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FAUNA OF SOIL PREDATORY MESOSTIGMATA MITES (ACARI, PARASITIFORMES) IN THE URBAN GRASSLANDS OF RĪGA, LATVIA

Ineta Salmane[1]*, Rūta Sniedze-Kretalova[2]

[1] Institute of Biology, University of Latvia, O. Vācieša iela 4, Rīga, Latvia

[2] Latvian Fund for Nature, ruta.sniedze@ldf.lv

* Corresponding author: e-mail: ineta.salmane@lu.lv

Abstract: Soil invertebrates are an integral part of soils and are important for the formation of soils. Soil invertebrates and among them Mesostigmata mites, play a vital role in the production and maintenance of healthy soils. Unfortunately, the significance of the soil invertebrates is seldom recognized. In collaboration with Latvian Fund for Nature and in the frames of the project "Introducing adaptive community-based biodiversity management in urban areas for improved connectivity and ecosystem health urban LIFE circles" collecting of soil samples in Rīga grasslands was performed. In total collection in 14 urban grassland sampling sites was made. Samples were taken by the soil corer and extracted on modified Berlese-Tullgren funnels. Although there was no intensive trampling in the investigated sites, grassland fragmentation and closeness of intensive traffic made a great impact on soil mite fauna. Mesostigmata mite species composition of investigated urban city sites differed from that in the natural grasslands of Latvia. Totally 20 Mesostigmata mite species in Rīga grasslands were determined. Nine of those species are also known from the natural grassland habitats in Latvia. The most frequent Mesostigmata species in urban grasslands were members of the families Rhodacaridae, Parasitidae, and Laelaptidae. Mesostigmata species, known as eudominant in the territory of Latvia, were not found in the urban grassland soils of Rīga.

Key words: mites, urban habitats, predation, soil invertebrates

Introduction

The soil is among the most complex habitat systems, yet its biological systems are poorly understood (Stork, Eggleton, 2014). Soil provides a living space for at least part of the life cycle of many animals. The connectivity of soil foodwebs means that most, if not all, terrestrial organisms depend directly or indirectly on biological processes in the soil. Understanding urban ecosystems requires information about the response of soil biotic communities to environmental changes within large cities (Smith et al., 2006). Unfortunately, the significance of the soil invertebrates is seldom recognized.

Mites are important in the soil as fungivores, detritivores, bacterivores and predators (Largerlof, Andren, 1988). Among the predatory mites, the well-known are Mesostigmata mites (Coleman et all, 2018, Koehler, 1999, Salmane, Brūmelis, 2011). Most of them are free-living predators and they are known for their wide range of habitats. Mesostigmata mites are dominant acarine predators playing a crucial role in soil food webs and are used to be indicators of the state of soil ecosystems including urban ones (Koehler, 1994, 1999, Manu et al., 2021). Mesostigmata mites are adapted to the respective soil conditions like soil moisture, temperature, structure, and chemical composition and they are highly sensitive to changes in those parameters (Coleman et all, 2018). Their presence or absence in the soil horizons may be a good base for describing changes in environmental conditions and ecosystem perturbations (Koehler, Melecis, 2010). Mesostigmata mites prey on springtails (Collembola), nematodes (Nematoda), other mites (Acari), enchytraeids (Enchytraeoidea), insect eggs and larvae. An indicator of the degree of ecosystem degradation is the number of Mesostigmata mite species and individuals, and species composition.

So far there are few investigations of urban soil invertebrates in Latvia (Grina et al., 2023, Minova et al., 2015, Telnov, Salmane, 2015). The current study aimed to get insight into the fauna of Rīga grassland habitats.

Material and Methods

In the frames of the project "Introducing adaptive community-based biodiversity management in urban areas for improved connectivity and ecosystem health urbanLIFEcircles," collection of soil samples in Rīga grasslands was made in October 2021. In total sampling was performed in 14 urban grassland sites. Samples were taken by the soil corer of 5 cm diameter. Extraction of soil invertebrates for ten-day period on modified Berlese-Tullgren funnels was performed. Microscopic slides for Mesostigmata mites were made. Mesostigmata species identification (Bregetova, 1977, Kaluž, S., Fenda, P., 2005, Karg, 1993) was made.

Results and discussion

In total, 20 Mesostigmata mite species in urban grasslands of Rīga were collected. Three of those species were the most frequent.

In 11 sampling sites *Rhodacarellus silesiacus* (Willmann, 1936) (Figure 1), *Dendrolaelaps foveolatus* (Leitner, 1949), and *Hypoaspis nolli* Karg, 1962 were found. Of those, *R. silesiacus* and *D. foveolatus* also had the highest number of individuals, 20 and 32 respectively. From 10 sampling sites *Parasitus beta* Oudemans & Voigts, 1904, 8 sites – *Asca bicornis* (Canestrini & Fanzago, 1887) (Figure 1), and 7 sites – *Hypoaspis aculeifer* (Canestrini, 1884) were sampled.

Table 1. Mesostigmata mite species and number of sampling sites they were recorded from urban habitats of Rīga city grasslands, October 2021. Identified species arranged in systematic order by genus.

Mesostigmata mite species	Number of grassland sites in Rīga
Leioseius minutus	1
Leioseius bicolor	2
Leioseius halophilus	2
Lasioseius youcefi	1
Rhodacarus mandibularis	3
Rhodacarellus silesiacus	11
Dendrolaelaps foveolatus	11
Dendrolaelaspis angulosus	1
Asca bicornis	8
Hypoaspis aculeifer	7
Hypoaspis vacua	2
Hypoaspis nolli	11
Hypoaspis karawaiewi	2
Ololaelaps placentula	1
Laelaspis astronomicus	3
Macrocheles glaber	5
Prozercon traegardhi	1
Pergamasus teutonicus	4
Pergamasus lapponicus	3
Parasitus beta	10

Figure 1. Rhodacarellus sileasiacus (Rhodacaridae) (left) and *Asca bicornis* (Ascidae) (right) from urban grasslands of Rīga city (images from the microscopic slides, courtesy Ineta Salmane).

Of the recorded Mesostigmata species *R. silesiacus* is well known as a pioneer species in disturbed soil habitats (Bregetova, 1977, Karg, 1993). It has Holarctic and Australian distribution and mainly is found in urban, barren, and poor soils. Also, *D. foveolatus* is usually found in anthropogenically impacted soils (Bregetova, 1977, Karg, 1993). *Hypoaspis nolli* is frequently recorded in newly forming soils (Bregetova, 1977, Karg,

1993). *Asca bicornis* is another common species in anthropogenically impacted, poor soils (Bregetova, 1977, Karg, 1993). *Hypoaspis aculeifer* and *A. bicornis* are recorded as dominant species in anthropogenically impacted ecosystems of Romania (Manu, Onete, 2016). *Parasitus beta* occurs in various habitats, including anthropogenic ones, and natural grasslands (Bregetova, 1977, Karg, 1993). *Rhodacarus mandibularis* Berlese, 1921 (Figure 2) was found only in three collection sites in urban grasslands of Rīga. It is known as not numerous, but typical inhabitant of anthropogenically impacted soils (Bregetova, 1977, Karg, 1993). Although there was no intensive trampling in the investigated sites of Rīga, grassland fragmentation and closeness to intensive traffic made a great impact on soil mite fauna. Soil Mesostigmata species composition showed significant variability among natural and urban grassland habitats. *Veigaia nemorensis* (C. L. Koch, 1839) (Figure 2) and *Pergamasus vagabundus* Karg, 1968 are known as eudominant species in the territory of Latvia (Salmane, Brūmelis, 2010). None of those were found during our study in urban grasslands of Rīga. Out of the species recording during the present study, nine Mesostigmata species are common for natural and urban grasslands. *Laelaspis astronomicus* C. L. Koch, 1839, *Dendrolaelaps foveolatus*, *Rhodacarellus sileasiacus, Rhodacarus mandibularis, Leioseius halophilus* (Willmann, 1949), *Leioseius minutus* (Halbert, 1915) and *Macrocheles glaber* (Müller, 1860) are rarely recorded in natural grasslands of Latvia (Salmane, Brūmelis, 2010). *Asca bicornis* and *Leioseius bicolor* (Berlese, 1918) are eudominant species in natural grasslands of Latvia (Salmane, Brūmelis, 2010).

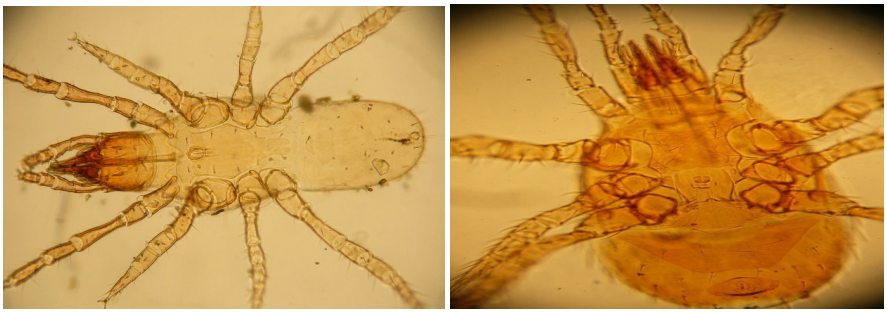

Figure 2. Rhodacarus mandibularis (Rhodacaridae) (left) and eudominant in the territory of Latvia *Veigaia nemorensis* (Veigaiaidae) (right) in urban grasslands of Rīga (images from the microscopic slides, courtesy Ineta Salmane).

Conclusions

Species composition revealed in urban grasslands of Rīga is specific, characterized mainly by small Mesostigmata mite species, commonly found in anthropogenically impacted habitats and bound with poor soils. Few of those are known to be pioneer species, like *Rhodacarellus silesiacus* and *Rhodacarus mandibularis*, typical in the initial stages of disturbed soils succession.

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