a, 2019b, present paper).

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