The Arthropod Fauna of Oak (Quercus spp., Fagaceae) Canopies in Norway

Karl H. Thunes 1,*, Geir E. E. Soli 2, Csaba Thuróczy 3, Arne Fjellberg 4, Stefan Olberg 5, Steffen Roth 6, Carl-C. Coulianos 7, R. Henry L. Disney 8, Josef Starý 9, G. (Bert) Vierbergen 10, Terje Jonassen 11, Johannes Anonby 12, Arne Köhler 13, Frank Menzel 13, Ryszard Szadziewski 14, Elisabeth Stur 15, Wolfgang Adaschkiewitz 16, Kjell M. Olsen 5, Torstein Kvamme 17, Anders Endrestøl 17, Sigitas Podenas 18, Sverre Kobro 1, Lars O. Hansen 2, Gunnar M. Kvifte 19, Jean-Paul Haenni 20, and Louis Boumans 2

1 Norwegian Institute of Bioeconomy Research (NIBIO), Department Invertebrate Pests and Weeds in Forestry, Agriculture and Horticulture, P.O. Box 115, NO-1431 Ås, Norway; torstein.kvamme@nibio.no (T.K.); s-kobro@online.no (S.K.)
2 Natural History Museum, University of Oslo, P.O. Box 1172 Blindern, NO-0318 Oslo, Norway; g.e.solii@nhm.uio.no (G.E.S.); lo.hansen@nhm.uio.no (L.O.H.); louis.boumans@us.uio.no (L.B.)
3 Malomarok, u. 27, HU-9730 Köszeg, Hungary; thuruczy.cs@freemail.hu
4 Mågerøveien 168, NO-3145 Tjome, Norway; arnecoll@gmail.com
5 Biofokus, Gaustadalleen 21, NO-0349 Oslo, Norway; steffen.roth@um.uib.no
6 Museum and Research Station, Bergen, P.O. Box 7800, NO-5020 Bergen, Norway; steffen.roth@um.uib.no
7 Kummelnäsvägen 90, SE-132 37 Solna-Boo, Sweden. cc.coulianos@telia.com
8 Department of Zoology, University of Cambridge, Downing St., Cambridge CB2 3EJ, UK; rhld2@cam.ac.uk
9 Institute of Soil Biology, Academy of Sciences of the Czech Republic, Na Sádkách 7, CZ-37005 České Budejovice, Czech Republic; josef.stary@seznam.cz
10 Netherlands Food and Consumer Product Authority, P.O. Box 9102, NL-6700 HC Wageningen, The Netherlands; g.vierbergen@nvwa.nl
11 Naustvikvegen 69, NO-4170 Sjøarøy, Norway; terjonas36@gmail.com
12 Øvre Nordstrand 429, NO-6823 Sandane, Norway; fjmsfja@statsforvalteren.no
13 Senckenberg Deutsches Entomologisches Institut, Eberswalder Straße 90, DE-15374 Müncheberg, Germany; arne.koehler@senckenberg.de (A.K.); frank.menzel@senckenberg.de (F.M.)
14 Department of Invertebrate Zoology and Parasitology, University of Göttingen, Wita Stwosza 59, PL-80-308 Gdańsk, Poland; ryszard.szadziewski@biol.ud.edu.pl
15 NTNU University Museum, Department of Natural History, Norwegian University of Science and Technology, NO-7491 Trondheim, Norway; elisabeth.stur@ntnu.no
16 Bismarckstraße 41, DE-28203 Bremen, Germany; wrui@arcor.de
17 Norwegian Institute for Nature Research, Sognsmeien 68, NO-0855 Oslo, Norway; anders.endrestol@nina.no
18 Nature Research Centre, Akademijos Str. 2, LT-08412 Vilnius, Lithuania; sigitas.podenas@gamte.lt
19 Faculty of Biosciences and Aquaculture, Nord University, N-7729 Steinkjer, Norway; gunnar.mikalsen-kvifte@nord.no
20 Muséum d’Histoire Naturelle, Rue des Terreaux 14, CH-2000 Neuchatel, Switzerland; jean-paul.haenni@unine.ch
* Correspondence: karl.thunes@nibio.no

Abstract: (1) We document the invertebrate fauna collected from 24 oak canopies in east and west Norway as a contribution to the Norwegian Biodiversity Information Centre’s ‘The Norwegian Taxonomy Initiative’. (2) A snap-shot inventory of the canopies was recorded by means of emitting a mist of natural pyrethrum into the canopies at night using a petrol-driven fogger and collecting the specimens in butterfly nets spread on the ground under the canopy. (3) Almost the entire catch of more than 6800 specimens was identified to 722 species. Out of 92 species new to the Norwegian fauna, 21 were new to science and, additionally, 15 were new to the Nordic fauna. Diptera alone constituted nearly half of the species represented, with 61 new records (18 new species). Additionally, 24 Hymenoptera (one new species), six oribatid mites (two new species) and one Thysanoptera were new to the Norwegian fauna. (4) Our study emphasizes the importance of the oak tree as a habitat both for a specific fauna and occasional visitors, and it demonstrates that the canopy fogging technique is an efficient way to find the ‘hidden fauna’ of Norwegian forests. The low number of
red listed species found reflects how poor the Norwegian insect fauna is still studied. Moreover, the implication of the IUCN red list criteria for newly described or newly observed species is discussed.

**Keywords:** Quercus; oak; canopy; fogging; new species; inventory; Norway

1. Introduction

Pedunculate oak (*Quercus robur* L.) and sessile oak (*Q. petraea* (Matt.) Liebl.) are regarded as a biodiversity hotspot in Northern Europe and have been the target of a wide variety of biodiversity studies on arthropods (e.g., [1–10]).

Relatively few studies have targeted oak canopy invertebrates sampled with canopy fogging methods in Europe but see, e.g., [11–13] and chapters in [14]. Efraín Tovar-Sánchez with colleagues, together with a few others (e.g., [15–23]), have been pioneers in the Americas on oak canopy studies.

Emitting insecticides into the forest canopy to sample invertebrates has opened up a new area of forest biodiversity research. Originally developed in the tropics, canopy fogging techniques are now being used increasingly in temperate forests to increase the knowledge of European arboreal fauna [11,14,24–38]. Stork and colleagues [34] discuss the efficiency of fogging as a method for sampling arthropods from the canopies. A larger spectrum of species is sampled compared with any other single method. This makes fogging a useful method for arthropod snapshot inventories. The major disadvantage is that external and internal feeders are underrepresented (phloem feeders, leaf miners and wood borers), non-obligate occasional by-passers (tourists) will be captured and that the method is sensitive to wind and precipitation [39,40].

This study presents empirical data and analyses of oak canopy invertebrate data from a survey of 24 oak canopies in Norway. We proposed the following hypotheses: 1) there are large geographical differences in species composition and 2) trees on cultivated lands (Berge and Mule Varde) have a different species composition than forest trees. Both hypotheses are related to climatic differences on macro- (H1) and microlevels (H2) (e.g., [41]) as well as the geography of Norway, where oaks are distributed along the coast, usually with scattered populations [42,43]. H2 is founded on the generally more uniform structure of managed lands and lack of a multi-layered canopy of such forest stands [44]. The project was granted by the Norwegian Biodiversity Information Centre as a part of the Norwegian Taxonomy Initiative to search for the hidden life and new species in Norway.

2. Materials and Methods

2.1. The Oaks

*Quercus robur* and *Q. petraea* have a sympatric distribution and often hybridize [45], though *Q. robur* is claimed to be more widespread [42,43]. Thus, we have not distinguished between the two species of oak or their hybrids in this study.

2.2. Site Descriptions

The study was carried out at six sites in southern Norway in June–July 2011 and 2012 (Figure 1, Table 1). All sites were continuous oak-dominated forests, except Berge (site 1) and Mule Varde (site 5), which had oak trees scattered on managed land. Four oaks were treated at each site. The sites were carefully selected to represent a gradient from the inner fjords of West Norway, via known biodiversity hotspots inland Vestfold and Telemark to the coastal areas of SE Norway [8,46–48] aligned with the hypotheses.

Site 1 (Berge) is a protected landscape area and classified as IUCN category V [49]. It contains the largest assemblage of old and pruned oak trees in the country. This and the proximity to a lake with specialized swamp vegetation and several old buildings are the main reasons for its protection status [47].
Figure 1. Site overview.

Table 1. Site details.

| Site | County       | Municipality | Locality  | Georeference | m asl | Sampling Period          |
|------|--------------|--------------|-----------|--------------|-------|--------------------------|
| 1    | Vestland     | Kvam         | Berge     | N60.32 E6.17 | 0–50  | 21–23 June 2011          |
| 2    | Vestland     | Kvam         | Skeianeset| N60.41 E6.35 | 100–200 | 28 June–14 July 2012   |
| 3    | Vestfold and Telemark | Drangedal  | Steinknapp| N59.08 E9.04 | 100–150 | 28–29 June 2011        |
| 4    | Vestfold and Telemark | Drangedal  | Djupedal  | N59.06 E9.22 | 150–200 | 2 July 2011            |
| 5    | Vestfold and Telemark | Porsgrunn | Mule Varde| N59.10 E9.70 | 0–50  | 6–10 July 2012          |
| 6    | Vestfold and Telemark | Larvik     | Skjærsjø  | N59.20 E9.92 | 100–150 | 3–5 July 2012         |

Site 2 (Skeianeset) is a steep slope facing south and has according to one of the highest concentrations of hollow, previously pruned oaks in Norway [46]. The area is characterized by having an unusually high proportion of red-listed species of plants, bryophytes and fungi and is considered to be one of the most important deciduous forests in West Norway [46].

Site 3 (Steinknapp) is a nature reserve that is known to harbor many rare and threatened species (e.g., [48]). Its importance for biological diversity also explains its status as a nature reserve (IUCN category IA). Most likely, large parts of this area were clear-cut in the past as really old oaks are sparsely present and the more or less continuous oak forest is rather homogenous. The oaks treated in this study were just outside of the reserve.

Site 4 (Djupedal) is also a nature reserve protected according to the IUCN IA criteria. In contrast to the nearby site 3, there are several giant oaks in this area and the forest is characterized as old growth. Moreover, the forest is more closed and heterogeneous than at site 3.
Site 5 (Mule Varde) is a cultural heritage site and public park. Large oak trees are scattered throughout the property.

Site 6 (Skjærsjo) is a mixed deciduous forest with larger areas of conifer woods intermixed.

2.3. Data Collection

The trees were chosen to represent ‘typical’ trees in the areas. This implies that after traversing the site, the chosen trees were not at the edges, not standalone trees except for at Berge and Mule Varde where most trees were standalone. Furthermore, the biggest and smallest trees were also avoided. Arthropod sampling was performed by emitting a 1% concentration of natural pyrethrum, Py-Sekt, into the canopy using a Golden Eagle 2610E fogger for approximately 10 minutes in the period between 1 AM and 3 AM on a windless and dry night. Py-sekt contains 1-5% piperonyl butoxide and 0-1% pyrethrum [50]. It breaks down quickly in direct sunlight and is, therefore, relatively safe to use in natural environments [51]. The available space for arthropods will obviously vary both according to the breadth and height of the crown, but for practical reasons we preferred to collect knocked-down invertebrates from a fixed area. Twenty large butterfly nets (18 with Ø50 cm and 2 with Ø100 cm, mesh size from 0.3–0.5 mm) were mounted on the ground or on the lower branches beneath the crown to collect the knocked-down invertebrates, i.e., 5.11 m² of the area beneath each tree was sampled. As so, the proportion of the crown projection area covered will vary slightly between individual trees but is assumed not to affect the qualitative data. The nets remained on the ground for approximately one hour after fogging before the collected material was transferred to 80% ethanol. The material was then sorted and shipped to the co-authors of this paper for identification, with the exception of Lepidoptera and cecidomyiid midges, which remain unidentified.

Most of the material is stored in the Natural History Museum at the University of Oslo and the Norwegian Institute of Bioeconomy Research’s entomological collection. The phorid flies are at the Zoological Museum at Cambridge University, England, and a part of sciarid material, including the holotype of Bradysia quercina Menzel and Köhler, 2014, is deposited at the Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany.

2.4. Species Records

Species designated as new records for Norway or the Nordic countries at the time of identification were based on the individual expert’s consideration, but also on published records in Fauna Europaea [52] and records in the Norwegian Biodiversity Information Centre’s species record database accessed throughout the preparation of this manuscript at www.artsdatabanken.no.

Specimens fully identified to species level were included in the analyses and counted in addition to unidentified species with only one species collected in the respective higher taxon. Uncertain species identifications, i.e., denoted with confer (cf.) or near, were included when the species were not already identified with certainty from other specimens. In cases where the identity of the species was clear, yet undefined (i.e., denoted as sp., sp. 1, etc.), the species beyond the number of identified species were counted. When more unidentified species within the same genus were found, i.e., spp., they were not included in the counts except for counting 1 when no other species in that genus was found. Abundances of common species of spiders and collembolans were sometimes indicated as ‘few’, ‘some’ and ‘many’, and were thence given dummy numbers 5, 10 and 20, respectively.

2.5. Data Analyses

Rarefaction curves extrapolated to three times the sample size, i.e., 72 trees were carried out with EstimateS, version 9.1.0 [53]. The extrapolation relies on statistical sampling methods rather than modeling. Here, the bias corrected form of Chao1 is the asymptotic richness estimator for individual-based abundance data [54]. We chose to extrapolate because rarefaction curves of insect assemblages are usually steep and do not converge unless
a massive sampling effort is conducted. However, extrapolation beyond three times the sample size is not recommended [53] because the variance increases with the extrapolation.

Whittaker’s β was calculated as a measure of species turnover along the sampling gradient. It is insensitive to species richness and is calculated as follows:

\[ \beta = \left( \frac{S_{\alpha_{\text{max}}} - 1}{N - 1} \right) \times 100 \]  

where \( S = \) total number of species, \( \alpha_{\text{max}} = \) highest number of species in any one locality and \( N = \) the number of localities [55]. It ranges from zero (no turnover) to 100 (every locality has a unique set of species). These calculations were performed to complement multivariate analysis using detrended correspondence analysis (DCA) with Canoco, version 4.56 [56] to relate species composition and site characteristics along the sampling gradient. The aim was to investigate whether the species composition within a site differed from the composition of species at the other sites and relate that to environmental characteristics. DCA assumes unimodal species responses to environmental factors in contrast to principal components analysis, or its detrended equivalent, where linear responses are assumed [57]. Therefore, over a longer geographic gradient with different climatic or other underlying environmental factors, DCA is to be preferred. The multivariate analysis was performed on untransformed species abundances with downweighing rare species.

3. Results

3.1. Faunistics

Combined, more than 6800 specimens were identified to 722 species. Ninety-two species (12.7%) were new to the Norwegian fauna upon sampling (Table A1), 61 Diptera, 24 Hymenoptera, one Thysanoptera and six oribatid mites. Of these, the following 21 species (2.9%) were new to science: 16 phorid flies (13 described in [25]), one sciarid midge [27], one chironomid midge [58], one aphelinid wasp [59] and two oribatid mites awaiting description. Additionally, of the 92 new Norwegian records, 15 were found in the Nordic countries for the first time (Table A1). Diptera was the most species-rich order of invertebrates with 334 species (46.3%), followed by Hymenoptera with 117 (16.2%) and Coleoptera with 84 (11.6%). Additionally, Diptera was represented with the highest number of species with 1339 (19.5%), followed by Hymenoptera with 1108 (16.1%) and Coleoptera with 821 (12.0%). Collembola and Araneae were not included in the specimen calculations as their abundances were ranked for the common species. These figures correspond well with other inventories from canopies.

Amongst the sites, the six most species-rich orders were represented in stable proportions with respect to the number of species present (Figure 2), with Diptera being the clearly most species rich at all the sites (29% in Skjærsva to 47% in Berge). The proportion of specimens for the six most abundant orders, however, showed a varied pattern in that Isopoda constituted 23% of the specimens collected at Djupeodal, Hemiptera almost 45% at Mule Varde and Coleoptera 25% at Skjaersjo (Figure 2). Moreover, the number of collected species ranged from 166 in Berge to 370 in Steinknapp, and the number of specimens collected was 4.6 times higher in Steinknapp (2440) than at Berge (536) (Table 2). Steinknapp contained 1.8 times as many species as the second most species-rich site, Djupeodal (just a few kilometers away). Although species new to science were found in all the localities, 14 of the 21 new species were found in Steinknapp (25 specimens) with five species as the second highest number in any of the other localities (Skjaersjo, 37 specimens). In addition, 45 species new to Norway (134 specimens) were found in Steinknapp, followed by 20 species (60 specimens) in Djupeodal.
Figure 2. (Left) Percentage distribution of species (top six orders). (Right) Percentage distribution of specimens (top six orders).

Table 2. Site diversity data. \( N_{\text{Species}} \) = Number of species collected from the site. \( N_{\text{Specimens}} \) = Number of specimens collected from the site. \( R_{\alpha} \) = Range of species numbers collected from any tree within the site. \( R_{\text{Specimens}} \) = Range of specimens collected from any tree within the site. \( N_{\text{Singletons}} \) = Number of species represented by one specimen only. Turnover = Whittaker’s \( \beta \) within the site.

| Site       | \( N_{\text{Species}} \) | \( N_{\text{Specimens}} \) | \( R_{\alpha} \) | \( R_{\text{Specimens}} \) | \( N_{\text{Singletons}} \) | Turnover |
|------------|--------------------------|----------------------------|------------------|-----------------------------|-----------------------------|----------|
| Berge      | 166                      | 536                        | 31–86            | 83–209                      | 82                          | 31.01    |
| Steinknapp | 170                      | 719                        | 40–88            | 76–324                      | 95                          | 31.06    |
| Djupedal   | 207                      | 2440                       | 69–192           | 278–916                     | 198                         | 30.90    |
| Mule Varde | 174                      | 669                        | 8–103            | 42–787                      | 103                         | 33.66    |
| Skjærsjø   | 177                      | 830                        | 52–76            | 179–230                     | 108                         | 44.30    |

Even though 50.6% of the species (358 species) were represented by singletons and 56.1% (397 species) were found in only one tree (uniques), the turnover along the entire sampling gradient (all 24 trees) was as low as \( \beta = 13.34 \). Rejecting H1, this means that the species communities along the gradient are comparably similar. Between-site turnover showed the same with \( \beta = 18.27 \). Within the sites, however, turnover was higher (Table 2), ranging from 31.01 (Berge) to 44.30 (Skjærsjø). Thus, despite the high turnover within each site (Table 2), the shift in species composition throughout the sampling gradient was comparably lower, indicating that a similar set of species appear in low numbers in geographically disjunct locations.

This separation of sites is also reflected in the DCA ordination diagram (Figure 3), as the two sites on cultivated land (Berge and Mule Varde) were nicely grouped separately from the other sites indicating similar within-site composition of species but different from each other (except tree 11 from Steinknapp), and thus supporting H2. At the opposite side of the gradient, the Djupedal site also indicates a similar species composition within the site, but different from the other sites. The strong explanatory powers of the DCA axes one and two (Eigenvalues = 0.51 and 0.32, respectively), as well as the long gradient (3.98 SD), corroborate this.

3.2. Species Records
3.2.1. Araneae

Spiders are all predators and are usually more associated with their prey than with tree species. Noteworthy though, among the 28 species collected, one threatened species was found (*Dipoena braccata* (C. L. Koch, 1841), see Table 3). *Diplocephalus picinus* (Blackwall, 1841) is a species normally found in broadleaf forests, while *Moebelia penicillata* (Westring, 1851), *Paidiscura pallens* (Blackwall, 1834), *Neriene pellata* (Wider, 1834) and *Theridion mystaceum* L. Koch, 1870 are all known to climb trees [6,60].
Figure 3. DCA ordination diagram. Eigenvalue 1 = 0.51. Eigenvalue 2 = 0.32. Dummy values 5, 10 and 20 for Araneae and Collembola included as described in the material and methods chapter.

Table 3. Red listed species [61]. Categories: VU = vulnerable, NT = near threatened.

| Order      | Family       | Species                                   | Category | Locality | Specimens | Biology                                      |
|------------|--------------|-------------------------------------------|----------|----------|-----------|----------------------------------------------|
| Araneae    | Theridiidae  | Diploena braccata (C. L. Koch, 1841)       | VU       | Steinknapp | Few       | Lower branches, conifer forests             |
| Isopoda    | Trachelipodidae | Trachelipus ratzeburgii (Brandt, 1833)  | NT       | Djupedal | 16        | Broadleaf forest                            |
| Coleoptera | Cantharidae | Malthinus seriepunctatus Kiesenwetter, 1852 | NT       | Steinknapp | 3         | Thermophilus, predator, Quercus             |
|            |              | Prionocyphon serricornis (Müller, 1821)   | NT       | Skeianeset | 2         | Eurytop, saprophagous                        |
|            | Dasytidae    | Dasytes aeratus Stephens, 1830             | NT       | Mule Varde | 1         | Eurytop, predator                           |

3.2.2. Acari

Two oribatid mites new to science were found. Damaeus sp. n. was abundant, with 51 specimens and was present at all the sites except Djupedal, while Phthiracarus sp. n. was found with five geographically disjunct specimens (Table A1). In addition, the following four oribatid species were recorded from the Nordic countries for the first time: Liacarus (Dorycranosus) splendens (Coggi, 1898) with one specimen from Steinknapp, Oribatella (Oribatella) quadricornuta (Michael, 1880) with 14 specimens from Steinknapp, Phauloppia nemoralis (Berlese, 1916) with one specimen from Skeianeset and two from Steinknapp, and Xenillus (Xenillus) discreps Grandjean, 1936 with 14 specimens from Skeianeset, three from Mule Varde and one from Skjærsvå, respectively.

Among the arboreal species of oribatid mites inhabiting the oak canopies, we can include the following species living in the growths of mosses and lichens therein: Camisia (C.) horrida (Hermann, 1804), Carabodes (C.) areolatus Berlese, 1916, Carabodes (C.) labyrinthicus (Michael, 1879), Cymberenaecus cymba (Nicolet, 1855), Eupelps acromios (Hermann, 1804) and Oribatula (Zygoribatula) exilis (Nicolet, 1855). The following specialized lichenophagous
species were also common in the treetops, feeding on the lichen thalluses: *Phauloppia lucorum* (C. L. Koch, 1841) and *Phauloppia nemoralis* (Berlese, 1916). The following oribatid species, preferring decaying wood, were also frequent in tree canopies: *Caleremaeus monilipes* (Michael, 1882), *Carabodes (C.) rugosior* Berlese, 1916 and *Euphthiracarus (E.) cribrarius* (Berlese, 1904). Arboreal species are usually bigger (length of body 600–1000 µm), dark brown or black, with a heavily sclerotized cuticle and a thick layer of waxy cuticulation on the body surface, protecting them from desiccation. Forest litter and soil species, on the other hand, are characteristically smaller, lighter in color, with a weaker sclerotized cuticle and a thinner layer of cuticulation (families Tectocepheidae, Oppiidae, Suctobelbidae, Brachychthoniidae, etc.). They were not found in the tree canopies.

### 3.2.3. Isopoda

*Trachelipus ratzeburgii* (Brandt, 1833) is categorized as near threatened on the Norwegian red list [61]. It appeared with 16 specimens in Djupedal and three in Skjærsjø (Table 3).  

### 3.2.4. Collembola

Being scavengers for most, springtails are common in trees [62]. All of the 23 species found in the oak canopies can be considered as common species, with *Entomobrya nivalis* (Linnaeus, 1758) as the most abundant species in this study by far. This species, together with *E. albocincta* (Templeton, 1835), *E. corticalis* (Nicolet, 1842), *E. marginata* (Tullberg, 1871) and *Sminthurinus alpinus* Gisin, 1953, are known arboreal species being associated with the lichens growing on bark.

### 3.2.5. Hemiptera

Altogether, 35 species of Hemiptera were collected—21 Heteroptera and 14 Auchenorrhyncha—most of them are oak associates [6,63,64]. *Temnostethus gracilis* Horvat, 1907 and *Phylus melanocephalus* (Linnaeus, 1767) were the two most common species of Heteroptera and were found in almost all the sites. Other oak dwellers worth mentioning are, for example, *Cyllecoris histrionicus* (Linnaeus, 1767), *Psallus varians* (Herrich-Schaeffer, 1841), *P. mollis* (Mulsant and Rey, 1852), *P. variabilis* (Fallén, 1807) and *P. wagneri* Ossiannilsson, 1953.

### 3.2.6. Psocodea

Twenty-four species of the order Psocodea were collected from the oak canopies, all belonging to families formerly referred to as the paraphyletic «order Psocoptera» [65,66]. Most Psocodea feed on algae, microfungi and lichens, or decomposing stages of these, as well as pollen. Most of the foliage-living species are associated with either conifers or broadleaved trees, whereas bark-living species (on trunks as well as branches and twigs) are less discriminate. For most Psocodea, the character of the foodstuff itself, which may be dependent on physical factors such as moisture, light and exposure, is probably more important than the tree species. No Psocodea species was found at all the sites, but *Reuterella helvimacula* (Enderlein, 1901), *Valenzuela flavidus* (Stephens, 1836) and *Mesopsocus unipunctatus* (Müller, 1764) were the most common species (see Table A1). Almost all of the collected species are arboreal on a variety of tree species; *Lachesilla quercus* (Kolbe, 1880) has been believed to be confined to oak [6], but may also be found on other tree species, and outside the distribution of oak. Its apparent association with oak may rather be an expression of its preference [67,68] for dead leaves lingering on the tree, as commonly found on oaks, or on cut-off branches on the ground. *Valenzuela flavidus* and *Grapheopsocus cruciatus* (Linnaeus, 1768) are associated with foliage of various deciduous trees [6,69].

### 3.2.7. Thysanoptera

Five specimens of *Poecilothrips albopictus* Uzel, 1895 were found at the two sites in Drangedal and in Larvik. This species was taken for the first time in Norway and its distribution indicates that it is fairly common. The biology of Thysanoptera is generally
poorly known and it cannot be claimed that any of the 14 species in this study are associated with oaks—they are more likely to be associated with substrates offered by the tree, such as fungal spores, algae, etc.

3.2.8. Diptera

This was by far the most species rich group, with 334 species collected, 18 species new to science, 7 species new to the Nordic fauna and an additional 52 species caught in Norway for the first time (Table A1). Phoridae was the family with the largest number of specimens collected (212 specimens), followed by Ceratopogonidae (203) and Chironomidae (123). Phoridae was also the most species rich family by far, with 76 species, of which 16 species were new to science (all of them in the genus *Megaselia*); in addition, four species were new to the Nordic countries and 23 were new to Norway [25]. *Borophaga agilis* (Meigen, 1830) was reported new to Norway in [25], but was later found to have been reported in [70]. Sciaridae was the second most species-rich group, with 43 species (one species new to science and eleven new records for Norway) [27,71], followed by Chironomidae with 42 species (one species new to science [58], and two new to Norway). In addition, the following families were represented by new records: Limoniidae and Lauxaniidae (one new to the Nordic countries and one new to Norway, respectively), Ceratopogonidae (one new to the Nordic countries) and Fanniidae (one new to Norway).

The ecology of Diptera is mostly poorly known, and the abundant families in this study, e.g., Phoridae, Ceratopogonidae and Chironomidae, are usually neglected in general faunistic surveys. Only adults were identified, while habitat requirements are a characteristic of the larvae of most species in these families. Nonetheless, most of the species in the sciarid genera *Bradysia*, *Corynoptera* and *Scatopsclara* in this study (see Table A1) might have a connection with oak trees beyond accidental visits, as they are mentioned as deciduous forest species in the literature [27,72]. Other species of Sciaridae are also mentioned as deciduous forest associates (see Table A1). Additionally, *Phyllodromia melanocephala* (Fabricius, 1794) (Empididae) and *Systenus bipartitus* (Loew, 1850) (Dolichopodidae) are species known to inhabit deciduous forests. The first was one of the most common species, with 77 specimens collected and from all the sites.

Many species of Diptera are known to be trunk dwelling, fungivores or associated with rotting wood, habitats that are present abundantly in old oak trees. A rather high proportion of the collected species, where ecological information is available, can be assigned to either of these categories, most of them with few specimens. One exception was *Forcipomyia titillans* (Winnertz, 1852), a rotting matter associate [73], which was found with 22 individuals.

Other individual species accounts worth mentioning are those being abundant at all the sites or aggregated at any one site. *Culicoides impunctatus* Goetghebuer, 1920 (Ceratopogonidae) is a haematophagous parasite on vertebrates and is also known to aggregate close to the breeding sites, which are humid areas, preferably peat bogs [74]. It was abundant in Steinknapp and Skjærsvaer in particular, with 36 and 30 specimens collected, respectively. *Phora edentata* Schmitz, 1920 (Phoridae), a species new to Norway, was fairly abundant at most of the sites, which indicates that it is a rather common species. Two other species, *Rhagio lineola* Fabricius, 1794 (Rhagionidae) and *Lyciella platycephala* (Loew, 1847) (Lauxaniidae) were abundant in most sites. Both of these species are common and occupy many habitats. Twelve specimens of *Anapausis helvetica* Haenni, 1984 (Scatopsidae) were collected from Mule Varde and not from elsewhere. This species is rarely collected, but present knowledge may indicate an association with open areas, farmlands and parks [75]. *Platypalpus ecalceatus* (Zetterstedt, 1838) (Hybotidae) was collected with 13 individuals and only in Djupedal. This species is most likely a predator, as are nearly all Empidoidea (Terje Jonassen, pers. comm), but we cannot readily explain why it appears aggregated at only one site. We can see a similar pattern for two other Empidoidea, the dolichopodids *Chrysotimus flaviventris* (von Roser, 1840) and *Dolichopus plumipes* (Scopoli, 1763), being represented with 21 and 66 specimens in the Drangedal samples,
respectively, and almost absent from all the other sites (see Table A1). Ten specimens of *Megaselia robertsoni* Disney, 2008 (Phoridae), a species new to Norway, were found only at Steinknapp.

3.2.9. Hymenoptera

A total of 117 species of Hymenoptera were collected, with one species new to science, four species new to the Nordic countries and 21 additional species new to Norway (Table A1). Many of the specimens could only be identified to genera or ‘near to’ designated species. Thus, we cannot rule out that there are additional undescribed species in this material. Of the two suborders, Symphyta and Apocrita were represented only by Apocrita. Of the 118 species, 12 Aculeata, i.e., nine Formicidae and three Crabronidae, were found, with the remaining 106 species all belonging to the ‘Parasitica infraorder’. Ceraphronoidea with 22 species (68 specimens); Chalcidoidea, 55 species (160); Cynipoidea, nine species (31); Diaprioidae, 11 species (15); Platygastroidea, 21 species (56). The Ichneumonoidea superfamily was not processed, only one species of *Gelis* sp. (1) has been added to the list.

Ants in the mound building *Formica rufa* group, namely *F. polyctena* ( Förster, 1850) were, not surprisingly, the most abundant species. They were all collected in Drangedal and from all the treated trees at Djupedal. None of the remaining species were abundant in any of the sites, but 30 specimens of *Tamarixia pubescens* (Nees, 1834) (Eulophidae), a new species to the Nordic fauna, were collected and taken at all the sites. This is a parasitoid of psyllids known to parasitize *Trioza remota* Förster, 1848 [76], which, as nymph, is an oak obligate. *T. remota* was, however, not found in this study. *Seladerma tarsale* (Walker, 1833) (Pteromalidae) was also rather common with 24 specimens, whereof 14 were collected in Steinknapp. This species is a primary parasitoid of Agromyzidae flies [77]. No Agromyzidae were present in the material, however.

The representation of species shows a well-defined association with oak-galls. The oak-galls living inquilins are *Ceroptres clavicornis* Hartig, 1840, *Neuroterus nr. politus* Hartig, 1840, *Saphonecrus connatus* (Hartig, 1840), *Synergus apicalis* Hartig, 1841, *S. crassicornis* (Curtis, 1838), *S. gallaeponiformis* (Fonscolombe, 1832) and *S. pallipes* Hartig, 1840, all of which are in the Cynipidae family. Of the large number of oak-gall parasitoids the following are worth mentioning: *Aulogymnus gallarum* (Linnaeus, 1761) (Eulophidae), *Eupelmus annulatus* Nees, 1834 (Eupelmidae), *Ormyrus pomaceus* (Geoffroy, 1785) (Ormyridae) and the pteromalids *Cecidostiba semifascia* (Walker, 1835), *Mesopolobus dubius* (Walker, 1834), *M. fasciventris* Westwood, 1833, *M. tarsatus* (Nees, 1834), *M. tibialis* (Westwood, 1833), *M. xanthocerus* (Thomson, 1878), *Megastigmus dorsalis* (Fabricius, 1798) and *Torymus flavipes* (Walker, 1833).

3.2.10. Coleoptera

Of the 84 species of beetles found, the following three are on the Norwegian red list: *Malthinus seriepunctatus* Kiesenwetter, 1851 (Cantharidae), *Pronocypyn serricornis* (Müller, 1821) (Scirtidae) and *Dasyes aeratus* Stephens, 1830 (Dasytidae) (Table 3), all of which are categorized as near threatened in [61].

Several of the following species are associated with oak or oak habitats: the curculionid *Archarius pyrrhoceras* (Marsham, 1802), *Coeliodes rana* (Fabricius, 1787), *Orchestes quercus* (Linnaeus, 1758), the already-mentioned cantharid *M. seriepunctatus*, the ciid *Cis vestitus* (Mellié, 1848), the melanidryid *Conopalus testaceus* (Olivier, 1790), the chrysomelid *Cryptophealus labiatus* (Linnaeus, 1761) and the cerambycid *Leiopus linnei* Wallin, Nylander and Kvamme, 2009 [10,36,78]. Furthermore, many species are known to be arboreal (see Table A1) but being rare in this material was common for most of them. A common, arboreal species was *Otiornynchus singularis* (Linnaeus, 1767) (Curculionidae), which is a species found almost everywhere. Thirty-one specimens were found at all the sites but Skjærsko. Another weevil, *Strophosoma capitatum* (De Geer, 1775), a common herbivore on broadleaf trees, was found with 86 specimens at all but the two sites in Western Norway. The predacious Cantharidae *Malthinus guttifer* Kiesenwetter, 1852 was collected at all the
sites, except for Berge, with a total of 61 specimens. This is a common species associated with shrubs and often found climbing trees [10]. Eleven specimens of *Orchesia micans* (Panzer, 1793) (Melandryidae) were taken in Skjaersjø, its only appearance in the study. It has a close association with polypore fungi in the genus *Inonotus* [79]. The throstid *Trixagus derrnestoïdes* (Linnaeus, 1767) was found with 11 specimens, ten of them from Steinknapp. This species is known as a generalist pollen and mold feeder (e.g., [80]), with habitats plentiful in oaks.

3.2.11. Species Accumulation

The number of invertebrate species collected was 722 and with an overall turnover of 13.34, suggesting a rather homogenous species pool along the sampling gradient, thus rejecting H1. Despite the apparent homogeneity, there is a logarithmic relationship between the number of specimens collected and the number of species found (Figure 4), suggesting that a much more profound sampling effort needs to be performed before the accumulation curve starts to converge. A steep species accumulation curve is to be expected, as the sample size was low and there was a high number of singletons and uniques.

![Figure 4](image)

**Figure 4.** Rarefaction curves of oak diversity extrapolated beyond the dot (i.e., 24 trees) to yield 72 treatments (i.e., trees). The dot shows the number of species sampled by the number of trees treated. Note the log2 x-axis and the log10 y-axis.

4. Discussion

4.1. Invertebrate Samples

The number of collected specimens in this study was very low compared with the material collected from a comparable study of 24 pine trees over a geographic gradient from west to east Norway, and where nearly 30,000 specimens were collected using the same methodology [38]. One explanation is fairly obvious, as the weather in both sampling periods (June/July 2011/2012) was generally cool and wet. The monthly temperature in 2011 was, on average, slightly higher than the normal temperature (ranging from −0.1 °C below (Kvam, June) to +1.7 °C above (Kvam, July)), but the precipitation ranged from 104% (Kvam, July) to 270% (Drangedal, July) of the normal [81,82]. For the year 2012, the monthly temperature was lower than the normal temperature (from −1.8 °C (Drangedal, June) to −0.2 °C (Kvam, July) below), and these months were also generally wetter than the normal (from 69% (Kvam, June) to 169% (Kvam, July)) [83,84]. Other reasons for the low catch may be related to the structure and complexity of the oak canopy compared with
the more open canopy of, for example, pine, in that a larger proportion of the invertebrates remain in the tree—either stuck in the dense foliage or on the branches [40].

4.2. Faunistics

Despite the fact that the ecology is unknown for many species (see Table A1), a large proportion of the species found in this study must be assumed to be occasional visitors (i.e., the oak canopy is not their primary habitat). As oaks offer a wide selection of sites to rest, swarm and feed, an abundance of generalists is to be assumed, as well as opportunists taking advantage of the secondary habitats in the trees, for example, the ant *Camponotus ligniperda* (Latreille, 1802) living in dead parts of the tree or the numerous species associated with deposited leaf litter or soils. Yet, a few other species are likely to be accidental visitors from the surroundings, e.g., species associated with grasses and *Calluna* (see Table A1). The presence of the marine chironomid *Halocladius variabilis* (Stæger, 1839) in Steinknapp is surprising, as the distance to the ocean is about 30 km. Its presence in Skeianeset and Mule Varde makes sense, however, as both sites are close to the sea.

Even though neither the psyllid *Trioza* nor agromyzid flies were found as adults, we must believe them to be present, as parasitoids of both were common—*Tamarixia pubescens* (Eulophidae) and *Seladerma tarsale* (Pteromalidae), respectively. Both host groups are known to live on oaks [85,86]. Another fact to note is that no species of the egg parasitoid family Mymaridae (Chalcidoidea) were collected. Mymaridae are among the smallest insects in the world and, regarding the number of species and specimens collected, it is inconceivable that Mymaridae species would not be present in larger numbers as well. Unfortunately, due to their size and fragility, they are likely to remain in the canopy foliage after fogging.

Correspondence in the presence of species over a broader selection of the literature shows that 80 of the species collected in this study were also present in other European studies on oak canopy or oak tree faunas [2,6,9,10,36,60,63,64,69,78,87,88].

4.3. Conservation and Distribution of Invertebrates

Some paradoxes arise when comparing the number of red-listed species with the number of species new to science or new occurrences. Only five red-listed species were found, while the number of new occurrences, including new species, were 92 altogether, most of them with very few specimens. This demonstrates how poorly known the Norwegian arboreal invertebrate fauna still is. One of the criteria for inclusion on the Red List is that a species should be known to reproduce for more than 10 years in the period 1800–2015 [61]. Moreover, rarity is not a criterion for inclusion as such, but reduced population sizes, reduced habitats or reduced distributions are. Thus, the value of the red list category for a species is based on the changes in the intermediate-term development of its population and no new species or species observations will qualify for considerations into the list, but it should incentivize the monitoring of those species. Inasmuch, a new species does not necessarily have to be rare, it may just have been overlooked. Several new species or occurrences were widespread and with intermediate numbers, e.g., *Damaeus* n. sp. (50 specimens, five localities), *Xenillus (Xenillus) discrepans* (18 specimens, three localities), *Tamarixia pubescens* (30 specimens, all localities), *Megaselia ignobilis* (19 specimens, four localities) and *Phora edentata* (40 specimens, four localities) (Table A1). Canopy specialists may well have been overlooked, as some are, apparently, rarely collected using conventional techniques and the obvious inaccessibility to the canopy complicates sampling.

Oaks used to be evenly distributed within its distributional range in Norway, and fragmentation was caused by overexploitation and a colder climate in the beginning of the sub-Atlantic era [89]. The rejection of H1 can be a response to a historically continuous distribution of oaks by the remaining relic populations of invertebrates. Additionally, compared with the more diverse forest sites, the poorer community of plants, homogeneous canopy structure [44] and different microclimate [41,90] in the actively managed sites, Mule
Varde and Berge, are likely to source a different fauna to the oak trees on these sites, thus, supporting H2.

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**Appendix A**

**Table A1.** Complete list of species with numbers per locality. Literature used for the table: [2,6,10,12,27,38,58–60,62–64,67–71,78,87,91–164], relevant volumes of Die Käfer Mitteleuropas, Danmarks Fauna, Svensk Insektfauna, Fauna Entomologica Scandinavica, and personal comments from the authors. The (B) and (S) in the heading under Kvam are Berge and Skeianeset, respectively, while the (S) and (D) under Drangedal are Steinknapp and Djupedal, respectively. An ¤, * or ** in front of the species name depicts a new record for either science, Norway or Nordic countries upon sampling, respectively. x, xx and xxx represent dummy numbers 5, 10 and 20, respectively.

| Higher Taxon | Species | Habitat | Kvam | Drangedal | Porsgrunn | Larvik |
|-------------|---------|---------|------|-----------|-----------|-------|
|             |         |         | 1(B) | 2(S)      | 3(S)      | 4(D)  | 5     | 6     |
| ARANEAE     |         |         |      |           |           |       |       |       |
| Anyphaenidae| Anyphaena accentuata (Walckenaer, 1802) | Varies | x    | x         | x         |       |       |       |
| Anaraneidae | Araneus sturni (Hahn, 1831) | Conifer forests | x    | x         |           |       |       |       |
|             | A. displicata (Hentz, 1847) | x      | x    |           |           |       |       |       |
| Clubionidae | Clubiona brevipes Blackwall, 1841 | x      | x    |           |           |       |       |       |
| Dictynidae  | Dicynus pusillus Thorell, 1856 | x      | x    |           |           |       |       |       |
| Linyphiidae | Aeneta comora (Cambridge, 1863) | Broadleaf forest | x    |           |           |       |       |       |
|             | Diplocephalus picius Blackwall, 1841 | x      | x    |           |           |       |       |       |
|             | Entelecra acuminata (Wider, 1834) | x      | x    |           |           |       |       |       |
|             | Ergyne abra Blackwall, 1833 | x      | x    |           |           |       |       |       |
|             | Muso sunderi (Westring, 1851) | Broadleaf forest | x    | x         |           |       |       |       |
|             | Morbiosa penicillata (Wight, 1851) | x      | x    |           |           |       |       |       |
| Tetragnathidae | N. peltata (Wider, 1834) | x      | x    |           |           |       |       |       |
|             | N. radula (Walckenaer, 1842) | x      | x    |           |           |       |       |       |
|             | Pelecosph longata (Wider, 1834) | x      | x    |           |           |       |       |       |
| Mimetidae   | Ero furcata (Villers, 1789) | x      | x    |           |           |       |       |       |
| Philodromidae | Philodromus spp (Walckenaer, 1802) | x      | x    |           |           |       |       |       |
| Pisauridae  | Pisa interrupta (Clerck, 1757) | x      | x    |           |           |       |       |       |
| Segestriidae| Segestra senoculata (Linnaeus, 1758) | x      | x    |           |           |       |       |       |
| Tetagnathidae | Tetragnatha montana Simon, 1874 | x      | x    |           |           |       |       |       |
|             | Selinus tittatus (C. L. Koch, 1836) | x      | x    |           |           |       |       |       |
|             | Dipoptera bracteata (C. L. Koch, 1841) | x      | x    |           |           |       |       |       |
|             | Paratrechalea pallens (Blackwall, 1834) | x      | x    |           |           |       |       |       |
|             | Platnickina tincta (Walckenaer, 1802) | x      | x    |           |           |       |       |       |
|             | Robertus neglectu (Cambridge, 1871) | x      | x    |           |           |       |       |       |
|             | Theridion hemerobium Simon, 1914 | x      | x    |           |           |       |       |       |
|             | T. mustaceum L. Koch, 1870 | x      | x    |           |           |       |       |       |
| Uloboridae  | Hyptiotes paradoxa (C. L. Koch, 1834) | x      | x    |           |           |       |       |       |
| Sum species: | 28 |      |       |           |           |       |       |       |
Table A1. Cont.

| Higher Taxon   | Species                                         | Kvam | Drangedal | Porsgrunn | Larvik |
|---------------|-------------------------------------------------|------|-----------|-----------|--------|
| **OPILIONES** |                                                 |      |           |           |        |
| Phalangiidae  | Lacinus ephippatus (C. L. Koch, 1835)            | 12   | 1         | 3         |        |
|               | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
| Sclerosomatidae | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Anystidae     | A cysta baccharum (Linnaeus, 1758)              |      |           |           |        |
| Ascidae       | Neojordensia sinuata Athias-Henriot, 1973       |      |           |           |        |
| Bdellidae     | Bdella iconica Berlese, 1923                    |      |           |           |        |
|                | R. muscorum Ewing, 1909                        |      |           |           |        |
|                | Biscinus silvatius (Kramer, 1881)               |      |           |           | 2      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Erythraeidae  |                                              |      |           |           |        |
| Acari         |                                                |      |           |           |        |
| Phalangiidae  | Phalangiidae                                    |      |           |           |        |
| Sclerosomatidae | Phalangiidae                                    |      |           |           |        |
|                | Lacinius ephippiatus (C. L. Koch, 1835)         | 12   |           |           | 8      |
|                | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
|                | Sclerosomatidae                                |      |           |           |        |
|                | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Erythraeidae  |                                              |      |           |           |        |
| Eupodidae     |                                              |      |           |           |        |
|                | Phalangiidae                                    |      |           |           |        |
| Sclerosomatidae | Phalangiidae                                    |      |           |           |        |
|                | Lacinius ephippiatus (C. L. Koch, 1835)         | 12   |           |           | 8      |
|                | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
|                | Sclerosomatidae                                |      |           |           |        |
|                | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Erythraeidae  |                                              |      |           |           |        |
| Stagnicola    |                                              |      |           |           |        |
|                | Phalangiidae                                    |      |           |           |        |
| Sclerosomatidae | Phalangiidae                                    |      |           |           |        |
|                | Lacinius ephippiatus (C. L. Koch, 1835)         | 12   |           |           | 8      |
|                | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
|                | Sclerosomatidae                                |      |           |           |        |
|                | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Erythraeidae  |                                              |      |           |           |        |
| Phalangiidae  | Phalangiidae                                    |      |           |           |        |
| Sclerosomatidae | Phalangiidae                                    |      |           |           |        |
|                | Lacinius ephippiatus (C. L. Koch, 1835)         | 12   |           |           | 8      |
|                | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
|                | Sclerosomatidae                                |      |           |           |        |
|                | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Erythraeidae  |                                              |      |           |           |        |
| Stagnicola    |                                              |      |           |           |        |
|                | Phalangiidae                                    |      |           |           |        |
| Sclerosomatidae | Phalangiidae                                    |      |           |           |        |
|                | Lacinius ephippiatus (C. L. Koch, 1835)         | 12   |           |           | 8      |
|                | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
|                | Sclerosomatidae                                |      |           |           |        |
|                | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
| Erythraeidae  |                                              |      |           |           |        |
| Phalangiidae  | Phalangiidae                                    |      |           |           |        |
| Sclerosomatidae | Phalangiidae                                    |      |           |           |        |
|                | Lacinius ephippiatus (C. L. Koch, 1835)         | 12   |           |           | 8      |
|                | Mitopus morio (Fabricius, 1799)                 | 1    |           |           | 1      |
|                | Sclerosomatidae                                |      |           |           |        |
|                | Lebomum gracile Thorell, 1876                   | 2    |           |           | 2      |
|                | Nolina gothica Lohmander, 1945                  |      |           |           | 1      |
|                | Sum species: 4                                  | 2    | 2         | 1         | 1      |
|                | Sum specimens: 23                               | 13   | 3         | 3         | 2      |
**Table A1. Cont.**

| Higher Taxon | Species | Habitats | Kvam | Drangedal | Porsgrunn | Larvik |
|--------------|---------|----------|------|-----------|-----------|--------|
| **COLEMBOLA** | | | | | | |
| Bourletiellidae | Bourletiella hortensis (Fitch, 1863) | Vegetation | 1 | | | |
| | Deuterosminthurus bicinctus (Koch, 1840) | Vegetation, bushes | 8 | | | |
| Dicyrtomidae | Dicyrtomina minuta (O. Fabricius, 1783) | Forest floor | 2 | 3 | | |
| Entomobryidae | Entomobrya albicincta (Templeton, 1835) | Bark, lichens | 3 | | | |
| | E. corticalis (Nicolet, 1842) | Bark, lichens | xx | xx | 1 | |
| | E. marginata (Tullberg, 1871) | Bark, lichens | x | | | |
| | E. nicoleti (Lubbock, 1868) | Forest floor | 9 | | | |
| | E. nivalis (Linnaeus, 1758) | Bark, lichens | 1 | 90 | xxx | 20 |
| | Lepidocyrtus lignorum (Fabricius, 1793) | Litter | | | | |
| | Lepidocyrtus violaceus (Geoffroy, 1762) | Litter | 1 | | | |
| | Orchesella bifasciata (Bourlet, 1839) | Moss, rocks, trunks | 11 | x | xx | 3 |
| | | Forest floor | 3 | xx | 3 | |
| | | Forest floor | | x | 1 | 1 |
| | Hypogastruridae | X. maritima Tullberg, 1869 | Xerophilous | 1 | xx | x | |
| Isotomidae | Isotoma anglicana (Lubbock, 1862) | Litter | 1 | | | |
| | Isotoma marginata Fjellberg, 2007 | Litter | 1 | | | |
| | Isotomuraus aureus (Lubbock, 1862) | Forest floor | 4 | 26 | 9 | xx |
| | L. lubbocki Tullberg, 1872 | Forest floor | x | 1 | | |
| Katiannidae | Sminthurinus aureus (Lubbock, 1836) | Litter | 2 | | | |
| | | | | | | |
| Sminthuridae | Allacma fusca (Linnaeus, 1758) | Forest floor | 9 | | | |
| | | | | | | |
| Tomoceridae | Pogonognathellus flavescens (Tullberg, 1871) | Forest floor | 7 | | | |
| | | | | 6 | 9 | 7 | 9 | 10 | 8 |
| | | | | | | | | | | |
| DICICTOPTERA | | | | | | |
| Blattelidae | Ectobius lapponicus (Linnaeus, 1758) | | 8 | 2 | | |
| DERMAPTERA | Forficulidae | Chelidura guentheri (Galvagni, 1994) | | 7 | 4 | 2 | 2 |
| | | | | 1 | 2 | 2 | 1 |
| | | | | 7 | 12 | 4 | 2 |
| EPHEMEROPTERA | | | | | | |
| Baetidae | Cloeon inscriptum Bengtsson, 1914 | Streams | 1 | | | |
| Nemouridae | Amphimemura borealis (Morton, 1894) | Streams | 1 | | | |
| | | | | | | |
| PLECOPTERA | | | | | | |
| | | | | | | |
| | | | | | | |
| HEMIPTERA | | | | | | |
| Anthocoridae | Anthocoris nemoralis (Fabricius, 1794) | Predator, arboreal, deciduous | 6 | | | |
| | A. nemorum (Linnaeus, 1761) | Predator, vegetation | 1 | 1 | | |
| | Orinus minutus (Linnaeus, 1758) | Predictor, varies | 1 | | | |
| | Tenuistethus gracilis Horváth, 1907 | Predictor, varies | 54 | 1 | 81 | 20 |
| Microphysidae | Loricula elegans (Baerensprung, 1858) | Predator, lichens, trunk | 2 | 2 | 71 | 4 | 19 | 1 |
| | L. palaeophorus Curtis, 1833 | Predator, lichens, trunk | 2 | 1 | 3 | 1 | | |
| | Indet. (Anthocoridae or Microphysidae) | Predator, lichens, trunk | 50 | 80 | 2 | 1 | 37 |
| Miridae | Blepharidopterus angustulus (Fallén, 1807) | Predator, arboreal, deciduous | 1 | | | |
| | Cylichneus histrionicus (Linnaeus, 1767) | Predator, oak | 3 | 6 | 3 | 1 |
| | Dicronocephalus rufipennis (Fallén, 1807) | Pine flowers and cones | 1 | | | |
| | Orthotylus tenellus (Fallén, 1807) | Predator, arboreal, deciduous | 2 | 1 | | |
| | Psilocoris obscurus (Fallén, 1807) | Predator, oak | 15 | 16 | 10 | 36 | 7 |
| | Phylus melanochlomus (Linnaeus, 1767) | Conifers | 2 | 1 | | 1 |
| | Phyllocooris intricatus Curcur, 1833 | Predator, oak | 1 | 9 | 1 | 1 |
| | Ps. confusius Rieger, 1981 | Predator, oak | 17 | 4 | 5 | 1 |
| | Ps. mulli (Mulsant and Rey, 1852) | Predator, oak | 1 | | | |
| | Ps. variabilis (Fallén, 1807) | Predator, oak | 1 | 10 | | | |
| | Ps. woodi Oesjannilsson, 1953 | Predator, oak | 23 | 3 | 84 | 31 | 104 | 1 |
| | Ps. sp. | Oak | 1 | 5 | | | |
| Lygaeidae | Rhadomorius striatellus (Fabricius, 1794) | Varied | 1 | | | |
| Pentatomidae | Miridae indet. | Predator, arboreal, deciduous | 1 | 1 | | |
| | Scolopostethus thomsoni Reuter, 1875 | Predator, oak | 3 | | 7 | | | |
| | | Varied | 1 | | | |
| | Pentatomus rufipes (Linnaeus, 1758) | Predator, arboreal, deciduous | 9 | 7 | 11 | 9 | 16 | 8 |
| | | | 149 | 71 | 377 | 59 | 284 | 90 |

**Sum species:** 332

**Sum specimens:** 1030
Table A1. Cont.

| Higher Taxon | Species | Habitat |
|--------------|---------|---------|
| Auchenorrhyncha | Cixiidae | Cixius cunicularius (Linnaeus, 1767) | Deciduous wood plants |
|                | Delphacidae | Jasesella forcipata (Bohemian, 1847) | Grass, open habitats |
|                |                | Strimia affinis Fieber, 1866 | Grass, forest |
|                |                | Xanthophyllox flavocerus (Flor, 1861) | Grass |
|                | Issidae | Issus muscaformis (Schrank, 1781) | Deciduous wood plants |
|                | Aphrophoridae | Neophilaenus lineatus (Linnaeus, 1758) | Grass |
|                |                | Alebra albostrrella (Fallén, 1826) | Quercus |
|                | Cicadellidae | Edwardsiana frustrator (Edwards, 1908) | Deciduous wood plants |
|                | E. sp. | Exoptera sp. | Quercus |
|                |                | Eurydema consina (Kermar, 1831) | Quercus |
|                |                | Issus lineatus (Linnaeus, 1761) | Populus tremula |
|                |                | Ribautiana scalaris (Ribaut, 1931) | Quercus |
|                |                | Typhlocyba quercus (Fabricius, 1777) | Prunus / Quercus |
|                | Psocodea | Trogiidae | Bark |
|                |                | Valenzuela burmeisteri (Brauer, 1876) | Conifers, arboreal |
|                |                | V. despax (Badonnel, 1936) | Conifers, arboreal |
|                |                | V. flavidus (Stephens, 1836) | Deciduous, arboreal |
|                |                | V. sp. | Bark, lichens |
|                |                | E. moehsi Tetens, 1891 | Bark |
|                |                | E. pulalis (Hagen, 1861) | Bark, lichens |
|                |                | Reuterella helvomaculata (Enderlein, 1901) | Bark, lichens |
|                | Mesopsocidae | Mesopsocus immius (Stephens, 1836) | Bark |
|                |                | M. laticeps (Kolbe, 1880) | Bark |
|                |                | M. unipunctatus (Müller, 1764) | Bark |
|                | Psocidae | Amphiphilornis bifasciata (Latreille, 1799) | Bark, xerophilous |
|                |                | Blastes conspunctata (Rambur, 1842) | Bark, xerophilous |
|                |                | Loensia fasciata (Fabricius, 1787) | Bark |
|                |                | L. sp. (variegata or pearmani) | Bark, lichens |
|                |                | Metlyophorus nobilis (Stephens, 1836) | Bark |
|                |                | Psococranus gibbos (Sulzer, 1776) | Bark |
|                |                | Trichadenotenu natquadntum (Linnaeus, 1758) | Bark |
|                | Lachesillidae | Lachesilla quercus (Kolbe, 1880) | Dead branches, leaves |
|                | Stenopsocidae | Graphopus cruciatus (Linnaeus, 1768) | Deciduous, arboreal |
|                |                | Stenosococus lachlani Kolbe, 1880 | Conifers, arboreal |
|                | Philotarsidae | Philotarsus parisipes Roesler, 1954 | Bark |
|                | Peripsocidae | Peripsocus phaeopterus (Stephens, 1836) | Bark |
|                |                | P. subfuscatus (Rambur, 1842) | Bark |
|                |                | P. sp. (didymus or phaeopterus) | Bark |
|                | Sum species: 24 | | Sum specimens: 655 |
|                | THYSANOPTERA | Aeolothripidae | Predator |
|                |                | A. cirsicolor Uzel, 1895 | Predator |
|                | Thripidae | Ceratathrips ericae (Haliday, 1836) | Callune, heath |
|                |                | Oxythrips ajaiae Uzel, 1895 | Pine cones |
|                |                | Thrips major Uzel, 1895 | Herb flowers |
|                |                | T. pini (Uzel, 1895) | Pine |
|                | Phlaeothripidae | Acantothrips nodicornis (Reuter, 1880) | Dead branches, bark |
|                |                | Haplothrips sp. | Dead wood, fungivore |
|                |                | Hoplothrips pedicullaris (Haliday, 1836) | Streune rugosus |
|                |                | H. ulmi (Fabricius, 1781) | Dead wood, fungivore |
|                |                | Phlaeothrips coriacus Haliday, 1836 | Dead wood, fungivore |
|                |                | *Plocothrips albopticus Uzel, 1895 | Buds, bark, predator |
|                | Sum species: 14 | | Sum specimens: 665 |
|                | TRICHOPTERA | Hydrouncididae | Hydropsyche silthali Doehler, 1963 |
|                |                | Linnéphiliidae | Linnéphilius centralis Curtis, 1834 |
|                |                | Sum species: 2 | Sum specimens: 7 |
Table A1. Cont.

| Higher Taxon       | Species                                  | Habitats                        | Kvam | Drangedal | Porsgrunn | Larvik |
|--------------------|------------------------------------------|---------------------------------|------|-----------|-----------|--------|
| **DIPTERA**        |                                          |                                 |      |           |           |        |
| **Nematocera**     |                                          |                                 |      |           |           |        |
| Tipulidae          | *Tipula irrorata* Macquart, 1826          | Rotten wood, mosses             |      |           |           |        |
|                    | *T. lunata* Linnaeus, 1758                | Shredder, leaf litter, soil     | 1    |           |           |        |
|                    | *T. scripta* Meigen, 1830                 | Shredder, leaf litter, green mosses | 1    | 1         |           |        |
|                    | *Nephrotoma analis* (Schummel, 1833)     | Shredder, leaf litter, soil, exposed riverine sediments | 1    |           |           |        |
| **Limoniidae**     |                                          |                                 |      |           |           |        |
|                    | **Achyrolimonia neonebulosa** (Alexander, 1924) | Rotten wood, fungi, wood sap | 1    | 1         |           |        |
|                    | *Austrolimnophila ochracea* (Meigen, 1804) | Rotten wood, fungi             |      |           |           |        |
|                    | *Dicranomyia alida* (Meigen, 1804)       | Aquatic, semi-aquatic           |      | 1         |           |        |
|                    |                                          | aquatic mosses, algae in waterfalls, shredder |      |           |           |        |
|                    | *D. mitis* (Meigen, 1830)                | Leaf litter, soil, exposed riverine sediments, shredder | 1    | 1         |           |        |
|                    | *D. modesta* (Meigen, 1818)              |                                 | 1    | 5         |           |        |
|                    | *Dicranophragma separatum* (Walker, 1848) | Predatory, semi-aquatic         |      | 1         |           |        |
|                    | *Epiphragma oxytans* (Linnaeus, 1761)    | Rotten wood                    |      | 1         |           |        |
|                    | *Erioptera lutea* Meigen, 1804           | Collector, semi-aquatic         |      | 1         |           |        |
|                    | *Euphyllodora phaostigma* (Schummel, 1829) | Predatory, semi-aquatic        |      | 1         |           |        |
|                    | *Limonia flavipes* (Fabricius, 1877)     | Leaf litter, soil, under bark, shredder | 2    |           |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    | *L. phragmitidis* (Schrank, 1781)        | Leaf litter, soil, under bark, riverside mud, shredder | 1    |           |           |        |
| **Bibionidae**     |                                          |                                 |      |           |           |        |
|                    | Bibio nigricentrus Haliday, 1833          | Eurytop, soil                   | 1    | 3         |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    | *Molophilus appendiculatus* (Staeger, 1840) | Collector, semi-aquatic         | 2    | 3         | 1         |        |
|                    | *M. bifidus* Goetghebuer, 1920           | Collector, semi-aquatic         | 1    |           |           |        |
|                    | *M. medius* de Meijere, 1918             | Collector, semi-aquatic         |      | 1         |           |        |
|                    | *M. ochraceus* (Meigen, 1818)            | Collector, semi-aquatic         |      | 1         |           |        |
|                    | *Neolimonia dumetorum* (Meigen, 1804)    | Collector, semi-aquatic         |      | 1         |           |        |
|                    | *Orniosia lineata* (Meigen, 1804)        | Collector, semi-aquatic         |      | 1         |           |        |
|                    | *O. rufacauda* (Zetterstedt, 1838)       | Collector, semi-aquatic         |      | 2         |           |        |
|                    | *Pilaria discicollis* (Meigen, 1818)     | Collector, semi-aquatic         |      | 1         |           |        |
|                    |                                          |                                 |      | 1         |           |        |
| **Psychodidae**    |                                          |                                 |      | 3         |           |        |
|                    | *B. fenestralis* (Lackschewitz, 1940)    | Collector, semi-aquatic         | 1    | 1         |           |        |
|                    |                                          |                                 |      | 1         |           |        |
|                    | Bibio nigricentrus Haliday, 1833          | Eurytop, soil                   | 1    | 1         |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    | *B. hilariformis* Tuomikoski, 1960        | Eurytop, soil                   | 2    | 1         |           |        |
|                    |                                          |                                 |      | 1         |           |        |
| **Anisopodidae**   |                                          |                                 |      | 2         |           |        |
| **Keroplatidae**   |                                          |                                 |      |           |           |        |
|                    | *Sylvicola cincta* (Fabricius, 1877)     | Rotten wood, fungi              | 1    | 6         | 1         |        |
|                    |                                          |                                 |      |           |           |        |
| **Mycetophilidae** |                                          |                                 |      |           |           |        |
|                    | *Boletina nigricans* Dziedzicki, 1885    | Mycetophagous                   | 1    |           |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    | *B. alpicola* (Winnertz, 1867)           | Mycetophagous                   | 1    |           |           |        |
|                    |                                          |                                 |      |           |           |        |
| **Sciaridae**      |                                          |                                 |      |           |           |        |
|                    | *Bradyisia affinis* (Zetterstedt, 1838)  | Woodland, wetlands, meadows, gardens, saprophagous | 2    | 2         |           |        |
|                    |                                          | Woodland, bogs, grasslands, dunes, saprophagous |      |           |           |        |
|                    |                                          | Woodland (oak, hazel, pine), heathland, meadows, gardens, saprophagous |      |           |           |        |
|                    |                                          | Woodland, wetlands (mires, bogs), saprophagous |      |           |           |        |
|                    | *B. fenestralis* (Zetterstedt, 1838)     | Mycetophagous                   | 1    |           |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    |                                          |                                 |      |           |           |        |
|                    | *B. hilariformis* Tuomikoski, 1960        | Mycetophagous                   | 1    |           |           |        |
### Table A1. Cont.

| Higher Taxon        | Species                              | Habitat                                                                 | Kvam | Drangedal | Porsgrunn | Larvik |
|---------------------|--------------------------------------|-------------------------------------------------------------------------|------|-----------|-----------|--------|
|                     |                                      | Woodland, heathland, wetlands (water meadows, fens, mires, bogs), grassland, dunes, saltmarsh, gardens, saprophagous | 1    |           |           |        |
| B. nitidicollis     | Meigen, 1818                         |                                                                         |      |           |           |        |
|                     |                                      | Woodland (oak, ash, aspen, spruce), saprophagous                        |      | 2         |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| □B. quercina        | Menzel and Köhler, 2014               |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      | 1         | 1         | 1      |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| *Corynoptera forcipata| Winnertz, 1867                   |                                                                         |      | 2         | 1         | 8      |
|                     |                                      |                                                                         |      |           |           |        |
| C. hypopygialis     | Lengersdorf, 1926                    |                                                                         |      | 2         | 3         |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| *C. irmgardis       | Lengersdorf, 1930                    |                                                                         |      | 1         |           |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| *C. membranigera    | Kieffer, 1903                        |                                                                         |      | 2         | 2         | 2      |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| *Cratyna (C.) ambigua| Lengersdorf, 1934                 |                                                                         |      | 1         |           |        |
|                     |                                      |                                                                         |      |           |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| Epidapus gracilis   | Walker, 1848                         |                                                                         |      | 1         |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| Leptosciarella sp. 1|                                      |                                                                         |      | 1         |           |        |
| Lycoriella ingenua  | Dufour, 1839                         |                                                                         |      | 1         |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| *Pseudolycoriella palidum| Frey, 1948                |                                                                         |      | 4         |           |        |
|                     |                                      |                                                                         |      |           |           |        |
| Scatopsiara atomaria| Zetterstedt, 1851                   |                                                                         |      | 4         | 12        | 1      |
|                     |                                      |                                                                         |      |           |           |        |
| *S. calamophila Frey| 1948                                 |                                                                         |      | 6         | 2         | 1      |

**Kvam**: Xylebiont, **Drangedal**: saprophagous, **Porsgrunn**: saprophagous, **Larvik**: saprophagous.
### Table A1. Cont.

| Higher Taxon | Species | Habitat | Kvam | Drangedal | Porsgrunn | Larvik |
|--------------|---------|---------|------|-----------|-----------|--------|
| *S. multispina* (Bukowski and Lengersdorf, 1926) | Woodland, grassland, heathland, wetlands (dump meadows, sedge beds), parkland, gardens, saprophagous Woodland, grassland, heathland, wetlands | 3 | 6 |
| *S. neglecta* Menzel and Mohrig, 1998 | Woodland, grassland, heathland, wetlands (water meadows, sedge beds), parkland, gardens, saprophagous | 1 |
| *S. pusilla* (Meigen, 1818) | Woodland, grassland, heathland, wetlands (bogs, dump meadows), saprophagous | 1 |
| *S. vitripennis* (Meigen, 1818) | Woodland, grassland, heathland, wetlands | 3 | 8 |
| S. sp. 1 | Saprophagous | 1 |
| S. sp. 2 | Saprophagous | 1 |
| *Trichosia (T.) flavicoxa* Tuomikoski, 1960 | Woodland, parkland (oak, alder, beech), Xylobiont | 1 |
| T. sp. 1 | Xylobiont | 1 |
| T. sp. 2 | Xylobiont | 1 |
| **Forcipomyia dichromata** Remm, 1968 | Rotting material | 1 |
| **F. tibialis** Remm, 1961 | Aquatic larvae, Rotting material | 1 |
| **F. titillans** (Winnertz, 1852) | Rotting material | 1 |
| **F. spp.** | Rotting material | 1 |
| *C. s. scoticus* Downes and Kettle, 1952 | Dung / saprophagous | 2 |
| C. s. segnis Campbell and Pelham-Clinton, 1960 | Dung / saprophagous | 2 |
| Danylehua spp. | 1 |
| **Forcipomyia dichromata** Remm, 1968 | Rotting material | 1 |
| *F. lilalis* Remm, 1961 | 1 |
| *F. tibialis* Winnertz, 1852 | 1 |
| *F. spp.* | 1 |
| Kolenhrelea calcitrea (Goethehebuer, 1920) | 1 |
| Palpomyia rubescens Kieffer, 1919 | 1 |
| Serromya femorata (Meigen, 1804) | 1 |
| Stiobizoa ochraca (Winnertz, 1852) | 1 |
| Anapausis hellvetica Haenni, 1984 | 1 |
| A. recticornis Duda, 1928 | 1 |
| Scatopsidae | 12 |
| *E. albitarsis* (Zetterstedt, 1850) | Saprophaus | 1 |
| Holoplagia bullata (Edwards, 1925) | Rotting wood, ants (?) | 1 |
| *T. signatus* (van der Wulp, 1859) | 1 |

**Chironomidae**

| *Chironomus (Chaeotolabis) macani* Freeman, 1948 | 1 |
| *Chironomus (Lobochironomus) pseudomendax* Wülker, 1996 | 1 |
| Glyptotendipes (G.) caulisinellus (Kieffer, 1913) | 5 |
| Microspectra nana (Meigen, 1818) | 1 |
| M. pallidula (Meigen, 1830) | 1 |
| Parachironomus tenacicaudatus (Malloch, 1915) | 1 |
| Paratendipes albinanus (Meigen, 1818) | 2 |
| Stempellinella brevis (Edwards, 1929) | 3 |
| Tanytarsus medius Reiss and Fittkau, 1971 | 1 |
| T. signatus (van der Wulp, 1859) | 1 |
Table A1. Cont.

| Higher Taxon | Species | Habitat | Kvam | Drangedal | Porsgrunn | Larvik |
|--------------|---------|---------|------|-----------|-----------|-------|
| Orthocladiinae | Brachyphaoecladius ictericus (Meigen, 1830) | | | | | |
| | B. cf. vernalis (Goethghebuer, 1921) | | | | | |
| | B. sp. 4ES | | | | | |
| | B. sp. 10ES | | | | | |
| Cernomyia lacustris Edwards, 1924 | | | | | | |
| Co. sp. 16ES | | | | | | |
| Cricotopus glacialis Edwards, 1922 | | | | | | |
| Cr. tibialis (Meigen, 1804) | | | | | | |
| Eukiefferiella brevicar (Kieffer, 111) | | | | | | |
| Gymnometrium (Gymnometrium) pallidus Stur and Ekrem, 2015 | | | | | | |
| Limnophyes asquamatus Søgaard Andersen, 1937 | | | | | | |
| L. habilis (Walker, 1856) | | | | | | |
| L. minimus (Meigen, 1818) | | | | | | |
| L. natalensis (Kieffer, 1914) | | | | | | |
| L. sp. 3ES | | | | | | |
| L. sp. 14ES | | | | | | |
| Metriocnemus alalinatus (Meigen, 1818) | | | | | | |
| M. fuscipes (Meigen, 1818) | | | | | | |
| M. picipes (Meigen, 1818) | | | | | | |
| M. sp. 3ES | | | | | | |
| Parametriocnemus stylatus adzharens Kownacki and Dziskze, 1973 | | | | | | |
| Parapanaeocladus impensus (Walker, 1856) | | | | | | |
| Bicellaria nigra (Meigen, 1824) | | | | | | |
| Drapetis pusilla Loew, 1859 | | | | | | |
| Euthyneura gyllenhali (Zetterstedt, 1838) | | | | | | |
| E. nigritarsis (Fallén, 1816) | | | | | | |
| Sympycnema pervicua (Fabricius, 1775) | | | | | | |
| Trichoneura calvescens (Edwards, 1929) | | | | | | |
| TrenitraRolandia spp. (Walker, 1856) | | | | | | |
| Brachycera | | | | | | |
| Empididae | | | | | | |
| Tachyromia umbrarum Haliday, 1833 | | | | | | |
| Tachyromia fusca (Fallén, 1815) | | | | | | |
| Trichina claupes Meigen, 1830 | | | | | | |
| Chelzera tropica (Zetterstedt, 1838) | | | | | | |
| Empis stercoria Linnaeus, 1761 | | | | | | |
| Gloina fusca (Meigen, 1822) | | | | | | |
| Hilara cunicolus Zetterstedt, 1849 | | | | | | |
| H. intermedia (Fallén, 1816) | | | | | | |
| H. platyura Loew, 1873 | | | | | | |
| Phylodromia melanocephala (Fabricius, 1794) | | | | | | |
| Rhamphomyia crassirostris (Fallén, 1816) | | | | | | |
| R. flava (Fallén, 1816) | | | | | | |
| Trichopeza longicornis (Meigen, 1822) | | | | | | |
| Higher Taxon   | Species                                                                 | Habitat           | Kvam (B) | Drangedal (S) | Porsgrunn (S) | Larvik (D) | 5 | 6 |
|---------------|--------------------------------------------------------------------------|-------------------|----------|---------------|---------------|------------|---|---|
| Atelestidae   | *Atelestus pulicarius* (Fallen, 1816)                                    | Habitats Atelestidae | 2        | 21            | 6             |            |   |   |
| Dolichopodidae| *Chrysotus flaviventris* (von Roser, 1840)                               | Habitats Dolichopodidae | 1        | 4             | 1             | 1          |   |   |
|               | *C. molliculus* (Fallen, 1823)                                           |                   | 1        | 1             |               |            |   |   |
|               | *C. cilipes* (Meigen, 1824)                                              |                   | 2        | 66            |               |            |   |   |
|               | *Dolichopus nigricornis* (Meigen, 1824)                                   |                   | 1        | 1             |               |            |   |   |
|               | *D. plumipes* (Scopoli, 1763)                                            |                   | 2        | 3             |               |            |   |   |
|               | *D. popularis* (Wiedemann, 1817)                                         |                   | 3        | 3             |               |            |   |   |
|               | *D. simplex* (Meigen, 1824)                                              |                   | 1        | 1             |               |            |   |   |
|               | *Cymnopterus aequus* (Fallen, 1823)                                      |                   | 1        | 1             |               |            |   |   |
|               | *Medetera abstrusa* (Pavlova, 1795)                                       |                   | 1        | 1             |               |            |   |   |
|               | *Medetera bellica* (Parent, 1936)                                         |                   | 1        | 1             |               |            |   |   |
|               | *Neurigona pallida* (Fallen, 1823)                                       |                   | 1        | 1             |               |            |   |   |
|               | *Sciapus platypterus* (Fabricius, 1805)                                   |                   | 1        | 1             |               |            |   |   |
| Phoridae      | *Borophaga agilis* (Meigen, 1830)                                         |                   | 1        | 1             |               |            |   |   |
|               | *Megaelia albicllava* (Schmitz, 1926)                                      |                   | 2        | 3             |               |            |   |   |
|               | *M. alliusmyia* (Disney, 2015)                                           |                   | 1        | 2             |               |            |   |   |
|               | *M. bimaculata* (Lundbeck, 1920)                                         |                   | 1        | 1             |               |            |   |   |
|               | *M. ciliata* (Zetterstedt, 1848)                                          |                   | 2        | 1             |               |            |   |   |
|               | *M. conformis* (Wood, 1909)                                              |                   | 2        | 3             |               |            |   |   |
|               | *M. coturnata* (Schmitz, 1919)                                           |                   | 3        | 1             |               |            |   |   |
|               | *M. crassipes* (Wood, 1909)                                              |                   | 1        | 1             |               |            |   |   |
|               | *M. deltaomyia* (Disney, 2015)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. diffrens* (Schmitz, 1948)                                            |                   | 2        | 4             |               |            |   |   |
|               | *M. discreta* (Wood, 1909)                                               |                   | 1        | 1             |               |            |   |   |
|               | *M. diversa* (Wood, 1909)                                                |                   | 1        | 1             |               |            |   |   |
|               | *M. ebuli* (Kim, 1910)                                                   |                   | 1        | 1             |               |            |   |   |
|               | *M. ebuli* (Kim, 1910)                                                   |                   | 1        | 1             |               |            |   |   |
|               | *M. geiri* (Wood, 1909)                                                  |                   | 1        | 1             |               |            |   |   |
|               | *M. giraudii* (Egger, 1862)                                              |                   | 1        | 1             |               |            |   |   |
|               | *M. gregaria* (Wood, 1910)                                               |                   | 1        | 1             |               |            |   |   |
|               | *M. hirticrus* (Schmitz, 1918)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. ignobilis* (Schmitz, 1919)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. immodensior* (Disney, 2001)                                          |                   | 1        | 1             |               |            |   |   |
|               | *M. insons* (Lundbeck, 1920)                                             |                   | 1        | 1             |               |            |   |   |
|               | *M. intercostata* (Lundbeck, 1921)                                       |                   | 1        | 1             |               |            |   |   |
|               | *M. karli* (Disney, 2015)                                                |                   | 1        | 1             |               |            |   |   |
|               | *M. kozlovi* (Disney, 2015)                                               |                   | 1        | 1             |               |            |   |   |
|               | *M. lambdanyia* (Disney, 2015)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. lati* (Wood, 1910)                                                   |                   | 1        | 1             |               |            |   |   |
|               | *M. longicostalis* (Wood, 1912)                                          |                   | 1        | 1             |               |            |   |   |
|               | *M. longifurca* (Lundbeck, 1921)                                         |                   | 1        | 1             |               |            |   |   |
|               | *M. lutea* (Meigen, 1830)                                                |                   | 1        | 1             |               |            |   |   |
|               | *M. malhamensis* (Disney, 1946)                                          |                   | 1        | 1             |               |            |   |   |
|               | *M. mixta* (Schmitz, 1918)                                               |                   | 1        | 1             |               |            |   |   |
|               | *M. nigricornis* (Meigen, 1830)                                          |                   | 1        | 1             |               |            |   |   |
|               | *M. nigrescens* (Wood, 1910)                                             |                   | 1        | 1             |               |            |   |   |
|               | *M. omeconymia* (Disney, 2015)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. pectoralis* (Schmitz, 1927)                                          |                   | 1        | 1             |               |            |   |   |
|               | *M. pilla* (Meigen, 1830)                                                |                   | 1        | 1             |               |            |   |   |
|               | *M. quadrifurca* (Schmitz, 1918)                                         |                   | 1        | 1             |               |            |   |   |
|               | *M. rhonida* (Disney, 2015)                                              |                   | 1        | 1             |               |            |   |   |
|               | *M. ruficornis* (Meigen, 1830)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. solis* (Disney, 2015)                                                |                   | 1        | 1             |               |            |   |   |
|               | *M. spinicincta* (Wood, 1910)                                            |                   | 1        | 1             |               |            |   |   |
|               | *M. speiseri* (Schmitz, 1929)                                            |                   | 1        | 1             |               |            |   |   |
|               | *M. spinicincta* (Wood, 1910)                                            |                   | 1        | 1             |               |            |   |   |
|               | *M. surdipons* (Wood, 1909)                                              |                   | 1        | 1             |               |            |   |   |
|               | *M. thunesi* (Disney, 2015)                                              |                   | 1        | 1             |               |            |   |   |
|               | *M. ticknensis* (Disney, 2000)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. ticknensis* (Disney, 2000)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. ticknensis* (Disney, 2000)                                           |                   | 1        | 1             |               |            |   |   |
|               | *M. ticknensis* (Disney, 2000)                                           |                   | 1        | 1             |               |            |   |   |

Table A1. Cont.
| Higher Taxon       | Species                          | Kvam | Drangedal | Porsgrunn | Larvik |
|-------------------|----------------------------------|------|-----------|-----------|--------|
|                    |                                  | 1(B) | 2(S)      | 3(S)      | 4(D)   | 5      | 6      |
|                    |                                  |      |           |           |        |        |        |
|                    | Menozziola obscuripes (Schmitz, 1927) | 1    |           |           |        |        |        |
|                    | Phalcaltrophora fasciata (Fallén, 1823) | 1    |           |           |        |        |        |
|                    | P. holosericea Schmitz, 1920 | 1    |           |           |        |        |        |
|                    | P. tincta Schmitz, 1920 | 1    |           |           |        |        |        |
| Rhagionidae        | P. flavifrons (Fallén, 1814) | 1    |           |           |        |        |        |
|                    | R. lineola Fabričius, 1794 | 1    | 2         | 12        | 19     |        |        |
|                    | R. maculatus (DeGeer, 1776) | 1    |           |           |        |        |        |
|                    | R. scrobipalpis (Linnaeus, 1768) | 1    |           |           |        |        |        |
| Symphoromyia crassicornis (Panzer, 1806) | 1 | | |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Symphoromyia crassicornis (Panzer, 1806) | 1 | | |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
|                    | B. clypeata (Linnaeus, 1767) | 1    | 2         | 14        |        |        |        |
| Tabanidae          | Tanyzoza longimana Fallén, 1820 | 1    |           |           |        |        |        |
| Higher Taxon | Species | Habitat | Kvam | Drangedal | Porsgrunn | Larvik |
|-------------|---------|---------|------|-----------|-----------|-------|
| **HYMENOPTERA** | Formicidae | Camponotus ligniperda (Latreille, 1802) | Woodlands, dead wood | 11 | 35 | 2 | 2 | 6 |
| | | Formica fusca Linnaeus, 1758 | Xerophilous | 2 | 15 | 1 | 2 |
| | | F. polyctena Förster, 1850 | 10 | 172 | |
| | | F. rufa Linnaeus, 1761 | 56 | | |
| | | Lasius brunneus (Latreille, 1798) | Deciduous | 2 | 1 | 1 | 1 |
| | | L. platythorax Seifert, 1991 | Forests | 2 | 25 | 1 | |
| | | Murmica rubra (Linnaeus, 1758) | Forests | 7 | | |
| | | M. ruginodis Nylander, 1846 | | | | |
| | | Temnothorax cf. tuberum (Fabricius, 1775) | | 3 | | |
| | **Ceraphronidae** | Crossocerus tarsatus (Shuckard, 1837) | 1 | | | |
| | | A. clavicornis Thomson, 1859 | 2 | | 1 | |
| | | A. cf. clavicornis sp. 1 | 3 | | 1 | |
| | | A. cf. clavicornis sp. 2 | 1 | | | |
| | | A. cf. clavicornis sp. 3 | 1 | | | |
| | | A. compressus (Ratzburg, 1852) | | 1 | 2 | 4 | 3 | 1 |
| | | A. nr. dessarti Hellen, 1866 | | 1 | | | |
| | | A. nr. compressus Pechom-Walker, 1956 | | | | | |
| | | A. steinitzi Priesner, 1936 | 2 | | 1 | |
| | | A. tenuiicornis Thomson, 1859 | | 2 | | | |
| | | A. spp. | 5 | 2 | 3 | |
| | | Gelas sp. | | | | | |
| | | Ichneumonidae | Gelis sp. | | | | |
| | | Crabronidae | A. cf. tuberum Fabricius, 1775 | | | | | |
| | | Megaspilidae | Conostigmus sp. 1 | | | | | |
| | | Apanteles sp. | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Megaspilidae | Conostigmus sp. 2 | | | | | |
| | | Apanteles sp. | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Megasphyrus spp. | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Eulophidae | A. pedalis (Smith, 1784) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Eulophidae | A. pedalis (Smith, 1784) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
| | | Ichneumonidae | A. caespitatus (Fabricius, 1775) | | | | | |
| | | Ceraphronidae | A. cinctus (Curtis, 1826) | | | | | |
Table A1. Cont.

| Higher Taxon | Species | Habitat | Kvam | Drangedal | Porsgrunn | Larvik |
|--------------|---------|---------|------|-----------|-----------|-------|
|              |         |         | 1(B) | 2(S) | 3(S) | 4(D) | 5 | 6 |
| Pteromalinae sp. | 1       |         |      |      |      |      | 1 |
| Seladerma tarsale (Walker, 1833) | 6 | 14 | 3 | 1 |
| Spalangiopelta sp. | 1    |         |      |      |      |      | 1 |
| Stenomalina episteta (Walker, 1835) | 1 |         |      |      |      |      |
| S. gracile (Walker, 1834) | 1 |         |      |      |      |      |
| Trigonoderus princeps Westwood, 1832 | 1 |         |      |      |      |      |
| Megastigmus dorsalis (Fabricius, 1798) | 9 | 2 | 3 | 1 | 5 |
| Torymus flavipes (Walker, 1833) | 5 | 1 | 2 |
| Torymidae |         |         |      |      |      |      | 2 |
| Trichogrammatidae |         |         |      |      |      |      | 1 |
| Trichogramma spp. | 1 |         |      |      |      |      |
| Cytocoris clavicornis Hartig, 1840 | 2 | 5 | 2 | 1 |
| Neuroterus nr. politus Hartig, 1840 | 1 |         |      |      |      |      |
| Saphoneurus connatus (Hartig, 1840) | 2 | 4 | 1 | 1 |
| Syntomopus thoracicus (Walker, 1833) | 1 |         |      |      |      |      |
| Trichogramma spp. | 1 |         |      |      |      |      |
| Cynipidae |         |         |      |      |      |      | 1 |
| Cynips sp. | 2 | 1 | 3 | 1 | 3 |
| A. tritici (Walker, 1830) | 2 | 1 | 2 | 1 | 3 |
| Eusyrphus spp. | 1 |         |      |      |      |      |
| Inostemma hispo Walker, 1838 | 1 |         |      |      |      |      |
| Phytomyza sp. | 1 |         |      |      |      |      |
| Scelionidae |         |         |      |      |      |      | 1 |
| T. lineolatus Kozlov, 1967 | 1 |         |      |      |      |      |
| T. punctatissimus (Ratzeburg, 1840) | 1 |         |      |      |      |      |
| T. sp. | 1 |         |      |      |      |      |
| Trichogramma spp. | 1 |         |      |      |      |      |
| Platygastridae |         |         |      |      |      |      | 1 |
| Amblyaspis angustula Thomason, 1859 | 1 |         |      |      |      |      |
| A. tritici (Walker, 1835) | 1 |         |      |      |      |      |
| Eusyrphus spp. | 1 |         |      |      |      |      |
| Diapriidae |         |         |      |      |      |      | 1 |
| Acrlesia sp. | 1 |         |      |      |      |      |
| A. sp. | 1 |         |      |      |      |      |
| Cinetus picus Thomason, 1859 | 1 |         |      |      |      |      |
| Diapriidae spp. | 1 |         |      |      |      |      |
| Diaphore sp. | 1 |         |      |      |      |      |
| Entomacris perlela (Haliday, 1857) | 1 |         |      |      |      |      |
| Ismarus albifrons Forster, 1850 | 1 |         |      |      |      |      |
| Trichopria aptera (Rhite, 1859) | 1 |         |      |      |      |      |
| Zygota ruficornis (Curtis, 1831) | 1 |         |      |      |      |      |
| Z. sp. | 1 |         |      |      |      |      |
| Encyrtidae |         |         |      |      |      |      | 1 |
| Cepidosoma floridum (Ashmead, 1900) | 1 |         |      |      |      |      |
| Habroplepsis delucchi, 1965 | 1 |         |      |      |      |      |
| Coleoptera |         |         |      |      |      |      | 1 |
| Ptiliidae |         |         |      |      |      |      | 2 |
| Acrotrichis intermedia (Gillmeister, 1845) | 1 |         |      |      |      |      |
| Adalia decempunctata (Linnaeus, 1758) | 1 |         |      |      |      |      |
| Halyzia sedecimguttata (Linnaeus, 1758) | 1 |         |      |      |      |      |
| Staphylinidae |         |         |      |      |      |      | 1 |
| Athleta zoga (Heer, 1839) | 1 |         |      |      |      |      |
| Decioxia forticornis (Strand, 1939) | 1 |         |      |      |      |      |
| Euphaleurus luteum (Marsham, 1802) | 1 |         |      |      |      |      |
| Haplogloisa villosula (Stephens, 1832) | 1 |         |      |      |      |      |
| Holobius floridus (Lacordaire, 1835) | 2 |         |      |      |      |      |
| Leptusa humida (Erichson, 1839) | 1 |         |      |      |      |      |
| L. rufifrons (Erichson, 1839) | 1 |         |      |      |      |      |
| Oxyopes arborea Zerche, 1944 | 1 |         |      |      |      |      |
| Philochoros subulatus Mannheim, 1830 | 1 |         |      |      |      |      |
| Phaenops parvula (Stephens, 1832) | 1 |         |      |      |      |      |
| Scaptiidae |         |         |      |      |      |      | 1 |
| Anaspis marginicollis Lindberg, 1925 | 1 |         |      |      |      |      |
| A. rufifrons (Gyllenhal, 1827) | 1 |         |      |      |      |      |
| A. thoracica (Linnaeus, 1758) | 1 |         |      |      |      |      |
| Aderidae |         |         |      |      |      |      | 1 |
| Anidus nigrinus (Germar, 1842) | 1 |         |      |      |      |      |
| Archarias pycrhopodes (Marsham, 1802) | 1 |         |      |      |      |      |
| Curculionidae |         |         |      |      |      |      | 1 |
| Brachysomus cinctus (Bonsdorff, 1785) | 1 |         |      |      |      |      |
| Cetilidae rana (Fabricius, 1787) | 1 |         |      |      |      |      |
Table A1. Cont.

| Higher Taxon | Species | Habitat | Kvam (B) | Drangedal (S) | Porsgrunn (S) | Larvik (D) |
|--------------|---------|---------|----------|--------------|--------------|-----------|
|              |         |         | 1(B)     | 2(S)         | 3(S)         | 4(D)      | 5          | 6          |
| Cryptophagida | Atomaria fuscata (Schönherr, 1808) | Eurytop, saprophagous, mycetophagous | 1         | 2            | 1            |           |            |
|              | A. turgida Erichson, 1846 | Xerophilous, mycetophagous | 1         | 1            | 2            | 1          | 1          |
| Byturidae    | Byturus tomentosus (De Geer, 1774) | Arborescent, carnivorous | 1         | 2            | 1            |           |            |
| Cantharidae  | Cantharis figurata Mannerheim, 1843 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Malthia flavescens (Herbst, 1786) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. sericopus Kiesenwetter, 1851 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. coccinellus (Packard, 1866) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. fulvus (Weber, 1838) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. gutfer Kiesenwetter, 1852 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. marginatus (Latreille, 1804) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. punctulatus (Brevi, 1835) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | M. spathifer Kiesenwetter, 1852 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Nitidulidae  | Nyctides politus (Suffrian, 1848) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | C. festivus (Panzer, 1793) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | C. gibralitei Mellie, 1848 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | C. vestitus (Mellié, 1848) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Melandryidae | Conopotus testaceus (Olivier, 1790) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Latridiidae  | Orthosia alni (Gyllenhaal, 1813) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Polypor, mycetophagous | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Polypor, mycetophagous | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Chrysomelidae| Cryptolea porphyrea (Kleemann, 1848) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Nitidulidae  | C. politus (Suffrian, 1848) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Epuraea unicolor (Olivier, 1970) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | C. similata | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Scirtidae    | Cymatoclytus Pavykull, 1799 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | C. opulata (Linnaeus, 1758) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Dasytidae    | Prionoclytus serricornis (Müller, 1821) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Carabidae    | Dasites aeratus Stephens, 1827 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | D. plumbus (Müller, 1776) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Pinidae      | Dryophila pusilla (Gyllenhaal, 1788) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Gnorimus plenus (Fabricius, 1775) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Hydropalus putnianus (Gyllenhaal, 1788) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Histeridae   | Gnathophana pygmaea August, 1917 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Cerambycidae | Leipsis innex Wallin, Nuteland and Kvamme, 2009 | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | Pogonoclytus siphius (Piller and Mitteracher, 1873) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Salpingidae  | Salpingien planotritris (Fabricius, 1775) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Silvanidae   | Silvanオスpus fagi (Guérin-Méneville, 1844) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
| Thrusidae    | Tragopogon bruniolus (Bornouilov, 1839) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | T. dermestoides (Fabricius, 1775) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |
|              | T. leseigneuri (Müller, 1776) | Eurytop, carnivorous | 1         | 2            | 1            |           |            |

| Sum species: 84 | Kvam (B) | Drangedal (S) | Porsgrunn (S) | Larvik (D) |
|----------------|----------|--------------|--------------|-----------|
| Sum specimens 821 | 19        | 28           | 39           | 21        | 26        |
|                  | 50        | 111          | 206          | 173       | 69        | 212       |
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