New data on introduced spider species (Arachnida: Aranei) from the Urals

Новые данные об интродуцированных видах пауков (Arachnida: Aranei) на Урале

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ABSTRACT. Data on four introduced spider species from the Urals are provided. One species, Coleosoma floridanum (Banks, 1900), is found in the fauna of Russia for the first time, and three others, Oecobius navus (Blackwall, 1859), Oostearius melanopygius (O. Pickard-Cambridge, 1880) and Parasteatoda tabulata (Levi, 1980), are new to the Urals fauna. Thus, the synanthropic fauna of spiders of Perm currently consists of 20 species. Four of the five recorded introduced species, C. floridanum, O. melanopygius, P. tabulata, and Nesticella mogera (Yaginuma, 1972), were found in the greenhouse of the Botanical Garden of the Perm State University. The greenhouse spider fauna appears to be rather diverse: besides four introduced species, three synanthropic and 20 native spider species are found there. Data on ecology and/or phenology of the newly recorded introduced species are provided as well.

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KEY WORDS: Araneae, synanthropic fauna, greenhouse, Coleosoma floridanum, Oecobius navus, Oostearius melanopygius, Parasteatoda tabulata.

КЛЮЧЕВЫЕ СЛОВА: Araneae, синантропная фауна, оранжерея, Coleosoma floridanum, Oecobius navus, Oostearius melanopygius, Parasteatoda tabulata.

Introduction

The European fauna is undergoing accelerating changes due to global warming, habitat transformation and the spread of invasive species [Rezáč et al., 2021]. A number of alien species is steadily increasing, mainly through continuous globalization with increasing transportation of people and goods [Hulme et al., 2009]. Such species are transferred, with direct or indirect human assistance, from the areas of their origin to other biogeographical areas where they may become established [Ricciardi et al., 2013]. First records of alien spiders in Europe date back 200 years; they were compiled by Bonnet [1929] for the first time. The latest review on this problem was made by Nentwig [2015].

Greenhouses, with relatively stable temperature and humidity conditions, provide a suitable environment for various groups of invertebrates. With the usual synanthropic and native species that occasionally make their way into greenhouses, newly introduced exotic (sub)tropical species can be found as well. It is an old tradition to search for exotic invertebrate animals in greenhouses [Simon, 1896; Boettger, 1929; Holzapfel, 1932]. A large part of such alien species seems to have been imported with overseas plants from nurseries or other greenhouses. In most cases, they are restricted to heated greenhouses (hothouses) due to their ecological demands, especially with regards to temperature [Hänggi et al., 2021].

The findings of introduced spider species in Russia are quite rare, even in the European part. Such finds usually belong to the synanthropic species collected from private houses and other kind of indoor habitats.
In 2019, the theridiid spider *Nesticella mogera* was discovered in the greenhouse complex of the Botanical Garden of the Perm State University (Russia). It was probably introduced there with plants originated from the Kuban Subtropical Botanical Garden [Eseyunin et al., 2019]. This finding prompted a more detailed study of the greenhouse complex for possible records of other introduced species.

In the present paper, new records of some anthropochorally distributed spider species are given, with some remarks on their ecology and phenology. Of these species, three are new to the greenhouse and one has established itself as a synanthropic species in Perm.

**Material and Methods**

The studied material was collected by pitfall-traps set up in the greenhouse complex of the Botanical Garden of the Perm State University (Russia) from January to December 2021. Ten greenhouse compartments (Fig. 1) that differ in a hydro-thermal regime and selected plants were examined (Figs 2–7): 1) Permian Period, 2) Wet Tropics, 3) Cacti and Succulents, 4) Epiphytes, 5) Dry Tropics, 6) Useful Tropic Plants, 7) Collection of orchids, 8) Subtropics, 9) Warm and 10) Cold Sections of the memorial greenhouse [Shumikhin, 2015]. The compartments No. 1–6 are located in the new part of the greenhouse which was built up in 2010; the compartments No. 7–10 belong to the memorial part of the greenhouse which was built up in 1930 (Fig. 1).

In each section of the greenhouse, the air temperature and humidity are adjusted to the needs of cultivated plants (Table 1). All greenhouse compartments are regularly treated with insecticides.

The material was collected every 14 days. The air temperature at the ground level was measured every time the traps were emptied. During the season, 5–7 measurements were made. Table 1 shows average temperatures.

In addition, specimens of *Oecobius navus* (Blackwall, 1859) recorded from the ‘urban wall spider’ were also observed in a high-rise apartment building from May 2019 to January 2022.

The studied material is deposited in the Zoological Museum of the Moscow State University (ZMMU, curator: K.G. Mikhailov), Manchester Museum of the University of Manchester, UK (MMUE, curator: D.V. Logunov) and the Department of Invertebrate Zoology and Aquatic Ecology of the Perm State University (PSU, curator: S.L. Eseyunin).

**Results**

**Linyphiidae**

*Ostearius melanopygius* (O. Pickard-Cambridge, 1880)

**Material**. Russia, Perm, botanical garden of the Perm State University, greenhouse, pitfall-traps, E. Plakhkina: 1♂ (ZMMU), 26.IV–11.V.2021; 1♂, 1♀ (ZMMU), 7–21.VI.2021; 3♂♀ (MMUE), 30.VIII.2021.
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Table 1. Basic climatic conditions in different compartments of the greenhouse complex of the Botanical Garden.

| Compartment* | Relative humidity (%) | Average air temperature (°C) |
|--------------|-----------------------|-----------------------------|
|              |                       | Winter | Spring | Summer | Autumn |
| 1            | 80–90                 | 22.3   | 21.5   | 23.3   | 19.3   |
| 2            | 90–100                | 28.6   | 23.6   | 23.2   | 23.2   |
| 3            | 60–70                 | 20.9   | 24.6   | 24.5   | 21.3   |
| 4            | 95–100                | 24.1   | 23.4   | 23.3   | 21.7   |
| 5            | 80                    | 27.5   | 22.9   | 23.0   | 22.9   |
| 6            | 80                    | 26.0   | 24.4   | 23.2   | 22.0   |
| 7            | 85–90                 | 14.8   | 21.1   | 23.2   | 13.3   |
| 8            | 85–90                 | 15.1   | 19.7   | 23.1   | 13.8   |
| 9            | 85–90                 | 12.5   | 16.6   | 20.2   | 13.1   |
| 10           | 85–90                 | 11.6   | 17.7   | 21.0   | 12.5   |

* Compartments 1–10 as in text.
IDENTIFICATION. Locket, Millidge [1953: Fig. 197D–G]. Wiehle [1960: Abb.8–15].

COMMENTS. It is believed that *O. melanopygius* is native to South America. The species has been introduced now to North and South Africa, Canary Islands, Turkey, China, Malaysia, Indonesia, New Zealand [WSC, 2022], Japan [Chikuni, 1989], Australia [GBIF, 2021] and Europe [Nentwig et al., 2022]. Wiehle [1960] suggested that the species was introduced to Europe via England (Zwisterne Station in the Atlantic Islands). Having summarized the available data, Ruzicka [1995] came to the conclusion that *O. melanopygius* spread eastward at a speed of about 50 km per year. Now the species has established throughout Europe [Nentwig et al., 2022].

*O. melanopygius* was discovered near the western border of Russia, in Donetsk Area of Ukraine in 2016 [Ponomarev et al., 2017]. In the same year, the species was caught in Udmurtia [Sozontov, 2021]. Yet, the species is known from the Maritime Territory of Russia [Marusik, Koponen, 2000]. *O. melanopygius* is recorded from Perm Region and the Urals for the first time.

HABITAT AND ECOLOGY. Data on the biotic preferences of *O. melanopygius* in South America are scarce. Freiberg [2017] noted that the species was abundant on pastures and soybean fields in the integrated agricultural production system of Rio Grande do Sul, Brazil. The species is confined to agricultural lands in Egypt [El-Hennawy et al., 2016] and Europe [Rozvalka et al., 2013] as well. At the same time, in Europe, the species inhabits urbanized territories, such as natural biotopes, parks, landfill areas and even buildings [Benz et al., 1983; Rozvalka et al., 2013]. Rozvalka with the co-authors [2013] showed that the main route of species’ expansion is gardening (houseplants, pots, packaging, etc.), which allows it to establish new populations almost everywhere. Yet, in addition to anthropogenic factors, the authors mentioned that ballooning could be another important way of dispersal for *O. melanopygius*. However, in northern Europe, this species was found in the greenhouses only [Pajunen et al., 2008].

In the Russian Plain, this species was recorded only from such natural landscapes as the steppe [Ponomarev et al., 2017] and the *Quercus-Tilia* forest [Sozontov, 2021].

On August 8th 2021, *O. melanopygius* was found in the Perm Botanical Garden for the first time. Since then, it has recorded from the greenhouse only. Yet, its distribution over the greenhouse sections is not uniform. Specimens were found in two compartments of the memorial part of greenhouse: ‘Collection of Orchids’ and ‘Subtropics’ (Table 2).

The species abundance in the ‘Collection of Orchids’ is twice as high than in the ‘Subtropics’. The compartments have the same temperature and air humidity, but differ in the soil surface. In the ‘Subtropics’, plants are kept as pot culture. The soil under the shelves is quite dense, consisting of peat and sand covered with a layer of synthetic coating. In the ‘Collection of Orchids’, the soil composition is lighter, consisting of peat and leafy soil covered with mulch of dry pine bark (about 3 cm thick).

In the papers available to us, the phenology data on *O. melanopygius* are scarce. Gruberg [1997] found this species in Vienna in the second half of May. In Zurich, the phenomenon of mass reproduction was recorded in the first half of November [Benz, 1983]. According to ‘Spiders of Europe’, *O. melanopygius* is found all year-round but “mainly early year and autumn” [Nentwig et al., 2022]. In the Perm Botanical Garden, the specimens of *O. melanopygius* were caught from August till December with a maximum abundance in September (Fig. 8).

**Oecobiidae**

*Oecobius navus* (Blackwall, 1859)

MATERIAL. 1♂ (PSU-8201), Perm, indoor (flat), 28.V.2019, T.S. Esyunin; 2♀♀, 1♂ (PSU-8542), same locality, 20.IX.2019.

Table 2. Numbers of three spider species collected by pitfall traps in greenhouses of the Botanical Garden of the Perm State University.

| Species                     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| *Ostearius melanopygius*    | –     | –     | 1 mm  | 1 f   | –     | 1 juv. | 1#    | –     | 1 juv. |
| *Para-steatoda tabulata*    | 1 m   | –     | 1 m   | 1 f   | –     | 1 juv. | 1#    | –     | 1 juv. |
| *Coleosoma floridanum*      | 10 mm | 2 im. | 11 mm | 8 ff  | 3 im. | 81 mm | 39 ff | –     | 11 mm |
|                             | 2 im. | ff    | 2 im. | 2 f   | 24 juv.| 1 im. | 1 f   | 2 juv. |       | 12 mm |
|                             |       | 2 im. | 19 im.| 15 mm | 24 juv.| 4 ff  | 1 im. | 1 f   | 2 juv. | 16 mm |
|                             |       | 2 im. | 19 im.| 15 mm | 24 juv.| 4 ff  | 1 im. | 1 f   | 2 juv. | 16 mm |
|                             |       | 2 im. | 19 im.| 15 mm | 24 juv.| 4 ff  | 1 im. | 1 f   | 2 juv. | 16 mm |

*Compartment* 1–9 as in the text. Abbreviations: im. — immature ♀♀ and ♂♂; juv. — juvenile specimens at different stages; f, ff — female(s); m, mm — male(s).
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S.L. Esyunin; 1♀ (MMUE), same locality, 25.VIII.2020, S.L. Esyunin; 2♀♀ (MMUE), same flat, X–XI.2020, S.L. Esyunin; 1♂ (ZMMU), same flat, 2.I.2021, G.Sh. Farzalieva; 1♀ (ZMMU), same flat, 16.X.2021, E.S. Esyunina; 1♀ (ZMMU), same locality, 17.1.2022, E.S. Esyunina.

IDENTIFICATION. [Wunderlich, 1987: Abb. 281–283].

COMMENTS. There are 90 species of Oecobius Blackwall, 1862 worldwide, of which many (8.9%) species have been introduced to many regions from outside their natural occurrence [WSC 2022]: viz., O. amboseli Shear et Benoit, 1974, O. annulipes Lucas, 1846, O. cellariorum (Duges, 1836), O. concinus Simon, 1893, O. maculatus Simon, 1870, O. marathaus Tikader, 1962, O. navus, O. putus O. Pickard-Cambridge, 1876).

O. navus was first described from Madeira but is now reported worldwide [Nentwig et. al., 2022]. Presumably its natural range was limited to the Mediterranean (southern Europe, northern Africa, Turkey, the Caucasus), but to date it has been introduced to South Africa, China, Korea, Japan, New Zealand, Canada, USA, South America [WSC, 2022], apparently, as a result of human transportation [Oxford, 2020].

In Europe, O. navus was first recorded by Pickard-Cambridge [1909] from Britain, based on the material sent to him from the Royal Botanic Gardens (Kew) where a single adult female was caught on a bundle of imported cork probably from Spain or northern Africa [Oxford, 2015]. Since then, during few decades, this species has spread out across Europe. Yet, it is not listed as alien or invasive because it is native to Europe [Nentwig et al., 2022].

O. navus has been recorded from the western borders of Russia since the 1980s: Estonia [Vilbaste, 1974: as Oecobius annulatus Lucas, 1846], Latvia [Sternbergs, 1980: as O. annulatus], Ukraine [Evtushenko, 2001: as Talamia annulata], Belarus [Dashkevich, 2015]. In 1996, the species was discovered in Ryazan City, and in 2017 in Chuvash Republic (for details, see Mikhailov & Borisova [2017]). However, O. navus is recorded from Perm Region (and the Urals) for the first time.

HABITAT AND ECOLOGY. In the temperate regions of Europe, O. navus is almost exclusively synanthropic, but in warmer regions it is also known from outdoor habitats such as garrigue, oak woods, heathlands, under stones [Nentwig et al., 2022]. In northern Africa, it was found in desert habitats, under stones [Hasan, 1953]. In South America, it is common in the Mediterranean scrubs in Chile and caves in Brazil (specimens were even collected at patches of bat guano in a cave, up to 120 m from the cave entrance) [Santos, Gonzaga, 2003].

In the City of Perm, O. navus was observed exclusively indoor, in an apartment of a multi-flat house. In the same house there is also a large colony of the Pharaoh Ant (Monomorium pharaonis (Linnaeus, 1758); Myrmicinae, Formicidae, Hymenoptera), which seems to represent a potential prey for this spider [Voss et al., 2007].

According to the GBIF Metrics [GBIF, 2021], individuals of O. navus are found throughout the year, with a significant increase in numbers in April and May. Such dynamics correlates with the data from ‘Spiders of Europe’: viz., females are observed all year round, while males are observed mainly in the summer [Nentwig et al., 2022].

Despite a small number of individuals caught (see above), it is worth mentioning that both males and females were caught in all seasons of the year.

**Theridiidae**

*Colesosoma floridanum* (Banks, 1900)

MATERIAL: Russia, Perm City, Botanic Garden of the Perm State University, pitfall traps, E. Plakkhina: 6♀♀, 7♂♂ (ZMMU), 11.1.2021; 20♀♀, 14♂♂ (MMUE), 25.1.2021.

IDENTIFICATION. [Knoflach, 1999: Abb. 71–82].

COMMENTS. *Colesosoma floridanum* is considered to be native to Central and South America [WSC, 2022], but now the species is known from Canada, USA, central and
The record of *C. floridanum* from the Netherlands was done from a different kind of artificial biocenoses. The species was found in large numbers in a hot-cell (28–30 °C, 80–85 relative humidity) of a Freesia Trading Company in Honselersdijk [Helsdingen, 1995].

In the Botanical Garden of the Perm State University, almost all specimens were collected from a new part of the greenhouse which was built up in 2010. In the memorial greenhouse of the Botanical Garden, only singletons were caught. The preferred habitat for *C. floridanum* was the compartment 'Cacti and Succulents' (Table 2), which was driest and most extreme in terms of temperature fluctuations of all other compartments of the new part of greenhouse (Table 1). The temperature in ‘Cacti and Succulents’ is highest in the spring/summer and lowest in the winter among all the compartments (Table 1). Yet, a significant number of the specimens of *C. floridanum* were captured in the ‘Useful Tropic Plants’ compartment (Table 2). This section does not differ significantly from other sections with regards to its temperature and humidity (Table 1).

Usually, in greenhouses, specimens of *C. floridanum* were hand-collected, or collected by beating trays [Tharmarajan, Benjamin, 2021]. It should be noted that a number of individuals collected by these methods is always relatively small. We used pitfall-traps which allowed us to collect a large number of individuals moving along the soil surface (332 individuals in total).

In the papers known to us, the phenology of *C. floridanum* is not described. In Europe, this species was observed from May to July [Nentwig *et al*., 2022]. In the City of Perm, *C. floridanum* was collected throughout the year, with a sharp decline in the summer (Fig. 9). We also observed two peaks of the *C. floridanum* activity: the spring (March) and the autumn (September–October).
Parasteatoda tabulata (Levi, 1980)

MATERIAL. Russia, Perm City, Botanic garden of Perm State University, greenhouse, pitfall-traps, E. Plakkhina: 1♂ (MMUE), 16.VIII.2021; 1♂, 1♀ (ZMMU), 11.X.2021.

OTHER MATERIAL. Russia. Lipetsk City: 1♂ (PSU-722), Pinus-Betula forest, 4.VII.1999, G.Sh. Farzalieva; 1♂ (PSU-722), same locality, outbuildings, VII.2004, S.L. Esyunin. – Amur Oblast: 1♂ (PSU-8140), Nora (=Norsky) Reserve, meadow with Carex and another herbs, VI.2018, coll. unknown; 1♀ (PSU-8141), Belogorsk District, Vozzhaevka Vil., kitchen garden, 20.VI.2018, coll. unknown.

IDENTIFICATION. [Knoflach, 1991: Abb.6–10, 14–15; Gromov, 1997: Figs 1–5.]

COMMENTS. Parasteatoda tabulata seems to be native to Russia [Dondale et al., 1994], but now it is widely distributed across the northern Hemisphere [WSC, 2022], displaying a Holarctic range [Le Peru, 2011], and was introduced to Europe at 1851.

In the European part of Russia, P. tabulata was hitherto recorded from the cis-Caucasia [Abdurakhmanov et al., 2012; Ponomarev, Komarov, 2013], Krasnodar Province [Eysunin, 2010], Kursk [Polchaninova, 2009], Belgorod [Ponomarev, Polchaninova, 2006], Rostov [Ponomarev, Tsvetkov, 2003] and Ulyanovsk Areas [Kuz'min, Alekseenko, 2011] and Republic of Udmurtia [Sostic Pfliegler, 2014]. In addition, this species was found in southern regions of Siberia [Trilikauskas, 2013; Azarkina. Trilikauskas, 2013; Danilov, 2008], and in the Far East [Seyfulina, 2006; Mikhailov, Temereva, 2015]. Yet, P. tabulata is recorded for the spider fauna of Lipetsk and Perm Regions for the first time.

HABITAT AND ECOLOGY. In Europe, P. tabulata appears to be a synanthropic specie that prefers outer house walls [Knoflach, 1991; Dimitrov, 1994; Šestáková, Gajdoš, 2011], but is occasionally found in pine forests [Le Peru, 2011] or under rubble [Bink, 2014]. Juveniles and adults build a shelter consisting of a dome lined with various materials such as plant debris, pebbles, prey remains or empty egg sacs [Bink, 2014], as well as glass and plastic fragments [Knoflach, 1991]. According to Gromov [1997], in Kazakhstan, P. tabulata was caught in the rocky steppe.

Specimens of P. tabulata can be found throughout the growing season, but calendar dates of their activity depend on a region. For example, in Germany it was active from May to October with the main activity period for males in May [Moritz et al., 1988]. In Canada, P. tabulata was found from June to September [Dondale et al., 1994]. Females with egg sacs were registered from September to November [Le Peru, 2011]. In the City of Perm, adult specimens were caught from August to November.

Discussion

Three years ago, we thought of the synanthropic spider fauna of the City of Perm as well-studied and extremely poor, with the finding of a new species being a sensation [Eysunin et al., 2019]. The research specifically designed to collect spiders changed that perception. The records of one species new to Russia (Coleosoma floridanum) and three new to the Urals (Parasteatoda tabulata, Oecobius navus and Ostearius melanopygius) underline the fact that the knowledge of the synanthropic spider fauna of European part of Russia is still unsatisfactory. At the moment, the synanthropic spider fauna of Perm accounts for twelve species [Eysunin et al., 2019; present data]: Aiutaria pontica (Spассky, 1932), Cheliferanum cristatus (Blackwall, 1833), Diplostyla concolor (wider, 1834), Enoplognatha ovata (clerk, 1757), Evarcha falcata (clerk, 1757), Gnaothorium dentatum, Lepthypantes leprosus (ohlert, 1865), Megalephytaphantes pseudocollinus Saaristo, 1997, Oedothorax apicatus (Blackwall, 1850), Pachynatha degeeri Sundevall, 1830, Pardosa amentata (clerk, 1757), Phiphonetra impressa (l. Koch, 1881), Piratula hygrophil (Thorell, 1872), Porrhomma pygmaeum (Blackwall, 1834), Singa hamata (clerk, 1757), Trochosa ruricola (De Geer, 1778), Walekenaeria nudipalpis (westring, 1851), Xysticus ssp., three synanthropic (S. castanea, S. grossa and T. domestica) and four introduced species (N. moger, O. melanopygius, P. tabulata, and C. floridanum) have been found there. The latest non-native species should have arrived with imported plants, in the same way as it happens in Europe [Paquin et al., 2008; Nentwig, Kobelt, 2010; Šestakova et al., 2013; Pfieger, 2014; Nentwig, 2015; Hänggi et al., 2021].

In Europe, there is a risk of naturalization of introduced species, especially in the context of climate change [Hänggi et al., 2021]. Tropical and subtropical spiders from the greenhouses of Perm have no potential to establish any populations outdoors due to the absence of necessary climatic conditions. Yet, in the early spring 2021 (May 7), we observed a male and a female of N. moger in a weedy area outside the greenhouse. Later, during the spring-summer period, we didn’t find any more specimens of introduced spider species outside greenhouses.

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