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

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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 Pulchelodromus 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 matures 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 matured and subsequently raised to maturity.

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.

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
Philodromus Thorell, 1870
Philodromus Walckenaer, 1826

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), Pulchelodromus 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 Mr 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) (= Tibellonimus 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...
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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 spermatheca 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 rifus 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 Arma 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.
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 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 II 1.2 mm. Ti II 2.8 mm. Mt II 3.0 mm. Ta II 1.6 mm. Fe III 3.55 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 with 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 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 0.11 mm. 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 1.63 mm. 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 3.25 mm. Pt III 1.63 mm. Ti III 3.25 mm. 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, another 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.

**Epigynal 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, globose tips.

**Table 1:** *Philodromus splendens* sp. 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 | Femur I | Patella I | Tibia I | Metatarsus I |
|-----------|---------|-----------|---------|--------------|
| Dorsal     | 1 pr, 1 med, 1 pr, 1 med | 1 pr, 1 med, 1 pr | 1 pr | 1 pr |
| Prolateral | 1 pr, 1 med, – (1 pr, 1 dis) | 1 pr, 1 med, 1 pr, 1 med | 1 pr, 1 med |
| Ventral    | –       | 2 pr, 2 med, 2 pr, 2 med | 2 pr, 2 med |
| Retrolateral | (1-2 pr), – | 1 pr, 1 med, 1 pr, 1 med | 1 pr, 1 med, 1 dis |
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[Image of Philodromus splendens spec. nov.]

Large specimens. Adult specimens are so far known only from two parks in Sofia, Bulgaria, where the species seems to be established. 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 (= Tibellominus 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 bulb (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 Tibellominus 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 wunderlichii (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 Rhyadrobus 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 I 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 Rhyadrobus histris, are also similar to those in Philodromus splendens spec. nov. Celerrimus dufeyi 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 male 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 bulb 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).

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 Scoliphetron 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 months 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

[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)]
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).

Acknowledgements

The author expresses gratitude to Maria Naumova (Institute of Biodiversity and Ecosystem research, Bulgarian Academy of Science) for all helpful improvements and comments on the text during the process of writing as well as for photo editing, Dragomir Dimitrov (National Museum of Natural History, Bulgarian Academy of Sciences, Sofia) for making high quality genitalia photos and suggesting improvements, Irina Paparo for the effort spent on sending the valuable material, Dmitri Logunov (The University of Manchester, United Kingdom), a second, anonymous reviewer and the editorial team for all improvements on the text, Jason Dunlop (Museum für Naturkunde, Berlin) for linguistic improvements and Christo Deltchev (National Museum of Natural History, Bulgarian Academy of Sciences, Sofia) for general support and guidance during the author’s arachnological activities. This study was partially supported by the project “Cybertaxonomic approach to phylogenetic studies of model invertebrate genera (Invertebrata, Arachnida, Insecta), clarifying the problems of origin, formation and conservation of the invertebrate fauna of the Balkan Peninsula”, National Science Fund, Ministry of Education, Youth and Science of the Republic of Bulgaria, Grant KP-06-H21/1-17.12.2018.

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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)
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