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PENSOFT

New records of arthropods from the priority Natura 2000 habitats in Estonian coastal areas

Kaarel Sammet[1*], Mylene R. Martinez[1], Kadri Tali[1], Indrek Melts[1]

1 Chair of Biodiversity and Nature Tourism, Estonian University of Life Sciences, Tartu, Estonia • KS: kaarel.sammet@gmail.com https://orcid.org/0000-0002-5326-8137 • MRM: mylene.martinez@emu.ee https://orcid.org/0000-0001-9772-1485 • KT: kadri.tali@emu.ee https://orcid.org/0000-0003-4390-3253 • IM: indrek.melts@emu.ee https://orcid.org/0000-0003-3097-9152

* Corresponding author

Abstract. The ground-dwelling arthropod fauna of Estonia has been unevenly studied, and there are significant gaps of knowledge regarding microarthropods. Our study focused on alvars and both coastal and wooded grasslands within the Natura 2000 network in Estonia. Forty-four previously unrecorded species were found, and the presence of two species in Estonia is confirmed. Seven species of Araneae, *Talavera thorelli* (Kulczyński, 1891), *Micaria micans* (Blackwall, 1858), *Drassodes cupreus* (Blackwall, 1834), *Pardosa maisa* Hippa & Mannila, 1982, *Rugathodes instabilis* (Pickard-Cambridge, 1871), *Donacochara speciosa* (Thorell, 1875), and *Pocadicnemis juncea* (Locket & Millidge, 1953), three species of Prostigmata, *Cunaxa capreolus* (Berlese, 1890), *Scirula impressa* Berlese, 1887, and *Storchia robusta* (Berlese, 1885), and two species of Mesostigmata, *Alloparasitus pratensis* (Huhta & Karg, 2010) and *Urotrachytes formicaria* (Lubbock, 1881), are recorded for the first time from the Baltic states. The records of *Diachromus germanus* (Linnaeus, 1758) and the invasive *Mermessus trilobatus* (Emerton, 1882) represent the northernmost occurrences in Europe.

Keywords. Araneae, biodiversity, Carabidae, coastal habitat, grassland-forest ecosystem, Mesostigmata, Prostigmata

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Introduction

The ground-dwelling arthropod fauna in Estonia has not been extensively studied, resulting in significant gaps in our knowledge, particularly regarding microarthropod fauna. Only five publications have focused on Estonian non-parasitic Mesostigmata and terrestrial Prostigmata mites (Grube 1859; Kadyte 1976; Lazauskiene 1976; Kuznetsov and Petrov 1984; Haitlinger 2010), but numerous unpublished records exist from various ecological research projects. On the other hand, macroarthropods, including ground beetles (Carabidae) and spiders (Araneae), have been relatively well documented (Haberman 1968; Vilbaste 1987; Koponen et al 2004; Koponen 2006; Silfverberg 2010, 2014; Roosileht 2015; Süda 2016; Mustonen and Siitonen 2020). However, there is always a possibility of discovering previously unrecorded species that were undetected due to low detectability, range shifts, or taxonomic revisions.

Here, we focused on ground-dwelling arthropods in a unique traditional coastal agricultural landscape with a high concentration of habitat types that are crucial for nature conservation at a European level (Council of the European Communities 1992). These habitats include various types of Estonian seminatural grasslands, which are defined as traditional grasslands shaped by long-standing extensive agricultural practices such as grazing or annual haymaking, devoid of cultivation, nutrient applications, etc., and inhabited by native

species (e.g. Pärtel et al. 1999; Eriksson and Rosén 2008; Doody 2008; European Commission 2013). It is vital for biodiversity conservation that seminatural habitats, particularly seminatural grasslands, are continuously managed using extensive agricultural practices (e.g. Kull and Zobel 1991; Pärtel et al. 1999; Heinsoo et al. 2010; Rannap et al. 2017; Melts et al. 2018). Biodiversity itself supports the resilience of grassland ecosystems and maintains a stable biomass yield (e.g. Melts et al. 2018; Heinsoo et al. 2020).

The aim of the current study is to provide information about several newly discovered species collected during ongoing surveys of Estonian coastal grasslands and alvars, both of which are priority Natura 2000 habitat types. The primary focus of the invertebrate surveys conducted as part of these projects was on spiders (Araneae), ground beetles (Carabidae), springtails (Collembola), and oribatid mites (Oribatida). The data on new records of Collembola and Oribatida are not included in this work and will be published separately. Selected adult specimens of collected Mesostigmata and Prostigmata were also identified, leading to the discovery of several new records for these poorly known groups.

Study Area

The study area is a unique traditional coastal agricultural landscape that is located along the coast of Estonia (57.3–59.5°N and 021.5–028.1°E) in northern Europe next to the Baltic Sea (Fig. 1). Estonia is in the northern part of the temperate climate zone and in the transition zone between maritime and continental climates.

The study area encompasses the West-Estonian Lowland, the Gulf of Livonia Coastal Lowland and West-Estonian Islands regions (Arold 2005). The West-Estonian Lowland and West-Estonian Islands are on limestone bedrock, while the Gulf of Livonia Coastal Lowland lies mainly on Devonian sandstones.

The study sites included three types of Estonian semi-natural grasslands (e.g. Kull and Zobel 1991; Paal 1997; Pärtel et al. 1999; Eriksson and Rosén 2008; Doody 2008; European Commission 2013):

- Alvars (priority habitat code 6280*) are characterised by a thin soil layer (0–30 cm) atop limestone bedrock, and with open, flat terrain. These habitats are exposed to winds, leading to dry conditions in summer, and they are impacted by low temperatures and frost-induced soil movements in winter. Estonian alvars are primarily found in western and northern Estonia, and the traditional maintenance method for these species-rich ecosystems involves grazing by domestic animals and the removal of woody plants.
- Coastal meadows (priority habitat code 1630*) are communities situated in flat, turfed geolittoral zones that are influenced by saline seawater. The vegetation in coastal grasslands occurs in distinct zones, with saline vegetation closest to the sea. Historically, most coastal grasslands were utilised for grazing.

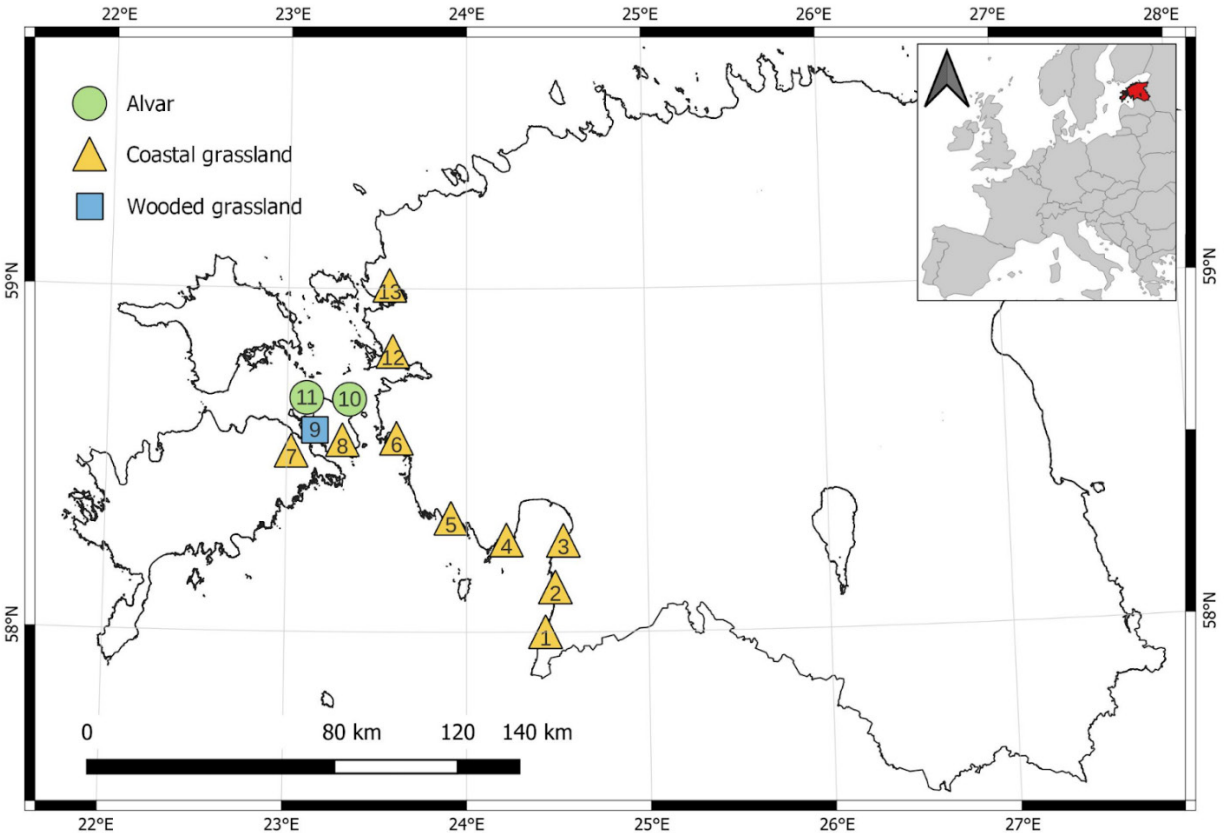

Figure 1. Sampling locations in three types of seminatural habitats in Estonia. The numbers correspond to the locality numbers in the main text and are ordered from south to north; one symbol may correspond to several collecting sites a few kilometres apart (see "New records" for location details).

- Wooded meadows (priority habitat code 6530*) comprise sparsely distributed natural stands with a regularly mown or grazed herb layer. These wooded meadows serve as important habitats, harbouring a high number of plant species even within small areas, sometimes exceeding 60 species per square metre (Kull and Zobel 1991; Heinsoo et al. 2020). These meadows were once widespread traditional seminatural ecosystems, mainly utilised for haymaking.

The majority of the habitats studied are located within the protected areas of the Natura 2000 network.

Methods

Modified protocols of the project SHOWCASE (Bretagnolle et al. 2021) for the collection of macroarthropods (spiders and ground beetles) and soil microarthropods were followed:

- Macroarthropods were captured using pitfall traps. Ten pitfall traps were placed in the suprasaline zone in each study site. Four of the pitfall traps were situated in the open grassland, two on the margin between grassland and forest, and four of them in forest or under trees. The pitfall traps consisted of 500 ml plastic cups buried at the ground level and filled with ethylene glycol. In July–August 2021 and August 2022 the pitfall traps were left in the studied site for four effective days (96 hours) (on the Saaremaa and Muhu islands for one week). Macroarthropods were stored in 70% ethanol and were identified to the species level using a Leica S8APO microscope.
- Together with pitfall traps emplacement, topsoil (the top 10 cm at most) samples of approximately 200 ml were taken from each point and packed into premarked plastic mini-grip bags. The soil samples that were not extracted immediately were kept at low temperature (about +4 °C). Soil microarthropods were extracted into 70% ethanol using standard Tullgren-Berlese funnels (Burkard Scientific Ltd.). Microarthropods were treated with lactic acid and identified to species level after making temporary or permanent microscope slides. Some specimens of Mesostigmata were dissected.
- Suction sampling with a modified vacuum shredder Stihl BG 56 (Andreas Stihl AG & Co. KG.) was used for ground-dwelling microarthropod and macroarthropod samplings. Suction sampling aligned to four 50 m length transects in each study site. Five suction samples (ground area of each subsample was 0.1 m^2) were taken in each transect and pooled as one sample. The collected samples were transferred into zip-sealed bags and stored in a cool-box and later in the freezer for further sorting and identification in the laboratory. Two sampling rounds were carried out in June and August 2022.

Fieldwork was conducted in accordance with Estonian Nature Conservation Act (Riigikogu 2004) and with the permission by e-mail from the Estonian Environmental Board (https://keskkonnaamet.ee/en).

Voucher specimens of the studied materials are deposited in the entomological collection of Estonian University of Life Sciences, Institute of Agriculture and Environmental Sciences (IZBE), and are accessible via the GBIF data portal (Kurina 2022). New country records are marked with an asterisk (*).

Results

Araneae

***Sibianor larae* Logunov, 2000**

Figure 2

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Rannametsa coastal grassland (Fig. 1: no. 2); 58.1294°N, 024.4868°E; 22.VI.2022; I. Melts leg.; suction sampling; 1 ♂, IZBE0312673.

Identification. The species was identified based on contrasting red patella of legs I and the shape of pedipalp tegulum (Logunov 2000).

Comments. Logunov (2000) suggested that the Estonian records of *Sibianor aurocinctus* (Ohlert 1865) by Vilbaste (1969) are actually misidentifications of *Sibianor larae*, although no Estonian material was examined at that time. This finding confirms the presence of *S. larae* in Estonia. We have also re-identified older Estonian material (collected between 1949 and 1972 by A. Vilbaste and in the IZBE collection) and found that all specimens identified as *Sibianor aurocinctus* (and in sufficiently good condition for unambiguous identification) were actually *S. larae*. Therefore, the former species should be removed from the list of Estonian spiders.

Talavera thorelli* (Kulczyński, 1891)

Figure 3

New records. ESTONIA – **Pärnu county** • Pärnu, Kavaru, Kavaru coastal grassland (Fig. 1: no. no. 4); 58.2701°N, 024.2221°E; 20.VII.2021; K.Sammet and I. Melts leg.; pitfall trap; 2 ♀, IZBE0312725.

Identification. The species was identified based on the shape of epigyne (Ahlmquist 2006; Nentwig et al. 2022).

Comments. The species has been found in neighbouring Finland, but there are no records from the Baltic states (Nentwig et al. 2022).

***Agroeca dentigera* Kulczyński, 1913**

New records. ESTONIA – **Lääne county** • Lääne-Nigula, Österby, Österby coastal grassland (Fig. 1: no. 13); 58.9837°N, 023.5043°E; 29.VI.2022; I. Melts leg.; suction sampling; 1♂, IZBE0312701.

Identification. The species was identified based on pedipalpal shape, especially the shapes of tegular apophysis and tibial apophysis (Grimm 1986; Ahlmquist 2006; Nentwig et al 2022).

Figure 2. *Sibianor larae* (♂ lateral view).

Comments. The occurrence of this species in Estonia was expected, as it has been found in all the neighboring countries and territories (Nentwig et al. 2022). There is also one other unpublished Estonian record of the species in recent years (Mart Meriste pers. comm.). This species was first found in northern Europe only in the recent decades and may have been expanding its range northwards (Koponen et al. 2001; Jonsson 2005; Cera 2013).

***Micaria micans* (Blackwall, 1858)**

Figure 4A

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Pulgoja coastal grassland (Fig. 1: no. 2); 58.1147°N, 024.4864°E; 14–18.VII.2021; K. Sammet and I. Melts leg.; pitfall trap; 1♀, IZBE0312095 – **Lääne county** • Haapsalu, Puise, Põgari coastal grassland (Fig. 1: no. 12); 58.7819°N, 023.4610°E; 03–07.VIII.2021; K. Sammet and I. Melts leg.; pitfall trap; 1 ♀.

Identification. The species differs from closely related European species by having femora III and IV with longitudinal dark stripes, epigyne as long as wide, with M-shape curved anterior transversal fold, and the copulatory ducts running parallel in part (Muster and Michalik 2020).

Comments. The species was considered a synonym of *Micaria pulicaria* (Sundevall, 1831) for a long time, but has now been recorded from many countries over Europe (Nentwig et al. 2022). We have also re-identified older Estonian materials in the IZBE collection that were collected 1959–1983 by A. Vilbaste and can confirm that both species are present in Estonia.

***Drassodes cupreus* (Blackwall, 1834)**

New records. ESTONIA – **Saare county** • Muhu Island, Rannaniidi alvar grassland (Fig. 1: no. 10); 58.6423°N, 023.3421°E; 30.VI–05.VII.2021; K.Sammet leg.; pitfall trap; 1 ♀ IZBE0312002 • Muhu Island, Koguva coastal grassland (Fig. 1: no. 11); 58.5925°N, 023.0822°E; 09–16.VIII–05.VII.2021; K.Sammet leg.; pitfall trap; 1 ♂ IZBE0312880.

Identification. The identification is based on shape of male pedipalp and chelicerae with 3 almost equidistant teeth (Nentwig et al. 2022).

Comments. The occurrence of the species in Estonia is not unexpected, as it has been found in the neighbouring Finland, but there are no records from the Baltic states (Nentwig et al. 2022). We studied older *Drassodes* specimens in the IZBE collection and found also a male specimen misidentified as *Drassodes lapidosus* (Walckenaer, 1802) (collected 17.VI.1956 from Saaremaa Island, Koorunõmme, approximately 58.47°N, 022.20°E, by A.Vilbaste).

***Arctosa lutetiana* Simon, 1876**

New records. ESTONIA – Saare county • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°E ; 09–16.VIII.2022; K. Sammet and K. Tali leg; pitfall trap 1 ♀, IZBE0312881.

Figure 3. *Talavera thorelli* (♀ dorsal view).

Identification. The identification is based on having olive-brown prosoma, laterally with 3 spots and bright median band, red-brown legs with yellowish coxa and femur, opisthosoma yellow greenish with scarce black hairs and distinct white haired cardiac mark, posterior to cardiac mark 4 bright triangular spots and characteristic shape of epigyne and vulva (Nentwig et al. 2022).

Comments. There are also other unpublished findings from the west-Estonian islands (Mart Meriste pers. comm.)

***Pardosa maisa* Hippa & Mannila, 1982**

New records. ESTONIA – **Pärnu county** • Häädemeeste, Häädemeeste, Häädemeeste coastal grassland (Fig. 1: no. 2); 58.0696°N, 024.4826°E; 14–18. VII.2021; K.Sammet, I. Melts leg.; pitfall trap; 1 ♀ • Häädemeeste, Rannametsa, Pulgoja coastal grassland (Fig. 1: no. 2); 58.1012°N, 024.4811°E; 14.VII.2022; I. Melts leg.; suction sampling; 1♀ • Pärnu, Värati, Suti coastal grassland (Fig. 1: no. 5); 58.3166°N, 023.9759°E; 12.VIII.2022; I. Melts leg.; suction sampling; 2 ♀, IZBE0312890.

Identification. The identification is based on having elongated yellowish prosoma with no lateral stripes and epigyne wit h asymmetrical anterior epigynal pockets (Nentwig et al. 2022, Hippa and Mannila 1982).

Comments. The occurrence of the species in Estonia is expected, as it has been found in the neighbouring Finland, but there are no records from the Baltic states (Nentwig et al. 2022).

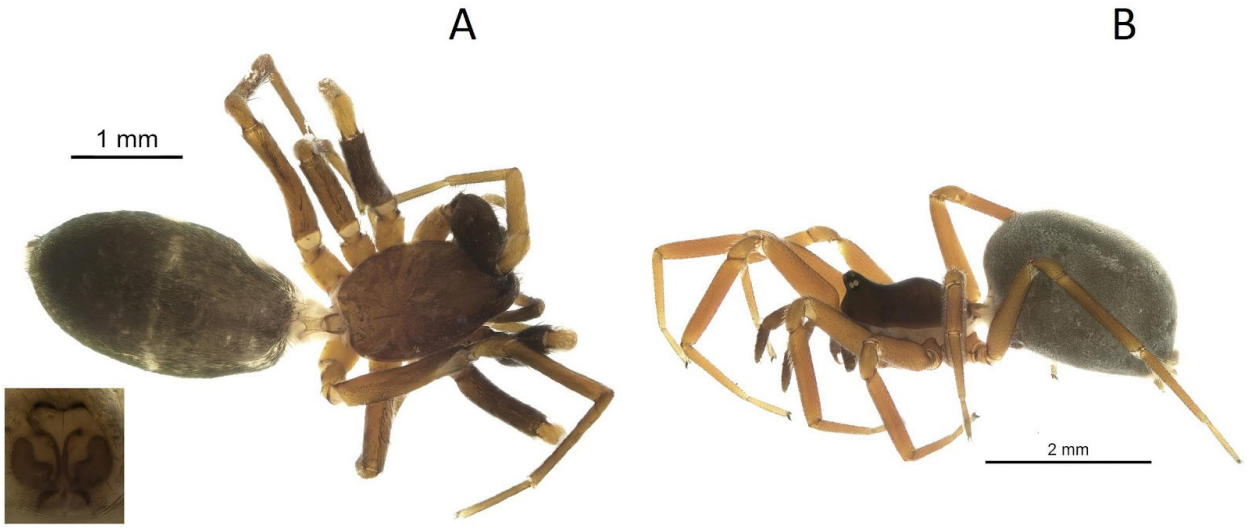

Figure 4. A. *Micaria micans* (♀ dorsal view and epigyne). **B.** *Walckenaeria acuminata* (♀ lateral view).

***Theridiosoma gemmosum* (L. Koch, 1877)**

New records. ESTONIA – **Pärnu county** • Pärnu, Vana-Pärnu coastal grassland (Fig. 1: no. 4); 58.3822°N, 024.4623°E; 17.06.2022; I. Melts leg.; suction sampling; 1♀, IZBE0312835.

Identification. The identification is based on having the globular opisthosoma largely vaulted over the prosoma, the sternum with two depressions at its anterior edge, and the epigyne with a shallow groove covered by a robust chitinous bulge (Nentwig et al. 2022).

Comments. The finding of this species in Estonia may be a sign of its northward range shift, as it has not been found in Finland or north-western Russia, but it was recently found in Lithuania (Mahač et al. 2016; Nentwig et al. 2022). There is also another recent, unpublished finding of the species from Estonia (Mart Meriste pers. comm.).

***Rugathodes instabilis* (Pickard-Cambridge, 1871)**

New records. ESTONIA – **Pärnu county** • Häädemeeste, Ikla, Ikla coastal grassland (Fig. 1: no. 1); 57.8807°N, 024.3592°E; 13.VI.2022, I. Melts leg.; suction sampling; 1♀, IZBE0312836.

Identification. The identification is based on having the prosoma with the longitudinal band reaching from posterior end to eye region, the yellowish brown opisthosoma dorsally with a large brown spot, and the shape of the epigyne (Nentwig et al. 2022).

Comments. The species has been recently found also in southern Finland (Pajunen and Väisänen 2015), but there are no records from the Baltic states or north-western Russia (Nentwig et al. 2022).

***Donacochara speciosa* (Thorell, 1875)**

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Luitemaa coastal grassland (Fig. 1: no. 2); 58.1295 °N, 024.4866°E; 15–19.VII.2021; K. Sammet and I. Melts leg.; pitfall trap; 1♂, IZBE0312067 • Pärnu, Kavaru, Kavaru coastal grassland (Fig. 1: no. 4); 58.2691°N, 024.2205°E; 08.VIII.2022; I. Melts leg.; suction sampling; 1 ♂, IZBE0312833.

Identification. The identification is based on having the male palp tibia twice as long as the cymbium, with a small bipartite tibial apophysis, and a small, hook-shaped paracymbium (Nentwig et al. 2022).

Comments. The occurrence of the species in Estonia is expected, as it has been found in the neighbouring Finland, but there are no records from the Baltic states (Nentwig et al. 2022).

***Mermessus trilobatus* (Emerton, 1882)**
Figure 5A

New records. ESTONIA – **Pärnu county** • Pärnu, Värati, Värati coastal grassland (Fig. 1: no. 5); 58.3044°N, 024.0005°E; 12.VII.2022; I. Melts leg.; suction sampling; 1 ♂, IZBE0312868.

Identification. The identification is based on the overall shape of the male palp and rounded palp tibial apophysis (Nentwig et al. 2022).

Comments. This is a North American species introduced to Central Europe in the mid-1970s, which has expanded its range ever since; it has not yet reached Scandinavia in the north or Russia and Belarus in the east. It was first found in southern Poland in 2003 (Rozwałka 2010) and has now become widespread there (Rozwałka et al. 2016). Recently it was also found in Lithuania (Biteniekytė et al. 2021).

***Pocadicnemis juncea* (Locket & Millidge, 1953)**
Figure 5B

New records. ESTONIA – **Pärnu county** • Pärnu, Metsaküla coastal grassland (Fig. 1: no. 3) 16.VI.2022; I.

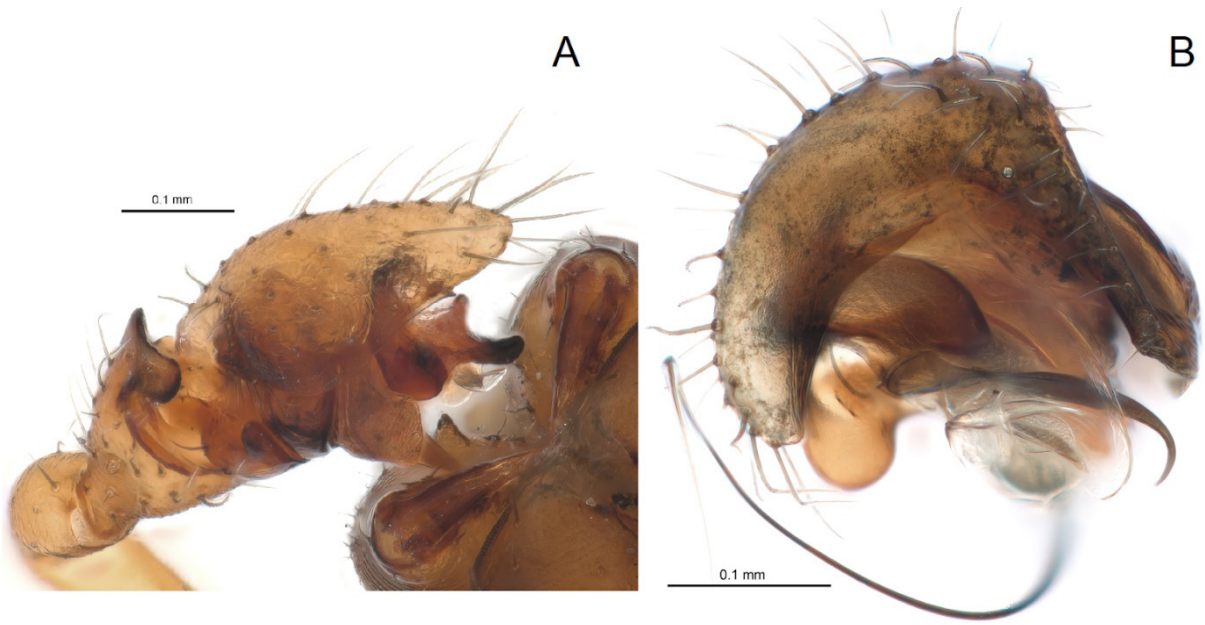

Figure 5. A. *Mermessus trilobatus* (♂ pedipalp). **B.** *Pocadicnemis juncea* (♂ pedipalp).

Melts leg.; suction sampling; 1 ♂, 1 ♀, IZBE0312870 • Häädemeeste, Piirumi coastal grassland (Fig. 1: no. 2); 58.1514°N, 024.4821°E; 11.VIII.2022; I. Melts leg.; suction sampling; 1 ♂, IZBE0312869.

Identification. The identification is based on having the male palp bulbus with a long, bent median apophysis (Nentwig et al. 2022).

Comment.: The species has been found in southern Sweden, but there are no previous records from the Baltic countries or Finland (Jonsson 1995; Nentwig et al. 2022).

***Walckenaeria acuminata* Blackwall, 1833**
Figure 4B

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Pulgoja coastal grassland (Fig. 1: no. 2); 58.1147°N, 024.4862°E; 14–18.VII.2021; K. Sammet and I. Melts leg.; pitfall trap; 1♀, IZBE0312096.

Identification. The identification is based on having an elevated eye region on the prosoma, the median epigynal plate merging with the remaining epigynal plates, and length of its clearly delimited part ½ of epigynal length (Nentwig et al. 2022).

Comments. The occurrence of the species in Estonia was expected, as it has been found in all the neighbouring countries and territories (Nentwig et al. 2022). There are also other records of the species in recent years from alvars in western Estonian islands (Mart Meriste pers. comm.).

***Walckenaeria alticeps* (Denis, 1952)**

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Pulgoja coastal grassland (Fig. 1: no. 2); 58.11473°N, 58.1147°E; 22.VI.2022; I. Melts leg.; suction collecting; 2 ♀, IZBE0312889.

Identification. The identification is based on the shape of epigyne and vulva (Nentwig et al. 2022).

Comments. The occurrence of the species in Estonia was expected, as it has been found in most of the neighbouring countries and territories (Nentwig et al. 2022).

Prostigmata

***Labidostomma luteum* Kramer, 1879**
Figure 6

New records. ESTONIA – **Saare county** • Muhu, Nõmmküla, Pallasma alvar (Fig. 1: no. 11); 58.6770°N, 023.1793°E; 30.VI.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel; 8 specimens, IZBE0311603 – **Lääne county** • Lääneranna, Rame, Rannasääre coastal grassland (Fig. 1: no. 6); 58.5606°N, 023.5686°E; 02.VIII.2021; K. Sammet and I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 2 specimens, IZBE0312680 – **Saare county** • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 2 specimens, IZBE0312499.

Identification. The species is the only representative of the family Labidostommatidae in northern Europe, and the studied specimens correspond in all details to the redescription of *L. luteum* by Lehtinen and Niemi (1995).

Comments. This widespread species is also recorded from south-western Finland (Lehtinen and Niemi 1995) and probably also Latvia (as *Nicoletiella denticulata* (Schrank): cf. Eglitis 1954).

***Dactyloscirus inermis* (Trägårdh, 1905)**

New records. ESTONIA – **Saare county** • Muhu, Nautse, Nautse coastal grassland (Fig. 1: no. 8); 58.5857°N, 023.1489°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel; 3 specimens, IZBE0312488.

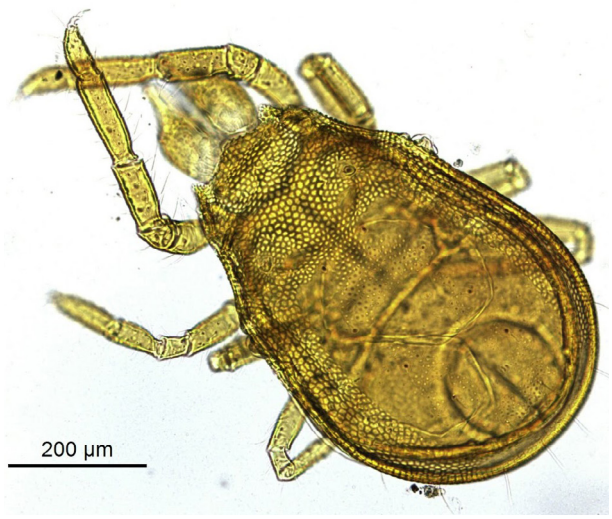

Figure 6. *Labidostomma luteum* (♀ dorsal view).

Identification. The identification is based on having the pedipalpal telofemora, tibiotarsi, and genua with one apophysis each and the dorsal lateral platelets present, with their length less than twice the length of *c1* (Skvarla et al. 2014; Michocka 1987).

Comments. This is a widespread, semicosmopolitan species (Skvarla et al. 2014), which is probably also in Latvia (Eglitis 1954).

***Scirula impressa* Berlese, 1887**
Figure 7A

New records. ESTONIA – **Pärnu county** • Pärnu, Kastna, Kastna coastal grassland (Fig. 1: no. 5); 58.3324°N, 023.9141°E; 26.VII.2021; K.Sammet and I.Melts leg.; topsoil and debris on ground, Tullgren funnel; 3 specimens, IZBE0311560.

Identification. The identification is based on having a hysterosomal shield (Skvarla et al. 2014; Michocka 1987).

Comments. This is a widespread species with no records from the Baltic states (Skvarla et al. 2014).

***Cunaxa capreolus* (Berlese, 1890)**
Figure 7B

New records. ESTONIA – **Saare county** • Muhu, Nautse, Nautse coastal grassland (Fig. 1: no. 8); 58.5857°N, 023.1489°E; 06.VIII.2021; K.Sammet and K.Tali leg.; pitfall trap; 1 specimen, IZBE0312487.

Identification. The identification is based on having basifemora I with four, III with three, and IV with one seta, genua I with five setae, the pedipalp telofemoral apophysis hook-shaped, and setae *c1* but not *f1* on a hysterosmal shield (Skvarla et al. 2014).

Comments. This is a widespread, semicosmopolitan species with no records from Baltic states (Döker et al. 2017).

***Storchia robusta* (Berlese, 1885)**

New records. ESTONIA – **Saare county** • Muhu, Nautse, Nautse coastal grassland (Fig. 1: no. 8); 58.5857°N, 023.1489°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel; 1 specimen, IZBE0312489.

Identification. The identification is based on having the genital valves with three pairs of setae, trochanter III with one seta, genua I and II with 4 + 1κ-4 setae, dorsal hysterosomal setae *c1* nearly one-third of the distance of *c1*–*c1*, setae *ve* normal and not reaching the posterior end of the prodorsal shield, and setae *c2* about 1.6 times the length of *c1* (Fan and Yan 1997; Fan et al. 2016; Akyol 2011; Bagheri et al. 2012).

Comments. This is a semicosmopolitan species also found in Sweden but with no previous records from the Baltic states (Akyol 2011).

***Cryptognathus lagena* Kramer, 1879**
Figure 8A

New records. ESTONIA – **Saare county** • Muhu, Lõetsa, Rannaniidi alvar (Fig. 1: no. 10); 58.6423°N, 023.3421°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel; 2 specimens, IZBE0311984.

Identification. The identification is based on having one proximoventral seta on tarsi III and IV, the front margin of the hood smooth, extensive ventral

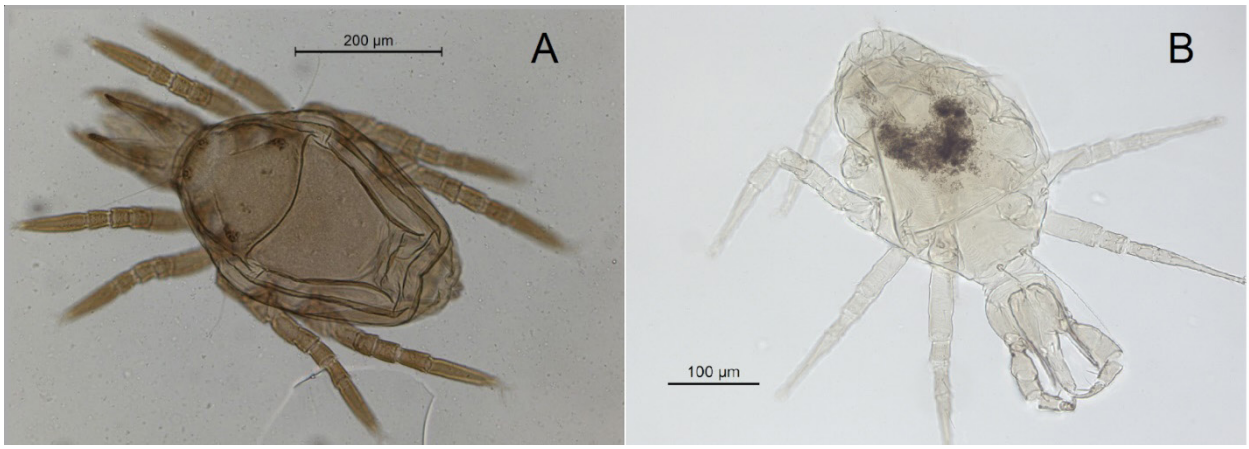

Figure 7. A. *Scirula impressa* (dorsal view). **B.** *Cunaxa capreolus* (dorsal view).

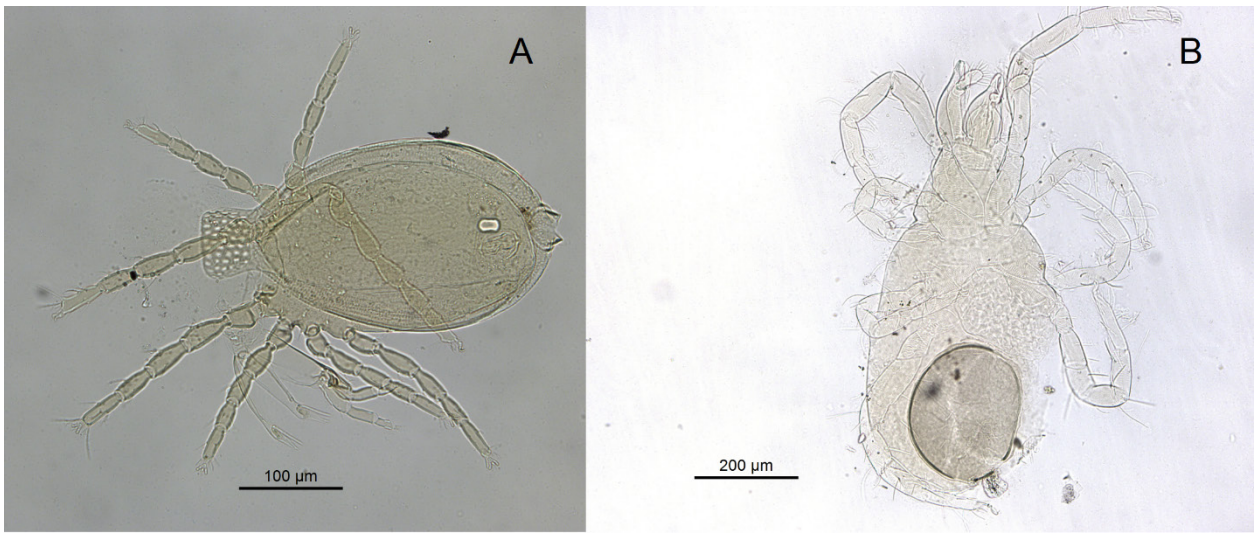

Figure 8. A. *Cryprognathus lagena* (dorsal view, gnathosoma dissected from the body). **B.** *Robustocheles mucronata* (dorso-lateral view).

punctation, and tarsi III and IV each with a solenidion (Uluçay and Koç 2013).

Comments. This is the first finding of the species in western Estonia and the second since the finding by Kuznetsov and Petrov (1984). The locality that they mentioned as "Rakke at the shore of lake Võrtsjärv" is probably Suure-Rakke (58.35°N, 026.18°E), as Rakke is actually a village about 100 km north of lake Võrtsjärv.

***Robustocheles mucronata* (Willmann, 1936)**
Figure 8B

New records. ESTONIA – **Saare county** • Muhu, Nautse, Nautse coastal grassland (Fig. 1: no. 8); 58.5857°N, 023.1489°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel; 1 specimen, IZBE0312496.

Identification. The identification is based on having a stellate famulus in rhagidial organ I positioned between first and second proximal rhagidial solenidia antaxially, trochanter IV with two ciliated setae, four rhagidial solenidia in rhagidial organ I separate and arranged obliquely, spiniform solenidion on tibia I dorsodistal, masticatory surface of cheliceral fixed digit with sharply pointed projection located at the base of the fixed digit (Zacharda 1997).

Comments. This is a cosmopolitan species (Zacharda 1997) with records also from Finland (Zacharda and Kučera 2010).

***Erythraeus cinereus* (Dugès, 1834)**

New records. ESTONIA – **Lääne county** • Lääneranna, Rame, Rannasääre coastal grassland (Fig. 1: no. 6); 58.5606°N, 023.5686°E; 02.VIII.2021; K. Sammet and I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 1 specimen, IZBE0312877.

Identification. The identification is based on having serratalae developed on all legs (on legs III and IV stouter than on I and II), robust, lateral teeth triangular, and wide, palptibia with 3–6 conalae, no conalae on palpgenu, and some dorsal opisthosomal setae short and lanceolate at their apex (Gabryś 2016).

Comments. This species is also present in neighbouring Finland (Stålstedt et al. 2019).

***Leptus trimaculatus* (Rossi, 1794)**
Figure 9

New records. ESTONIA – **Saare county** • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°N; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel; 1 specimen, IZBE0312495 – **Pärnu county** • Häädemeeste, Kabli, Kabli coastal grassland (Fig. 1: no. 1); 58.0014°N, 024.4336°E; 13.VI.2022; I. Melts leg.; suction sampling; 1 specimen, IZBE0312867.

Identification. The identification is based on having three big light spots of pale setae on the dorsal side of the idiosoma (two of these spots are symmetrical at the "shoulders" and one in the middle of the posterior part of the opisthosoma), and the opisthosomal setae spindle-shaped and covered with fish-bone-like setules (Gabryś 2016).

Comments. This species is also present also in neighbouring Latvia (Salmane and Mąkol 2018) and Finland (Stålstedt et al 2019). Grube (1859) mentioned the ocurrence *Trombidium trimaculatum* in an unspecified locality in Livonia (a historical region comprising modern-day southern Estonia and northern Latvia).

***Bryobia graminum* (Schranck, 1781)**

New records. ESTONIA – **Pärnu county** • Pärnu, Värati, Värati coastal grassland (Fig. 1: no. 4); 58.3044°N, 024.0005°E; 21.VI.2022; I. Melts leg.; suction sampling; 1 specimen, IZBE0312672.

Identification. The identification is based on having the propodorsal lobes well developed and long, legs I with reduced empodia with one seta, the tibia about

Figure 9. *Leptus trimaculatus* (lateral view).

1.5 times longer than the tarsus, and the femur about 3 times longer than the patella (Mitrofanov et al. 1987).

Comments. This is a widespread, cosmopolitan species (Mitrofanov et al. 1987).

***Scutacarus spinosus* Storkan, 1936**
Figure 10

New records. ESTONIA – **Saare county** • Muhu, Nõmmküla, Pallasma alvar (Fig. 1: no. 11); 58.6770°N, 023.1793°E; 09–16.VIII.2022; K. Sammet and K. Tali leg.; pitfall trap; 6 ♀, IZBE0312667.

Identification. The identification is based on having tibiotarsi I with a claw, tibiotarsi IV with 7 setae, seta *4b* absent, setae *e* and *a2* short, spine-like, and smooth, setae *c1*, *d*, and *f* not thickened, and seta *d* distinctly longer than *v'* on tibia IV (Khaustov 2008).

Figure 10. *Scutacarus spinosus* (ventral view).

Comments. This is a cosmopolitan species (Khaustov 2008) and has also been recorded from Lithuania (Eitminavičiūtė 2003).

Mesostigmata

***Veigaia nemorensis* (C.L. Koch, 1839)**
Figure 11A

New records. ESTONIA – **Lääne county** • Lääneranna, Rame, Rannasääre coastal grassland (Fig. 1: no. 6); 58.5611°N, 023.5689°E 2.VIII.2021; K. Sammet and I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 1 ♀, IZBE0312679 • Haapsalu, Kiideva, Haeska coastal grassland (Fig. 1: no. 12); 58.7729°N, 023.5604°E; 03.VIII.2021; K. Sammet and I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 2 ♀, IZBE 0312646.

Identification. The identification is based on having a completely divided, characteristically shaped dorsal shield, the cheliceral digitus fixus with few teeth, the ventral shield free from peritremal shields, and the characteristic shape of tectum (Karg 1993).

Comments. This is a widespread Holarctic species (Bregetova 1977), which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Gamasolaelaps excisus* (L. Koch, 1879)**
Figure 11B

New records. ESTONIA – **Lääne county** • Haapsalu, Kiideva, Haeska coastal grassland (Fig. 1: no. 12)

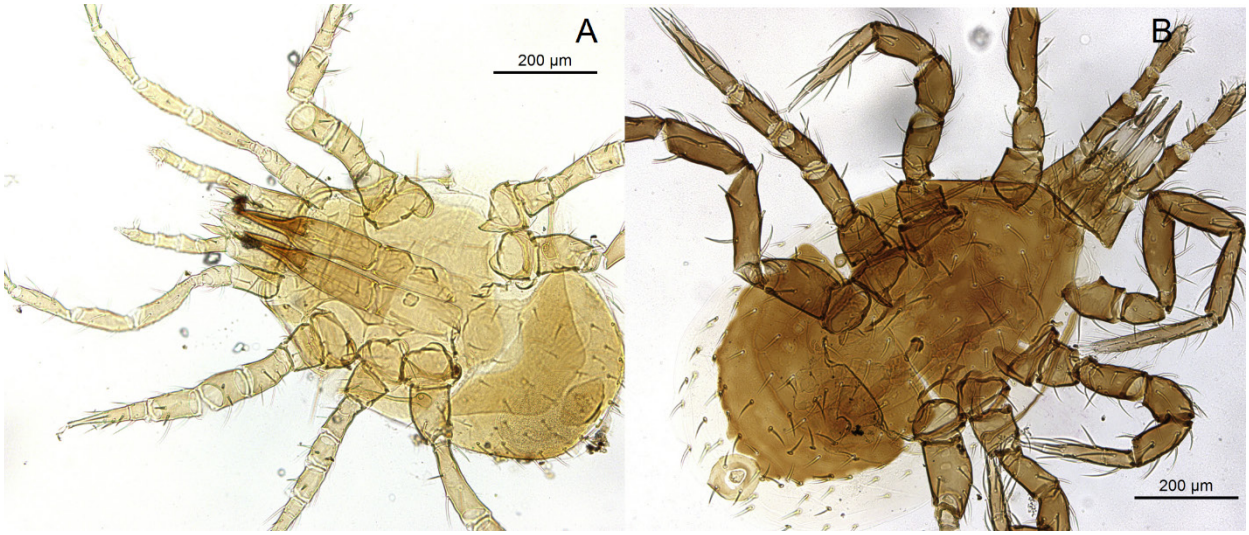

Figure 11. A. *Veigaia nemorensis* (♀ ventral view). **B.** *Gamasolaelaps excisus* (♀ ventral view).

58.7730°N, 023.5603°E; 03.VIII.2021; K. Sammet and I. Melts leg.; topsoil and debris on ground Tullgren funnel; 1 ♀, IZBE0312645.

Identification. The identification is based on having the podonotal shield with lateral excisions, the opisthonotal shield with 18 pairs of setae, and few teeth on the cheliceral digitus mobilis (Karg 1993).

Comments. This is a widespread Palaearctic (Bregetova 1977) species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Paragamasus truncus* (Schweizer, 1961)**
Figure 12A

New records. ESTONIA – **Saare county** • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°E; 05.VII.2022; K. Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 1 ♀, IZBE0312569.

Identification. The identification is based on having the genital shield with concave anterior edges and with a narrow *figura cuneata*, and the spheric endogynium with round, punctuated vaginal glands (Karg 1993).

Comments. This is a European species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Zercon carpathicus* Sellnick, 1958**
Figure 12B

New records. ESTONIA – **Saare county** • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°N; 06.VIII.2021; K.Sammet and K.Tali leg.; topsoil and debris on ground, Tullgren funnel; 4 ♀, IZBE0312497.

Identification. The identification is based on having dorsal pore *Po3* between setae *Z4* and *I4*, setae *I1–I5*, *Z1–Z-2*, and *S1–S2* short and smooth, *S3* shortened, as long as *Z2* setae, *Z3*, *Z4*, and *I5* distally denticulate, and length of *Z3* about 1.5 times *S4* (Błaszak 1974 and Karg 1993).

Comments. This is a widespread European species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

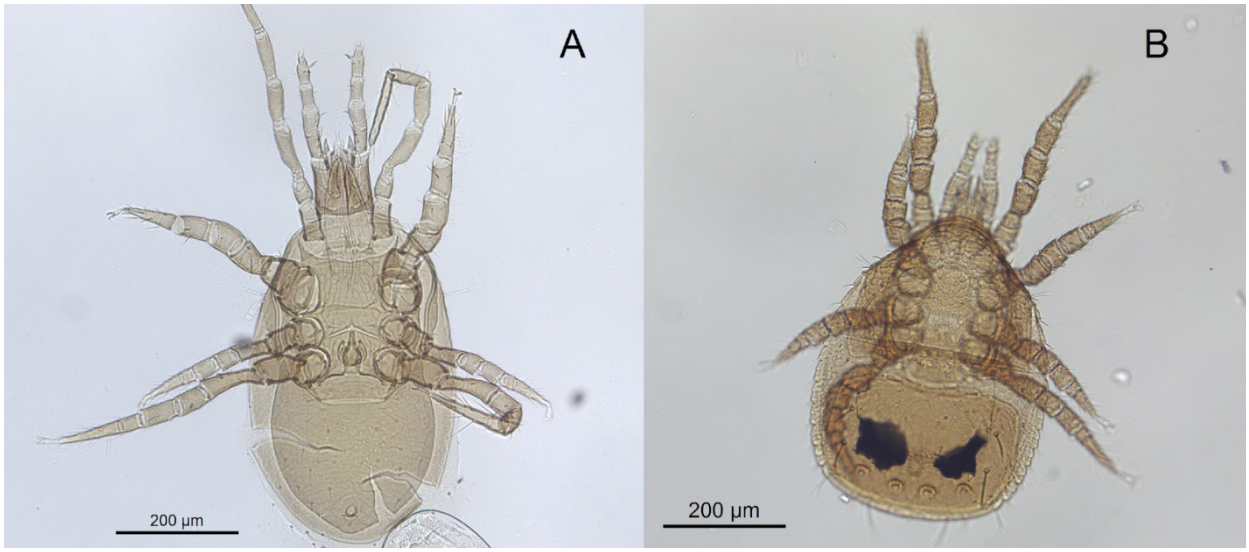

Figure 12. A. *Paragamasus truncus* (♀ ventral view). **B.** *Zercon carpathicus* (♀ ventral view).

***Zercon triangularis* C.L.Koch, 1836**

New records. ESTONIA – **Lääne county** • Lääne-Nigula, Lyckholm, Pürksi coastal grassland (Fig. 1: no. 13); 59.0102°N, 023.5678; 09.VIII.2021; I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 3 ♀, IZBE0312587.

Identification. The identification is based on having opisthonotal pores *Po3* between setae *Z4* and *I4*, pores *Po2* laterally near *Z2*, and *I1–I2*, *Z1–Z2*, and *S2* short (Błaszak 1974 and Karg 1993).

Comments. This is a widespread European species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Prozercon kochi* Sellnick, 1943**

New records. ESTONIA – **Lääne county** • Haapsalu, Kiideva, Haeska coastal grassland (Fig. 1: no. 12); 58.7729°N, 023.5604°E; 03.VIII.2021; I. Melts and K. Sammet leg.; topsoil and debris on ground, Tullgren funnel; 3 ♀, IZBE0312647 • Lääne-Nigula, Lyckholm, Silma coastal grassland (Fig. 1: no. 13); 59.0091°N, 023.5918°E; 09.VIII.2021; I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 1 ♀, IZBE0312481.

Identification. The identification is based on having short, smooth podonotal setae, except for the marginal ones, setae *S2–S4*, *I1*, and *I2* short and smooth, and the rest of plumose opisthonotal setae only slightly longer (Błaszak 1974 and Karg 1993).

Comments. This is a widespread European species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Mixozercon sellnicki* (Schweitzer, 1948)**

New records. ESTONIA – **Lääne county** • Lääne-Nigula, Lyckholm, Pürksi coastal grassland (Fig. 1: no. 13); 59.0103°N, 023.5680°E; 09.VIII.2021; I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 3 ♀, IZBE0312485.

Identification. The identification is based on having pore *Po3* located medially near seta *Z4* (Błaszak 1974; Karg 1993; Díaz-Aguilar and Ujvári 2010).

Comments. This is a widespread European species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Ameroseius corbiculus* (Sowerby, 1806)**

Figure 13A

New records. ESTONIA – **Saare county** • Saaremaa, Põripõllu; Orissaare coastal grassland 58.5538°N, 023.1175°E (Fig. 1: no. 7) 30.VI–05.VII. 2021; K. Sammet and K. Tali leg.; pitfall trap; 1 ♀, IZBE0312579.

Identification. The identification is based on having long, robust dorsal setae of different lengths, *JV4* absent, and *j1* conspicuously expanded and denate (Karg 1993; Mašán 2017).

Comments. This is a widespread European species, which is also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Epicriopsis horrida* (Kramer 1876)**

Figure 13B

New records. ESTONIA – **Saare county** • Saaremaa, Põripõllu; Orissaare coastal grassland (Fig. 1: no. 7); 58.5538°N, 023.1175°E; 09–15.VIII.2022; K. Sammet and K. Tali leg.; pitfall trap; 1 ♀, IZBE0312648.

Identification. The identification is based on having dorsal setae *r2*, *r3*, *z6*, *Z2*, and *S2* missing, setae *j5* conspicuously thickened and lengthened, genu I or genu III with different ventral setation (*av2* of genu I or *pv1* of genu III absent), genu IV with eight setae (*pd3* absent), and the area between lengthened *j5* and *J2* with one pair of setae (Karg 1993; Mašán 2017).

Comments. This is a widespread European species, which is also present in neighbouring Latvia (Salmane

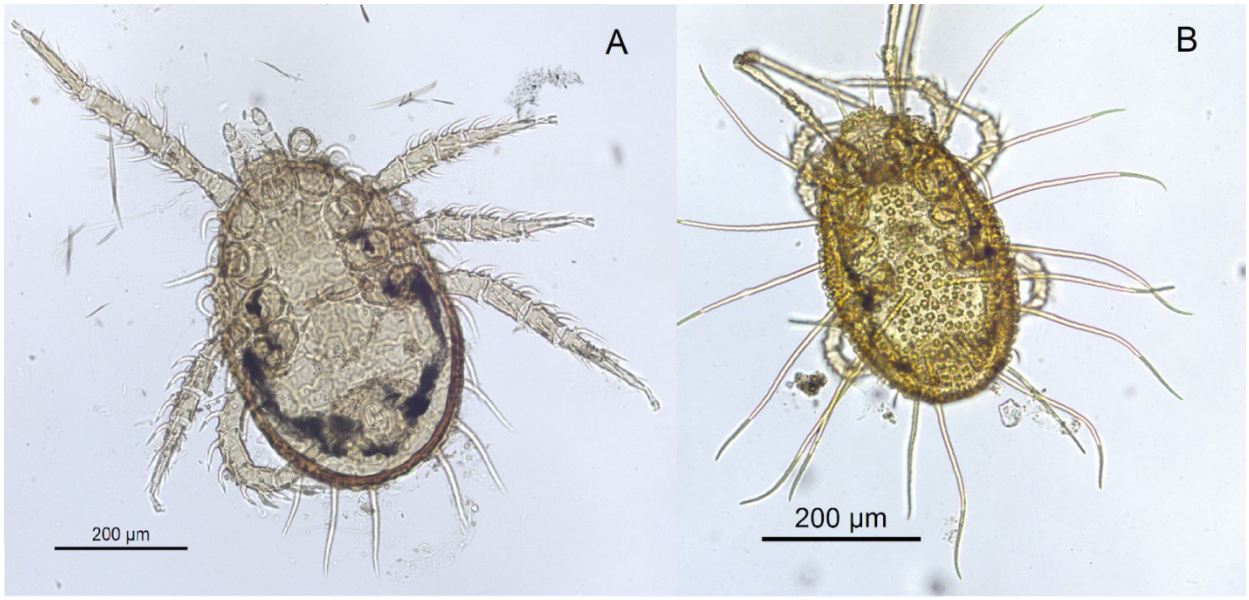

Figure 13. A. *Ameroseius corbiculus* (♀ ventral view). **B.** *Epicriopsis horrida* (♀ ventral view).

and Brumelis 2010) and Finland (Huhta 2016). There is also another, unpublished record from Estonia.

***Stylochirus fimetarius* (J. Müller, 1860)**
Figure 14

New records. ESTONIA – **Saare county** • Saaremaa, Põripõllu; Orissaare coastal grassland (Fig. 1: no. 7); 58.5538°N, 023.1175°E; 09–15.VIII.2022; K. Sammet and K. Tali leg.; pitfall trap; 6 deutonymphs, IZBE0312644.

Identification. The identification is based on having setae *i1* and three other setae needle-like and longer than other setae; thickened, blunt setae on hypostome and coxae II and III; and a triangular tectum (Karg 1993 as *Iphidosoma fimetarium*; Mašan and Kalúz 2001).

Comments. This is a widespread Palaearctic species (Bregetova 1977), which is also in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Cheiroseius viduus* (C.L. Koch, 1839)**

New records. ESTONIA – **Saare county** • Muhu, Koguva, Koguva wooded meadow (Fig. 1: no. 9); 58.5921°N, 023.0820°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and debris on ground, Tullgren funnel: 1 ♀, IZBE0311877.

Identification. The identification is based on having the peritremes not overstepping coxae IV; seta *i1* strong and forward directed; tarsus I without claws; a long and sclerotized vertex with setae *i1*, *s1* and *r1;* dorsal shield with scale-shaped pattern in frontal and opisthosomal parts, medio-lateral part with irregular pattern, setae in row *I* short (Karg 1993, Kalúz and Fenda 2005).

Comments. This is a widespread European species, also present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Gaeolaelaps similisetae* (Karg, 1965)**

New records. ESTONIA – **Lääne county** • Lääne-Nigula, Lyckholm, Silma coastal grassland (Fig. 1: no. 13); 59.0091°N 23.5918°E; 09.VIII.202; I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 2 ♀, IZBE0312483.

Identification. The identification is based on having the shortened peritremes reaching to the middle of coxae II and legs I shorter than idiosoma (Karg 1993).

Comments. This is a widespread European species, which is also present in neighbouring Finland (Huhta 2016).

***Laelaspis astronomica* (C. L. Koch, 1839)**
Figure 15A

New records. ESTONIA – **Pärnu county** • Lääneranna, Saare, Raespa coastal grassland (Fig. 1: no. 5); 58.3607°N, 023.8300°E; 22.VII.2021; I. Melts leg.; topsoil and litter on ground, Tullgren funnel; 2♀, IZBE0312681

Figure 14. *Stylochirus fimetarius* (ventral view).

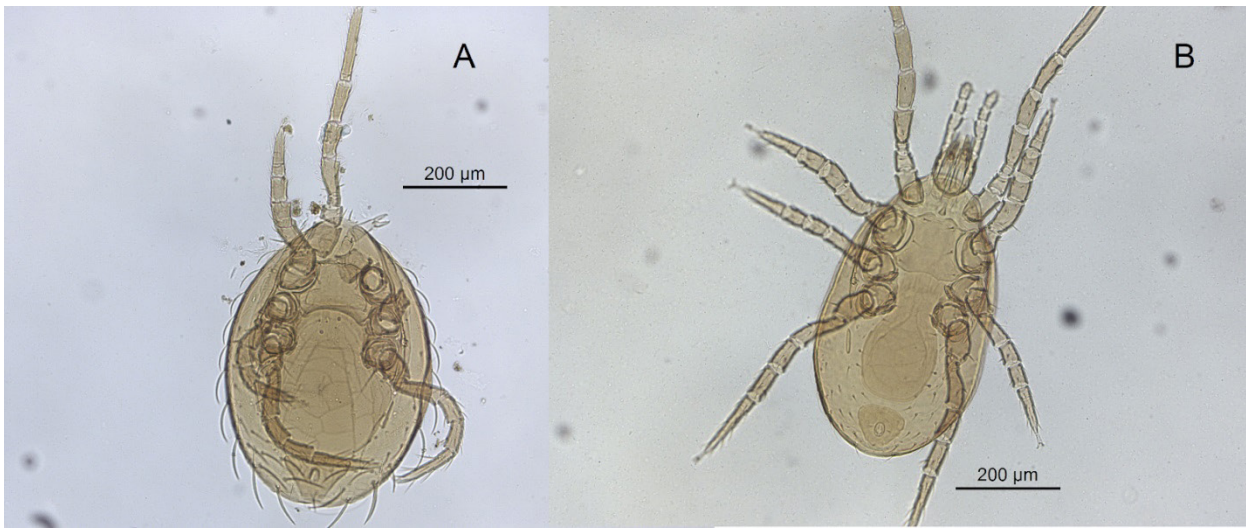

Figure 15. A. *Laelaspis astronomica* (♀ ventral view, capitulum and two legs removed). **B.** *Alloparasitus pratensis* (♀ ventral view).

– **Saare county** • Muhu, Nõmmküla, Pallasma alvar (Fig. 1: no. 11); 58.6770°N, 023.1793°E ; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 3 ♀, 1 ♂**,** IZBE0312669.

Identification. The identification is based on having unpaired dorsal setae, a genital shield with three marginal setae, and strong, dentate *R* setae on the dorsal shield (Karg 1993).

Comments. This is a widespread European species, which is present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Ololaelaps placentula* (Berlese, 1887)**

New records. ESTONIA – **Saare county** • Muhu, Nõmmküla, Pallasma alvar (Fig. 1: no. 11); 58.6770°N, 023.1793°E; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 1 ♀, IZBE 0312887.

Identification. The identification is based on having caudally free peritremal shields, which reach beyond coxae IV, and the sternal shield with a concave posterior edge (Karg 1993).

Comments. This is a widespread Holarctic and Afrotropical species (Joharchi et al. 2018), which is present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Alloparasitus pratensis* (Huhta & Karg, 2010)**
Figure 15B

New records. ESTONIA – **Saare county** • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°E ; 30.VI.2021; K. Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 3 ♀, IZBE0312580.

Identification. The identification is based on having the enlarged genital shield with two setae, the femur of leg II without a thorn-like seta, and unpaired *I*-series dorsal setae (Karg and Huhta 2010).

Comments. This is a northern European species, which was recently described from coastal areas of Finland (Karg and Huhta 2010).

***Trachytes aegrota* (C.L. Koch, 1841)**
Figure 16A

New records. ESTONIA – **Lääne county** • Lääne-Nigula, Lyckholm, Silma coastal grassland (Fig. 1: no. 12); 59.0091°N, 023.5918°E; 09.VIII.2021; I. Melts leg.; topsoil and litter on ground, Tullgren funnel; 2 ♀ – **Saare county** • Muhu, Lalli, Püssina alvar (Fig. 1: no. 10); 58.6272°N, 023.3566°E ; 06.VIII.2021; K. Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 1 ♀, IZBE0312888.

Identification. The identification is based on having separate sternal, ventrianal, and inguinal shields, the epigynal shield with pointed, laterally directed anterior angles, setae *v2* situated behind *v1*, and lateral parts of its vertex broadened and ribbed (Mašan 2003).

Comments. This is a widespread European species, which is present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Urotrachytes formicaria* (Lubbock, 1881)**
Figure 16B

New records. ESTONIA – **Saare county** • Muhu, Koguva, Koguva wooded meadow (Fig. 1: no. 9); 58.5925°N, 023.0822°E; 31.VI.2021; K.Sammet and K. Tali leg.; topsoil and litter on ground, Tullgren funnel; 1 ♀, 1 ♂, IZBE 0312595**.**

Identification. The identification is based on the dorsal sculpture, which consists of 6–8 tranverse folds; dentate dorsal setae; and a narrow, rectangular genital shield (Karg 1989).

Comments. This is a widespread European species, which is present in Finland (Huhta 2016).

***Urodiaspis tecta* (Kramer, 1876)**
Figure 17

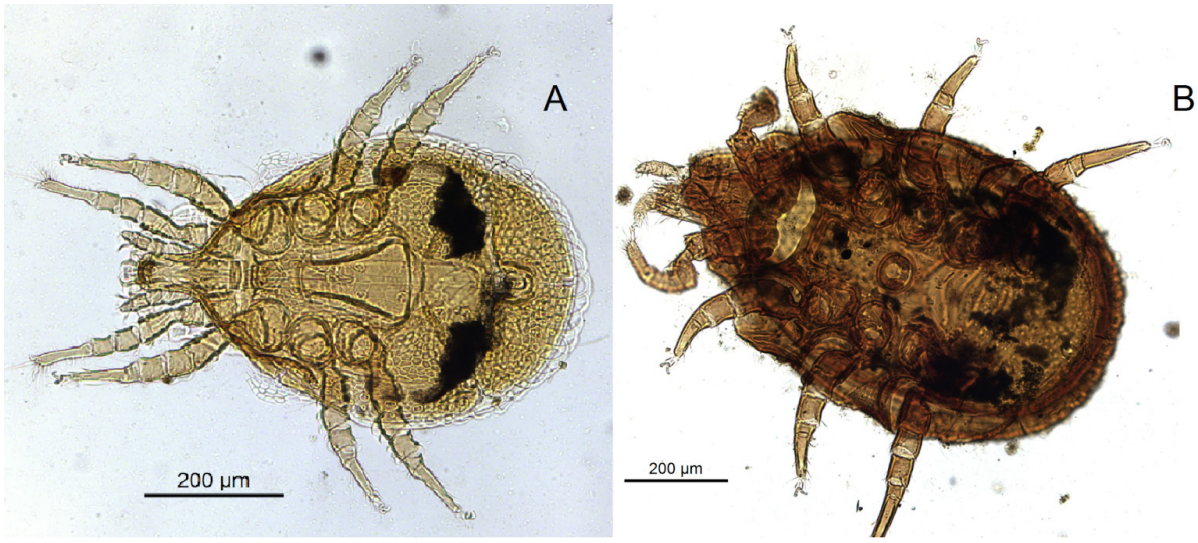

Figure 16. A. *Trachytes aegrota* (♀ ventral view). **B.** *Urotrachytes formicaria* (♂ ventral view).

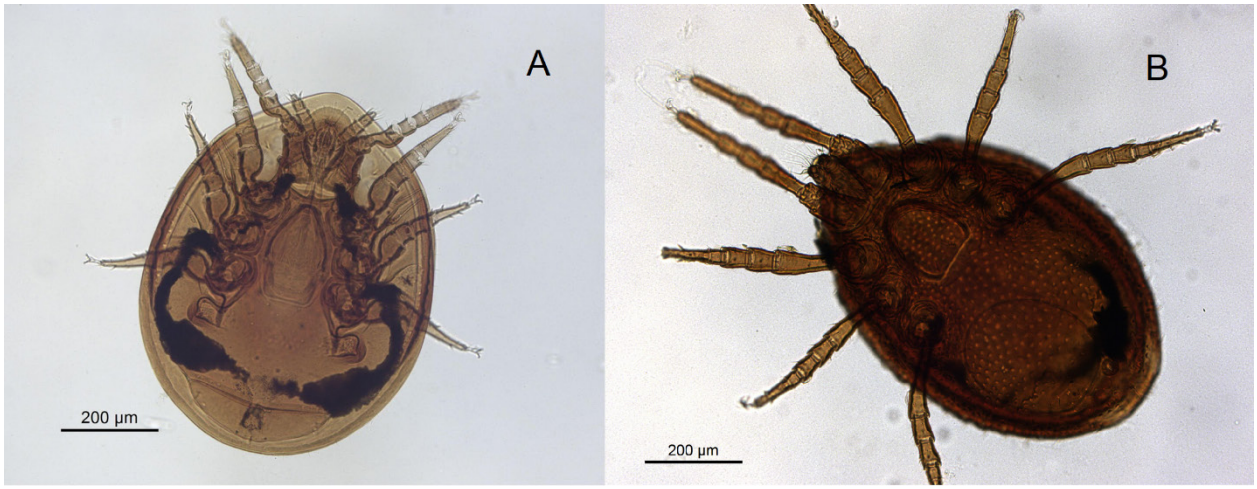

Figure 17. A. *Urodiaspis tecta* (♀ ventral view). **B.** *Dinychus perforatus* (♀ ventral view).

New records. ESTONIA – **Lääne county** • Lääne-Nigula, Lyckholm, Pürksi coastal grassland (Fig. 1: no. 13); 59.0102°N, 023.5678°E; 09.VIII.2021; I. Melts leg.; topsoil and debris on ground, Tullgren funnel; 1 ♀, IZBE0312590.

Identification. The identification is based on having postdorsal shield separate from dorsal shield and carrying three pairs of setae, short dorsal setae, anteriorly rounded genital shield and shape of peritremes (Karg 1989; Bal and Özkan 2007).

Comments. This is a widespread European species, which is present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Dinychus inermis* (C.L. Koch, 1839)**

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Luitemaa coastal grassland (Fig. 1: no. 2); 58.1295°N, 024.4873°E; 14.VII.2021; I. Melts and K. Sammet leg.; topsoil and debris on ground, Tullgren funnel; 1 ♀, IZBE0312337.

Identification. The identification is based on the shape and length of the peritremata and smooth dorsal setae, except for the dentate caudal ones (Karg 1989).

Comments. This is a widespread European species, which is present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

***Dinychus perforatus* Kramer, 1882**

Figure 17B

New records. ESTONIA – **Pärnu county** • Häädemeeste, Metsaküla, Metsaküla coastal grassland (Fig. 1: no. 3); 58.2673°N, 024.5350°E; 19.VII.2021; I. Melts and K. Sammet leg.; topsoil and debris on ground, Tullgren funnel; 1 ♀, IZBE0312593.

Identification. The identification is based on the shape and length of peritremata; genital shield placed between coxae II and III; genital shield anteriorly with two teeth (Karg 1989).

Comments. This is a widespread European species, which is present in neighbouring Latvia (Salmane and Brumelis 2010) and Finland (Huhta 2016).

Coleoptera (Carabidae)

***Diachromus germanus* (Linnaeus, 1758)**
Figure 18

New records. ESTONIA – **Pärnu county** • Häädemeeste, Rannametsa, Luitemaa coastal grassland (Fig. 1: no. 2); 58.1215°N, 024.4889°E; 10–14.VII.2021; I. Melts and K. Sammet leg.; pitfall trap; 2 specimens, IZBE0454044.

Identification. The identification is based on the hairy elytra and pronotum which have a characteristic colour pattern of dark metallic blue and orange (Freude et al. 2004).

Comments. *Diachromus germanus* is a widespread Turanic-European-Mediterranean species (Trautner et al. 1988). It is present in neighbouring Latvia (Silfverberg 2010). The Estonian findings represent the northernmost records of this species.

Discussion

The present study contributes the first country records of 44 arthropod species and confirms the occurrence of two species in coastal habitats in Estonia, addressing previous ambiguities in the records (Grube 1859; Kuznetsov and Petrov 1984). Two of the newly recorded spider species (*Micaria micans* and *Sibianor larae*) are the result of recent taxonomic revisions. However, the presence of the ground beetle *Diachromus germanus* in south-western Estonia and the spiders *Agroeca dentigera* and *Rugathodes instabilis* in western Estonia may indicate range shifts due to climate change (Trautner et al. 1988; Chen et al. 2011). Many spider and ground beetle species have been observed to shift their distributions in response to climate change (e.g. Krehenwinkel and Tautz 2013; Mammola and Isaia 2017; Huffeldt 2020; Marrec et al. 2021). Shifting distributions of arthropods are expected and are dependent on habitat availability (e.g. Kotze and O'Hara 2003; Platts et al. 2019). Therefore, it is crucial to continue monitoring ground-dwelling macroarthropods and assessing habitat suitability in different parts of the coastal grassland–forest ecosystems during global changes to facilitate biodiversity conservation (e.g. Milano et al. 2021; Boutaud et al. 2022).

The discovery of the spiders *Donacochara speciosa* and *Walckenaeria acuminata* may be attributed to their increased prevalence, as they were already found in Finland more than four decades ago (Palmgren 1977) and were, thus, expected to be present in Estonia as well. Nevertheless, they were not recorded during extensive local faunal research projects conducted in similar habitats in western Estonia during the 1970s and 1980s (Vilbaste 1970, 1973, 1982, 1993; Vilbaste et al. 1985). However, they have been consistently found in recent years (M. Meriste pers. comm.; current study).

Most of the identified mite species are widespread European or cosmopolitan species, some of which have previous unpublished records from Estonia. The discovery of a recently described species (*Alloparasitus pratensis*) improves our understanding of its distribution but also highlights the lack of previous studies. There is an evident need for fundamental faunal studies on poorly known taxa to assess current diversity and identify potential future faunal changes. This knowledge contributes also to a more comprehensive understanding of the interrelationships between arthropods and

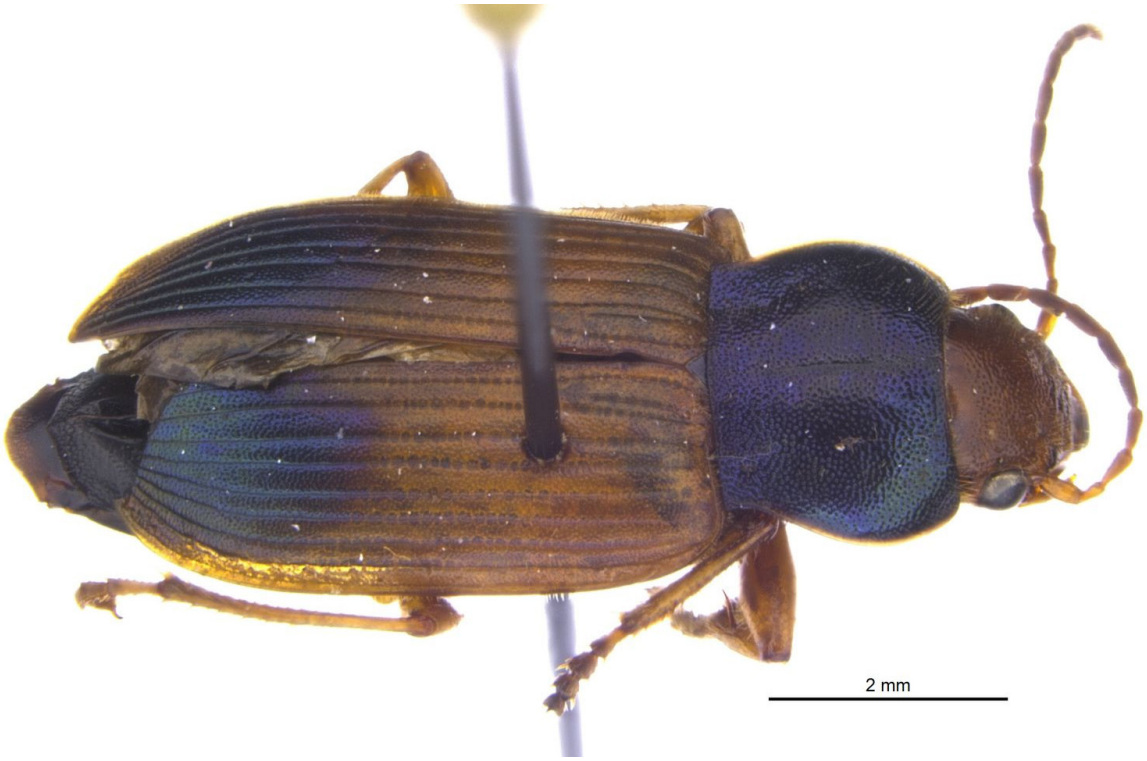

Figure 18. *Diachromus germanus* (dorsal view).

other environmental conditions, facilitating sustainable management of coastal habitats in northern Europe.

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Author Contributions

Conceptualization: IM, KS. Data curation: KS, IM. Funding acquisition: IM, KT. Investigation: KS, MRM. Methodology: IM, KS. Resources: IM, KS. Supervision: IM, KS. Visualization: KS. Project administration: IM. Writing – original draft: KS, IM. Writing – review and editing: IM, MRM, KS.

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