The first data on subnivean activity of spiders (Arachnida: Aranei) in Southwestern Siberia (Russia)

Alexander A. Fomichev — Altai State University, Lenina Pr., 61, Barnaul, RF-656049, Russia

Seppo Koponen — Zoological Museum, Biodiversity Unit, FI-20014 University of Turku, Finland

Thirteen species of spiders from four families were collected using pitfall traps in subnivean habitat in the foothills of Salair Mt. Range, eastern Altai Krai. Linyphiidae predominate in the material. *Agroeca limnicunae* (McCook, 1884), previously known from Yenisei River in Middle Siberia through Cisokhotia and Alaska to New Jersey (USA), is recorded for the first time in West Siberia and redescribed. The Euro-Uralian boreo-mountainous *Maro sublestus* Falconer, 1915 is recorded in West Siberia for the first time. A Trans-Palaearctic-NW Nearctic boreal species, *Tibioplus diversus* (L. Koch, 1879), is reported for the first time from Altai Krai. The winter active spider fauna of eastern Altai Krai consists of species which can be found as adults all year round. All collected species are illustrated.

Acta Biologica Sibirica 10: 1211–1228 (2024)

doi: 10.5281/zenodo.13956901

Corresponding author: Alexander A. Fomichev (a.fomichov@mail.ru)

Academic editor: R. Yakovlev | Received 1 October 2024 | Accepted 10 October 2024 | Published 22 October 2024

http://zoobank.org/A2F85873-403B-4625-8682-7DE5260774EB

Citation: Fomichev AA, Koponen S (2024) The first data on subnivean activity of spiders (Arachnida: Aranei) in Southwestern Siberia (Russia). Acta Biologica Sibirica 10: 1211–1228. https://doi.org/10.5281/zenodo.13956901

Keywords

Altai Krai, Araneae, new records, subnivean habitat, taiga forest

Introduction

Siberia is known for its harsh climate with extremely low winter temperatures. During the cold period of the year, which in Southwestern Siberia lasts about five months, activity of arthropods, including spiders, almost stops. A number of authors have shown that when the snow depth exceeds about 20 cm, the temperature of the soil surface stabilized at about 0 °C (Coulianos and Johnels 1962; Geiger 1965; Pruitt 1970). Investigations on arthropods living under snow, in the subnivean habitat, have been conducted in several regions of the world. The most important such studies include the following: Aitchison (1978; 2001, in Canada), Schmidt and Lockwood (1992, USA), Vanin and Turchetto (2007, Italy), Håvgar and Håvgar (2011, Norway) and Koponen (1977, Finland). Altai Krai is a region of Russia situated in the south-eastern part of West Siberia. The territory of Altai Krai is divided between two physiographical areas: West Siberian Plain and Altai-Sayan Mountain Region, represented by the Altai Mts and Salair Mt. Ridge. Our research took place on the border between West Siberian Plain and Salair Mt. Ridge. The spider fauna of Altai Krai is far less studied, as compared to the neighboring Altai Republic (mountain Altai). The territory of Altai Krai remains unevenly studied. Only the Tigirek Reserve and the Kulunda Steppe can be considered well-studied regions (Fomichev 2016; Fomichev 2022). Both areas are located in the west of Altai Krai. The eastern part of the Altai Krai, adjacent to the Salair Mt. Ridge, where our research was carried out, remains neglected. Some data on spiders of eastern part of Altai Krai was contained only in Azarkina and Trilikauskas (2012; 2013a; 2013b). The situation began to change quite recently with the publication of a pioneering paper by Trilikauskas (2023) focused on spiders of Salair National Park. In this paper 118 species of spiders, predominantly Linyphiidae, are recorded for Salair Mt. Range. However, all of the above papers are based on collections made during the snow-free months. To our knowledge, no earlier study exists regarding subnivean activity of spiders in Siberia. To begin to fill this gap, we undertook a study of spider fauna of subnivean habitat in the eastern part of Altai Krai. The goal of this paper is to report which spider species are active in subnivean conditions of Southwestern Siberia.

Materials and methods

The study was carried out in the vicinities of Smaznevo Train Station in Zarinsky District of Altai Krai (Russia) (53°52.058′N 85°12.986′E) (Figs 13–14) in the taiga forest dominated by *Pinus sibirica*, *Abies sibirica*, *Betula pubescens* and *Populus tremula*at 280 m (Figs 1–4). The thickness of the snow during the winter reached 60–70 cm (Figs 5–6). Pitfall traps were set on October 30, 2023, a few hours before an intense snowstorm after which a permanent snow cover formed. On April 1, 2024, the pitfall traps were dug out from under the snow and dismantled. There is no weather station in the immediate vicinity of Smaznevo Train Station (STS). Therefore, we provided meteorological data from the nearest weather station in Zarinsk Town (25 km SW of STS) (Table 1). The lowest temperature during the winter in Zarinsk Town was –38.5 °C. The highest recorded temperature was +11.2 °C. Multiple periods of freeze-thaw occurred during this winter. An original method was used to collect the spiders. A total of 40 pitfall traps were set. Pitfall traps were placed 1 meter apart in several lines (Figs 1–2). Plastic jars with a volume of 200 milliliters were used as a trap (Figs 7–10). Drainage holes were made in the walls of the jars to prevent them from flooding during the spring melting of snow. The jars were covered with plastic plates on top (Fig. 8). Two wooden sticks were placed between the glasses and plates, parallel to each other (Fig. 7). This design was used to provide space between the edges of the plate and the soil for spiders to move freely. This entire structure was pressed down from above with dead wood (Fig. 9). One part of pitfall traps was installed on lumpy place next to large logs or under overhanging fir branches (Fig. 1), and the other part was installed on flat open space (Fig. 2). Undiluted antifreeze (“Tosol”) was used as a preservation liquid. From antifreeze, all the material was placed immediately into ethanol (Fig. 11). During the dismantling of the traps, several spiders were found alive (Fig. 12). They even spun webs in the trap’s mouth. Specimens were photographed using an Olympus DP74 Camera attached to an Olympus SZX16 stereomicroscope at the Altai State University (Barnaul, Russia). Photographs were prepared in dish with lubricant or in dish with white cotton on the bottom, filled with alcohol. Endogynes were cleared in KOH/ water solution until soft tissues were dissolved. Digital images were montaged using “Zerene Stacker” image stacking software package. The map was produced using the online mapping application SimpleMappr (Shorthouse 2010). The meteorological data are taken from the website “Pogoda I klimat” (Weather and climate) (http://www.pogodaiklimat.ru). All measurements are in millimeters (mm). The length of leg segments was measured dorsally. Length of legs segments are given as: femur, patella, tibia, metatarsus, tarsus (total). Terminology and the format of description follow Mu et al. (2019) with modifications. Species new to the Altai Krai is marked by one asterisk (*); new to West Siberia with two asterisks (**). Material will be deposited in the Institute of Systematic and Ecology of Animals, SB RAS, Novosibirsk, Russia (ISEA, curator G.N. Azarkina).

Abbreviations: AG – accessorial gland, ALE – anterior lateral eye, AME – anterior median eye, CD – copulatory duct, CO – copulatory opening, d – dorsal, Em – embolus, Fe – femur, Ho – hood, LM – lateral margin, MA – median apophysis, MOA – median ocular area, Mt – metatarsus, p – prolateral, PLE – posterior lateral eye, PME – posterior median eye, PR – primarily receptacle, r – retrolateral, RTA – retrolateral tibial apophysis, SD – sperm duct, Se – septum, SR – secondary receptacle, St – subtegulum, STS – Smaznevo Train Station, Te – tegulum, Ti – tibia, v – ventral.

Date	Minimum temperature (°C)	Maximum temperature (°C)	Maximum snow depth (cm)
November	–17.9	+11.2	19
December	–36.3	+2.9	30
January	–33.3	+4.0	45
February	–38.5	+6.7	47
March	–17.0	+9.6	50

Table 1. *Meteorological data from the weather station in Zarinsk Town, winter 2023–2024 (http://www.pogodaiklimat.ru/)*


1
2
3
4
5
6

Figure 1. ***Figures 1–6.*** *Installed pitfall traps near the Smaznevo Train Station (STS): October 30, 2023 (**1–2**), studied site in winter time: February 28, 2024 (**3**), ditto, traps dismantled: April 1, 2024 (**4**), snow thickness in the studied site: February 28, 2024 (**5**) and an unremoved trap under a layer of snow: April 1, 2024 (**6**).*

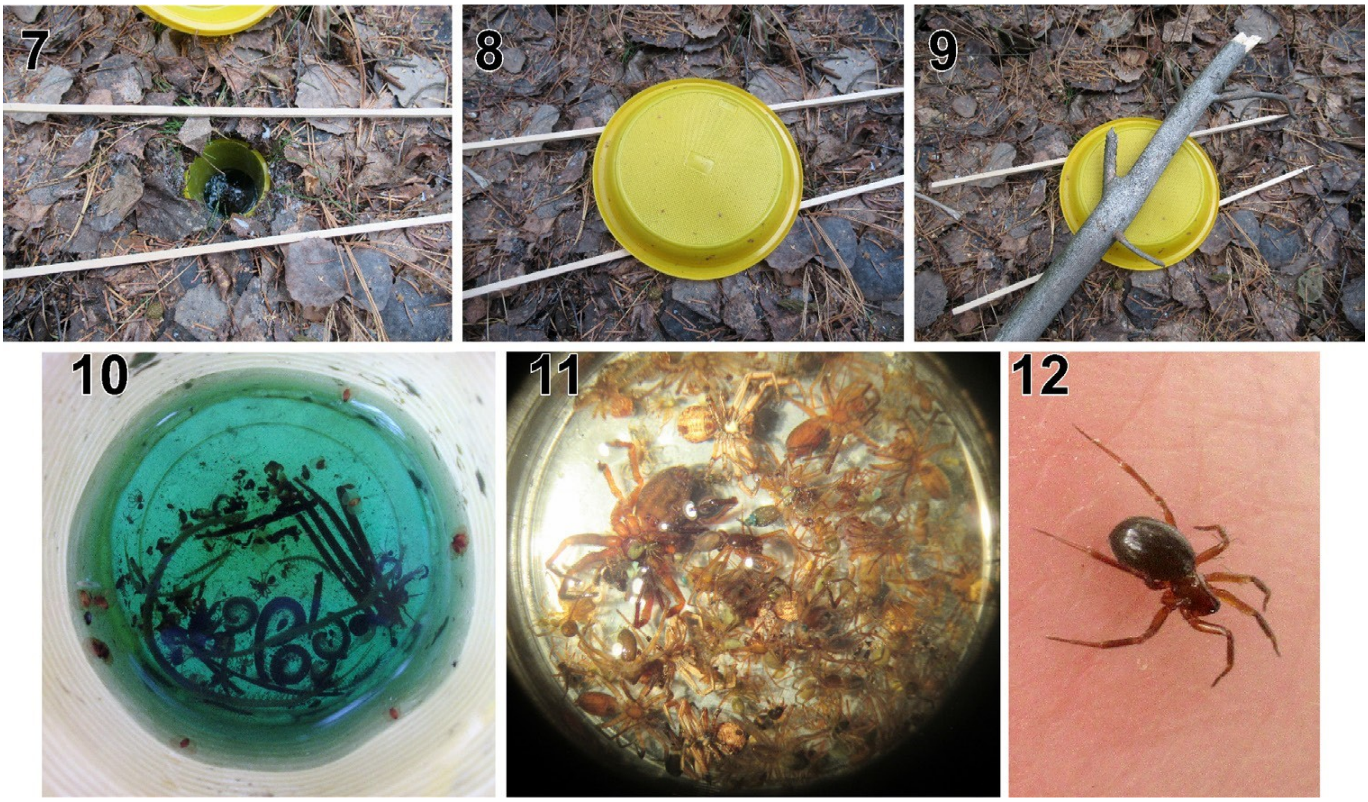

Figure 2. ***Figures 7–12.*** *Successive stages of mounting traps (**7–9**), the content of one of the traps (**10**), a sample of collected spiders (**11**) and a living Linyphiidae specimen found during dismantling of traps (**12**).*

Figure 3. ***Figures 13–14.*** *Location of the Smaznevo Train Station.*

Species survey

Family Agelenidae C. L. Koch, 1837

Pireneitega luctuosa **(L. Koch, 1878)**

Fig. 29

Material examined. 1♀.

Distribution. The species has is widespread from West Siberia and Central Asia to Japan (World Spider Catalog 2024). *Pireneitega luctuosa* was previously recorded in the southern and eastern parts of Altai Krai by Azarkina and Trilikauskas (2012). In the neighboring Kemerovo Region, it has been reported to inhabit a cave (Fomichev 2020).

Family Linyphiidae Blackwall, 1859

***Anguliphantes cerinus* (L. Koch, 1879)**

Figs 15, 22

Material examined. 12♂ 3♀.

Distribution. The species is distributed from South Siberia to Kazakhstan (World Spider Catalog 2024). The species was reported from Salair Mountain Range in Altai Krai by Trilikauskas (2023).

***Anguliphantes sibiricus* (Tanasevitch, 1986)**

Fig. 16

Material examined. **1♂.**

Distribution. The species is known from Salair Mountain Range, North-Eastern Altai and from Middle Siberia (Mirnoye Field Station) (Tanasevitch 1986; 2013; Trilikauskas 2023).

***Centromerus clarus* (L. Koch, 1879)**

Figs 17, 23

Material examined. 11♂ 12♀.

Distribution. Uralo-Baikalian boreal range (Marusik et al. 2000). It was previously reported from Altai Krai in Tigirek Reserve and Salair Mountain Range (Volynkin et al. 2011; Trilikauskas 2014; 2023).

***Centromerus sylvaticus* (Blackwall, 1841)**

Figs 18, 24

Material examined. 13♂ 12♀.

Distribution. This species has Holarctic range (World Spider Catalog 2024). It was previously recorded in Altai Krai from Tigirek Reserve and from Salair Mountain Range by Trilikauskas (2014; 2023).

***Helophora insignis* (Blackwall, 1841)**

Figs 19, 27

Material examined. 1♂ 2♀.

Distribution. Holarctic polyzonal range (Tanasevitch and Koponen 2007). The species was recorded in Altai Krai by Volkovsky and Romanenko (2010) and by Azarkina and Trilikauskas

(2013a). It is very common in Salair Mountain Range (Trilikauskas 2023).

** ***Maro sublestus*** **Falconer, 1915**

Figs 20, 26

Material examined. 3♂ 4♀

Distribution. This species is known from Northern and Central Europe to the Urals and is boreo-mountainous (Szymkowiak 2004). The new finding represents the first record of *M. sublestus* in West Siberia. World Spider Catalog (2024) indicates occurrence of this species in West Siberia. This is probably a mistake. *Maro sublestus* reaches only the Urals to the east (Mikhailov 2022).

Microneta viaria **(Blackwall, 1841)**

Figs 21, 25

Material examined. 1♂ 9♀

Distribution. Circum-Holarctic polyzonal range (Marusik et al. 2000). This species was recorded in Salair Mountain Range (Trilikauskas 2023).

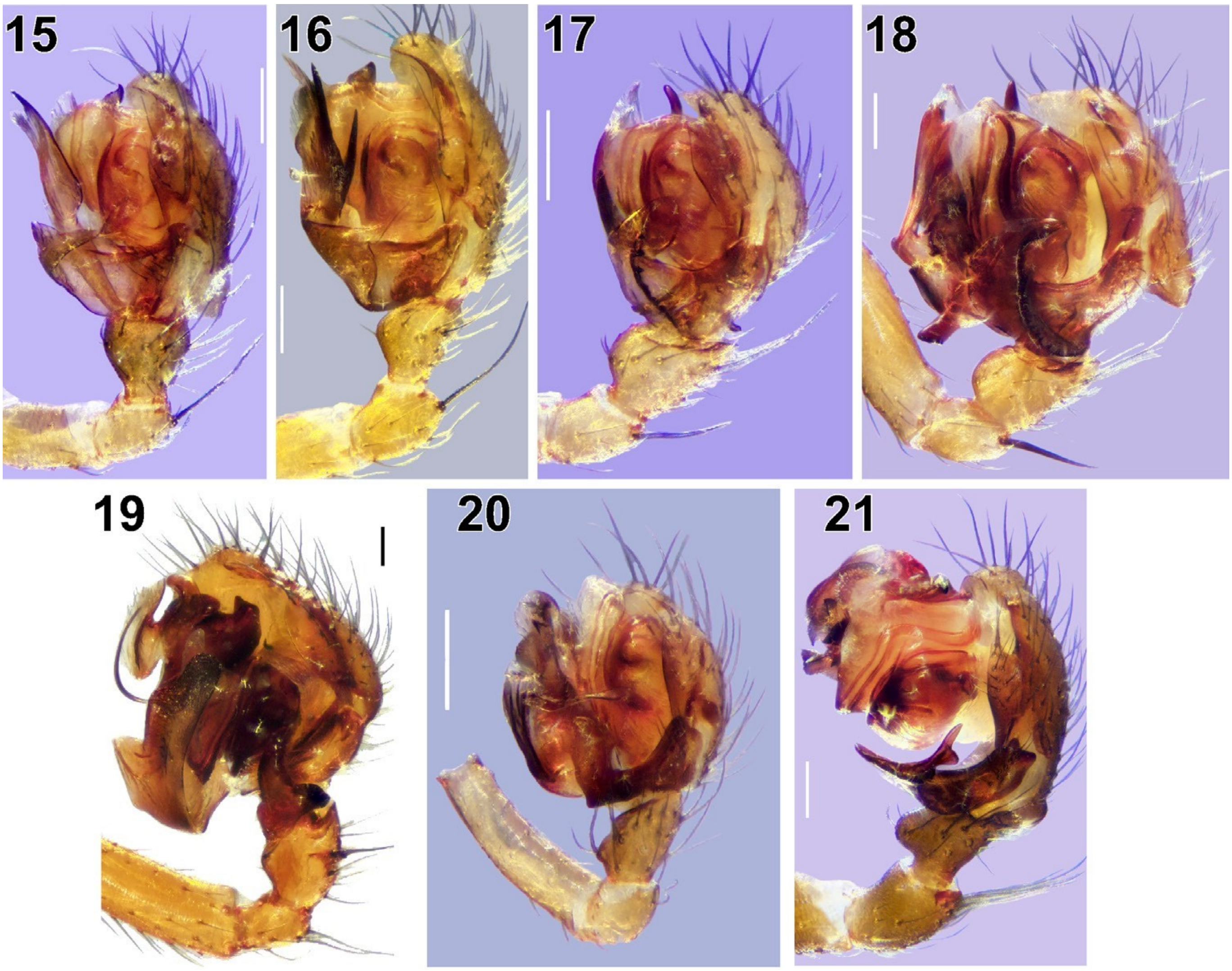

Figure 4. ***Figures 15–21.*** *Palps of males of Linyphiidae species collected in STS during the winter, retrolateral.* ***15*** *– Anguliphantes cerinus;* ***16*** *– A. sibiricus;* ***17*** *– Centromerus clarus,* ***18*** *– C. sylvaticus;* ***19*** *– Helophora insignis;* ***20*** *– Maro sublestus;* ***21*** *– Microneta viaria. Scale bars: 0.1 mm.*

*** *Tibioplus diversus* (L. Koch, 1879)**

Fig. 28

Material examined. 1♀.

Distribution. Although the species has a Trans-Palaearctic-NW Nearctic boreal range (Marusik et al. 2000), it was not reported from Altai Krai before.

Family Liocranidae Simon, 1897

*** *Agroeca cuprea* Menge, 1873**

Fig. 32

Material examined. 1♀.

Distribution. Recorded from Altai Krai for the first time. Distributed from Europe to Central Asia (World Spider Catalog 2024).

**** *Agroeca limnicunae* (McCook, 1884)**

Figs 33–43

Micaria limnicunae McCook, 1884: 153 (♀).

Micaria limnicunae: Platnick & Shadab, 1988: 7 (nomen dubium).

Agroeca ornata: Paquin & Dupérré, 2003: 152, f. 1669-1671 (♂♀).

Agroeca limnicunae: Eiseman, 2024: 283 (removed from nomen dubium, transferred from *Micaria*, synonymy of *Agroeca ornata*).

For the full list of 14 taxonomic entries see World Spider Catalog (2024).

Material examined. 10♂ 6♀.

Diagnosis. The male of *A. limnicunae* is similar to that of Trans-Palaearctic *A. brunnea* (Blackwall, 1833) in having wide ribbon-like embolus (Em) arising at 12-o'clock position. The male of *A. limnicunae* can be distinguished from that of *A. brunnea* by the basal part of Em 2 times wider than long (vs. basal part of Em 2 times longer than wide; cf. Figs 37, 40 and fig. 12F in Mu et al. (2019)). The female of *A. limnicunae* is similar to those of *A. brunnea* and Trans-Palaearctic *A. maculata* L. Koch, 1879 in having long and narrow septum (Se) tightly squeezed between lateral margins (LM). The female of *A. limnicunae* differs from that of *A. brunnea* by LM parallel almost along the entire length (vs. LM sharply diverging anteriorly; cf. Fig. 42 and fig. 12C in Mu et al. (2019)). The female of *A. limnicunae* can be distinguished from that of *A. maculata* by primarily receptacles (PR) as long as secondary receptacles (SR) (vs. PR twice longer than SR; cf. Fig. 43 and fig. 21 in Seropean et al. (2024)).

Redescription. Male. Total length 4.25. Carapace: 1.88 long, 1.4 wide. Abdomen: 2.15 long, 1.38 wide. Coloration. Carapace, chelicerae, endites and sternum light brown. Labium dark brown. Coxae, palps and legs yellow brown. Abdomen and spinnerets yellow gray. Eye sizes and interdistances: AME 0.09, ALE 0.09, PME 0.1, PLE 0.09, AME–AME 0.04, AME–ALE 0.03, PME–PME 0.11, PME–PLE 0.06. MOA 0.27 long, 0.21 anterior width, 0.29 posterior width. Leg measurements: I: 1.78, 0.83, 1.50, 1.25, 0.98 (6.34); II: 1.58, 0.75, 1.28, 1.15, 0.93 (5.69); III: 1.43, 0.65, 1.05, 1.30, 0.83 (5.26); IV: 1.95, 0.80, 1.65, 2.18, 1.05 (7.63). Leg spination: I: Fe d3 p1; Ti v2-2; Mt v2-2-2. II: Fe d3 p1; Ti p1 v1-1; Mt v2-2-2. III: Fe d3 p2 r1; Ti d1 p2 r2 v1-2-2; Mt p4 r4 v2-2-1. IV: Fe d3 p1 r1; Ti d2 p2 r2 v1-2-2; Mt d2 p4 r4 v2-2-2.

Male palp as shown in Figs 35–41. Tibia 1.6 times shorter than cymbium. Retrolateral tibial apophysis (RTA) twice shorter than tibia, digitiform, with sharply pointed tip. Cymbium 1.5 times longer than wide. Cymbial apex blunt. Bulb 1.4 times longer than wide. Subtegulum (St) elongated, almost rectangular in prolateral view. Tegulum (Te) with triangular posterior margin. Median apophysis (MA) hook-like in retrolateral view. Embolus (Em) ribbon-like, with whip-like distal part. Sperm duct (SD) runs on the prolateral side of embolus.

Female. Total length 6.00. Carapace: 2.30 long, 1.73. Abdomen: 3.40 long, 2.25 wide. Coloration as in male but more brownish. Eye sizes and interdistances: AME 0.09, ALE 0.10, PME 0.10, PLE 0.11, AME–AME 0.06, AME–ALE 0.06, PME–PME 0.13, PME–PLE 0.1. MOA 0.3 long, 0.24 anterior width, 0.3 posterior width. Leg measurements: I: 1.88, 0.95, 1.50, 1.20, 0.95 (6.48); II: 1.70, 0.88, 1.30, 1.13, 0.88(5.89); III: 1.58, 0.75, 1.08, 1.38, 0.83 (5.62); IV: 2.10, 0.93, 1.75, 2.15, 1.08 (8.01). Leg spination: I: Fe d3 p1; Ti v2-2; Mt v2-2-2. II: Fe d3 p1; Ti p1 v1-2; Mt p3 v2-2-1. III: Fe d3 p2 r1; Ti d1 p2 r2 v1-2-2; Mt d2 p4 r4 v2-2-2. IV: Fe d3 p1 r1; Ti d2 p2 r2 v1-2-2; Mt d2 p4 r4 v2-2-2.

Epigyne as shown in Figs 42–43. Epigyne approximately as long as wide. Lateral margins (LM) broad, almost parallel. Septum (Se) very long and narrow, 6 times longer than wide. Hoods (Ho) located medially. Copulatory openings (CO) open anteriorly. Primarily receptacles (PR) ovoid. Secondary receptacles (SR) kidneyshaped. Accessorial glands (AG) circular. Copulatory ducts (CD) almost parallel.

Distribution. The species was previously known from Yenisei River in Middle Siberia through Cisokhotia and Alaska to New Jersey (USA) (Marusik et al. 2002). Marusik and co-authors (2002) reported *A. limnicunae* from Mirnoye Field Station (69°19’N, 89°02’E), Ust’-Pit Village (58°55’N, 91°55’E) and Peredivinsk Village (57°03’N, 93°26’E). All three points are located within the Krasnoyarsk Krai, east of the Yenisei River. It seemed that the Yenisei River was the western limit of the species’ distribution. A new discovery in the Altai Krai has shown that this is not the case, and the species is distributed much further west. The new finding extends the known range of the species about 4° to the West and represents the first record of *A. limnicunae* in West Siberia.

Comments. Due to the fact that we collected *A. limnicunae* quite far from its known range, and also due to the fact that the last detailed description of this species was published quite a long time ago (Dondale and Redner 1982), we decided to provide its redescription.

Family Thomisidae Sundevall, 1833

***Ozyptila praticola* (C. L. Koch, 1837)**

Fig. 30

Material examined. 2♀

Distribution. Widespread from Europe to Altai Mountains and Salair Mountain Range. Introduced to both Americas (World Spider Catalog 2024). The species was previously recorded from Altai Krai including Salair Mountain Range (Volkovsky and Romanenko 2010; Trilikauskas 2014; 2023).

(?) *Xysticus pseudocristatus* Azarkina Logunov, 2001

Fig. 31

Material examined. 3♀.

Distribution. Widespread in Siberia and Central Asia (World Spider Catalog 2024). Females of *Xysticus pseudocristatus* are poorly distinguishable from those of *X. audax* (Schrank, 1803) and *X. cristatus* (Clerck, 1757) (Azarkina and Logunov 2001). The absence of the male does not allow to make a reliable determination.

Results

To sum up, 108 adult specimens of spiders belonging to 13 species were collected under the snow. In addition to adult specimens a number of juveniles were caught in the traps. Two families that were not present among adult spiders were represented among juveniles: Araneidae and Philodromidae. Of all the collected adult specimens, Linyphiidae made up 78.7%. In terms of the number of species, Linyphiidae also predominate: 8 species out of 13. Liocranidae are in second place in abundance (15.7% of adult specimens). The two most abundant species belong to *Centromerus* (Linyphiidae): *C. sylvaticus* and *C. clarus*. It should be noted that in addition to spiders, many other arthropods were collected. Collembola, which probably form the basis of spiders’ diet in the subnivean habitat, were especially abundant. In addition to springtails there were many other insects, from such orders as: Coleoptera, Diptera, Hemiptera, Hymenoptera and Megaloptera. The Myriapoda were represented by Geophilomorpha, Lithobiomorpha and Julida. Among the arachnids, in addition to spiders, there were Opiliones and Acariformes. All these materials will be transferred to specialists of the relevant groups.

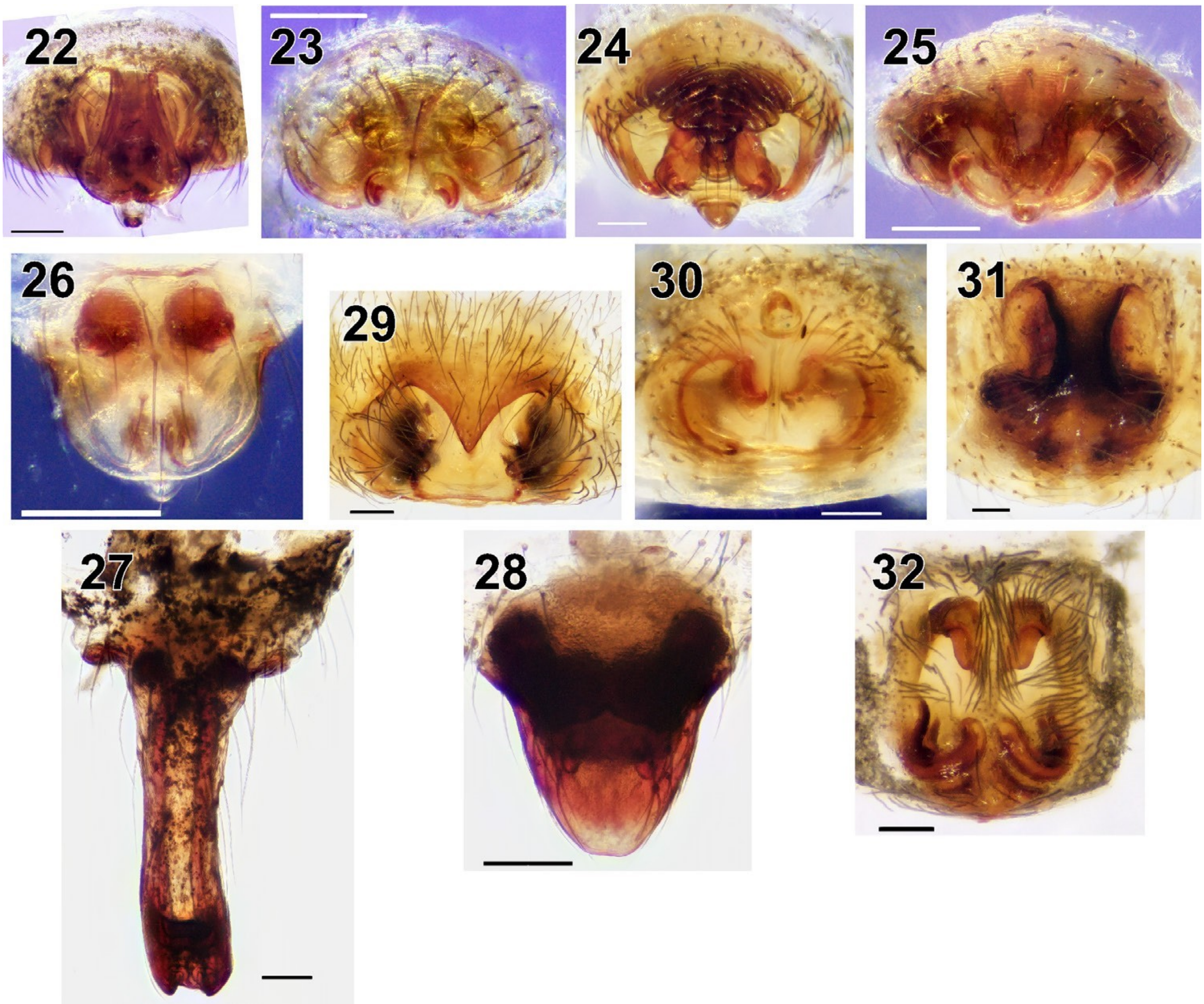

Figure 5. ***Figures 22–32.*** *Epigynes of spider species collected in STS during the winter, ventral.* ***22*** *– Anguliphantes cerinus;* ***23*** *– Centromerus clarus;* ***24*** *– C. sylvaticus;* ***25*** *– Microneta viaria;* ***26*** *– Maro sublestus;* ***27*** *– Helophora insignis;* ***28*** *– Tibioplus diversus;* ***29*** *– Pireneitega luctuosa;* ***30*** *– Ozyptila praticola;* ***31*** *– (?)Xysticus pseudocristatus;* ***32*** *– Agroeca cuprea. Scale bars:* ***22–28****,* ***30–32****=0.1 mm;* ***29****=0.2 mm.*

Discussion

Our research confirms that subnivean activity of spiders in Southwestern Siberia exists and the number of species that exhibit it is quite large. Even in the harsh climate of the north-east of the Altai Krai, the number of spider species whose mature specimens are active under the snow reaches 13. The Linyphiidae are absolutely dominant. Some studies in Europe have revealed much richer “winter faunas”. For example, a study conducted in southern Norway (60°10’N) revealed 23 species of adult spiders active under the snow (Hågvar and Hågvar 2011). In turn, in the north of Italy, 59 species of spiders (excluding juveniles) were collected during the winter period (Vanin and Turchetto 2007). In both cases, the fauna is also dominated by linyphiids. In northern Finnish Lapland, at the Kevo Subarctic Research Station (69°45’N), the proportion of linyphiids in winter trap material was very high, 92.3 % in pine forest (Koponen 1977). The difference to more southern regions is considerable, e.g. in Manitoba, Canada (49°49’ N), about 65 % of subnivean spiders were linyphiids in aspen dominated sites (Aitchison 1978). Thus, linyphiids dominate “winter faunas” in all study areas. According to Marusik and Kovblyuk (2011), linyphiids are preadapted to low temperatures due to their small size. In thin vessels, such as the body of a small spider, aqueous solutions freeze at lower temperatures than under normal conditions. There is a known observation of *Anguliphantes karpinskii* (O. Pickard-Cambridge, 1873) active at –11°C (Marusik and Kovblyuk 2011). Seven species of the total 13 occur also in Fennoscandia, northern Europe. However, only *Tibioplus diversus* and *Helophora insignis* were found in subnivean trap materials both in Altai and at the Kevo Subarctic Research Station, Finnish Lapland. The most abundant species at Kevo was *Macrargus multesimus* (O.P.-Cambridge, 1875). In spruce forests, southern Norway, the most abundant under snow species was *Tenuiphantes alacris* (Blackwall, 1853) (Hågvar and Hågvar 2011). In subnivean traps by Vanin and Turchetto (2007), *Tenuiphantes cristatus* (Menge, 1866) dominated in the Italian Alps. In our material *Centromerus sylvaticus* and *C. clarus* dominated in abundance. All dominants are linyphiids. Interestingly, subnivean pitfall trap material from Manitoba by Aitchison (1978) consisted two jointly occurring species with our material: *Centromerus sylvaticus* and *Agroeca ornata* (see *Agroeca limnicunae* above) among 19 winter active species.

In our study area, the minimum temperature in the winter 2023–2024 was –38.5°C (Table 1). The record low temperature in Barnaul, the capital of Altai Krai, 100 km from STS is –48.2°C. The minimum temperatures at Kevo are close to these in the Altai area, the lowest ones are –43.2°C (1970), –41.2°C (2014) and –41.1°C (2020) (Finnish Metereological Institute: https://en.ilmatieteenlaitos.fi/). The winters can be very cold also in continental Manitoba site, records are colder than –40°C. The minimum temperature of South Norwegian site was ca –28°C during the study by Hågvar and Hågvar (2011: fig. 1), thus clearly different from the research areas above due to the effect of the Golf Stream. Since snow cover is a good thermal insulator, it can be assumed that its thickness plays a much greater role in the winter activity of spiders than the air temperature during the winter. All regions of the temperate zone where winter activity of spiders has been confirmed, namely southern Norway, Finnish Lapland, Dolomite Alps, are characterized by high snowfall. Almost all the spiders collected have large ranges and are common in Siberia. Most of the spiders found are also common in Altai Krai, in particular in Salair Mt. Range. More than half of the species collected, namely *Pireneitega luctuosa*, *Anguliphantes cerinus*, *A. sibiricus*, *Centromerus clarus*, *C. sylvaticus*, *Helophora insignis*and *Microneta viaria*, have already been recorded in Salair Mt. Range nearby STS (Azarkina and Trilikauskas 2012; Trilikauskas 2023). Based on known phenological data, it can be assumed that the “winter fauna” of spiders in Southwestern Siberia consists of species whose mature specimens are found all year round (Table 2). Since most spider species inhabiting temperate latitudes have a one-year life cycle, it can be assumed that the year-round presence of adult specimens is explained by asynchronous maturation and reproduction. Thus, the “winter fauna” of spiders in studied region is not specific either in the zoogeographical aspect or phenologically.

However, the subnivean activity of spiders in harsh climatic conditions of Siberia is of considerable interest as a biological phenomenon. As Vanin and Turchetto (2007) point out, for spiders, winter activity may reduce rivalry between competing species and allows to use the resources that are available in winter in order to enter spring in better shape. We believe that it would be desirable to undertake researches of winter spider activity also in other regions. The most promising areas in this regard in Siberia are those where a thick snow cover forms: North Urals, western and northern parts of Altai Mountains, Kuznetsk Alatau and Kamchatka Peninsula.

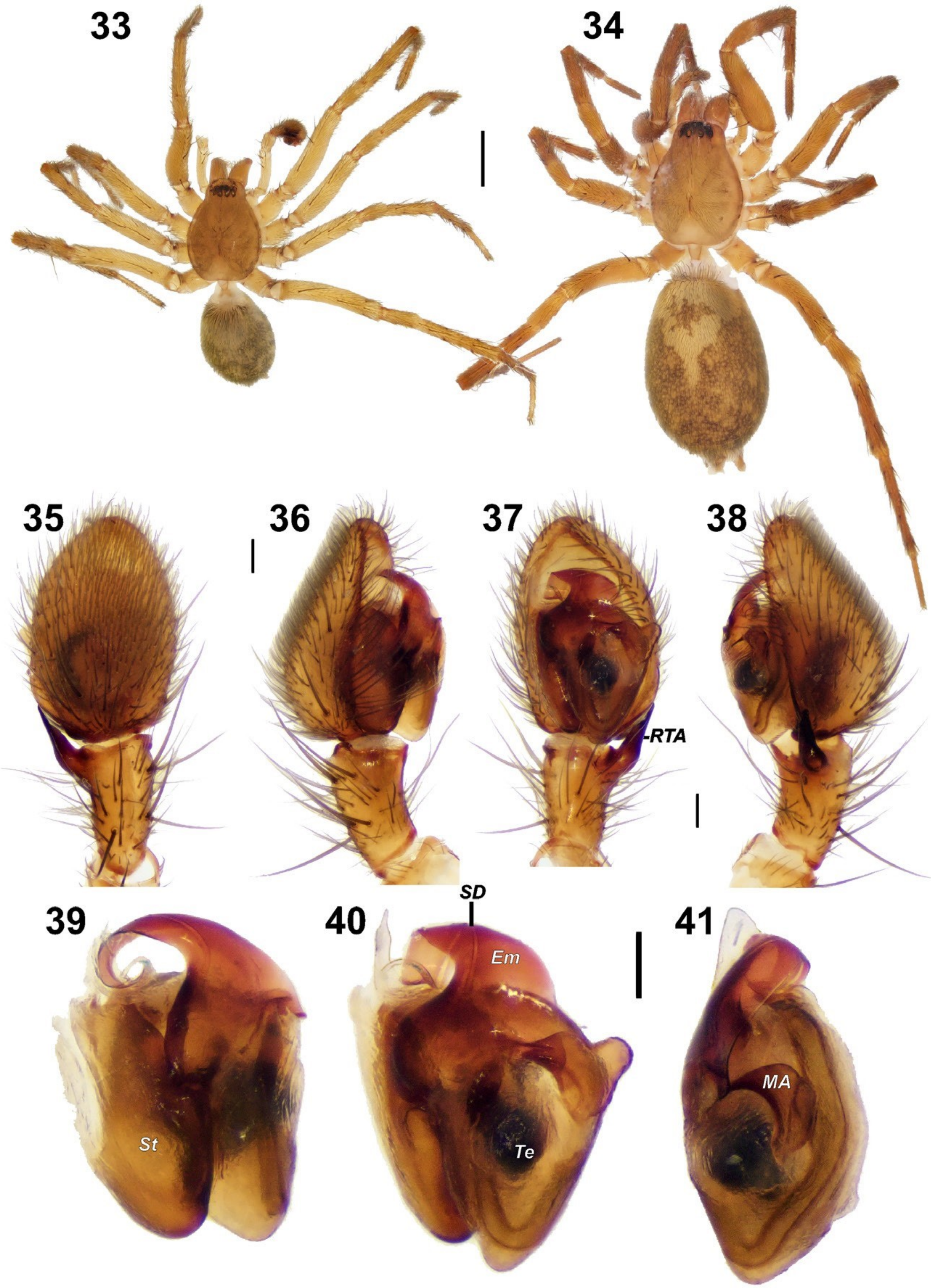
33
34
35
36
37
38
RTA
39
40
41
SD
Em
St
Te
MA

Figure 6. ***Figures 33–41.*** *Male (**33**) and female (**34**) habitus, male palp (**35–38**) and bulb (**39–41**) of Agroeca limnicunae. **33–35** – dorsal; **36**, **39** – prolateral; **37**, **40** – ventral; **38**, **41** – retrolateral. Scale bars: **33–34**=1 mm; **35–41**=0.1 mm. Abbreviations: Em – embolus, MA – median apophysis, RTA – retrolateral tibial apophysis, SD – sperm duct, St – subtegulum, Te – tegulum.*

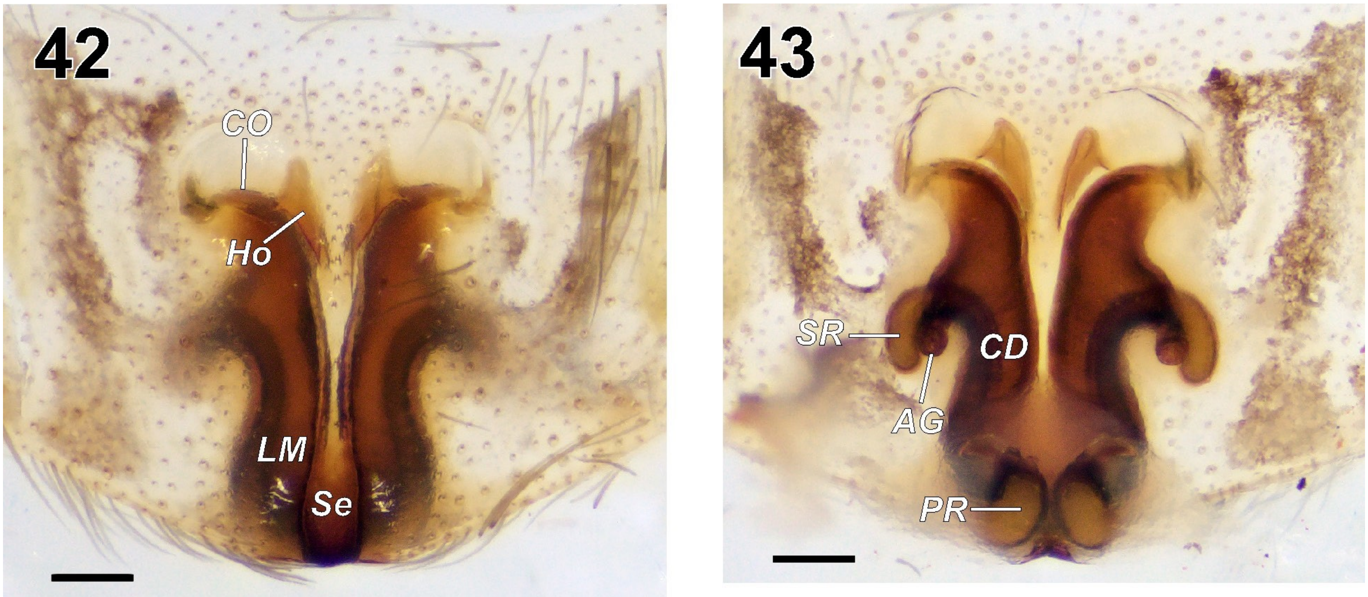

Figure 7. ***Figures 42–43.*** *Epigyne of Agroeca limnicunae. **42** – ventral; **43** – dorsal. Scale bars: 0.1 mm. Abbreviations: AG – accessorial gland, CD – copulatory duct, CO – copulatory opening, Ho – hood, LM – lateral margin, PR – primarily receptacle, Se – septum, SR – secondary receptacle.*

Trilikauskas 2023 (Salair Mt. Ridge)			Nentwig et al. 2024 (Europe)
Species	Earlies collecting date	Latest collecting date	Occurence
Agroeca cuprea	No data		January–December
Agroeca limnicunae	No data		No data
Anguliphantes cerinus	11 June	19 September – 20 October	No data
Anguliphantes sibiricus	26 May	1 September	No data
Centromerus clarus	11 June	20 September	No data
Centromerus sylvaticus	16 August	19 September – 20 October	January–December
Helophora insignis	13 August	20 October	January–December
Maro sublestus	No data		February, April, June – November
Microneta viaria	10 June – 1 July	19–20 September	January–December
Ozyptila praticola	10 June – 1 July	14–16 September	January–December
Pireneitega luctuosa	No data		No data
Tibioplus diversus	No data		No data
Xysticus pseudocristatus	No data		No data

Table 2. *Available phenological data on spider species collected in STS*

Acknowledgements

We wish to thank Yuri V. Dyachkov (Barnaul, Russia) for being a great help during the fieldworks. We are also grateful to Yuri M. Marusik (Magadan, Russia) and Andrei V. Tanasevitch (Moscow, Russia) for the help with identification of some Linyphiidae. Special thanks go to Laimonas A. Trilikauskas (Novosibirsk, Russia) for the help with identification of some Linyphiidae and reviewing the earlier draft of the manuscript. The work of Alexander A. Fomichev was funded by the state assignment of the Ministry of Science and Higher Education of the Russian Federation (project FZMW-2023-0006 “Endemic, local and invasive arthropods (Arthropoda) of the mountains of South Siberia and Central Asia: a unique gene pool of a biodiversity hotspot”. Finally, we thank the editor and the reviewer, Yuri M. Marusik, for their critical comments which helped to improve the manuscript.

References

Aitchison CW (1978) Spiders active under snow in southern Canada. In: Merret P (Ed) Arachnology. Symposia of the Zoological Society of London 42: 139–148.

Aitchison CW (2001) The effect of snow cover on small animals. In: Jones HG, Pomeroy JW, Walker DA, Hoham RW (Eds) Snow Ecology: An Interdisciplinary Examination of Snow-Covered Ecosystems. Cambridge University Press, Cambridge, 229–265.

Azarkina GN, Logunov DV (2001) Separation and distribution of *Xysticus cristatus* (Clerck, 1758) and *X. audax* (Schrank, 1803) in eastern Eurasia, with description of a new species from the mountains of Central Asia (Aranei: Thomisidae). Arthropoda Selecta 9(2): 133–150.

Azarkina GN, Trilikauskas LA (2012) Spider fauna (Aranei) of the Russian Altai, part I: families Agelenidae, Araneidae, Clubionidae, Corinnidae, Dictynidae and Eresidae. Euroasian Entomological Journal 11(3): 199–208, 212, pl. I.

Azarkina GN, Trilikauskas LA (2013a) Spider fauna (Aranei) of the Russian Altai, part II: families Gnaphosidae, Hahniidae, Linyphiidae, Liocranidae and Lycosidae. Euroasian Entomological Journal 12(1): 51–67.

Azarkina GN, Trilikauskas LA (2013b) New data on spider fauna (Aranei) of the Russian Altai, part III: families Mimetidae, Miturgidae, Oxyopidae, Philodromidae, Pholcidae, Pisauridae, Salticidae, Sparassidae, Tetragnathidae, Theridiidae, Thomisidae, Titanoecidae, Uloboridae and Zoridae. Euroasian Entomological Journal 12(3): 243–254.

Coulianos CC, Johnels AG (1962) Note on the subnivean environment of small mammals. Arkiv för Zoologi, Serie 2: 363–370.

Dondale CD, Redner JH (1982) The insects and arachnids of Canada, Part 9. The sac spiders of Canada and Alaska, Araneae: Clubionidae and Anyphaenidae. Research Branch Agriculture Canada Publication 1724: 1–194.

Eiseman CS (2024) On the identities of some distinctive, suspended spider egg sacs (Araneae: Liocranidae, Tetragnathidae). Proceedings of the Entomological Society of Washington 125(2): 278–284. https://doi.org/10.4289/0013-8797.125.2.278

Fomichev AA (2016) New data on the spiders (Arachnida: Aranei) from Altai Territory, Russia. Arthropoda Selecta 25(1): 119–126. https://doi.org/10.15298/arthsel.25.1.12

Fomichev AA (2020) New data on spiders (Arachnida, Aranei) from the caves of South-western Siberia (Russia). Acta Biologica Sibirica 6: 429–436. https://doi.org/10.3897/abs.6.e59450

Fomichev AA (2022) New data on spiders (Arachnida: Aranei) of the plain part of Altai Territory, Russia. Acta Biologica Sibirica 8: 211–236. https://doi.org/10.5281/zenodo.7703357

Geiger R (1965) The climate near the ground. Harvard University Press, Cambridge, Mass, 611 pp.

Hågvar S, Hågvar EB (2011) Invertebrate activity under snow in a South-Norwegian spruce forest. Soil organisms 83(2): 187–209.

Koponen S (1977) Spider fauna (Araneae) of Kevo area, northernmost Finland. Reports from the Kevo Subarctic Research Station 13: 48–62.

Marusik YM, Kovblyuk MM (2011) Spiders (Arachnida, Aranei) of Siberia and Russian Far East. KMK Scientific Press, Moscow, 344 pp.

Marusik YM, Logunov DV, Koponen S (2000) Spiders of Tuva, South Siberia. Institute for Biological Problems of the North, Magadan, 253 pp.

Marusik YM, Rybalov LB, Koponen S, Tanasevitch AV (2002) Spiders (Aranei) of Middle Siberia, an updated check-list with a special reference to the Mirnoye Field Station. Arthropoda Selecta 10(4): 323–350.

Mikhailov KG (2021) Advances in the study of the spider fauna (Aranei) of Russia and adjacent regions: a 2017 update. Invertebrate Zoology 18(1): 25–35, Supplements 1.01–1.15, 2.01–2.24. https://doi.org/10.15298/invertzool.18.1.03

McCook HC (1884) A spider that makes a spherical mud-daub cocoon. Proceedings of the Academy of Natural Sciences of Philadelphia 36: 151–153.

Mu Y, Jin C, Zhang F (2019) A survey of *Agroeca* Westring, 1861 from China (Araneae: Liocranidae). Zootaxa 4615(1): 91–112. https://doi.org/10.11646/zootaxa.4615.1.4

Nentwig W, Blick T, Bosmans R, Gloor D, Hänggi A, Kropf C (2024) Spiders of Europe. Version 08.2024. Online at https://www.araneae.nmbe.ch, accessed on 17 August, 2024. https://doi.org/10.24436/1

Paquin P, Dupérré N (2003) Guide d'identification des araignées de Québec. Fabreries, Supplement 11: 1–251.

Platnick NI, Shadab MU (1988) A revision of the American spiders of the genus *Micaria* (Araneae, Gnaphosidae). American Museum Novitates 2916: 1–64. Pogoda i klimat. Pogoda i klimat (2024) (http://www.pogodaiklimat.ru).

Pruitt WOJr (1970) Some ecological aspects of snow. In: UNESCO (Ed.) Ecology of the subarctic regions, Paris, 83–100.

Schmidt P, Lockwood JA (1992) Subnivean arthropod fauna of Southeastern Wyoming: Habitat and seasonal effects on population density. The American Midland Naturalist 127: 66–76.

Seropian A, Bulbulashvili N, Krammer H-J, Thormann J, Hein N, Karalashvili L, Karalashvili N, Datunashvili A (2024) Picking pearls from the Silk Road: insights into the spider (Arachnida, Araneae) diversity in Georgia from the Caucasus Barcode of Life (CaBoL) project. Part III. Caucasiana 3: 89–118. https://doi.org/10.3897/caucasiana.3.e120883

Shorthouse DP (2010) SimpleMappr, an online tool to produce publication-quality point maps, online at http://www.simplemappr.net[accessed on April, 2024]

Szymkowiak P (2004) *Maro sublestus* Falconer, 1915 (Araneae, Linyphiidae) – a species new to the fauna of Poland. Fragmenta Faunistica 47(2): 139–142.

Tanasevitch AV (1986) New and little-known species of *Lepthyphantes* Menge 1866 from the Soviet Union (Arachnida: Araneae: Linyphiidae). Senckenbergiana Biologica 67(1/3): 137–172.

Tanasevitch AV (2013) The linyphiid spiders of the Altais, southern Siberia (Aranei: Linyphiidae).

Arthropoda Selecta 22(3): 267–306. https://doi.org/10.15298/arthsel.22.3.11

Tanasevitch AV, Koponen S (2007) Spiders (Aranei) of the southern tundra in the Russian Plain. Arthropoda Selecta 15(4): 295–345.

Trilikauskas LA (2014) On some seasonal aspects of spiders and harvestmen population (Arachnida: Aranei, Opiliones) in larch forests of the Tigirekski Reserve (North-Western Altai). Tomsk State University Journal of Biology 28(4): 123–135. [In Russian, with English summary]

Trilikauskas LA (2023) First data on the spider fauna (Arachnida: Aranei) of the Salair National Park and surroundings (Altaisky Krai, Russia). Biota i sreda prirodnykh territoriy 11(4): 36–56. [In Russian, with English summary]

Vanin S, Turchetto M (2007) Winter activity of spiders and pseudoscorpions in the South-Eastern Alps (Italy). Italian Journal of Zoology 74(1): 31–38. https://doi.org/10.1080/11250000601017233

Volkovsky EV, Romanenko VN (2010) Population of spiders (Aranei) of soil-surface tier of Altay Region Mountain Valleys. Vestnik Tomskogo Gosudarstvennogo Universiteta 3(11): 60–67. [In Russian]

Volynkin AV, Trilikauskas LA, Baghirov RT-O, Burmistrov MV, Byvaltsev AM, Vasilenko SV, Vishnevskaya MS, Danilov YN, Dudko AY, Dudko RY, Knyshov AA, Kosova OV, Kostrov DV, Krugova TM, Kuznetsova RO, Kuzmenkin DV, Legalov AA, Lvovsky AL, Namyatova AA, Nedoshivina SV, Perunov YE, Reschnikov AV, Sinev SY, Solovarov VV, Tyumaseva ZI, Udalov IA, Ustyzhanin PY, Filimonov RV, Tshernyshev SE, Tshesnokova SV, Sheikin SD, Shcherbakov MV, Yanygina LV (2011) Invertebrates of the Tigirek Nature Reserve (an annotated check-list), Biota of the Tigirek Natural Reserve. Proceedings of the Tigirek State Natural Reserve 4: 165–226. [In Russian, with English summary]

World Spider Catalog (2024) World Spider Catalog. Version 25.5. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on August, 2024. https://doi.org/10.24436/2