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SPECIES LIST AND HABITAT PREFERENCE OF MESOSTIGMATA MITES (ACARI, PARASITIFORMES) IN LATVIA

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ABSTRACT — This paper provides a review of the Mesostigmata mite material collected from 1992 up to 2009 in Latvia in a wide range of habitats: dead wood, Aphyllophorales fungi, forests, meadows, dune habitats, agricultural habitats, bogs, epiphytic mosses, and mites associated with Insecta and Vertebrata. A list of 368 Mesostigmata species of 27 families in Latvia with occurrence in different habitats is provided, which can be used as a future reference. According to occurrence among the habitats, the species are classified as generalist species, habitat specialist species or other species. About half of the species recorded were found to be specialist for a given habitat type. The highest proportion of habitat specialist species was found associated with the Vertebrata habitat. In total 39 species were recorded as generalist species; of them two (*Parasitus kraepelini* and *Eviphis ostrinus*) were recorded in 8 of the 10 habitat types. The highest number of generalist species was recorded in the Parasitidae (11 species), Aceosejidae (7 species) and Laelaptidae (5 species). Variation of the numbers of habitat specialist species within families among respective habitats was observed. Rhodacaridae and Laelaptidae had high number of specialist species in some habitat types. In total 32 rare species were recorded.

KEYWORDS — mites; Mesostigmata ecology; habitat preference; generalists; habitat specialists

INTRODUCTION

Knowledge of species diversity is the key to understanding natural and disturbed ecosystems (Behan-Pelletier and Bissett, 1992), of which soil communities form an important part. Among soil dwelling organisms, mites are the one of the largest and most biologically diverse groups of the arachnids, rivaling insects in the extent to which they have successfully colonized aquatic and terrestrial habitats (Evans, 1992). A wide and variable group of mites is the Mesostigmata (Acari, Parasitiformes), which are important free-living mites involved in ecosystem processes (Koehler, 1999). The original home of mites was probably decaying vegetation and soil, which is where mites still have the highest diversity (Walter and Proctor, 1999). Nevertheless, mites also have high diversity in other habitats.

There exists some literature that has summarized data on the occurrence and habitat ecology of Mesostigmata mites in different habitats of Europe. Several reviews and check-lists have been produced for European Mesostigmata mites (Eitminavichute, 1976, 2003; Heldt, 1995; Mašán, 2003, 2007; Mašán and Fend'a, 2004; Kalúz and Fend'a, 2005; Salmane, Kontschán, 2005, 2006; Kontschán, 2006; Gwiazdowicz, 2007; Fend'a and Kalúz, 2009; Kaczmarek *et al.* 2009 etc.). Notes on Mesostigmata ecology are also available in various determination keys (Evans

et al. 1961; Bregetova, 1977; Krantz, 1978; Hyatt, 1980; Shcherbak, 1980; Karg 1989, 1993; etc.).

The first records on gamasin mites in Latvia were published by professor A.E. Grube (1859) of Tartu University in his work on arachnids of the Baltic region. The 28 mentioned species were free living or parasitic species. The next research was conducted almost a century later by V. Eglitis (1954), who gave short descriptions of 16 Gamasina families found in Latvia, but particularly noted only six species. In the middle of the 20 century a study of parasites of small mammals was made, and 9 parasitic blood sucking Mesostigmata mites (Acari, Parasitiformes) were recorded (Grinbergs, 1959, 1961 a, b, c, d). Predatory Phytoseiidae mites were investigated by Kuzņecov and Petrov (1984), who recorded 34 species of this family. Thirty five Mesostigmata mite species in Latvia were recorded by Kadite in her investigations of Mesostigmata fauna in Baltic Sea coastal habitats (Eitminavichute, 1976).

Previously, the most in-depth work on mites in Latvia was conducted by I. Lapiņa, who summarized her work in a monograph regarding soil Gamasina mites (Lapiņa, 1988). She described the preference of those mites to some habitat types (forests, meadows, agricultural lands) and small mammals. However, not all habitat types were covered, such as coastal dunes, bracket fungi or wood related habitats. Also, non-soil microhabitats were not investigated. In Latvia and also in Europe, there is insufficient information on the habitat preferences of Mesotigmata mite species, particularly regarding division into habitat specialist and generalist species. The current paper provides a review of Mesostigmata mites in Latvia, and produces a species list with habitat preferences.

MATERIAL AND METHODS

Collected material

Mites were collecterd from 1992 to 2009. Investigation sites were located throughout Latvia in diverse habitats. Qualitative soil and litter samples were taken by soil corer of various diameters or by spade. The number of samples varied among sites. Total number of samples was approximately 10,000. Samples of moss, wood, bark and Aphyllophorales fungi (total about 2,000) were collected by hand. In some cases mites from higher plants were collected by hand, placed in the plastic bags and brought to the laboratory. In the other cases vegetation was collected together with soil or litter and extracted on funnels. Mites from the sampled substrates were extracted using modified Tullgren funnels for a period of 14 days under 25-Watt bulbs. In addition, mites were collected from beetles and other invertebrates caught by hands or by entomological net, and placed in 70% ethyl alcohol and brought to the laboratory.

Mesostigmata mites were attached to insects on various locations on the whole insect bodies, but mostly on ventral side or legs. Mites were collected from insects and mammals with a piece of cotton wool soaked with ethylacetate or small brush with 70% ethyl alcohol. The collected mites were preserved in 70% ethyl alcohol. The mite specimens were mounted on permanent microscopic slides using Fora-Berlese media and species identified microscopically. Species were determined using identification keys of Arutunjan (1977), Begljarov (1981), Bregetova (1977), Hutu, Calugar (2002), Karg (1989, 1993), Kuzņetzov, Petrov (1984), Mašán (1998), and Shcherbak (1980).

A part of the materials reviewed here have been reported in previous publications by the author: (Melecis *et al.* 1995; Salmane, 1996, 1999, 2000 a, b, 2001 a, b, 2003, 2005a,b, 2006, 2007a,b, 2009; Pauliņa and Salmane, 1999; Salmane *et al.* 1999; Salmane and Heldt, 2001; Salmane and Petrova, 2002; Petrova *et al.* 2004; Kontschán and Salmane, 2005, 2008; Salmane and Meiere, 2005; Jaunbauere *et al.* 2008; Salmane and Brumelis, 2008; Salmane and Spunģis, 2008; Salmane and Telnov, 2009). However, the data collected has not been examined from the viewpoint of habitat preferences and a complete checklist is still lacking.

TABLE 1: Division of species by number of habitats in which recorded.

Number of habitats	Number of species
1	166
2	76
3	59
4	28
5	15
6	12
7	11
8	2
9	0
10	0

The collections were classified according to the following habitats: 1) wood and bark of living and dead trees, 2) Aphyllophorales fungi, 3) forests (soil, litter, understorey mosses and higher plants of coniferous, mixed, deciduous forests), 4) meadows (soil, mosses, higher plants of inland and coastal meadows), 5) dune habitats (soil, mosses, higher plants of embryonal, white, and grey dunes, washed ashore material on beach), 6) agricultural habitats (soil, mosses, higher plants of fields, gardens, parks etc.), 7) bogs (soil, mosses, higher plants), 8) Insecta (mainly Coleoptera, as well as Hymenoptera), 9) Vertebrata (bats, rodents, other small mammals), 10) epiphytic moss (including also epiphythic mosses on stones). A habitat can be defined as a part of biosphere where a certain species can live, temporarily or permanently (Krebs, 2001). In this study, habitats were defined as the part of the biosphere where a mite species tends to be found, i.e. collected.

A particular species can live in a specific microhabit, for example, dead wood, that is a part of a larger habitat (forest). We attempted to, as far as possible, divide larger habitats into smaller components (microhabitats). The forest, dune, meadow, agricultural and bog habitats contain both soil and plant components/habitats, and mites might be specialized to soil, or vegetation or both. Thus, a species might live in a general forest habitat, and another in a forest soil habitat. However, in practice, it was difficult to distinguish between preference to soil and plant compartments, as collected samples often contained both soil and plants, and these components were considered together. On the other hand, mites associated with Vertebrata, Insecta, wood and epiphytes could be collected separate from those in other substrates, and were considered as separate habitats (sensu Krebs, 2001).

Habitat specialist species were defined as those recorded in one habitat type only, generalist species as those found in five or more habitat types. Of the other species not fitting either of these definitions, rare species were defined as those with very low abundance (less than 10 specimens).

Statistical analysis

Furthest neighbour cluster analysis hierarchies were derived for habitats. The Sorensen similarity index was calculated for habitats based on presence-absence data.

RESULTS

A total of 368 Mesostigmata species of 27 families in 10 habitat types were recorded. Of these, about a half was found only in one habitat type (Table 1). No species were found in ten and in nine of the habitats, and only two species - *Eviphis ostrinus*, *Parasitus kraepelini* - in eight habitat types. A total of 39 were defined as generalist species found in five or more habitats. The highest numbers of species were recorded for Rhodacaridae (55 species), Laelaptidae (55), Aceosejidae (51), and Parasitidae (46).

Cluster analysis (Figure 1) showed the closest similarity between mites of meadows and dune habitats, and between wood habitats and bracket fungi. The latter is not surprising, as bracket fungi are also associated with wood. Bog mite communities differed from the other habitats (Figure 1), probably because they had a low total number of species and also habitat specialist species (Table 2). The highest number of species was recorded in forests, but of these only about one fifth was habitat specialist species.

In general, excepting the Insecta and Vertebrata habitats, more species were classified as generalists compared to habitat specialist species. The

mite communities associated with mammals differed widely from the other habitats (Figure 1), as the mites found there were generally not found in other habitats (Table 2). A large proportion (35 of 44) of habitat specialist species has been recorded on mammals. Same pattern is also true for the species associated with insects, as 15 of 41 were habitat specialist species (Table 2).

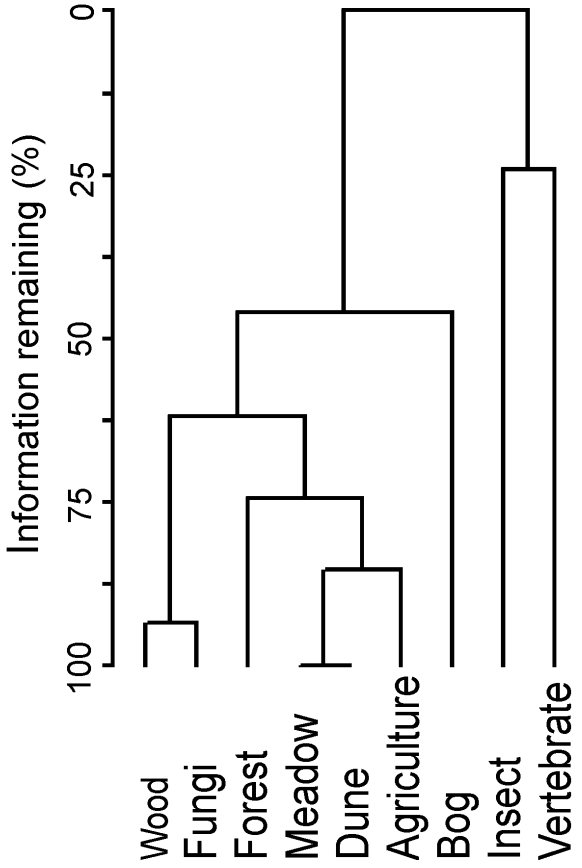


FIGURE 1: Similarity of habitats in occurrence of Mesostigmata species.

DISCUSSION

Lapiņa (1988) in her ecological investigations of Gamasina mites in Latvia mentioned 242 species. In accordance with her published data, the most numerous families were Laelaptidae (43 species), Parasitidae (31), Phytoseiidae (30), and Aceosejidae (19), which greatly differs from our summarized information 20 years later. The most diverse families observed in our work were, in descending order, Rhodacaridae, Laelaptidae, Aceosejidae and Parasitidae, all with at least 46 species.

Variation of the numbers of habitat specialist species within families among the respective habitats was observed (Table 3). Aphyllophorales fungi, dune and Vertebrata habitats appear to be dominated by specific mite families, shown by larger number of species. Mites of the family Rhodacaridae are typical for dune soils, wood and bracket fungi, while Laelaptidae are commonly found associated with vertebrates and invertebrates (Bregetova, 1977; Shcherbak, 1980; Koehler *et al.* 1992; Madej, 2008). Of the identified habitat specialist species, *Amblyseius andersoni* and *Anthoseius rhenanus* have been collected from Holarctic region, and *Amblyseius bakeri* has a world-wide distribution. The other species are known from the Palaearctic region.

Vertebrata

In total 44 Mesostigmata species were observed to be associated with Vertebrata; of them, 80% were recorded as habitat specialists (Table 2, Appendix 1). This habitat had the highest proportion of habitat specialist species among the all of investigated habitats. Many Mesostigmata species associated with vertebrates are known to be parasites or nidicoles (Rudnick, 1960; Radovsky, 1967, 1969; Stanyukovich, 1990, 1997; Baker and Craven, 2003; Mašán and Stanko, 2005). Of the 35 species recorded in our investigation as habitat specialist species of Vertebrata, some have high specificity for the host. For example, *Macronyssus crosbyi*, *Steatonyssus cavus* and *Spinturnix myoti* are parasites of bats (Rudnick, 1960; Stanyukovich, 1990, 1997). Mites of the genera *Haemolaelaps*, *Myonyssus*, *Hirstionyssus*, *Ornithonyssus, Laelaps* and *Haemogamasus* are associated with small mammals (Radovsky, 1969). Mašán and Stanko (2005) classified Mesostigmata communities associated with rodents as follows, in descending order of species richness: edaphic species, nidicoles (some *Parasitus*, *Hypoaspis*, *Macrocheles*), and parasites and coprophyllous species. More than 20 species recorded as habitat specialists of Vertebrata in our study,

for example, *Laelaps*, *Haemogamasus*, *Myonyssus*, *Hirstionyssus*, and *Hypoaspis heselhausi*, are parasites of small mammals (Chikilevskaya and Gembitski, 1968; Mrciak, 1979; Molnos, 1981, 1982; Mašán *et al.* 1994) in Europe. *Euryparasitus emarginatus* is known as a predatory nidicolous species often found in nests of small mammals in Latvia (Eglitis, 1954). *Cyrtolaelaps mucronatus*, *Androlaelaps casalis*, and *Eulaelaps stabularis* in our investigation were found in association with vertebrates as well as in other habitats (agricultural lands, wood and forests). *Macrocheles glaber* and *Parasitus fimetorum,* considered previously to be coprophyllous in the Palaearctic (Bregetova, 1977; Mašán and Stanko, 2005), in our study were collected also from vertebrates and other habitats and defined as generalist species. *Poecilochirus* species are well known associates of *Nicrophorus* spp. beetles (Springett, 1968; Bregetova, 1977; Salmane, 2009), but we recorded *Poecilochirus subterraneus* also on small mammals, as previously observed by Mrciak (1979). Some of the species found to be associated with small mammals and bird nests in Latvia, like *Androlaelaps casalis*, *Dermanysssus gallinae* and *Dermanyssus hirundinis* are also abundant in bird nests in Slovakia and Byelorussia (Mašán and Krištofík, 1995; Efremova, 2000; Švana *et al.* 2006).

Forests

In total, 150 Mesostigmata species were recorded from forest habitats, which was the highest number of species among the habitats. This may be partly due to more sampling of this habitat in our study, but is more likely explained by the higher number of available niches. The forests of Latvia cover a wide array of forest site types, which might also explain the higher species richness. Thirty six of the forest species in Latvia have been recorded in forests of Norway, Finland and Poland (Hågvar, 1984; Huhta *et al.*, 1986; Huhta, 1996; Huhta and Niemi, 2003; Huhta *et al.*, 2005; Skorupski *et al.*, 2009). Of these, the most common are *Veigaia nemorensis*, *Parazercon sarekensis*, *Pergamasus lapponicus*, and *Prozercon kochi*.

Only 22% (33 species) of the total number of species recorded in forests were selective to this habitat (Appendix 1). Twelve of them were rare species, and due to scarcity of records they should not be at present regarded as forest habitat specialist species. *Leioseius elongatus* occurs on decaying wood of deciduous forests in Slovakia, where it is regarded as a rare species (Kalúz and Fend'a, 2005; Fend'a and Kalúz, 2009), but in Poland it is common in forest litter (Gwiazdowicz, 2007). The other 20 species can be regarded as forest habitat specialist species that are typical for various forests in Europe. Another defined habitat specialist species in Latvia, *Lasioseius berlesei*, has been found in other studies to be common in forest litter, mosses, wood, on rodents and in moist habitats in Europe (Heldt, 1995; Gwiazdowicz, 2007; Fend'a and Kalúz, 2009). *Macrocheles penicilliger* is typical of woody habitats, but is also found in moist habitats and *Macrocheles carinatus* in flood plain forests (Heldt, 1995; Mašán, 2003). *Leioseius magnanalis* is found in various forest types throughout Europe (Bregetova, 1977; Kalúz and Fend'a, 2005), while *Halodarcia incideta* seems to prefer wet substrates in meadows and forests (Karg, 1993). *Dinychus inermis* has been found in mosses in Poland (Kaczmarek *et al.* 2009). Some of the species suggested in our study to be forest habitat specialists have previously been described to prefer a specific microhabitat, for example, wet mosses for *Epicriopsis rivus* and wet forest soil for *Panteniphis mirandus* (Bregetova, 1977).

Groups of species typical of both forests and meadows (10 species), and forests and agricultural habitats (7 species) were observed (Appendix 1). Of the first group, several species (*Parasitus remberti*, *Laelaspis markewitschi*, *Pachylaelaps furcifer*, *Iphidozercon poststigmatus, Antennoseius borrusicus, Trachytes pauperior*) are common in wet and moist substrates in forests, grasslands, agricultural habitats, and small rodent nests in Western and Central Europe (Bregetova, 1977; Karg, 1989, 1993; Gwiazdowicz, 2007; Mašán, 2007). *Paraseiulus soleiger* prefers various tree as well as grass habitats in the Holarctic (Bregetova, 1977; Karg, 1993). Among species of the second group, *Pergamasus mirabilis* is typical of wet agricultural and meadow habitats in Central Europe (Karg, 1993), and is a rare species found in agricultural habitats of Lithuania (Eitminavichute,

TABLE 2: Division of habitat specialist and generalist species among habitat types. For the habitat specialist species, the number of species found rarely are given in brackets and are included in the number of specialist species.

Habitat type	Total number of species	Habitat specialist species	Generalist species
Forests	150	33 (13)	38
Meadows	141	16 (7)	38
Dune habitats	115	20 (5)	35
Wood related habitats	104	13 (2)	20
Agricultural habitats	104	10 (2)	32
Bracket fungi	100	23 (2)	30
Bogs	45	2	25
Vertebrata	44	35	3
Insecta	41	15 (1)	7
Epiphytic mosses	3	0	0

2003). *Iphidozercon venustulus* has been described as typical of forest and agricultural habitats in Europe (Bregetova, 1977), but Kalúz and Fend'a (2005) recorded this species as rare for forest habitats in Slovakia, and Heldt (1995) recorded it from a moist site near Bremen (Germany). *Pachylaelaps dubius* is typical for forest habitats and rodent nests (Bregetova, 1977). *Macrocheles merdarius* is a cosmopolitan species distributed in a very wide range of habitats, including forests and agricultural habitats; it is typical for substrates with a high content of organic matter, and also is phoretic on coprophilous beetles (Bregetova, 1977; Eitminavichute, 2003; Karg, 1993; Mašán, 2003). *Anthoseius caudiglans* is characteristic of orchards in the Holarctic (Bregetova, 1977).

Wood related habitats

Wood habitats were characterized by a total number of 104 species, of which 20 species were generalists. 12% (13 species) of the total number of species were recorded only in this habitat type (Table 2, Appendix 1). Aceosejidae and Rhodacaridae had the largest numbers of habitat specialist species. *Lasioseius thermophilus* and *Anthoseius verrucosus* were rare species and can not be regarded as habitat specialist species. *Proctolaelaps cossi* is found on caterpillars of *Cossus cossus* (Lepidoptera: Cossidae) living in dead wood. *Proctolaelaps hystrix*, *P. scolyti* and *P. fiseri* have been recorded in the galleries of bark beetles (Coleoptera: Scolytidae) in Europe (Bregetova, 1977; Gwiazdowicz, 2008) and *Dendrolaelaps nikolai* and *D. longulus* from dead wood and in association with *Cerambix* and *Elater* beetles (Cerambycidae: Elateridae) in the territory of the former Soviet Union and Germany (Shcherbak, 1980). *Hypoaspis myrmecophila* has been recorded from ant hills and *H. giffordi* from birch wood in Europe and Russia (Bregetova, 1977; Karg, 1993).

Eleven species were found only in wood and Aphyllophorales fungi. Many of them belong to the families Rhodacaridae and Aceosejidae, which usually are typical of similar habitats (Bregetova, 1977; Shcherbak, 1980; Karg, 1993). *Sejus togatus* and *Celaenopsis badius* were found in wood habitats, soil and litter in Europe and Russia (Bregetova, 1977; Kontschán, 2006). *Ameroseius longitrichus* is typical for wood habitats, in association with Scolytidae and Curculionidae (Coleoptera) beetles, and is also found in forest litter (Bregetova, 1977).

Nine species were recorded only from wood and Insecta. *Schizosthetus simulatrix* and *Lobogiinoides spelaea* are common wood inhabitants (Al-Atawi *et al.* 2002; Kalúz *et al.* 2003). *Dendrolaelaps disetosimilis*, *D. uncinatus*, *Multidendrolaelaps hexaspinosus* and *Insectolaelaps armatus* are typically associated with wood-inhabiting insects (Shcherbak, 1980). *Zercon curiosus* has been described to prefer wood related habitats, but also is found in soil, litter and other substrates in Europe (Bregetova, 1977; Mašán, 2004). In our study it was recorded in wood and epiphytic mosses on trees.

Aphyllophorales fungi

Aphyllophorales fungi were characterized by a total number of 100 mite species, of which 30 species

were generalists. About ¼ of the total number of species recorded were found only in this habitat type (Table 2, Appendix 1). *Saprogamasus ambulacralis* and *Zercon triangularis* were considered as rare species and could not be recognized as habitat specialist species. Among the species on fungi, the greatest number of species belongs to Rhodacaridae, which is a typical feature of woody habitats (Shcherbak, 1980). Some mite species of other families are also typical for bracket fungi. *Ameroseius imparsetosus* is typical for various wood related habitats, including bracket fungi in the former Soviet Union and Europe (Bregetova, 1977). *Ameroseius delicatus* and *Zerconopsis decemremiger* are typical for rotting wood, forest litter and mosses in the former Soviet Union and Europe (Bregetova, 1977). *Ameroseius callosus* and *A. fungicollis* are typical inhabitants of bracket fungi in Slovakia (Mašán, 1998). *Dinychus woelkei, Trichouropoda shcherbakae*, *Trachyuropoda coccinea* and *Oplitis pecinai* have been recorded in various soils and litter, and from ant hills in Europe, and *Dinychus septentrionalis* from wood-related habitats (Karg, 1989).

Dune habitats

Dune habitats supported a total number of 115 species; of them 35 species were defined as generalists and 20 (17%) as habitat specialists (Table 2, Appendix 1). *Ameroseius plumea*, *Saprolaelaps reticulatus*, *Crassicheles concentricus*, *Pseudoparasitus dentatus* and *Protodinychus punctatus* were rare and are not regarded as dune-specialist species. *A. plumea* has been observed in agricultural habitats in Lithuania (Eitminavichute, 2003), and in forest habitats and rodent nests in the former Soviet Union and Western Europe (Bregetova, 1977). *P. punctatus* is a rare species recorded in organic matter of river washed-ashore material and riverside habitats in North and Middle Europe (Bregetova, 1977; Karg, 1989). *Crassicheles concentricus* in Latvia was recorded from washed-ashore material; in Europe it was found in forest litter (Karg, 1993). Disregarding the rare species, the remaining 15 habitat specialists can be defined as dune specialists. Five of them belong to the family Phytoseiidae. *Amblyseius beglјarovi*, *A. levis* and *A. nemorivagus* are known from soil and rodent nests, and have been found on trees and grasses in Europe and Africa (Bregetova, 1977; Karg, 1993; Kolodochka, 2006). *Amblyseius andersoni* and *A. bakeri* have a Holarctic and worldwide distribution, respectively, where they are found on trees and grasses, and rarely in soil. Unfortunately, for these Phytoseiidae species no exact habitat of the collected species has been mentioned in the literature. Phytoseiidae mites mostly live on plants, and are abundant in grey dunes overgrown with vegetation (Salmane and Spunğis, 2008). Several species of Rhodacaridae are typical for dune habitats and are small in size and adapted to living in compact substrates with small air spaces, as in seashore sandy soils (*Dendrolaelaps nostricornutus*, *Minirhodacarellus minimus*); others are typical for washed ashore material on the beach (*Halolaelaps marinus*, *Halolaelaps remanei*) (Shcherbak, 1980; Koehler *et al.* 1992; Karg, 1993; Madej, 2008). *Hypoaspis similisetae* has been found in various substrates of forests, meadows and agricultural habitats in Europe (Karg, 1993; Heldt, 1995; Kováč *et al.* 1999). *Zercon fageticola* has been recorded mainly in mesophytic substrates of highland forests in Slovakia (Mašán, 2004) and from mosses, epiphytic mosses and litter in Poland (Kaczmarek *et al.* 2009); we collected it from coastal pine forest soil. Fifteen species were found in both meadows and dunes. *Halolaelaps balticus*, *H. incisus*, *H. communis*, *Thinoseius spinosus*, *Parasitus halophilus*, *Gamasolaelaps excisus* and *P. kempersi* are typical sea coast inhabitants found in dunes and coastal meadows (Appendix 1). These species prefer wet substrates that are rich in organic matter, such as various washed ashore materials, including algae. *Rhodacarellus silesiacus* and *Rhodacarus clavulatus* have been described as typical of dune soil and forests; the former species is recognized as a pioneer species in soil succession processes, and the latter has a world-wide and European distribution (Shcherbak, 1980; Koehler *et al.* 1992). *Dendrolaelaps arenarius* has been observed in coastal dune habitats in Europe, and *Dendrolaelaspis angulosus* in wet meadow soils (Shcherbak, 1980; Karg, 1993). *Antennoseius bacatosimilis* was described from dry habitats in Slovakia (Fend'a and Kalúz, 2009); we found it in dry meadows and dune habitats.

TABLE 3: Families with the highest number of habitat specialist species in the respective habitat types. Up to two of the most common families are given.

	Wood	Bracket fungi	Forests	Meadows	Dunes	Agricultural	Bogs	Invertebrates	Vertebrates	Epiphytic mosses
Parasitidae			7			2		3		
Aceosejidae	5		5	3		3	2			
Pachylaelaptidae				4						
Rhodacaridae	3	9			7					
Ameroseiidae		4								
Phytoseiidae					6					
Laelaptidae								4	9	
Haemogamasidae									6	
Total number of habitat species-specialists	13	23	33	16	20	10	2	15	35	0

Meadows

Meadows were characterized by a total number of 141 species, of which 38 were generalists and 16 (11%) were habitat specialists (Table 2, Appendix 1). Of those species, *Parasitus numismaticus*, *Parasitus cavernicola*, *Laelaps humerata*, *Zercon anomalus*, *Trachytes minima*, *Pachylaelaps karawaiewi* and *P. bregetovae* were found in low numbers and were not considered as specific for meadows. *Oplitis latvica* was described for the first time from soil in the coastal meadows of Riga Gulf coast in Latvia (Kontschán and Salmane, 2008); therefore it is impossible to comment on its distribution yet. *Ameroseius insignis*, *Cheiroseius unguiculatus* and *Platyseius subglaber* have been recorded in various decaying and wet substrates, grassy habitats and mosses in Europe (Stammer, 1963; Bregetova, 1977; Karg, 1993; Kalúz and Fend'a, 2005). *Leioseius naglitschi* has been recorded in xerothermic grasslands in Central Europe and Algiers, and is regarded as a rare species (Bregetova, 1977; Karg, 1993; Kalúz and Fend'a, 2005; Fend'a and Kalúz, 2009). In our investigation it was found in xerophytic inland meadow soil associated with the grass rhizosphere. *Dendrolaelaps stammeri* has been described from rotting substrates in Europe and Ukraine, and *Pachylaelaps magnus* in the agricultural and forest soils in Europe and the Western part of Russia (Bregetova, 1977; Shcherbak, 1980; Karg, 1993). *P. siculus* is known to be associated with meadows and forests, in litter, animal excrements and rotting substrates in Europe and in the former Soviet Union (Bregetova, 1977; Karg, 1993; Mašán, 2007). *Mixozercon sellnicki* is a relatively rare species, found in high altitude grasslands in Slovakia and in forest litter, soil and mosses in Europe (Bregetova, 1977; Karg, 1993; Mašán and Fend'a, 2004).

Agricultural habitats

Agricultural habitats supported a large (104) total number of species, of which 32 were generalists and 10 (10%) were habitat specialists (Table 2, Appendix 1). Of the habitat specialist species, *Parasitus crassitarsis* and *Parasitus mustelarum* were relatively rare in the current investigation. These species have been found in forest litter, agricultural lands and meadows in Europe and Russia (Bregetova, 1977; Karg, 1993). *Arctoseius stammeri* has been previously recorded not only in agricultural habitats, but also in forests and in small mammal nests (Bregetova, 1977; Kalúz and Fend'a, 2005). *Arctoseius longispinosus* has been found in soil, litter, ant hills and bark beetle galleries in Poland and Germany (Gwiazdowicz, 2007) and in agricultural habitats in Lithuania (Eitminavichute, 2003). *Paragarmania mali* is known from forest and agricultural substrates, and *Anthoseius rhenanus* from trees and grasses in orchards, rarely from soil in the Holarctic (Bregetova, 1977). *Holostaspella ornata* is known from decomposing substrates in Europe (Bregetova,

1977) and pine forests and bogs in Lithuania (Eitminavichute, 2003).

Bogs

Of the 45 species recorded in bogs, 25 are generalists and only 2 (*Cheiroseius dungeri* and *Cheiroseius bryophilus*) were found only in this habitat, and in low abundance (Table 2, Appendix 1). These two specialists represented new species records in Latvia (Salmane, 2009), and therefore it is difficult to comment on their overall distribution. However, they are known from soil and wet mosses in forests of Europe, and considered as rare in Slovakia (Karg, 1993; Kalúz and Fend'a, 2005; Fend'a and Kalúz, 2009).

Gamasellus montanus and *Platyseius italicus* were found in forests and bogs, and mainly in wet rotting substrates in Europe (Bregetova, 1977; Karg, 1993). *Epicrius mollis* is a common species of forest litter and mosses in Europe (Bregetova, 1977). *Cheiroseius cassiteridium* has been reported from swamp meadows, and *Neojordensia sinuata* from rotting substrates, and *Ololaelaps sellnicki* and *O. veneta* in various wet substrates in the forests and meadows (Bregetova, 1977; Karg, 1993; Fend'a and Kalúz, 2009). *Cheiroseius necorniger* and *C. borealis* are known from organic substrates, and the latter also from pastures in Palaearctic (Karg, 1993; Heldt, 1995).

Insecta

A total of 15 (41%) of the 41 species associated with insects were habitat specialists and 7 were generalists (Table 2, Appendix 1). *Alliphis necrophilus* (Eviphidae) was recorded for the first time in Latvia (Salmane, 2009), and and with a low number of specimens. Hence, it's distribution in Latvia is not yet known. Previously, it was collected from *Nicrophorus* beetles (Coleoptera: Silphidae) in Slovakia and Japan (Mašán, 1994a, 1999; Takaku *et al.* 1994). Several species are known to be associated with beetles. *Hypoaspis krameri* is a well known and specific phoretic mite associate of *Oryctes* and Lucanidae beetles in Europe (Bregetova 1977; Karg 1993). *Scamaphis equestris* was recorded on Geotrupidae beetles in England and Slovakia (Hyatt, 1956; Mašán, 1994b), and *Scarabaspis inexpectatus* is known from soil and animal excrements in Europe (Karg, 1993). *Macrocheles nataliae* and *M. perglaber* have been found in soil, litter, various animal excrements and decaying substrates, and are phoretic on Geotrupidae beetles (Bregetova, 1977; Mašán, 2003). *Parasitus copridis* and *P. beta* have been recorded from Geotrupidae beetles, soil and excrements in Europe and Asia (Hyatt, 1980; Karg, 1993). *Holostaspis isotricha* and *Hypoaspis cuneifer* in our investigation were found in ant hills, as previously documented in Russia, Ukraine and Europe (Bregetova, 1977; Karg, 1993; Gwiazdowicz, 2008). *Hypoaspis bombicolens*, recorded as being phoretic on *Psithyrus* sp. in Latvia (Insecta, Apidae), was found in the nests of bumblebees in Europe and Russia (Bregetova, 1977; Karg, 1993). *Uropoda ocellata* was described recently from an Histeridae beetle in Latvia (Kontschán and Salmane, 2008). *Blattisocius tarsalis* was found in bird nests in Slovakia (Fend'a and Kalúz, 2009) and in insect culture in the laboratory (Bregetova, 1977).

Poecilochirus necrophori, *P. subterraneus*, and *P. davydovae* are typical symbionts of *Nicrophorus* spp. beetles (Springett, 1968; Schwarz and Koulianos 1998). In Latvia, *Stylochirus fimetarius* was observed to be abundant on Carabidae and some other beetles, as recorded in Europe and Asia Minor (Bregetova, 1977; Lundquist, 1991; Karg, 1993; Makarova, 1995). *Microsejus truncicola, Microgynium rectangulatum*, and *Loboginoides spelaea* mites are typical of decaying wood and wood inhabiting beetles (Bregetova, 1977).

Epiphytic mosses

Three Mesostigmata species were recorded from epiphytic mosses, none of which were specific to this habitat. *Pergamasus parinteger* is known to inhabit wood and litter in Europe (Karg, 1993) and *Hypoaspis lubrica* was found in rotting substrates and nests of rodents in Europe and North America (Bregetova, 1977; Karg, 1993). *Zercon curiosus* is common in wood habitats, and is found in soil, litter and other substrates in Europe (Bregetova, 1977; Mašán, 2004).

Generalist species

Thirty nine species were defined as species-generalists (Appendix 1). These species have a wide distribution range: world wide, Holarctic or Palaearctic. The highest number of generalist species was recorded in the Parasitidae (11 species), Aceosejidae (7 species) and Laelaptidae (5 species). The most frequent species in our investigation were *Parasitus kraepelini* and *Eviphis ostrinus*. These two species, along with *Holoparasitus excipuliger*, *Pergamasus vagabundus*, *P. wasmanni*, *Eviphis ostrinus*, *Leioseius bicolor*, *L. minutus*, *Prozercon kochi*, *P. traegardhi*, and *Veigaia exigua*, are widely distributed in Europe and/or in the territory of the former Soviet Union with no preference to a particular habitat; they are found in diverse substrates in forests, agricultural habitats, rodent nests, ant hills, and decomposing wood, (Bregetova, 1977; Karg, 1993; Eitminavichute, 2003; Gulvik, 2007; Fend'a and Kalúz, 2009). *Arctoseius semiscissus* is widely distributed, but is not frequent in Europe (Kalúz and Fend'a, 2005; Fend'a and Kalúz, 2009).

Some of the generalist species, such as *Hypoaspis vacua*, *H. aculeifer*, *Veigaia nemorensis*, *V. cervus*, *Alliphis halleri*, have a world-wide or Holarctic distribution (Bregetova, 1977; Karg, 1993; Halliday, 2008). *Asca bicornis* inhabits a wide range of habitats and conditions from cold and wet to xerothermic habitats, forests, meadows, and agricultural habitats (Kalúz and Fend'a, 2005). It is a species with wide ecological adaptability and an unclear preference to habitat in Europe, Russia and North America. Some other species are also widely distributed in the Holarctic or are found world-wide in various habitats and substrates, but still with preference to some type of habitat, like *Pergamasus teutonicus* and *Pergamasus crassipes* to forests, *Parasitus fimetorum* and *Amblyseius obtusus* to agricultural habitats, and *Parasitus coleoptratorum* to beetles and agricultural habitats. *Asca aphidioides* is freguent in forests, seldom in meadows and agricultural habitats, *Macrocheles glaber* is found in dung and on dung-related insects, and in agricultural habitats, and *Amblyseius obtusus* in meadow substrates (Bregetova, 1977; Hyatt, 1980; Karg, 1993; Kalúz and Fend'a, 2005; Niogret *et al.* 2006; Fend'a and Kalúz, 2009). Several of the generalist species are widely distributed in Europe and/or in the territory of former Soviet Union and Asia. Of these, *Pergamasus lapponicus* and *Veigaia transisalae* prefer various forest types, *V. kochi* is common in wet forests, *Ameroseius corbicula* in agricultural land, and *Zercon zelawaiensis* in wet forests and bogs in the boreal zone (Bregetova, 1977; Karg, 1993).

The wide distribution of 7 species (*Pergamasus vagabundus*, *P. crassipes*, *P. lapponicus*, *Holoparasitus excipuliger*, *Veigaia nemorensis*, *Hypoaspis praesternalis*, *Eviphis ostrinus*) in forest, and agricultural habitats has been previously described by Lapiņa (1988). The latter species was observed in our study to be the most widely distributed among the investigated habitats. *Cheiroseius necorniger,* known to inhabit wet meadows, riverside habitats, agricultural soils, mosses and rotting substrates (Bregetova, 1977; Karg, 1993), was found in Latvia also occasionally on Insecta.

Conclusion

The present survey of Mesostigmata species covers a broad range of habitats, and allows improve knowledge on habitat preference of these species. Several of the species were rare, and thus the data could not provide precise information of their preferred habitats. In previous investigations of Lapiņa (1988) on various soil and litter habitats she mentioned preference of *Parasitus lunaris* for various agricultural habitats, but we found it also in the forests and meadows; *Pergamasus misellus* was described from meadows, but we expanded the habitat range to include also bogs. Fend'a and Kalúz (2009) and Bregetova (1977) regarded *Zerconopsis remiger*, and especially *Proctolaelaps pygmaeus*, as cosmopolitan species from very wide range of habitats, but we found them only in wood, Aphyllophorales and agricultural habitats and forests in soil. The accuracy of the discerned habitat preferences is certainly dependent on the scope of the studies carried out, i.e. number of habitats covered and their replication. Much literature provides only general descriptions of the habitat, but omits the specific substrate. Many investigations have

made observations of frequency and dominance of species in a selected number of habitats, but information is lacking from others. Scarce information is available on which Mesostigmata species have been found only in one habitat type, indicating a habitat specialist species. The research conducted provides lists of Mesostigmata mites found in habitats previously not considered in Latvia: Aphyllophorales fungi (100 species recorded), dune habitats (115 species), dead wood habitats (104 species) and Insecta (41 species). A total of 32 species of the recorded 368 were rare. Of the species found to be rare in Latvia, 9 were also recorded as rare in other countries.

A list of 368 Mesostigmata species of 27 families in Latvia is provided with occurrence in habitats, which could be used as a future reference. This type of information is needed to identify species that require conservation. As our investigation covers both natural as well as human impacted habitats, it will be possible to use these data in various ecological investigations for assessment of habitat naturalness, vitality and biodiversity.

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APPENDIX 1

List of Mesostigmata species and their occurrence in habitats of Latvia. With * – marked rare species.

Mesostigmata species	Wood	Bracket fungi	Forests	Meadows	Dunes	Agricultural	Bogs	Invertebrates	Vertebrates	Epiphytic mosses
**Parasitus berlesei* (Willmann, 1935)			x							
**Parasitus loricatus* (Wankel, 1861)			x							
**Parasitus magnus* Krämer, 1876			x							
Pergamasus brevicornis Berlese, 1903			x							
**Pergamasus runcatellus* (Berlese, 1903)			x							
**Pergamasus oxygynelloides* Karg, 1968			x							
**Pergamasus similis* Willmann, 1953			x							
**Ameroseius eumorphus* Bregetova, 1977			x							
Epicriopsis baloghi Kandil, 1978			x							
Epicriopsis rivus Karg, 1971			x							
Lasioseius berlesei (Oudemans, 1938)			x							
**Leioseius elongatus* (Evans, 1958)			x							
Leioseius magnanalis Evans, 1958			x							
Melichares juradeus Schweizer, 1949			x							
Halodarcia incideta Karg, 1969			x							
**Stylochirus minor* (Willmann, 1953)			x							
**Rhodacarus roseus* Oudemans, 1902			x							
Dendrolaelaps rotundus Hirschmann, 1960			x							
Dendrolaelaps zwoelferi Hirschmann, 1960			x							
Macrocheles peniciliger (Berlese, 1904)			x							
Macrocheles carinatus (C. L. Koch, 1839)			x							
Pachylaelaps imitans Berlese, 1921			x							
Hypoaspis mixta Scherbak, 1970			x							
**Zercon jodathae* Sellnick, 1944			x							
Zercon forsslundi Sellnick, 1958			x							
Dinychus inermis (C. L. Koch, 1841)			x							
Dinychus perforatus Krämer, 1886			x							
Panteniphis mirandus Willmann, 1949			x							
Anthoseius rapidus Wainstein et Arutunjan, 1968			x							
Amblyseius astutus (Begljarov, 1960)			x							
Macrocheles submotus Falconer, 1924			x							
Cyrtolaelaps minor Willmann, 1952			x							
Urodiaspis tecta (Krämer, 1876)			x							
Holostaspis montana (Berlese, 1904)			x					x		
**Hypoaspis intermedius* Hirschmann, 1964			x							
Macrocheles rotundiscutis Bregetova et Koroleva, 1960		x	x							
Uropoda orbicularis (Müller, 1776)		x	x							
Oplitis minutissima (Berlese, 1903)		x	x							
Gamasellus montanus (Willmann, 1936)			x				x			
Euryparasitus emarginatus (C. L.Koch, 1839)			x				x		x	
Epicrius mollis (Kramer, 1876)		x	x				x			
Platyseius italicus (Berlese,1905)			x		x		x			
Pergamasus mirabilis Willmann, 1951			x			x				
Iphidozercon venustulus (Berlese, 1917)			x			x				
Macrocheles merdarius (Berlese, 1889)			x			x				
Macrocheles decoloratus (C. L. Koch, 1839)			x			x			x	
Pachylaelaps fuscinuliger Berlese, 1921			x			x				
Pachylaelaps dubius Hirschmann et Krauss, 1965			x			x				

Anthoseius caudiglans (Schuster, 1959)			x			x				
Amblyseius okanagensis (Chant, 1957)		x	x			x				
Rhodacarus reconditus Athias-Henriot, 1961			x		x	x				
Cyrtolaelaps mucronatus G. et R. Canestrini, 1881			x			x			x	
Androlaelaps casalis (Berlese, 1887)	x		x			x			x	
Parasitus oudemansi Berlese, 1903	x		x							
Ameroseius plumigerus Oudemans, 1902	x		x							
Hypoaspis oblonga Halbert, 1915	x		x							
Olopachys suecicus Sellnick, 1950	x		x							
Trachytes aegrota (C.L.Koch, 1841)	x		x							
Pergamasus parinteger Athias-Henriot, 1967	x		x							x
Hypoaspis lubrica Oudemans et Voigts, 1904	x		x							x
Platyseius major (Halbert, 1923)	x		x		x					
Pergamasus holzmannae Micherdzinsky, 1969	x		x				x			
Ololaelaps placentula (Berlese, 1887)	x		x	x			x			
Pergamasus quisquilarum (Canestrini, 1882)	x		x			x				
Phytoseius macropilis (Banks, 1904)	x		x			x				
Hypoaspis heyi Karg, 1962	x		x	x		x				
Pergamasus suecicus (Trägårdh, 1936)	x		x	x		x				
Typhlodromus tiliae Oudemans, 1929	x	x	x			x				
Lasioseius furcisetus Athias-Henriot, 1959	x	x	x			x				
Typhlodromus cotoneastri Wainstein, 1961	x	x	x			x				
Hypoaspis lusisi Lapina, 1976	x	x	x		x	x				
**Parasitus crassitarsis* (Halbert, 1923)						x				
**Parasitus mustelarum* Oudemans, 1902						x				
Arctoseius stammeri Bernhard, 1863						x				
Arctoseius longispinosus Hirschmann, 1963						x				
Paragarmania mali (Oudemans, 1929)						x				
Typhlodromus timidus Schuster, 1959						x				
Anthoseius rhenanus Oudemans, 1905)						x				
Macrocheles americana (Berlese, 1888)						x				
Holostaspella ornata (Berlese, 1904)						x				
Uroobovella fimicola (Berlese, 1903)						x				
Laelaps agilis C. L. Koch, 1836						x			x	
Eulaelaps stabularis (C. L. Koch, 1836)						x			x	
Parasitus lunulatus (Müller, 1859)	x					x		x		
Holostaspella subornata Bregetova et Koroleva, 1960	x					x				
Gamasodes bispinosus (Halbert, 1915)					x	x				
Amblyseius barkeri (Hughes, 1948)					x	x				
Amblyseius umbraticus (Chant, 1956)					x	x				
Amblyseius agrestis (Karg, 1960)					x	x				
Amblyseius herbarius Wainstein, 1960					x	x				
Phytoseius juvenis Wainstein et Arutunjan, 1970		x				x				
Dendrolaelaps strenzkei Willman, 1957		x				x				
Paraseiulus incognitus Wainstein et Arutunjan, 1967				x		x				
Pachylaelaps regularis Berlese, 1921				x		x				
Poecilochirus necrophori Vitzthum, 1930				x		x		x		
Gamasodes spiniger (Trägårdh, 1910)		x		x		x				
Leioseius halophilus (Willmann, 1949)		x		x	x	x				
Leioseius minutus (Halbert, 1915)		x		x	x	x				
**Parasitus numismaticus* Vitzthum, 1930				x						
**Parasitus cavernicola* Trägårdh, 1912				x						
Ameroseius insignis Bernhard, 1963				x						
Leioseius naglitschi Karg, 1965				x						
Cheiroseius unguiculatus Berlese, 1887				x						

Platyseius subglaber (Oudemans, 1903)				x						
Dendrolaelaps stammeri Hirschmann, 1960				x						
Pachylaelaps magnus Halbert, 1915				x						
**Pachylaelaps karawaiewi* Berlese, 1921				x						
Pachylaelaps siculus Berlese, 1892				x						
**Pachylaelaps bregetovae* Koroleva, 1977				x						
**Laelaspis humerata* (Berlese, 1904)				x						
**Zercon anomalus* Willmann, 1953				x						
Oplitis latvica Kontschán & Salmane, 2008.				x						
**Trachytes minima* Trägardh, 1910				x						
Mixozercon sellnicki Schweizer, 1948				x						
Hypoaspis miles Berlese, 1881	x			x						
Cheiroseius cassiteridium Evans et Hyatt, 1960				x			x			
Neojordensia sinuata Athias-Henriot, 1973				x	x		x			
Parasitus remberti (Oudemans, 1912)			x	x						
Iphidozercon poststigmatus Gwiazdowicz, 2003			x	x						
Paraseiulus soleiger (Ribaga, 1902)			x	x						
Pachylaelaps longisetis Halbert, 1915			x	x						
Trachytes pauperior Berlese, 1914			x	x						
Pergamasus parrunciger Bhattacharyya, 1963			x	x						
Antennoseius borrusicus Sellnick, 1945			x	x						
Pachylaelaps sculptus Berlese, 1921			x	x						
Laelaspis markewitschi Pirianyk, 1959			x	x						
Pachylaelaps furcifer Oudemans, 1903			x	x						
Stylochirus physogastris Karg, 1971			x	x			x	x		
Hypoaspis angusticutatus Willmann, 1951			x	x			x			
Ololaelaps veneta (Berlese, 1903)			x	x			x			
Pachylaelaps pectinifer (G. et R. Canestrini, 1882)			x	x			x			
Ololaelaps sellnicki Bregetova et Koroleva, nom. n.,1964			x	x			x			
Geholaspis longispinosus (Krämer, 1876)		x	x	x						
Hypoaspis incertus Bernhard, 1955	x	x	x	x						
Pergamasus robustus (Oudemans, 1902)			x	x		x				
Stylochirus fimetarius (Müller, 1859)			x	x		x		x		
Phytoseius salicis Wainstein et Arutunjan, 1970			x	x		x				
Amblyseius subsolidus Begljarov, 1960			x	x		x				
Neojordensia levis (Oudemans et Voigts, 1904)			x	x		x				
Geholaspis mandibularis (Berlese, 1904)			x	x		x				
Pachylaelaps littoralis Halbert, 1915			x	x		x				
Pachyseius humeralis Berlese, 1910		x	x	x		x				
Epicriopsis horridus (Krämer, 1876)		x	x	x		x				
Cheiroseius viduus C. L. Koch, 1839			x	x	x					
Dendrolaelaps latior (Leitner, 1949)			x	x	x					
Hypoaspis karawaiewi (Berlese, 1903)			x	x	x					
Leioseius montanulus Hirschmann, 1963			x	x	x					
Dendrolaelaspis bregetovae Shcherbak, 1978			x	x	x					
Macrocheles tardus (C. L. Koch, 1841)			x	x	x					
Laelaspis astronomicus C. L. Koch, 1839			x	x	x					
Amblyseius messor Wainstein, 1960		x	x	x	x					
Amblyseius meridionalis (Berlese, 1914)		x	x	x	x					
Parazercon sarekensis Willmann, 1939			x	x	x		x			
Zercon montanus Willmann, 1953			x	x	x	x				
Parasitus lunaris Berlese, 1906			x	x	x	x		x		
Amblyseius zwoelferi (Dosse, 1957)		x	x	x	x	x				
Arctoseius semiscissus (Berlese, 1892)		x	x	x	x	x				
Alliphis halleri (G. et R. Canestrini 1881)		x	x	x	x	x		x		

Prozercon traegardhi (Halbert, 1923)		x	x	x	x	x				
Hypoaspis aculeifer (Canestrini, 1883)		x	x	x	x	x				
Hypoaspis rigensis Lapina, 1976		x	x	x	x	x	x			
Leioseius bicolor (Berlese, 1918)	x	x	x	x	x	x				
Hypoaspis praesternalis Willmann, 1949	x	x	x	x	x	x				
Cheiroseius serratus (Halbert, 1915)			x	x	x	x	x			
Parasitus coleoptratorum (L.) sensu Oudemans, 1908			x	x	x	x	x	x		
Macrocheles glaber (Müller, 1860)			x	x	x	x		x	x	
Parasitus fimetorum Berlese, 1903		x	x	x	x	x		x	x	
Antennoseius bacatosimilis Karg, 1965				x	x					
Amblyseius graminis Chant, 1956				x	x					
Rhodacarellus silesiacus Wilmann, 1935				x	x					
Rhodacarus clavulatus Athias-Henriot, 1961				x	x					
Dendrolaelaspis angulosus Willmann, 1936				x	x					
Halolaelaps communis Goetz, in Hirshmann, 1966				x	x					
Parasitus kempersi Oudemans, 1902				x	x					
Gamasolaelaps excisus (C. L. Koch, 1879)				x	x					
Antennoseius delicates Berlese, 1916				x	x					
Amblyseius finlandicus (Oudemans, 1915)				x	x					
Dendrolaelaps arenarius Karg, 1971				x	x					
Halolaelaps balticus Wilmann, 1954				x	x					
Halolaelaps incisus Hyatt, 1956				x	x					
Thinoseius spinosus (Wilmann, 1939)				x	x					
Prozercon sellnicki Halaskova, 1963				x	x					
Dendrolaelaps tenuipilus Hirschmann, 1960		x		x	x					
Dendrolaelaps septentrionalis (Sellnick, 1958)		x		x	x					
Parasitus halophilus (Sellnick, 1957)		x		x	x					
Amblyseius aurescens Athias-Henriot, 1961				x	x	x				
Amblyseius rademacheri Dosse, 1958				x	x	x				
Rhodacarus mandibularis Berlese, 1921				x	x	x				
Hypoaspis claviger (Berlese, 1883)				x	x	x				
Amblyseius reductus Wainstein, 1962				x	x	x				
Hypoaspis kargi Costa, 1968				x	x	x				
Zercon spatulatus C. L. Koch, 1839	x		x	x	x	x				
Amblyseius bicaudus Wainstein, 1962				x	x	x				
Cheiroseius necorniger (Oudemans, 1903)				x	x	x	x	x		
Cheiroseius borealis (Berlese, 1904)				x	x	x	x			
Pergamasus truncus Schweizer, 1961	x			x	x					
Dendrolaelaps foveolatus (Leitner, 1949)	x			x	x					
Dendrolaelaps cornutus (Krämer, 1886)	x	x		x	x					
Cheiroseius curtipes (Halbert, 1923)	x			x	x		x			
Amblyseius cucumeris (Oudemans, 1930)	x			x	x	x				
Amblyseius marginatus (Wainstein, 1961)	x			x	x	x				
Macrocheles montanus Willmann, 1951	x		x	x	x	x				
Hypoaspis austriacus (Sellnick, 1935)	x		x	x	x					
Veigaia kochi (Trägårdh, 1901)	x		x	x	x		x			
Leioseius insignis Hirschmann, 1963	x	x	x	x	x					
Amblyseius obtusus (C. L. Koch, 1839)	x	x	x	x	x					
Pergamasus misellus Berlese, 1904	x	x		x			x			
Ameroseius corbicula (Sowerby, 1806)	x	x		x		x	x			
Asca aphidioides (Linnaeus, 1758)	x	x	x	x			x			
Zercon zelawaiensis Sellnick, 1944	x	x	x	x	x		x			
Prozercon kochi Sellnick, 1943	x	x	x	x	x		x			
Veigaia cervus (Krämer, 1876)	x	x	x	x	x		x			
Veigaia transisalae (Oudemans, 1902)	x		x	x		x	x			

Veigaia exiqua (Berlese, 1917)	x		x	x	x	x	x			
Leioseius minusculus (Berlese, 1905)	x		x	x	x	x	x			
Lasioseius youcefi Athias-Henriot, 1959	x	x	x	x		x	x			
Pergamasus teutonicus Willmann, 1956	x	x	x	x	x	x	x			
Asca bicornis (Canestrini et Fazago, 1877)	x	x	x	x	x	x	x			
Hypoaspis vacua (Michael, 1891)	x	x	x	x	x	x	x			
Pergamasus septentrionali (Oudemans, 1902)	x	x	x	x	x	x	x			
Parasitus kraepelini Berlese, 1903	x	x	x	x	x	x	x	x		
Pergamasus crassipes (Linnaeus, 1758)	x	x	x	x	x	x	x			
Pergamasus vagabundus Karg, 1968	x	x	x	x	x	x	x			
Pergamasus lapponicus Trägårdh, 1910	x	x	x	x	x	x	x			
Pergamasus wasmanni (Oudemans, 1902)	x	x	x	x	x	x	x			
Holoparasitus excipuliger (Berlese, 1905)	x	x	x	x	x	x	x			
Veigaia nemorensis (C. L. Koch, 1839)	x	x	x	x	x	x	x			
Eviphis ostrinus (C. L. Koch, 1836)	x	x	x	x	x	x	x		x	
Saprogamasus ambulacralis Willmann, 1949		x								
Ameroseius callosus Mašán, 1998		x								
Ameroseius fungicolis Mašán, 1998		x								
Ameroseius imparsetosus Westerboer, 1963		x								
Ameroseius delicates Berlese, 1918		x								
Proctolaelaps cyllodi Samśinak, 1960		x								
Zerconopsis decemremiger Evans et Hyatt, 1960		x								
Hoploseius sp.		x								
Dendrolaelaps procornutus Hirschmann, 1960		x								
Dendrolaelaps punctatulus Hirschmann, 1960		x								
Dendrolaelaps acornutus Hirschmann, 1960		x								
Dendrolaelaps halophilus Hirschmann, 1960		x								
Dendrolaelaps latus Hirschmann, 1960		x								
Insectolaelaps euarmatus (Hirschmann, 1960)		x								
Insectolaelaps pini (Hirschmann, 1960)		x								
Multidendrolaelaps ulmi Hirschmann, 1960		x								
Multidendrolaelaps euepistomus (Hirschmann, 1960)		x								
Zercon triangularis C.L.Koch, 1836		x								
Trichouropoda shcherbakae Hirschmann, 1972		x								
Trachyuropoda coccinea (Michael, 1891).		x								
Dinychus septentrionalis Trägårdh, 1938		x								
Dinychus woelkei Hirschmann et Zirngiebl-Nicol, 1969		x								
Oplitis pecinai Hirschmann, 1984		x								
Sejus togatus C.L.Koch, 1836	x	x								
Celaenopsis badius Berlese, 1886	x	x								
Ameroseius ulmi Hirschmann, 1963	x	x								
Ameroseius longitrichus Hirschmann, 1963	x	x						x		
Dendrolaelaps cornutulus Hirschmann, 1960	x	x								
Dendrolaelaps arvicolus (Leitner, 1949)	x	x								
Dendrolaelaps insignis Hirschmann, 1960	x	x								
Dendrolaelaps longifallax Hirschmann, 1960	x	x								
Insectolaelaps quadrisetus (Berlese, 1920)	x	x								
Hypoaspis brevipilis Hirschmann, 1969	x	x								
Zercon rogmaniolus Sellnick, 1944	x	x								
Aceoseius muricatus (C. L. Koch, 1839)	x	x				x				
Lasioseius ometes (Oudemans, 1903)	x	x				x				
Proctolaelaps pygmaeus (Müller, 1860)	x	x				x				
Proctolaelaps bickleyi (Bram, 1956)	x	x				x		x		
Dendrolaelaps trapezoides Hirschmann, 1960	x	x			x					
*Zerconopsis remiger (*Krämer, 1876)	x	x	x							

Uroobovella pulchella (Berlese, 1904)	x	x	x							
Zercon carpathicus Sellnick, 1958	x	x	x		x					
**Ameroseius plumea* Oudemans, 1930					x					
Amblyseius bakeri (Hughes, 1948)					x					
Amblyseius andersoni (Chant, 1957)					x					
Amblyseius begljarovi Abbasova, 1970					x					
Amblyseius nemorivagus Athias-Henriot, 1961					x					
Amblyseius levis Wainstein, 1960					x					
Minirhodacarellus minimus (Krag, 1961)					x					
Rhodacarus haarlovi Shcherbak, 1977					x					
Dendrolaelaps fallax (Leitner, 1949)					x					
**Saprolaelaps reticulatus* Blaszak, Ehrnsberger, 2000					x					
Halolaelaps marinus (Brady, 1875)					x					
Halolaelaps remanei Willmann, 1939					x					
Hypoaspis sclerotarsa Costa, 1968					x					
Hypoaspis similisetae Karg, 1965					x					
**Pseudoparasitus dentatus* (Halbert, 1920).					x					
**Crassicheles concentricus* Evans, 1962					x					
**Protodinychus punctatus* Evans, 1957					x					
Amblyseius marinus (Willmann, 1952)					x					
Dendrolaelaps nostricornutus Hirshmann et Wisnewski, 1982					x					
Zercon fageticola Halaskova, 1970					x					
**Lasioseius thermophilus* Willmann, 1953	x									
Proctolaelaps hystrix Vitzthum, 1923	x									
Proctolaelaps scolyti Evans, 1958	x									
Proctolaelaps cossi (Dugés, 1834)	x									
Melichares eccoptogasteris Vitzthum, 1923	x									
**Anthoseius verrucosus* Wainstein, 1972	x									
Dendrolaelaps nikolai Shcherbak, 1978	x									
Dendrolaelaps longulus Hirschmann, 1960	x									
Multidendrolaelaps spinosus (Hirschmann, 1960)	x									
Hypoaspis myrmecophila (Berlese, 1892)	x									
Hypoaspis giffordi Evans et Till, 1966	x									
Polyaspis sansonei Berlese 1916	x									
Zercon curiosus Trägårdh, 1910	x									x
Proctolaelaps fiseri Samšinak, 1860	x							x		
Loboginoides spelaea Willmann, 1941	x							x		
Parasitus fucorum (De Geer, 1778)	x							x		
Schizosthetus simulatrix Athias-Henriot, 1982	x							x		
Dendrolaelaps disetosimilis Hirschmann, 1960	x							x		
Dendrolaelaps uncinatus Hirschmann, 1960	x							x		
Insectolaelaps armatus (Hirschmann, 1960)	x							x		
Multidendrolaelaps hexaspinosus Hirschmann, 1960	x							x		
Hypoaspis fuscicolens Oudemans, 1963	x							x		
Hypoaspis lubricoides Karg, 1971	x					x		x		
Microsejus truncicola Trägårdh, 1942	x	x						x		
Microgynium rectangulatum Trägårdh, 1942	x	x						x		
Trichouropoda ovalis (C.L. Koch, 1839).	x	x	x					x		
**Cheiroseius dungeri* Karg, 1971							x			
**Cheiroseius bryophilus* Karg, 1969							x			
Haemogamasus pontiger (Berlese, 1914)									x	
Haemogamasus nidi Michael, 1892									x	
Haemogamasus hirsutus Berlese, 1889									x	
Haemogamasus hirsutosimilis Willmann, 1952									x	
Haemogamasus horridus Michael, 1892									x	

Haemogamasus ambulans (Thorell, 1872)									x	
Hirstionyssus sciurinus (Hirst, 1921)									x	
Hirstionyssus talpae (Zemskaya, 1954)									x	
Hirstionyssus soricis Turk, 1945									x	
Hirstionyssus isabellinus Oudemans, 1913									x	
Hirstionyssus musculi (Johnston, 1849)									x	
Dermanyssus gallinae (DeGeer, 1778)									x	
Dermanyssus hirundinus (Hermann, 1804)									x	
Ornithonyssus bacoti (Hirst, 1913)									x	
Steatonyssus cavus. Rybin, 1992									x	
Macronyssus crosbyi (Ewing & Stover, 1915)									x	
Spinturnix myoti (Kolenati, 1856)									x	
Laelaps pavlovskyi Zachvatkin, 1948									x	
Laelaps micromydis Zachvatkin, 1948									x	
Laelaps muris (Ljung, 1799)									x	
Laelaps clethrionomydis Lange, 1955									x	
Laelaps pitymidis Lange, 1955									x	
Laelaps hilaris C. L. Koch, 1836									x	
Laelaps multispinosus Banks, 1909									x	
Laelaps amphibius (Zachvatkin, 1948)									x	
Laelaps arvalis (Zachvatkin, 1948)									x	
Haemolaelaps glasgowi (Ewing, 1925)									x	
Haemolaelaps semidesertus Bregetova, 1952									x	
Myonyssus decumani Tirabosci, 1904									x	
Myonyssus gigas Oudemans, 1912									x	
Myonyssus rossicus Bregetova, 1956									x	
Myonyssus ingricus Bregetova, 1956									x	
Macrocheles matrius pratensis Bregetova et Koroleva, 1960									x	
Hypoaspis heselhausi Oudemans, 1912									x	
Poecilochirus subterrancus (Müller, 1860)								x	x	
**Alliphis necrophilus* Christie, 1983								x		
Scarabaspis inexpectatus (Oudemans, 1903)								x		
Scamaphis equestris (Berlese, 1911)								x		
Macrocheles nataliae Bregetova et Koroleva, 1960								x		
Macrocheles perglaber Filipponi et Pegazzano, 1962								x		
Parasitus copridis Costa, 1963								x		
Parasitus beta Oudemans et Voigts, 1904								x		
Poecilochirus davydovae Hyatt, 1980								x		
Hypoaspis krameri (G. et R. Canestrini, 1881)								x		
Hypoaspis cuneifer (Michael, 1891)								x		
Hypoaspis bombicolens (Canestrini, 1884)								x		
Holostaspis isotricha (Kolenati, 1858)								x		
Uropoda ocellata Kontschán et Salmane, 2008								x		
Paragarmania dentriticus (Berlese, 1918)								x		
Blattisocius tarsalis (Berlese, 1918)								x		