

Pseudoscorpions (Arachnida: Pseudoscorpiones) in Estonia: new records and an annotated checklist

Kaarel Sammet, Tõnu Talvi, Ilmar Süda & Olavi Kurina

Sammet, K., Talvi, T., Süda, I. & Kurina, O. 2016: Pseudoscorpions (Arachnida: Pseudoscorpiones) in Estonia: new records and an annotated checklist. — Entomol. Fennica 27: 149–163.

The current knowledge of pseudoscorpions in Estonia is summarized, based on specimens preserved in various Estonian collections and new material collected from 1993 to 2015. Altogether 474 studied specimens belonged to 14 species, including nine species recorded from Estonia for the first time. Supplemented by *Apocheiridium rossicum*, listed by literature data only, the number of known Estonian pseudoscorpions is now set at 15. The findings of *Mesochelifera resslii* are the northernmost known for the species. Some ecological and phenological observations were made on the most common species, along with notes on the habitat preferences of other species and the use of different trapping methods. The composition of the known Estonian fauna is compared with the published records from the neighbouring countries, revealing a highest similarity to the Finnish fauna. The possible occurrence of other species in Estonia and the latitudinal species diversity gradient in the Eastern Baltic region are shortly discussed.

K. Sammet & O. Kurina, Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, Kreutzwaldi 5D, 51014 Tartu, Estonia; Corresponding author's e-mail: kaarel.sammet@student.emu.ee

T. Talvi, Environmental Board of Estonia, Viidumäe, 93343, Saaremaa, Estonia
I. Süda, Institute of Forestry and Rural Engineering, Estonian University of Life Sciences, Kreutzwaldi 5, 51014 Tartu, Estonia

Received 9 February 2016, accepted 28 April 2016

1. Introduction

Pseudoscorpions, also known as false scorpions, are a moderately diverse group of small arachnids with over 3,500 known recent species globally (Harvey 2013a) while 787 species have been recorded from Europe (Harvey 2015). Most species are relatively small, have cryptic habits and are therefore rarely detected and easily overlooked. In contrast to larger arthropod orders, there are few specialists dedicated to their study, and consequently there are still insufficiently known areas even in Europe.

The first record of pseudoscorpions in Estonia

dates possibly back to 1791 when J. B. Fischer published his treatment of the natural history of Livonia, which covers the northern part of today's Latvia and southern Estonia (Fischer 1791). However, as the work does not give any exact locality data, the observations of *Phalangium cancroides* Linnaeus (probably *Chelifera cancroides* (Linnaeus, 1758)) could have been made also on the territory of present-day Latvia (Tumšs 1934). The first undisputable records of pseudoscorpions in Estonia derive from the classic treatment of Livonian arachnids by A. E. Grube (1859). He mentioned the occurrence of *Ch. cancroides* under two synonymous names

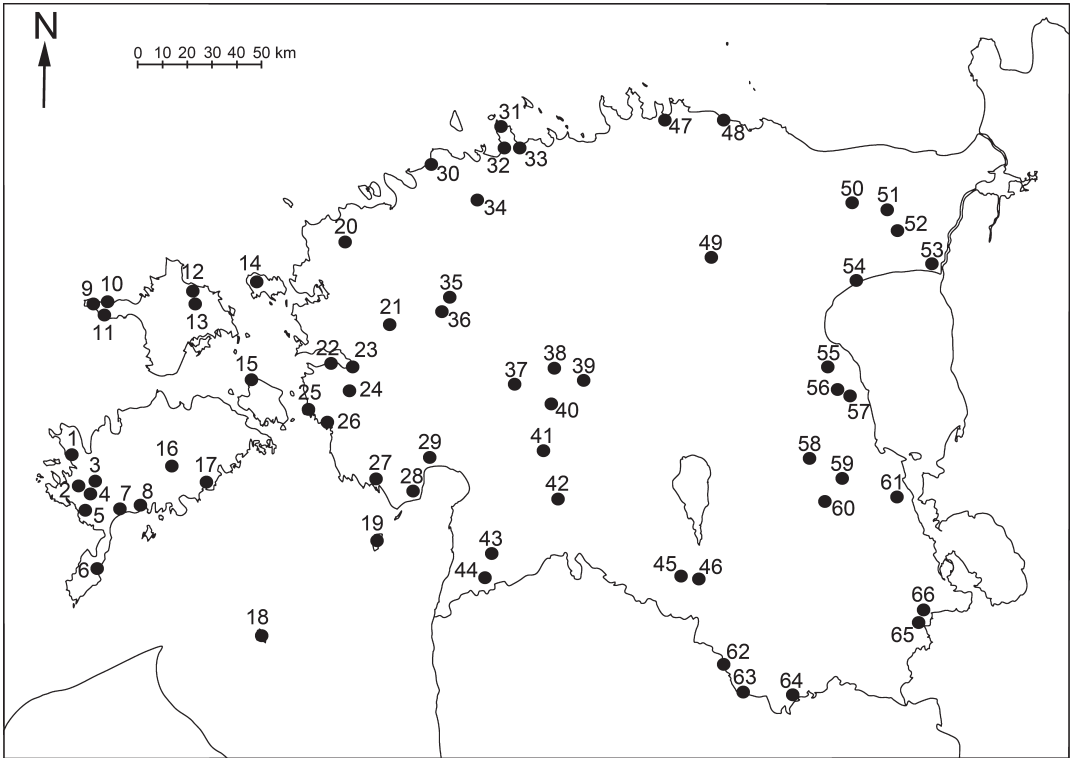


Fig. 1. Map of the sampling localities of Estonian pseudoscorpions. Some dots represent more than one nearby sites while exact coordinates can be found in sections of specimens studied.

from two localities. The next data on Estonian pseudoscorpions were published over sixty years later, when a new species, *Apocheiridium rossicum* Redikorzev, 1935, was described on the basis of Estonian material (a female specimen from Meriküla, North-Eastern Estonia; Redikorzev 1935: 184). Later on, three species were mentioned by L. Aru (1968), based on personal communication with Estonian arachnologist A. Vilbaste, however, without any list of voucher material. Some faunal surveys have mentioned the findings of unidentified pseudoscorpions (e. g. Remm 1988). Talvi (2010) summarized the previous information of Estonian pseudoscorpions and reported two new species from a broad-leaved forest in Puhtu, Western Estonia.

Thus, prior to our study, six species have been documented to occur in Estonia. From the neighbouring countries, there are 12 species known from Latvia (Tumšs 1934, Jansson & Hultengren 2002, Telnov & Salmane 2015), 17 species from Finland (Uddström & Rinne 2014) and 21 from Sweden (Gärdenfors & Wilander 1992). In the

North–Western part of Russia and Lithuania, pseudoscorpions are as yet too little known for any diversity estimates.

A large material of pseudoscorpions has accumulated in Estonian zoological collections from various research projects over the years. The aim of this study was 1) to identify and arrange the previously collected specimens and 2) together with newly collected material, to summarize all the available data of Estonian pseudoscorpions in order to get a preliminary overview of their species composition and ecology.

2. Materials and methods

The examined material, collected altogether from 66 localities (Fig. 1), originated from the following sources:

1. The major institutional and private zoological collections in Estonia were searched for pseudoscorpions.



Fig. 2. Trunk window trap, designed by I. Süda in 2004 (photo by I. Süda).

2. Specimens were collected by the third author during his coleopterological research projects and surveys. The window traps designed by the collector were attached to tree trunks (trunk window traps, abbreviated TWT below; Fig. 2; see also Süda 2009). These consisted of a transparent pane (55 × 45 cm) and a plastic tank with preserving fluid (ethylene glycol or propylene glycol) and were covered by a roof to avoid rainwater flooding. Of 57 collecting localities, three were sampled more thoroughly with window traps, namely the island of Ruhnu, Riimaru and Koiva-Mustjõe Nature Reserve (the localities 18, 42 and 62 in Fig. 1, respectively).
3. The preserved arachnid material from the extensive Estonian Malaise Trap Project (2008–2011, see Tomasson *et al.* 2014 for details) also yielded some specimens of pseudoscorpions.
4. Many pseudoscorpions were collected during a large-scale study of forest snails. During this project in 1995–2015, three most common forest types all over Estonia were studied by quantitative sampling. For more detailed descriptions of the studied habitats and sampling details see Mänd *et al.* (2002).
5. To recover ground-living specimens, sifting litter and moss in combination with thermoelector (Tullgren funnel) was used during

the recent years. Pitfall traps, consisting of 0.5 l plastic containers with preserving fluid (propylene glycol) were used to capture additional ground living specimens.

6. Suitable habitats (tree hollows, bark of trees etc.) were searched by eye.

The specimens were identified using Leica S8 APO stereo microscope and Leica DM 6000B compound microscope. The identifications were based on several keys to European species (e.g. Beier 1963, Legg & Jones 1988, Christophoryová *et al.* 2011). Some specimens were treated with 20% KOH and mounted on microscope slides (using Euparal™).

The details of collection and depository information of every specimen or series are noted in the sections of specimens studied of the annotated species list. All the records were entered also into the PlutoF cloud database (Abarenkov *et al.* 2010) and will be accessible through the Estonian eBiodiversity portal (<http://elurikkus.ut.ee>) and Global Biodiversity Information Facility (<http://www.gbif.org>).

The studied material is deposited in:

- IZBE: Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences [former Institute of Zoology and Botany], Tartu, Estonia;

- TAMZ: Estonian Natural History Museum, Tallinn, Estonia;
- AA: Allan Selin private collection, Tallinn, Estonia;
- JVO: Jaak Volkman private collection, Audru, Estonia;
- TT: Tõnu Talvi private collection, Viidu, Estonia.

The calculations were done and diagrams were prepared using the free software package R (version 3.2.2, R Development Core Team 2014).

3. Results

Altogether 474 specimens of five families including 14 species were found. Five specimens of them remain unidentified to species level (one dried and damaged specimen of Cheliferidae and four juvenile Chernetidae). Three specimens of *Neobisium carcinoides* (Hermann, 1804) lacked proper locality data and are not included in this work. *Apocheiridium* (*Apocheiridium*) *rossicum* Redikorzev, 1935, previously recorded from Estonia was not found during our studies. Nine species of pseudoscorpions are listed for the first time for Estonian fauna.

3.1. Annotated species list

The following list contains all the known identified findings of pseudoscorpions from Estonia, with comments on literature and general distribution in Northern Europe. The material previously published by Talvi (2010) was re-examined and included in the sections of specimens studied. An asterisk (*) before a species name indicates the first record of the species in Estonia. The locality (below as loc.) numbers correspond to those in Fig. 1. The findings from different traps or samples from the same localities at the same time are marked separately. The studied material is listed in chronological order of collecting events. The sequence of families follows Harvey (2013a), while the species in a family are ordered alphabetically. For the finding localities of each species, see Figs. 3, 4 and 5. The data of specimens not collected by the authors repeat the texts of the

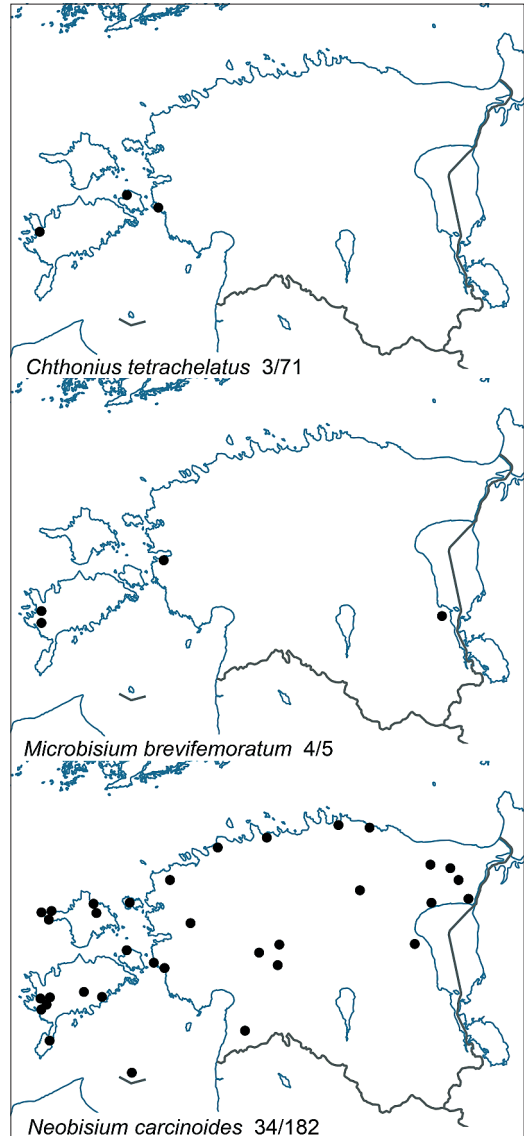


Fig. 3. Findings of Estonian pseudoscorpion species of the families Chthoniidae and Neobisiidae. Dots denote original data of this study. Number of collecting localities is followed by number of studied specimens.

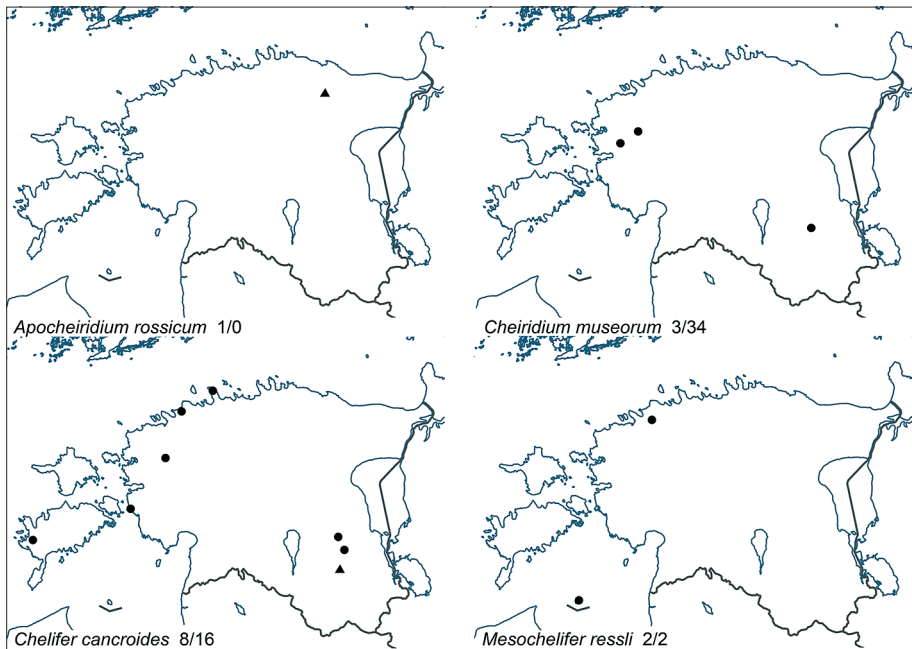
original labels, which in some cases did not specify some details.

3.1.1. Chthoniidae

Chthonius (*Ephippiochthonius*) *tetrachelatus* (Preyßler, 1790)

Estonian sources. Talvi 2010: 129, from Puhtu.

Fig. 4. Findings of Estonian pseudoscorpion species of the families Cheiridiidae and Cheliferidae. Dots denote original data of this study and triangle represents literature data. Number of collecting localities is followed by number of studied specimens.



Specimens studied. 1 ind., Puhtu 58.5500°N, 23.5500°E, forest litter, sifting 11.VI.1997, E. Õunap leg. (loc. 25; TT00005); 2 ind., same loc., forest litter, sifting 10.VI.1998, L. Saks leg. (TT00010 and TT00011); 1 ind., same loc., forest litter, sifting 10.VI.1999, I. Jõgisalu leg. (TT00004); 1 ind., Saaremaa island, Kurevere Roolaht, 58.40194°N, 21.99555°E, nearshore litter, sifting, 14.X.2001, T. Talvi leg. (loc. 1; TT00045); 1 ind., Muhu island, Pallasmaa, 58.67908°N 23.18008°E, 26.VII.2015, wrack on seashore, Tullgren funnel, O. Kurina leg. (loc. 15; IZBE0310058); 64 ind., same loc., 22.VIII.2015, wrack on seashore, Tullgren funnel, O. Kurina leg. (IZBE0310140).

Distribution. Widespread in Europe (Harvey 2013b), including Finland, mainly in glasshouses (Kaisila 1949), but also in seashore wrack in Åland archipelago (Backlund 1945) as well as Sweden (Gårdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

3.1.2. *Neobisiidae*

Neobisium (Neobisium) carcinoides (Hermann, 1804)

Estonian sources. Aru 1968: 607, from Estonia; Talvi 2010: 129, from Puhtu.

Specimens studied. 1 ind., Kaansoo, 58.5833°N, 25.1000°E, 11.VI.1979, sifting, A. Vilbaste leg. (loc. 40; IZBE0310039); 1 ind., Viluvere 58.6333°N, 24.8500°E, 12.VI.1979, Norway spruce forest litter, sifting, A. Vilbaste leg. (loc. 37; IZBE0310038); 3 ind., Võidula, 58.7000°N, 25.1166°E, 14.VI.1979, forest litter, sifting, A. Vilbaste leg. (loc. 38; IZBE0310048); 3 ind., Türisalu cliff, 59.42027°N, 24.3219°E, 25.VI.1979, sifting, A. Vilbaste leg. (loc. 30; IZBE0310051); 1 ind., Hindaste, 59.1500°N, 23.8000°E, 27.VI.1979, wooded meadow litter, sifting, A. Vilbaste leg. (loc. 20; IZBE0310046); 2 ind., Ruhnu 57.8000°N, 23.2333°E, 2.VII.1979, forest litter sifting, A. Vilbaste leg. (loc. 18; IZBE0310045); 2 ind. Ruhnu 57.8000°N, 23.2333°E, 3.VII.1979, forest litter sifting, A. Vilbaste leg. (loc. 18; IZBE0310047); 3 ind. Ruhnu, Haubjerre 57.8014°N, 23.2722°E, 3.VII.1979, seashore litter, sifting, A. Vilbaste leg. (loc. 18; IZBE0310053); 4, 1 and 5 ind., Ruhnu 57.8000°N, 23.2333°E, 4.VII.1979, sifting, A. Vilbaste leg. (loc. 18; IZBE0310050, IZBE0310052, IZBE0310044); 3 ind., same loc., 3.VIII.1981, sifting, A. Vilbaste leg. (IZBE0310042); 3 ind., Ruhnu, Haubjerre 57.8008°N, 23.2652°E, 3.VIII.1981, sifting, A. Vilbaste leg. (loc. 18; IZBE0310043); 1 ind.,

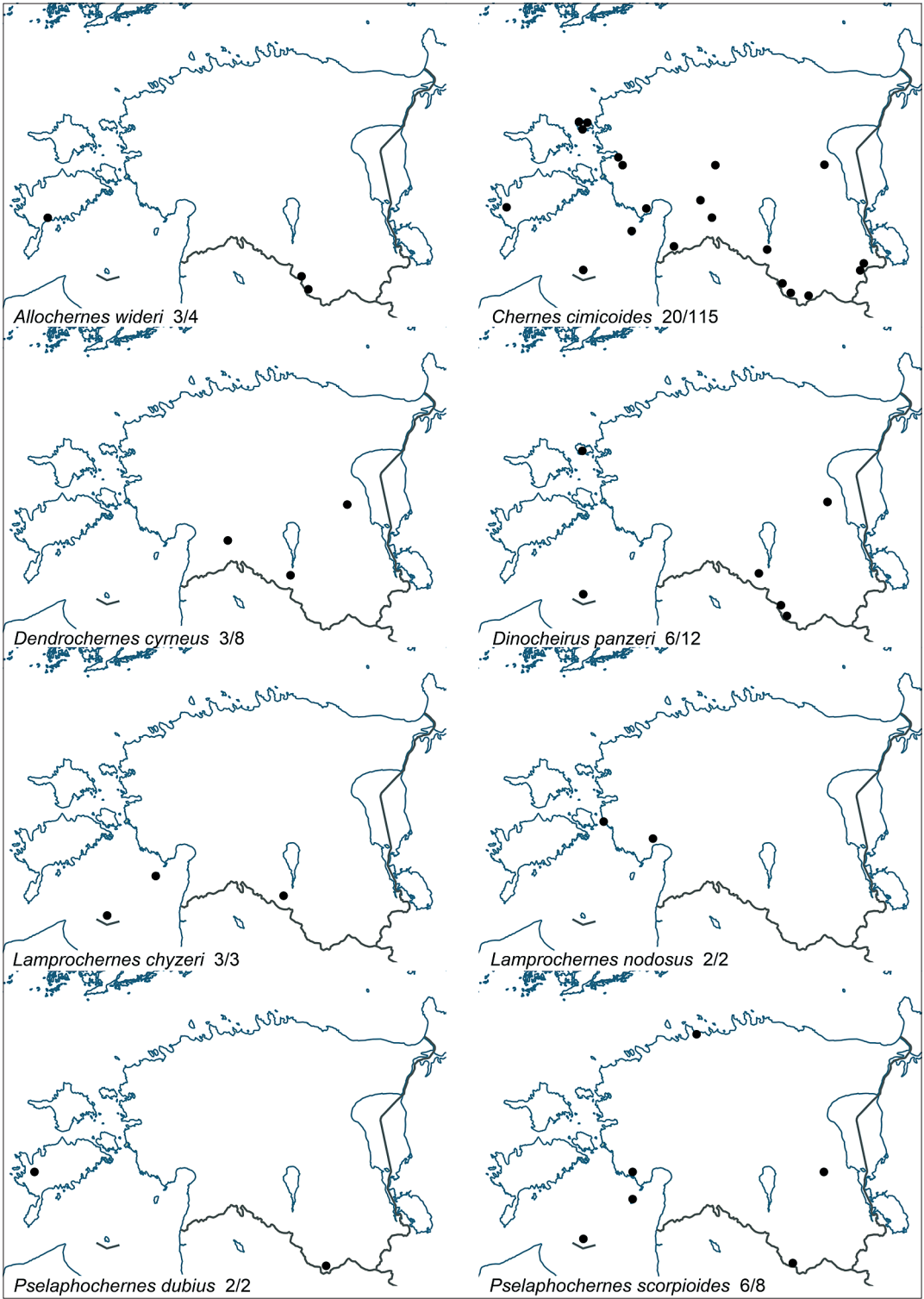


Fig. 5. Findings of Estonian pseudoscorpion species of the family Chernetidae. Dots denote original data of this study. Number of collecting localities is followed by number of studied specimens.

- Ruhnu 57.8000°N, 23.2333°E, 04.VIII.1981, sifting, A. Vilbaste leg. (loc. 18; IZBE0310040); 1 and 2 ind., Ruhnu, Haubjerre 57.8000°N, 23.2500°E, 4.VIII.1981, litter sifting, A. Vilbaste leg. (loc. 18; IZBE0310026 and IZBE0310041); 1 ind., Vormsi, Prästvike 58.9833°N, 23.2166°E, 31.VII.1983, sifting, A. Vilbaste leg. (loc. 14; IZBE0310013); 1 ind., Viidumäe, fen near Audaku 58.2833°N, 22.1000°E, 22.V.1984, litter sifting, A. Vilbaste leg. (loc. 3; IZBE0310019); 1 ind. Kivesselja 58.2666°N, 22.1166°E, 24.V.1984, forest litter, sifting, A. Vilbaste leg. (loc. 2; IZBE0310014); 4 ind. Viidumäe Pitkassoo, 58.3166°N, 22.2166°E, 24.V.1984, litter sifting, A. Vilbaste leg. (loc. 3; IZBE0310012); 1 ind., Viidumäe, Upsi 58.3000°N, 22.0833°E, 26.V.1984, coastal meadow with junipers, litter sifting, A. Vilbaste leg. (loc. 2; IZBE0310018); 1 ind. Viidumäe, Pitkassoo 58.3166°N, 22.2166°E, 6.VII.1984, Scots pine bog woodland litter, sifting, A. Vilbaste leg. (loc. 3; IZBE0310020); 1 and 1 ind., Viidumäe, Kanna 58.3166°N, 22.0833°E, 8.VII.1984, bog litter, sifting, A. Vilbaste leg. (loc. 2; IZBE0310016, IZBE0310022); 1 ind., Viidumäe Kivesselja 58.2666°N, 22.1166°E, 10.VII.1984, forest litter, sifting, A. Vilbaste leg. (loc. 2; IZBE0310021); 1 ind., Viidumäe, Sutru 58.2731°N, 22.1138°E, 18.IX.1984, sifting, A. Vilbaste leg. (loc. 2; IZBE0310032); 4 ind., Viidumäe, Kivesselja 58.2667°N, 22.1166°E, 18.IX.1984, sifting, A. Vilbaste leg. (loc. 2; IZBE0310023); 1 and 4 ind., Viidumäe, Pitkassoo 58.2744°N, 22.1858°E, 18.IX.1984, litter sifting, A. Vilbaste leg. (loc. 3; IZBE0310027 and IZBE0310033); 2 and 1 ind., Viidumäe, Kanna 58.3197°N, 22.0836°E, 19.IX.1984, coniferous forest litter, sifting, A. Vilbaste leg. (loc. 2; IZBE0310034 and IZBE0310029); 2 ind., Viidumäe, Nakimetsa 58.2833°N, 22.066°E, 20.IX.1984, Scots pine forest litter, sifting, A. Vilbaste leg. (loc. 4; IZBE0310030); 3 ind., Viidumäe, Surnuaiamägi 58.2913°N, 22.0958°E, 20.IX.1984, sifting, A. Vilbaste leg. (loc. 2; IZBE0310025); 2 ind., Viidumäe, Suurissoo mägi 58.2742°N, 22.0983°E, 20.IX.1984, litter sifting, A. Vilbaste leg. (loc. 2; IZBE0310031); 15 ind., Viidumäe 58.2970°N, 22.0990°E, 02.X.1988, litter sifting, A. Vilbaste leg. (loc. 2; IZBE0310037); 1 ind., Viidumäe, Audaku 58.3000°N, 22.1000°E, 2.X.1988, litter sifting, A. Vilbaste leg. (loc. 2; IZBE0310035); 1 ind., Sõrve peninsula 58.0211°N, 22.1616°E, 10.VII.1995, moss and litter in Norway spruce forest, sifting, T. Talvi leg. (loc. 6; TT00043); 1 and 1 ind., Sõrve peninsula, 58.0238°N, 22.1638°E, 15.VII.1995, deciduous forest litter sifting, T. Talvi leg. (loc. 6; TT00039 and TT00038); 1, 1 and 1 ind., Viidumäe 58.3091°N, 22.0761°E, 20.VII.1995, deciduous forest litter, sifting, T. Talvi leg. (loc. 2; TT00050, TT00035 and TT00036); 1, 1 and 1 ind., Viidumäe 58.3163°N, 22.0852°E, 20.VII.1995, mixed pine forest litter, sifting, T. Talvi leg. (loc. 2; TT00034, TT00041 and TT00042); 1 ind., Tubala 58.9680°N, 22.7700°E, 30.VII.1995, deciduous forest litter sifting, T. Talvi leg. (loc. 12; TT00014); 2, 1, 2 and 1 ind., Nõmba 58.9261°N, 22.7866°E, 30.VII.1995, mixed pine forest litter, sifting, T. Talvi leg. (loc. 13; TT00019, TT00016, TT00018 and TT00021); 1 ind., Viidumäe, Audaku 58.2972°N, 22.0986°E, 25. X.1995, occasional finding on bark of an oak, T. Talvi leg. (loc. 2; TT00047); 1 ind., Kaali crater 58.3725°N, 22.6691°E, 14.VI.1996, litter sifting, T. Talvi leg. (loc. 16; TT00046); 2 ind., Viidumäe 58.3091°N, 22.0761°E, 10.VIII.1996, deciduous forest litter and moss, sifting, T. Talvi leg. (loc. 3; TT00037); 1 ind., Puhtu 58.5500°N, 23.5500°E, 11.VI.1997, deciduous forest litter sifting, E. Õunap leg. (loc. 25; TT00006); 1 ind., same loc. 11.VI.1997, sifting, A. Hürden leg. (TT00007); 1 ind., same loc., sifting, L. Saks leg. (TT00012); 1 and 1 ind., same loc. 10.VI.1999, deciduous forest – coastal meadow, litter sifting, R. Mägi leg. (TT00002 and TT00003); 1 ind., same loc. 10.VI.1999, deciduous forest litter, sifting, I. Jõgisalu leg. (TT00013); 2 ind., same loc. deciduous forest – coastal meadow, litter sifting, R. Veeroja leg. (TT00008); 7 ind., Maardu, Kuldvitsa tee, 59.4703°N, 24.9436°E, 10.IX.2001, litter sifting, A. Selin leg. (loc. 33; AA0000001–AA0000007); 1 ind., Laiksaare, 58.1014°N, 24.7211°E, 17.VIII.2004, deciduous forest litter, sifting, T. Talvi leg. (loc. 43; TT00024); 1 ind., Kõpu peninsula 58.9166°N, 22.1169°E, 30.X.2005, litter sifting, T. Talvi leg. (loc. 11; TT00015); 1 ind., Hiiumaa, Kriip-suränga 58.9341°N, 22.1580°E, 30.X.2005, Norway spruce forest litter sifting, T. Talvi leg. (loc. 10; TT00022); 2 ind., Kõpu peninsula, Korbi

mäed 58.9272°N, 22.1672°E, 30.X.2005, Scots pine forest on dunes, litter sifting, T. Talvi leg. (loc. 10; TT00017); 9 ind., Tiharu 58.8855°N, 22.2275°E, 30.X.2005, wooded meadow, litter sifting, T. Talvi leg. (loc. 11; TT00020); 7 ind., Kõpu peninsula, Rebasemäe 58.9186°N, 22.2408°E, 30.X.2005, forest on dunes, litter sifting, T. Talvi leg. (loc. 10; TT00023); 1 ind., Vägara laht 58.2316°N, 22.3200°E, 21.VII.2010, moist birch forest, litter sifting, T. Talvi leg. (loc. 7; TT00053); 1 ind., Oessaare bay 58.3308°N, 22.8764°E, 28.VII.2010, litter sifting, T. Talvi leg. (loc. 17; TT00052); 1 ind., Käomardi bay 58.5372°N, 23.6836°E, 7.11.2011, moist forest, litter sifting, T. Talvi leg. (loc. 26; TT00025); 1 ind., Agusalu 59.0372°N, 27.6613°E, 7.11.2011, burnt woodland litter, sifting, T. Talvi leg. (loc. 53; TT00026); 1 ind., Äntu 59.0653°N, 26.2397°E, 02.VII.2015, forest litter and moss, Tullgren funnel, K. Sammet leg. (loc. 49; IZBE0310126); 1 ind., Viieristi 58.02389°N, 22.1638°E, 7.VII.2015, deciduous forest litter, sifting, T. Talvi leg. (loc. 6; TT00028); 1 ind., Kullamaa 58.8847°N, 24.0686°E, 24.VII.2015, Scots pine forest litter, sifting, K. Sammet leg. (loc. 21; IZBE0310056); 1 ind., Jõuga 59.1523°N, 27.3869°E, 09.VIII.2015, forest litter, Tullgren funnel, K. Sammet leg. (loc. 52; IZBE0310138); 2 ind., Tubala 58.9680°N, 22.7700°E, 20.VIII.2015, deciduous forest litter, sifting, T. Talvi leg. (loc. 12; TT00027); 5 and 4 ind., Võsu 59.5786°N, 25.9297°E, 20.VIII.2015, deciduous forest near seashore, Tullgren funnel, K. Sammet leg. (loc. 47; IZBE0310059 and IZBE0310124); 2 ind., Muhu, Pallasmaa 58.6791°N, 23.1800°E, 22.VIII.2015, wrack on seashore, Tullgren funnel, O. Kurina leg. (loc. 15; IZBE0310139); 1 ind., Rutja 59.5553°N, 26.3538°E, 5.IX.2015, Scots pine forest litter, Tullgren funnel O. Kurina leg. (loc. 48; IZBE0310114); 1 ind., Raadna 58.9747°N, 27.1307°E, 20.X.2015, forest litter, Tullgren funnel, T. Kesküla leg. (loc. 54; IZBE0310131); 4 ind., Mäetaguse 59.2288°N, 27.3247°E, 20.X.2015, forest litter, Tullgren funnel, M. Kruus and T. Kesküla leg. (loc. 51; IZBE0310134); 2 ind., Koseveski 58.7358°N, 26.8463°E, 21.X.2015, forest litter, Tullgren funnel, M. Kruus and T. Kesküla leg. (loc. 55; IZBE0310133); 2 ind., between Rääsa and Lipu

59.2582°N, 27.1036°E, 21.X.2015, Tullgren funnel, M. Kruus and T. Kesküla leg. (loc. 50; IZBE0310132).

Distribution. Widespread in Europe (Harvey 2013b), including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934), Lithuania (Tamutis 2011), Poland (Rafalski 1967).

Microbisium brevifemoratum (Ellingsen, 1903)

Estonian sources. Aru 1968: 607, from Estonia.

Specimens studied. 1 ind., Kihelkonna, Kanna bog 58.3166°N, 22.0833°E, 8.VIII.1984, sifting, A. Vilbaste leg. (loc. 2; IZBE0310017); 1 ind., Viidumäe, Pätsumaa bog 58.2216°N, 22.1000°E, 18.IX.1984, sifting, A. Vilbaste leg. (loc. 4; IZBE0310028); 1 ind., Viidumäe, Audaku 58.2833°N, 22.0666°E, 2.X.1988, bog litter sifting, A. Vilbaste leg. (loc. 3; IZBE0310036); 1 ind., Järvelja 58.2666°N, 23.8282°E, 20.VIII.2014, Sphagnum moss, Tullgren funnel, K. Sammet leg. (loc. 61; IZBE0310049); 1 ind., near Lihula 58.7281°N, 23.8282°E, 25.VII.2015, litter, Tullgren funnel, T. Kesküla leg. (loc. 23; IZBE0310057).

Distribution. Widespread in Central, Eastern and Northern Europe and parts of Asia (Harvey 2013b), including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

3.1.3. *Cheiridiidae*

Apocheiridium (*Apocheiridium*) *rossicum* Redikorzev, 1935

Estonian sources. Redikorzev 1935: 184, from Merreküll [Meriküla near Viru-Jaagupi, North-Eastern Estonia].

Distribution and remarks. Finland (Kaisila 1949), European Russia (Redikorzev 1935) and Central Asia (Dashdamirov & Schawaller 1993); see also "4. Discussion". Specimens of this species were searched for in coastal areas of North-Eastern Estonia with no positive results.

* *Cheiridium museorum* (Leach, 1817)

Specimens studied. 1 ind., Sõtke 58.9000°N, 24.3666°E, 10.IX.2005, occasional finding, A. Selin leg. (loc. 36; AA0000008); 1 ind., Kullamaa

58.8674°N, 24.0882°E, 23.VII.2015, occasional finding indoors, K. Sammet leg. (loc. 21; IZBE-0310015); 1 ind., Ignase 58.2500°N, 26.8333°E, 22.X.2015, occasional finding indoors, M. Kruus leg. (loc. 60; IZBE0310125); 21, 7 and 3 ind., same loc., 25.X.2015, litter and straw from an unused barn, Tullgren funnel, M. Kruus leg. (IZBE0310128, IZBE0310129 and IZBE-0310130).

Distribution. A widespread synanthropic species, present also in Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

3.1.4. *Cheliferidae*

Chelifer cancroides (Linnaeus, 1758)

Estonian sources. Grube 1859: 40, (as *Chelifer ixoides*) Dorpat [Tartu], (as *Chelifer grandimanus*) Heiligensee [Pühajärv near Otepää]; Aru 1968: 607, from Estonia; Talvi 2010: 130, from Puhtu.

Specimens studied. 1 ind., Väana-Jõesuu 59.4291°N, 24.3513°E, 28.VIII.1950, occasional finding, G. Reindorff leg. (loc. 30; TAMZ-0176957); 1 ind., Tartu, 58.3833°N, 26.7166°E, 7.II.1952, J. Tamm leg. (loc. 58; IZBE0310142); 1 ind., Kullamaa, 58.8674°N, 24.0882°E, VIII.1988, occasional finding indoors, K. Sammet leg. (loc. 21; IZBE0310054); 1 ind., Audaku 58.2980°N, 22.0997°E, 11.IV.1993, occasional finding indoors, T. Talvi leg. (loc. 3; TT00031); 1 ind., same loc., 14.IX.1995, occasional finding indoors, T. Talvi leg. (TT00048); 1 ind., Puhtu 58.5541°N, 23.5502°E, 15.IV.1998, occasional finding indoors, L. Saks leg. (loc. 25; TT00001); 1 ind., Audaku 58.2980°N, 22.0997°E, 2.IV.2001, occasional finding indoors, T. Talvi leg. (loc. 3; TT00033); 1 ind., same loc., 22.V.2002, occasional finding indoors, T. Talvi leg. (TT00049); 1 ind., same loc., 11.III.2003, occasional finding indoors, T. Talvi leg. (TT00040); 1 ind., Püünsi 59.5450°N, 24.7955°E, 15.VI.2004, light trap, A. Selin leg. (loc. 31; AA0000010); 1 ind. Audaku 58.2980°N, 22.0997°E, 18.VI.2004, occasional finding indoors, T. Talvi leg. (loc. 3; TT00032); 1 ind., same loc., 23.II.2005, occasional finding indoors, T. Talvi leg. (TT00030); 1 ind., same loc., 13.IX.2010, occasional finding indoors, T. Talvi

leg. (TT00051); 1 ind., same loc., 10.IX.2011, occasional finding indoors, T. Talvi leg. (TT00054); 1 ind., same loc. 20.III.2012, occasional finding indoors, T. Talvi leg. (TT00055); 1 ind., Ignase 58.2500°N 26.8333°E, 25.X.2015, litter and straw from an unused barn, Tullgren funnel, M. Kruus leg. (loc. 60; IZBE0310127); 1 ind., Tartu 58.3926°N, 26.6941°E, 16.IV.2015, occasional finding indoors, T. Kesküla, leg. (loc. 58; IZBE0310143).

Distribution. A widespread synanthropic species, present also in Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

**Mesochelifer resslii* Mahnert, 1981

Specimens studied. 1 ind., Saue 59.3166°N, 24.5500°E, 22.–28.IV.2000, oak forest, light trap, M. Kruus leg. (loc. 34; TAMZ0175867); 1 ind., Kihnu island 58.1352°N, 23.9722°E, 6.VIII.–13.IX.2011, TWT, I. Süda leg. (loc. 19; IZBE0310077).

Distribution. Known from Central Europe (including Poland, Jędrzykowski 1985, Harvey 2013a) and Kazakhstan (Harvey 2013b).

3.1.5 *Chernetidae*

**Allochernes wideri* (C. L. Koch, 1843)

Specimens studied. 2 ind., Loode 58.2377°N, 22.4388°E, 10.XI.2005 from a hollow old oak, T. Talvi leg. (loc. 8; TT00029); 1 ind., Koivakonnu 57.5916°N 26.3191°E, 14.V.–3.VI.2013, TWT, I. Süda leg. (loc. 63; IZBE0310111); 1 ind., Vaitka 57.6850°N 26.2041°E, 17.VII.–1.VIII.2013, TWT, I. Süda leg. (loc. 62; IZBE0310100).

Distribution. Widespread in Europe, present also in Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

**Chernes cimicoides* (Fabricius, 1793)

Specimens studied. 2 ind., Obinita, 57.8157°N, 27.4441°E, 3.VII.1981, occasional finding under the bark of a Scots pine stump, I. Süda leg. (loc. 65; IZBE0310152); 1 ind., Nigula N. Reserve 58.0191°N, 24.6794°E, 3.VI.1995, occasional finding, O. Kurina leg. (loc. 44; IZBE0310055); 1 ind., Kükita, [Märjamaa vald]

58°47'N, 24°33'E, 07.I.1998, from an ant-nest, U. Roosileht leg. (loc. 36; TAMZ0004387); 1 ind., Viidumäe 58.3169°N, 22.0925°E, 15.VI.2001, under the bark of a dead maple-tree, I. Süda leg. (loc. 2; TT00056); 2 ind., Riimaru 58.2716°N, 25.1838°E, 11.–29.VI.2005, TWT, I. Süda leg. (loc. 42; IZBE0310089); 1 ind., Riimaru 58.2719°N, 25.1798°E 11.–29.VI.2005, TWT, I. Süda leg. (loc. 42; IZBE0310011); 9 ind., Riimaru 58.2719°N, 25.1798°E, 11.–29.VI.2005, TWT, I. Süda leg. (loc. 42; IZBE0310078); 4 ind., Riimaru 58.2716°N, 25.1838°E, 29.VI.–13.VII.2005, TWT, I. Süda leg. (loc. 42; IZBE0310079); 2 ind., Riimaru, 58.2719°N, 25.1798°E, 29.VI.–13.VII.2005, TWT, I. Süda leg. (loc. 42; IZBE0310084); 1 and 1 ind., Riimaru 58.2719°N, 25.1798°E, 13.VII.–3.VIII.2005, TWT, I. Süda leg. (loc. 42; IZBE0310002 and IZBE0310081); 2 ind., Riimaru, 58.2716°N, 25.1838°E, 13.VII.–3.VIII.2005, TWT, I. Süda leg. (loc. 42; IZBE0310080); 1 ind., Riimaru 58.2716°N, 25.1838°E, 3.–17.VIII.2005, TWT, I. Süda leg. (loc. 42; IZBE0310085); 1 ind., Riimaru 58.2719°N, 25.1798°E, 17.–31.VIII.2005, TWT, I. Süda leg. (loc. 42; IZBE0310001); 12 ind., Riimaru 58.2719°N, 25.1798°E, 2.VI.–1.VII.2006, TWT, I. Süda leg. (loc. 42; IZBE0310109); 1 ind., Riimaru 58.2716°N, 25.1838°E, 31.VII.–2.IX.2006, TWT, I. Süda leg. (loc. 42; IZBE0310107); 2 ind., Riimaru 58.2719°N, 25.1798°E, 31.VII.–2.IX.2006, TWT, I. Süda leg. (loc. 42; IZBE0310108); 1 ind., Riimaru 58.2716°N, 25.1838°E, 19.VI.–3.VIII.2007, TWT, I. Süda leg. (loc. 42; IZBE0310090); 1 ind., Jõesuu 58.4311°N, 25.0422°E, 25.V.–8.VI.2009, Malaise trap, A. Martsoo leg. (loc. 41; IZBE0310121); 1 ind., Kunila 58.6308°N, 23.8106°E, 31.VII.–14.VIII.2009, Malaise trap, R. Nikkel leg. (loc. 24; IZBE0310123); 4 ind., Jõesuu 58.4311°N, 25.0422°E, 3.–18.VIII.2009, Malaise trap, A. Martsoo leg. (loc. 41; IZBE0310122); 1 ind., Matsalu 58.7310°N, 23.7149°E 11.VII.–14.VIII.2009, TWT, I. Süda leg. (loc. 22; IZBE0310004); 1 ind., Ruhnu 57.7994°N, 23.2702°E, 24.V.–27.VI.2011, TWT, I. Süda leg. (loc. 18; IZBE0310095); 1 ind., Ruhnu 57.8066°N, 23.2266°E, 25.V.–28.VI.2011, TWT, I. Süda leg. (loc. 18; IZBE0310082); 1 ind., Ruhnu 57.7994°N, 23.2702°E, 27.VI.–

2.VIII.2011, TWT, I. Süda leg. (loc. 18; IZBE0310091); 1 ind., Kärre 58.9697°N, 23.2058°E, 8.V.–4.VI.2012, TWT, I. Süda leg. (loc. 14; IZBE0310076); 1 ind., Hullo 59.0044°N, 23.2302°E, 10.V.–4.VI.2012, TWT, I. Süda leg. (loc. 14; IZBE0310065); 1 ind., Borrby 59.0227°N, 23.2033°E, 4.VI.–6.VII.2012, TWT, I. Süda leg. (loc. 14; IZBE0310073); 1 ind., Saxby 59.0222°N, 23.1369°E, 7.VI.–3.VIII.2012, TWT, I. Süda leg. (loc. 14; IZBE0310007); 8 ind., Ruhnu 57.8025°N, 23.2413°E, 7.VI.–10.VII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310062); 1 ind., Ruhnu 57.8025°N, 23.2402°E, 7.VI.–10.VII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310067); 3 ind., Ruhnu 57.8075°N, 23.2422°E, 9.VI.–10.VII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310072); 1 ind., Vaitka 57.6833°N, 26.2000°E, 9.VI.–1.VII.2012, window trap, U. Roosileht leg. (loc. 62; TAMZ0004386); 4 ind., Kihnu 58.1163°N, 23.9938°E, 11.VI.–12.VII.2012, TWT, I. Süda leg. (loc. 19; IZBE0310068); 8 ind., Ruhnu 57.8055°N, 23.2583°E, 8.VI.–9.VII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310060); 3 ind., Ruhnu 57.8025°N, 23.2402°E, 10.VII.–7.VIII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310066); 1 ind., Ruhnu 57.8025°N, 23.2413°E, 10.VII.–7.VIII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310070); 1 ind., Ruhnu 57.8075°N, 23.2422°E, 10.VII.–7.VIII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310075); 1 ind., Huitberg 59.0047°N, 23.1827°E, 3.VIII.–1.IX.2012, TWT, I. Süda leg. (loc. 14; IZBE0310136); 1 ind., Ruhnu 57.8055°N, 23.2583°E, 6.VIII.–4.IX.2012, TWT, I. Süda leg. (loc. 18; IZBE0310074); 5 ind., Vaitka 57.6847°N, 26.2052°E, 14.V.–3.VI.2013, TWT, I. Süda leg. (loc. 62; IZBE0310092); 1 ind., Vaitka 57.6850°N, 26.2041°E, 14.V.–3.VI.2013, TWT, I. Süda leg. (loc. 62; IZBE0310103); 3 ind., Vaitka 57.6847°N, 26.2052°E, 3.VI.–16.VI.2013, TWT, I. Süda leg. (loc. 62; IZBE0310098); 1 ind., Padakörve 58.5986°N, 26.9875°E, 3.VI.–16.VI.2013, TWT, I. Süda leg. (loc. 56; IZBE0310087); 1 ind., Mõisamõtsa 57.5727°N, 26.6413°E, 1.–15.VI.2013, TWT, I. Süda leg. (loc. 64; IZBE0310010); 2 ind., Mõisamõtsa 57.5730°N, 26.6402°E, 16.VI.–2.VII.2013, TWT, I. Süda leg. (loc. 64; IZBE0310083); 1

ind., Vaitka 57.6847°N, 26.2052°E, 16.VI.–2.VII.2013, TWT, I. Süda leg. (loc. 62; IZBE0310099); 1 ind., Vaitka, 57.6847°N, 26.2052°E, 16.VI.–2.VII.2013, TWT, I. Süda leg. (loc. 62; IZBE0310003); 1 ind., Vaitka 57.6850°N, 26.2041°E, 16.VI.–2.VII.2013, TWT, I. Süda leg. (loc. 62; IZBE0310102); 1 ind., Koivakonnu 57.5911°N, 26.3225°E, 17.VII.–1.VIII.2013, TWT, I. Süda leg. (loc. 63; IZBE0310005); 1 ind., Saarljõe 58.6427°N, 25.3063°E, 18.VII.–2.VIII.2013, TWT, I. Süda leg. (loc. 39; IZBE0310115); 1 ind., Vaitka 57.6847°N, 26.2052°E, 17.VII.–1.VIII.2013, TWT, I. Süda leg. (loc. 62; IZBE0310101); 1 ind., Piusa 57.8333°N, 27.4833°E, 27.VII.2013, under Scots pine bark, U. Roosileht leg. (loc. 66; TAMZ0004385); 2 ind., Vaitka 57.6850°N, 26.2041°E, 1.VIII.–17.VIII.2013, TWT, I. Süda leg. (loc. 62; IZBE0310094); 1 ind., Vaitka 57.6847°N, 26.2052°E, 17.VIII.–1.IX.2013, TWT, I. Süda leg. (loc. 62; IZBE0310097); 1 ind., Koiva wooded meadow 57.6886°N, 26.1830°E, 17.VIII.–1.IX.2013, TWT, I. Süda leg. (loc. 62; IZBE0310006); 1 ind., Mõisamõtsa 57.5730°N, 26.6402°E, 17.VIII.–1.IX.2013, TWT, I. Süda leg. (loc. 64; IZBE0310086); 1 ind., Soontaga 58.0066°N 26.0553°E, 29.V.–13.VI.2015, TWT I. Süda leg. (loc. 46; IZBE0310148); 1 ind., same loc. 29.VI.–14.VII.2015, TWT I. Süda leg. (IZBE0310149); 1 ind., same loc., 28.VII.–13.VIII.2015, TWT I. Süda leg. (IZBE0310146).

Distribution. Widespread in Eurasia, present also in Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

**Dendrochernes cyrneus* (L. Koch, 1873)

Specimens studied. 1 ind., Riimaru 58.2716°N, 25.1838°E, 13.VI.2005, TWT, I. Süda leg. (loc. 41; IZBE0310113); 1 ind., Välgi 58.5666°N, 26.8833°E, 4.V.–15.VI.2014, mixed forest, window trap, U. Roosileht leg. (loc. 56; TAMZ0175861); 2 ind., Soontaga 58.0066°N, 26.0553°E, 29.V.–13.VI.2015, TWT, I. Süda leg. (loc. 46; IZBE0310147); 1 ind., same loc. 13.–29.VI.2015, TWT, I. Süda leg. (IZBE0310144); 1 ind., same loc., 29.VI.–14.VII.2015, TWT I. Süda leg. (IZBE0310150); 1 ind., same loc. 28.VII.–13.VIII.2015, TWT, I. Süda leg. (IZBE-

0310145); 1 ind., same loc. 13.VIII.–31.VIII.2015, TWT I. Süda leg. (IZBE0310151).

Distribution. Widespread in Europe, including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

**Dinocheirus panzeri* (C. L. Koch, 1837)

Specimens studied. 1 ind., Matsalu 58.7144°N, 23.6896°E, 11.VII.–14.VIII.2011, TWT, I. Süda leg. (loc. 22; IZBE0310110); 1 ind., Ruhnu 57.7994°N, 23.2702°E, 24.V.–27.VI.2011, TWT, I. Süda leg. (loc. 18; IZBE0310096); 1 ind., Vormsi, Suuremõisa 58.9916°N, 23.1927°E, 6.VI.–3.VIII.2012, TWT, I. Süda leg. (loc. 14; IZBE0310064); 1 and 1 ind., Vaitka 57.6847°N, 26.2052°E, 14.V.–3.VI.2013, TWT, I. Süda leg. (loc. 62; IZBE0310093 and IZBE0310104); 2 ind., Koivakonnu 57.5916°N, 26.3191°E, 3.VI.–2.VII.2013, pitfall trap, I. Süda leg. (loc. 63; IZBE0310105); 1 ind., Padakõrve N. Reserve 58.5986°N, 26.9875°E, 15.–31.VII.2013, TWT, I. Süda leg. (loc. 56; IZBE0310088); 1 ind., near Tõrva 57.9900°N, 25.9663°E, 21.VI.2014, occasional finding in a grain dryer, I. Süda leg. (loc. 45; IZBE0310120); 3 ind., same loc. 7.VII.2014, occasional finding in a grain dryer, I. Süda leg. (IZBE0310117).

Distribution. Widespread in Europe, including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

**Lamprochernes chyeri* (Tömösváry, 1882)

Specimens studied. 1 ind., Kihnu 58.1163°N, 23.9938°E, 11.VI.–12.VII.2012, TWT, I. Süda leg. (loc. 19; IZBE0310069); 1 ind., Ruhnu 57.8050°N, 23.2408°E, 10.VII.–7.VIII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310063); 1 ind. near Tõrva 57.9900°N, 25.9663°E, 7.VII.2014, occasional finding in a grain dryer, I. Süda leg. (loc. 45; IZBE0310116).

Distribution. Widespread in Europe, including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

Lamprochernes nodosus (Schrank, 1803)

Estonian sources. Talvi 2010: 130, from Puhtu.

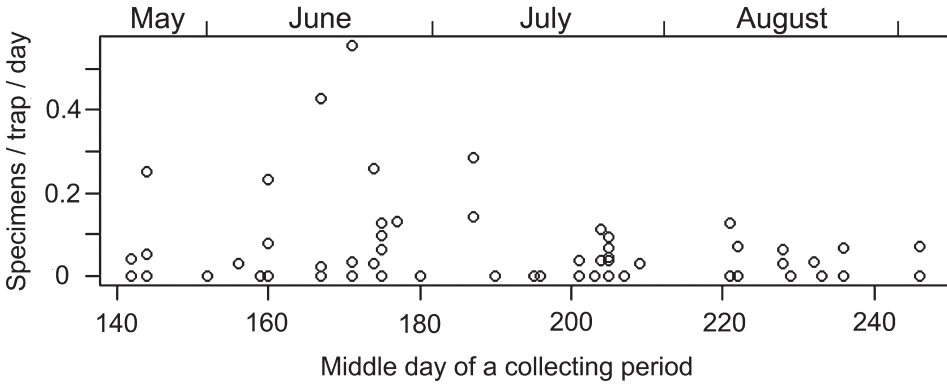


Fig. 6. Seasonal dynamics of *Chernes cimicoides* in all window traps over all years. Horizontal axis represents sequential numbers of days within a year.

Specimens studied. 1 ind., Puhtu 58.5500°N, 23.5500°E, 11.VI.1997, litter sifting, K. Olt leg. (loc. 25; TT00009); 1 ind., Audru 58.4147°N, 24.3332°E, 10.VIII.2008, J. Volkman leg. (loc. 29; JVO).

Distribution. Widespread in Eurasia, including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), and Poland (Rafalski 1967).

**Pselaphochernes dubius* (O. P.-Cambridge, 1892)

Specimens studied. 1 ind., Viidumäe 58.3091°N, 22.0761°E, 10.VIII.1996, deciduous forest litter sifting, T. Talvi leg. (loc. 3; TT00044); 1 ind., Mõisamõtsa 57.5730°N, 26.6402°E, 2.VII.–17.VII.2013, TWT, I. Süda leg. (loc. 64; IZBE0310112).

Distribution. Widespread in Europe, including Finland (Kaisila 1949) and Sweden (Gärdenfors & Wilander 1992).

**Pselaphochernes scorpioides* (Hermann, 1804)

Specimens studied. 1 ind., Maardu 59.4703°N, 24.9436°E, 1.X.2001, litter sifting, A. Selin leg. (loc. 33; AS0000009); 1 ind., Melliste 58.3288°N, 26.9402°E, 29.V.–12.VI.2011, Malaise trap, O. Kurina leg. (loc. 59; IZBE0310135); 1 ind., Tõstamaa 58.3362°N, 24.0065°E, 20.VI.–4.VII.2011, Malaise trap, E. Liiv leg. (loc. 27; IZBE0310119); 1 ind., Kihnu 58.1216°N, 23.9736°E, 23.V.–11.VI.2012, TWT, I. Süda leg. (loc. 19; IZBE0310071); 1 ind., Kihnu 58.1302°N, 24.0041°E, 12.VII.–9.VIII.2012, TWT, I. Süda leg. (loc. 19; IZBE0310008); 1

ind., Ruhnu 57.8055°N, 23.2583°E, 8.VI.–9.VII.2012, TWT, I. Süda leg. (loc. 18; IZBE0310061); 1 ind., Koivakonnun 57.8055°N, 23.2583°E, 14.V.–3.VI.2013 TWT, I. Süda leg. (loc. 63; IZBE0310106).

Distribution. Widespread in Eurasia, including Finland (Kaisila 1949), Sweden (Gärdenfors & Wilander 1992), Latvia (Tumšs 1934) and Poland (Rafalski 1967).

3.2. Notes on species diversity and ecology

The main focus of the present paper is on faunistics, but some ecological observations on the more common species were also made.

Neobisium carcinoides was the most common ground-living species in various biotopes, including different types of forests. The quantitative sampling of forest snails (Mänd et al. 2002) allowed us to collect some data on densities of pseudoscorpions in particular homogeneous forest habitats as well. The mean densities of *N. carcinoides* in the two sampled dry boreal pine forests in Western Estonia were 6.8 ± 2.8 SD individuals per 1 m² (range 0–48). In three sampled fresh boreo-nemoral deciduous forests in the same region the density was lower, 3.2 ± 1.6 SD ind./m² (range 0–32). All our density estimations are based on data obtained by hand-sorting which tends to underestimate the true densities (see e. g. Huhta et al. 1986). However, comparing our results with data from elsewhere, the density of *N. carcinoides* in coniferous forest litter was close to

that found in other European localities (Palmgren 1973, Christophoryová & Krumpál 2005, Tamutis 2011).

The most common (probably phoretic) species in flight intercept traps was *Ch. cimicoides*. Its average frequency in TWTs was 0.0303 specimens per trap per trapping day. Its incidence in traps was the highest in May and June, with a gradual decline from the first half of July (Fig. 6). Females with brood sacs were found during the trapping periods extending from 3.IV to 9.VII. The species was also found on tree trunks and from ant nests.

The phoretic behaviour of *L. chyzeri* is not considered common (Christophoryová *et al.* 2011), but several specimens were found in TWTs in our study.

Some species were clearly associated with particular habitats. *Chthonius tetrachelatus* was found only in seashore debris where it was locally quite abundant, *M. brevifemuratum* was found in fens and bogs and *Ch. museorum* and *Ch. cancroides* were found only in human settlements. The habitat preferences of those species in Estonia are thus in good agreement with those known from other parts of Northern and Central Europe (e. g. Tumšs 1934, Kaisila 1949, Meinertz 1962, Beier 1963, Legg & Jones 1988, Gärdenfors & Wilander 1992, Stol 2005).

4. Discussion

Although the use of flight intercept traps in broad sense is not widespread in pseudoscorpion research (Krajčovičová & Christophoryová 2014), the trunk window traps proved quite useful in our study as a means to catch phoretic species. Comparing the methods used, TWTs were two orders of magnitude more efficient (producing 8 species with a mean incidence of 0.0563 specimens per trap per trapping day) than Malaise traps (producing 2 species with a mean incidence of 0.00063 specimens per trap per trapping day).

Our findings of *M. ressli* from two sites in Estonia are the northernmost known, but its true range is presently unclear as it was described quite recently and has probably been earlier misidentified as *Ch. cancroides* in many cases (Mahnert 1981). It is possible that some species

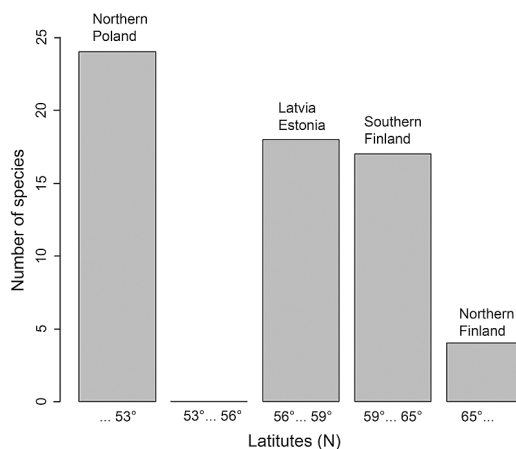


Fig. 7. Known latitudinal gradient of the number of pseudoscorpion species in Eastern Baltic region. Vertical axis represents the number of species; horizontal axis represents latitudes (N).

present in Estonia still remain unrecorded as the findings of *Larca lata* (Hansen, 1884), *Anthrenochernes stellae* (Lohmander, 1939) and *Chernes hahnii* (C. L. Koch, 1839) in Latvia (Jansson & Hultengren 2002, Telnov & Salmane 2015) show that the Central European species ranges reach further north in the Baltic region than previously known. The occurrences of *Dactylochelifer latreillii* (Leach 1817) and *Microbisium suecicum* Lohmander, 1945, present in Finland, Sweden and Poland, are not impossible also in Estonia. A preliminary comparison of the known Estonian fauna with the published records from Latvia, Sweden and Finland indicates the highest similarity to the Finnish fauna with Sørensen similarities 0.666, 0.722 and 0.875, respectively. We presume that the relatively low similarity to the Latvian fauna results from the currently incomplete knowledge of the faunas of both countries. A rough estimate of the latitudinal gradient in numbers of species in the Baltic region might be deduced using the combined Estonian and Latvian species lists (Fig. 7; the number of species in Finland north of 65 °N based on Kaisila (1949) and Lehtinen (1964) and the number of species in Northern Poland on Rafalski (1967) and Jędrzykowski (1985)).

In the key of Nordic pseudoscorpions, I. Stol presented approximate distribution maps of the treated species (Stol 2005). We would like to point out a few misinterpretations there, namely

the occurrences of *Neobisium (N.) sylvaticum* (C. L. Koch, 1835) and *Dactylochelifer latreillii* (Leach, 1817) in both Estonia and Latvia, whereas to our knowledge no records exist from this region. Moreover, the occurrence of *Apocheiridium (A.) ferum* (Simon, 1879) in Estonia and Finland instead of *A. (A.) rossicum* (Stol 2005, 2006: referred to as F. E. Klausen pers. comm.) is somewhat confusing. Both species are considered to be valid (e. g. Harvey 2013b, V. Mahnert pers. comm.) and Estonia is one of the type localities of *A. (A.) rossicum* (see Redikorzev 1935: 184). In addition, there are several older and recent specimens in collections from Finland that entirely correspond to the original description (V. Rinne & A. Uddström, pers. comm.). The seemingly incorrect information on occurrence in Estonia of *A. (A.) ferum*, a widespread European species, has been followed also by subsequent authors (e. g. Harvey 2015).

The present study makes the data of Estonian pseudoscorpions comparable with those from the neighbouring countries but it also serves as a basis for further more thorough investigations. More studies are needed to detect the possible additional species and to reveal the distribution patterns and ecology of the known species.

Acknowledgements. We wish to thank Dr. Volker Mahnert (Geneva) for advice and verifications of some identifications. Thanks are also due to Uno Roosileht (Tallinn), Aare Lindt (Tallinn), Allan Selin (Viimsi), Tõnu Kesküla (Tartu), Veikko Rinne (Turku), Annikka Uddström (Helsinki), Jaak Volkman (Audru), Märt Kruus (Tartu), Tiina Talvi (Viidumäe) and Evelin Silgo (Tartu), and two anonymous reviewers who helped to complete the present study in various ways. The study was partly funded by institutional research funding (IUT21-1) of the Estonian Ministry of Education and Research.

References

Abarenkov, K., Tedersoo, L., Nilsson, R. H., Vellak, K., Saar, I., Veldre, V., Parmasto, E., Proux, M., Aan, A., Ots, M., Kurina, O., Ostonen, I., Jõgeva, J., Halapuu, S., Põldmaa, K., Toots, M., Truu, J., Larsson, K. & Kõljalg, U. 2010: PlutoF – a Web Based Workbench for Ecological and Taxonomic Research, with an Online Implementation for Fungal ITS Sequences. — *Evolutionary Bioinformatics* 6: 189–196.

Aru, L. 1968: Ebaskorpionilistest. — *Eesti Loodus* 19(10): 607–608 [in Estonian.]

Backlund, H. O. 1945: Wrack fauna of Sweden and Finland. Ecology and chorology — *Opuscula Entomologica Supplementum* 1945, Lund. 236 pp.

Beier, M. 1963: Ordnung Pseudoscorpionidea (Afterscorpione). Bestimmungsbücher zur Bodenfauna Europas, vol. 1. — Akademie-Verlag, Berlin. 313 pp.

Christophoryová, J. & Krumpál, M. 2005: Communities of pseudoscorpions (Pseudoscorpiones, Arachnida) in epigeon of oak-hornbeam forests in the Malé Karpaty Mts and Trnavská pahorkatina hills (SW Slovakia). — *Ekológia (Bratislava)* 24: 76–86.

Christophoryová, J., Šťáhlavský, F. & Fedor, P. 2011: An updated identification key to the pseudoscorpions (Arachnida: Pseudoscorpiones) of the Czech Republic and Slovakia. — *Zootaxa* 2876(2876): 35–48.

Christophoryová, J., Stloukal, E. & Stloukalová, V. 2011: First record of phoresy of pseudoscorpion *Lamprochernes chyzeri* in Slovakia (Pseudoscorpiones: Chernetidae). — *Folia Faunistica Slovaca* 16(3): 139–142.

Dashdamirov, S. & Schawaller, W. 1993 Pseudoscorpions from Middle Asia, Part 3 (Arachnida: Pseudoscorpiones). — *Stuttgarter Beiträge zur Naturkunde Serie A* 497: 1–16.

Fischer, J. B. 1791: Versuch einer Naturgeschichte von Livland. — Friedrich Nicolovius, Königsberg. 826 pp.

Gärdenfors, U. & Wilander, P. 1992: Sveriges klokrypare med nyckel till arterna. — *Entomologisk Tidskrift* 113: 20–35.

Grube, A. E. 1859: Verzeichniss der Arachnoiden Liv-, Kur- und Ehstlands. — *Archiv für die Naturkunde Liv-, Ehst- und Kurlands* 2(1): 417–486.

Harvey, M. S. 2013a: Order Pseudoscorpiones de Geer, 1778. — In: Zhang, Z.-Q. (ed.), *Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness* (Addenda 2013). — *Zootaxa* 3703: 1–82.

Harvey, M. S. 2013b: Pseudoscorpions of the World, version 3.0. Western Australian Museum, Perth. — [www document]. URL <http://www.museum.wa.gov.au/catalogues/pseudoscorpions> (Site visited on 7 October, 2015).

Harvey, M. S. 2015: Fauna Europaea: Pseudoscorpiones Fauna Europaea version 2.6. — [www document]. URL <http://www.fauna-eu.org> (Site visited on 1 January, 2016).

Huhta, V., Hyvönen, R., Kaasalainen, P., Koskenniemi, A., Muona, J., Mäkelä, I., Sulander, M. & Vilkkamaa, P. 1986: Soil fauna of Finnish coniferous forests. — *Annales Zoologici Fennici* 23: 345–360.

Jansson, N. & Hultengren, S. 2002: Oaks, lichens and beetles on Moricsala Island in Latvia – an ecological approach. — *Miljövärdsheten Länsstyrelsen i Östergötland Rapport 2002-2*: 1–42.

Jędrzykowski, W. 1985: Pseudoscorpions (Pseudoscorpiones) of Mazovia. — *Fragmenta Faunistica* 29(5): 77–83. [In Polish.]

Kaisila, J. 1949: A revision of the pseudoscorpion fauna of Eastern Fennoscandia. — *Annales Entomologici Fennici* 15(2): 72–92.

Krajčovičová, K. & Christophoryová, J. 2014: Faunistic

- survey of pseudoscorpions collected from trees and using Malaise traps in Slovakia and the Czech Republic. — *Klapalekiana* 50: 167–180.
- Legg, G. & Jones, R. E. 1988: Pseudoscorpions (Arthropoda, Arachnida): Keys and notes for the identification of the species. — *Synopses British Fauna*, (new ser.) 40. 159 pp.
- Lehtinen, P. T. 1964: The Phalangids and Pseudoscorpionids of Finnish Lappland — *Annales Universitatis Turkuensis A, II* (Reports from Kevo Subarctic station) 1: 279–287.
- Mahnert, V. 1981: *Mesochelifer resslii* n. sp., eine mit *Chelifer cancroides* (L.) verwechselte Art aus Mitteleuropa (Pseudoscorpiones, Cheliferidae). — *Veröffentlichungen des Tiroler Landesmuseums Ferdinandeum* 61: 47–53.
- Mänd, R., Talvi, T., Ehlvest, A. & Kiristaja, P. 2002: Land snails in Estonian forests: numbers and species richness. — *Proceedings of the Estonian Academy of Sciences. Biology* 51: 204–216.
- Meinertz, N. T. 1962: Mosskorpioner og mejere. — *Danmarks Fauna* No. 67. 193 pp. [In Danish.]
- Palmgren, P. 1973: Über die Biotopverteilung waldbodenlebender Pseudoscorpionidea (Arachnoidea) in Finnland und Österreich. — *Commentationes Biologicae* 61: 1–11.
- R Development Core Team 2014: R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. — [www document]. URL <http://www.R-project.org>.
- Rafalski, J. 1967: Zaleszczotki. Pseudoscorpionidea. — *Katalog Fauny Polski* 32(1): 1–34. Państwowe Wydawnictwo Naukowe, Warszawa. [In Polish.]
- Redikorzev, V. 1935: *Apocheiridium rossicum* sp. n. — *Comptes Rendus de l'Académie des Sciences de l'URSS* n. s. 1: 184–186. [In Russian.]
- Remm, K. 1988: Mesofauna of the Moss Layer of the Koljaku-Oandu Nature Reserve in the Second Half of Summer — *Lahemaa Uurimused* 3: 120–141. [In Estonian.]
- Stol, I. 2005: Bestimmelsestabell over de Norske og Nordiske Mosskorpioner (Pseudoscorpiones). — *Norsk Entomologisk Forening* 18: 1–35. [In Norwegian.]
- Stol, I. 2006: Checklist of Nordic Pseudoscorpiones. — *Norwegian Journal of Entomology* 53: 85–87.
- Süda, I. 2009: New woodland beetle species (Coleoptera) in Estonian fauna. — *Forestry Studies* 50: 98–114.
- Talvi, T. 2010: Pseudoscorpions (Arachnida: Pseudoscorpiones) of the Puutu Island, Estonia. — *Estonia Maritima* 8: 127–132. [In Estonian.]
- Tamutis, V. 2011: The Pseudoscorpion *Neobisium carcinoides* (Herman, 1804) (Pseudoscorpiones: Neobissidae) in the litter of native and alien coniferous of Lithuania — 6th International Conference “Research and conservation of Biological Diversity in Baltic Region”, Book of Abstracts, Daugavpils, 28 – 29 April, 2011.
- Telnov, D. & Salmane, I. 2015: Ecology and Diversity of Urban Pine Forest Soil Invertebrates in Rīga, Latvia. — *Proceedings of the Latvian Academy of Sciences Section B* 69(3): 120 – 131.
- Tomasson, K., Tammaru, T. & Kurina, O. 2014: Harvestmen (Arachnida: Opiliones) in Estonia: results of the Estonian Malaise Trap Project. — *Entomologica Fennica* 25(3): 142–156.
- Tumšs, V. 1934: Beitrag zur Kenntnis der Pseudoscorpionen-Fauna Lettlands. — *Folia Zoologica et Hydrobiologica* 7(1): 12–19.
- Uddström A. & Rinne, V. 2014: A pseudoscorpion species new to Finland and an updated checklist (Arachnida: Pseudoscorpiones). — *Arthropoda Selecta* 23(2): 225–226.