

Arthropods on oak branches in SW Finland, collected by a new trap type

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Arthropods moving on large horizontal branches of old oaks (*Quercus robur* L.) in seven oak woodlands, SW Finland, were studied using a new trap type. The most abundant groups included Formicidae (Hym.), Oribatida (Acari), Thysanoptera, Nematocera (Dipt.), Collembola, Auchenorrhyncha (Hom.), Coleoptera, Araneae, Psocoptera and Hemiptera. The last three groups showed the least intersite variation in numbers of individuals. About 120 abundant, rare and other interesting species of Diplopoda (4 species mentioned), Chilopoda (2), Araneae (19), Opiliones (4), Pseudoscorpionida (1), Oribatida (9), Psocoptera (9), Blattodea (1), Neuroptera (1), Homoptera (10), Heteroptera (13), Coleoptera (25), Lepidoptera (14) and Formicidae (6) are listed, and the new trap is described.

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1. Introduction

Oak (*Quercus robur* L.) reaches its northern limit in southernmost Finland. The oak woodlands are small in area, with the largest forests found in the archipelago and in the narrow coastal area of southwesternmost Finland. The largest oak forest in Finland, almost 90 hectares, is situated on the island of Ruissalo, in Turku.

The fauna of local oak forests in Finland has been dealt with by several authors, their materials originating especially from Ruissalo. Laamanen (1938) and Lahtiperä (1955) described the beetle fauna, Salmikivi (1931) and Koponen *et al.* (1990) studied oak-feeding lepidopterans. In addition, Karhu *et al.* (1995) listed the threatened species

of the orders Heteroptera, Lepidoptera and Coleoptera found in Ruissalo.

In Europe, there are some studies on arthropod groups of trunks (e.g. Nicolai 1986) or hollow trees (Ruzicka & Bohac 1991), but the total fauna living on branches of old oaks has not been studied.

In the present paper, data on fauna living or moving on large horizontal branches of old oak trees near the city of Turku is presented, and a new trap type is described. This work is part of an investigation of invertebrates in protected oak forests in southwestern Finland (Rinne *et al.* 1997). Two groups in the present material are discussed in more detail separately, i.e. spiders (Koponen 1996) and psocopterans (Kanervo & Rinne 1996).

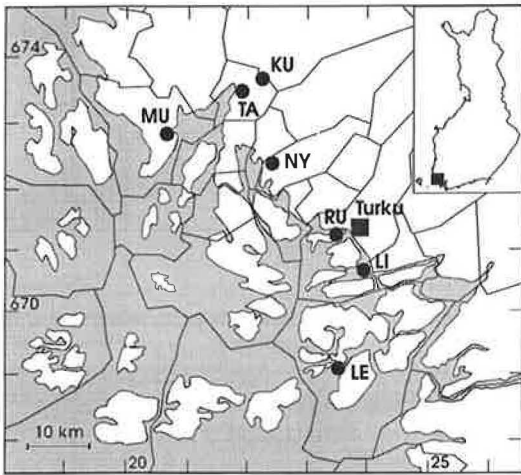


Fig. 1. Location of the oak forests studied in SW Finland. RU = Ruissalo, LE = Lenholm, NY = Nyytäinen, TA = Tammimäki, KU = Kurasmäki, LI = Linnavuori, MU = Muntti. The municipalities and 10 × 10 km squares of the Finnish uniform Grid 27°E are shown.

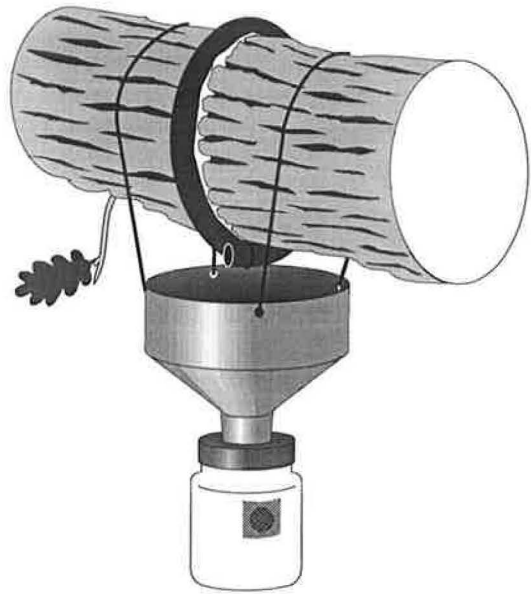


Fig. 2. The branch trap used. For details, see the text.

2. Material and methods

2.1. Study sites

The isolated oak forests studied (Table 1) lie at 60°15'–60°40' N, near the city of Turku (Fig. 1). They are all near the sea, less than 5 km from the coastline. All have been within the influence of human activity, for example grazing by cattle and timber cutting, for a long period. The forests are presently protected.

At most sites, other trees, usually deciduous ones, grow near the oaks with branch traps. In Ruissalo, these include *Tilia*, *Acer*, *Sorbus*, *Prunus*, *Betula* and *Pinus*; in Lenholm, *Sorbus*, *Prunus*, *Betula*, *Pinus* and *Picea*; in Nyytäinen, *Tilia*; in Tammimäki, *Acer*; in Linnavuori, *Tilia*, *Sorbus*, *Betula* and *Picea* and, in Muntti, *Acer*, *Betula* and *Prunus*.

2.2. Trap

We constructed a new type of trap for collecting arthropods actively moving on large oak branches. This trap has no cover, i.e. no dark or sheltered hiding place which could either attract or repel branch dwellers. In this respect, it differs from branch traps used earlier (e.g. Simon 1995: fig. 7).

The trap consists of a collar around the branch, a plastic funnel, and a container (Fig. 2). The collar (water pipe, diameter 15 mm) was fitted tightly around the branch with lute and cable tie. The collar was brushed with FLUON to give a teflon-like slippery surface. The funnel (upper diameter ca. 22 cm) was situated beneath the collar, at a distance of about 5 cm, fastened with plastic string. Placing the traps below thick branches and under/within the oak canopy diminished the effect of rainfall. In any case, the container (0.5 l) had an overflow hole covered by gauze. Saturated NaCl solution was used as a preservation liquid.

Table 1. The seven oak woodlands studied.

	Grid 27°E squares	Area (ha)	Trapping period	Average trap height (cm)	Average diam. of oaks with traps (cm)
Ruissalo (Turku)	6712 : 234–6	87	6.V.–29.IX.1994	420	75
Lenholm (Parainen)	6690 : 235	8	9.V.–29.IX.1994	470	100
Nyytäinen (Lemu)	6724 : 224–5	3.3	13.V.–30.IX.1994	420	80
Tammimäki (Mietoinen)	6735 : 219	3.1	13.V.–30.IX.1994	480	115
Kurasmäki (Mynämäki)	6737 : 222	2.3	13.V.–30.IX.1994	480	80
Linnavuori, Kulho (Turku)	6706 : 239	1.1	2.VI.–2.X.1994	360	55
Muntti (Taivassalo)	6729 : 206	0.5	13.V.–30.IX.1994	470	100

The branch traps were fitted on large (diameter 15–30 cm; mean 20 cm), more or less horizontal branches of old oaks. The branches were covered by lichens and often also by a moss layer. The traps were at a height of 3–6 m, on average 4.5 m. There were five traps at all study sites except Linnavuori, where there were three. Traps were emptied within 4–5-week intervals. The material is deposited mainly in the Zoological Museum of the University of Turku.

3. Results

3.1. Fauna on oak branches

The arthropod material collected by branch traps consists of about 33 000 specimens (Table 2). Oribatids were included, but other mite groups were omitted in the above figures. Only a part of the groups

Table 2. Arthropod material caught by branch traps on old oaks at seven study sites (5 traps/site, except Linnavuori, which had 3). RU = Ruissalo, LE = Lenholm, NY = Nyytäinen, TA = Tammimäki, KU = Kurasmäki, LI = Linnavuori, MU = Muntti; ind/tr = individuals/trap/summer.

	RU	LE	NY	TA	KU	LI	MU	Total	Ind/tr
Diplopoda	29	33	6	9	1	19	8	105	3.2
Chilopoda	12	1	1	—	—	—	2	16	0.5
Tardigrada	—	—	1	1	1	—	5	8	0.2
Pseudoscorpionida	2	—	—	1	—	2	—	5	0.2
Opiliones	6	10	5	8	—	22	2	53	1.6
Araneae	176	163	120	161	133	128	162	1 043	31.6
Acari: Oribatida*	411	855	898	1 452	600	63	481	4 760	144.2
Collembola	763	299	371	427	810	122	323	3 115	94.4
Psocoptera	253	215	99	85	83	74	129	938	28.4
Blattodea	46	3	11	13	44	32	5	154	4.7
Dermoptera	—	—	—	—	—	1	—	1	0.0
Ephemeroptera	—	—	—	—	1	—	1	2	0.1
Plecoptera	—	—	—	—	2	—	—	2	0.1
Neuroptera adults	6	3	2	2	6	3	1	23	0.7
larvae	15	10	6	5	21	11	4	72	2.2
Trichoptera	5	24	6	42	73	5	11	166	5.0
Thysanoptera	520	1 050	364	150	392	56	874	3 406	103.2
Homoptera									
Psyllodea	—	—	—	1	—	—	11	12	0.4
Aphidoidea	112	16	65	32	47	27	79	378	11.5
Auchenorrhyncha	30	8	2938	7	6	33	5	3 027	91.7
Heteroptera	185	102	192	173	91	79	83	905	27.4
Coleoptera adults	439	147	138	165	127	96	128	1 240	37.6
larvae	5	4	13	3	7	1	6	39	1.2
Lepidoptera adults	323	34	68	83	87	30	37	662	20.1
larvae	194	58	107	61	146	37	61	664	20.1
Hymenoptera									
Formicidae	6 280	5	24	104	54	860	7	7 334	222.2
Other adults	153	66	85	83	174	55	68	684	20.7
Symphyta larvae	—	36	—	8	2	4	—	50	1.5
Diptera									
Nematocera	468	660	475	480	561	138	542	3324	100.7
Brachycera–Cyclorrhapha	237	28	42	79	90	26	39	541	16.4
larvae	69	39	8	10	35	28	20	209	6.3
"Groups"	25	25	25	27	26	26	27	31	—
Individuals	10 739	3 869	6 045	3 645	3 594	1 952	3 094	32 938	997.9

* other mites excluded

caught have been identified to the species level. The identified material consists of about 400 species.

The largest number of individuals was caught in Ruissalo (2 150 ind./trap/summer) and the smallest in Muntti (620 ind./trap). If Ruissalo (2 150 ind./trap) and Nynäinen (1 210 ind./trap) with one peak-dominant species are excluded, the total catch varied little (620–775 ind./trap).

The most abundant groups caught were ants (especially in Ruissalo: great dominance of *Formica polyctena* Förster), oribatid mites, thrips, midges, springtails and leafhoppers (especially in Nynäinen: great dominance of *Alnetoidia alneti* (Dahlbom)). Also beetles, spiders, psocopterans and heteropteran bugs were trapped abundantly. Of the abundant groups, the least intersite variation (Table 2) was found for spiders, heteropterans, psocopterans and various hymenopterans (mainly parasitoids). As seen in Table 2, also flying insects were trapped in great numbers.

The most abundant species, as well as some rare (including threatened) species, of certain arthropod groups are presented below. In a separate report (Rinne et al. 1997), a more detailed presentation of the material will be given and (often great) differences between the present data and the data from small window traps on large oaks will be discussed. About 120 species are listed below, including the most abundant species, those associated with oak in Finland and some faunistically interested rarities.

3.2. Myriapods (Diplopoda, Chilopoda)

Four species of millipedes (Diplopoda) were caught by branch traps. The southwestern species *Nemasoma varicorne* C. L. Koch (80 inds.) clearly dominated. It was trapped at all sites except Kurasmäki, as was *Proteroiulus fuscus* (Am Stein) (17). Both are known as trunk-dwellers, living especially under bark. Other millipedes were the minute *Polyxenus lagurus* (Linnaeus) in Ruissalo, Kurasmäki and Muntti, and one specimen of the rare *Cylindroiulus britannicus* (Verhoeff) trapped in Ruissalo. *C. britannicus* has been regarded as synanthropic in Finland (Lehtinen 1962) but as a trunk-dweller in Great Britain (Blower 1985). Five centipede (Chilopoda) species were found; *Lithobius erythrocephalus* C. L. Koch, in Ruissalo, and

L. tenebrosus Meinert, in Ruissalo and Muntti, were the most abundant species.

3.3. Arachnids (Araneae, Opiliones, Pseudoscorpionida, Acari: Oribatida)

Altogether, 53 species of spiders (Araneae) were caught by branch traps. The most abundant spiders, all known from tree trunks, were *Moebelia penicillata* (Westring) (171 inds.), *Theridion tinctum* (Walckenaer) (155), *Anyphaena accentuata* (Walckenaer) (82), *Drapetisca socialis* (Sundevall) (82), *Salticus cingulatus* (Panzer) (52), *Zygiella stroemi* (Thorell) (41), *Hypomma cornutum* (Blackwall) (39) and *Steatoda bipunctata* (Linnaeus) (37). Five of the eight most abundant species were caught by branch traps at all study sites; *Drapetisca socialis*, *Zygiella stroemi* and *Steatoda bipunctata* at six of the seven sites. In addition to the above-mentioned species, trunk-dwellers include (see Koponen 1996) *Micaria subopaca* Westring and *Nuctenea umbratica* (Clerck). The following species are rare in Finland; many of them are restricted to the oak forest zone: *Xysticus lanio* C. L. Koch found in Ruissalo and Linnavuori, *Cheiracanthium oncognatum* Thorell in Linnavuori, *Clubiona comta* C. L. Koch in Ruissalo and Linnavuori, *Zygiella atrica* (C. L. Koch) in Ruissalo, *Theridion pallens* Blackwall in Ruissalo and Lenholm, *T. tinctum*, *Agyneta innotabilis* (O.P.-Cambridge) in Nynäinen, Tammimäki and Kurasmäki, *Lepthyphantes minutus* (Blackwall) in Kurasmäki, and *Hypomma cornutum*, which seems to be an oak species in Finland. Some species regarded as ground-dwellers were caught on oak branches 3–6 m above the ground; these include *Hahnina pusilla* C. L. Koch and *Savignya frontata* (Blackwall).

Six species of harvestmen (Opiliones) were caught. *Rilaena triangularis* (Herbst), *Mitopus morio* (Fabricius) and *Leiobunum rupestre* (Herbst) were the most abundant species. *Nelima gothica* Lohmander is a southwestern species; it was found in Ruissalo. The only pseudoscorpion (Pseudoscorpionida) species caught by branch traps was *Chernes cimicoides* (Fabricius), found in Ruissalo, Tammimäki and Linnavuori.

Oribatid mite (Acari) material included 33 species. Many of the species found are known to be

arboreous (Ritva Niemi, pers. comm.). The most abundant oribatids were *Phauloppia lucorum* (C. L. Koch) (1 470 inds.), *Eueremaeus oblongus* C. L. Koch (1136), *Phthiracarus* sp. (747), *Carabodes labyrinthicus* (Michael) (381), *Schelorbates latipes* (C. L. Koch) (358), *Camisia horrida* (Herrmann) (157), *Zygoribatula exilis* (Nicolet) (120), *Cymbaeremaeus cymba* (Nicolet) (91) and *Phauloppia coineaui* Trave (72). *P. lucorum* was the most abundantly trapped oribatid species at four, and *Eueremaeus oblongus* at two of the seven study sites. The largest number of species and individual numbers were observed in Lenholm and Tammimäki, respectively.

3.4 Insects (Insecta)

Psocoptera

A great proportion (40%) of the Finnish psocopterans was trapped: 25 species. The most abundant species were *Loensia pearmani* Kimmins (183 inds., perhaps some females of *L. variegata* (Latreille), are included), *Pseudopsocus fusciceps* (Reuter) (166), *Loensia fasciata* (Fabricius) (140), *Graphopsocus cruciatus* (Linnaeus) (64), *Trichadenotecnum majus* (Kolbe) (60) and *Reuterella helvimacula* (Enderlein) (41). *Loensia pearmani* and *Trichadenotecnum majus* were caught at all seven study sites, and *Loensia fasciata*, *Graphopsocus cruciatus* and *Reuterella helvimacula* at six sites. Rare species (see Kanervo & Rinne 1996) included the above-mentioned *Pseudopsocus fusciceps* found at all sites except "inland woodlands" Tammimäki and Kurasmäki, *Lachesilla quercus* (Kolbe) in Ruissalo and Lenholm, *Loensia variegata* (♂), earlier known only from Åland in Finland, found in Lenholm, and *Trichadenotecnum incognitum* Roesler, trapped in Tammimäki and previously known only from the Pyhä-Häkki National Park, Central Finland.

Neuroptera and Blattodea

The minute neuropteran, *Coniopteryx borealis* Tjeder is an oak species; it was found at most sites. Six neuropteran species were caught by branch traps. *Ectobius sylvestris* (Poda) was the only cockroach species.

Homoptera

Of the psyllids, *Trioza remota* Förster is an oak species. It was trapped in Tammimäki and Muntti. Four aphid species are known to live on oak in continental Finland (one additional in the Åland islands; A. Albrecht, pers. comm.); all four were caught by branch traps. The most abundant species was *Thelaxeres dryophila* (Schrank) (39 inds.) trapped in Ruissalo and Tammimäki. *Tuberculatus annulatus* (Hartig) (14) was found at all sites. *Lachnus roboris* (Linnaeus) (24) is associated with ants; it was found at sites with high ant abundance, i.e. Ruissalo, Tammimäki and Linnavuori. *Phylloxera coccinea* von Heyden was trapped only in Tammimäki. Great numbers of flying aphids only occasionally found on oaks were collected.

Thirteen species of leafhoppers were caught. The dominant species, *Alnetoidia alneti*, living especially on *Tilia*, was extremely abundant in Nyytäinen (2 913 inds.) but also found in Ruissalo, Linnavuori and Tammimäki. Interestingly, despite being a good flier, *A. alni* was found in much smaller numbers in window traps than in branch traps in Nyytäinen. Oak species included *Iassus lanio* (Linnaeus) caught in Ruissalo and Kurasmäki, *Eurhadina concinna* (Germar) in Lenholm, and *E. pulchella* (Fallén) in Tammimäki, Kurasmäki and Muntti; all these species were trapped in low numbers. Of these, *E. concinna* is a rare species, as well as *Edwardsiana frustrator* (Edwards), which was found in Linnavuori.

Heteroptera

Altogether 31 heteropteran bugs were trapped on branches. The most abundant species, found at all sites, were *Calocoris ochromelas* (Gmelin) (331 inds.), a typical oak species, and two trunk- and branch-dwelling predators *Loricula pselaphiformis* Curtis (250) and *Temnostethus gracilis* (Horvath) (75). Interesting trunk/branch species were also *Empicoris vagabundus* (Linnaeus), found in Tammimäki and Muntti, and *Myrmedobia distinguenda* Reuter found in good numbers (41) in Lenholm, Tammimäki and Muntti; the last mentioned is known from lichen-covered branches of conifers. Oak species were, in addition to *Calocoris ochromelas*, *Pilophorus perplexus* (Doug-

las & Scott) found in Ruissalo, *Cylloceria histriónica* (Linnaeus) in Ruissalo, Lenholm, Tammimäki and Linnavuori, *Dryophilocoris flavoquadrimaculatus* (De Geer) in Nyyinäinen, *Phylus melanocephalus* (Linnaeus) in Ruissalo, Lenholm, Tammimäki and Kurasmäki, *Psallus mollis* (Mulsant & Rey) trapped at all sites except Tammimäki and Kurasmäki, *P. perrisi* (Mulsant & Rey) and *P. variabilis* (Fallén), which were found at most sites, and the most rare species, *P. wagneri* Ossianilsson trapped in Ruissalo.

Coleoptera

The most abundant beetles, among the 148 trapped species, were *Dorcatoma chrysomelina* Sturm (234 inds.), found at six sites, *Dromius agilis* (Fabricius) (81) at all seven sites, *Amischa nigrofusca* (Stephens) (81) all sites, *Hapalarea ioptera* (Stephens) (70) all sites, *Leptusa ruficollis* (Erichson) (57) only in Ruissalo, *Enicmus rugosus* (Herbst) (49) at six sites, *Amischa decipiens* (Sharp) (48) all sites and *Ptinus subpilosus* Sturm (46) at all sites. The following seven threatened species (see Rassi et al. 1992) were caught by branch traps: *Plectrophloeus nitidus* (Fairmaire) in Ruissalo and Nyyinäinen, *Plegaderus caesus* (Herbst) in Ruissalo, *Paromalus flavicornis* (Herbst) in Ruissalo, *Ampedus nigroflavus* (Goeze) in Nyyinäinen, *Priorynchus ater* (Fabricius) in Lenholm and Muntti, *Mycetochara humeralis* (Fabricius) in Ruissalo, Lenholm and Nyyinäinen, and *Scraptia fuscula* Müller in Ruissalo. According to Karhu et al. (1995), the last finding of *Paromalus flavicornis* from Ruissalo was made in 1948. Some other rare species were also trapped: *Quedius brevicornis* Thomson in Ruissalo and Nyyinäinen, *Pachyatheta mortuorum* (Thomson) in Lenholm, *Thamiaraea hospita* (Märkel) in Lenholm, *Euplectus kirbyi* Denny in Nyyinäinen, *Mycetophagus decempunctatus* Fabricius in Nyyinäinen and *Otiorhynchus singularis* (Linnaeus) in Ruissalo. Typical oak species included *Dromius quadrimaculatus* (Linnaeus) trapped at all sites except Nyyinäinen, *Xyletinus pectinatus* (Fabricius) in Ruissalo and Kurasmäki, *Coeliodes dryados* (Gmelin) in Kurasmäki and *Scolytus intricatus* (Ratzeburg) in Linnavuori and Muntti. In addition to the four listed oak species, the following six above-mentioned

beetles are also associated with oaks in Finland: *Dorcatoma chrysomelina*, *Leptusa ruficollis*, *Plectrophloeus nitidus*, *Plegaderus caesus*, *Paromalus flavicornis*, and *Thamiaraea hospita*.

Lepidoptera

The most abundant microlepidopterans among the 43 species found were two oak species, *Zeiraphera isertana* (Fabricius) (400 inds.), found at all sites, and *Psoricoptera gibbosella* (Zeller) (55) at all sites except Muntti. The following oak species were trapped rather abundantly: *Pammene argyrana* (Hübner) in Ruissalo, Lenholm, Nyyinäinen, Kurasmäki and Muntti, *Eriocrania subpurpurella* (Haworth) in Tammimäki, Kurasmäki and Muntti, *Ypsolopha ustella* (Clerck) in Ruissalo, Lenholm, Tammimäki and Muntti, and *Y. sylvella* (Linnaeus) in Lenholm, Tammimäki, Kurasmäki, Linnavuori and Muntti. Many typical oak species were caught only in low numbers by branch traps, such as *Tortrix viridana* (Linnaeus), *Tischeria ekebladella* (Bjerkander), *Acleris ferrugana* (Denis & Schiffermüller) and *Stenolechia gemmella* (Linnaeus). Rare microlepidopterans included *Klimeschiopsis kiningerella* (Duponchel) in Nyyinäinen and the oak species *Pammene splendulana* (Guenée) in Kurasmäki.

Of the 18 macrolepidopteran species trapped, *Amphipyra* specimens were found commonly. They are known to run rapidly, probably also on branches. *Amphipyra berbera* Rungs was the most abundant macrolepidopteran species found in Ruissalo, Lenholm, Nyyinäinen, Tammimäki and Linnavuori; the expansion species *A. perflua* (Fabricius) was caught in Nyyinäinen.

Formicidae (Hym.)

Altogether, 14 ant species were caught by branch traps. The most abundant insect species in traps, *Formica polyctena*, was very abundant in Ruissalo; it was also numerous in Linnavuori and Tammimäki. *Myrmica ruginodis* Nylander was also common and caught at most sites. Other frequently trapped species were *Formica rufa* Linnaeus, *F. fusca* Linnaeus and *Lasius niger* (Linnaeus). A little collected species, *L. mixtus* (Nylander),

was trapped in Ruissalo, Tammimäki and Kurasmäki.

4. Conclusions

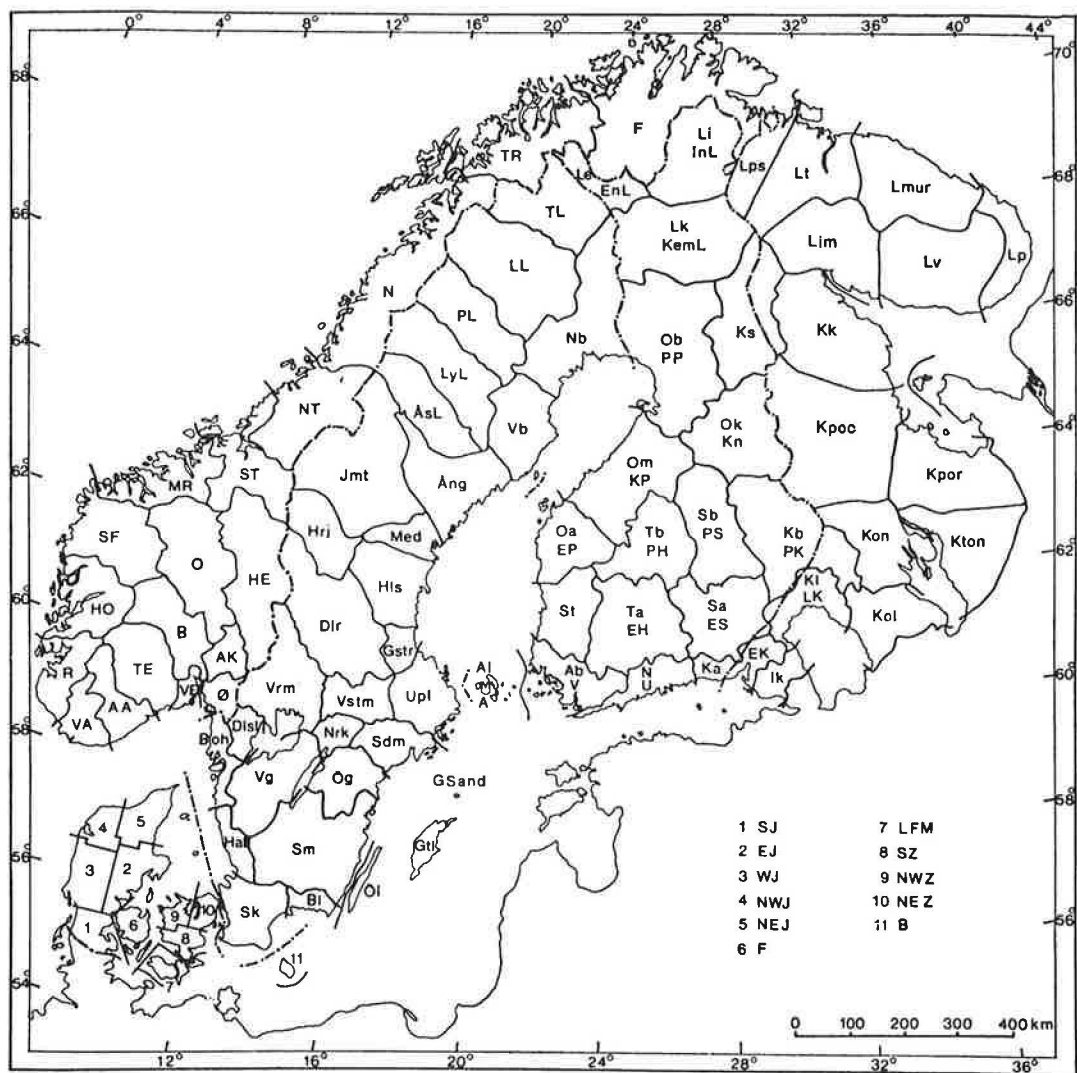
The number of typical oak-dwellers or rare southwestern species was highest in Ruissalo, the largest oak woodland in Finland. At other sites, the area of the oak forests studied (0.5–8 ha) had no marked effect on the total number of typical species and even in the smallest isolated forest the typical oak fauna was found. The highest species number for many groups was also found in Ruissalo, e.g. for Myriapoda, Araneae, Psocoptera and Heteroptera, but not for Oribatida and Coleoptera, where the highest diversity was observed in Lenholm and Nyynäinen, respectively.

The new trap is suitable for collecting groups moving on branches, although also flying insects were caught. For example, the psocopteran *Pseudopsocus fusciceps*, which has been found earlier very seldomly, was now caught in good numbers by the present traps (cf. Kanervo & Rinne 1996). The same was true for certain spiders (*Hypomma cornutum*), heteropterans (*Myrmedobia distinguenda*) and beetles (*Plectrophloeus nitidus* and *Leptusa ruficollis*). The combined use of the present trap and other trap types (e.g. window traps) is recommended when studying the total arthropod fauna of oak canopy (see Rinne et al. 1997).

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The biogeographical provinces of Fennoscandia and Denmark