Oribatid mites of Alpine Fennoscandia

MARIANNE PRESTHUS HEGGEN


The diversity and distribution of oribatid mites in alpine regions of Fennoscandia have been studied by many scientists since at least 1902. Increased focus on biodiversity in general and distributions in alpine regions in particular creates a need for a summary of these many published studies. The information that can be drawn from published articles is limited by their varying quality, and further studies are needed to explore altitudinal patterns of species richness. Some interesting distributional patterns are, however, revealed in this synthesis.

Ceratoppia sphaerica (L. Koch, 1879), Chamobates cuspidatiformes (Trägårdh, 1904), Camisia borealis (Thorell, 1871), Malaconychus globiger Trägårdh, 1910, Mycobates sarekensis (Trägårdh, 1910), Trichoribates monticola (Trägårdh, 1902), Phauloppia lucorum (C. L. Koch, 1841), and Trichoribates setiger (Trägårdh, 1910) show an alpine distribution in this data-set. Adoristes ovatus (C. L. Koch, 1840), Conchogneta traegardhi (Forsslund, 1947), Diapterobates humeralis (Hermann, 1804), Hemileius initialis (Berlese, 1908), Heminothrus longisetosus Willmann, 1925, Melanozetes mollicomus (C. L. Koch, 1839), Moritzoppia splendens (C. L. Koch, 1841), Moritzoppia neerlandica (Oudemans, 1900), Oppiella nova (Oudemans, 1902), and Suctobelbella subtrigona (Oudemans, 1900) are all found to have a distribution limited by altitude. Some species may additionally show signs of altitudinal limitations, and should be investigated further. Belba compta (Kulczynski, 1902), Edwardzetes edwardsi (Nicolet, 1855), and Oribatula tibialis (Nicolet, 1855) are equally present along the entire altitudinal gradient. Liochthonius lapponicus (Trägårdh, 1910), Liochthonius sellnicki (Thor, 1930), M. sarekensis, Camisia foveolata Hammer, 1955, O. nova, Oromurcia bicuspidata Thor, 1930, Suctobelbella acutidens (Forsslund, 1941), and Tectocepheus velatus (Michael, 1880) all thrive in glacier-forelands.

Key words: Acari, Oribatida, Alpine environments, Fennoscandia, Distribution, Diversity.

Marianne Presthus Heggen, University of Bergen, Department of Biology, P.O.Box 7803, NO-5020 Bergen, Norway E-mail: marianne.heggen@bio.uib.no

Introduction

Through the Convention on Biological Diversity, the Fennoscandian countries of Finland, Norway, and Sweden are committed to reduce significantly the loss of biodiversity by 2010 (United Nations Environment Programme 1993). This has led to a renewed attention to biodiversity loss and the urgent need to survey current biodiversity has emerged, for example through the initiation of national centres. Data on biodiversity have, however, been collected since the early days of pioneer naturalists who collected and identified what they found. This approach changed towards a more structured and rigid sampling and later to investigations of ecosystems and species traits. Much relevant basic knowledge on biodiversity can be obtained from all these studies.

Biodiversity is not only important in its own right. Anthropogenic changes of the environment and climate are occurring at an alarming speed and many organisms and environments have been suggested as suitable models for studying...
the ecological aspects of climate change (e.g., Parmesan & Yohe 2003). Among these is the alpine environment, where the altitudinal gradient may serve as an analogue to future climate changes (e.g., Körner 2000, Hodkinson 2005). This increases the importance of knowledge on species diversity and distribution in alpine areas. A majority of the fauna is soil-dwelling, and small arthropods, mainly Collembola and Acari, dominate together with enchytraeids, Diptera larvae, etc. (Solhøy et al. 1975, Solhøy 1997). A similar pattern is found in arctic conditions (Sømme 1981). At a lichen-heath on Hardangervidda, South Norway, oribatid mites accounted for 50% of the total abundance of Acari, and up to 70–90% of their biomass (Solhøy 1975).

Species richness is, in general, negatively correlated with altitude and latitude (discussed in Rahbek 1995), as increasing altitude and latitude pose severe restrictions on the environment. These factors are closely linked, and a species altitudinal range may change within its latitudinal range (Schatz 2004). The structuring factors of these trends are keenly debated, but it seems likely that both ecological and evolutionary factors are important (for discussion, see Lomolino 2001 and Colwell et al. 2004). When methodological factors such as sampling effort and gradient length are considered, the relationship between species and altitude often shows a hump-backed distribution with highest diversity at intermediate levels, possibly due to the mid-domain effect (Rahbek 1995, Colwell et al. 2004, Romdal & Grytnes 2007). The diversity of oribatid mites is also highest in warm temperate regions (Maraun et al. 2007).

The species distributional range increase with both latitude and altitude (Rapoport 1982, Stevens 1992). It has been suggested that the main structuring factor behind this may be physiological tolerances, as the upper thermal limits are rarely affected by geographical patterns while the lower thermal limits often are (Addo-Bediako et al. 2000). Mites and many other arthropods may have a range of adaptations to increase their cold hardiness (Cannon & Block 1988, Sømme 1997). Some of these processes are connected with resistance to another important altitudinal factor, namely increasing evaporation (Holmstrup 1992, Sjursen & Sømme 2000). The level of short-wave radiation also increases with altitude (Hodkinson 2005), having potentially deleterious effects on living organisms (Caldwell et al. 1998).

At the ecological scale of the mites, however, the environment will be affected by micro-, local-, and regional effects. Indirectly, these physical factors may also constrain the mites through their habitat, namely the plant communities within which they live. Altogether, these factors increase the need for special adaptations to live in the alpine environment and to limit the range of mite species in alpine environments (Sømme 1997).

These altitudinal factors will limit all invertebrates living in alpine areas. One example is the reduction of larger decomposers in alpine environments (Solhøy 1997, Maraun et al. 2008). Behan (1978) first hypothesized that this increased the importance of oribatid mites, and several researchers have later adopted this hypothesis (e.g., Maraun et al. 2007). The fungal community in the soil has higher species diversity and fungal abundance in the presence of oribatid mites. Mites are thought to enhance the recovery of the microbial system in the soil, primarily through the dispersal of fungal spores, stimulating energy metabolism of microorganisms by grazing, and stimulating microbial growth by reducing nutrient loss from the system (summarized in Maraun et al. 1998).

While the importance of alpine areas as key environmental areas is increasingly recognized, the need for knowledge of their oribatid fauna increases. However, old literature may be hard to obtain, and it is hard to acquire a complete overview of earlier published material. The first descriptions of oribatid mites from alpine Fennoscandia date back to the beginning of the previous century (Trägårds 1902). As a result, it is useful to compile previously reported species in this environment. A range of articles on oribatid mites in these areas has been published, as well as catalogues of mites from the Fennoscandian

Norw. J. Entomol. 57, 38–70
Heggen: Orbitid mites of Alpine Fennoscandia

countries (Mehl 1979, Lundqvist 1987, Niemi et al. 1997). However, only the Finnish checklist is regularly updated (Niemi et al. 2009). This review expands beyond the distributional data in these checklists, including information about habitats, altitude, and alpine zones in the relevant faunistic and ecological papers.

The aims of this article are: (1) to map the distribution and species diversity of oribatid mites in alpine areas in Fennoscandia, and (2) based on published material, search for possible structuring environmental factors on the oribatid assemblages. Information on the current state of knowledge can suggest further ways to investigate alpine oribatids.

Material and Methods

This study is based on material from previously published articles on oribatid mites from alpine Fennoscandia. From the first paper by Trägårdh (1902), 32 articles have been published on alpine oribatid mites. These studies range from thorough faunistic and ecological surveys with several sites (e.g. Trägårdh 1902, 1910, Willmann 1943, Dalenius 1960, Karppinen 1971, Solhøy 1976b, Seniczak et al. 2006) to taxonomic descriptions or ecophysiological studies focusing on one or a few species (e.g. Sømme & Conradi-Larsen 1977a, 1977b, Seniczak et al. 1990a, 1990b). Nine unpublished theses have also been included in order to try to provide the best overview possible. Only one published article (Thor 1937) is not included here. This was excluded as the information provided was insufficient to infer the alpine origin of the sampling sites. An overview of oribatid mites reported from alpine Fennoscandia is listed in Appendix 1. This list refers to the sites in Appendix 2, which also includes information on the different sites and types of studies.

Full consensus has not been achieved on the taxonomy of oribatid mites. As it is not within the scope of this article to review the taxonomy, the species list follows the classification in Subías’(2004, 2009 [updated]) list of the oribatid mite species of the world. Following Subías was chosen as it is the only complete and updated overview of oribatid mites. Still, one exception is taken and explained in the species list. Where species names have been synonymised since their reports, the originally published name is included. The taxonomies of some particularly interesting or controversial species are commented in the species list.

Alpine areas are defined as being above the potential altitudinal woodland limit (e.g. Moen 1999). The tree-line in Fennoscandia varies according to geographical patterns, in a gradient peaking at about 1200 m a.s.l. in central Norway, decreasing towards the western coast (ca 500 m a.s.l.), towards the east (1000 m a.s.l.), and gradually towards the north, at 600 m a.s.l. in northern Sweden, 300 m a.s.l. in northern Finland and near the coast in Finnmark, Norway (Nordic Council of Ministers 1984). In the same way, the arctic area is defined as being north of the potential latitudinal tree-line. The arctic/alpine zone is delimited where the altitudinal and latitudinal tree-line meets (Nordic Council of Ministers 1984).

The alpine oribatid species are listed in accordance with the alpine zones; sub-alpine, low-alpine, middle-alpine, and high-alpine zones (Fremstad 1997, Moen 1999). These are all additionally influenced by local conditions and associated variations in vegetation. Towards the northern parts of Fennoscandia, conditions are more affected by latitude than altitude (Nordic Council of Ministers 1984). In this study, these arctic sites are divided into sub-arctic/alpine sites and arctic/alpine sites. In addition, glacier-forelands are included as a special habitat. All definitions of the alpine zones follow Fremstad (1997) and Moen (1999).

The sub-alpine zone (sA) is characterized by birch forest, often consisting of Betula pubescens. It includes mainly northern or alpine flora and vegetation.

The low-alpine zone (lA) starts where trees disappear and dwarf-shrubs and shrubs dominate. It mainly consists of alpine ridges and snow
patches. This zone is often vegetated by different species of Salix, along with Empetrum hermaphroditum, Juniperus communis – Betula nana heath, Phyllodoce caerulea – Vaccinium myrtillus heath, and peat-forming mire vegetation are all limited to this zone within the alpine area. On periodically dry soils, heath occurs, while meadows occur on wetter ground. The formation of podsolic soils does not occur above this zone.

The middle-alpine zone (mA) starts where Vaccinium myrtillus ceases to dominate the leeside vegetation. In general, it has continuous vegetation including dwarf-shrubs like Salix herbacea and herbs such as Ranunculus spp. and Saxifraga spp. In late snow patches, the soil can be unstable and solifluction may occur.

The high-alpine zone (hA) lacks a continuous vegetation layer and the vegetation is dominated by lichens and bryophytes. Stony soils with stone polygons and block-fields may be common.

Glacier-forelands (Gf) are characterized by newly exposed ground, rather than by their altitude, and this habitat type is hence treated separately. Vegetation here is limited by primary succession.

The sub-alpine/arctic zone (saA) resembles the sub-alpine zone, although it is limited by its northern latitude rather than by altitude. It is characterized by the same species as the sub-alpine zone.

The arctic/alpine zone (aA) is also limited by its northern latitude rather than by altitude, but it resembles the alpine zones. The botanical criteria for the southern arctic zone in northern Norway are the same as for the low-alpine zone. In Fennoscandia, arctic areas are limited to the northernmost parts of Finnmark, Norway, and hence are not divided into further subdivisions. In Norway, where the alpine and the arctic zones meet, the limit between these zones is usually unclear.

The sub-alpine zone is a natural part of a study of alpine regions. In articles where the focus is on non-alpine areas, it can be impossible to know if any sites studied are from the sub-alpine forest. Here, I have tried to include this zone where it is specifically mentioned. Consequently, some forest studies may include samples from sub-alpine forest without being included in this study.

All alpine zones are divided into a range of different habitats, with snow cover as one of the most important local environmental factors (Moen 1999). From ridges to snow-bed communities, the amount and length of the snow cover increase. On the ridges this gives cold conditions with a high risk of desiccation, whereas in the better protected snow-beds the temperature and moisture are higher whereas the growing season is shorter. This pattern is clearest in the low-alpine zone, and ceases upwards (Moen 1999). In addition, the habitats are affected by topography, drainage and waterlogging of the soil, slope and exposition, substrate, and soil movements by cryoturbation, solifluction, and weathering (Fremstad 1997).

When designations to specific alpine zones are not given in the original literature, these are inferred, based on information given in the original papers, such as altitude and vegetation, information from other scientific papers, or personal knowledge of the sites. These designations follow the alpine zones described previously. Only seven of the 166 sites could not be assigned to any alpine zone. As Thienemann (1941) states, the term lichen zone used by Trägårdh (1910) and repeated by Colloff (1993) corresponds to the high-alpine zone. Appendix 2 includes an overview of ecological information from the cited papers. The ecological information was occasionally limited, while for the most extensive descriptions the information had to be summarized. The latter mainly concerns the works by Trägårdh (1910) and Dalenius (1960). However, the information included in Appendix 1 is sufficient to identify these samples in the original literature.

Arctic areas in Fennoscandia are limited to a small region in the northern part of Norway. This arctic fauna was compared with the fauna at Svalbard. Species records are from the faunistic surveys
summarized in Coulson and Refseth (2004) and Coulson (2007). For each faunistic survey the number of reported species is calculated per article, and will be an over-representation in comparison with the number of species per site reported in this article.

A map of the localities shows that they are distributed unevenly, and they were thus grouped into three different regions. South (S) consists of 60 localities, North West (NW) includes 79 localities, and North East (NE) includes 26 localities (Figure 1).

Data Analysis

The analysis of this data-set is limited by some inherent restrictions. First, only a few of the original papers includes information on the abundances of the oribatid mites, so my data-set only contains presence/absence data. Second, this data-set is unbalanced as certain geographical areas and alpine zones are better investigated than others. These factors limit the interpretation and numerical analysis of the data. Exploratory statistics were used to reveal basic patterns in the distributions. As the purpose of this was to search for ecological patterns in the distribution of the alpine oribatids, only samples from faunistic surveys were included. Only sites with a minimum of five species were used.

A divisive partitioning technique TWINSPAN (two-way indicator species analysis) was used to group the sites. This method divides the data-set based on differences in species occurrences. The resulting classification was assessed along with information on the indicator species of the divisions and on ecological, geographical, and other information about the sites. TWINSPAN was performed using WinTwins, version 2.3 (Hill & Šmilauer 2005).

Species richness was analyzed with simple box-plots, illustrating the numbers of species found in the faunistic surveys. Comparisons between

![Figure 1. Map of Fennoscandia with the sites and geographical regions distinguished. Some of the sites are clustered together and appear as one site on the map. The South comprises 61 sites, the North West comprises 26 sites, and the North East comprises 79 sites. For a full overview of the sites, see Appendix 2.](image)
the geographical regions and between the alpine zones were made. An extended transect were also investigated by including the data from Svalbard as an additional geographical zone.

The patterns of species distributions in the geographical and alpine zones were also investigated. A preliminary detrended correspondence analysis (DCA) of the data reveals a very long DCA axis1 (4.14 standard deviations, eigenvalue 0.427, total inertia 10.628) and further ordinations were therefore performed with unimodal-based methods. A correspondence analysis (CA) was performed on all sites from faunistic studies with more than 5 recorded species. Biplots of the first and second CA axes were drawn, with the sites tagged according to geographical regions. Correlations between the alpine zones and the distribution of alpine oribatid mites were investigated using canonical correspondence analysis (CCA) looking at inter-species distances. Glacier-forelands and alpine and arctic zones were used as simple binary environmental explanatory variables. Geographical areas and original articles were included as supplementary variables. The articles with more than three sites were used as separate variables. Many of the Norwegian studies have either been published in cooperation with or supervised by Torstein Solhøy. These were grouped together in one group, consisting of the following articles: Solhøy (1975), Solhøy et al. (1975), Solhøy (1976b), Solhøy and Koponen (1981), Alvheim (1982), Cifarelli (1997), Basilico (2000), Furlan (2000), Johannessen (2002), Riva-Caballero (2004), and Hågvar et al. (2009). The statistical significance of the species-environmental variable relationships were assessed by a Monte Carlo permutations test with 499 permutations, as implemented in Canoco for Windows version 4.5 (ter Braak & Šmilauer 2002).

**Results**

One hundred and ninety one species of oribatid mites have been published from 166 alpine sites in Fennoscandia (Appendix 1). The number of species recorded varies greatly with sampling effort, extraction techniques, and research aim. There may be a range of causes for this, but the most important are probably differences in sample size and extraction efficiency. Five species are noted as “species inquirenda”. Although the taxonomy and true identity of these species are unclear, they are included in the data analysis, as they may represent a taxon distinct from the other species at these sites. Information about the sites is listed in Appendix 2.

The TWINSAN analysis of presence/absence data is designed to reveal patterns in the site composition and in the species distribution. As this data-set is based on faunistic and ecological studies, it consists of a subset of 112 sites with 183 species. The TWINSAN results in a partitioning, where the sites are divided into 41 groups, based on nine split levels. At the first level, the data are split into two groups. One of these is characterized by *Eupelops septentrionalis* (Trägårdh, 1910) and *Chamobates cuspidatifrons* (Trägårdh, 1904) and consists of 17 sites. All sites in this group were published by Trägårdh (1902, 1910) from Swedish Lapland and Sarek. *Liochthonius sellnicki* (Thor, 1930), *Eupelops torulosus* (C. L. Koch, 1839), and *Ceratoppia sphaerica* (L. Koch, 1879) are indicators of the other sub-group, where all sites were published by Dalenius (1960) from Swedish Lapland. The other group is characterized by *Tectocepheus velatus* (Michael, 1880) and *Moritzoppia neerlandica* (Oudemans, 1900) and consists of 95 species. It is further split by *Heminothrus peltifer* (C. L. Koch, 1839) and *M. sarekensis* characterizing one sub-group, and *Oppiella nova* (Oudemans, 1902), *Ceratozetes gracilis* (Michael, 1884), *Carabodes subarcticus* Trägårð, 1902, *Conchogneta traegardhi* (Forsslund, 1947), and *Suctobelbella subcornigera* (Forsslund, 1941) characterizing the other. Not all divisions may be explained, but some clusters reveal interesting patterns. At
the fifth split level, one group only consists of
arctic sites, while another mainly comprises sites
from glacier-forelands. Interestingly, not only
Trägårdh and Dalenius get their sites closely
grouped. Eighteen of the 32 clusters consisting
of more than one site are published by the same
author. This is also often appropriate for adjacent
clusters. All sites in a cluster from the third split
level are published by Karppinen (1956b, 1962,
1971), and an adjacent cluster is also published
by this author. All the sites of Cadwalladr (1969)
and most of the sites from Willmann (1943) are
additionally clustered together. Although some
ecological considerations have been mentioned,
it seems as the author identities are the most
important explanatory factor for the majority of
these groups.

Species Richness

The faunistic and ecological surveys were used to
investigate species richness. Both the geographical
and alpine zones show similar species richness
(Figure 2). The arctic zone appears to have a
higher richness than the sub-arctic zone, although
the maximum observed number of species in each
locality decreases with environmental severity.
The differences in richness between the alpine
zones were not tested statistically due to the large
differences in the group size.

Geographical Distribution

Between 19 and 38% of the species are specific to
one geographical region, while 22% of the mites
have been found in all regions (Table 1). The ratio
between the species specific to each region and
the number of species in that region range from
19% in the intermediate region North West to 33
and 38% in the South and North East regions.
Neighbouring geographical groups have more
species in common than groups further apart.
South has 65 species in common with North West,
and North East has 61 species in common with
North East. South and North East, the two groups
farthest apart, share only 47 species. Only five
species are present in these two groups, but not in
the intermediate North West group.

Figure 2. A: Species richness, as number of species
per site, in the three geographical regions of alpine
Fennoscandia. The data from Svalbard (Sv) are
based on number of species per published paper, as
listed in Coulson and Refseth (2004) and Coulson
(2007). B: Species richness, as number of species
per site, in the alpine zones. Below each zone is the
number of sites for that group. The box plots show
the median and upper and lower quartiles. Where n
is nine or more, the 95% range and outliers are also
indicated.
Table 1. Summary of the number of species in the alpine regions in Fennoscandia. The total species richness is compared with the three geographical groups. Abbreviations: Spp=species, No=number.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>South</th>
<th>North West</th>
<th>North East</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. spp total</td>
<td>190</td>
<td>104</td>
<td>81</td>
<td>137</td>
</tr>
<tr>
<td>No. sites</td>
<td>166</td>
<td>61</td>
<td>26</td>
<td>79</td>
</tr>
<tr>
<td>No. specific species</td>
<td>34</td>
<td>15</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Ratio, specific spp/spp</td>
<td>0.33</td>
<td>0.19</td>
<td>0.38</td>
<td></td>
</tr>
</tbody>
</table>

As noted earlier, some of the clusters in the TWINSPAN follow geographical patterns. Most clusters are based on sites from a single geographical region, but no groups of clusters contain all data from any of them.

The geographical regions are grouped in the correspondence analysis (CA axis 1: 42.9%, axis 2: 38.1%) (Figure 3). Both the South and North East are quite closely clustered into separate groups. Along the first CA axis they are both situated around the origin and at the slightly negative side on the first axis. Along the second axis they are more clearly separated from each other. The North West is not so tightly clustered, and overlaps and expands beyond both South and North East (Figure 3). In the canonical correspondence analysis, North West and South are both found to be significant explanatory factors (Figure 5) (CCA eigenvalues: 1. axis 0.293, 2. axis 0.2238, cumulative percentage variance of species-environment relation: 55.3% for axis 1 and 100% for axis 2, p=0.002).

Altitudinal distribution

The altitudinal distribution of the oribatid mites has to be considered in relation to the varying altitude of the tree-line in Fennoscandia. Consequently, glacier-forelands, and alpine and arctic vegetation zones were used as explanatory variables in a CCA (CCA eigenvalues: 1. axis 0.258, 2. axis 0.228, total inertia 10.628, p≤0.012). sA, hA, saA, aA, and Gf were all found to explain significant parts of the variation (p≤0.002). The CCA biplot (Figure 4) shows a division into three parts, with the alpine zones in the lower part of the diagram, the arctic zones closely grouped on the top left, and glacier-forelands on the top right. Within the group of the alpine zones sA is separated from the more closely correlated lA, mA, and hA zones. As the TWINSPAN clusters seem to be best explained by the original authors of the reports, these and geographical regions were included as supplementary or passive variables in the CCA. They are not included in the calculations, but are displayed on the plot according to how they relate to the data (Figure 5). There is a clear correlation between the studies and the ecological zones. The NE region is naturally related to the arctic samples. All investigated glacier-forelands are from the S region, and these variables are strongly correlated.

Discussion

A literature review is naturally limited by the number and quality of reviewed studies. This survey was conducted to shed light on

Figure 5. Canonical Correspondence Analysis (CCA) biplot showing the relationship between the environmental and supplementary variables. The supplementary variables include geographical zones and the articles reporting more than three sites. Alpine and geographical zones follow the abbreviations used in the article. The articles are referred to as follows: Cad69: Cadwalladr 1969, Dal60: Dalenius 1960, Kar56: Karppinen 1956, Kar62: Karppinen 1962, Kar71: Karppinen 1971, Tr02: Trägårdh 1902, Tr10: Trägårdh 1910, DivSol: Miscellaneous articles and unpublished theses by Torstein Solhøy and coworkers, Other: the other articles.

Limitations of the data-set

The largest constraints on this data-set are the amount and quality of sampling. One of the challenges is the uneven cover of the alpine areas of Fennoscandia (Figure 1, Table 1). Some alpine areas are not covered at all, and large areas are
only covered with a few samples. This data-set is also limited by the uneven number of sites and samples investigated in the main vegetation zones. The majority of the samples are from sub-and low-alpine areas, and the middle- and high-alpine zones are clearly under-represented.

In any study using literature spanning more than 100 years, one of the shortcomings will inevitably be the lack of consistent sampling design. Laboratory methods, species descriptions, and research focus have changed over time. Trägårdh (1902) published his first paper before publication of the extraction of soil fauna with moisture gradients (Berlese 1905), and he was dependent on hand-picking of the mites. At the time of his second paper, Trägårdh (1910) used extraction funnels, and the number of species per site increased.

During these 100 years, knowledge on oribatid mites has increased and their taxonomy has changed. In 1902 only 55% of the species reported here were described, and the number of descriptions has increased gradually. It is likely that some of these species would be assigned to other species with better techniques and modern literature. Even today some oribatid groups are well investigated whereas others are in need of revision. The genera Eobrachychthonius, Liochthonius, Phthiracarus, and Eupelops are among these. Some of the most problematic species are discussed in footnotes in the species list.

A restricted number of scientists have been working in these areas and 60% of the sites in this report are published by only four authors (Trägårdh 1902, 1910, Willmann 1943, Karppinen 1956a, 1956b, Dalenius 1960, Karppinen 1962, 1971). The effect of this is inflated by the fact that many authors seem to have some favourite habitats where they collect samples. Of Willmann’s (1943) 14 samples, 12 are moss-samples, and most of them from wet habitats. This aquatic origin is not surprising, as these samples were collected by the freshwater biologist August Thienemann. Dalenius’ (1960) samples are, in contrast, primarily from heath and sub-alpine forest. The selection of habitats will also affect the species represented in the species list. For instance, the aquatic Limnozetes, Hydrozetes, and Mucronothrus are only reported from three localities, showing how few studies include truly aquatic environments. Other specific habitats, as lichen-sites, might also largely be lacking from the material. This problem is enlarged by the incomplete information on the sites and samples in most of the papers cited here. Karppinen’s information on his samples is, for instance, basically site descriptions. He does not include information on whether his samples are taken from the litter layer, moss within the habitat or other micro-habitats which will affect the species assemblages. In combination, these different sampling and extraction methods may be the most important explanation of the author-based TWINSpan clusters. The species distributions do not, however, seem to be affected by this. Only 33% of the species are restricted to the sites investigated by these four authors. It thus seems as if the authors selected primarily on sampled habitats.

Species richness

In this data-set, the species richness is similar for all the separate alpine zones (Figure 2). According to theory, species richness would be expected to decrease with altitude (Rahbek 1995). However, this material would probably not be sufficient to reveal any such trends. The variation between sites is large and the range varies with the number of sites. This suggests that the richness would increase with more sites. The reported species numbers are also surprisingly low. In the low-alpine zone the mean species richness is 10 species per sample. Solhøy (1975) investigated the oribatid community in low-alpine environments specifically and found 14 species in lichen heath and 16 in wet meadow. The different authors also show dissimilarities with respect to species richness. For example, Cadwalladr (1969) found between 14 and 40 species per sample while Karppinen (1971) found only 1 to 14 species. There seems to be no good ecological explanation for this difference from the presentations of their sites, and the species numbers for some of Karppinen’s sites
seem surprisingly low (Appendix 2). Karppinen’s samples were transported to Helsinki prior to extraction (Karppinen, personal communication to T. Solhøy), and this process would probably affect the extraction efficiency. The highest numbers of species per site also seem surprisingly high. Six sites are reported to have forty or more species. Four of these are published by Dalenius (1960), which generally have a higher species number than the other cited articles. Karppinen (1956b) and Cadwalladr (1969) published the other two sites. It seems likely that this high species number is a result of large samples, possibly with a range of microhabitats included.

For a majority of the articles reported here, the published information on the sampling regime is incomplete. This complicates the use of sampling design for separations between biologically realistic estimates and artificially low reports and restricts the interpretation of the data-set. Thus, no safe conclusions on patterns in species richness in the alpine areas can be made.

Theoretically, one might expect a decrease in species richness with increasing latitude. Seemingly contradicting this, the sub-alpine/arctic sites seem to have lower richness than the more extreme alpine/arctic sites. However, the high richness in the alpine/arctic zone is from only six samples, highlighting the limitations of this data-set. In a comparable arctic area at Svalbard, where 36 papers are reported, the richness is lower again, and is around the level of the sub-arctic/alpine zone (data from Coulson & Refseth 2004, Coulson 2007). The numbers from Svalbard are not completely comparable, as they present species richness in each paper, rather than in each site. The species list from Spitsbergen also probably over-reports the number of oribatid species (see comment in Coulson & Refseth 2004). Correcting for this overestimate would further lower the arctic species richness on Svalbard, giving an even stronger indication of lower species numbers at increasing latitudes.

Geographical distribution

The CA plot reveals strongest similarities within the South and North East regions (Figure 3). This coincides with a higher number of geographically specific species in these groups, reaching 33 and 38%, respectively (Table 1). In North West, only 19% of the species are specific to this area and the CA plot shows a group with wider distributions, overlapping with the two other groups. Additionally, the majority of species found in two groups are restricted to adjacent geographical groups. This suggests a gradual change in oribatid mites from south to north. However, when the fauna from alpine Fennoscandia is compared with arctic areas of Svalbard, the similarity does not increase with geographical proximity. From the South, 30% of the species are also found on Svalbard, while the corresponding values in the North West and North East are 26%. Some of the species only found in the South are also found on Svalbard. Although the data-set from Svalbard is incomplete and probably includes too many species (Coulson & Refseth 2004), it seems premature to identify any geographical patterns from the Fennoscandian data-set.

The geographical patterns will additionally be affected by the arctic sites, as all of them are situated in the North East region. The highest species specificity in the North East can be an effect of influence of the Arctic Ocean. Many primarily arctic plants are found both within and beyond the arctic zone in northern Norway (Moen 1999), and the Arctic influence may cover a large part of the North East region. Twenty three species of oribatid mites are reported more often from arctic than alpine areas in Fennoscandia. These are: Achipteria coleoptrata (Linnaeus, 1758), A. italica (Oudemans, 1914), Belba compta (Kulczynski, 1902), Passalozetes perforatus (Berlese, 1910), Caleremaus monilipes (Michael, 1882), Camisia segnis (Hermann, 1804), Eulohmannia ribagai Berlese, 1910, Heminothrus paolianus (Berlese, 1914), Melanozetes meridianus Sellnick, 1928, Nanhermannia nana (Nicolet, 1855), N. sellnicki Forsslund, 1958, Neoribates auranticus (Oudemans, 1914), Nothurus palustris C. L.
Koch, 1839, *Liacerus coracinus* (C. L. Koch, 1841), *Parachipteria punctata* (Nicolet, 1855), *Phthiracarus borealis* (Trägårdh, 1910), *P. globosus* (Koch, 1841), *P. longulus* (Koch, 1841), *P. piger* (Scopoli, 1763), *Rhinoppia subpectinata* (Oudemans, 1900), *Suctobelbella longirostris* (Forsslund, 1941), *S. perforata* (Strenzke, 1950), and *Synchthonius crenulatus* (Jacot, 1938). When compared with the distribution in other, not arctic, areas, mainly in Finland (Niemi et al. 1997), it is clear that they are not restricted to arctic habitats. Many of these species are neither found on Svalbard nor Greenland. They are also, however, not common in alpine areas in Fennoscandia. Thus, no indication of a separate arctic fauna within the Fennoscandian mainland could be found.

**Altitudinal distribution**

The alpine environmental variables are more or less clustered in the CCA, pinpointing the stronger correlation within the alpine sites than with sites from arctic or glacier-foreland conditions (Figure 4). High-alpine sites split off from the other alpine sites. Most of the species are distributed close to the middle of the CCA biplot, and the proximity of the environmental variables in the centre of the plot show the limited alpine influence in the dataset.

**Alpine species**

*Camisia borealis* (Thorell, 1871), *C. cuspidatiiformis*, *C. sphaerica*, *Malaconothrus globiger* Trädgårdh, 1910, *M. sarekensis*, *Trichoribates monticola* (Trädgårdh, 1902), and *T. setiger* (Trädgårdh, 1910) are all species which are more common in the higher alpine zones than in lower. Although one should be careful with conclusions based on this survey, the trend seems clear for all of these species. *Trichoribates setiger* is one of the most extreme of these, inhabiting 57% of the high-alpine sites, but only 7% of the low-alpine sites. It is also correlated with high-alpine environments on the CCA-plot. This pattern is the same, although the occurrences are less for *C. borealis*. *Phauloppia lucorum* (C. L. Koch, 1841) is strongly correlated with these conditions in the CCA, but this is based on one high-alpine study (Dalemius 1960). For some of the species the alpine distribution is also supported by literature from other regions. *Mycobates sarekensis* is also abundant in arctic tundra, and even more so in areas close to snow in the polar Urals (Sidorchuk 2009). From the CCA plot, *T. monticola* also seems to be correlated with high-alpine and glacier-zones (Figure 4). It is found in both sub-alpine conditions and in alpine screes in the Schlen/Scliar Massif in the Italian Alps (Schatz 2008), but is more frequent in mosses above than below the tree-line in the Krkonose mountains, Czech Republic (Materna 2000). This is also correlated with alpine and glacier-forelands zones in the CCA-plot. *Ceratoppia sphaerica* becomes gradually more common with altitude in Fennoscandia, and in the polar Urals it is found in the most extreme of the investigated habitats, namely near-snow assemblages (Sidorchuk 2009).

**Species limited in altitudinal distribution**

The sA and lA zones are represented by 45 and 59 sites, respectively, and mA and hA are represented by 11 and 7 sites. Due to this bias, one should be cautious in stating which species are limited by the most severe conditions, as the conclusion is based on the lack of presence in poorly investigated habitats. However, some species seem to be restricted by altitude, and can be divided into three groups.

*Adoristes ovatus* (C. L. Koch, 1840), *Conchogneta traegardhi* (Forsslund, 1947), *Diapterobates humeralis* (Hermann, 1804), *Hemileius initialis* (Berlese, 1908), *Heminothrus longisetosus* Willmann, 1925, *Melanozetes mollicomus* (C. L. Koch, 1839), *Moritzoppia splendens* (C. L. Koch, 1841), *M. neerlandica*, *O. nova*, and *Suctobelbella subtrigona* (Oudemans, 1900) are all species which are common in the lower zones but are not present in the higher alpine zones. *Oppiella nova* is present in as much as 35% of the sub-alpine sites and 41% of the sub-alpine/arctic sites, but is not reported from the high-alpine sites. The pattern is the same for all of these species although the other species are less common. *Suctobelbella*
subtrigona is also found below, but not above, the tree-line in the Krkonoše mountains, Czech Republic (Materna 2000). These species are hence considered to be limited in altitudinal distribution. *Camisia biurus* (C. L. Koch, 1839), *Metabelba pulverulenta* (C. L. Koch, 1839), *Eremeus oblongus* (C. L. Koch, 1835), and *Dissohrina ornata* (Oudemans, 1900) also seem to be restricted by altitude. However, their presences at lower altitudes are moderate, and their lack of presence at higher altitudes may simply be a result of chance. Although *C. biurus* is only present in 2–18% of the sites at lower altitudes in this study, its possible alpine limitation is supported by the reports from lower, but not higher, altitudes in the Italian Dolomites (Fischer & Schatz 2007). *Dissohrina ornata* and *E. oblongus* are also present in sub-alpine forests in the Alps, and although *D. ornata* was also found on cliffs, none of them were reported from the higher sites investigated in the Italian Dolomites (Fischer & Schatz 2007). Although still inconclusive, this supports the notion that these species might be limited by altitude, and their distribution should be investigated further.

*Ceratoppia bipilis* (Hermann, 1804) and *Carabodes subarcticus* Trägårdh, 1902 appear to be limited in this data-set, but are found in alpine conditions in other regions. *Carabodes subarcticus* is found in the Italian Alps, reported from alpine pasture and alpine meadow at around 2500 m a.s.l. (Fischer & Schatz 2007) and it is commonly found in arctic tundra in the polar Urals (Sidorchuk 2009). *Ceratoppia bipilis* is only found below sub-alpine altitudes in the Italian Alps (Fischer & Schatz 2007), but it is present in arctic tundra in the polar Urals (Sidorchuk 2009).

**Species from the entire altitudinal gradient**

*Belba compta*, *Edwardzetes edwardsi*, and *Oribatula tibialis* (Nicolet, 1855) are more or less equally common in all the ecological zones. However, in the Krkonoše Mountains, Czech Republic, *E. edwardsi* was only found below the tree-line (Materna 2000). *Carabodes labyrinthicus* (Michael, 1879), *Chamobates cuspidatiformis*, *Eupelos septentrionalis*, *E. torulosus*, and *Tectocepheus velatus sarekensis* Trägårdh, 1910 are present in all four altitudinal zones. *Carabodes labyrinthicus* is also found both below and above the tree-line in the Krkonoše Mountains, Czech Republic (Materna 2000). *Eulohmannia ribagai* and *Malacotonethus globiger* are present in several sites in both the high and low altitudinal zones, although not in all four. Since they are found in both ends of the gradient they can be assumed to occur along the entire gradient.

**Glacier-foreland species**

Glacier-forelands, the areas of newly exposed ground in front of retreating glaciers, are a special habitat mainly affected by primary succession. Although the immigration to these areas is affected by the species pool in the surrounding areas, these sites separate from the alpine sites in the CCA.

Based on their relative presence within the alpine communities, *Liochthonius lapponicus* (Trägårdh, 1910), *L. sellnicki* (Thor, 1930), *M. sarekensis*, *Camisia foveolata* Hammer, 1955, *O. nova*, *Oromurcia bicuspidata* Thor, 1930, *Suctobelbella acutidens* (Forsslund, 1941), and *T. velatus* seem to be related to glacier-forelands. *Liochthonius lapponicus* and *O. bicuspidata* are also linked to glacier-forelands on the CCA-plots. Although these species are found in glacier-forelands, they are not restricted to such areas. Many of these species are also common in other non-alpine environments. Both *T. velatus* and *O. nova* are, for instance, euryecious and globally distributed (Weigmann 2006). Their listing as glacier-foreland species is consequently an indication that these species thrive in glacier-foreland conditions, not that they are restricted to these.

Oribatid mites are often asexual, displaying female parthenogenesis, thelytoky, in both otherwise sexually genera and in larger completely asexual groups (Norton & Behan-Pelletier 2009). With the exception of *O. bicuspidata* and *M. sarekensis*, all the glacier-foreland species are thelytok. This simplifies establishment after initial immigration, and some of these species are also known as early
colonizers from other habitats. For example, *T. velatus*, *L. lapponicus*, *L. sellnicki*, and *O. nova* are reported as early colonizers in post-industrial dumps (Zyromska-Rudzka 1977, Skubała 1997). In glacier-forelands, the newly exposed ground provides harsh conditions often characterized by little vegetation and repeated soil disturbance. The ability to immigrate into these areas, withstand the harsh conditions, or to recolonize the area frequently, is important. A study of more or less exposed ground in and around vehicle tracks on high arctic tundra shows an increase of *L. lapponicus* and *L. sellnicki* in disturbed sites, and *T. velatus* was only observed in connection with the tracks (Kevan et al. 1995).

The increased presence of both the alpine species *M. sarekensis* and the sub-alpine *O. nova* in glacier-forelands in Fennoscandia highlights the differences between the surrounding alpine areas and glacier-foreland conditions. Both these species obviously possess the colonizer traits needed for survival in glacier-forelands, although they normally live in different habitats.

The connection between glacier-forelands and *Damaeus karelicus* (Bulanova-Zachvatkina, 1957), *Mycobates tridactylus* Willmann, 1929, *Suctobelba sorrentensis* Hammer, 1961, *Suctobelbella latirostris* (Strenzke, 1950), *Tectocepheus minor* Berlese, 1903, and *Trichoribates novus* (Sellnick, 1928) are additionally highlighted by the CCA. All of these are, however, only found in one or two sites. Although all of these are reported from glacier-forelands, more studies are required to study their connection with glacier-foreland conditions.

**Conclusions**

The primary aim of this study was to get an overview of the distribution of oribatid mites in alpine Fennoscandia judged from the published information. However, the previous discussion reveals many of the challenges concerned with the present status of information on soil-dwelling oribatids in alpine Fennoscandia. The limited numbers of published papers and study areas clearly restrict the amount of available information. Unlike Fennoscandia, there are many thorough publications on the diversity of oribatid groups published in North America. It is estimated that, even after a thorough study of the oribatid mites in Yukon, at most 40% of the oribatid species in the area is known (Behan-Pelletier 1997). Large areas of sub- and low-alpine habitats in the southern and eastern parts of Fennoscandia, and the continental areas in mid- and north-Norway remain poorly investigated. This also accounts for specialized habitats, like aquatic or high-alpine lichen habitats. It seems clear that further collection of oribatid mites within these regions and habitats would significantly increase the species number.

It is possible to classify primarily alpine or altitudinal limited species from alpine Fennoscandia. Our data-set gives some additional information about which species live in the entire altitudinal range. Certain species found within the alpine communities are particularly common on glacier-forelands. No true arctic species were revealed within Fennoscandia.

The second part of my study was to look at the structuring factors of the environment, considering the status of the present knowledge. This clearly reveals a lack of information on the details around distributional patterns, leaving additional constraints on the study design of further research. It is clear that microhabitat factors largely determine the species composition of oribatid mites. One example of the influence of microhabitat is the oribatid species richness in trees, which probably depends on the species of epiphytic lichens (Behan-Pelletier et al. 2008). Studies of habitat heterogeneity are needed to reveal the factors determining the distribution of oribatid mites in temperate regions (Maraun & Scheu 2000). Similarly, to reveal the structuring factors of the alpine oribatid community, studies of microhabitats are necessary.

Habitat descriptions vary greatly between the articles that this review is based on, limiting the information in my data-set. Comprehensive information on sampling design, with information
on sample size, sample practice, microhabitats, extraction method, selection of sample sites, and numbers of the different species of mites found are information that would make such studies more useful. Well considered studies with rigorous study designs have the potential to assess altitudinal species richness, the mid-domain effect, and species-area relationships. Such studies would greatly increase our understanding of the alpine oribatid environment.

Acknowledgements. This work was financed by NORPEC, an NFR funded strategic University Program at the University of Bergen, co-ordinated by H. J. B. Birks. Torstein Solhøy gave me free admission to his extensive collection of literature on oribatid mites, and Rivita Penttinen helped with much of the literature from Finland. They were both crucial in achieving overview of the literature. Subiás online list of Oribatida of the world has additionally been used extensively. John Birks and Torstein Solhøy have commented the manuscript repeatedly. This work would not have been completed without all your help, and you are all cordially thanked. Arguitxu de la Riva Caballero is especially thanked for all her support, encouragement, and thousand small advices.

References

Proc. R. Soc. B 267, 739–745.


Solhøy, T., & Koponen, S. 1981. Oribatei fauna (Acari) on alpine heath at Kevo, Finland. Reports of Kevo Subarctic Research Station 17, 41–43.


Heggen: Oribatid mites of Alpine Fennoscandia


*Received: 13 November 2009*

*Accepted: 22 March 2010*
Appendix 1. List of all oribatid species reported from alpine areas in Fennoscandia. The records are split according to their alpine zones. The site numbers correspond to the sites in Appendix 2. sA is sub-alpine sites, lA is low-alpine sites, mA is middle-alpine sites, hA is high-alpine sites, saA is sub-arctic/alpine sites, aA is arctic/alpine sites, and Gf are sites from glacier-forelands.

**ORBATIDA** Dugès, 1834

**PALAEOSTOMATA** Grandjean, 1969

**Palaeacaroidea** Grandjean, 1932

*Palaeacaridae* Grandjean, 1932

*Palaeacarus* Trägårdh, 1932

*P. hystricinus* Trägårdh, 1932

IA: 125, 126

**ENARTHRONOTA** Grandjean, 1947

**Hypochthonioidae** Berlese, 1910

**Hypochthoniidae** Berlese, 1910

*Hypochthonius* C. L. Koch, 1835

*H. rufulus* C. L. Koch, 1835

sA: 75, 121; lA: 146, 147, 154; aA: 80, 82

**Eniochthoniidae** Grandjean, 1947

**Eniochthonius** Grandjean, 1933

*E. minutissimus* (Berlese, 1904)

lA: 154; Gf: 157

**Brachychthonioida** Thor, 1934

**Brachychthoniidae** Thor, 1934

*Eobrachychthonius* Jacot, 1936

*E. borealis* Forsslund, 1942

sA: 41, 47, 48, 49, 50, 62, 63; lA: 52, 56, 67, 71; saA: 94, 98

*E. latior* (Berlese, 1910)

sA: 47, 49; lA: 52, 56

*E. oudemansi* (Hammen, 1952) (IA: 113)

**Liochthonius** van der Hammen, 1959

*L. alpestris* (Forsslund, 1958)

IA: 46

*L. brevis* (Michael, 1888)

sA: 41, 50*; lA: 54; ma: 44*

* as *Brachychthonius perpusillus*

*L. clavatus* (Forsslund, 1942)

IA: 52

*L. hystricinus* (Forsslund, 1924)

sA: 47*, 50*, 121

* as *Brachychthonius hystricinus*

*L. lapponicus* (Trägårdh, 1910)

sA: 10*, 31*, 37*; lA: 18*, 73, 74, 77, 113, 115; Gf: 155, 156, 160, 161, 162; unknown: 26*, 34*

* as *Brachychthonius brevis var. lapponica*

* L. sellnicki* (Thor, 1930)


* as *Brachychthonius scalaris*, * as *Liochthonius cf. sellnicki*

* L. simplex* (Forsslund, 1942)

sA: 41, 47*; lA: 42, 43; ma: 44

*as Brachychthonius simplex*

Selnickkochthonius Krivolutsky, 1964

* S. immaculatus* (Forsslund, 1942)

sA: 41, 47*, 48*, 49*, 50*, 51*; lA: 52, 53, 57; ma: 44, 58; Gf: 156, 157, 164

*as Brachychthonius immaculatus*

Synchthonius Hammen, 1952

* S. crenulatus* (Jacot, 1938)

sA: 78*; aA: 79*, 80*, 81*, 82*

*as S. boschmai

**MIXONOMATA** Grandjean, 1969

**Eulohmannioida** Grandjean, 1931

**Eulohmanniidae** Grandjean, 1931

**Eulohmannia** Berlese, 1910

*E. ribagai* Berlese, 1910

sA: 37, 41, 47, 51, 68, 85; lA: 52, 57, 125, 126, 146, 147; hA: 19*; saA: 78, 93, 94, 101, 112; aA: 79, 82, 105; unknown: 33

*as Arthronothrus biunguiculatus*

**EUPTYCTIMA** Grandjean, 1967

**Euphtthiracaroidea** Jacot, 1930

**Euphtthiracaridae** Jacot, 1930

**Acrotritia** Jacot, 1923

* A. ardua* (Koch, 1841)

sA: 91*

*as Rhysotritia ardua*

* A. loricata* (Rathke, 1799) “sp. inq.”

sA: 62*; aA: 79; unknown: 38*

*as Oribotritia loricata, *as Pseudotritia loricata

**Euphtthiracarus** Ewing, 1917

* E. monodactylus* (Willmann, 1919)

**1** This is the only species in this list that does not follow the taxonomy of Subías (2009), who assigns this to *Hypochthoniella*. It is here assigned to *Eniochthonius* following Norton and Behan-Pelletier (2007).
Appendix 1. continued

Phthiracaroidea Perty, 1841
Phthiracaridae Perty, 1841
• Atropacarus Ewing, 1917
  • A. striculus (C. L. Koch, 1835)
    sA: 41, 87, 91*, 93, 95, 96*, 99*, 102*, aA: 79, 80; unknown: 26*
  *as Steganacarus striculus

Notophthiracarus Ramsay, 1966
• N. pavidus (Berlese, 1913)
  sA: 91

Phthiracarus Perty, 1841
• P. borealis (Trägårdh, 1910)
  *as Hoplodermia boreale
• P. globosus (Koch, 1841)
  sA: 41, 92; saA: 95, 99, 102
• P. longulus (Koch, 1841)
  saA: 96*, 97*
  *as P. tarsus
• P. piger (Scopoli, 1763)
  sA: 41, 62; IA: 66, 68, 70, 89, 113; saA: 78, 99; aA: 79, 80, 82; unknown: 107

HOLOSOMATA Grandjean, 1969
Crotonioidea Thorell, 1876
Trhypochthoniidae Willmann, 1931
Mucronothrus Trägårdh, 1931
• M. nasalis (Willmann, 1929)
  sA: 32, 153; IA: 154; Gf: 156; unknown: 60
Trhypochthoniellus Willmann, 1928
• T. longisetus (Berlese, 1904)
  sA: 41*, 41’; IA: 42*
  *as Trhypochthonius excavatus, *as Trhypochthonius trichosus
Trhypochthonius Berlese, 1904
• T. cladonicola (Willmann, 1919)
  sA: 47, 49
Malaconothridae Berlese, 1916
Malaconothrus Berlese, 1904
• M. globiger Trägårdh, 1910
  sA: 29, 32, 50, 51; IA: 18; hA: 22; unknown: 26, 33, 38
• M. monodactylus (Michael, 1888)
  sA: 86*, IA: 114*, 117*, 147*
  *as M. egregius
Trimalacothrus Berlese, 1916
• T. glaber (Michael, 1888)
  sA: 41
• T. maius (Berlese, 1910)
  *as Malaconothrus sphagnicola, *as T. novus

Nothridae Berlese, 1896
Nothrus C. L. Koch, 1835
• N. biciliatus C. L. Koch, 1841 “sp. inq.”
  sA: 6, 10, 12; IA: 8, 18; hA: 21
• N. borussicus Sellnick, 1928
  sA: 25, 35, 41, 47, 48, 49, 51, 62, 83, 89, 91, 92; IA: 67, 70, 111, 117, 147, 148; mA: 76, 151, 152; saA: 78, 93, 94, 98, 102, 112; aA: 79, 80, 82; Gf: 162, 165, 166; unknown: 27, 107
• N. pautus C. L. Koch, 1839
  sA: 29, 50; aA: 79, 80, 81, 82
• N. pratensis Sellnick, 1928
  sA: 29, 32, 36, 41, 51, 63, 84, 90; IA: 111, 154; saA: 94, 99; unknown: 27, 28, 33, 34, 38, 108
• N. silvestris Nicolet, 1855
  IA: 56

Camisiidae Oudemans, 1900
Camisia von Heyden, 1826
• C. anomia Colloff, 1993
  mA: 140
• C. biurus (C. L. Koch, 1839)
  sA: 47, 48, 75, 89, 121, 134; IA: 113, 125, 126, 141, 146, 147, 148, 154; mA: 151, 152; saA: 100, 104; Gf: 156, 157; unknown: 27*, 107
  *as Uronothrus kochi
• C. biverrucata (C. L. Koch, 1839)
  IA: 52, 54
• C. borealis (Thorell, 1871)
  IA: 16*, 52, 54; hA: 21*, 23*
  *as Nothrus horridus var. borealis

1 Malaconothrus monodactylus is considered the senior synonym of M. egregius, M. gracilis, M. processus and M. punctulatus, as these species are often intermingled and not properly identified (Weigmann 2006).
2 N. biciliatus is considered a junior synonym of N. anaunusensis by Weigmann (2006).
3 Both C. anomia and C. solhoeyi have been described recently (Colloff 1993). While C. anomia are only found in one instance in this study, C. solhoeyi are found in many recent studies. It seems likely that some specimens reported as C. lapponica actually are C. solhoeyi.
4 According to Seniczak et al. (2006) C. borealis is a junior synonym of C. horrida.

Appendix 1. continued

2 Malaconothrus monodactylus is considered the senior synonym of M. egregius, M. gracilis, M. processus and M. punctulatus, as these species are often intermingled and not properly identified (Weigmann 2006).
3 N. biciliatus is considered a junior synonym of N. anaunusensis by Weigmann (2006).
4 Both C. anomia and C. solhoeyi have been described recently (Colloff 1993). While C. anomia are only found in one instance in this study, C. solhoeyi are found in many recent studies. It seems likely that some specimens reported as C. lapponica actually are C. solhoeyi.
5 According to Seniczak et al. (2006) C. borealis is a junior synonym of C. horrida.
Appendix 1. continued

- C. fovealata Hammer, 1955
  IA: 119, 133; mA: 120; Gf: 164, 165, 166; unknown: 60
- C. horrida (Hermann, 1804)\(^5\)
  sa: 47, 51; IA: 8, 70, 113, 125*, 126*, 138; Gf: 160, 162
  *as Camisia cf. horrida
- C. invenusta (Michael, 1888)
  IA: 136, 137
- C. lapponica (Trägårdh, 1910)\(^4\)
  sa: 10, 12, 31*, 47, 48, 51; IA: 42, 114, 117, 121, 139; hA: 21;
  saA: 78; aA: 79
  *as Platynothrus lapponicus
- C. segnis (Hermann, 1804)
  sa: 10; IA: 52; aA: 79, 80, 82
- C. solhoeyi Colloff, 1993\(^4\)
  IA: 146, 147, 148, 154; saA: 135; Gf: 155, 156
- C. spinifer (C. L. Koch, 1835)
  sa: 47, 48, 51, 134; IA: 70; mA: 151, 152; aA: 79; unknown:
  27, 33

Heminothrus Berlese, 1913
- H. capillatus (Berlese, 1914)
  IA: 121*, 148*; hA: 131, 132; Gf: 156
  *as Ovnonothrus septentrionales, *as Platynothrus capillatus
- H. humicola (Forsslund, 1955)
  mA: 44*; saA: 93*, 94*, 100*, 124*; Gf: 156, 157
  *as Neonothrus humicola
- H. longisetosus Willmann, 1925
  sa: 41*, 47*, 49*, 50*, 61*, 63*, 64*, 65*, 83*, 84*, 90*;
  IA: 43*, 113*, 121*, 146, 147, 148; mA: 111*; saA: 98*, 102*;
  aA: 106*; unknown: 107*, 108*
  *as H. paolianus var. longisetosus, *as Paulonothrus
  longisetosus
- H. paolianus (Berlese, 1913)\(^6\)
  aA: 78, 79
- H. peltifer (C. L. Koch, 1839)
  IA: 18*, 76*, 114, 121*, 131, 146, 147, 161, 154*; mA: 111*;
  saA: 78*; aA: 79*, 80*, 81*, 82*; Gf: 156; unknown: 26*, 27*,
  38*, 107*, 108*;
  *as Camisia peltifera, *as Nothisr peltifer, *as Platynothrus
  peltifer
- H. punctatus (L. Koch, 1879)
  sa: 24*, 35*, 50*, 51*, 75*, 90*; IA: 17*, 114*, 130; saA:
  98*, 99*; Gf: 161, 164*, 165*, 166*; unknown: 26*, 33*, 38*  
  *as Platynothrus punctatus, *as Nothisr punctatus
- H. targionii (Berlese, 1885)
  sa: 10*, 11*
  *as Nothisr targionii
- H. thi (Berlese, 1904)
  sa: 50*; IA: 54*, 55*; saA: 78*; aA: 79*, 80*; unknown:
  26 *as Platynothrus thi

Nanhermannioidea Sellnick, 1928
Nanhermanniidae Sellnick, 1928
Nanhermannia Berlese, 1913
- N. dorsalis (Banks, 1896)\(^7\)
  sa: 75*, 121*, 153*; IA: 146*, 147*, 148*, 154* *as N.
  coronata
- N. nana (Nicolet, 1855)
  sa: 6, 12*, 32, 35, 41, 48, 50, 92; IA: 72; saA: 78, 97, 99, 104;
  aA: 79, 80, 105; unknown: 33
  *as Hermannia nanus
- N. sellnicki Forsslund, 1958
  IA: 45; saA: 100, 111, 112

Hermannioida Sellnick, 1928
Hermannniidae Sellnick, 1928
Hermannia Nicolet, 1855
- H. reticulata Thorell, 1871
  IA: 147; hA: 59; aA: 79

BRACHYPYLLINA Hull, 1918
Damaeoidea Berlese, 1896
Damaeidae Berlese, 1896
Belha von Heyden, 1826
- B. compota (Kulczynski, 1902)
  sa: 10*, 12*, 14*, 35, 37, 41, 47, 48, 49, 50, 51, 62, 128*;
  IA: 15*, 18*, 43, 52, 54, 55, 56, 57, 68; mA: 58, 152*; hA: 59;
  saA: 98; aA: 79, 81, 82; Gf: 162*, 166*; unknown: 33
  *misidentified as Damaeus farinosus, *as B. verrucosa
Damaeus C. L. Koch, 1835
- D. auritus C. L. Koch, 1836
  sa: 89; mA: 111; unknown: 109
- D. bituberculatus (Kulczynski, 1902)
  sa: 47, 48, 51; IA: 52, 53; mA: 58
- D. brevitaliis Bulanova-Zachvatkina, 1957

\(^4\) In northern areas are H. paolianus often considered a junior synonym of H. longisetosus (e.g. Olczanowski 1996)
\(^5\) There has been extensive confusion concerning the nomenclature of N. nana, as N. nana sensu Willmann 1931 is identical with N. coronata Berlese 1913 (Forsslund 1963). N. coronata is now regarded a junior synonym of N. dorsalis (Subias 2009). N. nana sensu Nicolet 1855 is a separate species (Marshall et al. 1987). Accordingly, the separation between N. nana and N. dorsalis might not be consistent between publications and should be treated with caution.
Appendix 1. continued

sA: 128
• D. clavipes (Hermann, 1804)
sA: 10, 37*, 47, 49, 51*, 75, 121; IA: 15, 146, 147, 148; mA: 76, 151, 152; unknown: 33*, 38*  
*as Belba clavipes
• D. farinosus (Trägårdh, 1902)
sA: 1, 2, 3  
• D. gracilipes (Kulczynski, 1902)
sA: 47, 51, 62  
• D. karelicus (Bulanova-Zachvatkina, 1957)
Gf: 157  
• D. nidicola (Willmann, 1936)
sA: 32*  
*as Belba nidicola
• D. onustus Koch, 1841
sA: 41*  
*as Belba geniculosa
• D. taticus (Kulczynski, 1902)
sA: 47; IA: 113, 125, 126  
• D. tecticola Michael, 1888
sA: 48, 51; saA: 78  
• D. verticillipes (Nicolet, 1855)
sA: 47, 48, 49, 51; IA: 57, 70  
Metabelba Grandjean, 1936  
• M. pulverulenta (C. L. Koch, 1839)
sA: 62, 64, 65; IA: 52, 67, 70; saA: 102, 103; aA: 106  
Porobelba Grandjean, 1936  
• P. spinosa (Sellnick, 1920)
sA: 47, 48, 49, 51; IA: 113, 125, 126, 147; mA: 150, 151, 152

Niphocephedoida Travé, 1959  
Compactozetidae Luxton, 1988  
Cepheus Koch 1835  
• C. cepheiformis (Nicolet, 1855)
sA: 47, 51  
• C. dentatus (Michael, 1888)
sA: 75

Gustavioida Oudemans, 1900  
Ceratoppidiidae Kunst, 1971  
Ceratoppia Berlese, 1908  
• C. bipilis (Hermann, 1804)
sA: 10, 13, 47, 48, 51; IA: 8, 52, 54, 57, 121, 146, 147, 148; aA: 106  
• C. sphaerica (L. Koch, 1879)
sA: 47, 48; IA: 52, 53, 54, 56; mA: 58; hA: 23*, 59; aA: 79  
*as C. bipilis var. sphaerica

Liacaridae Sellnick, 1928  
Adoristes Hull, 1916  
• A. ovatus (C. L. Koch, 1840)
*as A. poppei  
Liacar us Michael, 1898  
• L. coracinus (C. L. Koch, 1841)
IA: 146; aA: 79, 80, 82  
• L. keretinus Nordenskiöld, 1901
sA: 50*, 75; saA: 95  
* as L. holmi

Eremaeoida Sellnick, 1928  
Eremaeidae Oudemans, 1900  
Eremaeus Koch, 1835  
• E. hepaticus C. L. Koch, 1835
sA: 41  
Eueremaeus Mihelčič, 1963  
• E. oblongus (C. L. Koch, 1835)
*as E. silvestris  
Eremelloidea Balogh, 1961  
Caleremaeidae Grandjean, 1965  
Caleremaeus Berlese, 1910  
• C. monilipes (Michael, 1882)
aA: 79, 82

Oppioidea Grandjean, 1951  
Autognetidae Grandjean, 1960  
Autogneta Hull, 1916  
• A. longilamellata (Michael, 1885)
sA: 1, 3, 6, 37*; unknown: 26*, 33*  
*as Oppia longilamellata  
• A. parva Forsslund, 1947
sA: 47  
Conchogneta Grandjean, 1963  
• C. traegardhi (Forsslund, 1947)
sA: 41, 47, 48, 50, 51, 61, 62, 63, 64, 65; IA: 43, 52, 57, 66, 71; saA: 93, 96, 103, 104, 124

Thyrisomidae Grandjean, 1954  
Banksinoma Oudemans, 1930  
• B. borealis (Willmann, 1943)
sA: 32*, 50*; IA: 57*; unknown: 34*
Appendix 1. continued

*as Oribella borealis
• B. castanea (Hermann, 1804) “sp. inq.”
  sa: 50*, saA: 99*
*as Oribella castanea
• B. lanceolata (Michael, 1885)
  sa: 148, 153

Oppiidae Grandjean, 1951
Multioppia Hammer, 1961
• M. (M.) wilsoni Moritz, 1966
  sa: 14*
*as Dameosoma clavipectinatum
Ramussella Hammer, 1962
• R. clavipectinata (Michael, 1885)
  IA: 8
Micropoppia Balogh, 1983
• M. minus (Paoli, 1908)
  saA: 101, 104*, 112*
*as Oppia minus
Rhinoppia Balogh, 1983
• R. subpectinata (Oudemans, 1900)
  sa: 36*, 37*, 41, 47, 49, 50, 51, 83*, 91*; IA: 43, 66*, 67*, 70*, 113, 125, 126, 146, 147, 148; mA: 151, 152; saA: 78, 94*, 96*, 97*, 98*, 101, 103*, 112*; aA: 79, 80, 81, 82, 105*, 106*; Gf: 159; unknown: 33*, 34*
*as Oppia subpectinata
Beriiniella Balogh, 1983
• B. bicarinata (Paoli, 1908)
  IA: 113
Dissohina Hull, 1916
• D. ornata (Oudemans, 1900)
*as Oppia ornata
Lauropoppia Subias & Rodríguez, 1986
• L. falcata (Paoli, 1908)
  sa: 47, 49, 50, 51; IA: 52, 53, 54; mA: 44, 58
• L. maritima (Willmann, 1928)
  saA: 124
Moritzopoppia Subias & Rodríguez, 1988
• M. keilbachii (Moritz, 1969)
  saA: 145
• M. neerlandica (Oudemans, 1900)
*as Eremamus longilamellatus, "as Ooppia translamellata, 'as Ooppa neerlandica, 'as Ooppia neerlandica
• M. splendens (C. L. Koch, 1841) “sp. inq.”
  sa: 10, 12, 14; IA: 56; saA: 96, 98, 101, 102, 112; aA: 106; Gf: 162)
• M. uncarinata (Paoli, 1908)
  sa: 47, 48, 49, 50, 51, 62*; IA: 52, 66*, 67*, 70*, 146
*as Oppia uncarinata
Oppiella Jacot, 1937
• O. nova (Oudemans, 1902)
  sa: 47, 48, 49, 50, 51, 62, 63, 64, 65, 83, 85, 87, 91, 92, 153; IA: 66, 70, 113, 154; mA: 111; saA: 93, 97, 100, 101, 102, 104, 112; aA: 105; Gf: 155, 156, 157, 159, 166*
*as O. cf. nova
• O. minidentata (Subias, 1977)
  saA: 145

Quadrroppiidae Balogh, 1983
Quadrroppia Jacot, 1939
• Q. quadricarinata (Michael, 1885)
  unknown: 108

Trizetoidea Ewing, 1917
Suctobelbidae Jacot, 1938
Suctobelba Paoli, 1908
• S. sorrentensis Hammer, 1961
  Gf: 156
• S. trigona (Michael, 1888)
  sa: 41, 47, 48, 49, 50; IA: 42, 52, 53; mA: 58
Suctobelbella Jacot, 1937
• S. acutidens (Forsslund, 1941)
  unknown: 34*
*as Suctobellota cornigera, “as S. sarekensis
• S. latirostris (Strenzke, 1950)
  Gf: 165*, 166*
*as Suctobelbella cf. latirostris
• S. longirostris (Forsslund, 1941)
  sa: 65; saA: 101, 103, 112; IA: 66, 69, 71, 72*; aA: 79, 80, 82
*as Suctobelba falcata
Appendix 1. continued

- S. perforata (Strenzke, 1950)
  saA: 78; aA: 79, 81

- S. similis (Forsslund, 1941)
  sa: 51, 121

- S. subcornigera (Forsslund, 1941)
  sa: 41, 47, 49, 83, 87, 89, 121; IA: 42, 43, 72, 146, 147; saA: 93, 94, 96, 100, 101, 103, 104, 112; aA: 106; GF: 156, 157; unknown: 110

- S. subtrigona (Oudemans, 1900)
  sa: 41*, 48*, 50*, 51*; saA: 93*, 94*, 100*, 104*

* as S. intermedia

Carabodoidea C. L. Koch, 1837

Carabodidae C. L. Koch, 1837

Carabodes C. L. Koch, 1835

- C. areolatus Berlese, 1916
  sa: 36, 47, 48, 50, 51; IA: 53, 57; saA: 97; unknown: 27, 33

- C. coriaceus Koch, 1835
  unknown: 27*

* as C. nepos

- C. femoralis (Nicolet, 1855)
  sa: 41, 49

- C. labyrinthicus (Michael, 1879)
  sa: 10*, 14*, 47, 49, 50; IA: 15*, 16*, 113, 115, 118, 123, 125, 126; maA: 44, 144, 151, 152; haA: 21*; saA: 96, 103, 124; aA: 106; unknown: 27, 27*

* as C. marginepunctatus

- C. marginatus (Michael, 1884)
  sa: 35, 41, 47, 48, 49, 50, 61, 64, 89, 121; IA: 42, 43, 66, 70, 116, 146, 147, 148; maA: 111; saA: 100; aA: 79, 80, 81, 82; unknown: 40, 108, 109

- C. minusculus Berlese, 1923
  sa: 89, 121; IA: 116, 148

- C. ornatus Štorkán, 1925
  sa: 39*, 41*, 47*, 50*, 51*; IA: 52*

* as C. forsslundi

- C. subarcticus Trägårdh, 1902
  sa: 41, 47, 48, 49, 50, 51, 61, 64, 65, 88, 91; IA: 52, 66, 71, 72; maA: 58; saA: 93, 97, 100, 104, 124; aA: 105

- C. willmanni Bernini, 1975
  IA: 146, 147, 154; maA: 150, 151

Tectocephoidea Grandjean, 1954

Tectocephidae Grandjean, 1954

Tectocephus Berlese, 1895

- T. minor Berlese, 1903
  GF: 156, 157

- T. velatus (Michael, 1880)*

- T. velatus sarekensis Trägårdh, 1910*

* as T. sarekensis

Hydrozetoidea Grandjean, 1954

Hydrozetidae Grandjean, 1954

Hydrozetes Berlese, 1902

- H. confervae (Schrank, 1781)
  sa: 24

- H. lacustris (Michael, 1882)
  IA: 154

Ameronothroidea Willmann, 1931

Ameronothridae Willmann, 1931

Ameronothrus Berlese, 1896

- A. lapponicus Dalenius, 1963
  IA: 142; maA: 143, 144, 149

Poronoticae Grandjean, 1954

Licneremaeoidae Grandjean, 1931

Licneremaeidae Grandjean, 1931

Licneremaeus Paoli, 1908

- L. licnophorus (Michael, 1882)
  sa: 49, 64; IA: 67

Passalozetidae Grandjean, 1954

Passalozetes Grandjean, 1932

- P. perforatus (Berlese, 1910)*

* C. minusculus sensu Willmann, 1931 is considered identical to C. willmanni, and is probably the only of these species which are present in alpine Fennoscandia. The original C. minusculus Berlese, 1923 is a separate, southern species (Weigmann 2006).

* The separation between T. velatus and T. velatus sarekensis is difficult and based on minor differences, even after several thorough studies (e.g. Knülle 1957, Nübel-Reidelbach 1994, Laumann et al. 2007). Tectocephus velatus sarekensis the only subspecies-level included in the species list, as this is a very common group and many authors try to separate these.

* Scutovertex bidactylus (later Bipassalozetes bidactylus) in Willmann (1931) is probably P. perforatus (Strenzke, 1953).
### Appendix 1. continued

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Description</th>
<th>Page Numbers</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phenopelopoidea</strong> Petrunkevitch, 1955</td>
<td>Phenopelopidae Petrunkevitch, 1955</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eupelops</em> Ewing, 1917</td>
<td><em>E. acromios</em> (Hermann, 1804)</td>
<td>147*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>E. geminatus</em> (Berlese, 1916)</td>
<td>82*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>E. occultus</em> (C. L. Koch, 1835)</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>E. planicornis</em> (Schrank, 1803)</td>
<td>32, 41, 58*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>E. plicatus</em> (C. L. Koch, 1835)</td>
<td>41, 58*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>E. auritus</em></td>
<td>79</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>E. septentrionalis</em> (Trägårdh, 1910)</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td><strong>Peloptulus</strong> Berlese, 1908</td>
<td><em>P. phaeonotus</em> (C. L. Koch, 1844)</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td><strong>Limnozetoidea</strong> Thor, 1937</td>
<td><strong>Limnozetidae</strong> Grandjean, 1954</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>L. ciliatus</em> (Schrank, 1803)</td>
<td>32, 41*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>L. rugosus</em> (Sellnick, 1923)</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td><strong>Achipterioidea</strong> Thor, 1929</td>
<td><strong>Achipteriidae</strong> Thor, 1929</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>A. coleoptrata</em> (Linnaeus, 1758)*11</td>
<td>50, 51*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>A. italica</em> (Oudemans, 1914)</td>
<td>37*</td>
<td></td>
</tr>
<tr>
<td><strong>Ceratozetoidea</strong> Thor, 1929</td>
<td><strong>Ceratozetidae</strong> Thor, 1929</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>C. gracilis</em> (Michael, 1884)</td>
<td>41, 51, 58*</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>C. mediocris</em> Berlese, 1908</td>
<td>36, 38*</td>
<td></td>
</tr>
</tbody>
</table>

---

11 Campachipteria fancogoi is considered a junior synonym of *A. coleoptrata* by Weigmann (2006), and he discusses further problems with this species.

12 Ceratozetes sp. from site 41 is identified as *C. thienemanni* by Karppinen (1958).
Appendix 1. continued

Edwardzetes Berlese, 1914
- E. edwardsi (Nicolet, 1855)
*as Notaspis edwardsii var. lapponica, 'as Oribata lapponica

Zetomimus Berlese, 1908
- E. globulus (Nicolet, 1855)
  IA: 147

Fuscozetes Sellnick, 1928
- F. fuscipes (C. L. Koch, 1844)
  IA: 114

Melanozetes Hull, 1916
- M. meridianus Sellnick, 1928
  aA: 105
- M. mollicomus (C. L. Koch, 1839)
  sA: 3, 4, 10, 14, 35, 41, 47, 49, 50, 51, 61, 63, 64, 65, 84, 89, 90; IA: 15, 42, 43, 114, 121, 147, 154; mA: 111; sA: 97, 98, 99, 100, 101, 104, 112, 128; aA: 79, 80, 82, 105, 106; Gf: 166; unknown: 26, 27, 33, 34, 38, 107, 109, 150*, 151*, 152*
*as Melanozetes cf. mollicomus

Oromucia Thor, 1930
- O. bicuspidata Thor, 1930
  sA: 75, IA: 114, 116, 127, 154; mA: 44, 150; sA: 78; aA: 79, 81; Gf: 156, 158, 159, 161, 162, 163, 164, 165, 166
- O. lucens (L. Koch, 1879)
  sA: 5*, 10, 13, 51; IA: 7, 15, 16, 54, 57
*as Notaspis setosa var. curta

Sphaerozetes Berlese, 1885
- S. piriformis (Nicolet, 1855)
  IA: 121

Trichoribates Berlese, 1910
- T. monticola (Trägårdh, 1902)
  sA: 8; IA: 16; mA: 58, 77; hA: 23; Gf: 155, 156
- T. novus (Sellnick, 1928)
  Gf: 158, 159
- T. setiger (Trägårdh, 1910)
  IA: 16*, 55*, 56*, 114; hA: 20*, 21*, 23*, 59*
*as Oribata piriformes var. setiger
- T. berlesiei (Jacot, 1929)
  sA: 47*, 51*, 147*; aA: 102*
*as T. trimaculatus

Zetomimus Hull, 1916
- Z. furcatus (Warburton & Pearse, 1905)
  IA: 154

Chamobatidae Grandjean, 1954
- Chamobates Hull, 1916
- C. cuspidatiformis (Trägårdh, 1904)\(^\text{13}\)
  sA: 10*, 12*, 47*, 48*, 75; IA: 15*, 16*, 52*, 53*, 56*, 113*, 115*, 121, 125, 126; mA: 150*, 151*; hA: 21*, 23*
*as Oribata cuspidata var. birulai, 'as C. trægårdhi, 'as C. borealis
- C. cuspidatus (Michael, 1884)
  IA: 121, 146, 147; mA: 150*, 151*, 152*
*as C. cf. cuspidatus
- C. pusillus (Berlese, 1895)
*as Oribata cuspidata var. borealis, 'as C. borealis, 'as Notaspis cuspidata var. borealis
- C. rastratus (Hull, 1914)
  sA: 49*
*as C. spinosus
- C. shuetzi (Oudemans, 1902)
  sA: 35, 37, 41, 61, 62, 65; IA: 42, 43, 68, 71; mA: 111; sA: 93, 96; unknown: 33

Humerobatidae Grandjean, 1970
- Diapterobates Grandjean, 1936
- D. humeralis (Hermann, 1804)
  sA: 37, 47*, 48*, 49*, 50*, 51*, 62; IA: 52*; sA: 96*
*as Trichoribates numerosus, 'as D. numerosus
- D. notatus (Thorell, 1871)
  sA: 11

Punctoribatidae Thor, 1937
- Mycobates Hull, 1916
- M. parmeliae (Michael, 1884)
  sA: 98, 102, 124
- M. sarekensis (Trägårdh, 1910)
  sA: 11, 14; IA: 15, 16, 113, 115, 125, 126, 154; mA: 77, 150*, 151*, 152*; hA: 21, 23; sA: 96*; aA: 79, 82, 106*; Gf: 160, 161, 162, 164, 165, 166; unknown: 107, 110
*as Calyptozetes sarekensis
- M. tridactylus Willmann, 1929
  Gf: 156, 157

\(^{13}\) The taxonomy of C. cuspidatiformis and the junior synonyms designated by Subias (2009) are discussed by Weigmann (2006).
Appendix 1. continued

Oripodoidea Jacot, 1925

Oribatulidae Thor, 1929

Oribatula Berlese, 1895

• *O. tibialis* (Nicolet, 1855)

*as *O. venusta,* ‘as *Eremaeus crassipes,* ‘as *O. crassipes*

• *O. exilis* (Nicolet, 1855)
  sA: 35, 41, 47; IA: 16, 52, 55, 57

Phauloppia Berlese, 1908

• *P. lucorum* (C. L. Koch, 1841)
  hA: 59*

*as *P. conformis

Hemileiidae J. & P. Balogh, 1984

Hemileius Berlese, 1916

• *H. initialis* (Berlese, 1908)

*misidentified as *Oribatula tibialis,* ‘as Scheloribates confundatus

Liebstadiidae J. & P. Balogh, 1984

Liebstadia Oudemans, 1906

• *L. humerata* Sellnick, 1928
  IA: 146

• *L. similis* (Michael, 1888)
  sA: 29, 37, 41, 47, 48, 50, 51, 75, 153; IA: 43, 114, 117; mA: 150, 151; saA: 78, 98; aA: 79, 81, 82

Scheloribatidae Jacot, 1935

Scheloribates Berlese, 1908

• *S. laevigatus* (C. L. Koch, 1836)
  sA: 75; IA: 52, 56

• *S. pallidulus* (C. L. Koch, 1841)
  sA: 49, 50, 51; IA: 55; mA: 58

Galumnoidea Jacot, 1925

Parakalummidae Grandjean, 1936

Neoribates Berlese, 1914

• *N. aurantiacus* (Oudemans, 1914)
  sA: 47, 49; IA: 52; saA: 124; aA: 79, 106

Galumnidae Jacot, 1925

Galumna Heyden, 1826

• *G. dorsalis* (C. L. Koch, 1835) “sp. inq”
  sA: 14

Pergalumna Grandjean, 1936

• *P. nervosa* (Berlese, 1914)
  sA: 36, 47, 49, 50, 61, 63, 64; IA: 43, 57
### Appendix 2. Summary of the alpine sites where oribatid mites have been recorded from alpine Fennoscandia

No is the site, Locality is the place of the site, C is country of origin; F: Finland, N: Norway and S: Sweden. Geo region is the geographical region used in this article; S: South, NW: North West, NE: North East. The alpine regions are listed as alpine and arctic zones; sub-alpine (sA), sub-artic/alpine (saA), low-alpine (mA), middle-alpine (mA), high-alpine (hA), arctic/alpine (aA), belts, sub-arctic/alpine sites (saA), arctic/alpine sites (aA) or glacier-forelands (Gf). Habitat is given if it is reported in the original articles or has been possible to infer in other ways. Altitude is given if it was possible to infer it from the articles or topographical maps. N species is number of species recorded in each site. Type of study corresponds to the nature/aim of the study; Fa/Ec: faunistic/ecological studies, EP: ecophysiological studies, Tax: species descriptions and taxonomical studies.

<table>
<thead>
<tr>
<th>No.</th>
<th>Locality</th>
<th>C</th>
<th>Geo region</th>
<th>Alpine zone</th>
<th>Habitat</th>
<th>N species</th>
<th>Type of study</th>
<th>Altitude m a.s.l.</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Abiskojokki, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Birch litter</td>
<td>3</td>
<td>Fa/Ec</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>2.</td>
<td>Kårsovangjokki, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Litter and leaves</td>
<td>3</td>
<td>Fa/Ec</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>3.</td>
<td>Mt. Kårsonjuonje, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Sphagnum spp. at the tree limit</td>
<td>6</td>
<td>Fa/Ec</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>4.</td>
<td>Mt. Tarakoski, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>In moss by the stream</td>
<td>1</td>
<td>Fa/Ec</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>5.</td>
<td>Mt. Tarakoski, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Under rocks in a stream</td>
<td>1</td>
<td>Fa/Ec</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>6.</td>
<td>Mt. Vorovardo, Tarakoski, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>In Sphagnum spp.</td>
<td>5</td>
<td>Fa/Ec</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>7.</td>
<td>Mt. Kårsonjuonje, Lapland</td>
<td>S</td>
<td>NW</td>
<td>mA</td>
<td>Under moist rocks</td>
<td>2</td>
<td>Fa/Ec 1000</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>8.</td>
<td>Mt. Kårsonjuonje, Lapland</td>
<td>S</td>
<td>NW</td>
<td>mA</td>
<td>Under rocks at the tree limit</td>
<td>7</td>
<td>Fa/Ec 1000,1050</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>9.</td>
<td>Mt. Kårsonjuonje, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Leaves and mosses, leaves and mosses under rocks</td>
<td>3</td>
<td>Fa/Ec 1040</td>
<td></td>
<td>(Trägårdh 1902)</td>
</tr>
<tr>
<td>10.</td>
<td>Birch zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>mA</td>
<td>In leaves and mosses</td>
<td>22</td>
<td>Fa/Ec 370-700</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>11.</td>
<td>Birch zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Under rocks</td>
<td>5</td>
<td>Fa/Ec 370-700</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>12.</td>
<td>Birch zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>In Sphagnum spp.</td>
<td>11</td>
<td>Fa/Ec 370-700</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>13.</td>
<td>Birch zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Under rocks at the banks of a stream</td>
<td>2</td>
<td>Fa/Ec 370-700</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>14.</td>
<td>Birch zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Under the bark of a rottling birch</td>
<td>9</td>
<td>Fa/Ec 370-700</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>15.</td>
<td>Oligotrophic heath, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>lA</td>
<td>In leaves and mosses</td>
<td>13</td>
<td>Fa/Ec 700-1000</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>16.</td>
<td>Oligotrophic heath, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>lA</td>
<td>On the side of boulders</td>
<td>10</td>
<td>Fa/Ec 700-1000</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>17.</td>
<td>Oligotrophic heath, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>lA</td>
<td>In moss in slowly flowing water</td>
<td>2</td>
<td>Fa/Ec 700-1000</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>18.</td>
<td>Oligotrophic heath, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>lA</td>
<td>East and west facing slopes of Mt. Säarak</td>
<td>9</td>
<td>Fa/Ec 700-1000</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>19.</td>
<td>Lichen zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>hA</td>
<td>In nest of Bombus kirkbyellus</td>
<td>1</td>
<td>Fa/Ec 1000-1300</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>20.</td>
<td>Lichen zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>hA</td>
<td>Mountain heath at the base of Mt. Tjukua</td>
<td>2</td>
<td>Fa/Ec 1000-1300</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>21.</td>
<td>Lichen zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>hA</td>
<td>Stony soils, cryoturbated</td>
<td>8</td>
<td>Fa/Ec 1000-1300</td>
<td></td>
<td>(Trägårdh 1910)</td>
</tr>
<tr>
<td>22.</td>
<td>Lichen zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>hA</td>
<td>Spring in Betula nana-heathland (sample nr. 54)</td>
<td>2</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>23.</td>
<td>Lichen zone, Sarek, Jokkmokk, Norrbotten</td>
<td>S</td>
<td>NW</td>
<td>hA</td>
<td>Brook by Vassajaure, in moss (sample nr. 85b), in birch region (after Thienemann 1941)</td>
<td>1</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>24.</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Thick moss, above a spring (sample nr. 115c), in birch region (after Thienemann 1941)</td>
<td>13</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>25.</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Moss surrounding these ponds (sample 122)</td>
<td>12</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>26.</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Moss in spring (sample 125a)</td>
<td>8</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>27.</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Meltwater drained moss in Betula nana-heathland (sample nr. 131), in birch region (after Thienemann 1941)</td>
<td>1</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>28.</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Moss in birch forest (sample nr. 136)</td>
<td>6</td>
<td>Fa/Ec</td>
<td></td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>No.</td>
<td>Locality</td>
<td>C</td>
<td>Geo region</td>
<td>Alpine zone</td>
<td>Habitat</td>
<td>N species</td>
<td>Type of study</td>
<td>Altitude m a.s.l.</td>
<td>Study</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------</td>
<td>-----</td>
<td>------------</td>
<td>-------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-----------</td>
<td>---------------</td>
<td>------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>32</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Spring moss (sample nr. 143a), in birch region (after Thienemann 1941)</td>
<td></td>
<td>Fa/Ec</td>
<td>380</td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>33</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Regio subalpina</td>
<td>1</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Karpinnen 1956a)</td>
</tr>
<tr>
<td>34</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Mountain birch zone</td>
<td>45</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1956b)</td>
</tr>
<tr>
<td>35</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Dwarf scrub heath land</td>
<td>12</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1956b)</td>
</tr>
<tr>
<td>36</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Litter in a rich herbal birch forest (sample nr. 176)</td>
<td>16</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>37</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Moss in spring area</td>
<td>11</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Willmann 1943)</td>
</tr>
<tr>
<td>38</td>
<td>Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Moss immersed in cold water</td>
<td>9</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Karpinnen 1960)</td>
</tr>
<tr>
<td>39</td>
<td>Abisko, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Regio subalpina</td>
<td>1</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Karpinnen 1956a)</td>
</tr>
<tr>
<td>40</td>
<td>Abisko, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Regio alpina</td>
<td>1</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Karpinnen 1960)</td>
</tr>
<tr>
<td>41</td>
<td>Abisko, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Mountain birch zone</td>
<td>45</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1960)</td>
</tr>
<tr>
<td>42</td>
<td>Mt. Pikkuli Malla</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Dwarf scrub heath land</td>
<td>12</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1956b)</td>
</tr>
<tr>
<td>43</td>
<td>Mt. Saana</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Hillsides</td>
<td>20</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1956b)</td>
</tr>
<tr>
<td>44</td>
<td>Mt. Saana, Klipsjärv, Lapland</td>
<td>F</td>
<td>NW</td>
<td>mA</td>
<td>Mountain heathland</td>
<td>9</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1956b)</td>
</tr>
<tr>
<td>45</td>
<td>Mt. Långfjellet, Dalarna</td>
<td>S</td>
<td>S</td>
<td>IA</td>
<td>Dwarf brush-lichen heath land</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1000</td>
<td>(Forslund 1958)</td>
</tr>
<tr>
<td>46</td>
<td>Mt. Långfjellet, Dalarna</td>
<td>S</td>
<td>S</td>
<td>IA</td>
<td>Sphagnum spp.</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1000</td>
<td>(Forslund 1958)</td>
</tr>
<tr>
<td>47</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Empetrum heath forest</td>
<td>66</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>48</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Vaccinium myrtillus heath birch forest</td>
<td>39</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>49</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Hylocomium heath birch forest</td>
<td>46</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>50</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Fen birch forest</td>
<td>49</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>51</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Meadow birch forest</td>
<td>51</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>52</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Empetrum heath</td>
<td>33</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>53</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Lichen heath</td>
<td>11</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>54</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Dryas heath</td>
<td>13</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>55</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Pos alpina-heath</td>
<td>9</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>56</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Carex bigelowii-heath</td>
<td>12</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>57</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Low alpine meadows</td>
<td>18</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>58</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>mA</td>
<td>Cassiope tetragona-heaths</td>
<td>15</td>
<td>Fa/Ec</td>
<td>1050</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>59</td>
<td>Tomtebräk, Lapland</td>
<td>S</td>
<td>NW</td>
<td>hA</td>
<td>Stony soils</td>
<td>8</td>
<td>Fa/Ec</td>
<td>1400</td>
<td>(Dalenius 1960)</td>
</tr>
<tr>
<td>60</td>
<td>Mt. Risajärvi, Abisko, Lapland</td>
<td>S</td>
<td>NW</td>
<td>sA</td>
<td>Moss in birch forest</td>
<td>2</td>
<td>Fa/Ec</td>
<td>300</td>
<td>(Hammer 1960)</td>
</tr>
<tr>
<td>61</td>
<td>Klipsjärv, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Bog at the banks of Klipsjärv, at the south side of Mt. Pikkul-Malla (site 6)</td>
<td>13</td>
<td>Fa/Ec</td>
<td>4607</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>62</td>
<td>Klipsjärv, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Birch stand between the hotel and Tschaikkajärvi, Vaccinium and Empetrum-rich heathland (site 7)</td>
<td>19</td>
<td>Fa/Ec</td>
<td>550</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>63</td>
<td>Klipsjärv, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Bog with rich Sphagnum vegetat- ion, close to previous birch stand (site 9)</td>
<td>13</td>
<td>Fa/Ec</td>
<td>550</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>64</td>
<td>Klipsjärv, Lapland</td>
<td>F</td>
<td>NW</td>
<td>sA</td>
<td>Bog with rich Sphagnum vegetat- ion, close to previous birch stand (site 9)</td>
<td>13</td>
<td>Fa/Ec</td>
<td>550</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>65</td>
<td>Mt. Sodankylä, Sormpio</td>
<td>F</td>
<td>NE</td>
<td>sA</td>
<td>Mt. Pyhänattanne, birch belt; Vaccinium uliginosum, Empetrum, Pleurozium, Diantra (site 12)</td>
<td>11</td>
<td>Fa/Ec</td>
<td>380</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>66</td>
<td>South aspect of Mt. Saana,</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Mountain dwarfbush heathland</td>
<td>16</td>
<td>Fa/Ec</td>
<td>50</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>67</td>
<td>Klipsjärv, Lapland</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Mountain heath with Juncus trifidus (site 2)</td>
<td>10</td>
<td>Fa/Ec</td>
<td>720</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>68</td>
<td>North aspect of Mt. Saana,</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Mountain heath with little vegetation, mainly peat (site 4)</td>
<td>3</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>69</td>
<td>South aspect of Mt. Saana,</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Mountain heath, under Betula nana, at the edge of a brink (site 5)</td>
<td>16</td>
<td>Fa/Ec</td>
<td>600</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>70</td>
<td>South aspect of Mt. Iso-Malla,</td>
<td>F</td>
<td>NW</td>
<td>IA</td>
<td>Peak of Mt. Pyhänattanne, poor vegetation cover with Empetrum, Vaccinium and Cladonia (site 10)</td>
<td>9</td>
<td>Fa/Ec</td>
<td>500</td>
<td>(Karpinnen 1962)</td>
</tr>
<tr>
<td>No.</td>
<td>Locality</td>
<td>C</td>
<td>Geo region</td>
<td>Alpine zone</td>
<td>Habitat</td>
<td>N species</td>
<td>Type of study</td>
<td>Altitude m a.s.l.</td>
<td>Study</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------</td>
<td>---</td>
<td>------------</td>
<td>-------------</td>
<td>----------------------------------------------</td>
<td>-----------</td>
<td>---------------</td>
<td>-------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>72</td>
<td>Mt. Sodankylä, Sompio</td>
<td>F</td>
<td>NE</td>
<td>IA</td>
<td>Mt. Pyhänanttanut, at upper three-line, Empetrum, Vaccinium uliginosum, V. myrtillus and Cladonia (site 11)</td>
<td>7</td>
<td>Fa/Ec</td>
<td>430</td>
<td>(Karppinen 1962)</td>
</tr>
<tr>
<td>73</td>
<td>Mt. Långfjellet</td>
<td>S</td>
<td>S</td>
<td>IA</td>
<td>Above the three line</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1000</td>
<td>(Forslund 1964)</td>
</tr>
<tr>
<td>74</td>
<td>Sarek</td>
<td>S</td>
<td>NW</td>
<td>IA</td>
<td>Above the three line</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1000</td>
<td>(Forslund 1964)</td>
</tr>
<tr>
<td>75</td>
<td>Vænahalset, Aurlandsdalen</td>
<td>N</td>
<td>S</td>
<td>saA</td>
<td>At the top of the birch zone</td>
<td>17</td>
<td>Fa/Ec</td>
<td>800</td>
<td>(Laken 1966)</td>
</tr>
<tr>
<td>76</td>
<td>Kvammadalset, Aurlandsdalen</td>
<td>N</td>
<td>S</td>
<td>ma</td>
<td>A lush alpine valley</td>
<td>6</td>
<td>Fa/Ec</td>
<td>900-1100</td>
<td>(Laken 1966)</td>
</tr>
<tr>
<td>77</td>
<td>Lake Homsvatn, Aurlandsdalen</td>
<td>N</td>
<td>S</td>
<td>ma</td>
<td>Stony soils</td>
<td>7</td>
<td>Fa/Ec</td>
<td>1286</td>
<td>(Laken 1966)</td>
</tr>
<tr>
<td>78</td>
<td>Birch forest, Olderdjord, Finnmark</td>
<td>N NE</td>
<td>saA</td>
<td></td>
<td>Humus in a birch forest</td>
<td>20</td>
<td>Fa/Ec</td>
<td>(Cadwalladr 1969)</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Dry heath, Olderdjord, Finnmark</td>
<td>N NE</td>
<td>aa</td>
<td></td>
<td>Dry heath, dominated by Vaccinium and Empetrum species</td>
<td>40</td>
<td>Fa/Ec</td>
<td>(Cadwalladr 1969)</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Wet heath, Olderdjord, Finnmark</td>
<td>N NE</td>
<td>aa</td>
<td></td>
<td>Wet heath, dominated by Vaccinium and Empetrum species</td>
<td>20</td>
<td>Fa/Ec</td>
<td>(Cadwalladr 1969)</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Hay meadow, Olderdjord, Finnmark</td>
<td>N</td>
<td>NE</td>
<td>aa</td>
<td>Dominated by Rumex and Poa</td>
<td>14</td>
<td>Fa/Ec</td>
<td>860</td>
<td>(Cadwalladr 1969)</td>
</tr>
<tr>
<td>82</td>
<td>Mineral soil, Olderdjord, Finnmark</td>
<td>N</td>
<td>NE</td>
<td>aa</td>
<td>Poor vegetation cover with herbs, Vaccinium and Empetrum species</td>
<td>22</td>
<td>Fa/Ec</td>
<td>700</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>83</td>
<td>Mt. Stedi</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>(site 62)</td>
<td>7</td>
<td>Fa/Ec</td>
<td>700</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>84</td>
<td>Mt. Stedi</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>(site 62)</td>
<td>4</td>
<td>Fa/Ec</td>
<td>650</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>85</td>
<td>Holmvann</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>Birch stand (site 62)</td>
<td>4</td>
<td>Fa/Ec</td>
<td>200</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>86</td>
<td>Border of Trons County</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>Bog on the top of a field (site 92)</td>
<td>1</td>
<td>Fa/Ec</td>
<td>420</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>87</td>
<td>Skjold</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>Top of a field with bog, growing low birches (site 94)</td>
<td>4</td>
<td>Fa/Ec</td>
<td>210</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>88</td>
<td>Galggiojavre</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>(site 104)</td>
<td>3</td>
<td>Fa/Ec</td>
<td>510</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>89</td>
<td>Mt. Tefjell, Kvam, Hordaland</td>
<td>N</td>
<td>S</td>
<td>saA</td>
<td>(site 138)</td>
<td>15</td>
<td>Fa/Ec</td>
<td>750</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>90</td>
<td>Arctic circle</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>Dominant plants Betula nana, Salix spp., Empetrum spp., Carex spp. (site 64)</td>
<td>6</td>
<td>Fa/Ec</td>
<td>700</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>91</td>
<td>Mt. Sattfjell</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>Birch limit, height of birches about 2-3 m (site 67)</td>
<td>8</td>
<td>Fa/Ec</td>
<td>930</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>92</td>
<td>Mt. Sattfjell</td>
<td>N</td>
<td>NW</td>
<td>saA</td>
<td>Birch zone, height of birches about 4-5 m (site 68)</td>
<td>6</td>
<td>Fa/Ec</td>
<td>510</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>93</td>
<td>Skigard</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Betula pubescens tortuosa stand (site 201)</td>
<td>13</td>
<td>Fa/Ec</td>
<td>130</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>94</td>
<td>Hammerfest</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Bare, wet field where the snow had partly remained (site 168)</td>
<td>10</td>
<td>Fa/Ec</td>
<td>100</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>95</td>
<td>Hammerfest</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Bare, wet field where the snow had partly remained (site 169)</td>
<td>5</td>
<td>Fa/Ec</td>
<td>100</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>96</td>
<td>Rafsboth</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Birch stand beside a lake (site 164)</td>
<td>14</td>
<td>Fa/Ec</td>
<td>230</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>97</td>
<td>Rafsboth</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Willows growing along the ground beside a lake (site 165)</td>
<td>11</td>
<td>Fa/Ec</td>
<td>230</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>98</td>
<td>Between Leiboth-Skaidi</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Bare field (site 166)</td>
<td>14</td>
<td>Fa/Ec</td>
<td>336</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>99</td>
<td>Between Skaidi-Porsanger</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Sloping bog with abundant grasses (site 172)</td>
<td>14</td>
<td>Fa/Ec</td>
<td>200</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>100</td>
<td>Between Skaidi-Porsanger</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Slope with birches and Vaccinium and Empetrum (site 173)</td>
<td>12</td>
<td>Fa/Ec</td>
<td>200</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>101</td>
<td>Mt. Vieksa</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Betula pubescens tortuosa stand (site 185)</td>
<td>15</td>
<td>Fa/Ec</td>
<td>200</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>102</td>
<td>Mt. Vieksa</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>From small patches of very low Betula nana and Empetrum in the middle of a wide gravel and stone field (site 187)</td>
<td>12</td>
<td>Fa/Ec</td>
<td>170</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>103</td>
<td>Mt. Vieksa</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Gravel and stone field with both Betula pubescens tortuosa and Betula nana (site 188)</td>
<td>8</td>
<td>Fa/Ec</td>
<td>150</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>104</td>
<td>Kirkenes</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Slope with birches and Vaccinium and Empetrum myrtillus (site 195)</td>
<td>12</td>
<td>Fa/Ec</td>
<td>30</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>105</td>
<td>Ifjord</td>
<td>N</td>
<td>NE</td>
<td>aa</td>
<td>Bog beside a pond (site 189)</td>
<td>11</td>
<td>Fa/Ec</td>
<td>250</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>106</td>
<td>Ifjord</td>
<td>N</td>
<td>NE</td>
<td>aa</td>
<td>Cliff with low Salix stand growing along the surface (site 190)</td>
<td>14</td>
<td>Fa/Ec</td>
<td>250</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>107</td>
<td>Green, Kvar, West coast</td>
<td>N</td>
<td>S</td>
<td>lA</td>
<td>(site 137)</td>
<td>11</td>
<td>Fa/Ec</td>
<td>867</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>108</td>
<td>Mt. Grøefjell, Kvar, West coast</td>
<td>N</td>
<td>S</td>
<td>lA</td>
<td>(site 144)</td>
<td>10</td>
<td>Fa/Ec</td>
<td>800</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>109</td>
<td>Mt. Fløyfjell, Kvar, West coast</td>
<td>N</td>
<td>S</td>
<td>lA</td>
<td>(site 141)</td>
<td>8</td>
<td>Fa/Ec</td>
<td>910</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>110</td>
<td>Mt. Reyfjell, Kvar, West coast</td>
<td>N</td>
<td>S</td>
<td>lA</td>
<td>(site 134)</td>
<td>5</td>
<td>Fa/Ec</td>
<td>940</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>111</td>
<td>Finse, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>ma</td>
<td>(site 134 and 135)</td>
<td>15</td>
<td>Fa/Ec</td>
<td>1220</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>112</td>
<td>Mt. Vieksa</td>
<td>N</td>
<td>NE</td>
<td>saA</td>
<td>Betula pubescens tortuosa stand</td>
<td>16</td>
<td>Fa/Ec</td>
<td>200</td>
<td>(Karppinen 1971)</td>
</tr>
<tr>
<td>113</td>
<td>Sletstuv, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>lA</td>
<td>Lichen heath</td>
<td>17</td>
<td>Fa/Ec</td>
<td>1220</td>
<td>(Søløy 1975)</td>
</tr>
<tr>
<td>No.</td>
<td>Locality</td>
<td>C</td>
<td>Geo region</td>
<td>Alpine zone</td>
<td>Habitat</td>
<td>N species</td>
<td>Type of study</td>
<td>Altitude m a.s.l.</td>
<td>Study</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------</td>
<td>---</td>
<td>------------</td>
<td>-------------</td>
<td>--------------------------------------------</td>
<td>-----------</td>
<td>---------------</td>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>114</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Wet meadow</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1320</td>
<td>(Sohøy 1975)</td>
</tr>
<tr>
<td>115</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Lichen heath</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1220</td>
<td>(Sohøy et al. 1975b)</td>
</tr>
<tr>
<td>116</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Dry meadow</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1275</td>
<td>(Sohøy et al. 1975b)</td>
</tr>
<tr>
<td>117</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Wet meadow</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1320</td>
<td>(Sohøy et al. 1975b)</td>
</tr>
<tr>
<td>118</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Lichen heath</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1225</td>
<td>(Steigen et al. 1975)</td>
</tr>
<tr>
<td>119</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Mosses in a stand of Salix herbacea</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1220</td>
<td>(Steigen 1978a)</td>
</tr>
<tr>
<td>120</td>
<td>Lake Hornsvatn, Aurland</td>
<td>N</td>
<td>S</td>
<td>mA</td>
<td>Stony soils</td>
<td>13</td>
<td>Fa/Ec</td>
<td>1286</td>
<td>(Sohøy 1978a)</td>
</tr>
<tr>
<td>121</td>
<td>Mt. Hæstefjell, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Moss dominated oceanic mountain, with scattered vascular plants</td>
<td>26</td>
<td>Fa/Ec</td>
<td>460</td>
<td>(Sohøy 1978b)</td>
</tr>
<tr>
<td>122</td>
<td>Finse, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Windswept mountain ridges with lichen health</td>
<td>1</td>
<td>EP</td>
<td>1200</td>
<td>(Samme &amp; Conradi-Larsen 1977a)</td>
</tr>
<tr>
<td>123</td>
<td>Finse, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Windswept mountain ridges with lichen health</td>
<td>2</td>
<td>EP</td>
<td>1200</td>
<td>(Samme &amp; Conradi-Larsen 1977b)</td>
</tr>
<tr>
<td>124</td>
<td>Kevo, Lapland</td>
<td>F NE</td>
<td>saA</td>
<td></td>
<td>Alpine heath, dominated by Vaccinium spp. and Empetrum spp., as well as mosses</td>
<td>9</td>
<td>Fa/Ec</td>
<td>310-320</td>
<td>(Solhøy &amp; Koponen 1981)</td>
</tr>
<tr>
<td>125</td>
<td>Dovre, ungrazed</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Ridge top with heathland, moss dominated vegetation</td>
<td>17</td>
<td>Fa/Ec</td>
<td>980</td>
<td>(Alvheim 1982)</td>
</tr>
<tr>
<td>126</td>
<td>Dovre, grazed</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Ridge top with heathland, moss dominated vegetation with stony soils</td>
<td>17</td>
<td>Fa/Ec</td>
<td>1100</td>
<td>(Alvheim 1982)</td>
</tr>
<tr>
<td>127</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Moist meadow</td>
<td>1</td>
<td>Tax</td>
<td>1300</td>
<td>(Seniczak &amp; Sohøy 1987)</td>
</tr>
<tr>
<td>128</td>
<td>Kevo, Lapland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Mountain birch forest</td>
<td>5</td>
<td>Tax</td>
<td>120</td>
<td>(Koponen 1989)</td>
</tr>
<tr>
<td>129</td>
<td>Torbjørnstølen, Finne,</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Gently sloping bog with mosses and sedges</td>
<td>1</td>
<td>Tax</td>
<td>1250</td>
<td>(Seniczak et al. 1998)</td>
</tr>
<tr>
<td>130</td>
<td>Finse, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Bog with sedges and mosses, sloping easily</td>
<td>2</td>
<td>Tax</td>
<td>1220</td>
<td>(Seniczak &amp; Klimek 1990)</td>
</tr>
<tr>
<td>131</td>
<td>Mt. Nordrut, Finne,</td>
<td>N S</td>
<td>IA</td>
<td>Meadow</td>
<td>Damp dwarf-birch litter in a small hollow in a mossy wood</td>
<td>1</td>
<td>Tax</td>
<td>ca. 900</td>
<td>(Seniczak et al. 1999b)</td>
</tr>
<tr>
<td>132</td>
<td>Stigstuv, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Wet meadow</td>
<td>1</td>
<td>Tax</td>
<td>1320</td>
<td>(Seniczak 1991)</td>
</tr>
<tr>
<td>133</td>
<td>Mt. Kvitbjøm, Bergen, Hordaland</td>
<td>N S</td>
<td>sA</td>
<td></td>
<td>Calluna heath and lichen on soil</td>
<td>2</td>
<td>Tax</td>
<td>390</td>
<td>(Colff 1993)</td>
</tr>
<tr>
<td>134</td>
<td>Mt. Hæstefjell, Bergen,</td>
<td>N S</td>
<td>sA</td>
<td></td>
<td>Alpine sedge meadow</td>
<td>5</td>
<td>Tax</td>
<td>1320</td>
<td>(Colff 1993)</td>
</tr>
<tr>
<td>135</td>
<td>Lake Styggevatn, Gaupne,</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td>Lichen on stone</td>
<td>1</td>
<td>Tax</td>
<td>1300</td>
<td>(Colff 1993)</td>
</tr>
<tr>
<td>136</td>
<td>Finse, Hardangervidda</td>
<td>N S</td>
<td>IA</td>
<td>Meadow</td>
<td>Lichen on stone</td>
<td>1</td>
<td>Tax</td>
<td>1160</td>
<td>(Colff 1993)</td>
</tr>
<tr>
<td>137</td>
<td>Finse, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>mS</td>
<td>Lichens on stone</td>
<td>1</td>
<td>Tax</td>
<td>1420</td>
<td>(Colff 1993)</td>
</tr>
<tr>
<td>138</td>
<td>Finse, Hardangervidda</td>
<td>F NE</td>
<td>saA</td>
<td></td>
<td>Snow-bed on lichen heath</td>
<td>1</td>
<td>Tax</td>
<td>1225</td>
<td>(Colff 1993)</td>
</tr>
<tr>
<td>139</td>
<td>Finse, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>mS</td>
<td>In lichens on erratic boulders</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1200</td>
<td>(Titrem 1994)</td>
</tr>
<tr>
<td>140</td>
<td>Finse, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>mS</td>
<td>In lichens on erratic boulders</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1350</td>
<td>(Titrem 1994)</td>
</tr>
<tr>
<td>141</td>
<td>Finse, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>mS</td>
<td>In lichens on erratic boulders</td>
<td>1</td>
<td>Fa/Ec</td>
<td>1240-1440</td>
<td>(Manazza 1995)</td>
</tr>
<tr>
<td>142</td>
<td>Finse, Hardangervidda</td>
<td>N</td>
<td>S</td>
<td>mS</td>
<td>In lichens on erratic boulders</td>
<td>2</td>
<td>Fa/Ec</td>
<td>120</td>
<td>(Niemi 1995)</td>
</tr>
<tr>
<td>143</td>
<td>Kevo, Finnish Lapland</td>
<td>F NE</td>
<td>saA</td>
<td>Mountain birch forest</td>
<td>2</td>
<td>Fa/Ec</td>
<td>120</td>
<td>(Niemi 1995)</td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td>Litter beneath Calluna vulgaris</td>
<td>29</td>
<td>Fa/Ec</td>
<td>600-640</td>
<td>(Cifarelli 1997)</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td>Litter beneath Juniperus communis</td>
<td>33</td>
<td>Fa/Ec</td>
<td>600-640</td>
<td>(Basilico 2000)</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td>Heathland covered with Calluna vulgaris</td>
<td>30</td>
<td>Fa/Ec</td>
<td>600-640</td>
<td>(Furlan 2000)</td>
<td></td>
</tr>
<tr>
<td>147</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>EP</td>
<td>1300-1380</td>
<td>(Hansen 2000)</td>
</tr>
<tr>
<td>148</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>ca 1245</td>
<td>(Johannesson 2002)</td>
</tr>
<tr>
<td>149</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>ca 1245</td>
<td>(Johannesson 2002)</td>
</tr>
<tr>
<td>150</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>650</td>
<td>(Riva-Caballero 2004)</td>
</tr>
<tr>
<td>151</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>830</td>
<td>(Riva-Caballero 2004)</td>
</tr>
<tr>
<td>152</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>720</td>
<td>(Skubala &amp; Gulvik 2005)</td>
</tr>
<tr>
<td>153</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>720</td>
<td>(Skubala &amp; Gulvik 2005)</td>
</tr>
<tr>
<td>154</td>
<td>Mt. Ulriken, Bergen, Hordaland</td>
<td>N S</td>
<td>IA</td>
<td></td>
<td></td>
<td>1</td>
<td>Fa/Ec</td>
<td>720</td>
<td>(Skubala &amp; Gulvik 2005)</td>
</tr>
</tbody>
</table>

Appendix 2. continued
<table>
<thead>
<tr>
<th>No.</th>
<th>Locality</th>
<th>Geo region</th>
<th>Alpine zone</th>
<th>Habitat</th>
<th>N species</th>
<th>Type of study</th>
<th>Altitude m a.s.l.</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>159</td>
<td>Austerdalsbreen, Veltastrand, Sogn og Fjordane</td>
<td>N</td>
<td>S</td>
<td>Gf</td>
<td>Oldest moraine – Salix spp.</td>
<td>8</td>
<td>Fa/Ec</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>Gf</td>
<td>Youngest moraine (deglaciated ~1955), with 9 plant species</td>
<td>5</td>
<td>Fa/Ec</td>
<td>ca. 1400</td>
</tr>
<tr>
<td>161</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>Gf</td>
<td>Middle moraine (deglaciated ~1934), with 14 plant species</td>
<td>5</td>
<td>Fa/Ecca.</td>
<td>1330</td>
</tr>
<tr>
<td>162</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>Gf</td>
<td>Oldest moraine (deglaciated ~1750), with 16 plant species</td>
<td>10</td>
<td>Fa/Ecca.</td>
<td>1370</td>
</tr>
<tr>
<td>163</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>GF</td>
<td>Youngest moraine (deglaciated 32-48 y ago)</td>
<td>3</td>
<td>Fa/Ec</td>
<td></td>
</tr>
<tr>
<td>164</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>GF</td>
<td>Moraine (deglaciated 52-66 y ago)</td>
<td>7</td>
<td>Fa/Ec</td>
<td></td>
</tr>
<tr>
<td>165</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>GF</td>
<td>Moraine (deglaciated 72-227 y ago)</td>
<td>12</td>
<td>Fa/Ec</td>
<td></td>
</tr>
<tr>
<td>166</td>
<td>Midtdalsbreen, Finse, Hardangerjøkulen</td>
<td>N</td>
<td>S</td>
<td>GF</td>
<td>Oldest moraine (deglaciated ~10 000 y ago)</td>
<td>16</td>
<td>Fa/Ec</td>
<td></td>
</tr>
</tbody>
</table>