



## On two enigmatic spiders (Araneae: Cybaeidae & Phrurolithidae) from the Russian Far East

YURI M. MARUSIK<sup>1,2,6\*</sup>, MIKHAIL M. OMEK<sup>3,4,7</sup> & SEPPO KOPONEN<sup>5,8</sup>

<sup>1</sup>Institute for Biological Problems of the North, Portovaya Street 18, Magadan 685000, Russia

<sup>2</sup>Department of Zoology & Entomology, University of the Free State, Bloemfontein 9300, South Africa

<sup>3</sup>Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok 690022, Russia

<sup>4</sup>Far Eastern Federal University, Laboratory of ecology and evolutionary biology of aquatic organisms (LEEBAO), School of Natural Sciences, Vladivostok 690091, Russia

<sup>5</sup>Zoological Museum, Biodiversity Unit, FI-20014 University of Turku, Finland

<sup>6</sup>✉ [yurmar@mail.ru](mailto:yurmar@mail.ru); <https://orcid.org/0000-0002-4499-5148>

<sup>7</sup>✉ [omelkom@gmail.com](mailto:omelkom@gmail.com); <https://orcid.org/0000-0002-1556-6248>

<sup>8</sup>✉ [sepkopo@utu.fi](mailto:sepkopo@utu.fi); <https://orcid.org/0000-0002-9113-7488>

\*Corresponding author

### Abstract

*Cybaeota* Chamberlin & Ivie, 1933, a genus previously known only in the Nearctic, has been found in the Maritime Province of Russia for the first time. It is represented by a new species, *C. wesolowskiae* **sp. nov.** (♂♀), which is close to the generotype, *C. calcarata* (Emerton, 1911). Additionally, a new species, *Phrurolithus lindemanni* **sp. nov.** (♀), is described from the Maritime Province as well. It has unusually light colouration in comparison to other congeners. Trans-Pacific disjunctive ranges on species, genus and family levels in arthropods are briefly discussed.

**Key words:** Asia, Cybaeinae, new species, first record

### Introduction

The southern region of the Russian Far East has been the subject of intensive arachnological studies during the last 25 years and the number of spider species recorded there has risen by 71.6%, from 507 species in 1996 to 870 in 2015 (Mikhailov 2016). This region has the greatest spider family level diversity in Russia, yet it still remains understudied. For a long time, we have had female specimens of two morphospecies of uncertain family placement from that region. Both were initially identified as clubionoids, belonging either to Corinnidae or Liocranidae, because of their general body shape and numerous conspicuous pairs of ventral spines on tibiae and metatarsi I–II, the basal sockets of which are each equipped with a locking mechanism.

Recently we received a sample containing a male and female of one of the morphospecies. Detailed study of the male palp revealed similarities to some dictynoid families (i.e. an elongate embolus, and a proximally complex, well-developed conductor located near the base of the embolus), rather than to other genera of clubionoid families occurring in the region. After consultation with experts familiar with clubionoid families, and particularly thanks to Martin Ramirez (pers. comm.), we realized that our specimens have three tarsal claws and are therefore not clubionoids. Looking through trionychan genera unfamiliar to us, we determined that this species belongs to *Cybaeota* Chamberlin & Ivie, 1933 (Cybaeidae), a genus previously only known from the Nearctic (WSC 2020).

It was easier for us to recognize the genus of the second morphospecies, which was represented by females only: when we removed mating plugs and cleared some epigynes, we found that it belongs to *Phrurolithus* C.L. Koch, 1839, a genus treated in the recent publication of the senior author (Zamani & Marusik 2020). Unlike other members of the genus known to us, however, this species is not dark in colour but pale with a distinct dark abdominal pattern, as in *Otacilia* Thorell, 1897, another phrurolithid genus occurring in the southern part East Asia but unknown in Russia. In this paper we provide descriptions of the two new species and briefly discuss trans-Pacific disjunctive ranges.

## Material and methods

Specimens were photographed using an Olympus Camedia E-520 camera attached to an Olympus SZX16 stereomicroscope or to the eyepiece of an Olympus BH2 compound microscope. Scanning electron micrographs were taken with a SEM JEOL JSM-5200 scanning electron microscope at the Zoological Museum of the University of Turku, Finland. Digital images were prepared using CombineZP image stacking software. Illustrations of internal genitalia were made after clearing them in a 10% KOH aqueous solution. Lengths of leg segments were measured in lateral view. Measurements are provided for legs as total length (femur, patella, tibia, metatarsus, tarsus). All measurements are given in millimeters.

Abbreviations not explained in the text: ALE—anterior lateral eye, AME—anterior median eye, p prolateral, PLE—posterior lateral eye, PME—posterior median eye, v ventral, uv—unpaired ventral spine. Depositories: ZMMU—the Zoological Museum of Moscow University, Moscow, Russia; ZMUT—Zoological Museum of University of Turku, Finland.

## Taxonomy

### Cybaeidae Banks, 1892

#### *Cybaeota* Chamberlin & Ivie, 1933

*Cybaeota* Chamberlin & Ivie, 1933: 3; Lehtinen 1967: 226; Roth & Brame 1972: 17; Bennett 1988: 105.

**Type species.** *Liocranum calcaratum* Emerton, 1911.

**Diagnosis.** This genus differs from other genera placed in Cybaeidae by the habitus, spination, and the bases of the ventral leg spines with a locking mechanism (see Bennett 1988: 105), like in *Zora* C.L. Koch, 1847 (Miturgidae) and some phrurolithids (*Otacilia*, *Phrurolithus*), amongst others. Regarding the shape of the copulatory organs, it is most similar to *Calymmaria* Chamberlin & Ivie, 1937 from the Nearctic Region by having a very similar male palp, with a short embolus directed posteriorly, and a similar two-armed conductor directed retrolaterally having a stem directed posteriorly, and an epigyne with globular receptacles. *Cybaeota* can be distinguished from *Calymmaria* by the generally smaller size (ca 2 mm, vs. 2–10 mm), by the more numerous tibial spines on leg I (5 pairs vs. 2), the epigyne lacking long copulatory ducts (shorter than the radius of receptacle vs. longer), and by the more closely spaced receptacles (less than one radius vs. more). The male palps are almost indistinguishable.

**Description.** See Bennett (1988).

**Composition.** The genus comprises five species, including the new one described in this paper.

**Distribution.** Until our discovery, *Cybaeota* was known exclusively from the Nearctic, from Alaska to Newfoundland and south to southernmost California (WSC 2020). Our record extends the genus range to the southeastern Palaearctic.

**Comments.** Judging from the similarity between the copulatory organs in *Calymmaria* and *Cybaeota* mentioned in the diagnosis, and dissimilarity with other Cybaeinae and Cybaeidae, these two genera may deserve status of a separate taxon of the family group name rank.

#### *Cybaeota wesolowskiae* sp. nov.

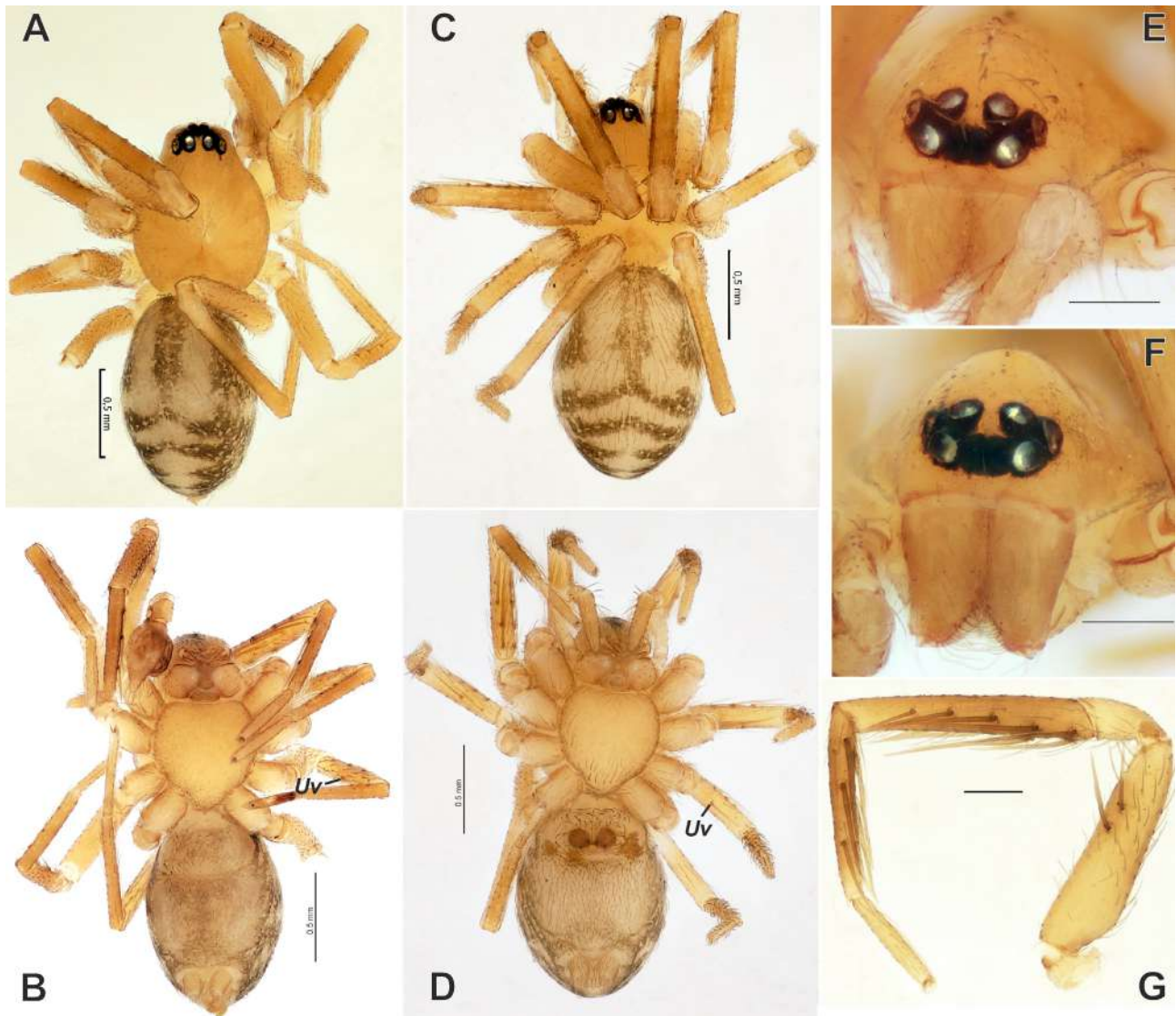
Figures 1A–G, 2A–H, 3A–H, 4A–B, 5A–E

**Etymology.** This species is named after Wanda Wesółowska, honouring her great contribution to arachnology and to the taxonomy of Salticidae in particular, and on the occasion of her 70<sup>th</sup> birthday.

**Diagnosis.** The male of the new species is most similar to those of *C. calcarata* (Emerton, 1911) by having a meandering sperm duct on the embolic base and by the shape of the anterior arm of the conductor, but differs from it by having a claw-like posterior arm of the conductor (vs. square), and a square-shaped anterior part of the anterior arm of the conductor protruding anteriorly (vs. rounded and not protruding). The epigyne of *C. wesolowskiae* sp.

**nov.** is also similar to that of the generotype and differs by the more widely spaced receptacles (ca. by  $\frac{1}{3}$  of receptacle diameter vs. by less than  $\frac{1}{2}$  of the radius). The epigyne of *C. wesolowskiae* **sp. nov.** is somewhat similar to that of *C. munda* Chamberlin & Ivie, 1937, *C. nana* Chamberlin & Ivie, 1937 and *C. shastae* Chamberlin & Ivie, 1937 by the more widely spaced receptacles, but differs from these three species by the more posteriorly located fovea.

**Description. Male (Holotype).** Total length 2.17. Carapace 1.06 long, 0.79 wide. Prosoma light coloured; carapace without pattern. Carapace with small longitudinal, almost indistinct fovea; with very few setae on thoracic part, represented by median row with ca 5 setae; eyes subequal in diameter (ca 0.09), except for AME (ca. 0.06), contiguous except PME which are separated by about one radius; clypeus height equal to eye diameter. Sternum without pattern, with slightly darker margins, covered by setae. Chelicerae relatively short (Fig. 1F), with distinct mesal (*Mr*) ridge, 3 promarginal and 4 retromarginal teeth, all teeth small; setae on anterior surface near fang with globose bases. Maxillae and labium of subequal width, maxillae converging, 2 times longer than labium, maxillae 1.2 times longer than wide.



**FIGURE 1.** *Cybaeota wesolowskiae* **sp. nov.** A–B Male habitus, dorsal and ventral; C–D Female habitus, dorsal and ventral; E–F Prosoma, frontal, female and male; G Female, leg I prolateral. Scales = 0.1 mm (E, F) and 0.2 mm (G). Abbreviations: *Uv*—unpaired ventral spine.

Legs uniformly coloured, relatively long (leg I greater than 3 times longer than carapace), with conspicuous pairs of ventral tibial and metatarsal spines on legs I–III, spines with locking mechanisms (*Ls*); femur I with 1 one prolateral spine with locking mechanism. Leg III with unpaired ventral spine.

**TABLE 1.** Leg segment lengths of male *Cybaeota wesolowskiae* sp. nov.

	Fe	Pa	Ti	Mt	Ta	Total
I	0.89	0.30	0.93	0.71	0.44	3.27
II	0.80	0.30	0.83	0.66	0.44	3.03
III	0.70	0.29	0.61	0.60	0.37	2.57
IV	0.97	0.30	0.87	0.79	0.50	3.43

**TABLE 2.** Spination of legs of male *Cybaeota wesolowskiae* sp. nov.

	Fe	Ti	Mt
I	1p	5-5v	3-3v
II	0	1p 4-4v	3-3v
III	0	3-0v 1uv	3p 0-3v
IV	0	0	0

Abdomen oval, 1.5 times longer than wide, with distinct dorsal pattern and less distinct ventral pattern (Figs 1A, B); booklungs light-coloured.

Palp. Femur unmodified, ca 2.8 times longer than wide, subequal in length to patella+tibia; patella unmodified, about 1.3 times shorter than tibia; tibia with 2 retrolateral apophyses, flat anterior one (*Ra*) flattened, wider than long, and claw-like posterior one (*Rp*); anterior apophysis located on distal part, wider than long. Cymbium drop-let-shaped, lacking folds, 1.7 times longer than wide and 2.8 times longer than deep; tip slightly longer than 1/3 of cymbial length; distinct spines absent, setae on tip stronger than those on other parts. Bulb oval, 1.25 times longer than wide; subtegulum (*St*) located antero-prolaterally; tegulum with 2 appendages, embolus (*Em*) and complex conductor (*Co*); sperm-duct long, extending along tegulum edge, smoothly rounded, undulating near base of embolus. Conductor weakly sclerotized, only part of it visible in light microscopy, with 2 arms standing on joint stem (*Cs*) originating near base of embolus and directed posteriorly, anterior arm (*Aa*) truncate, square-shaped, posterior section bipartite with sharply pointed tip directed posteriorly and posterior arm (*Pa*) small, well-sclerotized, with bluntly pointed, anteroventrally directed tip. Embolus claw-like, originating at 12 o'clock and directed posteriorly, broad basally and tapering towards tip, slightly twisted around its axis.

**Female (Paratype).** Total length 2.45–2.80. Carapace 1.00–1.04 long, 0.77–0.84 wide. General appearance as in male. Palpal tarsus without claw. Integument of tibia covered with sparse scale-like structures (*Ss*) and transverse wrinkles; femur with smooth integument and scale structures, metatarsus with numerous deep transverse wrinkles. Paired claws of tarsus with ca. 7 teeth, unpaired claw with 3 teeth. Leg lengths as shown in Table 3. Spination (Table 4) differs from that of male, ventral spine in tibia III present.

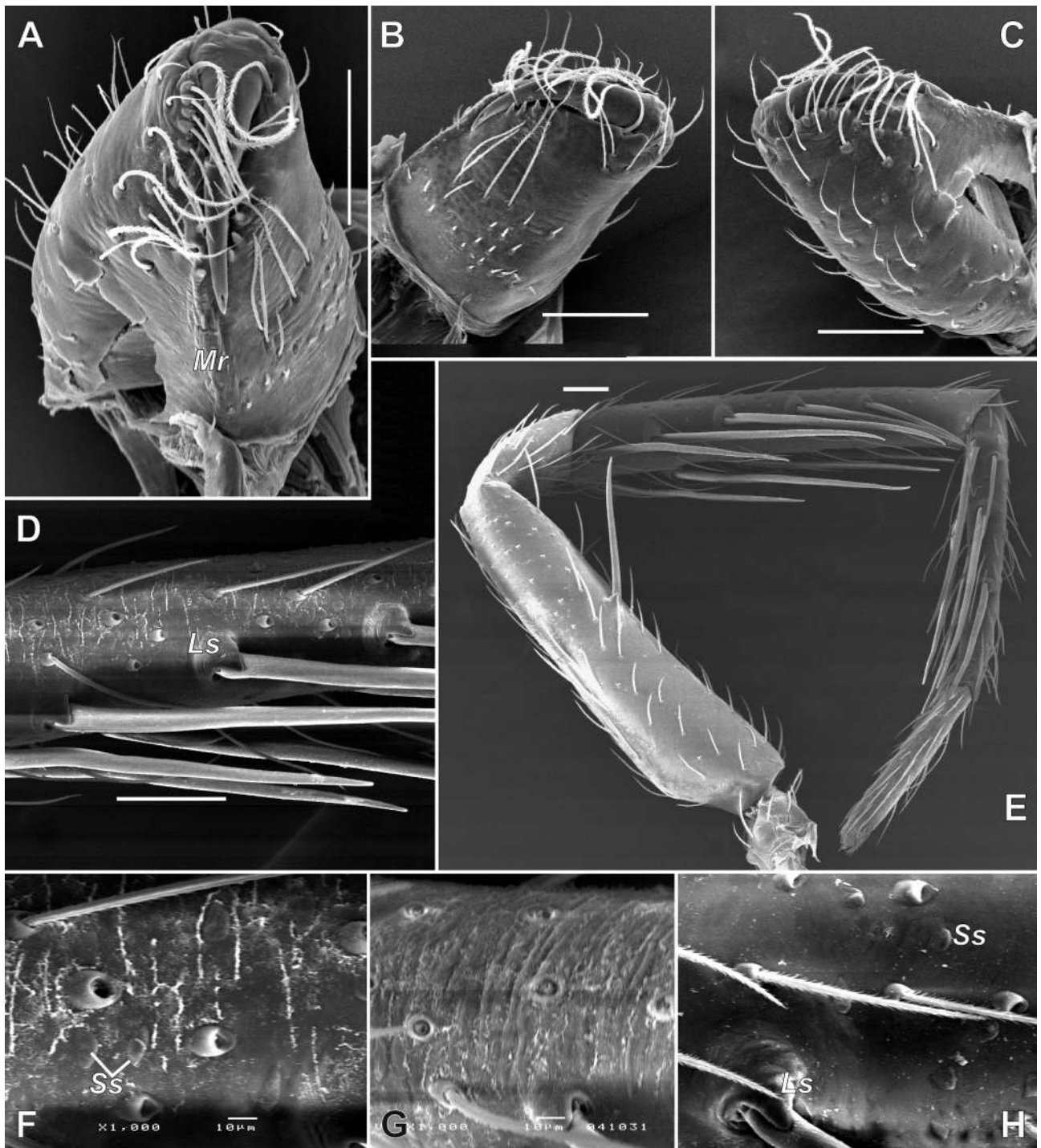
**TABLE 3.** Leg segment lengths of female *Cybaeota wesolowskiae* sp. nov.

	Fe	Pa	Ti	Mt	Ta	Total
I	0.89	0.36	0.94	0.70	0.40	3.28
II	0.79	0.36	0.81	0.71	0.40	3.07
III	0.67	0.30	0.63	0.57	0.37	2.54
IV	0.94	0.31	0.89	0.81	0.44	3.40

**TABLE 4.** Spination of legs of female *Cybaeota wesolowskiae* sp. nov.

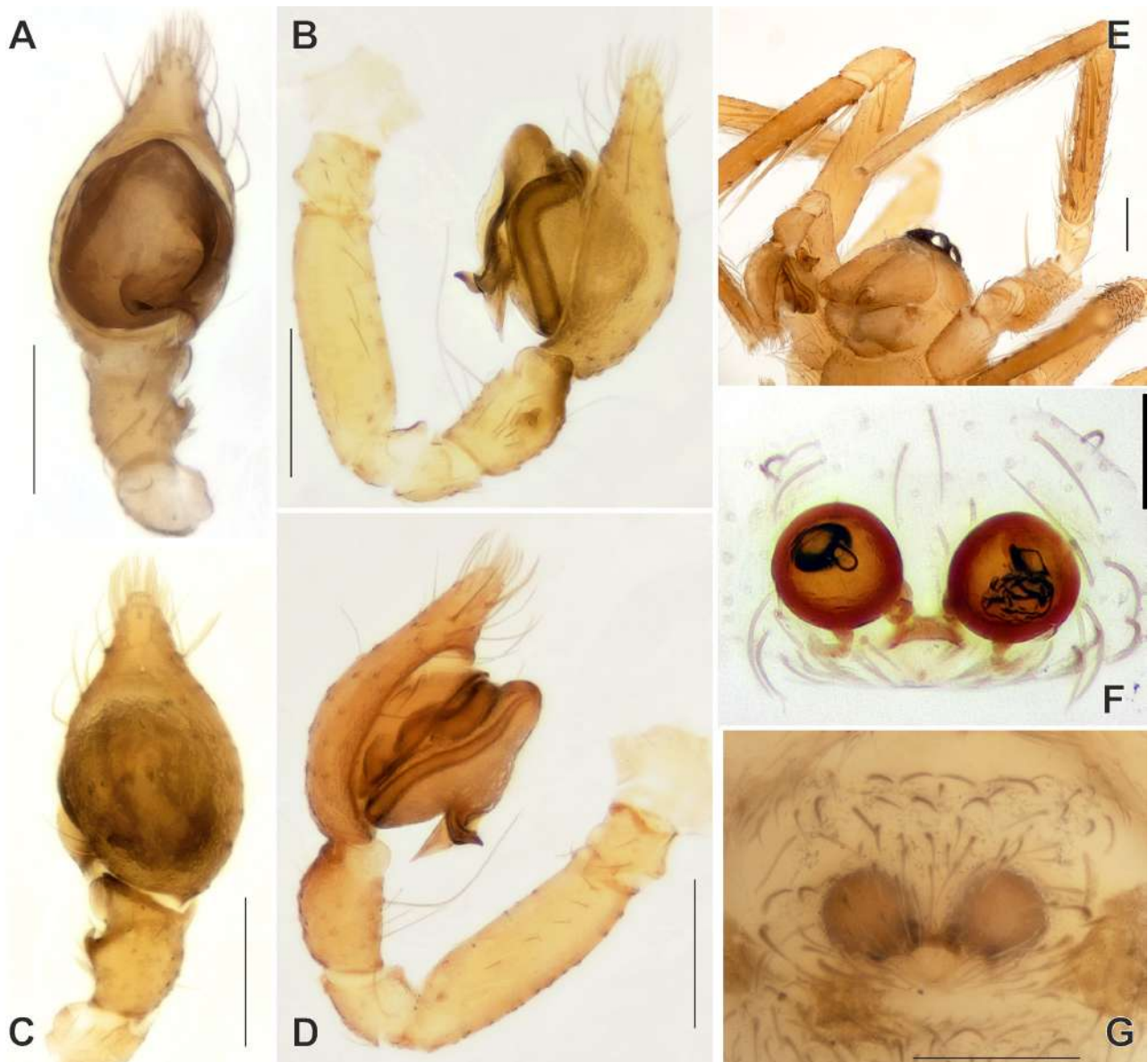
	Fe	Ti	Mt
I	1(2)p	5-5v	3-3v
II	0	1p 5-5v	4-4v
III	0	2p 3-0v 1uv	3p 0-3v
IV	0	0	0

Spinnerets relatively large, spinneret field wider than 1/2 of abdomen width near spinnerets; anterior lateral spinneret thicker than tibia IV; colulus reduced to 2 setae.



**FIGURE 2.** SEM micrographs of somatic characters of *Cybaeota wesolowskiae* **sp. nov.**, female. A–C Chelicera, ventral, posterior and anterior; D, F Tibia I, prolateral; E Leg I, prolateral; G Metatarsus I, prolateral; H Femur I, prolateral. Scales = 0.1 mm unless otherwise indicated. Abbreviations: *Mr*—mesal ridge; *Ls*—locking mechanism structures; *Ss*—sparse scale-like structures.

Epigyne as in Figs 3G, H; simple, covered with plumose setae, weakly-sclerotized, receptacles and copulatory ducts clearly visible through integument; wider than long, with central fovea; fovea with distinct anterior hood slightly wider than receptacle radius, fovea posteriorly rebordered in some specimens; copulatory openings located in hood and not visible, copulatory ducts short, about half of receptacle radius; receptacles large, globular, separated from each other.



**FIGURE 3.** *Cybaeota wesolowskiae* sp. nov. A–D Male palp, ventral, retrolateral, dorsal and prolateral; E Male prosoma, antero-ventral; F–G Epigyne, dorsal and ventral. Scales = 0.2 mm.

**Type material.** Holotype ♂ and paratype ♀: **RUSSIA: Maritime Province:** ca 30 km E of Ussuriysk, Kamenushka Vill., 43°36.45'N, 132°13.60'E, leg. S.Y. Storozhenko, 30.VIII.2001 (bark spraying) (ZMMU).

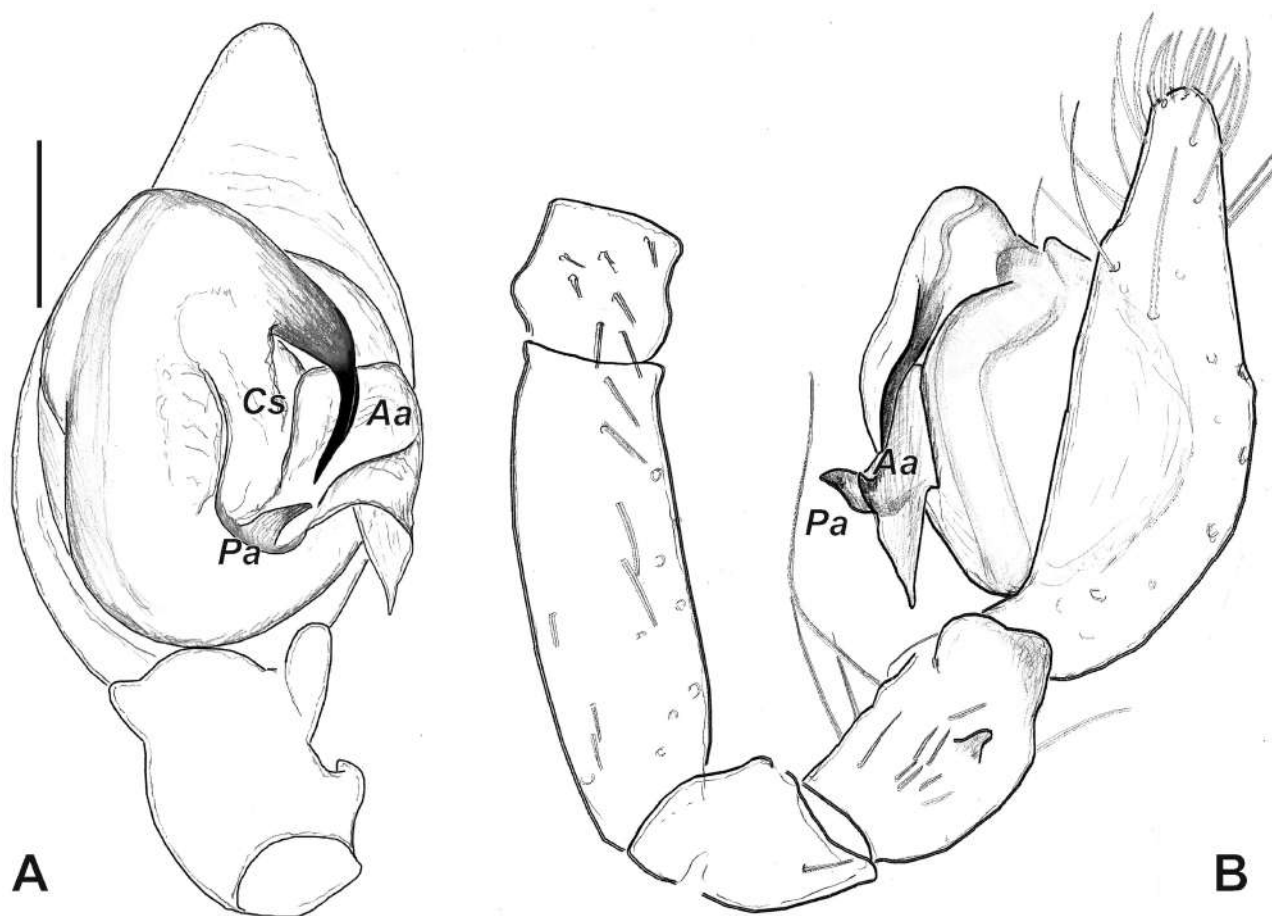
Paratypes: **RUSSIA: Maritime Province:** Chuguyevka Field Station, ca. 43°50'N, 134°15'E, leg. S. Koponen, 31.VII–5.VIII.1998, 2♀ (ZMUT); Lazo District, Korpad' Camp, 43°16'N, 134°08'E, leg. S. Koponen, 6–9.VIII.1998, 1♀ (ZMUT); Pravaya Izvilinka River, 43°55'N, 134°23'E, leg. Y.M. Marusik, 1–2.VIII.1998, 1♀ (ZMMU); Same data as holotype, leg. Y.M. Marusik, 29.VIII.2001, 1♀ (ZMMU).

**Habitats.** This species was collected either by bark spraying with repellent or in forest litter.

**Distribution.** All records of this species are from the South part of the Maritime Province.

**Remarks.** There are several families of spiders occurring in the southeastern Palearctic (NE China, Korea, Japan, and the southern part of Russian Far East) and the Nearctic, but most of them also occur in the western Palearctic (e.g., Atypidae, Ctenidae (*Anahita* Karsch, 1879), Cybaeidae, Leptonetidae, Nesticidae, Oonopidae and Theridiosomatidae) and have a disjunction in Central Asia, Mongolia and Siberia (Marusik & Kovblyuk 2011). However, one family has a similar distribution to *Cybaeota*: Antrodiaetidae are known from the Nearctic and south-east Palearctic only. Its type genus, *Antrodiaetus* Ausserer, 1871, is represented in Asia by two species in Japan and 12 in the United States (WSC 2020). Another family, Hypochilidae, displays a similar distributional pattern: its type

genus, *Hypochilus* Marx, 1888, is represented by 10 species in North America and two species of another hypochilid genus, *Ectatosticta* Simon, 1892, are known from China. The micronetine genus *Arcuphantes* Chamberlin & Ivie, 1943 (Linyphiidae) also displays a similar range, with 12 species known in the Nearctic and another 39 in Far East Asia. It is likely, however, that the Asian and American species are not congeneric.



**FIGURE 4.** Male palp of *Cybaeota wesolowskiae* sp. nov. A Ventral; B Retrolateral. Scales = 0.2 mm. Abbreviations: *Aa*—anterior arm of conductor; *Cs*—stem of conductor; *Pa*—posterior arm of conductor.

The apparent distribution of *Cybaeota* is a little bit unusual: only one species has been found in Asia (and only in the Russian part of the southeastern Palaearctic) and the genus is unknown in adjacent China, Korea or Japan.

A review of other groups of arthropods reveals that a similar distribution pattern is not uncommon among other arachnids and insects. A peculiar genus of harvestmen, *Caddo* Banks, 1892 (Caddidae), has two species, *C. agilis* Banks, 1892 and *C. pepperella* Shear, 1975, both of which are known in Sakhalin, Japan, and across the United States. The mite genus *Yachatsia* Cook, 1963 (Hydrachnidae) (Abé 2019), cockroach genus *Cryptocercus* Scudder, 1862 (Cryptocercidae) (Maekawa & Nalepa 2011), orthopteran genera *Atlanticus* Scudder, 1894 and *Sphagniana* Zeuner, 1941 (Tettigoniidae) (Storozhenko, pers. comm.), and homopteran genus *Pagaronia* Ball, 1902 (Cicadellidae) (Dmitriev, pers. comm.) have amphi-Pacific disjunctive ranges and do not occur in the more northern parts of the Pacific Region.



**FIGURE 5.** SEM micrographs of the male palp of *Cybaeota wesolowskiae* **sp. nov.** A Ventral; B Retrolateral; C Ventro-retrolateral; D Ventro-prolateral; E Antero-ventral. Scales = 0.1 mm. Abbreviations: *Aa*—anterior arm of conductor; *Cs*—stem of conductor; *Pa*—posterior arm of conductor; *Ra*—anterior retrolateral apophysis; *Rp*—posterior retrolateral tibial apophysis; *St*—subtegulum.

**Phrurolithidae Banks, 1892**

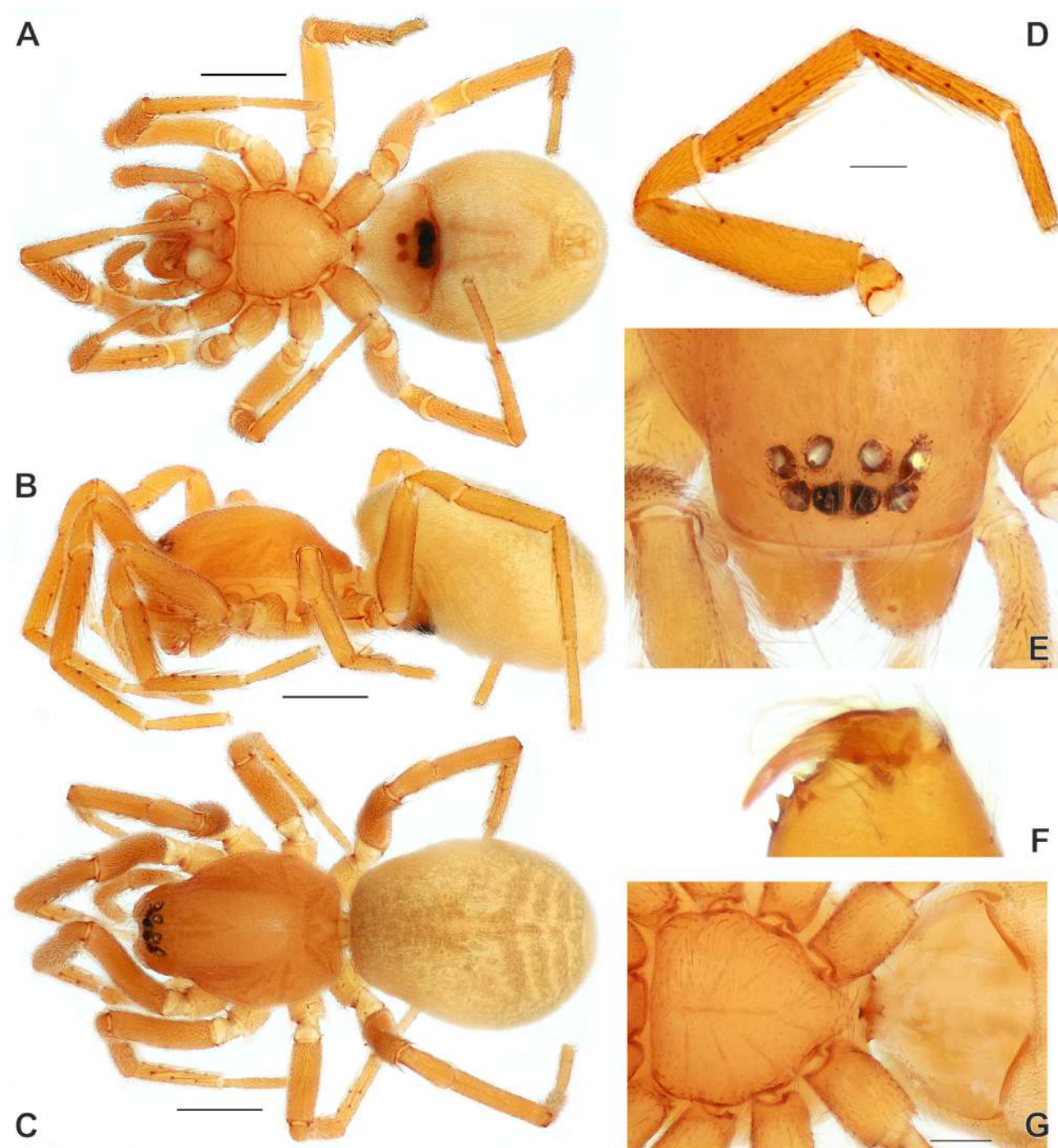
***Phrurolithus* C.L. Koch, 1839**

Type species. *Macaria festiva* C.L. Koch, 1835.

**Diagnosis.** See Zamani & Marusik (2020).

***Phrurolithus lindemanni* sp. nov.**

Figs 6A–G, 7A–F



**FIGURE 6.** General appearance of *Phrurolithus lindemanni* sp. nov. female. A–C Habitus, ventral, lateral and dorsal; D Leg I, prolateral; E Prosoma, antero-dorsal; F Chelicera, posterior; G Prosoma and epigastral part of opisthosoma, ventral. Scales = 0.2 mm unless otherwise indicated.

**Etymology.** The species is named after Till Lindemann, the lead vocalist and lyricist of the band “Rammstein”.

**Diagnosis.** The new species differs from all congeners occurring in the Palaearctic by the pale colouration with a distinct dark abdominal pattern (*vs.* dark colouration with pale abdominal pattern). Except for *P. labialis* Paik, 1991, the female of *P. lindemanni* **sp. nov.** differs from all other species where the structure of the endogyne has the anterior (secondary) receptacles each with a thin stalk (ca. ¼ of receptacle diameter *vs.* distinct stalk lacking), the globular posterior (primary) receptacles each with a long gland located laterally and broad copulatory ducts (*vs.* posterior receptacles not globular, or glands not located laterally, and copulatory ducts lacking or indistinct). The only species likely to be confused with *P. lindemanni* **sp. nov.** is *P. labialis*. *Phrurolithus labialis* has longer stalks of the anterior receptacles, the receptacles are more widely spaced (cf. Figs 7D, E and figs 19–25 in Paik 1991), and the fovea has a pair of distinct anterior pockets (*vs.* fovea without distinct margins). Male unknown.

**Description. Female (Holotype).** Total length 2.68–2.78. Carapace 1.17–1.20 long, 0.87–0.94 wide. Carapace uniformly pale coloured, evenly covered with light dense setae (Fig. 6C). Sternum with distinct pattern formed by tissues lying below integument: median stripe and radial stripes directed to spaces between coxa. Chelicerae with 3 promarginal and 2 retromarginal teeth.

Abdomen yellowish, with distinct dorsal pattern, venter with two dark median stripes. Postero-lateral margins of epigastric fold sclerotized (Fig. 6G). Legs uniformly coloured as in carapace, covered with whitish setae. Leg lengths as shown in Table 5. Legs I-II equipped with numerous ventral spines (Table 6).

**TABLE 5.** Leg segment lengths of female *Phrurolithus lindemanni* **sp. nov.**

	Fe	Pa	Ti	Mt	Ta	Total
I	0.86	0.39	0.73	0.69	0.49	3.14
II	0.79	0.36	0.60	0.54	0.47	2.76
III	0.64	0.30	0.50	0.56	0.49	2.48
IV	0.80	0.37	0.70	0.77	0.57	3.21

**TABLE 6.** Spination of legs of female *Phrurolithus lindemanni* **sp. nov.**

	Fe	Pa	Ti	Mt
I	1p	0	4-4v	3-3v
II	0	0	4-3v	4-3v
III	0	0	0-1v	2-2v
IV	0	0	1-2v	2-2v

Epigyne as in Figs 7A–F; plate wider than long, fovea lacking distinct margins and having separate copulatory openings; pair of rounded anterior receptacles visible through integument. Endogyne with large mushroom-shaped anterior receptacles with short stalks; copulatory ducts as wide and as long as diameter of posterior receptacles; posterior receptacles separated by 2 diameters, with long glands located laterally and directed anteriorly, glands longer than diameter of receptacle; fertilization ducts divergent and located near glands on anterior part of posterior receptacle.

**Type material.** Holotype ♀ and 4♀ paratypes: **RUSSIA: Maritime Province:** Lazo Village, ca. 43°23'N, 133°55'E, leg. Y.N. Sundukov, 15–20.IV.2002 (ZMMU).

Paratypes: **RUSSIA: Maritime Province:** Khasan District, env of Andreevka Village, ca. 42°39'N, 131°08'E, leg. S. Koponen, 11–15.VIII.1998, 1♀ (ZMUT); Lazovskii Reserve, Korpad' Camp, 43°16'N, 134°08'E, leg. Y.N. Sundukov, 19–24.V.2004, 1♀ (ZMMU).

**Note.** All specimens studied have the epigynal fovea covered with mating plugs.

**Distribution.** This species was found in widely separated localities in the southern part of the Maritime Province (Fig. 8).

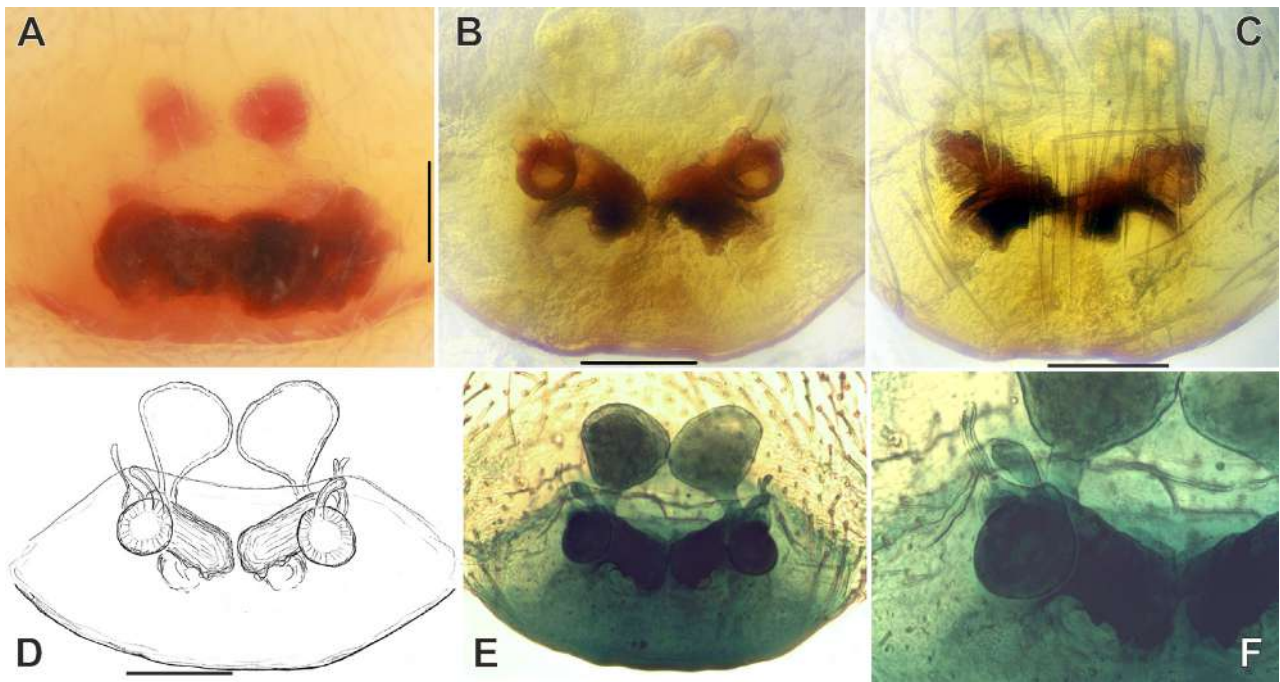


FIGURE 7. Epigyne of *Phrurolithus lindemanni* sp. nov. A Intact, with mating plug; B–C Dissected, dorsal and ventral; D–F Dorsal, macerated and coloured. Scales = 0.2 mm if indicated.



FIGURE 8. Collecting localities of *Cybaeota wesolowskiae* sp. nov. (●) and *Phrurolithus lindemanni* sp. nov. (◆)

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