

## The arthropod community of Scots pine (*Pinus sylvestris* L.) canopies in Norway

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We summarise the findings of arthropods collected by fogging the canopy of 24 pine trees in two sites in Eastern and Western Norway. From the samples, taken in 1998 and in 1999, almost 30,000 specimens were determined to 512 species, with Diptera being most species rich (210 species), followed by Coleoptera (76 species) and Araneae (49 species). Of the 96 new species records, nine were new to science (5 Diptera and 4 Oribatida), two were new to the European, three to the Scandinavian and 82 to the Norwegian faunas. The paper demonstrates the need for detailed faunistical inventories of European forests.

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## 1. Introduction

With the development of new methods in the early 1970's to access tree canopies, the study of arboreal arthropod communities changed from guesswork to highly accurate scientific standards. Deforestation especially in tropical regions encouraged scientists concerned with biodiversity loss, conservation issues, ecology and systematics to document the species and ecological systems associated with the largest proportion (by volume) of the forests, viz. the forest canopies. As a consequence, currently a large array of methods exist to gain access to the canopy, ranging from aerial trams and systems of ropes, pulleys and ladders to methods using insecticide fogging. While the arboreal arthropod forest-canopy research still is in its infancy, it has nevertheless documented a highly specialised fauna virtually wherever carried out. The number of arthropod species that may exist on Earth is continuously being discussed; partly as a consequence of recent canopy studies, the most optimistic estimates suggest a number as high as 50–80 million species (Erwin 1982, 1988, 1991, May 1988, Stork 1988). However, more modest global species richness estimates, also based upon canopy studies in the tropics, suggest a number of species as low as three million (e.g. Ødegaard 2000).

While the faunistics of several conifer species have been investigated to some extent, the associated fauna of pine canopies, particularly in Europe, is rather poorly known (Höregott 1960, Basset 1985, Borkowski 1986, Tenow & Larsson 1987, Cmoluchowa & Lechowski 1993, Simandl 1993, Bankowska 1994, Chobotow 1994, Cholewicka-Wisniewska 1994a, b, Czechowska 1994, Kolodziejak 1994, Sterzynska & Slepowronski 1994, Wasowska 1994, Docherty & Leather 1997, Brändle & Rieger 1999, Gunnarsson *et al.* 1999, Aakra 2000, Hagan *et al.* 2000, Ozanne *et*

*al.* 2000, Thunes *et al.* 2003). Moreover, most of these studies do not present a complete coverage of the fauna at a specific time, as only parts of the canopy were sampled, sampling had been extended over a very long period of time or samples were not identified to species for all groups.

This study is the first attempt to inventory the arboreal arthropod fauna associated with Scots pine (*Pinus sylvestris* L.) in Scandinavian forest. It was initiated in 1998 as part of a larger biodiversity program, Miljøregistrering i Skog, funded by the Norwegian Ministry of Agriculture. This paper will focus on the faunistics, whereas other papers investigate in more depth ecological aspects of major arthropod groups (e.g. Hagan *et al.* 2000, Hauge & Nielsen 2001, Thunes *et al.* 2003). We present the complete list of identified taxa found in the investigated pine canopies, with ecological discussion on the most important species. Also, as many of the taxa identified in this study rarely are treated in other surveys, the number of rarely recorded species is unusually high. Thus, a general discussion of rarity and red lists is given.

## 2. Material and methods

### 2.1. Study sites

The study was carried out in two forest sites in Norway (Fig. 1). One site, Geitaknottane in Kvam municipality (Hordaland County, 5°53' E, 60°05' N, 180–200 m a.s.l.), was a *Pinus sylvestris* dominated coastal forest with scattered *Juniperus communis*, *Sorbus aucuparia* and *Betula pubescens*. The other site, Heimseteråsen in Sigdal municipality (Buskerud County, 9°25' E, 60°03' N, 400–450 m a.s.l.), was a *P. sylvestris* dominated boreal forest where also *B. pubescens* and *Picea abies* were abundant. Additional site

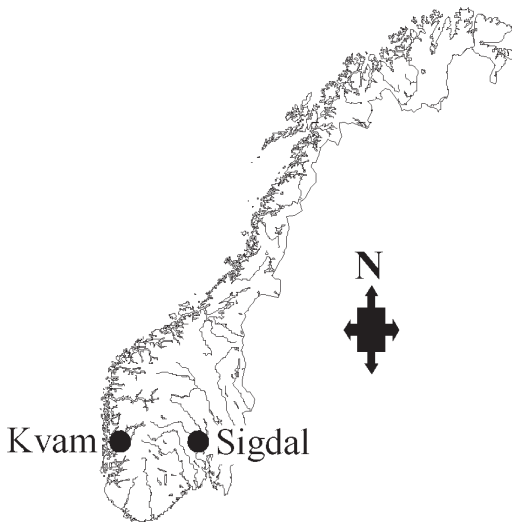


Fig. 1. The study areas.

details can be found in Ihlen *et al.* (2001) and Thunes *et al.* (2003).

## 2.2. Data collection

In Kvam, we sampled six trees between 26 and 29 May in 1998. In Sigdal, a total of 18 trees were fogged: six trees between 5 and 9 June in 1998 and 12 additional trees between 19 June and 17 July in 1999. To sample the arthropods, we used 1% synthetic pyrethroid (PySekt), dissolved in non-aromatic white spirit. While standing on the ground, we emitted the solution using a motorised canopy fogger (Swingfog 50) that heats up the gas that consequently rises into the canopy as a visible fog. It is, then, easy to observe if the entire tree has been treated. To avoid drift-away of the fog and to minimise disturbance, all trees were treated before dawn after a windless and dry night.

Increment core samples were taken in order to age each tree. We then separated the samples to be from either old (250+ years) or mature (70–110 years) trees.

Clean plastic funnels (diameter 30 cm) were examined for unwanted taxa, and placed concentrically on the ground to collect arthropods falling from the fogged canopies. Circles of funnels were placed 0.5 m apart from each other. Within each circle, the funnels were 1.0 m apart at Kvam, and

0.5 m apart from each other at Sigdal. The funnels remained on the ground for ca. one hour after fogging. Material collected from a given circle was pooled into one container, representing the sample from that circle.

Almost all the arthropods were identified to species by the following authors who also provided some faunistical information of the respective groups. John Skartveit – Coleoptera and Diptera: Lonchaeidae, Bibionidae, Pseudopomyzidae, Scatopsidae and Blattodea. Josef Starý and Torstein Solhøy – Oribatida. Arne Fjellberg – Collembola. Sverre Kobro, Sueo Nakahara, Richard zur Strassen and Gijsbertus Vierbergen – Thysanoptera. Ryszard Szadziewski, Daniel V. Hagan and William L. Grogan Jr. – Diptera: Ceratopogonidae. Terje Jonassen – Diptera: Hybotidae, Empididae and Dolichopodidae. Kjetil Aakra – Araneae. Johannes Anonby – Psocoptera. Lita Greve – Diptera: Lonchaeidae, Lauxaniidae, Acroceridae and Pallopteridae, Raphidioptera and Planipennia. Berend Aukema – Hemiptera: Heteroptera. Kai Heller – Diptera: Sciaridae. Verner Michelsen – Diptera: Anthomyiidae, Muscidae, Fannidae, Calliphoridae and Sarcophagidae. Jean-Paul Haenni – Diptera: Scatopsidae. Alexandr F. Emeljanov – Hemiptera: Auchenorrhyncha. Per Douwes – Hymenoptera: Formicidae. Kai Berggren – Lepidoptera. Jutta Franzen, R. Henry L. Disney and Sabine Prescher – Diptera: Phoridae and Sphaeroceridae. Kjell A. Johanson – Ephemeroptera, Plecoptera and Trichoptera. Boris Mamaev – Diptera: Cecidomyiidae. Sigita Podenas – Diptera: Tipulidae, Limoniidae and Pediciidae. Stig Andersen – Diptera: Tachinidae. Stephen D. Gaimari – Diptera: Chamaemyiidae. Emilia Nartshuk – Diptera: Chloropidae. Geir E. E. Søli – Diptera: Mycetophilidae. Laszlo Papp – Diptera: Acartophthalmidae, Borboropsidae and Miliichiidae. Fred Midtgaard – Hymenoptera: Symphyta. Arild Andersen – Diptera: Agromyzidae. Michael von Tschirnhaus – Diptera: Agromyzidae. Gerhard Bächli – Diptera: Drosophilidae. Kjell M. Olsen – Chilopoda. Hans Olsvik – Odonata. Mihály Földvári – Diptera: Pipunculidae. Jan E. Raastad – Diptera: Simuliidae. Lars O. Hansen – Hymenoptera: Vespidae. Per Djursvoll – Diplopoda.

The following taxa were not identified to spe-

cies level due to the lack of taxonomical expertise or time restrictions. Diptera: Chironomidae and some minor families, Hymenoptera: Parasitica and some Aculeata except ants, and Acari except Oribatida. The majority of the material will be deposited in the collections of the Norwegian Forest Research Institute, Ås. Some collaborators retained voucher specimens for the collections of their own institutions. Type material of two species of Diptera: Ceratopogonidae that were described from this material (Szadziewski & Hagan 2000) is deposited in the University of Gdansk, Poland. Six additional species (four Acari: Oribatida, two Diptera: Cecidomyiidae) await description and will subsequently be deposited in the Academy of Sciences of the Czech Republic and the Russian Academy of Sciences, St. Petersburg, Russia, respectively.

### 2.3. Assignment of new faunistic records and central references for ecological information

To assign Diptera species as new records is mostly based on the information by Papp and Darvas (1997, 1998), but also on considerations and recommendations from the authors. For other groups, a species is assigned a new record also when it is represented in collections but is yet, to our knowledge, to be published.

We present here a list of articles used in the species record chapter below. Araneae – Roberts (1987, 1995), Aakra (2000) and Hauge & Nielsen (2001). Oribatida – Wunderle (1992) and Prinzing & Wirtz (1997). Collembola – Prinzing (1997), Prinzing & Wirtz (1997) and Hågvar & Fjellberg (2002). Hemiptera – Wagner (1952, 1966), Southwood & Leston (1959), LeQuesne (1960, 1965), Péricart (1972), Ossiannilsson (1978–1983) and LeQuesne & Payne (1981). Psocoptera – New (1974), Prinzing & Wirtz (1997) and Lienhard (1998). Thysanoptera – Lewis (1973) and Mound *et al.* (1976). Raphidioptera and Planipennia – Aspöck *et al.* (1980) and Plant (1997). Lepidoptera – Heath (1976), Emmet (1979), Skinner (1984), Skou (1984) and L. Aarvik (pers. comm). Diptera – Chvála (1975), Miller (1977), d'Assis Fonseca (1978), McAlpine (1987), Greve (1993), Chvála (1994),

Gilka (1996), Menzel and Mohrig (1997), Disney (1998), MacLean (1998), Merz (1998), Hagan *et al.* (2000) and Szadziewski & Hagan (2000). Hymenoptera – Benson (1951, 1958) and Bolton & Collingwood (1975). Coleoptera – Henriksen (1913), Hansen (1918, 1927, 1938, 1945, 1950–1951, 1951–1954), Spessivtseff (1925), Palm (1948, 1968, 1970, 1972), Buck (1954), Brendell (1975), Lindroth (1986, 1992), Bílý & Mehl (1989) and Majerus & Kearns (1989).

## 3. Results

### 3.1. Faunistics

The complete list of species is presented in the Appendix and in Figs. 2–3. Altogether 29,736 specimens were identified to 512 species. Ninety-six species were new to the Norwegian fauna (78 Diptera; 10 Oribatida, 3 Araneae, 2 Thysanoptera, 2 Hymenoptera and 1 Psocoptera) (Table 1). Of these, nine species were new to science; two ceratopogonid midges have recently been described by Szadziewski and Hagan (2000). In addition, three of these species were new records for Scandinavia and two were new European records. One Diptera family, Borboropsidae, was recorded from Norway for the first time.

As conifer needles are a relatively poor nitrogen source, compared to leaves, and the epiphytic cover is almost negligible in these forests, compared to old-growth conifer forests of western United States and Canada, we did not expect a very high number of specimens (Schowalter *et al.* 1988, Recher *et al.* 1996, Winchester & Ring 1996b). Nevertheless, in the 24 trees, Oribatida was the most abundant taxon with 8,532 specimens (29.0% of the total invertebrate catch), followed by Collembola (19.9%) and Diptera (19.8%) (Fig. 3a). When ranked, these numbers are very close to results from similar studies carried out in temperate and tropical regions (e. g. Ammer & Schubert 1999, Fagan & Winchester 1999, Palacios-Vargas *et al.* 1999).

Diptera and Coleoptera were the two most species rich groups in both study areas (Fig. 2). Altogether they comprised almost 50% of the number of species (alpha diversity) collected in 1998. In 1999, the percentage represented by

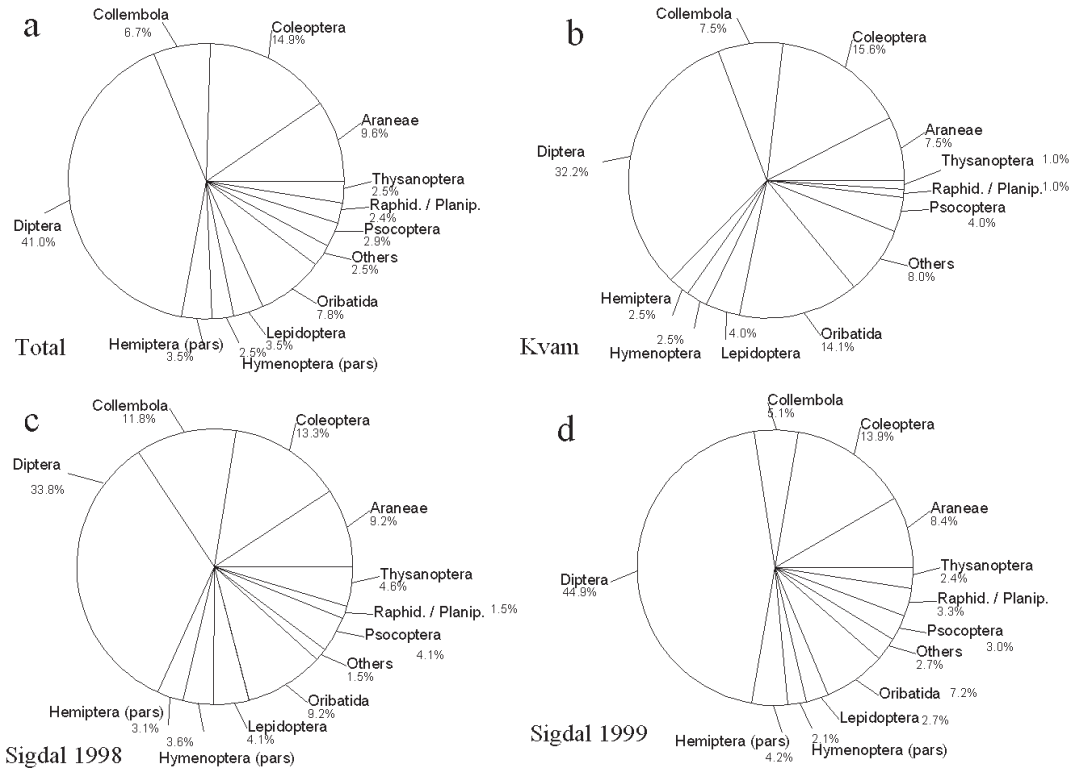


Fig. 2. Proportions of species. – a. Total, years combined. – b. Kvam. – c. Sigdal in 1998. – d. Sigdal in 1999.

these taxa was even higher (59%). Spiders, which have been shown to be very abundant in canopies, did not exceed 10% of the species in either Kvam or Sigdal (Fig. 2b–d), and the number of specimens was very low (Fig. 3b–d). While Diptera constituted one-third of the specimens collected in Kvam (Fig. 3b), the thysanopterans constituted more than one-third (36%) of the Sigdal material collected in 1998, with the dipterans represented by less than one-fifth (17%).

It is particularly interesting to see the drastic change from 1998 to 1999 in the material from Sigdal (Fig. 2c–d); the proportion of Thysanoptera was more than quartered while the proportion of Oribatida was doubled. The proportion of Diptera and Collembola in the samples was strikingly similar between the two years. Thysanoptera, Collembola, Oribatida and Diptera made up 94% of all specimens sampled from Sigdal in 1998, while the same groups constituted 84% in 1999. Thysanoptera dominated the 1998 samples (36%), while Oribatida played the most important role in 1999 (37%).

## 3.2. Species records

### 3.2.1. Araneae

Three species, viz. *Entelecara flavipes* (Blackwall), *Theridion pinastri* L. Koch and *Dipoena torva* (Thorell), of totally 49 species were new records for Norway. The faunistics of spiders is relatively well known in Norway (K. Aakra, pers. comm.), and even though the three species were found in low numbers, both *D. torva* (an ant predator) and *T. pinastri* are species known to be associated with pine forests. Aakra (2000) presents details on the Araneae found in this study.

While *Minyriolus pusillus* (Wider), *Pocadicnemis pumila* (Blackwall), *Tenuiphantes alacris* (Blackwall), *Pardosa lugubris* (Walckenaer) and *Neon reticulatus* (Blackwall) most likely are visitors, most of the other species are typical conifer forest species. Particular species records worth mentioning as pine associated species are *Clubiona subsultans* Thorell and *Robertus scoticus* Jackson that are only known from

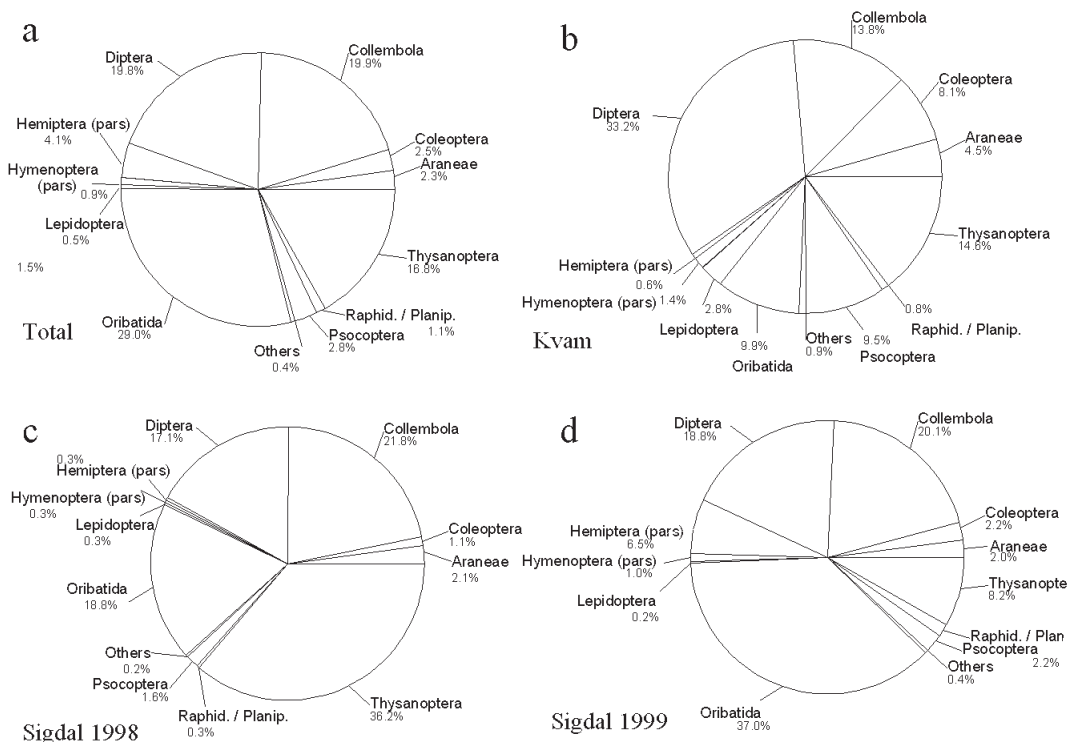


Fig. 3. Proportions of specimens. – a. Total, years combined. – b. Kvam. – c. Sigdal in 1998. – d. Sigdal in 1999.

pine forests, even though both species are predominantly ground living.

Furthermore, *Philodromus collinus* C. L. Koch lives on lower branches of trees, especially conifers, while *Atea sturmi* (Hahn) is associated with evergreen trees and bushes. *Walckenaeria dysderoides* (Wider) is usually found in pine needles and moss. Likewise, *Dismodicus elevatus* (C. L. Koch) is usually found on conifers. *Philodromus margaritatus* (Clerck) (on the bark of lichen-covered trees) and *Moebelia penicillata* (Westring) (in crevices of tree trunks) were commonly found species that, we believe, do not use pines as a prime habitat. Two species, *Entelecara congenera* (Cambridge) and *Dendryphantès rudis* (Sundevall) were found in Norway for the second time. The last time *D. rudis* was collected was in 1875.

### 3.2.2. Oribatida

The five most abundant oribatid species, *Phauloppia lucorum* (C. L. Koch), *Cymbere-*

*maeus cymba* (Nicolet), *Camisia segnis* (Hermann), *Hemileius initialis* (Berlese) and *Carabodes labyrinthicus* (Michael), constituted 96.1% of the total oribatid material. These species, except for *H. initialis*, are known arboreal species. Further known arboreal species are *Carabodes ornatus* Storkan, *C. willmanni* Bernini, *Paraleius leontonycha* Travé, *Phauloppia coineau* Travé, *P. saxicola* Travé, *Micreremus brevipes* (Michael), *Diapterobates humeralis* (Hermann) and possibly *Steganacrus magnus* (Nicolet). The remaining species are known to live predominantly in other habitats than canopies.

### 3.2.3. Collembola

Thirty-four Collembola species were found, and none of these was new to the Norwegian fauna; instead, all species are considered common. *Lepidocyrtus lignorum* (Fabr.) and *Entomobrya nivalis* (L.) were the dominating species, constituting over 90% of the total material. It is note-

Table 1. List of new species records, with their preferred habitat association when known. Number of species in each group is given in parentheses. “?” = habitat unknown, <sup>1</sup> = species described from the current material.

Higher taxon	Species name	Habitat
<b>Species new to science</b>		
Acari: Oribatida (4)	<i>Hypodamaeus</i> sp. n.	?
	<i>Oribatula</i> sp. n.	?
	<i>Phthiacarus</i> sp. n. (nr. 1)	?
	<i>P.</i> sp. n. (nr. 2)	?
Diptera: Cecidomyiidae (2)	<i>Lestodiplosis</i> sp. n.	?
	<i>Sitodiplosis</i> sp. n.	?
Diptera: Ceratopogonidae (2)	<i>Brachypogon norvegicus</i> Szadziewski & Hagan <sup>1</sup>	?
	<i>Dasyhelea norvegicus</i> Szadziewski & Hagan <sup>1</sup>	?
Diptera: Phoridae (1)	<i>Megaselia</i> sp. n.	?
<b>Species new to Europe</b>		
Diptera: Ceratopogonidae (2)	<i>Bezzia rhynchostylata</i> Remm	?
	<i>Dasyhelea ledi</i> Remm	?
<b>Species new to Scandinavia</b>		
Diptera: Phoridae (3)	<i>Megaselia emarginata</i> (Wood)	?
	<i>M. aculeata</i> (Schmitz)	Arable fields
	<i>M. cothurnata</i> (Schmitz)	?
<b>Species new to Norway</b>		
Araneae (3)	<i>Theridion pinastris</i> L. Koch	Pine woods, heathland, low vegetation
	<i>Dipoena torva</i> (Thorell)	Pine woodlands
	<i>Entelecara flavipes</i> (Blackwall)	Conifer forest
Acari: Oribatida (6)	<i>Chamobates pusillus</i> Berlese	Ground
	<i>Diapterobates humeralis</i> (Hermann)	Arboreal
	<i>Paraleius leontonycha</i> Travé	Arboreal
	<i>Phauloppia coineaui</i> Travé	Arboreal
	<i>P. saxicola</i> Travé	Arboreal
	<i>Micreremus brevipes</i> (Michael)	Arboreal
Pscoptera (1)	<i>Dorypteryx domestica</i> (Smithers)	Anthropogenic
Thysanoptera (2)	<i>Aeolothrips vittatus</i> Haliday	Pine, spruce, predator
	<i>Acanthothrips nodicomis</i> (Reuter)	Arboreal, bark
Diptera: Pediciidae (1)	<i>Tricyphona</i> s. str. <i>unicolor</i> (Schummel)	?
Diptera: Sciaridae (8)	<i>Corynoptera boletiphaga</i> (Lengersdorf)	?
	<i>C. trepida</i> (Winnertz)	?
	<i>Ctenosciara hyalipennis</i> (Meigen)	Conifer forests
	<i>Camptochaeta camptochaeta</i> (Tuomikoski)	?
	<i>Bradysia brevispina</i> Tuomikoski	?
	<i>Cratyna uliginosa</i>	?
	<i>C.</i> sp.	?
	<i>Epidapus gracilis</i> (Walker)	Coniferous forests
Diptera: Cecidomyiidae (1)	<i>Porricondyla fuscostriata</i> Panelius	?
Diptera: Ceratopogonidae (40)	<i>Culicoides alatavicus</i> Smatov & Isimbekov	?
	<i>C. albicans</i> (Winnertz)	Peat bogs
	<i>C. clintoni</i> Boorman	Peat bogs
	<i>C. comosioculatus</i> Tokunaga	?
	<i>C. dewulfi</i> Goetghebuer	Dung
	<i>C. grisescens</i> Edwards	?
	<i>C. heliophilus</i> Edwards	Peat bogs
	<i>C. kibunensis</i> Tokunaga	?
	<i>C. sphagnumensis</i> Williams	?
	<i>C. scoticus</i> Downes & Kettle	Dung
	<i>C. vexans</i> (Staeger)	?



	<i>Alluaudomyia quadripunctata</i> (Goetghebuer)	?
	<i>Brachypogon bialoviesicus</i> Krzywinski	?
	<i>B. nitidulus</i> (Edwards)	?
	<i>B. perpusillus</i> (Edwards)	?
	<i>B. vitiosus</i> (Winnertz)	?
	<i>Schizohalea leucopeza</i> (Meigen)	?
	<i>Bezzia affinis</i> (Staeger)	?
	<i>B. bicolor</i> (Meigen)	?
	<i>Palpomyia serripes</i> (Meigen)	?
	<i>Atrichopogon lucorum</i> (Meigen)	Rotting material
	<i>A. minutus</i> (Meigen)	Rotting material
	<i>Forcipomyia acidicola</i> (Tokunaga)	Rotting material
	<i>F. albostyla</i> Remm	Rotting material
	<i>F. ciliata</i> (Winnertz)	Rotting material
	<i>F. brevipennis</i> (Macquart)	Dung
	<i>F. fuliginosa</i> (Meigen)	Rotting material
	<i>F. hygrophila</i> Kieffer	Rotting material
	<i>F. kaltenbachi</i> (Winnertz)	Rotting material
	<i>F. monilicornis</i> (Coquillet)	Rotting material
	<i>F. nigra</i> (Winnertz)	Rotting material
	<i>F. nigrans</i> Remm	Rotting material, arboreal
	<i>F. palustris</i> (Meigen)	Rotting material
	<i>F. titillans</i> (Winnertz)	Rotting material
	<i>Dasyhelea bensoni</i> Edwards	?
	<i>D. biunguis</i> Kieffer	?
	<i>D. europaea</i> Remm	?
	<i>D. luteiventris</i> Goetghebuer	?
	<i>D. modesta</i> (Winnertz)	?
	<i>D. parallela</i> Remm	?
Diptera: Empididae (2)	<i>Rhamphomyia poplitea</i> Wahlberg	?
	<i>Iteaphila nitidula</i> (Zetterstedt)	?
Diptera: Phoridae (7)	<i>Megaselia robusta</i> Schmitz	?
	<i>M. spinigera</i> (Wood)	?
	<i>M. fusciclava</i> Schmitz	?
	<i>M. nigriceps</i> (Loew)	Necrophagous
	<i>Phora obscura</i> (Zetterstedt)	?
	<i>Menoziola obscuripes</i> (Schmitz)	Ant parasite
Diptera: Lonchaeidae (2)	<i>Lonchaea laxa</i> Collin	Bark?
	<i>L. stackelbergi</i> Czerny	Bark?
Diptera: Acartophthalmidae (1)	<i>Acartophthalmus nigrinus</i> (Zetterstedt)	Saprophagous
Diptera: Milichiidae (1)	<i>Phyllomyza formicae</i> Schmitz	?
Diptera: Borboropsidae (1)	<i>Borboropsis puberula</i> (Zetterstedt)	?
Diptera: Drosophilidae (1)	<i>Scaptomyza teinoptera</i> Hackman	?
Diptera: Chloropidae (2)	<i>Thaumatomyia notata</i> (Meigen)	Roots
	<i>Conioscinella sordidella</i> (Zetterstedt)	?
Diptera: Anthomyiidae (2)	<i>Alliopsis brunneigena</i> (Schnabl)	?
	<i>Anthomyia mimetica</i> (Malloch)	?
Hymenoptera: Tenthredinidae (2)	<i>Pristiphora coniceps</i> Lindquist	<i>Salix</i>
	<i>P. pallidiventris</i> Fallén	Rosaceae

worthy that 98% of the specimens of *Hypogastrura socialis* (Uzel) were sampled from one single tree in Sigdal in 1998. The species is known for its aggregation behaviour and is often reported undertaking large mass migrations on the forest floor.

### 3.2.4. Hemiptera

Of the 18 species found, none were new to the Norwegian fauna. Moreover, the following species are to varying extent associated with pine: *Plesiodema pinetella* (Zetterstedt) and *Phoeni-*

*cocoris obscurellus* (Fallén) commonly occur on both pine and spruce, whereas both species of *Acomporis*, *Elatophilus nigricornis* (Zetterstedt) and *Gastrodes grossipes* (DeGeer) are pine associated. *Aguriahana germari* (Zetterstedt) is oliphagous on *Pinus* species. *Oncopsis flavicollis* (L.), *Cixius similis* (Kirschbaum) and *Speudotettix subfuscus* (Fallén) are associated with several habitats, and we suspect them to be occasional visitors.

### 3.2.5. Psocoptera

*Valenzuela burmeisteri* (Brauer), *V. despaxi* (Badonnel), *Enderleinella obsoleta* (Stephens), *Cuneopalpus cyanops* (Rostock) and *Stenopsocus lachlani* Kolbe are closely associated with conifers, as some of them are typical conifer-associated species known to feed on fungal spores, algae and lichens growing on conifers. Interestingly, one female nymph of *Valenzuela gynapterus* (Tetens) was collected; females of this species are wingless and extremely rarely collected. Moreover, *V. burmeisteri* is known to overwinter as egg. However, we sampled two adult specimens as early as late May and early June, possibly indicating that it also overwinters as nymph or imago. One species, *Dorypteryx domestica* (Smithers), was recorded from Norway for the first time (J. Anonby in prep.). *Liposcelis silvarum* (Kolbe) is the only free-living Norwegian species of a genus otherwise known for its several domestic species (the “book-lice”). The flattened body may be an adaptation to life under flakes of bark on tree trunks, habitat for several Central and Southern European species. Rather few finds of *L. silvarum* are known from Norway. Its abundance in our material, particularly in the inner parts of the canopy, suggests that the species prefers the tree trunk and inner parts of the branches, where it is not readily collected by the “beating tray” most often used for Psocoptera sampling. It has not previously been found in Western Norway; together with its absence on the British Isles, this supports an idea that the species prefers dry climate.

### 3.2.6. Thysanoptera

Of fourteen species of thrips, two were new to the

Norwegian fauna, namely *Aeolothrips vittatus* Haliday and *Acanthothrips nodicornis* (Reuter). Twenty-nine *A. vittatus* individuals were found in Sigdal, and it is likely to be a canopy specialist, as it is believed to be a predator in *Pinus* and *Picea*. In addition to *A. vittatus*, both *Oxythrips* species and *Thrips pini* (Uzel) are pine-living species. *Hoplothrips ulmi* (Fabricius), *A. nodicornis* and *Hoplandrothrips williamsianus* Priesner are all associated with saprophytic fungi. Many species of thrips are also known to use pine crevices as overwintering habitats.

### 3.2.7. Raphidioptera and Planipennia

All but one species, viz. *Coniopteryx pygmaea* Enderlein, were sparsely represented in this material. *C. pygmaea* is a conifer specialist, often aggregating in pine and spruce, where the larvae prey upon mites. Other pine-associated species include *Raphidia ophiopsis* (L.), *Conwentzia pineticola* Enderlein, *Parasemidalis fuscipennis* (Reuter), *Symphorobius fuscescens* (Wallengren), *Hemerobius nitidulus* Fabricius and *H. stigma* Stephens.

### 3.2.8. Lepidoptera

Almost the entire moth sample was collected as larvae, and most of the species are also known to feed directly on needle material. In the list of species (Appendix), the following species that include all the common species are ubiquitous pine specialists: *Hylaea fasciaria* (L.), *Heterothera firmata* (Hübner), *Thera obeliscata* (Hübner), *Panolis flammea* (Denis and Schiffermueller), *Exotelia dodecella* (L.), *Ocnerostoma piniarella* Zeller, *O. friesei* Svensson, *Sphinx pinastri* L. and *Cedestis subfasciella* (Stephens).

### 3.2.9. Diptera

Seventy-eight of the 210 dipterous species (37.1%) were new to the Norwegian fauna. Of these, five were new to Scandinavia, one new to Europe and five new to science. Among the Diptera, the lesser known families Ceratopogonidae and Phoridae showed an extraordinary high number of new faunistical records. Of the 78 new records, 44 were ceratopogonids (56.4%),

including two species new to science, and ten species (12.8%) of Phoridae were new to the Norwegian fauna, with one new to science. In addition, the following families had new records: Sciaridae (eight, including *Cratyna* as a new genus), Cecidomyiidae (three, including two new species), Empididae (two), Anthomyiidae, Lonchaeidae, and Chloropidae with two species each, and Borboropsidae (new family record), Milichiidae, Drosophilidae, Acartophthalmidae and Pediciidae with one species each (Appendix). Thus, by fogging 24 pine trees, our samples hosted almost 2.2% new records to the Norwegian fauna [numbers based on Ottesen (1993)].

Because no Diptera larvae were identified, it is difficult to assign specific host associations. However, based on the limited information available for many dipterous groups, the following taxa are probably associated with pine to some extent: all the species of Chamaemyiidae from this study are predators associated with pine living Adelgidae (Aphididae) in the genus *Pineus*. Although there are no relevant biological records for the lauxaniid species *Minettia lupulina* (F.) in the Palearctic, several species of *Minettia* s. str. have been reared as saprophages from decaying cones and club tops of various gymnosperms, including species of *Pinus*. Moreover, the sciarids *Ctenosciara hyalipennis* (Meigen) and *Epidapus gracilis* (Walker) are very numerous in conifer forests. The hybotid species *Tachypeza nubila* (Meigen) and *Medetera* of the family Dolichopodidae are commonly found on tree trunks. *Empis* (*Anacrostichus*) *lucidus* (Empididae) is known to copulate on the branches on coniferous trees. Members of the genus *Lonchaea* (Lonchaeidae) and *Palloptera usta* (Meigen) (Pallopteridae) and *Medetera* (Dolichopodidae) are associated with bark beetles. The ceratopogonid midge *Forcipomyia nigrans* Remm has been collected on rotting pine debris. The two species of *Lasiomma* (Anthomyiidae), *Mydaena sootryeni* Ringdahl (Muscidae) and *Fannia verrallii* (Stein) (Fanniidae) are extremely rarely collected by conventional insect collecting methods. Even though they are not abundant in our material, their presence indicates an association with canopies beyond accidental visits. Finally, the phorid genus *Menozziola* is an ant parasitoid and may parasitize arboreal ants.

### 3.2.10. Hymenoptera

Two species of Symphyta, *Pristiphora coniceps* Lindquist and *P. pallidiventris* Fallén, were new to the Norwegian fauna. The former species is associated with *Salix*, while the latter is associated with species in the family Rosaceae. The few specimens found, suggest no obligatory relationship with pines whatsoever. *Xyela julii* (Brebisson) is strictly associated with pine however, as it feeds from pollen of male pine flowers. All the sampled species of *Formica* and *Lasius* are common species in conifer forests.

### 3.2.11. Coleoptera

The majority of the beetle species recorded are somehow linked to Scots pine, either inhabiting or feeding on dead or living trees, or on other insects associated with the trees. The five species of *Dromius* found are all arboreal. *D. angustus* Brullé is apparently confined to pine in Scandinavia, while *D. fenestratus* (Fabricius) and *D. schneideri* Crotch occur mainly on pine. *D. agilis* Fabricius can be found on a wide range of trees. Other pine associates are *Ernobius nigrinus* (Sturm) which lives in pine shoots, *Rhagonycha elongata* (Fallén), *Cryptophagus angustus* Ganglbauer, *C. dorsalis* Sahlberg, *Brachonyx pineti* (Paykull), *Pissodes piniphilus* (Herbst), *Scymnus suturalis* Thunberg, *Exochomus quadripustulatus* (L.) and *Sphaeriestes castaneus*. The coccinellids found are all species of conifer woodlands. *Myrrha octodecimguttata* (L.) and *Myzia oblongoguttata* (L.) are particularly found in the crowns of mature Scots pines.

## 4. Discussion

A few species present may indicate some degree of pollution of either the water used to dilute the alcohol, *Calluna* specialists entering the funnels from the ground or specimens brought with the funnels from the storage. The aquatic *Limnozetes rugosus* Sellnick (Oribatida) is probably present due to contaminated water. *Hyledelphax elegantula* (Boheman) (Auchenorrhyncha) might also be a contaminating species, because it is considered as being associated with *Calluna* heaths

and *Vaccinium* wood glades. *Dorypteryx domestica* (Psocoptera) was probably hidden in the funnels prior to sampling, because this domestic species has previously been unknown from nature.

#### 4.1. Are the pine canopies that special?

Based on results from temperate and tropical studies, canopies represent a unique hotspot for invertebrate biodiversity (e.g. Winchester & Ring 1996a, b, Stork *et al.* 1997, Walter *et al.* 1998). Pine canopies seem to be no exception, but their importance is missed at the conventional sampling height of 1.5–2 m. However, broadleaf species such as *Quercus*, *Fagus*, *Betula* and *Salix* have been shown to be comparably much richer (Overgaard Nielsen 1975, Overgaard Nielsen & Ejlersen 1977, Gjelstrup 1979, Southwood *et al.* 1982, Ammer & Schubert 1999). Nevertheless, 510 species, almost 30,000 specimens and almost 20% [(96 new spp. / 512 spp. altogether)\*100] new species to the national fauna sampled within a total time span of roughly 24 hours is a very high 'revenue' compared to any conventional method and sampling regime. It is, however, important to take into consideration that many, if not most of the taxa with new records are disregarded or assigned to morphospecies in most studies, usually because of the lack of taxonomic expertise or small budgets granted to species identification. Moreover, species richness *per se* does not necessarily tell much about the uniqueness of the canopy fauna for a given species of tree. Complimentary species, i.e. those that are not found elsewhere, may be more important to be considered when comparing relatively species-poor pine trees with e.g. oak.

Probably the most advantageous feature of canopy fogging is that one can be certain of the origin of the material; even 'tourists' are definitely present in the canopy upon sampling. One cannot ascertain, however, that the entire material is obligatorily associated with canopies *per se*, and wood borers and several phytophagous species (e. g. miners) are underrepresented in this kind of material. Even if they are killed by the insecticide fog, they will remain inside their habitat. However, many dipterous species use overhang-

ing branches or the canopy as reference points during swarming (Chvála 1983, 1990). Consequently, a number of species not directly associated with canopies, such as *Euthyneura myrtillii*, will be over-represented in such material, as corroborated by the high proportion of males in our material.

#### 4.2. How valuable are faunistical lists?

This study demonstrates how little we know about the arthropod fauna in temperate forests. Huge efforts have been put into documenting the fauna and flora of tropical rain-forest canopies, but so much information awaiting to be revealed is hidden also within temperate forests. Many of the species we collected in the present study are clearly associated with pine trees, but most of the species are not. This raises a critical question to how we set a price on natural values. The red lists of species are often used as an alibi for habitat conservation or perhaps more commonly the opposite, habitat destruction: if only a few currently red-listed species are present in one area, its value is lower than the value of another area with more red-listed species. In Norway, the only red-listed arthropod groups are spiders, beetles, Lepidoptera and some minor groups, mainly aquatic insects. Apart from these groups, none of the species-rich groups in forests are faunistically or ecologically well known enough to be included in the list. Counting both number of species and specimens, these groups (with beetles as an exception) are most abundant in the pine forest, at least in canopies, the part of the forest making up the largest proportion of its volume. Paradoxically, because of the lack of taxonomists, these groups are rarely studied, and because of the lack of studies, their significance is neglected. However, the present paper, representing the first step of describing the canopy fauna of pine trees in Norway, substantiates the need for further basic faunistical surveys and studies.

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Appendix. List of species. New records are marked with an asterisk. Species marked with asterisk(s) in parentheses are new records but have been published separately from this material. The numbers under Kvam, Sigdal 1998 and Sigdal 1999, respectively, are the actual numbers of specimens sampled of that particular species.

Order/Family	Species	Habitat	Kvam	Sigdal 1998	Sigdal 1999	
<b>Araneae</b>						
Dictynidae	<i>Dictyna arundinacea</i> (L.)	Conifer forest	–	9	8	
	<i>D. sp.</i> (juveniles)	–	–	–	5	
Segestriidae	<i>Segestria senoculata</i> (L.)	Holes in walls and bark	1	–	–	
Clubionidae	<i>Clubiona comta</i> C. L. Koch	–	11	–	–	
	<i>C. trivialis</i> L. Koch	–	1	–	–	
	<i>C. subsultans</i> Thorell	Pine	–	4	4	
	<i>C. spp.</i> (juveniles)	Bushes and trees, under bark	4	23	53	
Thomisidae	<i>Coriachne depressa</i> (C. L. Koch)	Under bark and stones, conifers	–	1	–	
	<i>Xysticus audax</i> (Schrank)	–	–	–	2	
	<i>X. sp.</i> (juveniles)	–	–	–	2	
Philodromidae	<i>Philodromus aureolus</i> (Clerck)	Conifer forests	1	1	8	
	<i>P. collinus</i> C. L. Koch	Lower branches, especially conifers	–	4	6	
	<i>P. margaritatus</i> (Clerck)	Bark on lichen-covered trees, conifers	–	1	–	
	<i>P. fuscomarginatus</i> DeGeer	Conifer forests	–	2	1	
	<i>P. cespitum</i> (Walckenaer)	Conifer forests	–	–	1	
	<i>P. spp.</i> (juveniles)	–	–	–	12	
Salticidae	<i>Dendryphantas rudis</i> (Sundevall)	Branches and trunks, conifers	–	1	–	
	<i>Evarcha falcata</i> (Clerck)	Woodlands, lower branches, bushes	–	1	–	
	<i>Neon reticulatus</i> (Blackwall)	–	–	–	1	
Lycosidae	Salticidae (juvenile)	–	–	1	–	
	<i>Pardosa lugubris</i> (Walckenaer)	–	–	–	1	
	<i>P. sp.</i> (juvenile)	–	–	–	1	
	Lycosidae indet. (juveniles)	–	–	–	2	
Hahniidae	<i>Cryphoea silvicola</i> (C. L. Koch)	Woodlands, bark, crevices, conifers	1	–	–	
Theridiidae	<i>Theridion varians</i> Hahn	–	1	–	2	
	<i>T. tinctum</i> (Walckenaer)	Conifer forest	–	2	–	
	<i>T. sisyphium</i> (Clerck)	–	–	–	2	
	(*) <i>T. pinastris</i> L. Koch	Pine woods, heathland, low vegetation	–	–	1	
	<i>T. sp.</i> (juvenile)	–	–	–	1	
	<i>Robertus scoticus</i> Jackson	Pine	–	3	–	
	<i>Steatodea bipunctata</i> (L.)	–	–	1	–	
	<i>Theonoe minutissima</i> (Cambridge)	–	1	–	–	
	<i>Paidiscura pallens</i> (Blackwall)	Conifer forest	9	–	–	
	(*) <i>Dipoena torva</i> (Thorell)	Pine woodlands	–	–	1	
	<i>Episinus angulatus</i> (Blackwall)	–	–	–	1	
	Tetragnathidae	<i>Tetragnatha montana</i> Simon	–	5	–	1
		<i>T. spp.</i> (juveniles)	–	2	–	2
Araneidae	<i>Atea sturmi</i> (Hahn)	Conifer forest	8	6	13	
	<i>A. sp.</i> (juveniles)	–	–	–	5	
	<i>Araneus sp.</i> (juveniles)	–	–	–	19	
	<i>Arianella cf. cucurbitina</i> (Clerck)	–	1	–	–	
	<i>Zygiella stroemi</i> (Thorell)	Pine	–	–	1	
	<i>Cyclosa conica</i> (Pallas) (juveniles)	Conifer forest	–	–	2	
	<i>Nuctenea sp.</i> (juvenile)	Bark, crevices	–	–	1	
	<i>Araneidae</i> (juveniles)	–	–	2	57	
Linyphiidae	<i>Tenuiphantes alacris</i> (Blackwall)	–	2	–	–	
	<i>Lepthyphantes obscurus</i> (Blackwall)	–	2	–	–	
	<i>L. pallidus</i> (Cambridge)	–	–	1	–	



	<i>Moebelia penicillata</i> (Westring)	Crevices, conifer forest	–	3	8
	<i>Bolyphantes crucifer</i> (Menge)	–	–	1	1
	<i>Walckenaeria dysderoides</i> (Wider)	Pine needles, moss	–	2	–
	<i>Minyriolus pusillus</i> (Wider)	–	–	1	–
	<i>Dismodicus elevatus</i> (C. L. Koch)	Conifers	4	–	–
	<i>Centromerus arcanus</i> (Cambridge)	–	1	–	–
	A. sp.	–	–	–	1
	<i>Pityohyphantes phrygianus</i> (C. L. Koch)	Conifer forest	–	–	41
	<i>Agnyphantes expunctus</i> (Cambridge)	–	–	–	5
	* <i>Etelecara flavipes</i> (Blackwall)	Conifer forest	–	–	2
	<i>E. congenera</i> (Cambridge)	Conifer forest	–	–	1
	<i>Pocadicnemis pumila</i> (Blackwall)	–	–	–	5
	<i>Maso sundevalli</i> (Westring)	–	–	–	1
	Linyphiidae (juveniles)	–	6	–	1
Indet. juveniles		–	77	101	77
Sum of species (total 49)			15	18	28
Sum of specimens (total 668)			138	171	359
<b>Oribatidae</b>					
Liacaridae	<i>Adoristes poppei</i> (Oudemans)	Ground	3	15	–
	<i>A. ovatus</i> (C. L. Koch)	Ground	–	–	4
	<i>Liacarus subterraneus</i> (C. L. Koch)	Ground	–	–	1
Damaeidae	<i>Belba compta</i> (Kulczynski)	Ground	1	–	–
Camisiidae	<i>Camisia biurus</i> (C. L. Koch)	Ground	2	2	3
	<i>C. segnis</i> (Hermann)	Arboreal	17	67	193
	<i>Platynothrus peltifer</i> (C. L. Koch)	Ground	1	–	–
Carabodidae	<i>Carabodes labyrinthicus</i> (Michael)	Arboreal	25	35	51
	<i>C. ornatus</i> Storkan	Ground, arboreal	2	–	–
	<i>C. willmanni</i> Bernini	Arboreal	1	–	–
	<i>Odontocephus elongatus</i> (Michael)	Ground	2	1	1
Cepheidae	<i>Cepheus latus</i> C. L. Koch	Ground	2	–	–
	<i>C. cepheiformis</i> (Nicolet)	Ground	–	1	2
Metrioppiidae	<i>Ceratoppia bipilis</i> (Hermann)	Ground	9	–	2
Chamobatidae	* <i>Chamobates pusillus</i> Berlese	Ground	1	–	–
	<i>C. borealis</i> (Trägårdh)	Ground	–	1	5
Cyberemaeidae	<i>Cyberemaeus cymba</i> (Nicolet)	Arboreal	11	57	371
Ceratozetidae	* <i>Diapterobates humeralis</i> (Hermann)	Arboreal	64	2	34
	<i>Fuscozetes fuscipes</i> (C. L. Koch)	Ground	1	–	–
Eremaeidae	<i>Eueremaeus oblongus</i> (C. L. Koch)	Ground	–	5	34
Phenopelopidae	<i>Eupelops acromios</i> (Hermann)	Ground	1	2	15
Scheloribatidae	<i>Hemileius initialis</i> (Berlese)	Ground	112	12	68
	<i>Liebstadia similis</i> (Michael)	Ground	1	–	–
	* <i>Paraleius leontonycha</i> Travé	Arboreal	–	–	10
Hypochthoniidae	<i>Hypochthonius rufulus</i> C. L. Koch	Ground	2	–	–
	* <i>Hypodamaeus</i> sp. n.	Ground?	2	–	–
Limnozetestidae	<i>Limnozetes rugosus</i> Sellnick	Aquatic	2	–	–
Nanhermanniidae	<i>Nanhermannia coronata</i> Berlese	Bog	1	–	2
Oribatulidae	* <i>Oribatula</i> sp. n.	Ground, arboreal?	1	1	5
	<i>O. tibialis</i> (Nicolet)	Ground	–	–	21
	* <i>Phauloppia coineai</i> Travé	Arboreal	–	3	23
	<i>P. lucorum</i> (C. L. Koch)	Arboreal	24	1,354	5,804
	* <i>P. saxicola</i> Travé	Arboreal	–	4	8
Phthiracaridae	* <i>Phthiracarus</i> sp. n. (nr. 1)	Ground / miner?	4	1	2
	* <i>P.</i> sp. n. (nr. 2)	Ground / miner?	8	–	–
	<i>Steganacarus magnus</i> (Nicolet)	Ground	3	–	–
Xenillidae	<i>Xenillus tegeocranus</i> (Hermann)	Ground	1	–	–
Tectocephidae	<i>Tectocephus velatus</i> (Michael)	Ground	–	1	–
Micreremidae	* <i>Micreremus brevipes</i> (Michael)	Arboreal	–	–	2
Oppiidae	<i>Oppiella nova</i> (Oudemans)	Ground	–	–	3
Sum of species (total 40)			28	18	24
Sum of specimens (total 8,532)			304	1,564	6,664

**Myriapoda**

## Chilopoda

Lithobiidae	<i>Lithobius borealis</i> Meinert	–	–	13	6
Diplopoda	indet. juvenile	–	1	–	–
Sum of species (total 2)			1	1	1
Sum of specimens (total 20)			1	13	6

**Collembola**

Hypogastruridae	<i>Hypogastrura socialis</i> (Uzel)	Conifer forests	–	271	–	
	<i>Xenylla maritima</i> Tullberg	Several dry habitats	1	103	16	
	<i>X. brevicauda</i> Tullberg	Conifer forests, litter	–	5	–	
	<i>X. boeimeri</i> Axelson	Moss, rocks, litter	1	–	–	
	<i>Choreutinula inermis</i> (Tullberg)	Conifer forests, under bark	–	2	–	
Neanuridae	<i>Pseudachorutes subcrassus</i> Tullberg	Forest litter	–	3	1	
Isotomidae	<i>Tetracanthella fjellbergi</i> Deharveng		–	1	–	
	<i>T. sp.</i> (juv.)		–	1	–	
	<i>Anurophorus laricis</i> Nicolet		–	39	1	
	<i>A. septentrionalis</i> Palissa		–	–	1	
	<i>Isotoma olivacea</i> Tullber		–	–	1	
	<i>I. viridis</i> Bourlet		–	–	1	
	<i>I. anglicana</i> Lubbock		–	1	–	
	<i>I. notabilis</i> Schäffer		–	1	1	
	<i>I. violacea</i> Tullberg		–	–	–	
	<i>I. hiemalis</i> Schött		–	–	–	
	<i>Pseudisotoma sensibilis</i> Tullberg		–	1	–	
	Entomobryidae	<i>Entomobrya albocincta</i> (Templeton)	Lichens	–	8	–
		<i>E. nivalis</i> (L.)	Bark on trees, lichens	127	483	1,311
<i>E. marginata</i> (Tullberg)			–	95	70	
<i>E. lanuginosa</i> (Nicolet)			–	6	31	
<i>Lepidocyrtus lignorum</i> (Fabricius)			–	204	285	
<i>Orchesella cincta</i> (L.)			–	–	3	
<i>O. bifasciata</i> Nicolet			–	–	2	
<i>O. flavescens</i> (Bourlet)			–	–	10	
Katiannidae	<i>Tomocerus sp.</i> (juv.)		–	–	1	
	<i>Sminthurinus aureus</i> (Lubbock)		–	2	–	
	<i>S. flammeolus</i> Gisin		–	–	75	
Bourletiellidae	<i>Dicyrtomina minuta</i> (Fabricius)		–	–	123	
	<i>Bourletiella pistillum</i> Gisin		–	–	13	
	<i>Heterosminthurus claviger</i> Gisin		–	9	1	
	<i>Deuterosminthurus flavus</i> (Gisin)		–	–	423	
Sminthuridae	<i>D. bicinctus</i> (Koch)		–	–	1	
	<i>Allacma fusca</i> (L.)		–	21	4	
Sum of species (total 34)			15	23	17	
Sum of specimens (total 5,853)			423	1,815	3,615	

**Aquatic orders (ex. Trichoptera)**

Ephemeroptera	<i>Baetis sp.</i>	–	1	–	–
	<i>Leptophlebia vespertina</i> (L.)	–	1	–	3
Odonata					
Libellulidae	<i>Leucorrhinia dubia</i> (Van der Linden)	–	–	2	–
Plecoptera					
Nemouridae	<i>Nemoura cinerea</i> (Retzius)	–	19	–	52
	<i>Nemurella pictetii</i> Klapalek	–	–	–	1
Leuctridae	<i>Leuctra nigra</i> (Olivier)	–	1	–	–
Sum of species (total 6)			4	1	3
Sum of specimens (total 80)			22	2	56
<b>Blattodea</b>					
Ectobiidae	<i>Ectobius lapponicus</i> (L.)	–	–	–	5
	<i>E. lapponicus</i> (L.) (juveniles)	–	–	–	3
Sum of species (total 1)			–	1	1
Sum of specimens (total 14)			–	3	11

**Hemiptera**

Microphysidae	<i>Loricula pselaphiformis</i> Curtis	Lichens on trunks	–	–	27
	<i>L. pselaphiformis</i> Curtis (juveniles)	Lichens on trunks	–	–	511
Miridae	<i>Myrmedobia exilis</i> (Fallén)	Conifer woods, moss	–	–	19
	<i>M. exilis</i> (Fallén) (juveniles)	Conifer woods, moss	–	–	18
	<i>Plesiodema pinetella</i> (Zetterstedt)	Pine, spruce	–	–	2
	<i>Phoenicocoris obscurellus</i> (Fallén)	Pine, spruce	–	–	8
	<i>Phytoecoris</i> sp. (juveniles)	–	–	–	10
	<i>Campptozygum aequale</i> (Villers) (juvenile)	Pine	–	–	1
	<i>Cremanocephalus</i> sp. (juveniles)	Pine, spruce	–	–	20
	<i>Lygus punctatus</i> (Zetterstedt)	–	–	3	–
	Miridae indet. (juveniles)	–	–	–	157
	Anthocoridae	<i>Acompocoris alpinus</i> Reuter	Pine, other conifers, predator	2	1
<i>A. pygmaeus</i> (Fallén)		Pine, other conifers, predator	1	–	–
<i>A. sp.</i> (juveniles)		–	–	–	8
<i>Anthocoris nemorum</i> (L.)		Predator	2	–	–
<i>Elatophilus nigricornis</i> (Zetterstedt)		Pine, predator	–	16	14
<i>E. nigricornis</i> (Zetterstedt) (juveniles)		Pine, predator	–	–	47
Anthocoridae (juveniles)		–	–	–	6
Lygaeidae	<i>Gastrodes grossipes</i> (DeGeer)	Pine cones, seed feeder	–	4	–
	<i>Eremocoris abietis</i> (L.)	–	–	1	–
<b>Heteroptera</b>					
Pentatomidae	<i>Chlorochroa pinicola</i> (Mulsant & Rey)	Pine	–	1	1
<b>Auchenorrhyncha</b>					
Cicadellidae	<i>Aguriahana germari</i> (Zetterstedt)	Pine	–	–	55
	<i>A. germari</i> (Zetterstedt) (juveniles)	Pine	10	–	217
	<i>Oncopsis flavicollis</i> (L.)	Birch	–	–	2
	<i>O. sp.</i>	–	–	–	2
	<i>Speudotettix subfuscus</i> (Fallén) (juvenile)	Several habitats	–	–	1
Cixiidae	<i>Cixius similis</i> (Kirschbaum)	Boggy heaths	–	–	23
	<i>C. similis</i> (Kirschbaum) (juveniles)	Boggy heaths	–	–	1
Delphacidae	<i>Hyledelphax elegantula</i> (Boheman)	<i>Calluna</i> heaths, <i>Vaccinium</i>	–	–	11
	<i>H. elegantula</i> (Boheman) (juveniles)	<i>Calluna</i> heaths, <i>Vaccinium</i>	2	–	2
<b>Sternorrhyncha</b>					
Psyllidae	Psyllidae indet. (juveniles)	–	–	–	5
Sum of species (total 18)			5	6	14
Sum of specimens (total 1,211)			17	26	1,168
<b>Psocoptera</b>					
Trogidiidae	<i>Cerobasis guestfalica</i> Kolbe (juveniles)	Lichens	15	–	–
	<i>Lepinotus patruelis</i> Pearman	–	–	–	8
	<i>L. patruelis</i> Pearman (juveniles)	Domicolous	–	–	7
Psyllipsocidae	* <i>Dorypteryx domestica</i> (Smithers)	Domicolous	1	–	–
Liposcelididae	<i>Liposcelis silvarum</i> (Kolbe)	Bark?	–	3	8
	<i>L. silvarum</i> (Kolbe) (juveniles)	Bark?	–	1	2
Psocidae	<i>Loensia fasciata</i> (Fabricius)	Bark	–	–	10
	<i>L. fasciata</i> (Fabricius) (juvenile)	Bark	–	1	–
	<i>Trichadenotecnum</i> sp. (juveniles)	Bark	–	–	3
Psocidae indet. (juveniles)	–	–	–	2	
Philotarsidae	cf. <i>Philotarsus</i> spp.	Bark	–	10	15
Elipsocidae	<i>Reuterella helvimacula</i> Enderlein	Bark	–	49	59
	<i>R. helvimacula</i> Enderlein (juveniles)	Bark	1	19	64
	<i>Elipsocus hyalinus</i> (Stephens) (juveniles)	–	2	–	–
	cf. <i>Cuneopalpus cyanops</i> (Rostock)	Conifers	–	–	5
Elipsocidae indet. (juveniles)	–	264	4	–	
Mesopsocidae	<i>Mesopsocus unipunctatus</i> (Müller)	–	–	–	4
	<i>M. cf. unipunctatus</i> (Müller) (juveniles)	–	3	11	23
Stenopsocidae	<i>Stenopsocus lachlani</i> Kolbe	Conifers	–	1	–

	<i>S. lachlani</i> Kolbe (juveniles)	Conifers	–	–	20
	<i>Graphopsocus cruciatus</i> (L.) (juveniles)	–	–	2	–
Caeciliusdae	<i>Valenzuela despaxi</i> (Badonnel) (juveniles)	Conifers	1	29	145
	<i>V. burmeisteri</i> (Brauer)	Conifers	1	1	12
	<i>V. burmeisteri</i> (Brauer) (juveniles)	Conifers	–	–	4
	<i>V. gynapterus</i> (Tetens) (juveniles)	–	–	–	4
	<i>V. spp.</i> (juveniles)	–	–	–	2
	<i>Enderleinella obsoleta</i> (Stephens) (juveniles)	Conifers	2	–	–
Indet. juveniles		–	–	1	2
Sum of species (total 15)			8	8	10
Sum of specimens (total 821)			290	132	399
<b>Thysanoptera</b>					
Aeolothripidae	* <i>Aeolothrips vittatus</i> Haliday	Pine, spruce, predator	–	17	12
Thripidae	<i>Oxythrips ajugae</i> Uzel	Pine cones	–	147	61
	<i>O. ajugae</i> (juv.)	Pine cones	9	113	112
	<i>O. bicolor</i> (Reuter)	Pine cones	–	186	54
	<i>O. bicolor</i> (juv.)	Pine cones	65	623	602
	<i>Ceratothrips ericae</i> (Haliday)	Grass, heath	–	13	4
	<i>Taeniothrips picipes</i> (Zetterstedt)	Herb flowers	–	5	–
	<i>Thrips flavus</i> Schrank	Dicotyledons	–	1	–
	<i>T. pini</i> (Uzel)	Pine	–	–	2
	<i>Limothrips denticornis</i> Haliday	Grass	–	–	1
	<i>Aptinothrips stylifer</i> Trybom	Grass	–	–	1
	Unidentified juveniles	–	373	1,909	626
Phlaeothripidae	* <i>Acanthothrips nodicornis</i> (Reuter)	Dead branches, bark	–	1	–
	<i>Hoplandrothrips williamsianus</i> Priesner	Dead branches, fungivore	–	1	–
	<i>Xylaplothrips fuliginosus</i> Schille	Dead buds, bark, predator	–	2	–
	<i>Hoplothrips ulmi</i> (Fabricius)	Dead wood, fungivore	–	–	4
	<i>Haplothrips aculeatus</i> (Fabricius)	Grass	–	–	1
Sum of species (14)			2	9	9
Sum of specimens (total 4,945)			447	3,018	1,480
<b>Lepidoptera</b>					
Micropterigidae	<i>Micropterix aureatella</i> (Scopoli)	Woodland, <i>Carex</i>	2	–	8
Nepticulidae	<i>Ectodemia minimella</i> (Zetterstedt)	Mines on <i>Betula</i> and <i>Alnus</i>	–	–	1
Gracillariidae	<i>Phyllocnistis labyrinthella</i> (Bjerkander)	<i>Populus</i> , <i>Salix</i>	–	–	2
Yponomeutidae	<i>Ocnerostoma piniarella</i> Zeller	Pine	45	–	–
	<i>O. friesei</i> Svensson	Pine	–	–	1
	cf. <i>Ocnerostoma</i> sp. (larvae)	–	–	–	2
	<i>Cedestis subfasciella</i> (Stephens)	Pine	–	–	2
Elachistidae	<i>Cosmiotes exatella</i> (Herrich-Schaeffer)	Grass	–	1	–
Gelechiidae	cf. <i>Exotelia dodecella</i> (L.) (larvae)	Pine	11	–	–
Tortricidae	Tortricidae indet. (larvae)	–	–	–	2
Geometridae	cf. <i>Hylaea fasciaria</i> (L.) (larvae)	Pine	6	2	1
	<i>Hydriomena furcata</i> (Thunberg) (larvae)	<i>Salix</i> and other deciduous	1	3	–
	<i>Eupithecia</i> sp. (larva)	–	1	–	–
	cf. <i>Heterothesa firmata</i> (Hübner) (larvae)	Pine	5	8	–
	cf. <i>Thera obeliscata</i> (Hübner) (larvae)	Pine	–	2	5
Sphingidae	<i>Sphinx pinastri</i> L.	Pine	–	–	1
Noctuidae	<i>Panolis flammea</i> (Denis & Schiffermueller) (larvae)	Pine	14	2	–
	<i>Xestia</i> sp. (larva)	–	–	1	–
	<i>Papestria biren</i> (Goeze)	Ground vegetation	–	2	–
	cf. <i>Polia</i> sp. (larvae)	–	–	–	2
	<i>Lycophotia porphyrea</i> (Denis & Schiffermueller)	Heather	–	–	1
Sum of species (total 18)			8	8	9
Sum of specimens (total 134)			85	21	28

<b>Trichoptera</b>					
Polycentropodidae	<i>Plectrocnemia conspersa</i> (Curtis)	–	–	1	
Limnephilidae	<i>Limnephilus vittatus</i> (Fabricius)	–	4	–	
	<i>L. centralis</i> Curtis	–	–	1	
	<i>L. sp.</i>	–	–	1	
	<i>Rhadicoleptus alpestris</i> (Kolenati)	–	–	1	
Sum of species (total 4)			1	–	4
Sum of specimens (total 8)			4	–	4
<b>Diptera</b>					
Tipulidae	<i>Tipula (Vestiplex) scripta</i> Meigen	–	–	–	1
	<i>T. (Pterelachisus) irrorata</i> Meigen	–	–	–	1
Limoniidae	<i>Dicranomyia s.str. mitis</i> (Meigen)	–	2	–	–
	<i>Molophilus s.str. bifidus</i> Goetghebuer	–	1	–	–
	<i>Ormosia ruficauda</i> (Zetterstedt)	–	–	–	3
	<i>Phylidorea squalens</i> (Zetterstedt)	–	–	–	9
	<i>Euphylidorea phaeostigma</i> (Schummel)	–	–	–	11
Pediciidae	* <i>Tricyphona s.str. unicolor</i> (Schummel)	–	1	–	–
Bibionidae	<i>Biblio nigriventris</i> Haliday	Woodland	–	–	1
Mycetophilidae	<i>Ectrepesthoneura pubescens</i> (Zetterstedt)	Decaying wood	–	13	N.D.
	<i>Cordyla murina</i> Winnertz	–	1	–	N.D.
	<i>Boletina</i> spp. (females)	Wood streams	–	5	N.D.
Sciaridae	<i>Lycoriella latilobata</i> (Menzel & Mohrig)	Boreoalpine	–	1	1
	<i>L. globiceps</i> (Becher)	Boreoalpine	–	1	–
	<i>Corynoptera minima</i> (Meigen)	–	–	1	2
	* <i>C. boletiphaga</i> (Lengersdorf)	–	–	4	–
	* <i>C. trepida</i> (Winnertz)	–	–	–	2
	* <i>Ctenosciara hyalipennis</i> (Meigen)	Conifer forests	–	2	143
	<i>Scatopsciara atomaria</i> (Zetterstedt)	Decaying wood	–	2	18
	* <i>Camptochaeta camptochaeta</i> (Tuomikoski)	–	–	2	–
	<i>C. hitula</i> (Lengersdorf)	Boreoalpine	–	–	4
	* <i>Bradysia brevispina</i> Tuomikoski	–	–	–	1
	<i>B. sp.</i> (females)	–	2	–	5
	* <i>Cratyna uliginosa</i> (Lengersdorf)	–	–	1	–
	* <i>C. sp.</i> (female)	Decaying wood	1	–	–
	* <i>Epidapus gracilis</i> (Walker)	Conifer forests	–	–	4
	<i>Xylosciara</i> sp.	Decaying wood	–	–	2
Sciaridae indet.	–	4	21	59	
Cecidomyiidae	<i>Lestodiplosis conii</i> (Kieffer)	–	2	4	3
	* <i>L. sp. n.</i>	–	–	4	4
	<i>Campylomyza</i> sp. (females)	–	2	–	–
	* <i>Porricondyla fuscostriata</i> Panelius	–	1	2	8
	<i>Cecidomyia pini</i> (DeGeer)	–	–	2	–
	<i>Bryimyia gibbosa</i> (Felt)	–	1	–	–
	* <i>Sitodiplosis</i> sp. n.	–	2	–	–
	<i>Asynapta</i> sp.	–	–	1	–
	<i>Lestremia cinera</i> Macquart	–	–	–	1
	<i>L. leucophaea</i> (Meigen)	–	–	–	1
Simuliidae	<i>Eusimulium</i> cf. <i>cryophilum</i> Rubtsov	–	1	–	N.D.
	<b>Ceratopogonidae</b>				
	(*) <i>Culicoides alatavicus</i> Smatov & Isimbekov	–	5	–	–
	(*) <i>C. albicans</i> (Winnertz)	Peat bogs	11	7	86
	<i>C. chiopterus</i> (Meigen)	Dung / saprophagous	2	2	4
	(*) <i>C. clintoni</i> Boorman	Peat bogs	1	–	195
	(*) <i>C. comosioculatus</i> Tokunaga	–	–	–	3
	(*) <i>C. dewulfi</i> Goetghebuer	Dung / saprophagous	3	–	–
	(*) <i>C. grisescens</i> Edwards	–	–	–	2
	(*) <i>C. heliophilus</i> Edwards	Peat bogs	29	10	–
	<i>C. impunctatus</i> Goetghebuer	Peat bogs	17	–	18

	(*) <i>C. kibunensis</i> Tokunaga	–	1	5	–
	<i>C. obsoletus</i> (Meigen)	–	1	–	35
	(*) <i>C. sphagnumensis</i> Williams	–	–	–	5
	(*) <i>C. scoticus</i> Downes & Kettle	Dung / saprophagous	–	1	1
	(*) <i>C. vexans</i> (Staeger)	–	–	1	2
	<i>C. sp.</i> (female)	–	–	–	24
	(*) <i>Alluaudomyia quadripunctata</i> (Goetghebuer)	–	–	–	21
	<i>Ceratopogon lacteipennis</i> Zetterstedt	–	36	4	39
	(*) <i>Brachypogon bialoviesicus</i> Krzywinski	–	3	–	–
	(*) <i>B. norvegicus</i> Szadziewski & Hagan	–	3	8	19
	<i>B. incompletus</i> (Kieffer)	–	4	91	9
	(*) <i>B. nitidulus</i> (Edwards)	–	30	58	32
	(*) <i>B. perpallidus</i> (Edwards)	–	32	–	1
	<i>B. sociabilis</i> (Goetghebuer)	–	2	191	78
	(*) <i>B. vitiosus</i> (Winnertz)	–	–	–	5
	<i>B. spp.</i> (females)	–	164	773	828
	(*) <i>Schizohalea leucopeza</i> (Meigen)	–	–	1	2
	<i>Serromyia femorata</i> (Meigen)	–	9	–	14
	(*) <i>Bezzia affinis</i> (Staeger)	–	–	–	1
	(*) <i>B. bicolor</i> (Meigen)	–	–	–	6
	(*) <i>B. rhynchostylata</i> Remm	–	2	12	17
	<i>B. nigriflora</i> (Zetterstedt)	–	–	–	3
	<i>B. solstitialis</i> (Winnertz)	–	–	–	7
	<i>Palpomyia pubescens</i> Kieffer	–	–	–	5
	(*) <i>P. serripes</i> (Meigen)	–	1	–	–
	(*) <i>Atrichopogon lucorum</i> (Meigen)	Rotting material	–	2	9
	(*) <i>A. minutus</i> (Meigen)	Rotting material	1	–	–
	(*) <i>Forcipomyia acidicola</i> (Tokunaga)	Rotting material	–	–	1
	(*) <i>F. albostyla</i> Remm	Rotting material	–	–	2
	<i>F. bipunctata</i> (L.)	Rotting material	3	–	–
	(*) <i>F. ciliata</i> (Winnertz)	Rotting material	–	–	2
	(*) <i>F. brevipennis</i> (Macquart)	Dung / saprophagous	–	3	–
	(*) <i>F. fuliginosa</i> (Meigen)	Rotting material	–	–	1
	(*) <i>F. hygrophila</i> Kieffer	Rotting material	–	–	3
	(*) <i>F. kaltenbachii</i> (Winnertz)	Rotting material	–	–	8
	(*) <i>F. monilicornis</i> (Coquillett)	Rotting material	2	–	5
	(*) <i>F. nigra</i> (Winnertz)	Rotting material	1	1	23
	(*) <i>F. nigrans</i> Remm	Rotting material incl. Pine	10	2	326
	(*) <i>F. palustris</i> (Meigen)	Rotting material	7	–	1
	(*) <i>F. titillans</i> (Winnertz)	Rotting material	–	–	15
	<i>F. spp.</i> (females)	Rotting material	–	–	132
	(*) <i>Dasyhelea bensoni</i> Edwards	–	1	3	–
	(*) <i>D. biunguis</i> Kieffer	–	–	–	3
	(*) <i>D. europaea</i> Remm	–	6	–	–
	(*) <i>D. ledi</i> Remm	–	3	1	4
	(*) <i>D. luteiventris</i> Goetghebuer	–	2	–	–
	(*) <i>D. modesta</i> (Winnertz)	–	107	–	–
	(*) <i>D. norvegica</i> Szadziewski & Hagan	–	1	–	–
	(*) <i>D. parallela</i> Remm	–	2	–	–
Scatopsidae	<i>Colobostema sp.</i>	–	–	1	–
Acroceridae	<i>Paracrocera orbicula</i> (Fabricius)	–	–	–	1
Hybotidae	<i>Euthyneura myrtilli</i> Macquart	Peat bogs	439	50	555
	<i>Bicellaria austriaca</i> Tuomikoski	Several habitats	5	–	36
	<i>B. nigra</i> (Meigen)	Several habitats	2	–	10
	<i>B. pilosa</i> Lundbeck	Several habitats	–	–	27
	<i>Platypalpus nigratarsis</i> (Fallén)	Ground vegetation	–	–	1
	<i>P. boreoalpinus</i> Frey	Ground vegetation	–	–	4
	<i>Tachypeza nubila</i> (Meigen)	Tree trunks	–	–	14
	<i>Ocydromia glabricula</i> (Fallén)	Dung	–	–	1

	<i>Trichina bilobata</i> Collin	Low vegetation, predator	–	–	2
	<i>T. clavipes</i> Meigen	Low vegetation, predator	–	–	1
	<i>Hybos grossipes</i> (L.)	Low vegetation, predator	–	–	2
Empididae	<i>Rhamphomyia</i> (s.str) <i>stigmosa</i> Macquart	–	4	–	–
	<i>R. (Pararhamphomyia) curvula</i> Frey	–	12	45	25
	<i>R. (P.) unguiculata</i> Frey	–	3	14	30
	<i>R. (P.) caesia</i> Meigen	–	2	–	–
	<i>R. (P.) murina</i> Collin	–	–	1	–
	<i>R. (P.) obscuripennis</i> Meigen	–	–	2	4
	* <i>R. (P.) poplitea</i> Wahlberg	–	–	–	7
	<i>R. (P.) angulifera</i> Frey	–	–	–	1
	<i>R. (P.) lividiventris</i> (Zetterstedt)	–	–	–	1
	<i>R. (Holoclera) umbripennis</i> Meigen	–	6	–	–
	<i>R. (Megcyttarus) crassirostris</i> (Fallén)	–	–	–	1
	* <i>Iteaphila nitidula</i> (Zetterstedt)	–	–	1	–
	<i>Empis (Anacrostichus) lucida</i> Zetterstedt	Copulates on conifer branches	–	–	4
	<i>Hilara interstincta</i> (Fallén)	–	–	–	42
	<i>H. intermedia</i> (Fallén)	–	–	–	1
Dolichopodidae	<i>Dolichopus annulipes</i> Zetterstedt	–	–	1	3
	<i>D. discifer</i> Stannius	–	–	–	2
	<i>Medetera setiventris</i> Thunberg	Tree trunks, predator	–	1	2
	<i>M. striata</i> Parent	Tree trunks, predator	–	1	–
	<i>M. sp.</i>	Tree trunks, predator	–	1	–
	<i>Rhaphium longicorne</i> (Fallén)	–	–	–	4
Phoridae	<i>Triphleba opaca</i> (Meigen)	–	1	–	–
	<i>Megaselia eccoptomera</i> Schmitz	–	–	4	6
	* <i>M. robusta</i> Schmitz	Boreoalpine?	–	1	–
	* <i>M. spinigera</i> (Wood)	–	–	2	2
	* <i>M. emarginata</i> (Wood)	–	–	–	3
	<i>M. aquilonia</i> Schmitz	–	–	–	3
	<i>M. gartensis</i> Disney	–	–	1	1
	* <i>M. aculeata</i> (Schmitz)	Arable fields	–	–	2
	* <i>M. fusciclava</i> Schmitz	–	–	–	1
	* <i>M. nigriceps</i> (Loew)	Necrophagous	–	–	5
	* <i>M. cothurnata</i> (Schmitz)	–	–	–	1
	<i>M. pleuralis</i> (Wood)	Polysaprophagous	–	–	1
	<i>M. pusilla</i> (Meigen)	Polysaprophagous	–	–	1
	<i>M. sp. (giraudii group)</i>	–	1	–	–
	* <i>M. sp. n.</i>	–	–	1	–
	<i>M. spp. (females)</i>	Several habitats	–	12	27
	* <i>Phora obscura</i> (Zetterstedt)	Boremontane?	–	1	–
	<i>P. holoserica</i> Schmitz	Root aphid predator	–	1	–
	<i>P. sp.</i>	–	–	10	1
	* <i>Menoziola obscuripes</i> (Schmitz)	Ant parasite	–	1	1
Pipunculidae	<i>Jassidophaga</i> sp.	Cicad parasite	–	–	1
Lonchaeidae	* <i>Lonchaea laxa</i> Collin	Prob. Bark	1	6	31
	* <i>L. stackelbergi</i> Czerny	Prob. Bark	1	–	1
Pseudopomyzidae	<i>Pseudopomyza atrimana</i> (Meigen)	Rotting wood	–	–	1
Pallopteridae	<i>Palloptera usta</i> (Meigen)	Predator, under bark	–	–	1
Acartophthalmidae	* <i>Acartophthalmus nigrinus</i> (Zetterstedt)	Saprophagous	1	1	–
Agromyzidae	<i>Cerodontha (Poemyza) incisa</i> (Meigen)	Grass	1	–	–
	<i>Chromatomyia fuscula</i> (Zetterstedt)	Grass	–	–	3
	<i>Phytomyza nigrifemur</i> Hering	Grass	–	–	1
Milichiidae	* <i>Phyllomyza formicae</i> Schmitz	–	–	1	–
	<i>P. securicornis</i> – group	–	–	–	3
Lauxaniidae	<i>Minettia lupulina</i> (Fabricius)	–	–	–	1
	<i>Pachycerina seticornis</i> (Fallén)	–	–	–	2
*Borboropsidae	* <i>Borboropsis puberula</i> (Zetterstedt)	–	–	1	–
Chamaemyiidae	<i>Anchioleucopsis geniculata</i> (Zetterstedt)	Pine aphid predator	9	–	–
	<i>Leucopsis</i> sp.	Pine aphid predator	–	–	1

	<i>Neoleucopis tapiae</i> (Blanchard)	Pine aphid predator	–	–	2
	<i>N. obscura</i> (Haliday)	Pine aphid predator	–	–	2
Sphaeroceridae	<i>Apteromyia claviventris</i> (Strobl)	Polysaprophagous	–	1	–
	<i>Terrilimosina</i> sp.	–	–	1	–
	<i>Minilimosina v-atrum</i> (Villeneuve)	Several habitats	–	–	1
Drosophilidae	<i>Stegana</i> cf. <i>coleoprata</i> Scopoli	–	–	–	1
	* <i>Scaptomyza teinoptera</i> Hackman	–	–	–	1
Chloropidae	* <i>Thaumatomyia notata</i> (Meigen)	Root	1	–	–
	<i>T. trifasciata</i> (Zetterstedt)	Root	–	–	1
	<i>Tricimba cincta</i> (Meigen)	–	–	–	8
	<i>Oscinella frit</i> L.	Seeds, cereals	–	–	1
	* <i>Conioscinella sordidella</i> (Zetterstedt)	–	–	–	1
Anthomyiidae	<i>Alliopsis silvestris</i> (Fallén)	–	–	2	6
	* <i>A. brunneigena</i> (Schnabl)	–	–	2	2
	<i>A. denticauda</i> (Zetterstedt)	–	–	–	5
	<i>Lasiomma cuneicorne</i> (Zetterstedt)	–	–	1	–
	<i>L. atricauda</i> (Zetterstedt)	–	–	1	–
	<i>Hylemya partita</i> (Meigen)	–	–	–	1
	* <i>Anthomyia mimetica</i> (Malloch)	–	–	–	1
	<i>Hydrophoria lancifer</i> (Harris)	–	–	–	3
	<i>Pegomya winthermi</i> (Meigen)	–	–	–	1
Muscidae	<i>Helina evecta</i> (Harris)	Various habitats	–	4	14
	<i>H. daicles</i> (Walker)	–	–	–	2
	<i>H. subvittata</i> (Séguy)	Under bark, <i>Populus</i>	–	1	2
	<i>Mydaea sootryeni</i> Ringdahl	–	–	2	–
	<i>M. electa</i> (Zetterstedt)	–	–	–	2
	<i>Limnophora nigripes</i> (Robineau-Desviody)	–	1	–	–
	<i>Spilogona contractifrons</i> (Zetterstedt)	–	–	–	124
	<i>S. cf. albisquama</i> (Ringdahl)	–	–	–	2
	<i>S. sororcula</i> (Zetterstedt)	–	–	–	1
	<i>Thricops innocuus</i> (Zetterstedt)	–	–	–	9
	<i>T. lividiventris</i> (Zetterstedt)	–	–	–	1
	<i>T. cunctans</i> (Meigen)	–	–	–	9
	<i>T. semicinereus</i> (Wiedemann)	–	–	–	2
	<i>Coenosia mollicula</i> (Fallén)	–	–	–	2
	<i>C. lacteipennis</i> (Zetterstedt)	–	–	–	1
	<i>C. means</i> Meigen	–	–	–	3
	<i>C. octopunctata</i> (Zetterstedt)	–	–	–	4
	<i>Phaonia incana</i> (Wiedemann)	–	–	–	1
	<i>P. meigeni</i> Pont	–	–	–	2
Fannidae	<i>Fannia verrallii</i> (Stein)	–	1	–	1
	<i>F. carbonaria</i> (Meigen)	–	–	–	1
	<i>F. canicularis</i> (L.)	–	–	–	2
	<i>F. aff. umbrosa</i> (Stein)	–	–	–	3
	<i>F. umbrosa</i> (Stein)	–	–	–	1
Calliphoridae	<i>Pollenia pediculata</i> Macquart	Saprophagous	2	–	–
Sarcophagidae	<i>Metopia campestris</i> (Fallén)	–	–	1	–
Tachinidae	<i>Lypha dubia</i> (Fallén)	Parasitoid on tree-feeding larvae	–	2	1
	<i>Ramonda ringdahli</i> (Villeneuve)	Parasitoid on Geometridae	–	3	–
	<i>Peribaea setinervis</i> (Thomson)	Parasitoid on Geometridae	1	–	–
	<i>Actia resinellae</i> (Schrank)	Parasitoid on pine living Tortricidae	1	–	–
	<i>Blepharomyia pagana</i> (Meigen)	Parasitoid on tree-feeding Lepidoptera	1	–	2
	<i>Medina collaris</i> (Fallén)	Parasitoid on adult Coleoptera	–	–	1
	<i>Trixa caerulescens</i> Meigen	–	–	–	1
	Sum of species (total 210)		64	67	149
	Sum of specimens (total 5,837)		1,019	1,423	3,394



**Hymenoptera**

Xyelidae	<i>Xyela julii</i> (Brebisson)	Pine flowers	1	1	–
Tenthredinidae	* <i>Pristiphora coniceps</i> Lindquist	<i>Salix</i>	1	–	–
	* <i>P. pallidiventris</i> Fallén	Rosaceae	1	–	–
	<i>P. pallipes</i> Lepeletier	Deciduous trees, bushes	–	1	–
Formicidae	<i>Myrmica ruginodis</i> Nylander	Open woodlands	8	10	15
	<i>M. lobicomis</i> Nylander	Open woodlands	–	–	1
	<i>Camponotus herculeanus</i> (L.)	Open woodlands, dead wood	–	–	1
	<i>C. sp.</i>	–	1	–	1
	<i>Formica lugubris</i> Zetterstedt	Coniferous forests	–	13	55
	<i>F. aquilonia</i> Yarrow	Coniferous forests	–	1	89
	<i>F. fusca</i> L.	Coniferous forests	30	–	–
	<i>F. lemami</i> Bondroit	Coniferous forests	–	1	11
	<i>F. sp.</i> (males)	–	–	–	7
	<i>Lasius fuliginosus</i> (Latreille)	Coniferous forests	–	–	1
Vespidae	<i>Vespula rufa</i> (L.)	Many habitats	–	1	–
	Sum of species (total 13)		5	7	7
	Sum of specimens (total 251)		42	28	181

**Coleoptera**

Carabidae	<i>Dromius spilotus</i> (Illiger)	Arboreal	67	–	–
	<i>D. fenestratus</i> (Fabricius)	Arboreal, pine	2	–	1
	<i>D. schneideri</i> Crotch	Arboreal	1	4	13
	<i>D. angustus</i> Brullé	Arboreal, pine	–	3	–
	<i>D. agilis</i> Fabricius	Arboreal	–	–	3
Leiodidae	<i>Anisotoma humeralis</i> (Fabricius)	Saproxyllic, fungivore	1	–	–
Staphylinidae	<i>Leptusa pulchella</i> (Mannerheim)	Bark, dead material	1	–	–
	<i>L. ruficollis</i> (Erichson)	Bark, dead material	51	–	–
	<i>Phloeocaris subtilissima</i> Mannerheim	Bark, dead trees	1	–	–
	<i>Bryaxis puncticollis</i> (Denny)	Moss	1	–	–
	<i>Bibloporus bicolor</i> (Denny)	Moss	1	–	–
	<i>Euplectus decipiens</i> Raffray	Moss	1	–	–
	<i>Antophagus omalinus</i> Zetterstedt	Shrubs, <i>Salix</i>	–	–	35
	<i>Phloeonomus lapponicus</i> (Zetterstedt)	Bark, dead conifers	–	–	3
	<i>Megarthrus sinuatocollis</i> Lacordaire	Decaying matter	–	–	1
	<i>Acrostiba borealis</i> Thomson	Decaying matter	–	–	1
	<i>Omalium caesum</i> Gravenhorst	Decaying matter	–	–	1
	<i>Atheta picipennis</i> Mannerheim	Decaying matter	–	–	1
Scirtidae	<i>Cyphon ochraceus</i> Stephens	Vegetation near water	–	2	–
Elateridae	<i>Selatosomus impressus</i> (Fabricius)	Conifers	2	4	2
	<i>Ampedus balteatus</i> (L.)	Trees, moss	1	–	–
	<i>A. nigrinus</i> (Herbst)	Stumps	1	1	2
	<i>Dalopius marginatus</i> (L.)	Decaying matter	3	3	4
	<i>Limonium aeneoniger</i> (DeGeer)	Conifers, shrubs	–	1	–
	<i>Sericus brunneus</i> (L.)	Flowers, <i>Betula</i>	–	1	–
	<i>Athous vittatus</i> (Fabricius)	Flowers	–	–	2
Cantharidae	<i>Rhagonycha lignosa</i> (Müller)	Flowers, shrubs	10	–	–
	<i>R. atra</i> (L.)	Spruce	–	2	13
	<i>R. elongata</i> (Fallén)	Pine	–	–	46
	<i>Malthodes fuscus</i> Waltl	Shrubs	–	–	16
	<i>M. brevicollis</i> Paykull	Shrubs	–	–	91
	<i>M. pumilus</i> Brebisson	–	–	–	23
	<i>M. guttifer</i> Kiesenwetter	<i>Salix</i>	–	–	2
	<i>Absidia schoenherri</i> Dejean	Shrubs	–	–	3
Anobiidae	<i>Emobius nigrinus</i> (Sturm)	Pine canopies	1	–	–
	<i>Episemus angusticollis</i> Thomson	Conifer cones	–	1	3
Ptinidae	<i>Ptinus fur</i> L.	Omnivore	–	–	1
Cleridae	<i>Thanasimus femoralis</i> (Zetterstedt)	Conifers	–	–	1
Melyridae	<i>Aplocnemus nigricornis</i> (Fabricius)	Conifer flowers	4	–	1
Nitidulidae	<i>Epuraea pygmaea</i> (Gyllenhal)	Spruce	–	–	1
	<i>Pityophagus ferrugineus</i> (L.)	Under bark, conifers	–	–	2

	<i>Thalycra fervida</i> (Olivier)	Phloeophagous	–	–	1
Rhizophagidae	<i>Rhizophagus dispar</i> (Paykull)	Under bark	1	–	–
Cryptophagidae	<i>Cryptophagus angustus</i> Ganglbauer	Pine	1	–	–
	<i>C. dorsalis</i> Sahlberg	Pine	–	1	–
	<i>C. abietis</i> (Paykull)	Spruce	–	–	2
	<i>Atomaria turgida</i> Erichson	Spruce	–	1	–
Coccinellidae	<i>Scymnus suturalis</i> Thunberg	Pine	38	2	9
	<i>Myzia oblongoguttata</i> (L.)	Pine canopies	2	–	6
	<i>Myrrha octodecimguttata</i> (L.)	Pine canopies	10	2	5
	<i>Exochomus quadripustulatus</i> (L.)	Pine	–	5	–
	<i>Aphidecta oblitterata</i> (L.)	Conifer woodlands	–	1	–
Latridiidae	<i>Enicmus fungicola</i> Thomson	Fungivore	1	–	–
	<i>Corticarina latipennis</i> (Sahlberg)	Fungivore	–	9	–
	<i>C. lambiana</i> Sharp	Fungivore	–	–	3
Tenebrionidae	<i>Corticeus linearis</i> (Fabricius)	Bark, conifer branches	–	1	–
Salpingidae	<i>Sphaeriestes castaneus</i> (Panzer)	Pine	29	10	5
Anaspidae	<i>Anaspis rufilabris</i> Gyllenhal	Broadleaves, flowers	–	–	1
	<i>A. marginicollis</i> Lindberg	Broadleaves, flowers	–	–	1
Cerambycidae	<i>Molorchus minor</i> (L.)	Pine, Spruce, <i>Larix</i>	–	2	–
	<i>Pityphilus fasciculatus</i> (DeGeer)	Pine, Spruce	–	–	1
Chrysomelidae	<i>Lochmaea suturalis</i> (Thomson)	Heathland	1	1	–
	<i>Altica</i> sp.	–	–	1	–
Curculionidae	<i>Strophosoma capitatum</i> Dejean	Conifers	–	–	1
	<i>Polydrusus undatus</i> (Fabricius)	<i>Betula</i> and others	1	–	–
	<i>Brachonyx pineti</i> (Paykull)	Pine	2	5	5
	<i>Hylurgops palliatus</i> (Gyllenhal)	Conifers	1	–	–
	<i>Anthonomus phyllocola</i> (Herbst)	Conifers	6	24	61
	<i>Anoplus plantaris</i> (Naezen)	Broadleaves	2	–	–
	<i>Pissodes piniphilus</i> (Herbst)	Pine	3	–	3
	<i>P. pini</i> (L.)	Conifers	–	1	2
	<i>Hylobius abietis</i> (L.)	Conifers	–	2	8
	<i>H. piceus</i> (DeGeer)	Conifers	–	–	1
	<i>Pityophthorus micrographus</i> (L.)	Spruce	–	–	2
	<i>Pityogenes chalcographus</i> (L.)	Spruce	–	–	2
	<i>Ips duplicatus</i> Sahlberg	Conifers	–	–	1
	Sum of species (total 76)		31	26	46
	Sum of specimens (total 729)		247	90	392