Metsähallituksen luonnonsuojelujulkaisuja. Sarja A, No 131
Nature Protection Publications of the Finnish Forest and Park Service. Series A, No 131

Diversity studies in Koitajoki Area

(North Karelian Biosphere Reserve, Ilomantsi, Finland)

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METSÄHALLITUS

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Julkaisun sisällöstä vastaavat tekijät, eikä julkaisuun voida vedota Metsähallituksen virallisesna kannanottona.

ISSN 1235-6549
ISBN 952-446-325-3

Oy Edita Ab
Helsinki 2001

Cover picture:Veli-Matti Väänänen

ISO 14001 DNV SERTIFIOITU YRITYS

DOCUMENTATION PAGE

Published by
Metsähallitus

Date of publication
14.9.2001

Type of publication
Research report

Commissioned by

Date of assignment / Date of the research contract

Author(s)
Timo J. Hokkanen (editor)

Title of publication

Diversity studies in Koitajoki Area (North Karelian Biosphere Reserve, Ilomantsi, Finland)

Parts of publication

Abstract

The mature forests of Koitajoki Area in Ilomantsi were studied in the North Karelian Biosphere Reserve Finnish – Russian researches in 1993-1998. Russian researchers from Petrozavodsk (Karelian Research Centre) , St Petersburg (Komarov Botanical Institute) and Moscow (Moscow State University) were involved in the studies.

The goal of the researches was to study the biolgical value of the prevailing forest fragments.

An index of the value of the forest fragments was compiled. The index includes the amount and quality and succession of the decaying wood in the sites. The groups studied were Coleoptera, Diptera, Hymenoptera and aphyllophoraceous fungi.

Coleoptera species were were most numerous in Tapionaho, where there were over 200 spedies found of the total number of 282 found in the studies. Endangered coleoptera were presented by 14 species. The most important one was *Cyllodes ater*, a beetle only found twice in Finland and already thought to be extinct. *Monochamus urussovi* and *Orthotomicus longicollis* are considered vulneralble.

The reserches revealed 502 species of Diptera. Diptera studies were concentrated on the family Mycetophilidae, which is an important group in forest wood webs. Six of the species found were endangered. Of these *Pachyneura fasciata, Keroplatus tipuloides, Xylophagus ater ja Xylophagus junki* are considered vulnerable. As many as 82 of the species are new for Finland, seven of the species were new for Europe, and assumably there were several species new for science.

Total of 264 species of Hymenoptera were found. *Dolichomitus aciculatus, Dolichomitus terebrans, Odontocolon punctulatus, O. spinipes* ja *O. dentipes* are rare species. *Aniseres caudatus* is a species recently (1997) described for science in Russian Karelia.

Total of 170 species of polyporaceous fungi were found. The most species rich site was Tapionaho, which also had been studied most carefully. Total of 21 endangered species were found, and moreover, several species which have been recently described or are poorly known. *Polyporus pseudobetulinus* in considerd endangered, *Clavaria zolingeri, Diplomitoporus crustulinus, D. lindbladii, Haploporusodorus, Hericum clathroides, H. fragile, Hydnellum suaveolens, Polyporus badius* ja *Sceletocutis lenis* are vulnerable.

According to the studies Koitajoki area species diversity is high and especially Tapioanho area is very important from protection point of view.

Keywords

Mature forest, forest fragmentation, diversity, aphylloproraceous fungi, Coleoptera, Hymenoptera, Mycetophilidae

Other information

ISBN
952-446-325-3

Series (key title and no.)
Metsähallituksen luonnonsuojelujulkaisuja. Sarja A 131

ISSN
1235-6549

Pages	Language	Price	Confidentiality
217	English	80 FIM	Public

Distributed by
Metsähallitus
Natural Heritage Services

Publisher
Metsähallitus

KUVAILULEHTI

Julkaisija
Metsähallitus

Julkaisun päivämäärä
14.9.2001

Tekijät (toimielimestä: toimielimen nimi, puheenjohtaja, sihteeri)

Timo J. Hokkanen (toim.)

Julkaisun laji
Tutkimusraportti

Toimeksiantaja

Toimielimen asettamispvm

Julkaisun nimi

Eliölajiston monimuotoisuustutkimuksia Koitajoen alueella (Pohjois-Karjalan biosfäärialue, Ilomantsi, Suomi)

Julkaisun osat

Tiivistelmä

Ilomantsin Koitajoen alueen vanhojen metsien eliölajistoa tutkittiin 1993–1998 Pohjois-Karjalan biosfäärialueen suomalais – venäläisenä yhteistyönä, jossa oli mukana tutkijoita Petroskoista (Karjalan Tiedekeskus), Pietarista (Komarovin Kasviteteellinen Instituutti) ja Moskovasta (Moskovan valtionyliopisto).

Tutkimusten tavoitteena oli selvittää alueen vanhojen metsien pirstaleiden suojelubiologista arvoa.

Tutkimuksia varten kehitettiin metsien vertailua varten indeksi, jonka avulla arvioitiin metsien arvoa (lahopuun laatu ja määrä sekä lahopuujatkumo). Vanhojen metsien indikaattorilajeja tutkittiin ryhmistä kovakuoriaiset, kaksisiipiset, pistiäiset, käävät ja käävakkäät.

Kovakuoriaisia löydettiin yhteensä 282 lajia. Lajistollisesti monimuotoisin kohde oli Tapionaho, josta löytyi yli 200 lajia. Uhanalaisia kovakuoriaisia löytyi 14 lajia, joista merkittävin oli sukupuuttoon kuolleeksi luultu mustahälvekäs (*Cyllodes ater*). *Monochamus urussovi* ja *Orthotomicus longicollis* ovat vaarantuneita lajeja.

Kaksisiipisiä löytyi tutkimuksissa yhteensä 502 lajia. Tutkimusten painopiste oli sienisääskissä, jotka ovat merkittäviä vanhan metsän ravintoketjuissa. Kuusi lajeista on uhanalaisia: vaarantuneita lajeja olivat *Pachyneura fasciata, Keroplatus tipuloides, Xylophagus ater ja Xylophagus junki.* Löydetyistä lajeista 82 oli Suomella uusia, seitsemää ei ollut löydetty ennen Euroopassa ja todennäköisesti tieteelle uusia lajeja on useita.

Pistiäisiä löydettiin yhteensä 264 lajia. Harvinaisia lajeja olivat *Dolichomitus aciculatus, Dolichomitus terebrans, Odontocolon punctulatus, O. spinipes* ja *O. dentipes. Aniseres caudatus* on laji, joka on kuvattu tieteelle uutena Venäjän Karjalasta v. 1997.

Kääpiä löydettiin yhteensä 170 lajia ja runsaslajisin paikka oli Tapionaho, joka oli myös intensiivisimmän tutkimuksen kohteena. Erittäin uhanalaisia lajeja löytyi yksi, *Polyporus pseudobetulinus. Clavaria zolingeri, Diplomitoporus crustulinus, D. lindbladii, Haploporusodorus, Hericum clathroides, H. fragile, Hydnellum suaveolens, Polyporus badius* ja *Sceletocutis lenis* on luokiteltu vaarantuneiksi lajeiksi. Yhteensä uhanalaisia lajeja löytyi 21, sekä lisäksi useita lajeja jotka on kuvattu vasta äskettäin tai joiden levinneisyys on huonosti tunnettu.

Tutkimusten perusteella Koitajoen alue on eliölajistoltaan monipuolinen ja etenkin Tapionahon alue suojelun näkökulmasta erittäin arvokas.

Avainsanat
Vanha metsä, pirstoutuminen, diversiteetti, käävät ja käävakkäät, kovakuoriaiset, pistiäiset, sienisääsket

Muut tiedot

ISBN
952-446-325-3

Sarjan nimi ja numero
Metsähallituksen luonnonsuojelujulkaisuja. Sarja A 131

ISSN
1235-6549

Kokonaissivumäärä
217

Kieli
Englanti

Hinta
80 mk

Luottamuksellisuus
julkinen

Jakaja
Metsähallitus, luonnonsuojelu

Kustantaja
Metsähallitus

PRESENTATIONSBLAD

Utgivare Forststyrelsen	Utgivningsdatum 14.9.2001
Författare (uppgifter om organet, organets namn, ordförande, sekreterare) Timo J. Hokkanen (red.)	Typ av publikation Forskningraport Uppdragsgivare Datum för tillsättandet av organet

Publikation
Studier i biologisk mångfald i Koitajoki (Norra Karelens biosfärsområde, Ilomantsi, Finland)

Publikationens delar

Referat

Åren 1993–1998 undersöktes artstrukturen i Koitajokiområdets gamla skogar inom det nordkarelska biosfärområdet i Ilomants. Arbetet utfördes i form av ett finländskt – ryskt samarbete i vilket forskare från Petroskoi (Vetenskapliga centralen i Karelen), S:t Petersburg (Komarovs botaniska institut) och Moskva (statsuniversitetet i Moskva) deltog.

Syftet med undersökningarna var att utreda det skyddsbiologiska värdet hos spillrorna av gammal skog i området.

För att kunna utföra jämförelser mellan bestånden av gamla skogar i samband med undersökningarna utvecklades ett särskilt index. Med hjälp av indexet utvärderades skogarnas kvalitet (kvalitet och volym död ved samt den döda vedens kontinuitet). I grupperna skalbaggar, tvåvingade, steklar, tickor och svampar av släktet Aphyllophorales undersöktes indikatorarter för gamla skogar.

Sammanlagt 282 arter skalbaggar påträffades. Den största mångfalden i arthänseende fanns i Tapionaho-området, där över 200 arter påträffades. 14 hotade arter av skalbagge påträffades, den mest remarkabla var den svarta kalglansbaggen (*Cyllodes ater*) som redan troddes vara utdöd. *Monochamus urussovi* och *Orthotomicus longicollis* är sårbara arter.

Under undersökningarna påträffades sammanlagt 502 arter av tvåvingar. Tyngdpunkten för undersökningarna låg på svampmyggor, som har stor betydelse i den gamla skogens näringskedja. Sex av de påträffade arterna är hotade: *Pachyneura fasciata, Keroplatus tipuloides, Xylophagus ater och Xylophagus junki* är sårbara arter. Av de påträffade arterna är 82 nya i Finland, sju arter har inte tidigare påträffats i Europa och sannolikt är många arter nya för vetenskapen.

Av steklar påträffades sammanlagt 264 arter. Till de rara arterna hörde *Dolichomitus aciculatus, Dolichomitus terebrans, Odontocolon punctulatus, O. spinipes och O. dentipes. Aniseres caudatus* är en art som har beskrivits som ny för vetenskapen i Karelska republiken år 1997.

Av tickor påträffades sammanlagt 170 arter. Artrikast var också för tickornas del Tapionaho-området, som också var föremål för de intensivaste undersökningarna. En starkt hotad art påträffades, *Polyporus pseudobetulinus. Clavaria zolingeri, Diplomitoporus crustulinus, D. lindbladii, Haploporusodorus, Hericum clathroides, H. fragile, Hydnellum suaveolens, Polyporus badius och Sceletocutis lenis* har klassificerats som sårbara arter. Sammanlagt påträffades 21 hotade arter. Därtill kommer många arter som först nyligen har beskrivits eller för vilkas del det ännu råder kunskapsbrist om deras spridning.

Utgående från resultaten av de utförda undersökningarna konstateras att Koitajokiområdet har en mångsidig artstruktur och att särskilt Tapionaho-området är synnerligen värdefullt ur skyddssynpunkt.

Nyckelord
Gammal skog, splittring, diversitet, tickor och Aphyllophorales-arter, skalbaggar, steklar, svampmyggor

ISBN
952-446-325-3

Seriens namn och nummer Metsähallituksen luonnonsuojelujulkaisuja. Sarja A 131		ISSN 1235-6549	
Sidoantal 217	Språk engelska	Pris 80 mk	Sekretessgrad offentlig
Distribution Forststyrelsen, naturskydd		Förlag Forststyrelsen	

PREFACE

The North Karelian Biosphere Reserve was accepted to UNESCO's Biosphere Reserve Programme in November 1992. The said programme is a part of UNESCO's MaB (Man and the Biosphere) Programme. The fundamental goal of this programme is to promote sustainable development, which means efforts directed at applying ecological knowledge to everyday life and to seek a balance between nature and economic development. The primary principles of the Biosphere Reserve Programme are scientific research, comprehensive collaboration, and nature conservation. The co-operative units engaged in this activity are local, regional, national and international. The fundamental role of research is emphasised in the goal of the programme: a sustainable solution needs to be found both in terms of ecology and economy.

The operational office of the North Karelian Biosphere Reserve is located in Ilomantsi, eastern Finland, within the premises of the University of Joensuu Research Station at Mekrijärvi. Seamless co-operation between the Biosphere Reserve's researchers and those employed at Mekrijärvi Research Station provides the backbone of research.

Metsähallitus is entrusted with the care of about 60 % of the forests lying within the bounds of the North Karelian Biosphere Reserve. Indeed, Metsähallitus has been a natural, and proactive, partner in the Biosphere Reserve's biological studies dealing with forests. Metsähallitus, the Ministry of the Environment, the Regional Environment Agency of North Karelia, the Ministry of Labour (Ilomantsi branch office), and the University of Joensuu's Mekrijärvi Research Station have borne the responsibility for the funding of research.

The Republic of Karelia (Russian Federation) lies just across the border. The University of Joensuu and the Regional Environment Agency of North Karelia have established good relationships with the Karelian Research Centre of the Russian Academy of Sciences (Petrozavodsk, Republic of Karelia). Thanks to these contacts, the Karelian Research Centre has become an important partner representing Russia. Especially scientists from the Institute of Forestry and Institute of Biology have been engaged in the Biosphere Reserve's projects. Contacts with Petrozavodsk have broadened the network of actors from Petrozavodsk to include Moscow and St Petersburg. The number of working days in Mekrijärvi has been about 400, both in 1995 and 1996.

This report deals with the species diversity of insects, polyporaceous fungi, vascular plants, mosses and lichens. These studies, the first ever conducted within the bounds of the North Karelian Biosphere Reserve, have involved both practising of co-operation and carrying out ecological inventories. The goals of the research, methods and reporting have undergone several changes during the past three (four) years, but we believe that this report – despite its shortcomings – will be of importance when evaluating the role of the old-growth forests studied.

Research would not have been possible without the involvement of all the aforementioned organisations. The work done has been successful both in the field and in the laboratory. It has required skills of adaptation from everyone – however – learning about different cultures is enriching. Good team spirit and positive approach towards common goals has been preserved throughout the project.

The research dealt with here is the first in the history of the North Karelian Biosphere Reserve, especially as regards international collaboration. All the parties that have participated in these studies deserve to be congratulated. This is a promising beginning.

Timo J. Hokkanen
Co-ordinator
North Karelian Biosphere Reserve

CONTENTS

1 THE DILEMMA OF KOITAJOKI AREA IN A NUTSHELL
Timo J. Hokkanen 13
1.1 Establishment of Koitajoki National Park, Finnish part 13
1.2 Establishment of Koitajoki National Park, Russian part 14
1.3 North Karelian Biosphere Reserve and co-operation with Russian researchers 15
1.4 International Karelian Biosphere Reserve and sustainable development in cross-border areas 15
1.5 Brief history of biodiversity studies in Koitajoki area 16
1.6 Focal points of the study and the structure of this report 17
References 17

2 DESCRIPTION OF STUDY SITES AT KOITAJOKI AND BASIC INVENTORY METHODS *Timo J. Hokkanen and Ville Vuorio* 18
2.1 Introduction 18
2.2 Research outline 18
2.3 Site descriptions 20
2.4 Study sites 24
2.4.1 Tapionaho A 24
2.4.2 Tapionaho B 24
2.4.3 Tapionaho C 25
2.4.4 Tapionaho D 25
2.4.5 Tapionaho E 25
2.4.6 Tapionaho F 26
2.4.7 Niemijärvi 26
2.4.8 Koitajoki 26
2.4.9 Lahnavaara 27
2.4.10 Mökkilampi 1 and Mökkilampi 2 27
2.4.11 Pampalo (slope) 28
2.4.12 Pampalo 28
2.4.13 Pirhunvaara 29
2.4.14 Other sites 29
2.5 Trapping and inventory methods 29
2.5.1 Diptera and Hymenoptera 29
2.5.2 Coleoptera 29
2.5.3 Polyporaceous fungi 30
References 30

3 SAPROXYLIC COLEOPTERA OF UNMANAGED MATURE FORESTS IN KOITAJOKI AREA *Evgeny Yakovlev, Nikolai Nikitsky and Alexander Scherbakov* 32
3.1 Introduction 33
3.2 Study area, material and methods 33
3.2.1 Site descriptions 33
3.2.2 Trapping methods 36
3.2.3 Identification and taxonomic coverage 38

3.2.4 Statistical methods ... 38
3.3 Results and discussion ... 38
3.3.1 Numbers of species and individuals caught ... 38
3.3.2 Species-richness and species-diversity of Coleoptera on the study sites ... 42
3.3.3 General synecological analysis of the beetle fauna of study area ... 46
3.3.4 A comparison of two methods of sampling with ecological notes on certain species of saproxylic beetles collected more effectively by means of polypore traps ... 50
3.3.5 Inter-year fluctuations of beetle catches ... 57
3.3.6 Occurrence of potential forest pests in the study area ... 59
3.3.7 Occurrence of threatened beetle species in the study area ... 62
3.3.8 Conclusions ... 66
3.4 Acknowledgements ... 67
References ... 67

4 THE STUDY OF FOREST DIPTERA FAUNA IN KOITAJOKI AREA *Alexei Polovoi* ... 72
4.1 Introduction ... 72
4.2 Material and methods ... 73
4.2.1 Study area ... 73
4.2.2 Sampling methods ... 73
4.2.3 Identification and taxonomic coverage ... 73
4.2.4 Data analysis ... 73
4.3 Results ... 74
4.3.1 Species composition in general ... 74
4.3.2 New elements in regional fauna ... 77
4.3.3 Endangered species ... 77
4.3.4 The effect of forest structure on species composition ... 78
4.4 Discussion ... 81
4.4.1 Species composition ... 81
4.4.2 Endangered species ... 81
4.4.3 The effect of site structure on species diversity and composition ... 81
4.5 Conclusion ... 82
4.6 Acknowledgements ... 82
References ... 83

5 OCCURRENCE OF HYMENOPTERA APOCRITA WITHIN THE NORTH KARELIAN BIOSPHERE RESERVE 1993–1996 *Andrei Humala* ... 86
5.1 Introduction ... 86
5.2 Materials and methods ... 87
5.2.1 The study area ... 87
5.3 Results ... 88
5.4 Discussion ... 88
5.5 Conclusions ... 89
References ... 90

6 STUDIES ON APHYLLOPHORACEOUS FUNGI IN NORTH KARELIAN BIOSPHERE RESERVE 1993–1996 *Margarita Bondartseva, Vera Lositskaya, Timo J. Hokkanen and Vitali Krutov* ... 91
6.1 Introduction ... 91
6.2 Materials and methods ... 92
6.3 Results ... 94
6.4 Discussion ... 97
6.4.1 Characteristics of distribution of studied aphyllophoraceous fungi in different types of forest ... 100
6.4.2 Characteristics of aphyllophoraceous fungi in different sites ... 100
6.4.3 Characterisation of study sites ... 102
6.5 Conclusions ... 109
6.6 Acknowledgements ... 110
References ... 110

7 KOITAJOKI AREA: AN OASIS OF BIODIVERSITY OR WORTHLESS FRAGMENTS OF MATURE FOREST? *Timo J. Hokkanen* ... 112
7.1 Introduction ... 112
7.2 Insects ... 112
7.2.1 Coleoptera (Yakovlev et al., in this publication) ... 112
7.2.2 Diptera (Polevoi, in this publication) ... 114
7.2.3 Hymenoptera (Apocrita) (Humala, in this publ.) ... 115
7.2.4 Polyporaceous fungi (Bondartseva et al., in this publ.) ... 116
7.3 Summary of inventories on the best sites and some future prospects ... 117
7.4 Old-growth forests at Koitajoki: Jewels in the crown or mediocre leftovers? ... 119
7.5 Acknowledgements ... 122
References ... 122

APPENDICES
Appendix 1 Forest stand description form. ... 125
Appendix 2 Sample sites' growing stock and field inventory data ... 126
Appendix 3 Maps of sudy sites ... 134
Appendix 4 A list of Coleoptera species collected with window and polypore traps on all the sample sites in Koitajoki area in 1993–1995 ... 182
Appendix 5 List of Diptera, collected within Koitajoki area during the study period (1993–1996). ... 191
Appendix 6 List of Hymenoptera, Apocrita species collected within the North Karelian Biosphere Reserve with Malaise traps in 1993–1996 ... 204
Appendix 7 List of aphyllophoraceous fungi ... 211

1 THE DILEMMA OF KOITAJOKI AREA IN A NUTSHELL

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Abstract

The issue of nature conservation has been of current interest in the Koitajoki area for about 20 years. Nature conservation and the consequent changes in land-use in traditional hunting and fishing areas, for example, have been considered to constitute violations of the basic rights of the local people and their way of living. Nature conservation is also reducing the scope of forestry at Koitajoki and thereby undermining traditional means of living. The severe counter-reaction against conservation is largely due to drastic overall decrease in habitats, especially forests. What remains of the forests is considered irreplaceable for a number of reasons. The resistance to change in the status and scope of protected areas can, thus, also be considered a reaction against changes in the means of living and structure of rural communities. These changes, however, are not outcomes of nature conservation.

This chapter provides background information about the situation at Koitajoki and outlines the structure of the Koitajoki diversity studies.

1.1 Establishment of Koitajoki National Park, Finnish part

A committee report on the protection of old-growth forests in Finland was published in 1992 (Vanhojen metsien suojelutyöryhmä 1992). The report dealt only with state-owned land, and immediately gave rise to a substantial counter-reaction in eastern Finland, where the projected new nature reserves had been pinpointed. However, the absolute size of the reserves was quite small.

The early 1990s also witnessed a bitter ”quarrel” about developing the nature reserves in the easternmost corner of the Ilomantsi municipality, within the Koitajoki area. A plan was created to unite a number of nature reserves to form a new national park. These reserves have been subject to different levels of protection; i.e. Koivusuo Strict Nature Reserve, which has been set aside solely for scientific research, mire reserves allowing such practising of forestry as does not disturb mire ecosystems, and proposed old-growth forest reserves. Uniting these different types of reserves would create a reasonably large conservation unit, which would be far easier to deal with than separate smaller reserves under different protection statuses. This solution would be good from the biological point of view, too, but it would also facilitate easier access to the area and act as a lure for tourism.

A preliminary decision about creating a new national park was taken in 1993. So far, this process has been exceptional in the history of Finnish nature conservation: the idea of creating a new national park had been developed and accepted in mutual discussions between the municipality of Ilomantsi and Metsähallitus, without any major discrepancies. Had it been successful, it would have served as a good example of how to proceed with nature conservation in a biosphere reserve: co-operation and understanding are the driving forces for locally acceptable solutions in conservation issues. It will be noted that the Metsähallitus is entrusted with the management of all the land proposed to be included in the national park, and it could therefore have created the national park through internal decisions. Because the Metsähallitus is a major local player, it has wanted to take decisions that enjoy wide local approval. The forests belonging to the North Karelian Biosphere Reserve are mainly under the jurisdiction of the Metsähallitus. The biosphere reserve nomination form (1991 notes that the government owns 60 % of the forests belonging to the reserve.

Soon after these plans were made public, the Regional Nature Conservation Association suggested that a substantially larger national park be created within the Koitajoki area. This triggered widespread, local opposition to the whole idea of creating a new national park. Thus, the process reached the ”normal” state of affairs: there are clear antipodes – the environmentalists demanding a larger national park and the other party requiring a smaller one. The third party, in this case, represents a kind of a counter-reaction to the environmentalists' demands and calls for every effort to be taken to bury plans for a new national park, to the extent that even existing nature reserves should be restored to commercial forestry use.

1.2 Establishment of Koitajoki National Park, Russian part

Simultaneously with the above, intensive mire and vegetation studies were carried out in the neighbouring Republic of Karelia (Russian Federation) in the vicinity of Koitajoki River, and adjacent to the proposed Koitajoki National Park in Finland. The aim of these studies was to bring about a nature reserve called ”Koitajoki” on the Russian side of the border. In 1994, a decision was taken in the Republic of Karelia to create Koitajoki National Park within 10 years. The proposed national park will be 34 000 ha in area.

1.3 North Karelian Biosphere Reserve and co-operation with Russian researchers

The acceptance of the North Karelian Biosphere Reserve to the UNESCO Man and Biosphere (MaB) Programme in late 1992 happened at a very difficult time. Anything connected to nature conservation was due to be rejected at the local level. At the provincial level, the beginning was, however, smooth. The new biosphere reserve, although mostly an unknown entity as regards its organisation, was accepted as an opportunity to increase mutually beneficial scientific co-operation between Russia and Finland. In the field of biological sciences, there was already a tradition of co-operation which could only be strengthened. The Vaara-Karjala Park Group formed by the Metsähallitus, the University of Joensuu (Mekrijärvi Research Station), the North Karelian Biosphere Reserve, and the Karelian Research Centre based in Petrozavodsk (Republic of Karelia, Russian Federation) decided to launch biodiversity studies in the Koitajoki area. A three-year programme was created for this purpose and it was approved as a joint effort between the University of Joensuu and the Karelian Research Centre.

1.4 International Karelian Biosphere Reserve and sustainable development in cross-border areas

The creation of a new national park on the Finnish side of the Finnish-Russian border around the existing Koivusuo Strict Nature Reserve and Koitajoki River, with the park extending along the river until the border, would be a remarkable achievement. This would mean the establishment of an extensive nature conservation unit on the other side of the border, and together these two national parks would form a very interesting and significant forest, mire and river conservation complex, and one that would be outstanding in the context of Europe as a whole.

From the scientific point of view, the area is extremely valuable because the land-uses on the two sides of the border have been very different during the past 50 years. On the Finnish side, forestry has been practised in a highly mechanised and efficient form, and management of the forests has extended throughout the area right up to the border zone. Forest roads intersect the area creating a mosaic of small forest fragments, with only a fraction of the forests being still in the natural state. The mires have been largely drained for forestry and partly for fuel-peat production. Mires in their natural state are rare outside the nature reserves.

On the Russian side, the border zone has been under the strict supervision of the central administration in Moscow, and laws concerning the border zone have prevented almost all economic development. Thus, border zone area has developed ”naturally” since World War II, and in effect they have been under conservation without any actual conservation measures having been implemented. It is quite remarkable, thus, that we should have neighbouring areas under totally different management regimes. Recent measures adopted in Russia have ensured that there will be nature reserves near the border in the future, too. Several national parks will be established, the smallest of them being over 30 000 ha in area. For comparison, the total area of the protected core zone in the North Karelian Biosphere Reserve is 14 200 ha.

Moreover, recent efforts to create a zone of nature reserves along the long border between Finland and Russia emphasise the importance of mutual efforts in biological research along the border zone. This conservation plan is better known as the ”Green Belt”, and it was first mentioned officially by Titov et al. (1995). The idea of the Green Belt is now being promoted on high administrative levels in the Republic of Karelia and in Finland, and the conservation value of this kind of a set of nature reserves is widely accepted. The practical meaning of the Green Belt is, however, still to be developed. It is clear that research will benefit, but also the goal of sustainable development can be promoted. The Regional Council of North Karelia, in connection with a planning session held in Petrozavodsk in early December of 1996, adopted as its environmental goal the creation of an internationally recognised model area for sustainable development in the border zone between North Karelia (Finland) and the Republic of Karelia (Russia). This plan is a part of the Atlantic–Karelian Corridor participated in by Norway, Sweden, Finland and the Republic of Karelia (Russian Federation).

1.5 Brief history of biodiversity studies in Koitajoki area

The beginning of research in 1993 took place amidst overheated feelings for and against Koitajoki National park, as well as old-growth forests. Detailed information was needed for backing up the decisions about the prospective nature reserves, as well as about the biota of already existing reserves.

From the very beginning, it was clear that detailed research takes several years, because insect studies especially are very time consuming and need specific professional skills on part of the researchers. An agreement concerning the programme for co-operation with Karelian Research Centre was entered into for a period of five years.

The first research sites were selected to represent the best of the sites, and ones that could be reached with reasonable effort for continuous monitoring of the traps. Tapionaho area south from Koitajoki, near the Hanhisuo–Ruosmesuo mire reserve, was selected for the first studies. Coleoptera, fungus gnats, ichneumonid wasps and polyporaceous fungi were the subjects of research. Studies were also started in Pirhunvaara (Koivusuo Strict Nature Reserve) near the former forest-ranger’s house. This site served as a control for fungus gnat and hymenopteran studies. By the end of 1997, the studies had been extended to all parts of Koitajoki area.

1.6 Focal points of the study and the structure of this report

The joint programme with the Russian party has been formulated to consist of biodiversity studies within the North Karelian Biosphere Reserve. The focal points have been selected to satisfy both parties. The broad goals, the details of which have diversified along the years, have been defined as

1. Extensive diversity studies in Koitajoki area (scientific goals)
2. Background data for decision-makers for nature conservation issues (developmental and administrational goals), e.g. regional ecological planning
3. Better knowledge and understanding oft biota in the North Karelian Biosphere Reserve (goals for developing the biosphere reserve)

This report has been structured to cover the diverse aspects of the studies. All its chapters can be read also as independent articles. Chapter 1 is introductory, and gives the background to and general framework of the studies. Chapter 2 states briefly what has been done and how, and gives descriptions of the sites. Chapters 3–6 are devoted to the original articles. Chapter 7 summarises the results and evaluates the situation in the Koitajoki area from the biological standpoint.

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2 DESCRIPTION OF STUDY SITES AT KOITAJOKI AND BASIC INVENTORY METHODS

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2.1 Introduction

Research at Koitajoki began in 1993 with basic inventories focusing on various groups of organisms in the surroundings of Tapionaho (Figure 2.1), to the south of the Ruosmesuo–Hanhisuo mire reserve. In 1994 and 1995, the inventories were extended to nearby sites along the river. Some groups of organisms were studied on a couple of reference sites, e.g. Pampalo, an exceptional site north of Hattuvaara village, as well as on some managed forests and in Pirhunvaara within the Koivusuo Strict Nature Reserve.

The studies of various groups of organisms have varied somewhat from year to year. This chapter described the sites and the basic methods used in the inventories so as to provide an outline of the course of the research. More detailed treatments of each group of organisms are given in Chapters 3–6.

2.2 Research outline

1993: The first study sites were selected to represent the best sites, which can also be reached with reasonable effort for continuous operation of intensive trapping. Tapionaho area south of Koitajoki, near the Hanhisuo–Ruosmesuo mire reserve, was selected for the first studies. Coleoptera, fungus gnats, ichneumonid wasps and polyporaceous fungi were studied. Studies were started also in Pirhunvaara (Koivusuo Strict Nature Reserve) near the former forest-ranger's house. This site served as a control for fungus, gnat and hymenopteran studies. Polyporaceous fungi were inventoried also in Lahnavaara and in Kitsi (extensive forest fire area).

1994: The results from 1993 showed, as expected, that the sites selected using more ecological reasoning are good for diversity studies. Several endangered species of Coleoptera and polypores were found, and thus it was reasonable to continue the studies in Tapionaho. Cutting of adjacent forest sections in Tapionaho also urged to continue – the effects of cuttings needed to be studied immediately. Pirhunvaara and the burned forest site at Kitsi were also studied.

1995: In 1995, the insect studies were extended to other sites (Niemijärvi, Koitajoki and Lahnavaara), but only two sites at Tapionaho were studied. Polypores were inventoried, in addition to the aforementioned sites, also in the surroundings of Hoikka-Syväjärvi and Kitsi forest-fire area. Autiovaara in Patvinsuo National Park was sampled once as a reference site.

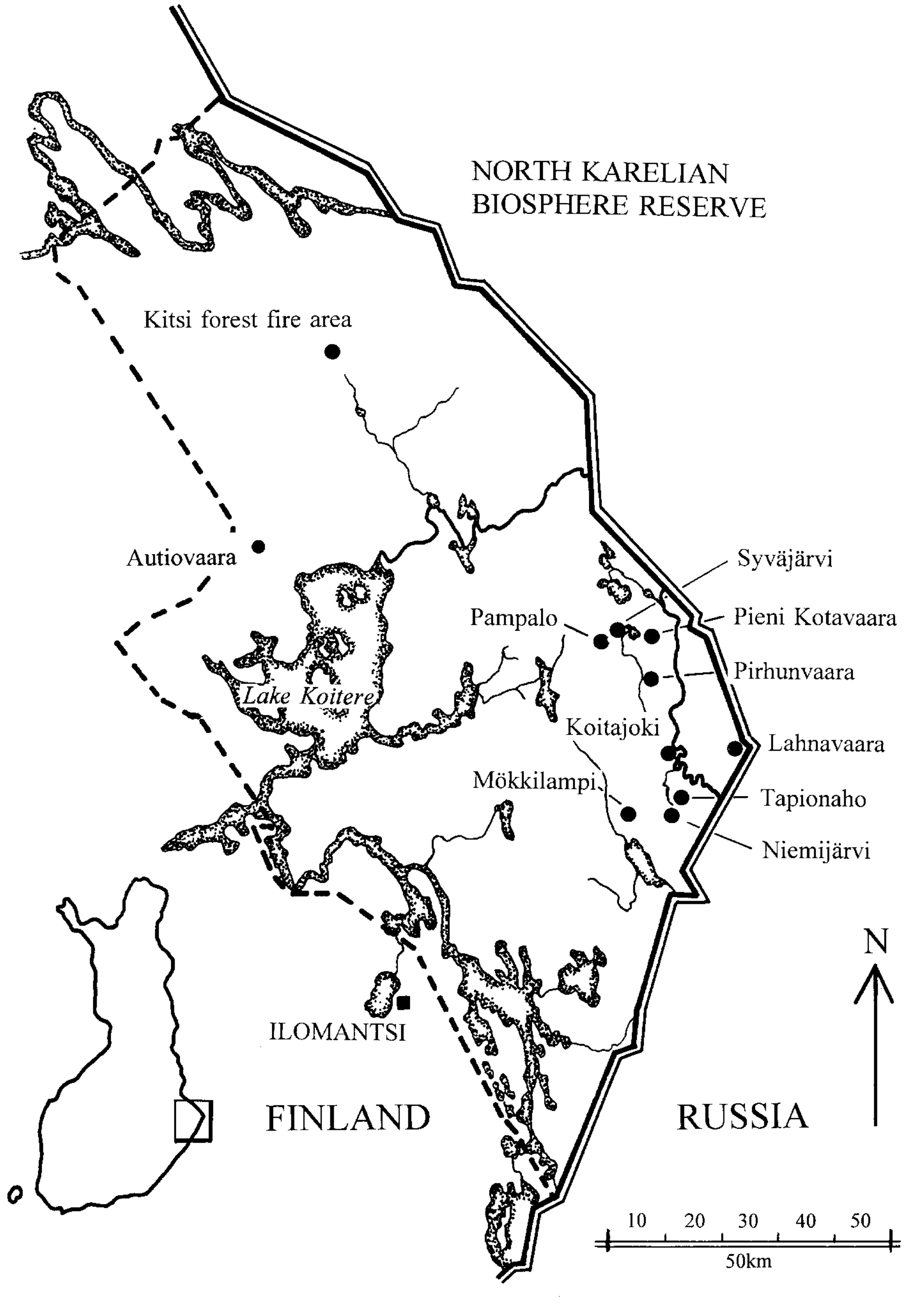

Figure 2.1. Study sites within the North Karelian Biosphere Reserve.

A comparison of polypores in managed and natural forest stands was performed around the Tapionaho area.

1996: Pampalo old-growth forest site and some sites to the north of the Koivusuo Strict Nature Reserve were sampled for polypores and insects. All sites – except Lahnavaara – were described to compare the succession of decomposing wood.

2.3 Site descriptions

General remarks: All the study sites – except Lahnavaara – were described using the field form presented in Appendix 1. The form was created and tested for characterising forest stands, which have been left unmanaged for a longer period of time (old-growth forest, pristine forests). The form was designed to emphasise features not fully expressed in conventional forest descriptions used for forestry purposes. The forestry information (stand description) and our data are thus complementary, and reveal some of the conservation values of the stands. The information is meant to be used together with the data obtained from other inventories (vegetation, insects, polyporaceous fungi).

The description procedure was as follows: The site was studied by referring to maps (stand descriptions), aerial photos, and data provided by previous inventories (if available). This was followed by walking through the sites in the field to find and pre-check the obviously best sites. Thus the key sites and the best (core) areas within them could be determined for the studies. If the studied site was large enough, several core areas were defined; in the case of minor sites, only one core area was chosen. Detailed inventories were performed only in selected core areas (results presented in Appendix 2).

Fallen trunks and degree of decomposition. Special emphasis was placed on fallen trunks in different stages of decomposition. The number of fallen trunks (minimum diameter 5 cm) was counted from two or three 20x50 m plots, and the number and proportions of tree species per hectare were computed. Also, the diameter of tree trunks, their degree of decomposition, and the succession of different stages of decomposition were estimated and recorded.

The degree of decomposition was estimated by a three-step classification with help of a knife: (i) a freshly fallen tree is hard and the blade of the knife can hardly be made to penetrate it; (iii) an old tree is highly decomposed and the blade of the knife penetrates it easily; stage (ii) is between these two.

Succession of decomposing wood was explained as follows: if there was a continuous series of different size classes and of different degrees of decomposition, succession was defined 1–3. In situation 2–3, trees in their early stages of decomposition were absent, but there were highly decomposed trees present. In situation 1–2, only quite recently fallen trunks were present.

Index of succession of decomposition: A specific index describing the general situation of decomposing wood was drawn up to enable the comparison of sites. This index incorporates all the considered measures about dead and decomposing trees for all the tree species present on a site.

The theoretical range of variation for between one and four tree species is 1–36; 1 denotes a site with, for example, only one fallen trunk (or a few trunks of same degree of decomposition) present. The index value 36 denotes a site where the four tree species are present and each showing all stages of decomposition, and the total number of visible fallen trunks is over 250 per ha.

The index was computed as follows (Renvall 1989):

1. Degree of decomposition: 1–6 points for each tree species

6 points	= All degrees of decomposition (1 to 3) present
4 points	= Trees demonstrating only decomposition degrees 2 and 3
2 points	= Trees demonstrating only decomposition degrees 1 and 2
1 point	= Tree demonstrating only one degree of decomposition (1, 2 or 3)
(0 point	= No decomposing trees present)

The points were summed up for each site to cover all the tree species with necromass; e.g. a good site with three tree species demonstrating decay and all degrees of decomposition got 18 points. The tree species considered in these computations were spruce, pine, birch and aspen.

Background: The full scale of degrees of decomposition indicates a good situation where there is a lot of specific niches for organisms requiring different types of substrates. This situation was accordingly valued at 6 points. A situation with only old and rather old decaying trees present indicates a discontinuation of succession in decaying trees in absence of young fallen trunks. This situation is, however, quite easy to rectify by, for example, felling trees or carrying trunks to the area from elsewhere (e.g. aspen). Such a situation was given a score of 4 points. If only freshly fallen trees were present, there is no reasonable means of rectifying the situation. It is impossible to bring old, decomposing trees to the site soon enough. This situation was given a score of 2 points. If only one degree of decomposition was present, it meant a serious discontinuation in the decomposition series – it was, nevertheless, given a score of 1 point (better than nothing).

A diverse site has several tree species present and all of them would be given points according to the same system.

2. Number of dead trunks per hectare: sites with a high number of dead, fallen trunks got a higher coefficient than sites with a low number of trunks; the range of the coefficient was between 1.0 and 1.5

Coefficient	Explanation	
1.0	Less than 70	fallen, dead trunks per ha
1.1	70–100	–″–
1.2	101–150	–″–
1.3	151–200	–″–
1.4	200–250	–″–
1.5	More than 250	–″–

Background: Classification based only on the degree of decomposition did not provide adequate segregation between sites, especially in cases where there was a great difference in the number of dead, fallen trees. This drawback was alleviated by using a coefficient for sites having a great number of dead trees.

The classification was designed to reveal the variation in the studied forests. As background data for these studies, data was collected simultaneously from over 40 sites in Northern Karelia (Valtimo, Nurmes, Lieksa, Ilomantsi). Literature data (Sirén 1955, Kubin 1981) gives the number of dead fallen trunks per hectare as being as high as 750–800 at the end of primary succession in spruce stands. Junninen (1996) has also counted fallen trunks, and in her results old-growth forests contained about 300 trunks per ha, and even managed forests left untouched for 80 years or so contained about 100 trunks per ha. None of our stands were near the end of succession. Despite possible differences in the methods used, the difference between 800 and 300 trunks could be too great to be true. The highest number of fallen trunks per ha in these studies was about 300, and without doubt these forests represent, at present, noteworthy sites where the succession of decomposing trees is adequate.

The index of succession of decomposition could, therefore, differ for three sites having all degrees of decomposition of the four tree species from 24 to 36.

Specific features of site: All the stands were also studied for their specific features. These include variation in small-scale topography, sheltered depressions, tiered structure of the canopy, windthrows, moist and luxuriant spots, brook banks, seepage areas, swampiness, and cliffs. All these features may have great local influence on (bio)diversity.

Adjacent areas: In addition to these, the nature of adjacent areas has also been described. These data are important in planning the use of the inventoried areas, because the state of an area's nature is also dependent on the nature management applied in nearby areas; e.g. drainage of mires or clear-cutting of adjacent forests inevitably impairs the ecological state of target areas.

Stand history: These data describe the influence of man on stand development. The traces of forest fires have also been recorded. If indications of slash-and-burn cultivation have been found, these are mentioned separately. This presupposes signs of notches in the burnt stumps or in standing dead pine trunks. Also, thinning, ring-barking or notching of aspen, cleaning or modification of brooks for timber floating, feeding sites of elks, and other such activities influencing the natural state of the site have been described. Also, natural disturbances, such as beaver activity, have been recorded.

Stand height, volume of standing crop and stand age: Measurements of tree height and volumes of standing crops (m^3) and stand age have been recorded from the Metsähallitus's stand descriptions. If the height of several tree species has been included in the data, the height of the dominant species – usually spruce – has also been recorded.

Living trees: The proportions of different tree species of the stand's living trees has been recorded. All trees with diameter at breast height (dbh) over 5 cm have been included. The average dbh has been estimated per tree species, as well as minimum and maximum dbh.

Dead, standing trees: the number of dead standing trees was estimated by tallying them on two or three plots measuring 20x50 m per site.

2.4 Study sites

2.4.1 Tapionaho A

Tapionaho A (Grid 27°E) (see map, Appendix 3) is a moist spruce stand situated on a northern slope descending to a mire. There are indications of forest fires and selection cuttings. Spruce is the predominant tree species. The trees are old – around 160 years – and thick, with diameters up to 40 cm. Also large aspens and pines are present.

Fallen trunks: The number of fallen trunks is at its densest 300 per ha. Fallen trunks are mainly those of spruce and birch, only a few pines can be found. The succession of decomposing trees is complete, and also thick trees are to be found. Dead, standing trees number about 40 per ha.

Characteristics: The stand is over-dense, and characterised by windthrows.

Surroundings: The stand is surrounded by a natural mire to the north. To the west and east, the stand continues as it is on the study site; to the south, the stand has been thinned, and behind the thinned strip there is a forestry plantation.

2.4.2 Tapionaho B

Tapionaho B (Grid 27°E) (see map, Appendix 3) is also a moist forest stand on a gentle northern slope. Signs of slash-and-burn cultivation and selection cuttings can be traced on the site. Spruce is the predominant tree species, accounting for about 75 % of the stems, with birch in second place (15 %). Also the proportion of aspen is significant – about 5 %. The trees are large.

Fallen trunks: There are about 200 fallen trunks per hectare, most of them of spruce. The proportion of aspen of the fallen trunks is about 20 % and there are also some large willows (*Salix caprea*) to be found. All degrees of decomposition are present in spruce, birch and aspen. The diameter of spruce trunks varies up to 45 cm, aspen up to 35 cm, and birch up to 25 cm. Dead standing trees number about 40 per hectare.

Characteristics: This site is very picturesque due to a brook running through the area, and the over-dense canopy of large trees.

Surroundings: To the north of the site there is a virgin mire, the forest is continuous to the west and to the east. To the south there is young forestry plantation, about 200 metres from the site.

2.4.3 Tapionaho C

This dryish stand (Grid 27°E) is situated on a gentle slope running north-eastwards (see map, Appendix 3). Indications of forest fires and selection cutting can be found. Spruce is the predominant tree species, with a proportion of about 50 %. The proportion of pines is about 40 %, and aspen is also to be found.

Fallen trunks: There is a small section of the stand with a dense number of fallen trunks (about 250 per ha). The fallen trunks are mainly of pine, the proportion of aspen is about 5 %. There is a complete succession of decaying trees in all tree species and all size classes. The number of dead, standing trees is about 70 per ha.

Characteristics: This stand is characterised by gaps and several layers of trees. Windthrows are common.

Surroundings: To the west there are recent thinnings in mature forests and behind them a forest road and a cutting. The forest is continuous to the south; to the north and to the east there is a virgin mire.

2.4.4 Tapionaho D

Tapionaho D (Grid 27°E) (see map, Appendix 3) is also a moist forest stand situated on a northern slope, its age is about 150 years. There are traces of fires, and old stumps remain of the former forestry use of the stand. The stand is spruce-dominated and all size classes of stems can be found up to the diameter of 40 cm. Pine is presented up to the diameter of 50 cm, and the proportion of pine of stems in the site is about 20 %. Thick aspens characterise the stand.

Fallen trunks Numerous – as many as about 270 per hectare. The average is over 200 per hectare. The fallen trunks are mainly thick, the proportion of pine is about 50 % and that of aspen about 20 %. The succession of all decaying tree species is continuous. Dead, standing trees are numerous, and the number of dead pines is striking. However, the area is being taken over by spruce.

Characteristics: Some windthrows are to be found on the southern side of the site, adjacent to a cutting area.

Surroundings: To the north, there is a virgin mire; to the west and to the east the forest continues, but is a little dryer.

2.4.5 Tapionaho E

Tapionaho E (Grid 27°E) is a moist, spruce-dominated stand on a gentle north-west slope (see map, Appendix 3). Signs of ancient forest fires are provided by burnt stumps and signs of selection cuttings by old stumps. The stand is changing gradually to be more and more spruce-dominated; the more open gaps have some juniper. The trees are quite thick, the dbh of spruce is up to 45 cm, that of pine and aspen up to 50 cm, and that of birch up to 45 cm.

Fallen trunks number, on average, about 150 per ha. The succession of decaying trees is continuous in all decay classes and size classes of trees. Dead, standing trees are about 50 per hectare.

Characteristics: The specific feature of the site is a boggy, luxuriant depression.

Surroundings: The forest continues to the north, east and south. About 100 metres to the south there is a pine plantation. The site is intersected by a recently built forest road.

2.4.6 *Tapionaho F*

Tapionaho F (Grid 27°E) (see map, Appendix 3) is a site consisting of a dryish slope facing south-west, and ending in a virgin mire. The site was characterised by ancient ”aihki” pines. The site was cut in the autumn of 1993.

2.4.7 *Niemijärvi*

Niemijärvi (Grid 27°E) (see map, Appendix 3) is a site consisting of a dryish pine-dominated forest. Indications of forest fires are to be found, and not so long ago the aspens on the site were felled. The diameter of pine and spruce is up to 35 cm.

Fallen trunks are numerous, about 250 per ha. The majority – about 90 % – are pine trunks, and only about 5 % of both spruce and birch. All classes of decomposition are present in pine and birch. In spruce, there are no highly decomposed fallen trees. The area is being over taken by spruce, and it is already now over-dense. Dead, standing trees number about 70 per ha.

Characteristics: There is a moist, boggy depression on the site, and also some ancient pines (”aihki” pines).

Surroundings: To the west there is a lake, to the east a drained mire, which has led to the draining of the border zone of the site. The forest is continuous and similar to the east and to the north.

2.4.8 *Koitajoki*

Koitajoki (Grid 27°E) (see map, Appendix 3) is a moist spruce forest stand situated near Koitajoki river. It is characterised by boggy depressions and small ”billabongs” (long, narrow ponds, formerly parts of the main course of the river) now separated from the river by the process of meandering. The tree stand has developed naturally for over 100 years following selection cutting. Spruce is the

predominant tree species with diameters from 10 cm to 50 cm. There are also a few old aspens – with diameters up to 60 cm.
Fallen trunks can be found in numbers up to 200 per ha. These are mainly of spruce, with some thick ones (diameters up to 60 cm). The series of decaying birch and spruce is complete. There are also about 50 dead, standing trees per hectare.

Characteristics: The specific features of the site are the occurrence of spring floods originating from Koitajoki river, and – at least partly due to this – the exceptional diversity of the site. The stand is also clearly over-dense, but also characterised by gaps. Topographic variations within the site are quite abrupt, but not wide in area.

Surroundings: The stand is surrounded by Koitajoki river with its riparian forests. These forests are in the natural state, but they have been subjected to selection cutting, except to the west where the pine forest is subject to intense management.

2.4.9 Lahnavaara

Lahnavaara (Grid 27°E) (see map, Appendix 3) site is situated on a dryish southern slope of a hill, but it includes a moist depression with a brook running to the east. The area is – near the brook – predominated by spruce, and more up the hill by pine. Thick aspen are present near the depression.

The forest is continuous to the north, west and east; to the south there is a recently built forest road. To the east there is a drained mire about 400 metres from the site.

2.4.10 Mökkilampi 1 and Mökkilampi 2

Mökkilampi sites (Grid 27°E) (see map, Appendix 3) are managed forests where all the signs of cutting are clear: broadleaved trees have been removed from the area, and thinnings have been done in due course. The volume of timber on Mökkilampi 1 was 270 m^3/ha, whereas on Mökkilampi 2 it was only 180 m^3/ha. Both of the sites were dominated by spruce (Mökkilampi 1, 60:40 spruce:pine; Mökkilampi 2, 80:20 spruce:pine).

Fallen trunks were few, with only about 100 trunks per ha being found. The number of dead standing trees was only about 20 per ha compared to about 200 in mature forests. The succession of decomposing dead trees is non-continuous, especially due to the lack of half-decayed fallen trunks and the scarcity of dead, standing trees.

2.4.11 *Pampalo (slope)*

Pampalo (slope) (Grid 27°E) (see map, Appendix 3) site is situated on a very steep south-western slope. The forest is mainly dry, and no signs of cuttings can be seen in the middle and lower part. Ancient ”aihki” pines are numerous. On the upper part of the slope, there are some moss-covered stumps as reminders of past selection cuttings and thinnings, and also some ring-barked aspens are to be found. The study area is spruce-dominated, with all diameter classes up to 45 cm present. Aspen is quite common, and the diameter of aspens ranges from 35 cm to 45 cm. The study site was located in the moist part of the slope.

Fallen trunks are common, as many as 300 trunks per ha being found. The proportion of spruce among the fallen trunks is 60 %, and that of birch 40 %. Both of species have a continuous series of decomposition classes in all size classes of trunks.

Characteristics: Thickness of the fallen trees is a distinctive feature of the site.

Surroundings: To the south and to the north, a similar forest continues; to the west there is a young pine forest and to the east a young spruce forest.

2.4.12 *Pampalo*

The forests of Pampalo (Grid 27°E) (see map, Appendix 3) are very moist compared with those of Pampalo (slope). Large stumps remain as mementoes of past selection cuttings. The southern part of the area has been subject to slash-and-burn cultivation, and also other parts show clear signs of forest fires. Practically all the aspens have been ring-barked. The forests are dominated by spruce, also aspen is common. The trees are large and there are several ”aihki” pines in the area, with diameters of as much as 85 cm. There are all size classes of spruce up to dbh of 45 cm, and aspen is present up to dbh of 50 cm.

Fallen trunks are numerous, the best sites having about 300 trunks per ha. Most of the fallen trunks are spruce, the proportion of aspen is about 15 %. The area has in part reached the climax of the succession, and the fallen trunks are very heavy, with diameters up to 70 cm. The succession of decomposition is continuous for all tree species and in all size classes. Dead, standing trees number about 100 per ha. The proportion of dead aspen is higher than on a natural site due to ring-barking.

Characteristics: There is a buzzard’s (*Buteo buteo*) nest, the stand is picturesque and rich in nutrients. Small-scale topography varies from steep precipices of rocks and to long and narrow mires.

Surroundings: The study site is surrounded by forest cuttings in all directions. Nearby, to the south, there is a gold mine (open-cut mine).

2.4.13 *Pirhunvaara*

Pirhunvaara hill is located in Koivusuo Strict Nature Reserve. Three sites from Pirhunvaara were chosen for reference purposes (for maps see Appendix 3). The sites have been named as Pirhu 1, Pirhu 2 and Pirhu 3.

Pirhu 1 is an bandoned field planted with birch about 20 years ago. Field layer in the site is meadow-like. Pirhu 2 is an abandoned, dry meadow with a diverse field layer. Pirhu 3 is a 10–15 years old planted spruce stand on a former peat field. This site is located on the foot of the hill, near the Koivusuo mire. It is a very moist site including large gaps where regeneration of spruce has failed.

2.4.14 *Other sites*

Maps are presented in Appendix 3.

2.5 Trapping and inventory methods

2.5.1 *Diptera and Hymenoptera*

Trapping of Diptera and Hymenoptera was performed using Malaise traps (Townes 1972), which are tent-like traps especially suitable for trapping flying insects. The traps were placed in a little gap in the forest or in an open meadow (Pirhu), so that the opening of the trap with the collector jar pointed to the south.

In 1993, there were four traps in operation – three in Pirhu, and one in Tapionaho A. The traps were operated from early June to late September. In 1994, the number of traps in both Pirhu and Tapionaho was three. In 1995, Niemijärvi, Koitajoki and Lahnavaara were also accessed to trap Diptera and Hymenoptera.

The scientists in charge of identifying the material were Alexei Polevoi, Ph.D., regarding Diptera, and Andrei Humala, Ph.D., regarding Hymenoptera. Both represent the Karelian Research Centre of Russian Academy of Sciences, Petrozavodsk, Russia.

For trapping, see also Polevoi (2001) and Humala (2001).

2.5.2 *Coleoptera*

Trapping of Coleoptera was done using standard window traps comprising acrylic sheets measuring 40x70 cm. A specific trunk trap – polypore trap mounted onto a shelf polypore cut into two (see also Kaila 1993) – was used as well. In addition, some of the sites were studied by examining suitable trunks in the field (peeling off bark, destroying some decomposed trees).

The number of traps per site was 10–12 for standard window traps, and five for polypore traps.

The group of scientists working on Coleoptera consisted of Dr Evgeny Yakovlev (Karelian Research Centre of Russian Academy of Sciences, Petrozavodsk, Russia), Dr Alexander Scherbakov (Moscow State University, Russia), and Dr Nickolai Nikitsky (Moscow State University, Russia). In the field and in the laboratory, the group has assisted Kirill Yakovlev (field inventories, pre-treatment of material), Hannu Hokkanen (pre-treatment of material), and Markku Tietäväinen (all arrangements of trapping and pre-treatment of material). Dr Yakovlev is the leader of the Russian group.

For further methods on Coleoptera studies, see also Yakovlev et al. 2001.

2.5.3 Polyporaceous fungi

Inventories of polyporaceous fungi were done by Dr Margarita Bondartseva and Vera Lositskaya, M.Sc., both from the Komarov Botanical Institute, St Petersburg. They were accompanied by Dr Vitali Krutov from the Karelian Research Centre of Russian Academy of Sciences, Petrozavodsk, Russia. Kaisa Junninen, Ville Vuorio and Soile Turkulainen assisted in the field collecting the material.

One inventory trip to one site lasted long enough for the site to be thoroughly investigated. The time consumed per site varied according to the size of the site, time of the year, weather conditions (wet year >< dry year), and the number of participants.

For more details, see also Bondartseva et al. (1995), Penttilä (1994) and Junninen (1996).

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3 SAPROXYLIC COLEOPTERA OF UNMANAGED MATURE FORESTS IN KOITAJOKI AREA

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Abstract

Local species-richness and structure of communities of saproxylic Coleoptera were investigated in patches of mature unmanaged forests within the North Karelian Biosphere Reserve in Ilomantsi, Eastern Finland. Samples were obtained by means of window flight traps and by hand-picking insects from under the bark of dead trees around the traps. The pooled trapping sample comprised 15 603 individuals of 294 species of 55 Coleoptera family groups. Of these, saproxylic beetles relying on dead wood and the reproductive parts of wood-growing fungi and myxomycetes were found to represent 227 species. Samples caught using standard window traps were richer in terms of both the number of species (280) and individuals caught (181.7 individuals/trap) than those obtained using polypore traps (where the ”window” is attached to the basidiocarps of bracket fungi). Polypore traps attracted a total of 166 beetle species and 112.03 individuals/trap, but for 67 species (including rare and threatened ones) the polypore traps proved to be more productive than the standard window traps.

The numbers of species obtained vary between the sites, but the diversity indices calculated for the sites are similar. Timber felling has led to marked increases in species richness and numbers of individuals, mainly on the part of Scolytidae. Potential forest-pest species: *Dendroctonus micans*, *Tomicus piniperda, T. minor* and *Ips typographus* were found in window flight catches in the only sample site situated close to a fresh clear-fell area but not in undisturbed sites. Signs of successful colonisation by bark beetles were observed only on dead trees; the exception was *Dendroctonus micans*, which was found to infest weakened pines in a pine-covered *Sphagnum* bog.

Altogether 14 beetle species considered as threatened in Finland were found (one endangered, two vulnerable and seven in need on monitoring). Of these, 13 species are saproxylic and three of them develop in the fruiting bodies of wood growing fungi. Thus the areas investigated can be considered valuable from the nature conservation point of view.

3.1 Introduction

The sustainability of forest ecosystems is determined by the harmony of the assimilation and decomposition processes. In boreal forests saproxylic insect communities associated with the wood-decomposing system are crucial in maintaining the biological balance. These communities are of principal importance for global biodiversity as well. However, the long-term experience of intensive exploitation of natural forests in Western Europe shows that saproxylic insects are highly vulnerable to the anthropogenic changes taking place in forests as this leads to the loss or deterioration of their habitats (Speight 1989, Väisänen et al.1993). It seems quite probable that, given the modern-day situation, the habitat requirements of saproxylic insects generally coincide with the main criteria of biodiversity in boreal forest ecosystems. At present, Coleoptera are the best-known saproxylic invertebrates. Recent investigations (Siitonen et al. 1995; Siitonen & Martikainen, 1994) have proven that due to the intensive commercial forestry practised many saproxylic beetle species – still common in Russian Karelia – have become endangered in Finland. The most sensitive among these are rare species with constrained habitat requirements. The presence of dead woody material of different tree species, in different stages of decay and in large enough quantities, seems to be a crucial factor for the preservation of these species.

This situation has made the study of the communities of saproxylic Coleoptera in the last remains of unmanaged semi-natural forests near the Finnish–Russian border of such great current interest. Pajari (1995) has made a review of the available records of Coleoptera occurring in recent years within the territory of the North Karelian Biosphere Reserve. Additional data on the beetle fauna in Ilomantsi are to be found in publications by Rutanen (1994a) on Patvinsuo National Park, Siitonen et al. (1995), and Martikainen et al. (1996).

This study was aimed at clarifying the species composition, structure of communities and distribution of rare and threatened species of saproxylic Coleoptera in the easternmost part of Finland, within North Karelian Biosphere Reserve. Extensive trapping was carried out in fragments of unmanaged mature spruce-dominated forests preserved among mires and managed areas. The first results of this study have already been published elsewhere (Yakovlev et al. 1995, Yakovlev & Hokkanen 1995).

3.2 Study area, material and methods

3.2.1 Site descriptions

Trapping was performed in ten study sites situated in four localities (Tapionaho, Koitajoki, Niemijärvi and Lahnavaara) separated by distances of 10–15 km within an area of continuous forest and large mires (Figure 3.1).

The study area comprises forests predominated by Norway spruce (*Picea abies*). Scots pine (*Pinus sylvestris*) predominates only on higher ground. In the past, these forests have been shaped by slash-and-burn (swidden) cultivation and a small-scale domestic forestry but have not been treated with clear-felling or any other forms of forest management. All of the study sites are situated in unmanaged forests with no or only few signs of previous logging (dating back 60–70 years at least). The average age of the forest stands is between 110–140 years. Individual pines and spruces are more than 200 years old. Birch is still fairly abundant throughout, while aspen exists only as single large trees on hillsides. Several felling areas were established during the course of our study in 1993–1994, e.g., in Tapionaho. The details of the study area are given by Hokkanen & Vuorio (in this publication). Data on forest structure, solid volume measure and proportions of different tree species among the dead tree trunks are presented in Table 3.1 for all the study sites.

Table 3.1. Forest structure and stock of dead woody material on the sample sites in the Koitajoki area. Tapionaho F was felled in 1993–1994 and its inventory is incomplete.

			Tapionaho			Koi	Nie	Lah
Forest structure	A	B	C	D	E			
Mean age (years)	112	112	112/92	127	140	116	90/110	160
Mean height, m	20	20	17/11	21	25	25	19/23	23
Solid volume , m^3/ha	223	223	114	216	230	160	257	175
Tree species composition, %								
Pine	5	5	40	20	20	1	50	5
Spruce	75	75	50	70	80	95	50	90
Birch	20	15	10	5	1	5	1	5
Aspen	1	5	1	5	1	1	0	1
Mean diameter of live trees, cm								
Pine	23	21	21	24	24	16	17	23
Spruce	13	13	11	13	13	14	12	13
Birch	12	20	20	20	13	12	16	20
Aspen	13	21	20	23	22	15	0	21
Dead wood, pcs/ ha	340	240	320	370	200	270	320	350
Pine, %	1	0	50	50	20	1	90	20
Spruce, %	50	60	30	30	70	90	5	50
Birch, %	50	20	15	10	10	10	5	30
Aspen, %	0	20	5	10	10	0	0	1
Tree diameter of dead trees cm								
pine	23	0	12	21	21	25	20	13
spruce	13	13	11	12	12	15	10	13
birch	12	11	20	20	12	13	16	20
aspen	0	12	20	12	0	0	0	20

Trapping in the Tapionaho area was performed on six sample sites, A–F.

Sites A, B and C are situated along the edge of the vast Tapionsuo mire. Sites A and B are located in moist spruce-predominated forest with the average age being 112 yr. There is a considerable proportion of birch, although site C is on higher alnd with a greater proportion of pine.

Sites E, D and F are situated apart from the first three sites. Sites D and E were established in spruce-predominated forest with the average age being 127–140 yr. Site E adjacent to a pine-covered *Sphagnum* bog is an almost pure coniferous stand with the occasional birch and aspen tree. Site D is located on more fertile soil with a higher proportion of birch and aspen. Site F occupies a hillside and it was characterised by old and huge veteran pines (age in excess of 200 years) and aspens. After the logging operation of the winter of 1993–1994, site F was totally destroyed and trapping was stopped there. Logging continued in the winter of 1994–1995 and resulted in site D being transformed into a forest-edge site adjacent to an extensive clear-fell area with an abundance of cutting residues, including huge aspen logs. Site E was also converted into a fragment of unmanaged forest surrounded by new roads and freshly felled sites; however, it is not directly adjacent to a felling area as is site D.

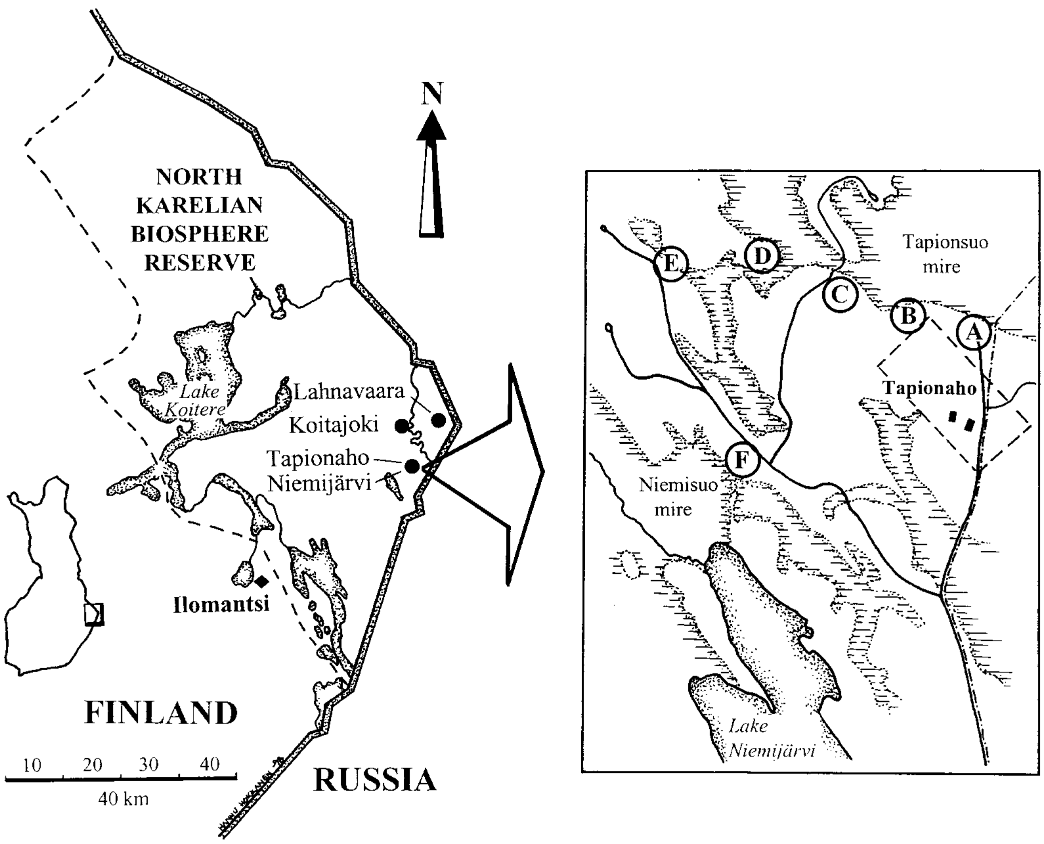


Figure 3.1 Study sites in Koitajoki area.

3.2.2 *Trapping methods*

The quantitative sampling employed in the study included trapping and examination of trees at each of the sample sites. For trapping we used a series of twelve window flight traps and five polypore window traps at each of the ten sites as a basic trapping method. A standard window trap (called window trap below) is a flight interception trap, based on the principle that flying individuals hit against a transparent ”window” and fall into a collecting funnel (Økland 1995). In our study, the window trap consisted of two cross-wise sheets of transparent acrylic (70x40 cm) mounted above a plastic funnel. A collecting jar (diameter of opening 7 cm) containing a concentrated solution of NaCl in water and a small amount of detergent was mounted below the funnel.

The polypore-window trap (polypore trap below) is especially designed for insects associated with shelf fungi and it is described by Kaila (1993). It shares the same principle with the window trap, but in this case the 20x25 cm ”window” was placed in a vertical slit cut through the sporocarp of a polyporaceous fungus (*Fomes fomentarius* or *Fomitopsis pinicola*).

The window traps on the sample sites were placed close to dead trees or logs to attract saproxylic beetles along the transect across the whole area of the sampling site. The distances between the traps were uneven, averaging 50 m. The numbers of traps used in each sample site are given in Table 3.2. Only on two sites at Tapionaho trapping was carried out during all the three years: 1993–1995. Trapping in the site F was stopped after 1993 because the trees on the site were felled in the winter of 1994. Trapping in the sites Koitajoki, Niemijärvi and Lahnavaara was performed only in 1995.

Table 3.2. Number of window and polypore traps exposed in the all sample sites.

Site	Window traps			Polypore traps		
	1993	1994	1995	1993	1994	1995
Tapionaho						
A	12	12	–	5	5	–
B	12	12	–	5	5	–
C	12	12	–	5	5	–
D	12	12	12	5	5	5
E	12	12	12	5	5	5
F	10	–	–	5	–	–
Koitajoki	–	–	12	–	–	5
Niemijärvi	–	–	12	–	–	5
Lahnavaara						
A	–	–	12	–	–	5
B	–	–	12	–	–	5

Table 3.3. The beginning of the trapping periods on the sampling sites.

Sites	Date of the beginning of trapping		
	1993	1994	1995
Tapionaho			
A	12.VI	6.VI	–
B	12.VI	6.VI	–
C	12.VI	6.VI	–
D	13.VI	6.VI	5.IV
E	13.VI	6.VI	5.IV
F	13.VI	–	–
Koitajoki	–	–	18.VI
Niemijärvi	–	–	18.VI
Lahnavaara			
A	–	–	19.VI
B	–	–	19.VI

The traps were emptied continuously throughout the growing season. However, the time of beginning of the trapping season differed year by year (Table 3.3). Only in 1995 trapping was started in early spring, before the melting of the snow. The spring peak of flight activity of several beetle species was included in our trapping season. In 1994 and 1995 trapping was started later, during the first half of June. All of the traps were exposed until the beginning of September, when the flight activity of beetles gradually declines and, on the other hand, fallen leaves block up the collecting jars. During the period of exposure, all the traps were emptied once every two–three weeks. The samples of insects collected with the traps were immersed in 70% alcohol and sorted.

Along with sampling beetles in their flying phase by means of window traps, saproxylic insects inhabiting dead and weakened trees have been observed on the same sites by means of the following scheme. All trees within an area defined by a radius of five metres around every trap were examined. Trees bearing signs of insect colonisation (old and new larval galleries, live insects) were registered and the species were identified where possible.

3.2.3 Identification and taxonomic coverage

All the individuals of Coleoptera except Staphylinidae (only the genera *Scaphisoma* and *Oxyporus* were included) and the genus *Atomaria* (Cryptophagidae), whose identification is not yet complete, were identified by species and counted. The nomenclature of beetles used follows that of Silfverberg (1992) with one difference: the genus *Rhizophagus* is included in the family Monotomidae. The majority of material is stored at the Forest Research Institute (Petrozavodsk, Russia) and a few specimens at the Zoological Museum of the Moscow State University, Russia.

3.2.4 Statistical methods

Species diversity was measured using three indices: the Shannon-Wiener diversity index – H′, the Pielou's evenness index – E′, and the Simpson's index of species dominance – C, implying two variables: the number of species on the sample site and the number of individuals in the sample. The indices H′ and E′ increase due to both species richness and equitable distribution among species, although the index C gives relatively little weight to rare species and more weight to common species, and therefore, increases due to the uneven numbers of individuals between the species caught. The Czekanowsky-Sørensen similarity index was chosen to compare the samples among the study sites. We used the BIODIV software (Baev & Penev 1993) for all of these computations.

3.3 Results and discussion

3.3.1 Numbers of species and individuals caught

The pooled sample comprised 15 603 individuals of 294 species of 55 Coleoptera family groups. Of these, 12 968 individuals of 280 species were collected by means of window traps and 2 633 individuals of 166 species by means of polypore traps (Table 3.4). A complete list with quantitative data on each Coleoptera species obtained is given in Appendix 4. Although the number of species seems rather high, the total number of forest-dwelling beetle species in the study area must be two–to-three times greater (cf. Rutanen 1994a). Several species-rich groups are not involved in this study because our sampling methods were especially targeted at tree-living beetles.

Table 3.4. Number of beetle species and individuals collected by means of window and polypore traps.

Coleoptera families	Number of species			Number of individuals		
	window	polypore	Total	window	polypore	Total
Carabidae	1	1	1	78	10	88
Hydrophilidae	3	–	3	4	–	4
Leiodidae	14	14	16	465	412	877
Silphidae	3	1	3	17	2	19
Cholevidae	2	1	2	32	3	35
Staphylinidae	5	6	6	104	75	179
Sphaeritidae	1	–	1	2	–	2
Histeridae	4	3	5	5	3	8
Eucinetidae	1	–	1	1	–	1
Scirtidae	6	4	6	65	4	69
Scarabaeidae	9	1	9	76	2	78
Lucanidae	1	–	1	20	–	20
Lycidae	3	–	3	52	–	52
Lampyridae	1	–	1	1	–	1
Cantharidae	8	4	8	183	18	201
Elateridae	18	14	18	1 065	111	1 176
Throscidae	1	–	1	1	–	1
Buprestidae	1	–	1	1	–	1
Byrrhidae	2	–	2	2	–	2
Dermestidae	1	–	1	1	–	1
Anobiidae	12	5	12	237	92	329
Lymexylidae	2	1	2	82	7	89
Trogossitidae	2	2	2	39	6	45
Cleridae	2	2	2	28	6	34
Nitidulidae	26	20	27	309	221	530
Sphindidae	1	–	1	1	–	1
Monotomidae	8	7	8	562	111	673
Cucujidae	3	1	3	23	1	24
Cryptophagidae	10	4	10	155	89	244
Erotylidae	5	5	5	291	276	567
Cerylonidae	3	2	3	71	19	90
Endomychidae	1	–	1	3	–	3
Coccinellidae	2	–	2	2	–	2
Latridiidae	13	10	15	241	124	365
Cisidae	12	9	12	49	74	123
Colydiidae	1	–	1	2	–	2
Mycetophagidae	3	3	4	18	5	23
Oedemeridae	1	–	1	2	–	2
Pythidae	2	–	2	6	–	6
Salpingidae	2	2	2	21	7	28
Anthicidae	1	–	1	1	–	1
Meloidae	–	–	1	1	–	1

Table 3.4. cont.

Coleoptera families	Number of species			Number of individuals		
	window	polypore	Total	window	polypore	Total
Tenebrionidae	5	4	6	41	91	132
Anaspidae	3	2	3	145	71	216
Mordellidae	–	1	1	–	2	2
Tetratomidae	1	1	1	9	1	10
Melandryidae	10	4	10	309	100	409
Cerambycidae	17	6	18	115	9	124
Chrysomelidae	4	–	4	11	–	11
Nemonychidae	–	1	1	–	1	1
Attelabidae	1	–	1	1	–	1
Apionidae	1	–	1	6	–	6
Curculionidae	14	11	15	172	65	237
Scolytidae	28	14	28	7 842	615	8 457
Total sum	280	166	294	12 970	2 633	15 603

The most species-rich groups were Scolytidae (28 species), Nitidulidae (27), Cerambycidae (18), Elateridae (18), Leiodidae (16), Latridiidae (15), Curculionidae (15), Anobiidae (12), and Cisidae (12). About 98 per cent of all the beetles were collected on the sampling sites situated in Tapionaho (Table 3.5). In three other localities (Koitajoki, Niemijärvi and Lahnavaara) where trapping was performed only in 1995, the numbers of Coleoptera were very low. This could be explained by the late starting date of the trapping there and, therefore, a full-scale comparison of the quantitative data obtained from these sites in 1995 with those from Tapionaho is not fully justified.

*Table 3.5. The number of Coleoptera individuals collected by means of flight-intercept trapping on all of the sites in the Koitajoki area in 1993–1995. * Including hand-picking.*

Coleoptera Families	Tapionaho						Koi	Nie	Lahnav		Total
	A	B	C	D	E	F					
Carabidae	15	13	11	19	21	6	–	2	–	1	88
Hydrophilidae	–	–	1	1	2	–	–	–	–	–	4
Leiodidae	124	84	147	258	217	32	9	2	3	1	877
Silphidae	1	1	2	5	8	2	–	–	–	–	19
Cholevidae	4	4	4	20	1	2	–	–	–	–	35
Staphylinidae	13	4	23	19	120	–	–	–	–	–	179
Sphaeritidae	–	1	–	–	–	1	–	–	–	–	2
Histeridae	–	–	2	4	2	–	–	–	–	–	8
Eucinetidae	–	–	–	1	–	–	–	–	–	–	1
Scirtidae	20	16	10	11	8	2	2	–	–	–	69
Scarabaeidae	18	7	2	10	15	1	1	6	11	7	78
Lucanidae	2	3	3	8	2	2	–	–	–	–	20

Table 3.5. cont.

	Tapionaho						Koi	Nie	Lahnav		Total
	A	B	C	D	E	F					
Coleoptera Families											
Lycidae	10	7	4	16	11	4	–	–	–	–	52
Lampyridae	0	–	–	1	–	–	–	–	–	–	1
Cantharidae	47	14	21	66	44	5	–	2	2	–	201
Elateridae	96	52	68	488	341	86	19	22	1	3	1 176
Throscidae	–	–	–	1	–	–	–	–	–	–	1
Buprestidae	–	–	–	1	–	–	–	–	–	–	1
Byrrhidae	–	–	–	2	–	–	–	–	–	–	2
Dermestidae	–	1	–	–	–	–	–	–	–	–	1
Anobiidae	31	40	25	131	67	16	12	3	1	3	329
Lymexylidae	21	32	5	14	8	9	–	–	–	–	89
Trogossitidae	9	6	4	11	15	–	–	–	–	–	45
Cleridae	3	7	–	16	7	1	–	–	–	–	34
Nitidulidae	71	42	88	167	144	10	4	1	1	2	530
Sphindidae	–	–	–	–	1	–	–	–	–	–	1
Monotomidae	123	61	162	195	91	29	11	–	1	–	673
Cucujidae	3	2	2	9	8	–	–	–	–	–	24
Cryptophagidae	19	26	39	80	62	18	–	–	–	–	244
Erotylidae	124	22	148	163	104	–	1	–	–	5	567
Cerylonidae	14	13	26	26	9	1	–	–	–	1	90
Endomychidae	–	–	–	–	2	1	–	–	–	–	3
Coccinellidae	–	–	–	2	–	–	–	–	–	–	2
Latridiidae	65	55	87	65	79	3	11	–	–	–	365
Cisidae	17	18	26	29	28	2	3	–	–	–	123
Colydiidae	–	2	–	–	–	–	–	–	–	–	2
Mycetophagidae	2	–	8	1	11	1	–	–	–	–	23
Oedemeridae	–	–	–	–	2	–	–	–	–	–	2
Pythidae	–	–	–	4	2	–	–	–	–	–	6
Salpingidae	2	7	1	10	6	1	1	–	–	–	28
Anthicidae	–	–	–	1	–	–	–	–	–	–	1
Meloidae *	–	–	–	–	–	1	–	–	–	–	1
Tenebrionidae	22	10	23	58	17	1	–	–	–	1	132
Anaspidae	34	24	26	76	41	12	1	1	1	0	216
Mordellidae	0	–	1	1	–	–	–	–	–	–	2
Tetratomidae	–	3	–	7	–	–	–	–	–	–	10
Melandryidae	59	28	70	88	134	18	2	5	–	5	409
Cerambycidae *	8	20	3	48	30	10	1	3	1		124
Chrysomelidae	–	–	1	5	2	1	2	–	–	–	11
Nemonychidae	–	–	–	1	–	–	–	–	–	–	1
Attelabidae	–	1	–	–	–	–	–	–	–	–	1
Apionidae	1	–	1	3	1	–	–	–	–	–	6
Curculionidae	34	15	43	83	40	4	10	4	4	–	237
Scolytidae	962	741	465	4 792	1 226	218	43	1	7	2	8 457
Total	1 974	1 382	1 552	7 017	2 929	500	133	52	33	31	15 603

Generally, the results presented show the predominating groups among the Coleoptera collected by means of traps of both types on every sampling site. The total number of insect individuals caught by mean of both window and polypore traps was distinctly higher on sites D and E situated near the felling area, especially on site D, than on the other sites within the Tapionaho study area. In both cases, this was due to the great contribution made by Scolytidae attracted by both the fresh timber felling and the early start of trapping on these sites (in April) which enabled us to catch scolytids during their spring peak of flight activity.

However, in spite of these variations in abundance of insect individuals trapped, the differences in the proportions of Coleoptera families between the six sample sites were statistically fairly insignificant. In terms of individuals, the most abundant families on the all sample sites were Scolytidae. On average, this family formed 50.8% of the total beetle catches. The highest proportion of scolytids (average 68.8%) was recorded on the sites close to the felling site. The proportions of bark beetles on the other sample sites varied from 31.0% to 54.7%. Other consistently very numerous groups were Elateridae, Leiodidae, Rhizophagidae, Erotylidae, Nitidulidae, Melandryidae, Anobiidae, Latridiidae, Cryptophagidae, Curculionidae, Anaspidae, and Cantharidae. Each one of these formed more than 1% of all the beetles collected during the study.

3.3.2 Species-richness and species-diversity of Coleoptera on the study sites

On the basis of the material obtained from window trapping, the six sites A–F from Tapionaho contained the best representative beetle fauna. These sites were selected for species-composition analysis. The species-diversity and heterogeneity values for the beetle fauna on each sampling site are given in Figure 3.6 and Table 3.2.

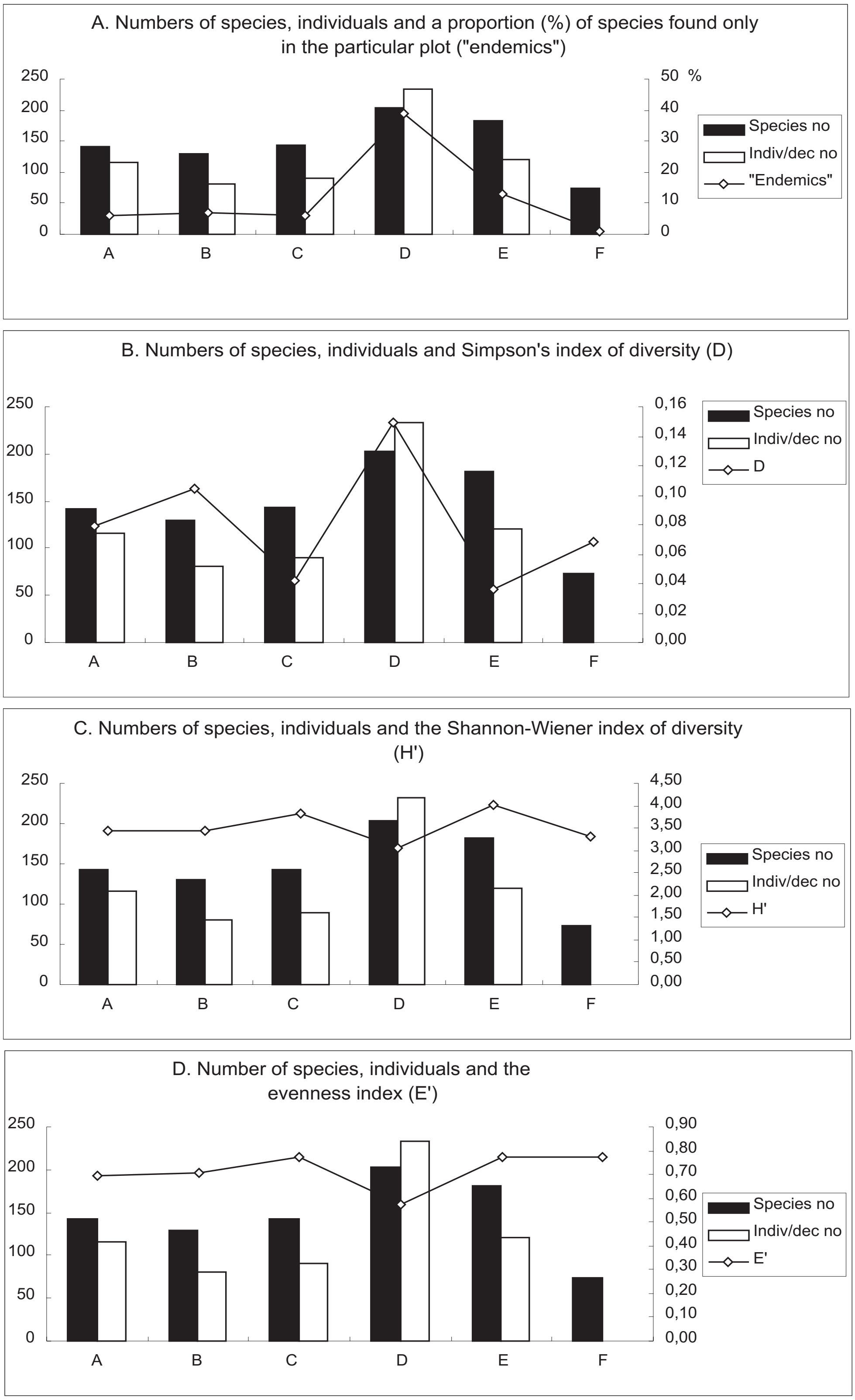


Figure 3.2 Species diversity and heterogeneity values for beetle fauna on the Tapionaho study sites.

Table 3.6. Species-richness, abundance and diversity values for beetle fauna on the Tapionaho sampling sites.

Values	Sampling sites at Tapionaho					
	A	B	C	D	E	F
Number of species	150	132	149	215	187	76
Number of species found only on particular sampling site	9	9	8	44	15	2
Number of threatened species	3	2	6	10	8	1
Average number of individuals per trap/ten days						
a) all beetle species	115.4	80.4	90.2	232.8	120.0	62.4
b) the most abundant Scolytidae species						
Hylurgops palliatus	0.2	0.1	5.8	77.4	3.5	0.0
Hylurgops glabratus	1.1	1.4	0.2	0.3	0.2	0.6
Hylastes cunicularius	21.8	22.0	4.1	40.8	10.5	9.3
Xylechinus pilosus	2.5	3.5	1.1	2.3	2.3	0.1
Dryocoetes autographus	17.5	7.6	9.6	9.9	7.1	3.9
Trypodendron lineatum	8.8	0.4	5.9	8.5	7.2	9.5
Trypodendron signatum	2.7	2.0	0.8	5.2	5.8	3.9
Hylastes brunneus	0.1	1.4	0.1	7.4	3.5	0.0
Pityogenes chalcographus	0.1	1.5	0.1	4.6	0.3	0.0
Diversity indices						
Shannon (diversity) = H'	3.45	3.43	3.84	3.06	4.01	3.30
Pielou (evennes) = E'	0.70	0.70	0.78	0.58	0.77	0.77
Simpson (dominance) = C	0.08	0.10	0.04	0.15	0.04	0.07

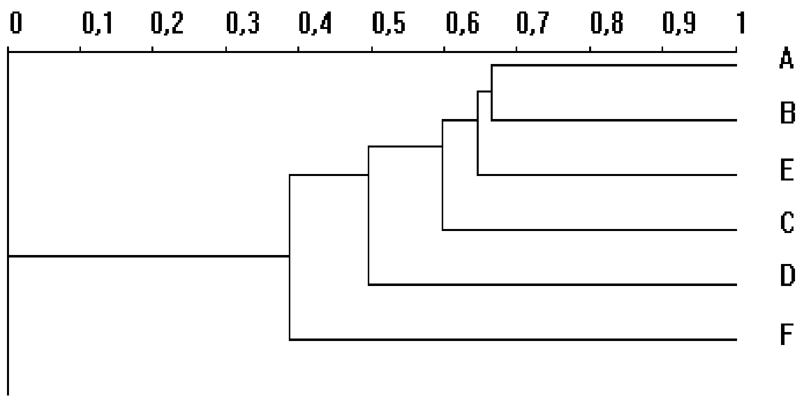
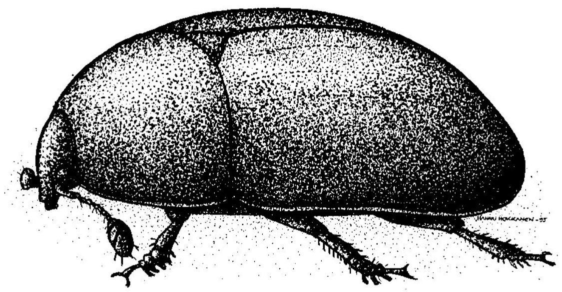


Figure 3.3. Cluster diagram for the beetle fauna found on six study sites at Tapionaho (A-D) based on Czekanovski-Sorensen similarity index.

The Czekanowsky-Sorensen Index (Figure 3.3) indicates a great similarity in terms of species composition and the abundance of particular beetle species between the sites A, B and E. Site C, standing somewhat apart, however, appears to be similar to them, whereas the sites D and F markedly differ from the other study sites.

In terms of species richness, sample site D appears to the most interesting. A total of 203 Coleoptera species were found there with 40 of these species being obtained only from this site (Fig 3.2A). Of these, *Lacon fasciatus*, *Cyllodes ater*, *Pytho abieticola* and *Monochamus urussovi* are considered to be threatened in Finland. Such species as *Necydalis major* (Cerambycidae), *Ptilinus fuscus* (Anobiidae) associated with aspen and *Agathidium nigrinum* (Leiodidae) appearred to be fairly rare within the study area and characterised by their local distribution. However, the Shannon's diversity and the Pielou's evenness indices for the beetle fauna obtained from site D are lower than the indices for all the other sample sites (Figure 3.2C, D) and, on the contrary, the Simpson dominance index was at its highest there. This could be explained by the impact of the fresh timber-felling operation close to site D. Due to this, the number of individuals of several Scolytidae species within site D had significantly increased. This uneven distribution among species was reflected in the decline in the values of the diversity indices (despite the species richness of Coleoptera on the disturbed site D having generally increased) and by the highest value of the Simpson's index of species diversity (Figure 3.2B).



Cyllodes ater Herbst.

The species richness of beetles found on site E was less than on site D, but higher than on sites A, B and C. Thirteen beetle species were found only on site E. Of these, *Dendroctonus micans*, a well-known forest-dwelling pest, was the most notable. The occurrence of *Dendroctonus micans* in the window flight sample from site E is connected to the pines of the adjacent bog having been heavily infested by this species.

Site E was characterised by its higher values of species diversity and evenness, and its lower value of the Simpson dominance index. Sites A, B and C proved to have fairly similar values for species diversity and evenness. However, the differences in tree.species composition between these sites influenced the structure of the communities of saproxylic beetles there. Mass species of scolytids associated with spruce, e.g. *Hylastes cunicularius*, *H. brunneus*, *Xylechinus pilosus*, *Hylurgops glabratus* and *Pityogenes chalcographus*, were more numerous, whereas *Hylurgops palliatus* was less numerous on spruce-dominated sites A and B than on site C,which was located in a forest stand with a higher proportion of pine.

3.3.3 General synecological analysis of the beetle fauna of study area

When conducting a synecological analysis of Coleoptera communities present on sites representing different forest site types, there is a need for a basic knowledge of the larval microhabitats and the nutritional specialisation of the larvae. On the basis of the literature concerning both the ecological and trophic demands of the larvae, all the beetle species obtained in our study can be roughly divided into two groups: saproxylic species defined by Speight (1989) as ”dependent, during some part of their life cycle, upon the dead or dying wood of moribund or dead trees (standing or fallen), or upon wood-inhabiting fungi, or upon the presence of other saproxylics”, and non-saproxylic species, which have no evident associations with the wood-decomposing system. The grouping of all the beetle families represented on the study sites is given in Table 3.7, and that for the most abundant beetle species in Table 3.8. The species caught in numbers in excess of one exemplar per trap were considered the most abundant, and these species constituted, in terms of individuals, about 86% of the pooled catch.

Table 3.7. Numbers of Coleoptera species associated with the wood-decomposing system (saproxylics) and other substrates (non-saproxylics).

Coleoptera Families	Wood-decomposing		Other substrates	Total
	Dead wood and bark	Reproductive Parts of fungi		
Scolytidae	28	0	0	28
Nitidulidae	15	12	0	27
Elateridae	10	0	8	18
Cerambycidae	17	0	0	17
Curculionidae	10	0	6	16
Leiodidae	0	16	0	16
Latridiidae	0	10	5	15
Anobiidae	9	3	0	12
Cisidae	0	12	0	12
Melandryidae	4	6	0	10
Cryptophagidae	5	5	0	10
Monotomidae	3	5	0	8
Scarabaeidae	1	0	8	9
Cantharidae	1	0	7	8
Tenebrionidae	2	4	0	6
Staphylinidae	0	6	0	6
Scirtidae	0	0	6	6
Erotylidae	0	5	0	5
Histeridae	4	0	1	5
Mycetophagidae	0	4	0	4
Chrysomelidae	0	0	4	4
Anaspidae	3	0	0	3
Cerylonidae	3	0	0	3
Lycidae	3	0	0	3
Hydrophilidae	0	0	3	3

Table 3.7. cont.

Coleoptera Families	Wood-decomposing		Other substrates	Total
	Dead wood And bark	Reproductive Parts of fungi		
Lymexylidae	2	0	0	2
Trogossitidae	2	0	0	2
Cholevidae	0	0	2	2
Cleridae	2	0	0	2
Salpingidae	2	0	0	2
Cucujidae	2	0	0	2
Silphidae	0	0	2	2
Pythidae	2	0	0	2
Coccinellidae	0	0	2	2
Byrrhidae	0	0	2	2
Carabidae	1	0	0	1
Lucanidae	1	0	0	1
Tetratomidae	0	1	0	1
Apionidae	0	0	1	1
Endomychidae	0	1	0	1
Colydiidae	1	0	0	1
Oedemeridae	1	0	0	1
Mordellidae	1	0	0	1
Sphaeritidae	0	0	1	1
Eucinetidae	1	0	0	1
Lampyridae	0	0	1	1
Throscidae	0	0	1	1
Dermestidae	0	0	1	1
Buprestidae	0	0	1	1
Sphindidae	0	1	0	1
Attelabidae	0	0	1	1
Nemonychidae	0	0	1	1
Anthicidae	0	0	1	1
Meloidae	0	0	1	1
Total	136	91	65	293

Table 3.8. The most abundant beetle species caught by means of window and polypore traps grouped according their breeding substrates.

	Number of individuals			Number of individuals per trap	
Species	Window	Polypore	Total	Window	Polypore
I Saproxylic beetles developing in decaying wood or under bark of dead or damaged trees					
I.1. Species developing in newly dead trees					
Hylobius abietis	43	20	63	0.90	0.67
Hylurgops palliatus	2298	235	2533	36.19	7.83
Hylastes brunneus	324	31	355	5.07	1.03
Hylastes cunicularius	2404	86	2490	35.57	2.87
Xylechinus pilosus	157	27	184	2.63	0.90
Tomicus piniperda	56	13	69	0.99	0.43
Pityogenes chalcographus	173	4	177	2.53	0.13
Dryocoetes autographus	1103	35	1138	16.26	1.17
Trypodendron lineatum	739	79	818	11.69	2.63
Trypodendron signatum	402	82	484	6.91	2.73
Hylecoetus dermestoides	81	7	88	1.26	0.23
I.2. Species developing in wood decayed by fungi					
Denticollis linearis	83	1	84	1.20	0.03
Ampedus nigrinus	77	13	90	1.29	0.43
Melanotus castanipes	263	33	296	4.23	1.10
Xylita laevigata	221	31	252	3.60	1.03
Anaspis arctica	120	66	186	2.66	2.20
I.3. Obligatory and facultative predators living under tree-bark					
Dromius agilis	78	10	88	1.26	0.33
Epuraea bickhardti	30	16	46	0.66	0.53
Epuraea pygmaea	66	3	69	0.99	0.10
Glischrochilus quadripunctatus	29	20	49	0.70	0.67
Rhizophagus depressus	34	15	49	0.70	0.50
Rhizophagus ferrugineus	368	27	395	5.64	0.90
Rhizophagus dispar	54	38	92	1.31	1.27
Rhizophagus nitidulus	69	13	82	1.17	0.43
Rhizophagus cribratus	29	16	45	0.64	0.53
II Saproxylic beetles directly associated with wood-growing fungi and myxomycetes					
II.1. Species feed on myxomycetes and microfungi					
Anisotoma humeralis	47	72	119	1.70	2.40
Anisotoma glabra	90	137	227	3.24	4.57
Agathidium confusum	38	27	65	0.93	0.90
Agathidium seminulum	138	89	227	3.24	2.97
Agathidium badium	14	19	33	0.47	0.63
Agathidium pisanum	46	23	69	0.99	0.77
Cryptophagus lapponicus	74	66	140	2.00	2.20
Cryptophagus scanicus	32	19	51	0.73	0.63
Cerylon histeroides	41	12	53	0.76	0.40
Enicmus rugosus	78	8	86	1.23	0.27
Corticaria lapponica	84	88	172	2.46	2.93

Table 3.8. cont.

Species	Number of individuals			Number of individuals per trap	
	Window	Polypore	Total	Window	Polypore
II.2. Species feeding on macrofungal fruiting bodies					
Scaphisoma subalpinum	32	45	77	1.10	1.50
Oxyporus maxillosus	56	15	71	1.01	0.50
Dorcatoma dresdensis	125	67	192	2.74	2.23
Dorcatoma robusta	13	19	32	0.46	0.63
Epuraea biguttata	14	23	37	0.53	0.77
Epuraea silacea	5	59	64	0.91	1.97
Triplax russica	221	238	459	6.56	7.93
Triplax scutellaris	40	23	63	0.90	0.77
Cis alter	11	20	31	0.44	0.67
Bolitophagus reticulatus	26	86	112	1.60	2.87
Orchesia micans	58	66	124	1.77	2.20
III Non-saproxylic species					
III.1. Species developing deep in soil					
Eanus costalis	206	14	220	3.14	0.47
Athous subfuscus	242	28	270	3.86	0.93
III.2. Predators living on vegetation					
Rhagonycha atra	101	8	109	1.56	0.27
Absidia schoenherri	49	7	56	0.80	0.23
Total	11 182	2 199	13 381	3.75	1.44

Saproxylic beetles associated with the wood-decomposing system constituted a pool of 227 species, or 78% of all the species obtained by means of window trapping (Table 3.7). In terms of the numbers of individuals, the saproxylic beetles accounted for over 70% of the total beetle catch. This proportion of saproxylics in the pooled window trap material is clearly higher (approx. 50%) than the figures obtained by Siitonen at al. (1995) from neighbouring areas. This is most probably due to our traps not having been set randomly, but instead placed especially close to potentially attractive dead tree trunks or logs.

All the saproxylic species obtained could be roughly divided into two main groups: (1) beetle species with wood-boring or subcortical larvae and (2) species directly associated with wood-growing fungi and myxomycetes, e.g. those living as larvae, and most probably feeding on mycelium or fruiting bodies.

The first group in this study was represented by 137 species, and these could be grouped into at least three subgroups (Table 3.8). A subgroup of species developing in newly-dead trees or in the moribund parts of living trees was the most abundant one due to several mass species of Scolytidae, first of all, *Hylastes cunicularius*, *Hylurgops palliatus*, *Dryocoetes autographus*, *Trypodendron lineatum* and of Lymexylidae (*Hylocoetus dermestoides*). The subgroup of species developing in wood severely-decayed by fungi was more diverse, but the numbers of individuals of particular species were markedly lower. Only three species of Elateridae (*Melanotus castanipes*, *Ampedus nigrinus*, *Denticollis linearis*), one species of Melandryidae (*Xylita laevigata)* and Anaspidae (*Anaspis arctica)* were represented among those with more than one individual per trap. The subgroup of subcortical predators contains nine species considered to have been abundant in our beetle catch. Of these, *Glishrochilus guadripunctatus* (Nitidulidae), and a species of the genus *Rhizophagus*, are known to be obligatory predators feeding on the larvae and pupae of bark beetles in their galleries. The most common species of the genus *Epuraea, E. marseuli* and *E. pygmaea* (Nitidulidae) seemed to be rather facultative predators feeding partly on microfungi such as Ascomycetes and Deuteromycetes.

The second group – beetles directly associated with fungi and myxomycetes – was comprised of 91 species. Of these, the species of Leiodidae, Latridiidae, Cryptophagidae and Cerylonidae feeding on microfungi and myxomycetes (subgroup II.1) were the best represented in our catch. Among species feeding as larvae on the reproductive parts of macrofungi (subgroup II.2) *Triplax russica* was the most abundant. The larvae of this species develop almost exclusively in the fruiting bodies of *Inonotus obliquus* (Nikitsky et al. 1996). In its adult stage, it is well known as an inhabitant of the soft sporophores of wood-growing Agarics, although Benick (1952), Kompantzev (1984) and Krasutsky (1996) have reported this species from *Fomes fomentarius*, too. *Triplax russica* was also mentioned by Kaila et al. (1994) as one of the most abundant species in polypore traps attached to *Fomes fomentarius* in southern Finland (Heinola) and Russian Karelia (Kivach Nature Reserve).

The third group consisted of non-saproxylic species, which do not directly consume wood, wood growing fungi, slime moulds or other saproxylic organisms. The non-saproxylic beetles obtained by means of window flight traps in this study include eight species of soil-dwelling Elateridae, six species of Cantharidae and five species of Curculionidae living in the soil, litter, canopy and herb-level in forests. Several species of Scarabaeidae, particularly *Aphodius rufipes*, and Silphidae, were frequently attracted by the smell of dead insects from the collecting jars.

3.3.4 A comparison of two methods of sampling with ecological notes on certain species of saproxylic beetles collected more effectively by means of polypore traps

Knowledge about effectiveness and selectivity of the various methods of trapping saproxylic beetles is considered fundamental when deciding on the choice of methods and interpretation of results (Økland 1995). Window flight trapping is a very useful quantitative method of collecting insects. Standard window traps are well known and there are numerous publications about trapping with them. The data about ”trunk” or ”polypore” window traps attached to tree trunks or fruiting bodies of polypore fungi are rather scanty and have appeared only in recent years following the work of Kaila (1993).

Our results enable a comparison of the effectiveness of standard window and polypore traps. (Figure 3.4). Standard window traps, which have approximately eight times the barrier surface area of polypore traps, appear to be more effective in fauna studies. Significantly more beetle species and individuals were captured using standard window traps than when using polypore traps (cf. Table 3.4). The number of species collected by means of window traps was 280 (of these, 122 species were not caught in polypore traps) compared with 166 (13) species obtained by means of polypore traps. The numbers of individuals collected per trap was 181,7 and 112,0, respectively. However, the polypore traps were generally more productive than the window traps in catching certain Coleoptera species due to the attractive effect of the fruiting bodies on which these traps were placed. The sixty-seven beetle species that proved to be clearly more effectively collected by means of polypore traps are listed in Table 3.9. Of these, eleven species, including the threatened *Tomoxia bucephala* and two fairly uncommon species *Scaphisoma inopinatum* and *Necydalis major,* were collected only by means of polypore traps.

All species of Leiodidae obtained belong to the tribe Anisotomini. They are known to feed as larvae on myxomycetes, but the adults are capable of feeding on the spores, mycelium or fruiting bodies of fungi as well. They were predominated, in terms of the numbers of individuals caught, by *Anisotoma glabra, A. humeralis* and *Agathidium seminulum*. *Anisotoma* species showed evident attraction to the polypore fungi employed in the traps while *Agathidium* species, with the exception of *A. badium*, *A. arcticum* and *A. laevigatum,* were more numerous in window traps. The greater number of *Anisotoma* species in the polypore traps as compared to *Agathidium* species has been mentioned also by Kaila et al. (1994). Jonsell and Nordlander (1995) reported *Anisotoma glabra* as a species effectively attracted to *Fomes fomentarius* while *Agathidium seminulum* did not appear to be significantly attracted to any polypores.

Table 3.9. The Coleoptera species caught more effectively by means of polypore traps than by means of window traps.

Coleoptera species	Average number of individuals per trap Polypore traps	Window traps	Ratio polypore / windows catches
LEIODIDAE			
Anisotoma humeralis	2.40	0.67	3.57
Anisotoma axillaris	0.27	0.06	4.67
Anisotoma castanea	0.37	0.31	1.17
Anisotoma glabra	4.57	1.29	3.55
Amphicyllis globus	0.03	0.03	1.17
Agathidium varians	0.40	0.23	1.75
Agathidium arcticum	0.03	0	–
Agathidium confusum	0.90	0.54	1.66
Agathidium nigripenne	0.23	0.16	1.48
Agathidium laevigatum	0.06	0	–
Agathidium seminulum	2.97	1.97	1.50
Agathidium badium	0.63	0.20	3.17
Agathidium pisanum	0.77	0.66	1.17
STAPHYLINIDAE			
Scaphisoma inopinatum	0.03	0	–
Scaphisoma boleti	0.30	0.06	5.25
Scaphisoma subalpinum	1.50	0.46	3.28
Scaphisoma boreale	0.03	0.03	1.17
HISTERIDAE			
Gnathoncus buyssoni	0.03	0.03	1.17
Dendrophilus pygmaeus	0.03	0.01	2.33
Platysoma lineare	0.03	0	–
CANTHARIDAE			
Malthodes guttifer	0.07	0.06	1.17
ELATERIDAE			
Ampedus tristis	0.30	0.11	2.63
Ptilinus fuscus	0.03	0.03	1.17
ANOBIIDAE			
Dorcatoma dresdensis	2.23	1.79	1.25
Dorcatoma robusta	0.63	0.19	3.41
TROGOSSITIDAE			
Peltis grossa	0.10	0.03	3.50
NITIDULIDAE			
Epuraea concurrens	0.20	0.04	4.67
Epuraea oblonga	0.07	0.01	4.67
Epuraea marseuli	0.53	0.43	1.24
Epuraea terminalis	0.09	0	–
Epuraea biguttata	0.77	0.20	3.83
Epuraea unicolor	0.07	0.04	1.56
Epuraea variegata	0.27	0.10	2.67
Epuraea silacea	1.97	0.07	27.53
Epuraea rufomarginata	0.47	0.10	4.67
Ipidia binotata	0.30	0.11	2.63
Pocadius ferrugineus	0.20	0.06	3.50

Table 3.9. cont.

Coleoptera species	Average number of individuals per trap: Polypore traps	Window traps	Ratio polypore / windows catches
Cyllodes ater	0.30	0.11	2.63
Glischrochilus hortensis	0.37	0.11	3.21
Glischrochilus quadripunctatus	0.67	0.41	1.61
MONOTOMIDAE			
Rhizophagus depressus	0.50	0.49	1.03
Rhizophagus dispar	1.27	0.77	1.64
Rhizophagus bipustulatus	0.03	0.03	1.17
Rhizophagus cribratus	0.53	0.41	1.29
CRYPTOPHAGIDAE			
Cryptophagus lapponicus	2.20	1.06	2.08
Cryptophagus labilis	0.03	0.01	2.33
Cryptophagus scanicus	0.63	0.46	1.39
EROTYLIDAE			
Triplax russica	7.93	3.16	2.51
Triplax scutellaris	0.77	0.57	1.34
Triplax rufipes	0.10	0.03	3.50
Dacne bipustulata	0.13	0.06	2.33
LATRIDIIDAE			
Latridius hirtus	0.23	0.16	1.48
Stephostethus pandellei	0.13	0.04	3.11
Corticaria serrata	0.07	0.06	1.17
Corticaria lapponica	2.93	1.20	2.44
Corticaria foveola	0.06	0	–
CISIDAE			
Cis alter	0.67	0.16	4.24
Cis jacquemartii	0.43	0.07	6.07
Cis comptus	0.03	0.01	2.33
Cis hispidus	0.27	0.04	6.22
Cis boleti	0.37	0.16	2.33
Ennearthron laricinum	0.03	0.01	2.33
Orthocis alni	0.13	0.07	1.87
Ropalodontus strandi	0.50	0.03	17.50
MYCETOPHAGIDAE			
Litargus connexus	0.03	0	–
TENEBRIONIDAE			
Bolitophagus reticulatus	2.87	0.37	7.72
Diaperis boleti	0.03	0	–
Bius thoracicus	0.07	0.03	2.33
ANASPIDAE			
Anaspis arctica	2.20	1.71	1.28
MORDELLIDAE			
Tomoxia bucephala	0.06	0	–
MELANDRYIDAE			
Orchesia micans	2.20	0.83	2.66

Table 3.9. cont.

Coleoptera species	Average number of individuals per trap Polypore traps	Window traps	Ratio polypore / windows catches
CERAMBYCIDAE			
Necydalis major	0.03	0	–
NEMONYCHIDAE			
Cimberis attelaboides	0.03	0	–
CURCULIONIDAE			
Polydrosus undatus	0.27	0.21	1.24
Strophosoma capitatum	0.37	0.17	2.14
Rhyncolus elongatus	0.33	0.07	4.67
Rhyncolus ater	0.06	0	–
Hylobius abietis	0.67	0.61	1.09
Hylobius pinastri	0.03	0.01	2.33

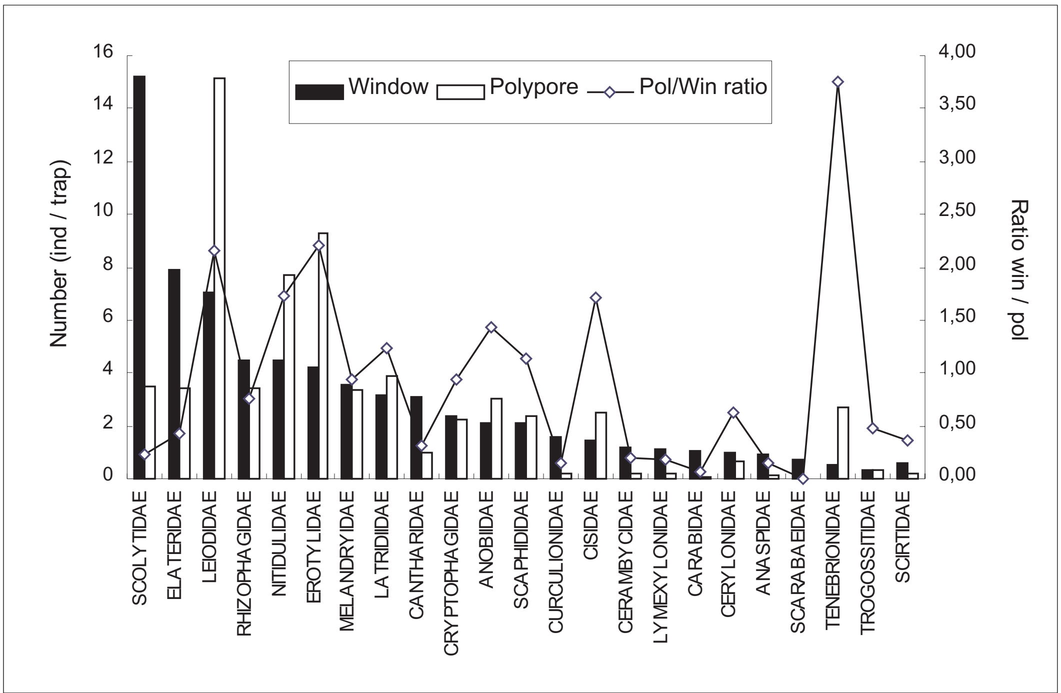


Figure 3.4. The numbers of individuals collected by means of polypore and window traps, and the catch ratio between these two types of traps.

Two species – *A. discoideum* and *A. nigrinum,* mentioned by Rutanen (1994a) as faunistically interesting finds in the adjacent area at Patvinsuo National Park – demonstrated a very local distribution on our study sites. The first was common, and the second was found only on the sample site E, near the felling operation with its numerous aspen logs. No species belonging to the family Leiodinae were found in the study area although Rutanen (1994a) reported ten species (of these, seven belong to the genus *Leiodes* Latr.) from a burnt forest area at Patvinsuo. This was probably due to the impact of the forest fire, which stimulated fungal growth and, thus, increased potential breeding-sites of the Leiodinae species developing in subterranean mycorrhizae (Muona & Rutanen 1994).

Staphylinidae were represented by five *Scaphisoma* species, with *S. subalpinum* as the most common, and *S. inopinatum* and *S. boreale* – rare species – were represented by single individuals. All these species are known to be typical inhabitants of fruiting bodies of wood-growing fungi (Nikitsky et al. 1996, Pototskaya 1982, Krasutsky 1996). At least three of them, particularly *S. boleti* and *S. subalpinum*, tended to be attracted to polypore fungi.

Scirtidae were represented by five species of the genera *Cyphon* Payk. and *Microcara* Thoms. None of them showed any preference to polypore traps. Very little is known about the biology of these genera. The wood-growing species seem to be semi-aquatic, developing in moist substrates inside tree hollows (Lafer 1989, Nikitsky et al. 1996). Larval associations with fungi or myxomycetes, or the species obtained in this study, have not been established. Adults could be usually found on flowers and herbs, although several *Cyphon* and *Microcara* species were also registered on fungal fruiting bodies (Benick 1952, Jonsell & Nordlander 1995, Krasutsky 1996).

Cantharidae. All of the species obtained are known as predators living among the vegetation. The most common species *Rhagonycha atra* and *Absidia schoenherri* were more numerous in window traps. Only the species *Malthodes guttifer* showed a slight preference to the polypore traps. The members of the genus *Malthodes* Kies., in contrast to other cantharids, includes species that develop underneath the bark of dead trees. Fungus associations are possible with some of the species because adults of *Malthodes* were found on polypore fungi (Benick 1952).

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Anobiidae were mostly collected by window traps. As expected, only species of the genus *Dorcatoma* Herbst (*D. dresdensis* and *D. robusta*), which develop in the fruiting bodies of wood-growing fungi, were collected with greater effectiveness in polypore traps. A third species, *D. punctulata*, probably confined only to *Fomitopsis pinicola*, did not demonstrate evident attraction to our polypore traps which were mainly placed on *Fomes fomentarius*.

Nitidulidae was the best-represented family in terms of beetle species in this study. In general, both mycophagous and predatory species were collected more effectively in polypore traps. The genus *Epuraea* Erich., however, deserves special attention. Of the twenty-seven species of Nitidulidae found in the sample area, nineteen belonged to this large genus. Data on the larval diet and associations with microhabitats of many *Epuraea* species are contained in recent publications by Nikitsky (Nikitsky et al. 1996) and Rutanen (1994b, 1995). Most of the members of this genus are known to be subcortical inhabitants living in the larvae galleries of other saproxylics, particularly of Scolytidae and in the fruiting bodies of wood-growing fungi. Such niche specialisation is typical for the majority of *Epuraea* species found in this study (only *E. aestiva* appears to be a non-saproxylic developing in the nests of bumblebees). Eight species of the genus *Epuraea* (*E. silacea, E. biguttata, E. marseuli, E. rufomarginata, E. variegata*, E. *concurrens, E. terminalis, E. oblonga* and *E. unicolor*) were more effectively collected by means of polypore traps. This holds at least for the first six species, which were common enough in our trapping. All of them were formerly recorded as imagoes collected on the fruiting bodies of various wood-growing fungi (Benick 1952, Nikitsky et al. 1996, Krasutsky, 1996). Another ten *Epuraea* species (of these *E. pygmaea* and *E. angustula* are the most numerous ones) were caught only, or mainly, by means of standard window traps.

Cisidae associating with the fruiting bodies of macrofungi both as larvae and adults are generally characterised by their obligate relationships with particular groups of fungus host species (Paviour-Smith 1960). As expected, all species of cisid beetles abundant enough in our sample were collected more effectively by means of polypore traps. The only exception was *Cis punctulatus*: six individuals were caught by window traps and only one by polypore trap. The probable reason for this is that this species does not breed in *Fomes fomentarius* or in *Fomitopsis pinicola* but prefer other fungi - *Trichaptum abietinum*, *T. fusco-violaceum*, *T. biforme* and *Onnia circinata* (Benick 1952, Kompantzev 1984, Nikitsky et al. 1996, Krasutsky 1996).

Tenebrionidae catches on all of the sample sites were predominated by *Bolitophagus reticulatus*, which was caught six times more effectively by means of polypore traps than window traps. This species is a well-known inhabitant of hard polypores with a clear preference for *Fomes fomentarius* (Kaila et al. 1994, Økland 1995). *Diaperis boleti,* the other species exhibiting obligatory association with polypores, appeared to be rare in the study area. Species of the genus *Mycetochara* Bert. (*M. flavipes* and *M. obscura*), which develop in severely-decayed wood, did not demonstrate any attraction to polypore traps.

Melandryidae. Of the eight species obtained in this study *Xylita laevigata* (the most numerous species on all the sample sites), *Zilora* species and *Melandrya dubia* live as larvae in rotten wood. Other species develop in the fruiting bodies of wood-growing fungi. Only one of them, *Orchesia micans*, was clearly more abundant in polypore traps although the others were represented by a few individuals caught in standard window traps.

Curculionidae. It was rather surprising to find several species developing under the bark and in the dead wood of conifers (*Rhyncolus elongatus*, *Hylobius abietis* and *H. pinastri*) and in the ground vegetation layer (*Strophosoma capitatum*, *Polydrosus undatus*) to be more common in the polypore traps. All except the few in number *Hylobius pinastri* demonstrated an attraction to the fruiting bodies of polypores growing mostly on dead birch trunks.

3.3.5 Inter-year fluctuations of beetle catches

According to Muona & Rutanen (1994), the yearly variation in the abundance of beetle species in Finnish coniferous forests can be six-to-ten fold, with the fluctuation in the numbers of specimens varying strongly and independently within different species. Our results cannot make any precise contribution to this inadequately researched matter. A comparison of year-to-year beetle catches included in our study (Figure 3.5A, B) is not entirely appropriate due to differences in the starting dates of collection. However, at least one general trend would appear to be evident.

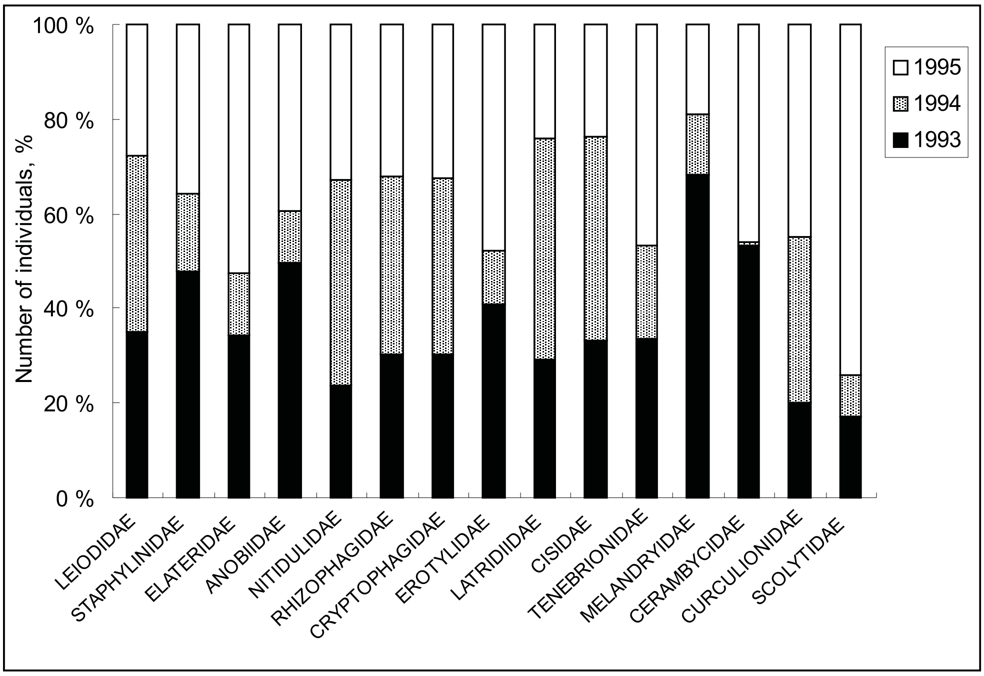

Figure 3.5a. Inter-year fluctuations of the total beetle catches in 1993–1995.

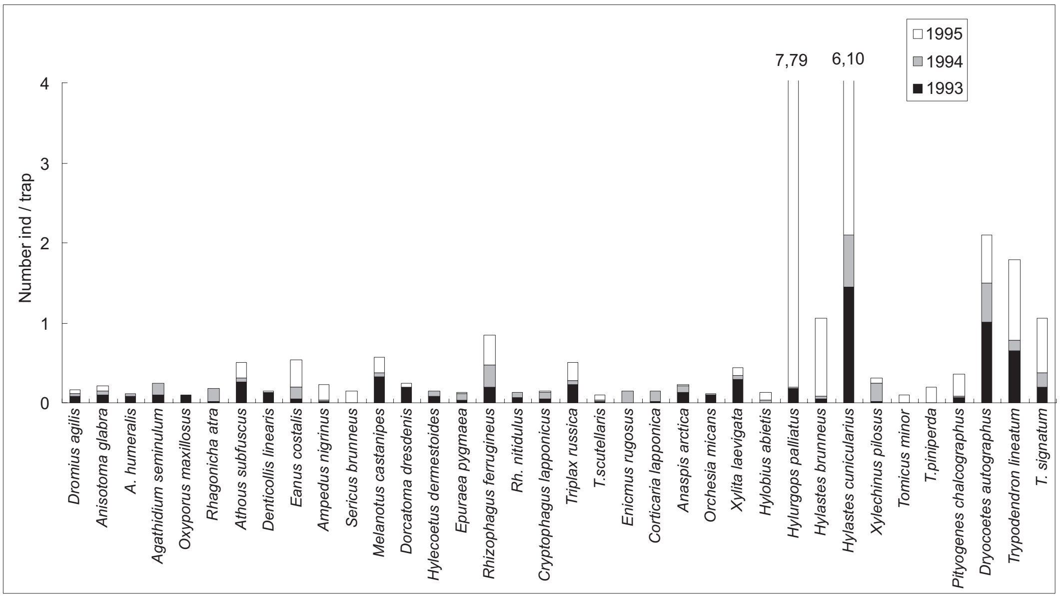

Figure 3.5b. Inter-year fluctuations of catch-numbers of the most abundant beetle species.

A very clear flush of Scolytidae was obtained on site D in 1995 after wintertime timber felling there. In 1994, scolytids, as a whole, were almost equally abundant on sites D and E, although in 1995 the number of bark beetles caught from site D was over twice than caught from site E. The most notable increase in the number of individuals was noted for two species of the genus *Hylastes* Erich., namely *H. brunneus*, associated with pine, *H. cunicularius*, which live in spruce stumps, and *Hylurgops palliatus*, which lives in large fallen trunks. All three are known to be secondary invaders colonising only dead trees. The most important pest scolytids were less abundant, but there were three species whose numbers increased after timber felling as well. First of all, the pine shoot beetles, *Tomicus minor* and *T. piniperda*, known to be the most destructive forest pests in all of Europe, appeared on the Tapionaho sample sites only in 1995. Among the primary invaders of spruce, *Pityogenes chalcographus* increased in numbers in 1995, although a more dangerous potential pest species, *Ips typographus*, was present in very low numbers.

To summarise the situation concerning Scolytidae, the total beetle catch in 1994 comprised only about a half of the catches in 1993 or in 1995. The diminished catch of 1994 was not manifested equally among the beetle families. Generally, only certain species of Staphylinidae, Anobiidae, Erotylidae, Tenebrionidae and Melandryidae associated with fungi declined in 1994, while others (including members of the family Leiodidae feed on slime moulds) did not show any decrease in numbers of individuals trapped.

3.3.6 *Occurrence of potential forest pests in the study area*

The percentage of dead trees with signs of colonisation by different species of saproxylic Coleoptera resulting from the observations of dead trunks of conifers in each sampling site are given in Table 3.10. The average date for all sample sites is pesented in Figure 3.6.

Table 3.10. Percentage of dead coniferous trees with signs of colonisation by saproxylic Coleoptera on the sample sites in the Koitajoki area (1995).

Coleoptera species	Tapionaho				Koita-joki	Niemi-järvi	Lahnavaara		Total
	A	B	D	E					
Spruce									
ELATERIDAE									
Melanotus castanipes	7.1	–	–	–	–	–	–	–	1.0
BUPRESTIDAE									
Anthaxia quadripunctata	7.1	–	33.3	–	16.7	50	27.3	15.6	20.4
ANOBIIDAE									
• in the bark	14.2	–	66.7	–	22.4	16.7	–	3.8	11.7
• in the wood	21.4	–	66.7	–	5.6	11.2	–	–	7.8
MELANDRYIDAE									
Xylita laevigata	7.1	16.7	66.7	14.3	5.6	5.6	18.2	7.6	10.7
CERAMBYCIDAE									
Tetropium sp.	28.5	16.7	–	14.3	33.3	5.6	–	11.5	15.5
Callidium sp.	14.2	–	33.3	–	5.6	–	–	–	3.9
Rhagium inquisitor	21.4	50	–	14.3	22.4	5.6	9.1	7.6	14.6
Leptura sp.	–	–	–	–	5.6	–	–	–	1.0
Other species of Cerambycidae	7.1	–	–	–	–	–	–	3.8	1.9
CURCULIONIDAE									
Rhyncolus sculpturatus	–	–	–	–	–	1	18.2	3.8	3.9
Pissodes harcyniae	28.5	50	–	–	–	1	54.6	30.4	21.4
Hylobiuis abietis	–	–	–	–	–	–	–	3.8	1.9
SCOLYTIDAE									
Hylurgops glabratus	–	–	–	42.9	–	–	9.1	–	3.9
Hylurgops palliatus	14.2	16.7	–	57.1	16.7	–	18.2	23.1	17.5
Hylastes cunicularius	–	–	–	–	16.7	–	45.5	–	2.9
Xylechinus pilosus	35.7	66.7	–	42.9	39.2	50	45.5	73.1	50.5
Phloeotribus spinulosus	7.1	–	–	14.3	5.6	–	–	7.6	4.9
Polygraphus sp.	42.9	50	66.7	–	50	22.4	45.5	61.5	43.7
Pityogenes chalcographus	–	–	–	42.9	11.2	–	18.2	15.6	10.7
Ips duplicatus	–	–	–	–	5.6	–	9.1	–	1.9
Ips typographus	–	–	–	42.9	5.6	5.6	–	3.8	5.8
Dryocoetes autographus	–	–	–	14.3	–	–	–	11.5	3.9
Crypturgus cinereus	–	–	–	–	11.2	–	–	–	1.9
Trypodendron lineatum	7.1	–	–	14.3	5.6	–	–	15.6	6.8
Cryphalus saltuarius	–	–	–	–	5.6	–	18.2	3.8	3.9
Number of trees examined	14	6	3	7	18	18	11	26	103

Table 3.10. cont.

Coleoptera species	Tapionaho				Koita-joki	Niemi-järvi	Lahnavaara		Total
	A	B	D	E					
Pine									
ELATERIDAE									
Melanotus castanipes	28.6	–	42.6	27.3	–	23.8	16.7	–	27.4
ANOBIIDAE									
• in the bark	14.3	–	–	–	–	–	–	–	1.6
• in the wood	–	–	6	9.1	–	4.8	–	–	12.9
TROGOSSITIDAE									
Ostoma ferruginea	–	–	7.1	–	–	–	–	50	3.2
PYTHIDAE									
Pytho depressus	–	50	7.1	9.1	–	–	–	–	4.8
MELANDRYIDAE									
Xylita laevigata	57.1	50	14.2	45.5	–	23.8	16.7	50	30.6
CERAMBYCIDAE									
Callidium sp.	–	–	7.1	–	–	–	–	–	1.6
Rhagium inquisitor	14.3	50	7.1	45.5	–	4.8	–	–	14.5
Leptura sp.	14.3	50	7.1	9.1	–	–	–	–	6.5
Monochamus sp.	–	–	–	–	–	–	16.7	–	1.6
Acanthocinus aedilis	–	–	21.3	–	–	4.8	–	–	6.5
Other species of cerambycids	42.9	–	56.8	45.5	–	38.1	33.4	50	43.5
CURCULIONIDAE									
Phyncolus sp.	71.4	50	42.7	36.4	–	23.8	33.4	50	38.7
Pissodes sp.	14.3	–	–	–	–	–	–	–	1.6
SCOLYTIDAE									
Hylurgops palliatus	28.6	–	14.2	54.6	–	9.5	33.4	50	22.6
Tomicus minor	–	–	50	63.7	1	33.3	33.4	100	40.3
Tomicus piniperda	100	100	50	81.9	–	61.9	66.7	100	69.4
Ips acuminatus	–	–	–	9.1	–	–	–	–	1.6
Dryocoetes autographus	–	–	7.1	9.1	–	–	–	–	3.2
Crypturgus cinereus	–	–	–	9.1	–	–	–	–	1.6
Trypodendron lineatum	71.4	–	14.2	100	–	97.6	16.7	–	46.8
Number of trees examined	7	2	14	11	0	21	6	2	63

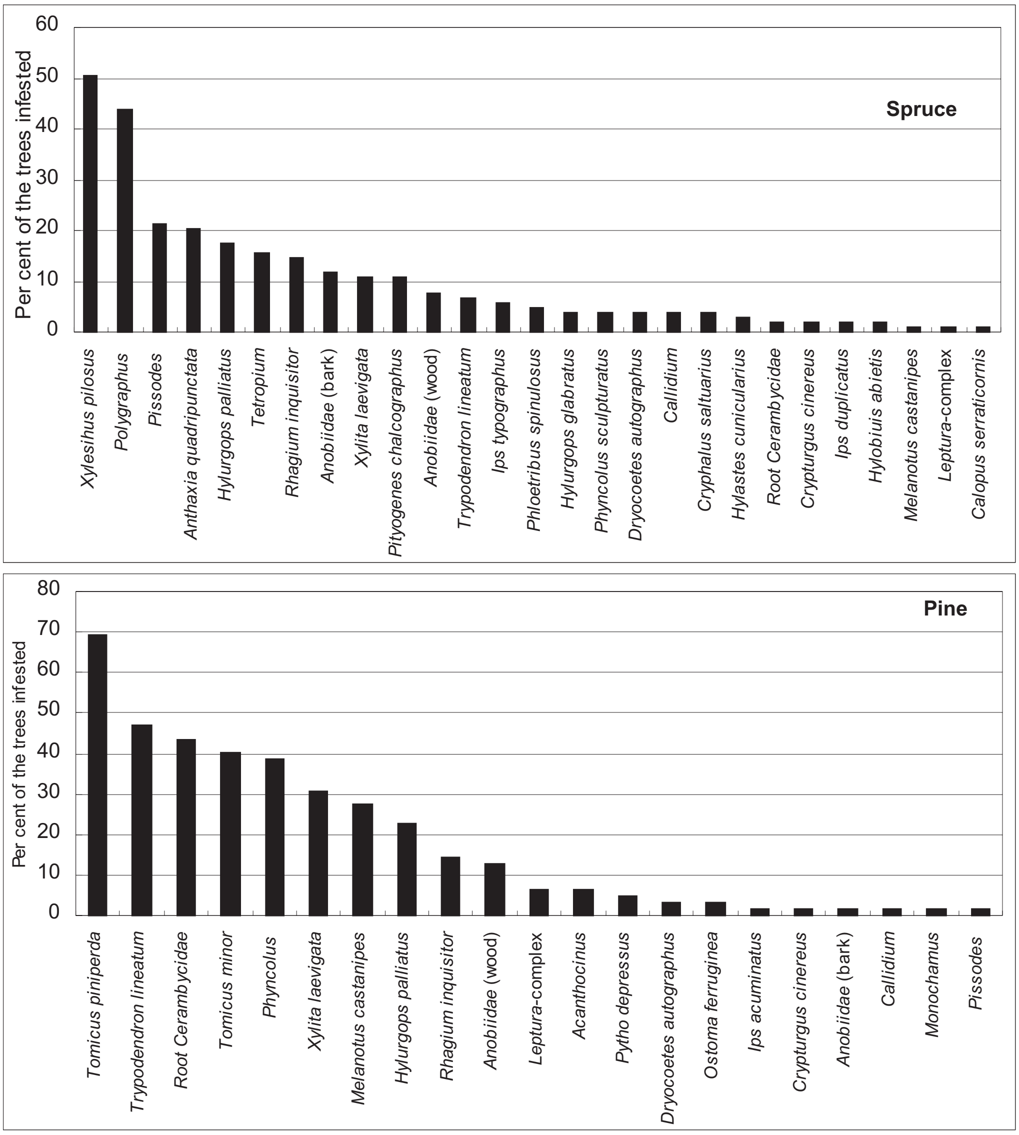

Figure 3.6. The average percentage of dead coniferous trees with signs of colonisation by saproxylic beetles.

Spruce. Almost all dead trees contained galleries of Scolytidae. The most abundant species, *Xylechinus pilosus*, and species of the genus *Polygraphus* Erich. were found, on average, infesting every second dead spruce on all of the sampling sites. On snags *Polygraphus* species are often accompanied with cerambycids of the genus *Tetropium*.Two species of bark beetles, *Ips typographus* and *Pityogenes chalcographus* known to be potential pests able to colonise living trees were found only on site D at Tapionaho and on site C at Koitajoki. As expected, they appeared in the study sites with high numbers of newly-dead trees due to timber felling (site D) or spring floods (Koitajoki site). On site D at Tapionaho, numerous signs of unsuccessful colonisation attempts by *Ips* *typographus* (larval galleries and undeveloped pupae) were found even on the few living spruces at the forest edge adjacent to the felling area.

About twenty per cent of the dead spruces on the six sample sites had larval galleries of *Anthaxia quadripunctata*, which proved to be a common species in the study area. However, neither *Anthaxia* nor other buprestids (with the exception of one individual of *Buprestis rustica* collected by window trap at the edge of the felling area on site D) were obtained by means of flight window trapping.

Pine was colonised mainly by the pine shoot scolytids *Tomicus piniperda*, *T. minor* and *Trypodendron lineatum*. It should be mentioned that the bulk of window flight catches of *Tomicus* species were obtained only on site D, whereas on the undisturbed, pine-predominated site C they were not found in the adult stage.

Almost half of the pines examined as regards their basal part contained larvae galleries of cerambycids (species of *Rhagium* Fabr., *Arhopalus* Aud.-Serv., and *Acanthocinus* Dej.) and live larvae of elaterids (*Melanotus castanipes*) and melandryids (*Xylita laevigata*). Every third pine was colonised by the bark weevil *Rhyncolus sculpturatus* Waltl. Weakened pines growing in the adjacent *Sphagnum* bog were infested by the bark beetle *Dendroctonus micans*.

Thus, a typical complex of saproxylic beetles associated with dead coniferous trees was found to prevail on the sampling sites. All signs of successful colonisation by xylophagous beetles, including such aggressive Scolytidae species as *Tomicus piniperda*, *T. minor* (pine), *Ips typographus* and *Pityogenes chalcographus* (spruce) were found only on dead trees. In the case of window flight catches, populations of these species rise only on sample site adjacent to freshly felled area, but they were rare or absent on the undisturbed forests sites. This confirms the recent results obtained in southern Finland (Martikainen et al., 1999). Infestation by *Dendroctonus micans* of living pines was noted only on pine-covered bogs but not in upland forests. In other words, the areas of mature unmanaged forests preserved within the North Karelian Biosphere reserve could not be considered to be dispersal centres of forest-dwelling insect pests.

3.3.7 Occurrence of threatened beetle species in the study area

The order Coleoptera incorporates the most numerous set of species considered to be vulnerable to anthropogenic changes in forests throughout Northern Europe. Saproxylic beetles comprise more than half of all insect species in the Red Data Books of Finland (Uhanalaisten... 1992), Sweden (Ehnström et al. 1993) and Russian Karelia (Ivanter et al. 1995). Our data contained records of fourteen beetle species (Table 3.11) included in the most recent edition of the Finnish list of threatened animals (Uhanalaisten... 1992). Five of them have already been found within the territory of the North Karelian Biosphere Reserve; three species, *Pytho abieticola*, *Peltis grossa* and *Eucilodes caucasicus* have been reported from Pallosenvaara in Ilomantsi (see Pajari, 1995); and two others (*Lacon fasciatus* and *Triplax rufipes*) from small burnt forest areas of Patvinsuo National Park

(Rutanen 1994a). Nine species were reported from the North Karelian Biosphere Reserve for the first time.

Table 3.11. A list of Coleoptera species considered to be threatened in Finland (Uhanalaisten... 1992) and collected by means of window and polypore traps, and by hand-picking on Tapionaho sample sites (A-F) in 1993–1995.

		Number of individuals											Total		
Coleoptera species	*Category*										*1993–1994*			*1995*	
															Hand-
		A	B	C	D	E	F	A	B	C	D	E	Win	Pol	picking
Cyllodes ater	H	–	–	2	9	4	–	–	–	–	1	1	8	9	1
Monochamus urussovi	V	–	–	–	1	–	–	–	–	–	–	–	–	–	1
Orthotomicus longicollis	V	–	–	1	–	–	–	–	–	–	–	–	1	–	–
Lacon fasciatus	St	–	–	–	–	1	–	–	–	–	–	–	1	–	–
Peltis grossa	St	–	–	2	–	3	–	–	–	–	1	–	2	3	–
Mycetophagus quadripustulatus	St	1	–	1	–	5	–	–	–	–	–	–	5	2	1
Pytho abieticola	St	–	–	–	1	–	–	–	–	–	–	1	2	–	–
Tomoxia bucephala	St	–	–	1	1	–	–	–	–	–	–	–	–	2	–
Melandrya dubia	St	2	2	–	2	2	–	–	–	–	–	1	7	2	–
Leptura nigripes	St	–	–	–	–	–	–	–	–	–	3	3	6	–	–
Triplax rufipes	Sh	–	–	2	1	1	–	–	–	–	–	1	2	3	–
Eucilodes caucasicus	Sh	–	–	–	–	–	–	–	–	–	1	–	1	–	–
Meloe violaceus	M	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Zilora elongata	M	–	–	–	2	–	1	–	–	–	–	–	5	–	–

The following nine species were found from North Karelian biosphere Reserve for the first time:

* *Cyllodes ater* Herbst. Category E (Endangered). A total of eighteen individuals were found on three sites in Tapionaho over the period of three years: twelve in 1993, four in 1994, and two in 1995. Of these, eight individuals were caught by means of standard window traps, nine by means of polypore traps: one individual was found on 28.7.1993 on the hymenophore of *Pleurotus pulmonarius* growing on the trunk of a dead birch. *Cyllodes ater* has been considered to be extinct in Finland since 1918 (Uhanalaisten... 1992). Following our first record of its occurrence in Tapionaho in 1993 (Yakovlev & Hokkanen 1995), it was moved to the 'Endangered' category (Kotiranta et al. 1998). The species has been in decline in other parts of Fennoscandia, too (Ehnström et al. 1993, Asbirk & Sodgaard 1991), although in southern parts of Russian Karelia it is still common (Yakovlev 1995, Siitonen et al. 1996). However, despite great sampling efforts, it has not been found in the westernmost parts of Karelia (i.e. Puikkola, Janisjärvi area (Yakovlev 1996, Martikainen et al. 1998) and along the road Korpiselka–Tolvajärvi (Siitonen et al. 1995). The population of *Cyllodes ater* in the Koitajoki area appears to be unique in Finland and it is also the northernmost of the known occurrences of this insect. Urgent conservation measures for these forests

occurrences of this insect. Urgent conservation measures for these forests are necessary to preserve it.

* *Monochamus urussovi* (Fischer von Waldheim). Category V (Vulnerable). One individual was found on a fallen spruce trunk at the edge of the felled area near site D. This species needs newly dead trees to enable larval development. It has become rare in Finland due to intensive forest management. It is believed to require old, large spruces, or then it is somehow dependent on forest fires (Muona et al. 1998). To the east of Finland, however, the species is still widespread and fairly common throughout the taiga zone. In Siberia, and partly in the European taiga, it is known as an important pest able to attack living larch trees. (Yatzentkovskii 1938, Pavlovskii and Stackelberg 1955). The species is widely distributed in the southern parts of Russian Karelia. It is to be readily found on newly dead or severely weakened spruces along the edges of felled area and in stands destroyed by fires, water flooding or other disturbing factors (Yakovlev et al. 1986, Mozolevskaya et al. 1991).

* *Orthotomicus longicollis* (Gyllenhall) Category V (vulnerable). One individual was collected by means of a window trap on site C, populated by numerous huge pines. This is a very rare species in Finland and in other parts of Fennoscandia (Uhanalaisten... 1986). Its larvae develop under the bark of the basal parts of large Scots pines which have died recently in old and vast forests of pine. Managed forests lack suitable breeding material for this species (Martikainen et al. 1996). In Russian Karelia it appears to be a southern species because it has been found only in the Kivach Nature Reserve (Yakovlev et al. 1986, Mozolevskaya et al. 1991), but not in the more extensive pine forest areas in the Paanajärvi National Park and the proposed Kalevalsky National Park (Yakovlev et al., 2000).

Lacon fasciatus (L.) Category Md (Declined). One individual was collected by means of a window trap on site E. This is a fairly uncommon species which develops underneath the bark of deciduous trees infected by fungi.

Peltis grossa (L.) Category Md (Declined). Two individuals were collected by means of window traps and three by means of polypore traps on sites C and E. Its larvae develop in the dead wood of spruce and deciduous trees infected by the fungi *Fomes fomentarius* and *Fomitopsis pinicola*. This species is subject to decline in numbers due to intensive forest management. In southern parts of Russian Karelia it is still common.

Mycetophagus quadripustulatus (Linnaeus) Category Md (Declined). Five individuals were collected by means of window traps and two by means of polypore traps on three sites in Tapionaho. The larvae of this species develop in the sporophores of fungi growing mostly on birch or aspen. In Russian Karelia, the species is common in the southern parts, but it has never been found north of Tolvajärvi.

Pytho abieticola J. Sahlberg. Category Md (Declined). Two individuals were collected by means of window traps on site D. Its larvae develop under the bark of fallen spruces of modest size, mostly in moist spruce forests with a plenty of fallen trees. *Pytho abieticola* is a rare species, and apparently it has limited distribution abilities and is not able to survive in managed forests. In Russian Karelia it appears to be rarer than the related species *Pytho kolwensis* Sahlberg that is fairly common on favourable sites.

Tomoxia bucephala Costa Category Md (Declined). Two individuals were collected by means of polypore traps on two sites in Tapionaho. The larvae develop in soft, white-rot wood of deciduous trees with fungus mycelia, mostly *Fomes fomentarius* or *Phellinus* (Nikitsky et al. 1996).

* *Melandrya dubia* (Schaller) Category Md (Declined). Several individuals were collected by means of window and polypore traps from four sites in Tapionaho and one site in Lahnavaara. This species seems to be a fairly common one, usually encountered in forests with plenty of dead birch infected by *Fomes fomentarius*.

* *Leptura nigripes* (Fabricius) Category Md (Declined). Six individuals were collected by means of window traps on two sites, D and E, in 1995 following timber felling. Its larvae develop in dead birch and aspen, prefer dry tree trunks and stumps, but the adult beetles are attracted to fresh timber-felling sites. It is common in the southern parts of Russian Karelia.

Triplax rufipes (Fabricius) Category Mr (Rare). Two individuals were collected by means of window traps and three by means of polypore traps on three sites in Tapionaho. Its larvae develop in the sporophores of fungi (preferably *Pleurotus* species) growing on deciduous trees. The population of this species in Finland has significantly declined during the past few decades (Rutanen & Kashevarov 1997).

Eucilodes caucasicus (Reitter) Category Mr (Rare). One individual was collected by means of a window trap on site E in 1995 following timber felling. For Finland this is a rare insect, but widespread, with individuals being caught mostly by means of window traps baited with freshly felled spruce or pine (Muona & Viramo 1986). The species has not been found in Russian Karelia, probably due to lack of efforts. The larvae most probably feed on the fungal mycelium in rotten wood, with adult beetles being attracted by fresh timber-felling operations.

* *Meloe violaceus* Marsham Category M (In need on monitoring). One individual was found on the road near site D on 12.06.1993. Its status of vulnerability has been reduced in Finland from Md (Uhanalaisten... 1986) to M (Uhanalaisten... 1992). In Russian Karelia it is common in the southern part of the republic.

* *Zilora elongata* J. Sahlberg. Category M (In need on monitoring). Five individuals were collected by means of window traps on sites D and F. The

larvae develop underneath the bark of pine and spruce and feed on the fungi *Trichaptum abietinum* and *T. fusco-violaceum* (Nikitsky et al. 1996). *Zilora elongata* is a typical species of old forests. Its taxonomic status needs to be clarified.

All but one (*Meloe violaceus*) of the threatened species obtained are typical inhabitants of mature, unmanaged forests, and are associated with the wood-decomposing system. Two species (the bark beetle *Orthotomicus longicollis* and the longhorn beetle *Monochamus urussovi*) need newly dead and dying trees for their larval development. Two other species (*Eucilodes caucasicus* and *Leptura nigripes*), which were found only in 1995 after a timber-felling operation near our sample sites, indicating the attraction of freshly-felled trees. The other threatened species obtained develop in wood in advanced state of decay caused by fungi. Of these, *Lacon fasciatus, Eucilodes caucasicus, Pytho abieticola* and *Zilora elongata* are associated mainly with spruce, *Melandrya dubia* and *Leptura nigripes* with birch, and *Tomoxia bucephala* with both birch and aspen. *Peltis grossa* is able to develop both in spruce and deciduous trees if decay type is suitable for it. Three species (*Cyllodes ater*, *Mycetophagus quadripustulatus* and *Triplax rufipes*) develop in the fruiting bodies of coniferous-wood-based fungi, particularly in *Pleurotus pulmonarius* or in the dead wood of deciduous trees impregnated with the mycelia of this fungus species.

3.3.8 Conclusions

Thanks to the results of recent studies conducted in North European countries (Siitonen & Martikainen 1994, Siitonen et al. 1995, Økland 1995, Engstrom, 1999), it has become clear that many saproxylic beetle species are able to live only in unmanaged old-growth forests. Some of them can breed only in downed timber of sufficient size, others need a particular tree species for their development. From the nature conservation point of view, it is very important that there is available a critical, minimum amount of dead wood as otheriwse many saproxylic species are unable to survive. These species could be used as bioindicators of site quality in the selection of areas of relic forests and as instruments for assessing the effect of different forestry practices on biodiversity in forest ecosystems. The species included in the national lists of threatened fauna appear to be the most sensitive to the anthropogenic transformation of natural forests.

Saproxylics constitute 227 of the 294 beetle species collected in the course of this study. Fourteen species are listed in the Finnish Red Book, and of these thirteen species are saproxylics. This shows how great the importance of dead wood is for preserving the biodiversity of the study area. In particular, wood-growing fungi and myxomycetes appear to be crucial factors in maintaining the species diversity of forest Coleoptera. About one hundred species obtained, including threatened ones, *Cyllodes ater, Triplax rufipes* and *Mycetophagus quadripustulatus*, develop in the fruiting bodies of wood-based fungi and plasmodia of myxomycetes. The other 136 species of saproxylic beetles found in this study live underneath the bark of trees or in dead wood containing fungal mycelia and, to some extent, they are also associated with wood-growing fungi. Sixty-seven species were clearly attracted by the fruiting bodies of *Fomes fomentarius* and *Fomitopsis pinicola* used as baits in polypore traps. Had we used more species of fungi in the polypore traps, the number of beetle species caught could have been higher due to the fact that several beetle species are confined to particular fungal hosts. And vice versa, had we only used standard window traps, we would have missed several beetle species inhabiting the study area.

In general, the remains of mature unmanaged forest preserved in the Koitajoki area appear to be important in the endeavour to preserve biodiversity in Finnish forests. Viable populations of threatened beetle species indicating high conservation value of the forest habitats still exist there. At least for one of them, *Cyllodes ater*, it is, very probably, the last suitable area in Finland. Together with the fact of the practical absence of the risk of insect pests outbreaks, there is a strong argument for including the investigated area on the list of high-quality European forests identified as possessing potential international importance due to their fauna of saproxylic invertebrates. This area could also be included in the core zones of the North Karelian Biosphere Reserve.

3.4 Acknowledgements

The authors are grateful to Timo Hokkanen, Ph. Lic., for carrying out the trapping in the most interesting patches of the North Karelian Biosphere Reserve. Markku Tietäväinen and Kirill Yakovlev assisted in operating the traps and in the pre-treatment of the material. Dr. Georgii Lubarskiy (Zoological Museum of Moscow University) kindly identified beetles of the family Cryptophagidae. The work is part of a Finnish-Russian co-operative project studying the biodiversity of old-growth forests in the North Karelian Biosphere Reserve, and it was co-funded by Metsähallitus, the Finnish Ministry of the Environment, Finland's North Karelia Regional Environment Centre, and the University of Joensuu's Mekrijärvi Research station. In 1996, the work was partly funded by the Russian Fund of Fundamental Research.

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4 THE STUDY OF FOREST DIPTERA FAUNA IN KOITAJOKI AREA

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4.1 Introduction

Diptera fauna of Finland have been studied fairly well with more than 5 000 species having been recorded (Uhanalaisten... 1992). However, our recent collecting operations in protected areas of the Republic of Karelia (Russian Federation) allow one to assume that regional species composition within some groups of Diptera is evidently richer than has been thought hitherto. In this sense, even small areas of forests, preserved within commercially logged regions, and especially those not intensively managed, may be of significant interest from the fauna point of view. On the other hand, such spots would appear to offer favourable shelter for species involved in the wood-decomposing system, these species being poorly equipped to survive the drastic changes in their environment caused by intensive forestry (Biström & Väisänen 1988).

The present work was aimed at finding out the species composition of Diptera and elucidate the possible occurrence of rare species in the Koitajoki area. To achieve this, we performed a large-scale trapping in the ecosystems representing a mosaic of sites preserved among large clear-cut areas in eastern Finland.

4.2 Material and methods

4.2.1 Study area

The study was conducted in 1993–1996 at eight sites in the Koitajoki area. In 1993, material was collected in Pirhu and Tapionaho. In 1994, more far-ranging trapping was done at Tapionaho. During the next two years, the study was extended to cover six new localities: Niemijärvi, Koitajoki, Lahnavaara, Kotavaara, Hoikka and Syväjärvi. The study site at Pirhu comprised of abandoned and afforested fields. The other sites were located in mixed, spruce-dominated stands, 120–150 years old. All the sample sites have been comprehensively described in Hokkanen and Vuorio (in this publication).

4.2.2 Sampling methods

The bulk of the material was obtained using Malaise traps. Four portable Malaise traps (Townes 1972) were operated in 1993–1994 and six traps in 1995–1996. The traps were exposed from the beginning of June to the end of September, two to three times per month. Every trapping period lasted two to ten days, depending on the weather conditions. Minor additional samples we obtained from bait traps, polypore traps (Kaila 1993), sweep netting, and by hand collecting insects from the trunks of dead trees.

4.2.3 Identification and taxonomic coverage

All catches were either immediately pinned or kept in a freezer. Identification was conducted mainly in September–December of each year. Only certain groups of Diptera were subjected to treatment (Table 4.1) and the females in most cases were omitted. The majority of the material was stored at the Forest Research Institute (Petrozavodsk, Russia). Some specimens of rare species were sent to the Museum of Natural History (Helsinki, Finland). Type series of species newly described from the material are kept at the Zoological Institute (St Petersburg, Russia). In general, the nomenclature and higher taxonomy of Diptera applied here complies with the Catalogue of Palearctic Diptera (Vol. I–XIII).

4.2.4 Data analysis

Unfortunately, technical problems with the modifications of the Malaise traps made it impossible to obtain equal catches from every site. On the basis of the material obtained, six primary sites at Tapionaho and three at Pirhu were selected for species-composition analysis. The Tapionaho sites were grouped into three entities because they were very close to one another and also ecologically very similar.

The Shannon diversity index (H’) and Pielou’s evenness index (E') were computed for every site. The Czekanowsky-Sørensen similarity index was used to compare the samples obtained from the various study sites. The BIODIV software (Baev & Penev 1993) was used to execute these computations.

4.3 Results

4.3.1 Species composition in general

A total of 5 606 adults of Diptera were identified and placed in 502 species (Table 4.1, Appendix 5). The comparative numbers of specimens and species collected on the sample area are given in Figure 4.1. Pirhu and Tapionaho proved to be the richest sites regarding both species richness and abundance, which undoubtedly partly reflects the number of collecting operations made here. Only three species: *Mycomya circumdata, Cordyla parvipalpis* and *Suillia atricornis*, were found on all the sample sites, and one species, *Boletina onegensis*, occurred everywhere else, except at Pirhu.

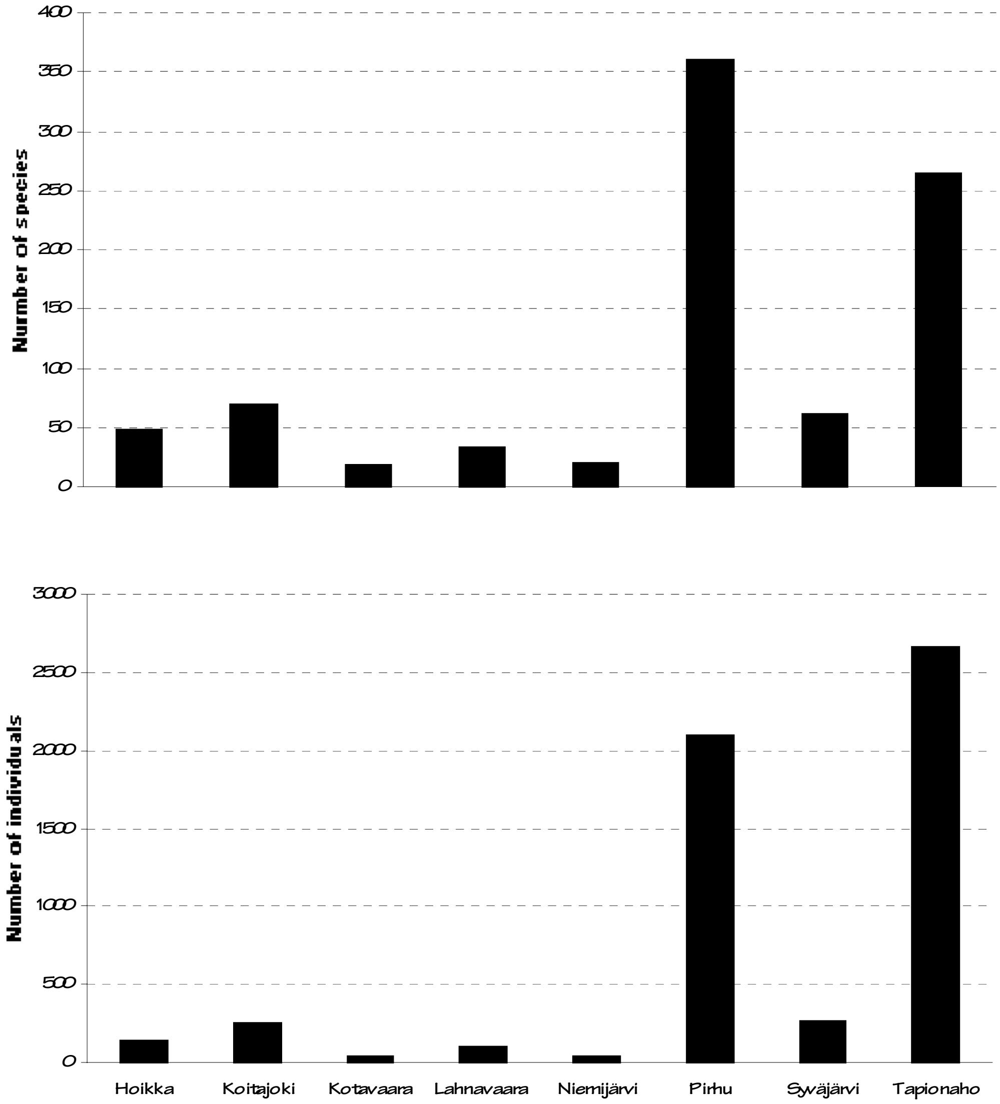

Figure 4.1. Numbers of species and individuals collected on the sample sites during the study period.

The number of species of some completely treated groups made up from 27 % to 100 % of the species known to occur in province Karelia borealis (eastern Finland) (Figure 4.2).

Table 4.1. Taxonomic coverage of Diptera involved in the study.

Family	Number of species	Degree of treatment
Cylindrotomidae	1	Complete
Tipulidae	8	Complete
Limoniidae	19	Excluding some Dicranomyia
Pachyneuridae	1	Complete
Bolitophilidae	14	Complete
Keroplatidae	13	Complete
Diadocidiidae	3	Complete
Mycetophilidae	280	Complete
Bibionidae	3	Complete
Anisopodidae	1	Complete
Rhagionidae	2	Complete
Xylophagidae	4	Complete
Stratiomyiidae	3	Complete
Asilidae	4	Only some genera
Empididae	33	Excluding Hilara
Dolichopodidae	9	Excluding Medetera
Platypezidae	1	Complete
Syrphidae	21	Only some genera
Conopidae	2	Complete
Micropezidae	2	Complete
Psilidae	9	Excluding some Chamaepsila
Tephritidae	1	Excluding Tephritis
Dryomyzidae	2	Complete
Sepsidae	1	Complete
Sciomyzidae	8	Complete
Lauxaniidae	3	Complete
Piophilidae	2	Complete
Pallopteridae	3	Complete
Clusiidae	7	Complete
Heleomyzidae	13	Only some genera
Chloropidae	4	Complete
Scathophagidae	16	Only some genera
Anthomyiidae	1	Only some species
Muscidae	3	Only some species
Calliphoridae	4	Complete
Sarcophagidae	1	Complete
Total	502	

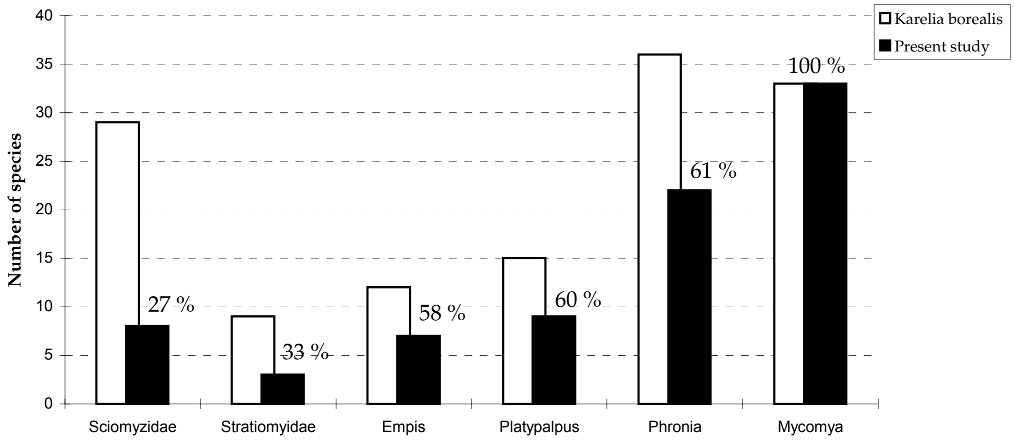

Figure 4.2. The numbers of species in the various groups of Diptera found in the present study compared to the numbers of species recorded in province Karelia borealis. Data for North Karelia taken from Väisänen (1984), Hackman (1960), Rozkosny (1973, 1984), Chvála (1975, 1994).

4.3.2 New elements in regional fauna

The study revealed an astonishingly large number of species new to the regional fauna. 83 species were estimated as being new to Finland, 75 of them belonging to the super-family Sciaroidea. Several species differed from the existing descriptions; these species (marked n.sp. in the Appendix 5.), most probably being new to science, are presented designated by numerals until they have been completely checked and described. The said records have already been partly given by Polevoi (1995a). The other work (Polevoi 1995b), includes two species newly described from the study area. It is worth mentioning that several species are such as have not previously been recorded to occur in Europe (Table 4.2).

4.3.3 Endangered species

Seven Diptera species included in the Finnish Red Data Book (Uhanalaisten... 1992) were found. Four of them (*Pahyneura fasciata* Zetterstedt, *Keroplatus tipuloides* (Bosc), *Xylophagus ater* Mg. and *X. junki* Szilady) belong to the category ″V″ (vulnerable) and three other species (*Temnostoma vespiforme* (L.), *Sphegina sibirica* Stackelberg, *Hendelia beckeri* Czerny) are in need of monitoring. Polevoi and Ståhls (1994) have given more elaborate reviews of the recent records on these and some other endangered species in Finland.

Table 4.2. The known distribution of some fungus gnats (Mycetophilidae), found in the present study.

Species	Distribution
Sciophila jakutica	Russia, Jakutia (Blagoderov 192)
Boletina nitiduloides	Russia, Altai (Zaitzev 1994a)
Freenomyia baikalica	Russia Buryatia (Zaitzev 1994a)
Mycetophila stricklandi	USA (Laffoon 1956), recently found on the British Isles (Chandler 1998)
Phronia gagnei	USA (Chandler 1992)
Allodia adunca	USA, Alaska (Zaitzev 1992)
Allodia simplex	Russian Far East; Canada, Alberta; USA, Alaska (Zaitzev 1983), recently found in Norway (Økland 1994)
Anatella crispa	Russia, Altai (Zaitzev 1994b)
Brevicornu improvisum	USA, Alaska (Zaitzev 1992), recently found in Russian Karelia (Zaitzev & Polevoi 1995) and Germany (Caspers 1996)
Brevicornu setulosum	Russia, Siberia and USA, Idaho (Zaitzev 1988b)

4.3.4 The effect of forest structure on species composition

A cluster diagram of six study sites, based on the Czekanowsky-Sørensen similarity index (Figure 4.3), shows that Tapionaho and Pirhu represent distinctly separate groups. Also the Pirhu group is more heterogeneous than Tapionaho. Such results are not surprising as the sample sites on Pirhu were actually located in very young stands formed no more than 30–40 years ago on abandoned meadows. They still retained patches of rich ground vegetation and varied considerably as regards their tree-species composition. Contrary to this, Tapionaho comprises rather uniform communities of about same age and structure.

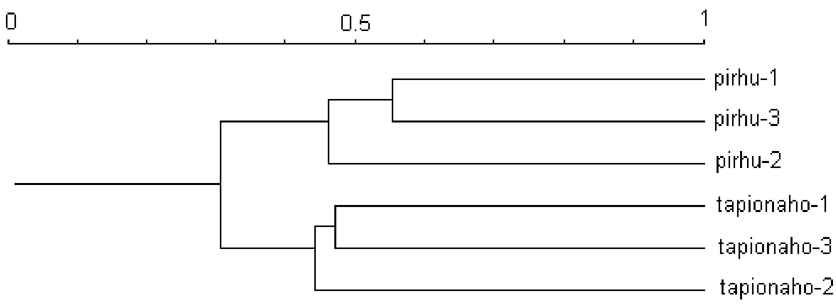

Figure 4.3. A cluster diagram of four study sites, based on the Czekanowsky-Sörrensen similarity index.

The structure of forest stands at Pirhu undoubtedly contributed to the diversity of Diptera present there. The Shannon diversity index (H') and evenness index (E') were generally higher here, reaching maximum values on sites 1 and 3, where respectively 226 and 194 species were found to occur (Table 4.3). From this point of view, the Tapionaho sites were more even. Only site B was outstanding in its number of collected specimens, but this can be largely attributed to a spring flash of several Scathophagidae species especially on this site, and probably due to the availability of necessary substrates (as a rule, the dung of large mammals).

Table 4.3. The characteristics of stands and species composition on Pirhu and Tapionaho study sites.

	Pirhu			Tapionaho		
	1	2	3	A	B	C
Number of Species	226	154	194	162	171	126
Number of Individuals	817	637	642	789	1310	561
H' = Shannon diversity index	4.78	3.98	4.74	4.23	3.96	3.91
E' = Pielou's evenness index	0.88	0.79	0.9	0.83	0.77	0.81
Site characteristics:						
Age (a)	–	–	–	120	150	140
Number of dead trunks per hectare	–	–	–	190	345	200
Proportion of pine (%)	–	–	–	5.25	40.0	19.5
Proportion of spruce (%)	–	–	–	64.0	45.0	74.5
Proportion of birch (%)	–	–	–	26.0	9.75	5.50
Proportion of aspen (%)	–	–	–	6.50	5.25	0.50

Some trends in the species preference regarding certain study sites can be shown in the case of brachycerous flies and fungus gnats. It was found that many families of flies were more abundant at Pirhu (Figure 4.4), though others either preferred Tapionaho (Clusiidae), or did not show any clear partiality (Heleomyzidae).

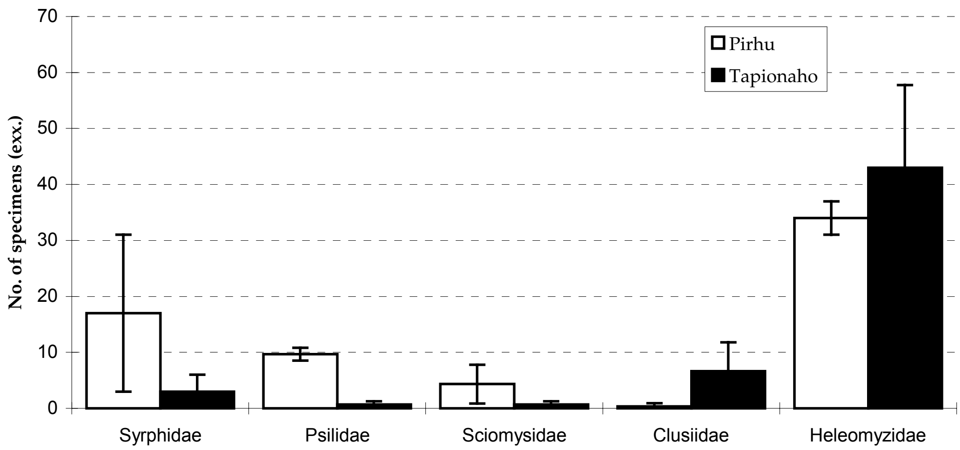

Figure 4.4. The means and standard deviations of the numbers of specimens per sample site among some families of brachycerous Diptera collected at Pirhu and Tapionaho.

Fungus gnats, especially the groups that were generally fairly rare, appeared to demonstrate evident preference to certain sites even on the generic level (Figure 4.5). Gnats of the genera *Anatella* and *Exechiopsis* were collected almost exclusively at Pirhu, whereas representatives of the genera *Cordyla* and *Syntemna*, apart from the numerous and ubiquitous *Cordyla parvipalpis*, favoured Tapionaho. In the case of more diverse and abundant genera, such us *Mycomya* and *Boletina*, this generic preference was not evident (Figure 4.6). Most of the *Boletina* species were more abundant either at Pirhu or Tapionaho, while some species of *Mycomya* were distributed more evenly.

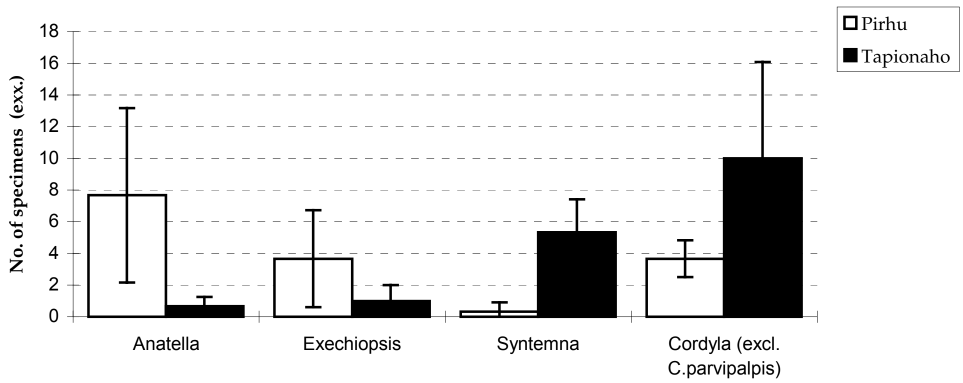

Figure 4.5. The means and standard deviations of the numbers of specimens per sample site for some scarce fungus gnat genera collected at Pirhu and Tapionaho.

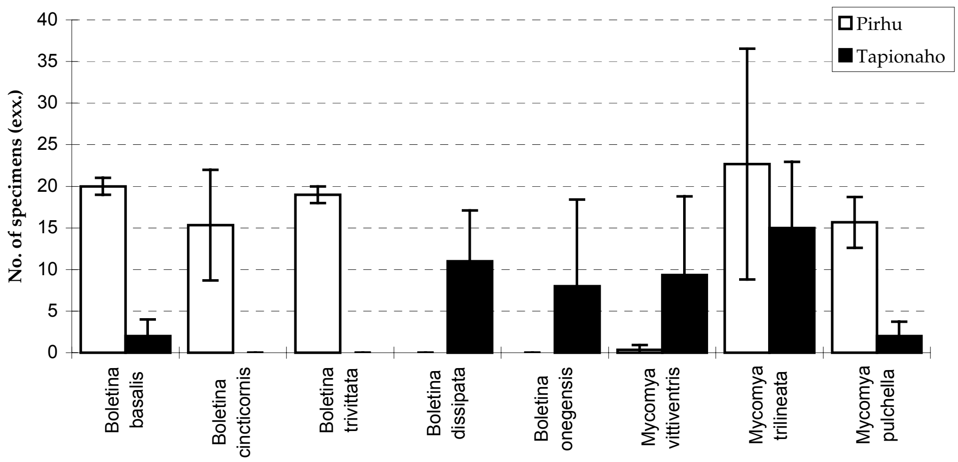

Figure 4.6. The means and standard deviations of the numbers of specimens per sample site for the genera Boletina and Mycomya collected at Pirhu and Tapionaho.

4.4 Discussion

4.4.1 Species composition

The number of Dipteran species found during the present study is rather high, bearing in mind that only a few groups were treated. The result obtained is comparable with those of studies conducted in the Kivach Nature Reserve in the Republic of Karelia. The latter revealed 577 species, although it was continued for much longer time and various trapping methods were used (Yakovlev & Polevoi 1997, Polevoi 1997). The observed diversity can be substantially attributed to fungus gnats (here including the families Bolitophilidae, Keroplatidae, Diadocidiidae and Mycetophilidae), which accounted for more than 60 % of the total species number.

Fungus gnats represent one of the most diverse groups of forest-dwelling Diptera and they can be especially efficiently collected using Malaise traps. The latter method has not been widely used in Finland previously and this may explain the great number of new species found in the course of the present study. Good results with Malaise traps have also been recently obtained in Norway (Søli 1994). As can be seen in Figure 4.2, these traps work well with other flies too, allowing one to cover a fairly large portion of the local fauna within a short period.

4.4.2 Endangered species

The endangeredness of some Dipteran species, included in the last edition of the Finnish Red Data Book (Uhanalaisten... 1992), was undoubtedly somewhat over-estimated. In our case, this applied to flies such as *Sphegina sibirica* and *Temnostoma vespiforme*, on which there is a sufficient amount of recent records to date (Polevoi & Ståhls 1994). The other species, mentioned in Section 3 of the results, deserve more attention as they seemed to occur only on some favourable sites (one of which is Koitajoki), offering a sufficient amount of substrate to flies associated with decaying wood.

4.4.3 The effect of site structure on species diversity and composition

The structure of the available data does not allow one to draw conclusions of any crucial significance. However, some features can be mentioned. The greater variety at Pirhu agrees well with the general trends in species diversity dynamics from moderately disturbed to equilibrium stages (Biström & Väisänen 1988). Nevertheless, the opposite has been observed to apply to some groups (e.g. Mycetophilidae) (Økland 1994). At Tapionaho, diversity did not fluctuate significantly, reflecting the prevailing monotony in the structure of the sites in question. However, even in this case, a slight increment of diversity was observed on younger sites (Table 4.3). The possible influence of tree-species composition and of the amount of dead wood should not be ignored. This problem may needs to be addressed in future research.

There is little to be said about the effect of forest structure on species composition. The majority of brachycerous flies when visiting flowers clearly prefer more open sites, e.g. Pirhu (Figure 4.4). The choice of Clusiidae, being predators of wood-boring Coleoptera, is dealt with in their relation to dead wood. The flies of the family Heleomyzidae, here represented almost solely by the genus *Suillia*, inhabit agaric mushrooms and probably found sufficient amounts of nourishment on both sites.

The distribution patterns of Mycetophilidae are not so easily explained, because of their poorly-studied biology. The genera *Exechiopsis* and *Cordyla* are known to be inhabitants of fungal fruiting bodies. Contrary to this, there are no data for *Syntemna* and *Anatella* as to their relationship with macrofungi (Yakovlev 1994). Both groups did, however, demonstrate different preferences (Figure 4.5). Among *Mycomya* and, especially *Boletina*, food links are virtually unknown. On the basis of our data (Figure 4.5), we can only asume, that every species in these diverse groups has peculiar biology.

4.5 Conclusion

Our study revealed some interesting faunistic trates regarding the Koitajoki area. The general structure of the area is favourable to a great variety of Diptera species, including ones that have become rare in other places. Having survived amidst large clear-cut areas, sites such as these are of significance as reservoirs for future re-establishment of local fauna and thus they unquestionably deserve at least some degree of protection. Tapionaho sites are especially interesting in this regard. Sharing approximately the same age structure and tree species composition, these sites are certainly outstanding in some aspects and may serve as basic sites for further, more detailed ecological research. The latter should be conducted to thoroughly assess the influence of forest structure on the species composition of Diptera.

4.6 Acknowledgements

I take great pleasure in thanking all the staff at the Mekrijärvi Research Station for providing me an excellent working environment during the course of the study. The same goes to the officials of the Forest Research Institute (Petrozavodsk) for making my work here possible. My special thanks go to Dr E. Nartchuk (St Petersburg) for identifying Chloropidae species and for checking several other families, to Dr A. Zaitzev (Moscow) and Dr P. Chandler (Maidenhead) for their many important comments on Mycetophilidae. The comments by T. J. Hokkanen, Lic. Sc. (Joensuu) on the manuscript are also sincerely acknowledged. Last but not least, I wish to thank my colleagues at the

Finnish Forest Research Institute for their pleasant company and cordial help in resolving the day-to-day problems I encountered during my stay at Mekrijärvi.

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5 OCCURRENCE OF HYMENOPTERA APOCRITA WITHIN THE NORTH KARELIAN BIOSPHERE RESERVE 1993–1996

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5.1 Introduction

The order Hymenoptera is the insect order richest in species in Finland and one of the most abundant in the boreal forests. According to the most recent inventory, the number of recorded species exceeds 6 000 (Koponen et al. 1995). Such a tremendous group of living organisms undoubtedly plays a very important role in ecological systems. The overwhelming majority of hymenopterous species comprise parasitic insects or predators (wasps, ants). The only exception within the order Hymenoptera Apocrita are the bees (Apoidea), an important pollinator group. Consequently, it is difficult to overestimate the significance of these insects, their role in ecosystems. However, the taxonomy of Hymenoptera is still poorly developed, and the fauna belonging to it even in Europe remains incompletely known, mainly due to their diversity, abundance and small size. Every year, new species of Hymenoptera are recorded and described in Finland.

The territory of the North Karelian Biosphere Reserve (eastern Finland) belongs to eastern Fennoscandia (province Karelia borealis), the Hymenoptera fauna of which, as well as the insect fauna as a whole, is quite poorly known in comparison to other Finnish biogeographical provinces. Even in the case of such a notable group as ”yellow-jackets” (wasps of the family Vespidae) there have been no records in UTM squares in this part of Finland (Pekkarinen & Huldén 1995). Another important point is that, due to the generally poor development of the infrastructure in this region, its sparse population, the human impact on the environment has not been as destructive as in the other, more southern, parts of Finland. Some spots of untouched natural biotopes are still preserved here, and it is more interesting from the scientific point of view to study insects occurring in such habitats (sometimes very strictly confined), especially in old-growth forests. The investigation of Hymenoptera here allows to enrich our knowledge of this group of insects and their biology, and to obtain new regional data on their distribution.

Our goal was to create a base for an environmental monitoring programme, to select some indicator species of Hymenoptera to enable the monitoring of the state of health of boreal ecosystems. The application of biological indicators for these purposes enables us (i) to detect the first changes in nature, invisible when using other methods, (ii) to obtain data on the occurrence of Hymenoptera Apocrita within this territory, and (iii) to prepare a list of species recorded here.

5.2 Materials and methods

5.2.1 The study area

The present study was conducted as part of complex investigations targeting on the ecological systems of the North Karelian Biosphere Reserve, located in the easternmost corner of Finland, very close to the Finnish-Russian border.

Our trapping efforts were conducted during several field seasons over the years 1993–1996 in the following localities (co-ordinates are given according to the 27°E Grid system):
Tapionaho (6981:727) – in 1993–1995
Koitajoki (6987:725) – in 1995–1996
Lahnavaara (6987:730) – in 1995–1996
Niemijärvi (6979:728) – in 1995
Syväjärvi (6999:718) – in 1996
Hoikka (6999:722) – in 1996
Kotavaara (6999:720) – in 1996
Pirhu (6993:723) – in 1993–1994

The majority, excluding the abandoned meadows at Pirhu, were on various forest site types (see Hokkanen, T. J. & Vuorio, V., in this publication).

Light-weight Malaise traps (Townes 1972) were chosen as being the most convenient neutral method for our purposes and allowing us to obtain representative samples of the local flying insects (Hansen 1988, Hutcheson 1990). This kind of trapping is recommended as being an excellent method for collecting hymenopterous insect species resulting in a true-to-life picture of the local insect fauna (Tereshkin & Shlyakhtyonok 1989, Pesenko 1982). Most of the samples were obtained using the said Malaise traps; additional material consisting of bait traps, polypore traps, sweep-netting and hand-collecting were also used. Only certain groups falling within the author's field of expertise were identified.

The order Hymenoptera is the second most abundant insect order in boreal forests, consisting of about 15–20 % of all the flying insects collected using Malaise traps, which has been demonstrated to be the case in earlier entomological research conducted in the Republic of Karelia (Yakovlev & Polevoi 1991). The collected Hymenoptera (Aculeata and especially the family Ichneumonidae) were treated most comprehensively, being a group of major importance for ecosystems and falling within the author's special scientific interest. Much attention was given to ichneumonid wasps of the subfamily Oxytorinae (=Microleptinae sensu Townes), which are fungi inhabitants. Several families of Hymenoptera Parasitica (e.g. Braconidae, Chalcidoidea, Cynipoidea, etc.) were excluded from the investigation. The material obtained during this study are stored at the Forest Research Institute (Petrozavodsk, Russia). The species nomenclature follows mainly The Guide of Insects of the European part of the USSR (Vol. 3). All Aculeata species are presented according to Vikberg (1986) while the Ichneumonidae nomenclature complies with Townes (1971) and Yu & Horstmann (1977).

5.3 Results

The main result of the present study is a list of Hymenoptera species inhabiting various forest ecosystems as well as abandoned meadows (Appendix 6). It consists of 264 Hymenoptera Apocrita species, recorded in the North Karelian Biosphere Reserve over a period of 4 years (1993–1996). The list contains several species new to Finnish insect fauna, but it is difficult to give the exact number as the old check-list of Finnish Hymenoptera Parasitica, published more than fifty years ago (Hellén 1940), is considerably out of date, and the new one is still under preparation, with only the first part published as yet (Koponen et al. 1995). It is possible to say that only six recorded species of parasitic wasps are reported as a new for the Finnish fauna, all of them belong to the subfamily Oxytorinae = Microleptinae sensu Townes, (Hymenoptera, Ichneumonidae).

5.4 Discussion

Some forest-dwelling insects species assessed to be vulnerable, endangered, or even extinct, in the Nordic countries, have been found in the Republic of Karelia (Russia) in recent years. The similarity to natural conditions of unmanaged isolated patches of old-growth forests in eastern Finland tempt one to assume that habitats for such species are still preserved within the territory of the North Karelian Biosphere Reserve. In the course of long-term research on insect fauna conducted in the Kivach Nature Reserve (in the Republic of Karelia, Russia) communities of species occurring in old-growth forests only were singled out. The majority of them are represented by saproxylic complex species of insects associated with the wood-decomposing system. ”Primeval” spots are characterised most of all by an abundance of decaying wood and the absence of management. The wood-decomposing ecological system, including polypore fungi, saproxylic insects, and their specialised parasites and predators, can survive only in such forests. These species are natural bioindicators of the state of health of forest ecosystems, enabling the monitoring of changes taking place in it.

The area examined contains fragments of almost untouched old-growth forests with minimal anthropogenic pressure, where natural conditions and a high level of biodiversity are still preserved. This has been confirmed by many rare insects being found in them. The species of Hymenoptera included in such wood-decomposing communities have proved to be more vulnerable as consumers of the highest level – most of them are predators or parasites of other insects.

The present list of species is based on only a part of the obtained material and it should not, therefore, be considered to be a comprehensive list of Hymenoptera Apocrita of the North Karelian Biosphere Reserve. Neither is our material sufficient for drawing conclusions about the peculiarities of the fauna there. However, despite the lack of material in this study, it has been possible to determine the occurrence of some rare insect species. All the species considered as being rare or vulnerable occur mostly in old-growth forests containing large amounts of dead, decaying wood, and they are probably associated with the wood-decomposing system.

Several saproxylic ichneumon flies (*Dolichomitus aciculatus, D. terebrans, Dolichomitus* sp., *Odontocolon punctulatus, O. dentipes, O. spinipes*, etc.) were caught at Tapionaho and Koitajoki. *Aniseres caudatus*, described from Russian Karelia (Humala 1997), is associated with the polypore fungus *Fomitopsis pinicola*. Now this species was observed to occur in the Koitajoki area (this species is new for Finland).

The species composition of our sampling sites differed greatly from one an other, with very few species occurring throughout. But at times it was out of place to compare sample sites merely on the basis of the number of registered species as the traps were operated in different years, differently orientated, etc.

Only the species *Dolichovespula norwegica* was recorded on all the localities (which was new for this UTM square). Within the family Ichneumonidae species such as *Tryphon obtusator, Misetus oculatus, Cylloceria melancholica, Helictes borealis, Agrypon flaveolatum, Hadrodactylus* sp. were very abundant on the study sites. Some rare species (*Dolichomitus aciculatus, Spudaeus scaber, Eusterinx tenuicincta, E. inaequalis, Catastenus femoralis, Phthorima compressa, Sussaba punctiventris* and *Alomya pygmaea*) were also recorded during our study. Almost all of them occurred in old, unmanaged forests.

The list contains several species new to the Finnish insect fauna, e.g. *Aniseres caudatus, Catastenus femoralis, Hemiphanes townesi, Helictes conspicuus, Eusterinx inaequalis, Proeliator proprius*, and these will be included in the newest edition of the check-list of Finnish Hymenoptera Parasitica (Part 6).

5.5 Conclusions

As a result, a total of 264 species of Hymenoptera Apocrita inhabiting the biotopes of the North Karelian Biosphere Reserve were listed. Many rare and vulnerable saproxylic species were reported. Several species were recorded for the first time in Finland. However, the obtained data should not be seen as being exhaustive as further entomological research as well as other complex research within the biosphere reserve is felt to be necessary and of importance.

All these finds showed that the area studied is of a great importance as a reservation for all saproxylic biota. It seems that the conditions in the examined sites are very similar to pristine conditions and thus the target sites should be protected to save their biodiversity.

To sum up, it should be noted that it is necessary to continue intensive entomological studies within the North Karelian Biosphere Reserve covering large areas and to record rare species. Comparisons should be made in terms of the insect species composition of anthropogenic habitats and nature reserves. This would enable the pinpointing of new bio-indicators within the insect fauna inhabiting such reserve ecosystems, to discover species new to Finnish fauna and to the field of entomology, too.

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— Suomen loispistiäisluettelo (Hymenoptera: Parasitica) Osa 6. heimo Ichneumonidae, alaheimot Phrudinae, Mesochorinae, Metopiinae, Acaenitinae, Microleptinae, Oxytorinae, Cylloceriinae, Orthopelmatinae, Collyriinae, Othocentrinae ja Diplazontinae (in prep.)

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6 STUDIES ON APHYLLOPHORACEOUS FUNGI IN NORTH KARELIAN BIOSPHERE RESERVE 1993–1996

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6.1 Introduction

Most of the species of aphyllophoraceous fungi have specialised to decay wood. The specialisation of fungi to certain substrates is determined by tree species, various thickness of the dead trunk or a certain stage in the succession of decomposition. Some species grow only in trunks having been decomposed by a certain other aphyllophoraceous species. Several species require a continuation of old growth forest existence in the area or nearby. Thus this group of organisms is important in determining the nature protection value of significant old growth forest areas (Kotiranta & Niemelä 1996).

Over 200 species from Polyporaceae s. lato and almost 300 species of Corticiaceae s. lato and other groups (referred to as Corticiaceae) have been found from

Finland (Kotiranta & Niemelä 1996). Sixty two species of Polyporaceae s. lato and 124 species of all the order have been classified endangered. Present forestry practices have been considered the main reason for endangerness for high per cent of the wood-rotting aphyllophoraceous fungi. Old pine and spruce forests are the main biotopes for endangered Polyporaceous fungi (61 per cent of Polyporaceae s. lato , 54 per cent of all Aphyllophoraceous fungi favour these forest types). All forests form 90 per cent of the primary biotopes of polyporaceous fungi (Kotiranta & Niemelä 1996).

This report includes the results of study of the aphyllophoraceous fungi in North Karelian biosphere reserve during summer seasons 1993-1996. Some results from mature forests in Valtimo area were added too. The aims of the studies have been to make basic inventories of the fungi diversity in the biosphere reserve and give background to assess the nature conservational value of some interesting and essential forest areas in the biosphere reserve.

6.2 Materials and methods

The studies have been performed 1993–1996. Valtimo area north from North Karelia biosphere reserve was studied in 1996. The sites were studied not equally, someones very attentively during several seasons (e.g. Tapionaho, Kitsi, Koitajoki), some others in a form of one – two daily visits (e.g. Patvinsuo, Petkeljärvi etc.). In total almost 50 sites have been examined:

1993: Tapionaho, Kitsi natural and burned forests, Lahnavaara, Petkeljärvi.
1994: Tapionaho, Kitsi natural and burned forests, Lahnavaara, Niemijärvi, Koitajoki.
1995: Tapionaho, Kitsi natural and burned forests, Lahnavaara, Koitajoki, Niemijärvi, Patvinsuo.
1996: Hoikka, Hoikanpuro, Kotavaara, Pieni Kotavaara, Pampalo, Pampalo (slope), Lakonjärvi, Pahkavaara E (east), Pahkavaara W (west), Ukonsärkkä–Aittalampi, Ukonsärkkä–Suolamminvaara, Ukonsärkkä– Mustalampi, Ukonsärkkä–Pieni Haukilampi, Ukonkangas, Päävaara, Majakangas, Haukilahti, Särkilammenkangas NW (northwest), Särkipuro, Koitajoki, Lahnavaara, Murtovaara, Murtojärvi W (west), Koiravaara, Sormusenvaara, Kivimäki NE (northeast), Salmivaara, Hoikka E (east), Syväjärvi S (south), Pyötikönkosket, Lakonjärvi SW (southwest), Valtimo–Väärälampi S (south), Alimmainen Verkkojärvi Nikara, Petkeljärvi.

Herbarium samples are kept in the V.L. Komarov Botanical Institute. Collected samples have been identified partly at Mekrijärvi Research Station and mostly in V. L. Komarov Botanical Institute. Some critical samples were revised at the mycological herbarium of Helsinki University. For the identification of fungi were used key-books and floras dedicated to the different groups of aphyllophoraceous fungi (Parmasto 1965, Ryvarden 1973–1988, Julich & Stalpers 1980, Bondartseva & Parmasto 1986, Ryvarden & Gilbertson 1993–1994). These books present a standard set for the identification of the North European aphyllophoraceous fungi, though, having been written in different years, there are some differencies in interpretation of certain species. Also some discrepancies can be found in conception of certain genera between different authors.

We have tried to use the fungal names accepted by Finnish mycologists (mainly according to Hansen & Knudsen (1997), to keep the data compatible with the other studies in Finland. The few exclusions concern to the comprehension of some genera. In many cases we follow to the views of Finnish specialists, but sometimes we cannot agree with their conceptions. The order Aphyllophorales and families we regard in more traditional borders because when comparing such families as Corticiaceae, Coniophoraceae, Poriaceae etc. in more wide sense it is possible to understand better their ecological significance. At Mekrijärvi Research Station database of the whole examined mycological material is being done (T. J. Hokkanen).

For treatment of the data all the localities were enumerated and in the list of species the sites have been indicated with these numbers:

1 Tapionaho
2 Kitsi, natural forest
3 Kitsi, burned forest
4 Lahnavaara
5 Syväjärvi:
    5 Syväjärvi
    5a Hoikka
    5b Hoikanpuro
    5c Hoikka E
    5d Syväjärvi S
6 Koitajoki
7 Niemijärvi
8 Patvinsuo
9 Pieni Kotavaara:
    9 Pieni Kotavaara
    9a Kotavaara
    9b Pyötikönkosket
10 Petkeljärvi
11 Pampalo:
    11a Pampalo
    11b Pampalo (slope)
12 Lakonjärvi:
    12a Lakonjärvi S
    12b Lakonjärvi SW
13 Pahkavaara:
    13a Pahkavaara E
    13b Pahkavaara W
    13c Pahkavaara VMS

14 Ukonsärkkä:
- 14a Ukonsärkkä–Aittalampi
- 14b Ukonsärkkä–Suolamminvaara
- 14c Ukonsärkkä–Mustalampi
- 14d Ukonsärkkä–Pieni Haukilampi
- 14e Ukonsärkkä–Ukonkangas

15 Valtimo:
- 15a Murtovaara
- 15b Murtojärvi W
- 15c Koiravaara
- 15d Sormusenvaara
- 15e Kivimäki
- 15f Salmivaara
- 15g Väärälampi S
- 15h Alimmainen Verkkojärvi Nikara
- 15i Alimmainen Verkkojärvi Iso-Kuohu
- 15j Piilopirtinaho Murtopuro
- 15k Piilopirtinaho N
- 15l Paistinvaara N
- 15m Paistinvaara VMS

16 Päävaara:
- 16a Majakangas
- 16b Haukilahti

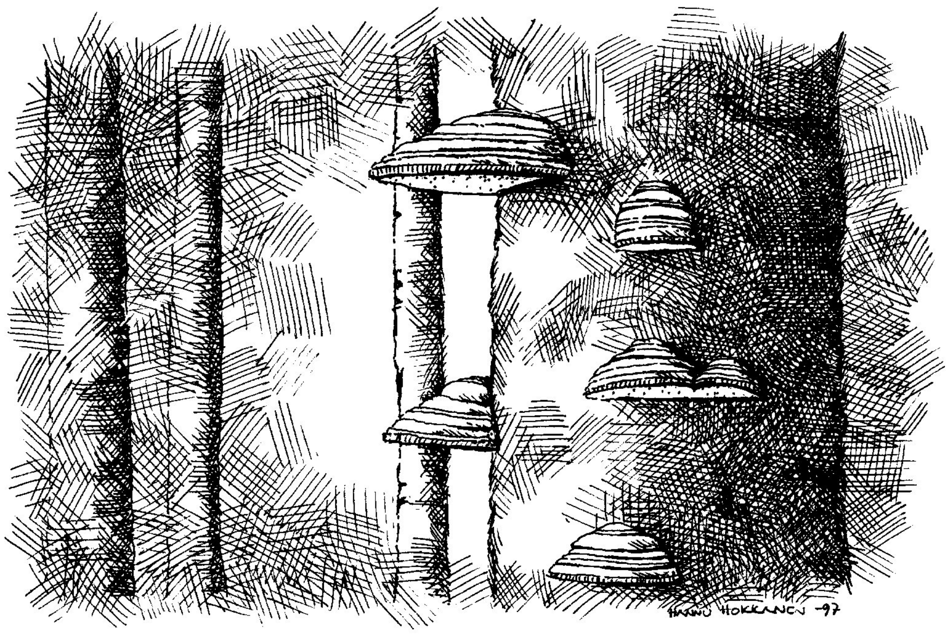
17 Särkilammenkangas:
- 17a Särkipuro
- 17b Särkipuro NW

6.3 Results

In total near 1 500 samples were collected and identified. The most recognisable species were noted in the field when collecting. The full list to the end of 1996 was 169 species of the order Aphyllophorales and 6 carbophilous species from different taxonomical groups collected from burned forest.

The following information is included in the list (Appendix 7): number of site; category of the species included in the Red Data Book of Finland (Uhanalaisten … 1992), marked with the symbols in parentheses: (E) endangered, (V) vulnerable, (Sh) rare species, (St) declined species, in need of monitoring. Old growth forest indicator species (Kotiranta & Niemelä 1996) are marked with an asterisk. The species in the list are presented in alphabetical order (Appendix 7).

The Red Data Book species (Uhanalaisten… 1992) and old growth forest indicator species are summarised in Table 6.1.



In total 42 species present importance as indicators of old or natural forests. It is 24,8 % of the whole number of species.

Not all of the Red Data Book species (Uhanalaisten… 1992) are very rare in the studied areas. *Hericium coralloides*, *Phellinus populicola* and *Trichaptum pargamenum* were met in several sites. Such species as *Polyporus pseudobetulinus, Hydnellum suaveolens, Polyporus badius, Amylocorticium subincarnatum, Ceriporiopsis pannocincta* and *Junghuhnia collabens* were collected more than once. However, the abundance of these species is low. Simultaneously some other species not included in the Red Data Book, were met only once or few times, in spite of special searches. It means, that the list of conserved species may be widened, and also regional abundance can be taken into account.

Table 6.1. Old growth forest indicator species (Kotiranta & Niemelä 1996), marked with (*) and Red Data Book species (Uhanalaisten… 1992) from North Karelian biosphere reserve and adjacent areas in Nurmes and Valtimo. Classification: E = endangered, V = vulnerable, Sh = rare species, St = declined.

Species	Category	N of site
Amylocorticium subincarnatum	Sh	14,15
Amylocystis lapponica	*	1,4–9,11,13–15,17
Antrodia albobrunnea	St, *	1,9
A. pulvinascens	*	6
Asterodon ferruginosus	*	1,2,4,5,7,8,9,12, 15,16
Ceriporiopsis pannocincta	Sh	6,9,10,13
Chaetoderma luna	*	6,14
Clavaria zollingeri	V	8
Dentipellis fragilis	V	5
Dichomitus squalens	St	1
Diplomitoporus crustulinus	V, *	9
D. lindbladii	V	5
Fomitopsis rosea	*	1,2,4,5,6,7,8,9
Gloeophyllum protractum	*	1
Gloeoporus taxicola	*	6
Haploporus odorus	V	4
Hericium coralloides	V	1,4,5,9,10,14,15
Hydnellum suaveolens	V	1,6,9
Junghuhnia collabens	St, *	8,9,11
Leptoporus mollis	*	11,15
Mycoacia aurea	Sh	10
Phellinus chrysoloma	*	1,2,4–9,11–17
Ph. Ferrugineofuscus	*	1,4–17
Ph. Lundellii	*	1,2,4–9,11–13,15–17
Ph. Nigrolimitatus	*	1,6,7,8,11,15
Ph. Pini	*	1–16
Ph. Populicola	St	1,2,5,6,9,10,15
Ph. Viticola	*	1,2,4–11,15
Phlebia centrifuga	*	6,8,11
Ph. Radiata	*	1,4,8
Polyporus badius	V	2,3,6
P. pseudobetulinus	E	4,11,12
Postia guttulata	Sh, *	4
P. hibernica	Sh, *	7
P. lateritia	*	9
P.sericeomollis	*	1,10
P. placenta	*	1,2,10
Protomerulius caryae	Sh	14
Pseudomerulius aureus	*	1
Pycnoporellus fulgens	Sh, *	4
Skeletocutis lenis	V, *	1
S. odora	*	4
Trichaptum pargamenum	Sh	1,3–6,8–10,12,14

6.4 Discussion

Almost all of the studied sites comprise of a group of subsites – islands of forests – surrounded by a sea of bogs. The intensity of the study was not equal in all sites, some of which were studied during 3–4 years, another ones not more than one season. List of species, as well as floristic comparison of the localities, reflects the results received to the end of 1996. The greatest family diversity was observed in Tapionaho (14), which was also the best studied site. Also from Syväjärvi (12), Valtimo (12) and from Petkeljärvi (12) a great number of families has been found (Table 6.2).

The highest diversity also on the generic level has been registered in Tapionaho (54 genera), followed by Lahnavaara (40), Syväjärvi (44), Koitajoki (42), Kotavaara (44) and Valtimo area (40 genera). The greatest species number was marked in Tapionaho (94 species), over 50 species were found in Lahnavaara (66), Syväjärvi (69), Koitajoki (68), Kotavaara (63), Valtimo (62 species). Patvinsuo National Park, as well as Petkeljärvi, are also sites rich with aphyllophoraceous fungi species, because collections of only one day amounted to 43 and 44 species respectively (Table 6.2).

The highest number of genera and species (27 genera, 63 species) has been found from family Poriaceae, family Corticiaceae shows the second place (27 genera, 42 species) one of the greatest in the order (Table 6.3). Family Hymenochaetaceae includes 5 genera and 19 species. The last one is the most important family in the practical sense the main species, developing on living trees, belong to it. Families Bankeraceae, Clavariaceae, Coniophoraceae, Polyporaceae, Rigidoporaceae include several species, but in our collections they are presented only by a few species in spite of special searches. The number of species is 10, 4, 5, 6, 4, respectively. All the other families are presented by 1–3 species only.

The highest number of the Red Data Book species (Uhanalaisten… 1992) has been found from the same localities, were the greatest biological diversity has been observed: In Tapionaho we found 19 Red Data Book and indicator species, from Koitajoki and Kotavaara 17 species from each, in Lahnavaara 15, Syväjärvi and Patvinsuo 13 each, Valtimo area 12, Pampalo 11, Niemijärvi and Petkeljärvi 10 species each. These areas have the best index for conservation.

Tables 6.4 and 6.5 list newly described and/or rare species.

Table 6.2. Comparative study of wood destroying fungi in different localities.

NN	Locality	Families	Genera	Species	Red Data Book and indicator species
1	Tapionaho	14	54	93	19
2	Kitsi, natural forest	6	24	40	8
3	Kitsi, burned forest	7	26	30	2
4	Lahnavaara	11	40	66	15
5	Syväjärvi	12	44	69	13
6	Koitajoki	10	42	68	17
7	Niemijärvi	8	26	40	10
8	Patvinsuo	11	29	43	13
9	Kotavaara	11	44	63	17
10	Petkeljärvi	12	33	44	10
11	Pampalo	8	29	46	11
12	Lakonjärvi	9	25	37	7
13	Pahkavaara	8	25	35	6
14	Ukonsärkkä	7	23	33	9
15	Valtimo	12	40	62	12
16	Päävaara	7	19	27	5
17	Särkilammenkangas	4	16	21	4
	Total	19	87	169	42

Table 6.3. Taxonomical composition of the aphyllophoraceous fungi in North Karelian Biosphere Reserve and some adjacent areas in Nurmes and Valtimo.

Family	Genera	Species
Albatrellaceae	1	2
Aporpiaceae	1	1
Bankeraceae	3	10
Cantharellaceae	1	1
Clavariaceae	3	4
Coniopharaceae	4	5
Corticiaceae	27	42
Ganodermataceae	1	1
Hericiaceae	3	3
Hydnaceae	1	1
Hymenochaetaceae	5	19
Lachnocladiaceae	2	2
Phaeolaceae	1	1
Polyporaceae	2	6
Poriaceae	27	63
Rigidoporaceae	2	4
Schizophyllaceae	1	1
Steccherinaceae	1	2
Thelephoraceae	1	1
Total	87	169

Table 6.4 Species newly described from Finland with an unknown geographical distribution.

Species	Sites where found
Antrodia macra	1, 6, 8
A. mellita	4, 7, 15e
A. pulvinascens	6
Postia lateritia	9
Skeletocutis brevispora	5

In the table 6.4 is presented a group of species, which has been described only a few years ago and the geographical distribution of them is still unknown. Nevertheless, these species are studied in Finland attentively and it is possible to say that they are not widespread inside the country. Only few localities are known for all of them and when being found they are not abundant.

Table 6.5. Rare species.

Species	Sites where found
Antrodiella romellii	4, 5, 9
A. semisupina	5, 6, 11b
Ceriporia reticulata	11b
C. viridans	1
Ceriporiopsis resinascens	-1, 5, 5d, 6, 11a, 12a
Gloephyllum protractum	1
Gloeoporus taxicola	6
Hericium cirrhatum	4
Junghuhnia luteoalba	3, 4
J. separabilima	12b
Postia leucomallella	5, 7
P. rennyi	11a
Phanerochaete laevis	1, 2
Ramaria flava	10
Skeletocutis kuehneri	7
S. odora	4
Stereopsis vitellina	1
Trichaptum fuscoviolaceum	1, 5
T. laricinum	4, 15l
Vararia investiens	10, 15b

The group of species in the table 6.5 contains that ones, which were not included in the Red Data Book (Uhanalaisten… 1992), but have limited distribution. Everyone may be found from 0 to 6–7 times per season and some of them may be regarded as candidates to the new edition of the Red Data Book.

6.4.1 Characteristics of distribution of studied aphyllophoraceous fungi in different types of forest

The richest type of forest is *Pinetum myrtillosum*, but almost the same species diversity was observed in *Piceetum myrtillosum*. Types with *Vaccinium vitis-idaea* and lichens are more dry and species composition is more poor there. On coniferous wood in *Pinetum myrtillosum* such species as *Amyloporia xantha, Antrodia sinuosa, Coniophora arida, Phellinus pini, Phellinus chrysoloma, Postia fragilis, Skeletocutis amorpha, S. lenis, Stereum sanguinolentum* and *Trichaptum abietinum* are widely distributed. *Bjerkandera adusta, Cerrena unicolor, Fomes fomentarius, Inonotus obliquus, Lenzites betulina, Phellinus igniarius, Ph. laevigatus, Piptoporus betulinus, Trametes hirsuta, T. ochracea, T. pubescens* and *Trichaptum pargamenum* were found on deciduous trees. Such species as *Fomitopsis pinicola* and *Postia caesia* grow both on coniferous and deciduous trees.

One of the most widely distributed terrestrial fungi is *Phellodon tomentosum*. In this type of forest also such species as *Coniophora olivacea, Phlebiopsis gigantea, Trichaptum fuscoviolaceum, T. laricinum (*on *Pinus), Antrodia serialis, Asterodon ferruginosus, Fomitopsis rosea, Gloeophyllum sepiarium, Hyphodontia aspera, Phanerochaete sanguinea, Phellinus chrysoloma, Ph. viticola, Phlebia centrifuga, Postia placenta, P. stiptica, Pycnoporellus fulgens* (on *Pinus* and *Picea*) were observed.

Chondrostereum purpureum, Clavicorona pyxidata, Ganoderma lipsiense, Gloeoporus dichrous, Hapalopilus rutilans, Hericium coralloides, Laeticorticium roseum, Merulius tremellosus, Peniophora incarnata, Phellinus conchatus, Ph. lundellii, Ph. populicola, Ph. tremulae, Phlebia radiata, Plicatura nivea, Postia tephroleuca, Oxyporus corticola, Schizopora paradoxa, Steccherinum ochraceum, and *Stereum rugosum* were found on deciduous trees in *Pinetum myrtillosum*. In pine forests the presence of terrestrial fungi plays a great role, especially in more dry types, though in myrtillosum type they are noticeable too. In our collections these species are *Coltricia perennis, Hydnellum ferrugineum, H. concrescens, Phellodon niger, Sarcodon scabrosus* and *Thelephora terrestris*.

6.4.2 Characteristics of aphyllophoraceous fungi in different sites

The total number of species is much higher than the number of species for any of the individual sites (Table 6.2 and Table 6.3). It means that the specific conditions and substrates of the sites stimulate a certain selection of species, and only very few of them are distributed in all localities: *Fomes fomentarius, Fomitopsis pinicola, Phellinus igniarius* and *Trichaptum abietinum* belong to these widespread species. *Amyloporia xantha, Antrodia serialis, A. sinuosa, Inonotus obliquus, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. pini, Piloderma fallax, Piptoporus betulinus* and *Trametes ochracea* have been distributed in all sites with 1–2 exclusions. Kitsi burned forest is the most different site, where the absence of some widely distributed species is quite explicable. Thus all these species are widespread and in every forest their presence is not limited to one or few fruit bodies; also their role in degradation of wood is substantial.

Inonotus obliquus, *Phellinus chrysoloma* and *Phellinus pini* grow on living trees and influence on the succession of forest trees. Almost the same is applicable to *Fomitopsis rosea*, *Phanerochaete sanguinea, Phellinus lundellii, Ph. tremulae, Coniophora arida, C. olivacea* and *Phlebiopsis gigantea* which were met in 13 or 14 localities. In this group *Phellinus tremulae* is a pathogenic fungus, which attacks living trees of *Populus tremula*. Distribution of this fungus correlates with the distribution of *Populus*. Other species from this group are well known decomposers of dead wood in forests.

Total of 52 species from our list were met in one locality only, sometimes they are presented by several samples, sometimes only by one. These ”endemic” species have been mentioned in site descriptions. A great group is presented by species collected in a few sites. This group includes rare species having limited distribution in the area, as well as the ones whose development is restricted into 1–2 weeks during the season. These species can easily be absent during one year due to, e.g., too dry weather or unfavourable period for collecting. Rare species are, e.g., *Amylocorticium subincarnatum, Antrodia albobrunnea, Meruliopsis albostraminea, Junghuhnia luteoalba, Postia sericeomollis* and *Serpula himantioides*. To the group of occasional absentees belong, e.g., *Botriohypochnus isabellinus, Clavicorona pyxidata, Plicatura nivea.*

Some species have specific requirements to the ecosystem and may be widespread in the area, but in special conditions only. *Datronia mollis, Hydnum repandum, Leptoporus mollis* are examples of this type of species.

Comparison of the distribution of rare species in the area shows, that very few of them are common in different localities. For example, the greatest number of rare species known in 2–5 localities was found between Tapionaho and Lahnavaara (8 rare species in common), and Tapionaho and Koitajoki (10 rare species in common). In other cases species composition is more unique.

In total 48 species are common for Tapionaho and Lahnavaara, 47 species for Tapionaho and Syväjärvi, 50 for Tapionaho and Koitajoki, 45 for Tapionaho and Kotavaara. Lahnavaara and Syväjärvi demonstrate 47 common species, Lahnavaara and Koitajoki 40, Lahnavaara and Kotavaara 42 species. Between Syväjärvi and Koitajoki 37 common species were registered, Syväjärvi and Kotavaara 42 species, Koitajoki and Kotavaara 40 common species.

The comparison shows the greatest similarity between species composition of aphyllophoraceous fungi of Tapionaho and Koitajoki, then follow the pairs Tapionaho and Lahnavaara, Tapionaho and Syväjärvi, Lahnavaara and Syväjärvi. The lower similarity in other pairs may be explained by differencies in forest conditions. The differencies are also partly due to the slightly varying intensity of sampling.

6.4.3 *Characterisation of study sites*

The study on aphyllophoraceous fungi made in 1993-1996 was not equal in the different sites and correspondingly data on its distribution were not full. The improved list for all studied sites, including new data received in 1997–1998, was already published (Bondartseva et al. 1999). When describing the sites here we indicated the species found in only one site as a specific characteristic of the site. When revising a list of 1999 we found some species more widespread than it could be seen of the data of 1996 and we do not mention its now. Only the species remaining unique to a place during all years of investigation (1993–1998) have been enumerated.

Tapionaho was the best studied location, because investigations there took place in 1993–1995, in different months of the vegetation seasons. The whole taxonomical diversity was 14 families, 54 genera and 94 species. In number of species the greatest family was Poriaceae with 34 species of 18 genera. The next ones by species number are Corticiaceae (24 species of 18 genera) and Hymenochaetaceae (16 species of 4 genera). Families Bankeraceae, Coniophoraceae, Polyporaceae include 2–7 species everyone, other 8 families are presented by 1 species only. For species the greatest genera are *Phellinus* (11 species), *Postia* (6 species); *Antrodia* (4 species). The other genera include 1–3 species 11 species grow on the ground (11,7 % of the total number), being terrestrial saprotrophs and possibly mycorrhizal fungi.

The following species were found in Tapionaho only: *Dichomitus squalens, Gloeophyllum protractum, Phellodon connatus, Phlebia rufa, Polyporus ciliatus, Stereopsis vitellina.*

Red Data Book species in Tapionaho were *Antrodia albobrunnea* (St), *Hericium coralloides* (V), *Hydnellum suaveolens* (V), *Phellinus populicola* (St), *Skeletocutis lenis* (V) and *Trichaptum pargamenum* (Sh).

Indicator species: *Amylocystis lapponica, Asterodon ferruginosus, Fomitopsis rosea, Gloeophyllum protractum, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. nigrolimitatus, Ph. pini, Ph. viticola, Ph. radiata, Postia placenta, P. sericeomollis, Pseudomerulius aureus.*

Lahnavaara. Collections were performed in 1993–1996 in *Pinetum myrtillosum* and *Piceetum myrtillosum*. In total 66 species of 40 genera and 11 families were collected and determined. The greatest family for species and genera is Poriaceae (28 species, 16 genera). Next ones by species diversity are Hymenochaetaceae (12 species, 4 genera) and Corticiaceae (11 species, 9 genera). 4 families (Rigidoporaceae, Cantharellaceae, Ganodermataceae, Phaeolaceae) are presented by 1 species, the other ones by 2–5 species The greatest genera are *Phellinus* (8 species), *Postia* (5 species), another ones contain 1–3 species. Group of terrestrial fungi presented by 9 species of 7 genera, 4 families (13,6 % of total number).

Lahnavaara is the only site where *Haploporus odorus, Pycnoporellus fulgens, Sarcodon scabrosus* were found till now.

Red Book species: *Haploporus odorus* (V), *Hericium coralloides* (V), *Postia guttulata* (Sh), *Trichaptum pargamenum* (Sh).

Indicator species: *Amylocystis lapponica, Asterodon ferruginosus, Fomitopsis rosea, Phellinus chrysoloma*, *Ph. ferrugineofuscus, Ph. lundellii, Ph. pini, Ph. viticola, Phlebia radiata, Pycnoporellus fulgens, Skeletocutis odora.*

Koitajoki. Collections in 1994–1996. Types of forest: *Pinetum myrtillosum, Piceetum myrtillosum*. 68 species of 42 genera and 10 families were collected and determined from this site. The greatest family is Poriaceae 25 species from 17 genera, the next ones Corticiaceae (15 species, 12 genera) and Hymenochaetaceae (14 species, 3 genera). The other families are presented by 1–4 species. The greatest genera are *Phellinus* (11 species), *Antrodia* (5 species), *Stereum* (4 species). Terrestrial fungi belong to the family Bankeraceae (3 species of 2 genera), that make up to 4,9 % of the total species number.

”Endemic” species found only in Koitajoki: *Antrodia pulvinascens, Cytidia salicina, Gloeoporus taxicola, Hydnellum aurantiacum.*

Red Data Book species: *Ceriporiopsis pannocincta* (Sh), *Hydnellum suaveolens* (V), *Phellinus populicola* (St), *Polyporus badius* (V), *Trichaptum pargamenum* (Sh).

Indicator species: *Amylocystis lapponica, Antrodia pulvinascens, Chaetoderma luna, Fomitopsis rosea, Gloeoporus taxicola, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. nigrolimitatus, Ph. pini, Ph. viticola, Phlebia centrifuga.*

Syväjärvi is one of the richest sites among all studied ones. Collections in 1995–1996 in *Pinetum myrtillosum* and *P. vacciniosum*. Even a brief study showed a great biological diversity: 69 species were found of 44 genera and 12 families. The greatest family Poriaceae includes 27 species of 12 genera, Hymenochaetaceae 13 species of 4 genera, Corticiaceae 10 species of 8 genera. The other families were presented by 1–2 species. The greatest genera are *Phellinus* (9 species), *Antrodia* (4 species), *Stereum* (3 species), *Trichaptum* (3 species). Terrestrial fungi belong to 5 families, 6 genera, 6 species, making up to 9.8 % of total number.
Syväjärvi is the only site where *Dentipellis fragilis, Leucogyrophana sororia, Skeletocutis brevispora* were found.

Red Data Book species: *Diplomitoporus lindbladii* (V), *Dentipellis fragilis* (V), *Phellinus populicola* (St), *Trichaptum pergamenum* (Sh).

Indicator species: *Amylocystis lapponica, Asterodon ferruginosus, Fomitopsis rosea, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. pini, Ph. viticola*

Kotavaara. The study of this site was begun in 1995 at Pieni Kotavaara site, in 1996 some other sites (Kotavaara, Pyötikönkosket) were added. In spite of the short time of investigation 63 species of 44 genera and 9 families were registered. The greatest family, as always, is Poriaceae (20 species, 14 genera), next ones are Corticiaceae (12 species, 11genera) and Hymenochaetaceae (10 species, 3 genera). The greatest genus is *Phellinus* 8 species, another genera include not more than 1–3 species. Total of 6 species of terrestrial fungi are arranged between 4 families and 5 genera (11,5 %).

Stereum gausapatum was found in Kotavaara only, *Diplomitoporus crustulinus* was collected in Pieni Kotavaara only.

Red Data Book species: *Antrodia albobrunnea* (St), *Diplomitoporus crustulinus* (V), *Hydnellum suaveolens* (V), *Phellinus populicola* (St), *Trichaptum pargamenum* (Sh).

Indicator species: *Amylocystis lapponica, Asterodon ferruginosus, Diplomitoporus crustulinus, Fomitopsis rosea, Junghuhnia collabens, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. pini, Ph. viticola, Postia laterita.*

Valtimo. Valtimo municipality is presented by 13 sites, designated here as 15a Murtovaara, 15b Murtojärvi W, 15c Koiravaara, 15d Sormusenvaara, 15e Kivimäki, 15f Salmivaara, 15g Väärälampi S, 15h Alimmainen Verkkojärvi, Nikara, 15i Alimmainen Verkkojärvi Iso-Kuohu, 15j Piilopirtinaho Murtopuro, 15k Piilopirtinaho N, 15l Paistinvaara N, 15m Paistinvaara VMS. Type of forests here are *Pinetum myrtillosum, Piceetum myrtillosum*, with good addition of *Betula* and *Populus tremula*, and rocky lichen pine stands. Study of this locality was begun in 1996 and in spite of a very short time of investigation a great species diversity was noted. In total there were collected and determined 62 species of 40 genera and 11 families. For the whole area family Poriaceae includes 21 species of 14 genera, Corticiaceae 15 species of 12 genera, Hymenochaetaceae 15 species of 4 genera.

The other families include 1–2 species. Terrestrial fungus flora was very poor, (only 3 species of 3 genera). The reason may be the dry summer time when all collections were made.

Red Data Book species: *Amylocorticium subincarnatum* (Sh), *Hericium coralloides* (V), *Phellinus populicola* (St).

Indicator species: *Amylocystis lapponica, Asterodon ferruginosus, Leptoporus mollis, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. nigrolimitatus, Ph. pini, Ph. viticola.*

Valtimo area in this study is extensive and contains is a set of small, environmentally fairly different sites. Also the forest types vary. Though the visits to all these sites were short, and it was dry summer time, species composition in every site is somewhat different. The richest from the species diversity point of view are sites 15a and 15e Murtovaara and Kivimäki, where 26 species were collected.

In Murtovaara a Red Data Book species (*Phellinus populicola*) and some rare ones were found. In Kivimäki we found one Red Data Book species (*Amylocorticium subincarnatum*) and several other rare ones, the distribution of which is restricted within the natural forests.

Almost the same type of forest was found in site 15k Piilopirtinaho. There were 22 species of aphyllophoraceous fungi collected there, several of which are rare and require natural forest conditions for development. This group of sites is very interesting and it is necessary to study these sites more. Some interesting results were received also when examining the sites 15d Sormusenvaara (21 species in total, 3 rare species), 15f Salmivaara (17 species, 3 rare species), 15i Piilopirtinaho Murtopuro (18 species in total, 2–3 species are rare), 15m Paistinvaara VMS (15 species, 2 rare ones, one of which is a Red Data Book species *Hericium coralloides*). It is quite possible, that next study of these sites will give a good result.

From the other sites (15b Murtojärvi W, 15h Alimmainen Verkkojärvi Nikara, 15j Piilopirtinaho Murtopuro, 15l Paistinvaara N, 15g Väärälampi S) we did not find interesting species. The total number of species is not high there, especially in 15g not more than 7 species! The last group of sites seems to be not perspective in future investigations.

Niemijärvi. Collections in 1994–1995, the type of forest *Pinetum myrtillosum* with Picea. 40 species of 26 genera and 8 families were found. The greatest family Poriaceae includes 16 species of 12 genera, Hymenochaetaceae 11 species of 3 genera, Corticiaceae 7 species of 5 genera. 5 families are presented by 1–2 species. The greatest genus *Phellinus* is presented with 8 species and *Stereum* with 3 species.

Species *Skeletocutis kuhneri* was not found in the other sites besides Niemijärvi.

Only one species was included in Red Data Book namely *Postia hibernica* 3(Sh).

Indicator species are presented by *Amylocystis lapponica, Asterodon ferruginosus, Fomitopsis rosea, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. nigrolimitatus, Ph. pini, Ph. viticola.*

Petkeljärvi. There was one visit to the driest part of this National Park in 1993 and one day we passed in this site with the excursion of the 13th Nordic Mycological Congress in August 1996. During these two visits 44 species of 33 genera, 12 families were registered; among those 12 species (11 genera) of Corticiaceae, 11 species (10 genera) of Poriaceae, 9 species (3 genera) of Hymenochaetaceae. Another families were presented by 1–2 species. The greatest genus *Phellinus* includes 7 species on this territory.

Short visits to Petkeljärvi fulfilled our list of species with *Hydnellum coeruleum, Mycoacia aurea, Peniophora rufa, Ramaria formosa*. These species were not found in another localities.

Red Data Book species: *Ceriporiopsis pannocincta* (Sh), *Hericium coralloides* (V), *Mycoacia aurea* (Sh), *Phellinus populicola* (St), *Trichaptum pargamenum* (Sh).

Indicator species: *Phellinus pini*, *Ph. viticola, Postia sericeomollis, P. placenta.*

Patvinsuo. National Park Patvinsuo, site Autiovaara, was visited once in 29.08.1995. During this short visit 43 species of 29 genera, 11 families were collected and determined. Family Poriaceae was presented by 16 species of 12 genera, family Hymenochaetaceae 11 species of 3 genera, Corticiaceae 6 species of 5 genera. Another families were presented by 1–2 species. The greatest genus in this site was *Phellinus* with 8 species. 5 species of terrestrial fungi are distributed between 5 families, 5 genera (11,6 %).

Clavaria zollingeri is the only species, that was not presented in our collections from the other localities.

Red Data Book species: *Clavaria zollingeri* (V), *Junghuhnia collabens* (St), *Trichaptum pargamenum* (Sh).

Indicator species: *Amylocystis lapponica, Asterodon ferruginosus, Fomitopsis rosea, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. nigrolimitatus, Ph. pini, Ph. viticola, Phlebia centrifuga, Ph. radiata.*

The next localities, as well as the Valtimo group of sites, were examined only in summer 1996. Species number in all of these is not very impressive because the investigations took place during a short period in dry summer.

Pampalo. This locality consists of two sites Pampalo and Pampalo (slope). The first site is somewhat more wet (”korpi”) and, correspondingly, more rich in the species diversity. The whole list for this locality includes 8 families, 29 genera and 46 species of aphyllophoraceous fungi. Family Poriaceae is presented by 19 species of 14 genera, family Hymenochaetaceae 11 species of 2 genera, Corticiaceae 8 species of 7 genera. Another families are presented by 1–3 species of 1–2 genera. Only *Albatrellus ovinus* in Pampalo (”korpi” part) represents the group of terrestrial species. The greatest genus in this locality is *Phellinus*, which includes 9 species.

Two species new for our list were found here *Postia rennyi* in Pampalo, and *Ceriporia reticulata* in Pampalo (slope). Both species are rather rare.

Red Data Book species: *Junghuhnia collabens* (St).

Indicator species: *Amylocystis lapponica, Leptoporus mollis, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. nigrolimitatus, Ph. pini, Ph. viticola, Phlebia centrifuga.*

Lakonjärvi locality consists of two sites Lakonjärvi S and Lakonjärvi SW. Its Aphyllophorales species diversity includes 37 species of 25 genera, 9 families. The greatest one among those is Poriaceae (13 species of 10 genera), than follow Hymenochaetaceae (11 species of 3 genera), Corticiaceae (6 species, 6 genera). The other families are rather small. The greatest genus is *Phellinus* (8 species).

Two species from this locality are new to our list *Stromatoscypha fimbriatum* from Lakonjärvi S and *Junghuhnia separabilima* from Lakonjärvi SW.

Red Data Book species: *Trichaptum pargamenum* (Sh*).*

Incicator species: *Asterodon ferruginosus, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. pini.*

Pahkavaara locality includes 3 sites, its total species number is 35 (25 genera, 9 families). Poriaceae is presented by 13 species, 11 genera, Hymenochaetaceae 9 species, 3 genera (*Phellinus* species composition for this site is 7 species), Corticiaceae 6 species, 6 genera. Another families of 1–2 species.

Red Data Book species: *Ceriporiopsis pannocincta* (Sh).

Indicator species: *Amylocystis lapponica, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. pini.*

Ukonsärkkä area includes 5 sites. In total 33 species belonging to 23 genera and 7 families were collected. The greatest family is Poriaceae (14 species of 11 genera), followed by Hymenochaetaceae (8 species, 3 genera) and Corticiaceae (4 species, 4 genera). The greatest genus *Phellinus* includes in this area 6 species.

Protomerulius caryae was collected in Ukonsärkkä Ukonkangas only till this time. Red Data Book species: *Amylocorticium subincarnatum* (Sh), *Hericium coralloides* (V), *Protomerulius caryae* (Sh), *Trichaptum pargamenum* (Sh). Such a high per cent of Red Book species makes this area very interesting for the future investigation.

Indicator species: *Amylocystis lapponica, Chaetoderma luna, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. pini.*

Päävaara and **Särkilamminkangas** were examined the most briefly and, correspondingly, aphyllophoraceous fungi diversity from these sites is low. From Päävaara we collected 27 species (19 genera, 7 families), from Särkilamminkangas 21 species of 16 genera and 4 families. In Päävaara the most diverse family is Hymenochaetaceae with 10 species and 3 genera, *Phellinus* includes 7 species. In Särkilammenkangas 9 species representing 8 genera were found from family Poriaceae. Hymenochaetaceae was represented by 6 species only.

Red Book species were not marked from these localities.

Indicator species in Päävaara: *Asterodon ferruginosus, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. pini.* Indicator species in Särkilammenkangas: *Amylocystis lapponica, , Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii.*

Kitsi burned forest was a specific site in our investigations. An extensive forest fire destroyded over 200 ha of *Vaccinium vitis-idaea* and *V. myrtillus* type of forest. During 1993–1995 special observations were made to follow up the recovery of aphyllophoraceous fungi flora in these forests. For the comparison a natural pine forest situated nearby was examined.

The general data on biological diversity in natural and burned forest are not too different: in natural forest representatives of 6 families of fungi were marked, in burned forest of 7 families (Table 6.2). The total number of species in natural forest was 40 species of 24 genera, in burned forest 38 species of 26 genera. 18 species of them are common for both forests.

Next species found in natural forest were found in burned forest during the first year of observations: *Amyloporia xantha, Antrodia sinuosa, Fomes fomentarius, Fomitopsis pinicola, Piloderma fallax*. In summer of 1994 in the burned forest emerged young fruit bodies of *Chondrostereum purpureum, Phellinus igniarius, Polyporus badius, Stereum sanguinolentum*, species distributed in natural forest. In 1995 to these species added *Botryobasidium vagum, Cerrena unicolor, Ganoderma lipsiense, Phellinus pini, Trichaptum abietinum.* It might be due to pure chance that such species as *Coniophora arida, Phlebiopsis gigantea, Piptoporus betulinus, Trametes ochracea* were found in burned forest before finding them from the natural one.

The next species were found in natural forest, but were absent in burned one during all years of observations: *Amphynema byssoides, Antrodia serialis, Asterodon ferruginosus, Ceraceomyces serpens, Coniophora olivacea, Fomitopsis rosea, Inonotus obliquus, Phanerochaete laevis, Ph. sanguinea, Phellinus chrysoloma, Ph. conchatus, Ph. lundellii, Ph. tremulae, Ph. viticola, Postia caesia, P. fragile, P. placenta, Trametes hirsuta, T. pubescens, Phlebiella sulphurea.*

Some species were absent in natural forest all the years of observations, but were found in burned one in different years: *Coltricia perennis, Pycnoporus cinnabarinus, Thelephora terrestris, Trichaptum pargamenum* in 1993; *Gloeophyllum sepiarium, Lenzites betulina, Merulius tremellosus, Phellinus nigrolimitatus, Polyporus brumalis, Stereum hirsutum*, *Tyromyces chioneus* were found in the burned side in 1994; *Gloeoporus dichrous*, *Junghuhnia luteoalba, Polyporus varius* were firstly marked in 1995.

All these species are characteristic for dry sites and they are carbophilous. There were also noted the presence of specific carbophilous species from other fungal groups, mainly heterobasidial macromycetes and ascomycetous fungi. The only species of this specific group *Daldinia concentrica* was also found in the natural forest. Some species were developed in the burned forest only: in 1993, besides *Daldinia concentrica*, also *Calocera viscosa*, *Pleurotus ostreatus* and *Rhizina inflata* were found. All these species, apart from *Pleurotus ostreatus*, are typical carbophiles. In 1995 *Gyromitra infula* was added to these species, in 1995 *Exidia saccharina*.

The number of *Daldinia concentrica* and especially *Rhizina inflata* decreased from 1993 to 1995 gradually. In 1993 both species were numerous, in 1995 it was very difficult to meet 2–3 fruit bodies of either one of them.

Red Data Book species: both natural and of burned forests included 2 Red Data Book species: *Polyporus badius* (V)2 and *Phellinus populicola* (st)4 were found in the natural forest, and *Polyporus badius* (V)2 and *Trichaptum pargamenum* (Sh)3 in burned one.

In the natural forest 7 indicator species were found: *Asterodon ferruginosus, Fomitopsis rosea, Phellinus chrysoloma, Ph. lundellii, Ph. pini, Ph. viticola* and *Postia placenta*. In the burned forest only *Ph. pini* was found.

6.5 Conclusions

During 4 summer seasons (1993–1996) aphyllophoraceous fungi were collected in almost 50 sites of 17 localities in North Karelian Biosphere Reserve and adjacent municipalities Nurmes and Valtimo. The determined mycological material contained 169 species of 89 genera and 18 families of the order Aphyllophorales. Monotoring studies of the next seasons (1997-1998) fulfilled much the whole list of the species, especially for the scanty researched sites. The full list includes now 252 species (Bondartseva et al. 1999). For many species new localities were found and the data on their distribution into the area are more full now. The comparison of species number changes in the different sites shows, that floristic study made during 1 and even 2 years is not sufficient, whereas 3-4-year study could discover the main part of species composition. According to the most fresh data the richest site is Syväjärvi (170 species); the second place belongs to Kotavaara area (140 species). List of species for Tapionaho did not grow much (98 species now, 93 in 1996), as it was the best studied locality. Lahnavaara list of species enlarged from 66 to 78 species, that one of Koitajoki – from 68 to 70 species. At the other sites the changes are insignificant. Another sites with good biological diversity of aphyllophoraceous fungi are Pampalo, Murtovaara, Kivimäki, Piilopirtinaho N and Ukonsärkä Ukonkangas. Some sensitive species of aphyllophoraceous fungi found from these sites, show, that the forests there still have features of natural habitats, especially that ones in Syväjärvi and Kotavaara sites, that was confirmed by investigations of 1997-1998. Pampalo site was studied only fragmentary, but the first results are impressive (58 species, 12 indicator and threatened). Some sensitive species of aphyllophoraceous fungi found from these sites, show, that the forests there still have features of natural habitats. Many species of wood-destroying fungi are very sensible to every changes in the balanced ecosystem, so they serve as indicators of ecosystem integrity.

Some of the studied sites, including Tapionaho, show some features of degradation of the natural state. The greatest number of determined species there is a result of the most comprehensive studies. Nevertheless, the presence of rare and endangered fungi indicates that these sites can be restored to the natural state. The most important thing is to protect neighbouring areas from all forms of hard utilisation, because for conservation of the very site it is necessary to have an area on where the same type of vegetation can be maintained. There is no necessity – or possibility – to protect any fungal species themselves, they may be conserved only with their plant hosts and the whole ecosystem which they are adapted to.

According to these rules it is possible to divide all studied areas to three groups: The best sites with the practically natural forest ecosystems: Lahnavaara, Syväjärvi, Koitajoki, Pieni Kotavaara, Pampalo (wet side, ”korpi”), Murtovaara, Kivimäki, Piilopirtinaho N, Ukonsärkkä Ukonkangas. Some of the sites are incompletely studied now. Somewhat destroyed sites with possibilities for restoration, because sensitive species still grow there: Tapionaho, Niemijärvi, Kotavaara, Lakonjärvi, Päävaara. Sites as Patvinsuo and Petkeljärvi National Parks having good form of protection that must be maintained in future.

The next program must concentrate to study the species composition more carefully in every site, with more attention to the type of forest determination and more deep study of regularities of fungi distribution in different ecosystems. It is very desirable to collect during the season, for study fungal fenology better. The next step is also to study resistant fungal complexes in different ecosystems, with notes on tendencies in changes of species composition.

6.6 Acknowledgements

The authors are indebted to the curator of the Herbarium of Helsinki university (H) Prof. T. Koponen for allowing to study the collections. We are also grateful to Prof. T. Niemelä who kindly helped us to identify some specimens and presented for study type materials of the species recently described by him.

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7 KOITAJOKI AREA: AN OASIS OF BIODIVERSITY OR WORTHLESS FRAGMENTS OF MATURE FOREST?

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7.1 Introduction

The area of Koitajoki in Ilomantsi (province Karelia borealis) has been a subject of some heated environmental debate for several decades. The development work for a new national park, Koitajoki National Park, there by combining some existing nature reserves and adding adjoining areas, has had its proponents and antagonists. The old-growth forests in the area have diminished rapidly, but what is the biological value of those which remain? There has, unfortunately, been only little research results to support arguments for or against. The political part, too, is not without its complexities. Powerful argumentation has taken place regarding the economic and sociological consequences of establishing a new national park in the area.

As an endeavour towards providing some additional biological knowledge concerning the area, a summary of research done in there is presented in this chapter. Also, a brief discussion of the value of the Koitajoki area is presented.

7.2 Insects

7.2.1 Coleoptera (Yakovlev et al., in this publication)

A total of 15 600 individual beetles were identified from the material collected at Koitajoki. This comprised 282 species, 221 species being of saproxylic groups of coleoptera. Almost 98 % of the catch was came from Tapionaho. The most numerous group was that of bark beetles (Scolytidae), and this was due to forestry logging operations conducted near the Tapionaho sites. Almost 4800 scolytids were caught from just one site – Tapionaho D – during the years 1993–1995. Normally, the distribution of species in a forest area is even, and most species do not exhibit mass occurrences (for the site descriptions see Hokkanen & Vuorio, in this publication).

Tapionaho D and E were the most diverse sites studied. This holds true even when bearing in mind that only the best sites were studied continuously throughout the study period. Tapionaho E was the specific site for Cyllodes ater, and thirteen species not found to occur elsewhere were found there. The total number of species collected from this site was 182. Tapionaho D maintained the most diverse species composition. As many as forty species were found only on Tapionaho D, where the total number of species was 203. Some species associated with aspen were found only on Tapionaho D.

It was clear that the tree-species composition of the sites, as well as the nature of the adjacent areas, influences the insect-species composition. This was most easily demonstrated by the mass occurrence of scolytids following logging operations in the nearby areas. The tree-species composition within a site, tree size (large – small), age, etc., all favour the occurrence of certain, highly-specialised species. The big picture can be revealed only by conducting a full-scale analysis of the species composition.

Three-year trapping revealed a couple of significant trends: one was that the number of insects in the fungivorous groups (cf. Yakovlev et al., in this publication) was clearly lower in 1994, which was a very dry year. This is indicative of changes in the availability of fungal mycelia, and thus of fungivorous species in the food web. Unfortunately, fungal production is very difficult to measure.

7.2.1.1 Endangered species

Endangered species were rare, or their living conditions have been impaired in the area mainly due to anthropogenic changes. These species can also be considered as indicators of specific niches still supporting versatile biotic communities. About half of the endangered Coleoptera species in Finland, Sweden, and in the Republic of Karelia are forest-dwelling species depending on decaying wood (see Uhanalaisten... 1992, Ehnström et al. 1993, Ivanter 1996).

A total of fourteen endangered Coleoptera species were found in the years 1993–1995 (Table 7.1). All of them – apart from one occurrence of Melandrya dubia at Lahnavaara – were found at Tapionaho. The species were generally typical old-growth forest species. Especially *Cyllodes ater* (Nitidulidae) was a good find: it has been found only twice before this (Uhanalaisten eläinten ja kasvien seurantatoimikunta 1992), and has been considered to be extinct in Finland. However, there have been several finds of *Cyllodes ater* in the Republic of Karelia (Siitonen & Martikainen 1994, Yakovlev & Hokkanen 1995).

The occurrence of *Cyllodes ater* appeared to stabilise in the short term – the species was found in three consecutive years very different as regards the weather conditions. Thereafter, trapping was intentionally stopped to save the species from further loss. *Cyllodes* was caught about equally by means of both window traps and polypore traps. The species moves actively in the area, but although the species has been found on several sites at Tapionaho, half of the finds were from site D.

Two species, *Meloe violaceus* and *Zilora elongata*, were found only on Tapionaho F, which was, unfortunately, cut after the first year of study.

The ”goodness” of the best sites seems to be connected with the amount and diversity of dead wood on these sites (see Hokkanen & Vuorio and Yakovlev et al., in this publication).

Table 7.1. Species and numbers of endangered Coleoptera trapped at the Koitajoki area in 1993–1995. The category of endangeredness and method of trapping are indicated by H = extinct, V = vulnerable, St = declining, Sh = rare, M = in need of monitoring (Uhanalaisten... 1992).

Species	Category	Handcollected	Window-traps	Trunk-traps
Cyllodes ater	H		8	9
Monochamus urussovi	V		1	
Orthotomicus longicollis	V		1	
Lacon fasciatus	St		1	
Peltis grossa	St		2	3
Mycetophagus quadripustulatus	St		6	2
Pytho abieticola	St		2	
Tomoxia bucephala	St			2
Melandrya dubia	St		7	2
Leptura nigripes	St		6	
Triplax rufipes	Sh		2	3
Eucilodes caucasicus	Sh		1	
Meloe violaceus	M	1		
Zilora elongata	M		5	
	Total	1	40	21

7.2.2 *Diptera (Polevoi, in this publication)*

A total of 5 600 adult Diptera individuals (representing 502 species) were found and identified on eight sites within the Koitajoki area in 1993–1996. The localities studied were Tapionaho, Pirhu, Koitajoki, Lahnavaara and Hoikka–Syväjärvi, giving a total of eight sites. The emphasis was on fungus gnats, which are also an important and indicative group in the food webs in old-growth forests.

Six of the found Diptera species in present study are included in the Finnish Red Data Book (Uhanalaisten... 1992) (see Table 7.2) and 82 species were new to Finland. Seven of these had not been recorded previously as occurring in Europe, and eight species are, apparently, new to science. Most of the species were found at Tapionaho and Pirhu, which happened to be the most intensively studied sites.

Some specialised groups of fungus gnats appear to manifest site preferences even on the genus level: the genera *Anatella* and *Exechiopsis* were collected mainly from semi-cultural biotopes in Pirhu, whereas the genera *Cordyla* and *Syntemna* (apart from the abundant and ubiquitous *Cordyla parvipalpis*), favoured Tapionaho's old-growth forests. Many other diverse and abundant genera, e.g. *Mycomya* and *Boletina*, did not demonstrate generic preferences.

Table 7.2. Diptera species considered to be endangered in Finland (according to Uhanalaisten... 1992). The categories used: V = vulnerable, M = in need of monitoring.

Species	Category	Site where found	exx.
Pachyneura fasciata	V	Pirhu	3
Keroplatus tipuloides	V	Tapionaho	1
Xylophagus ater	V	Hoikka, Syväjärvi, Tapionaho	4
Xylophagus junki	V	Tapionaho	1
Temnostoma vespiforme	M	Pirhu	1
Sphegina sibirica	M	Pirhu	3
Hendelia beckeri	M	Pirhu, Tapionaho	2

The species composition of Diptera is relatively well known in Finland. However, sites containing new species are still be found when conducting specialised studies such as ours. Especially the species connected with decaying wood, which may also have a poor ability to adapt to environmental changes, are of interest. They are also important in pursuing the changes in forest environments. Many of these species or groups of species are poorly known. Thus, simultaneously with the fauna studies, thorough studies about the biology of these groups should be conducted.

7.2.3 Hymenoptera (Apocrita) (Humala, in this publication)

The order Hymenoptera is a diverse group and most of the species are parasites or predators. Although the order plays a significant role in the regulation of natural systems, for instance, its taxonomy is poorly developed and the order is generally incompletely studied. This holds true also in North Karelia.

In these studies, 264 species of Hymenoptera (Aculeata), were identified from old-growth forests and some abandoned meadows in Pirhu (altogether eight sites). The Hymenoptera catch was the biggest at Tapionaho, Pirhu and Koitajoki. The full list of species contains several species new to Finland, but it is difficult to state the exact number due to the check-list dating back to the 1940s and thus being clearly out of date (Hellén 1940).

Despite the limited material of this study, there were several rare species which are most probably associated with the wood-decomposing system. These rare species included saproxylic ichneumonids such as *Dolichomitus aciculatus* (Tapionaho), *Dolichomitus terebrans* (Pirhu), *Odontocolon punctulatus* (Koitajoki), *O. spinipes* (Koitajoki), and *O. dentipes* (Tapionaho, Niemijärvi).

Aniseres caudatus (Humala) is a species associated with a polyporous fungus, *Fomitopsis pinicola*, and it was described a few years ago (Humala 1997). This species has been found at only two places in the world, the Kivach Nature Reserve near Petrozavodsk (Republic of Karelia, Russia) and Tapionaho (North Karelia, Finland). In terms of the catch quantity and species rarity, Koitajoki and Tapionaho turned out to be the most diverse forested sites studied.

7.2.4 *Polyporaceous fungi (Bondartseva et al., in this publication)*

Polyporaceous fungi were studied comprehensively in the surroundings of Koitajoki and also elsewhere within the North Karelian Biosphere Reserve. Altogether, about 1 500 samples were collected and 170 species from the order Aphyllophorales were identified. The total number of species (Aphyllophorales) in Finland is currently 207 (Niemelä 1996).

Tapionaho is the most intensively studied locality – a total of 94 species were found there, seven of which are included in the Finnish Red Data book (Uhanalaisten... 1992). Lahnavaara, Koitajoki and Syväjärvi are also noteworthy localities with 66, 68 and 69 species being found there, respectively. The highest number of Red Data Book species were found at Koitajoki and Lahnavaara – eight species each. The list of Red Data species found is presented in Table 7.3. Several rare species or recently described species were also found (Table 7.4). The status of newly-described species is unclear because their distribution and habitat requirements are unknown.

Table 7.3. Red Data Book species found at Koitajoki during inventories conducted in 1993–1996. The categories used: E = endangered, V = vulnerable, Sh = rare, St = occurrences declining (Uhanalaisten... 1992).

Species	Category	Found on site
Polyporus pseudobetulinus	E	Lahnavaara, Pampalo, Lakonjärvi (Southwest)
Clavaria zolingeri	V	Autiovaara
Diplomitoporus crustulinus	V	Pieni Kotavaara
Diplomitoporus lindbladii	V	Syväjärvi
Haploporus odorus	V	Lahnavaara
Hericium clathroides	V	Tapionaho, Lahnavaara, Syväjärvi, Kotavaara, Petkeljärvi, Ukonsärkkä (Ukonkangas), Paistinvaara (VMS)
Hericum fragile	V	Syväjärvi
Hydnellum suaveolens	V	Tapionaho, Koitajoki, Pieni Kotavaara
Polyporus badius	V	Kitsi (natural), Kitsi (burned), Koitajoki
Skeletocutis lenis	V	Tapionaho
Amylocorticium subincarnatum	Sh	Ukonsärkkä (Pieni Haukilampi), Kivimäki
Gelatoporia pannocincta	Sh	Koitajoki, Kotavaara, Petkeljärvi, Pahkavaara (West)
Mycoacia aurea	Sh	Petkeljärvi
Postia guttulata	Sh	Lahnavaara
Postia hibernica	Sh	Niemijärvi
Protomerulius caryae	Sh	Ukonsärkkä (Ukonkangas)
Pycnoporellus fulgens	Sh	Lahnavaara
Trichaptum pargamenum	Sh	Tapionaho, Kitsi (burned), Lahnavaara, Syväjärvi, Hoikka, Koitajoki, Autiovaara, Pieni Kotavaara, Petkeljärvi, Lakonjärvi (South), Ukonsärkkä (Ukonkangas)
Antrodia albobrunnea	St	Tapionaho, Pieni Kotavaara
Junghuhnia collabens	St	Autiovaara, Kotavaara, Pampalo (slope)
Phellinus populicola	St	Tapionaho, Kitsi (natural), Syväjärvi, Koitajoki, Pieni Kotavaara, Petkeljärvi, Murtovaara

Table 7.4. Recently described species with unknown geographical distributions.

Species	Found on site
Antrodia macra	Tapionaho, Koitajoki, Autiovaara
Antrodia mellita	Lahnavaara, Niemijärvi, Kivimäki
Antrodia pulvinascens	Koitajoki
Postia lateritia	Pieni Kotavaara
Skeletocutis brevispora	Syväjärvi

According to the results of the analysis of the entire polypore material, the best sites at Koitajoki were Lahnavaara, Syväjärvi, Koitajoki, Pieni Kotavaara and Pampalo. The species composition on these sites showed some of the features of natural habitats and good integrity and balance of the communities. Tapionaho, on the other hand, was the locality most intensively studied with numerous species and several of them being endangered. The species composition, however, showed some signs of disturbances (see also Bondartseva et al. 1997). The high total number of species indicates, however, that these changes could be reversible if the surrounding areas are retained untouched and the conditions within the studied sites remains stable. Niemijärvi and Kotavaara belong to the same category of ”slightly disturbed” sites.

7.3 Summary of inventories on the best sites and some future prospects

Tapionaho is one of the most intensively studied sites in the whole of North Karelia as regards biological diversity, and according to the results obtained in the present study the site is of extremely high value. The occurrence of *Cyllodes ater* alone would be enough to warrant his claim, but there thirteen other endangered Coleoptera species (Yakovlev et al., in this publication), seven endangered polypore species (Bondartseva et al., in this publication), and several Diptera (Polevoi 1997) and Hymenoptera species (Humala 1997b) were also encountered there. Almost all of these species were found near the Tapionsuo mire, from within a narrow preserved forest strip between the mire and managed forests.

The best sites were characterised by their complete succession series of dead wood of several tree species (see also Hokkanen & Vuorio, in this publication). The diversity of the key biotopes and the good composition of tree species (spruce, pine, birch, aspen) are further strong points of Tapionaho, as is the virgin mire. A disadvantage of the site is that the forest strip is narrow and thus likely to be impaired if forestry operations, for example, continue near the site.

Niemijärvi is adjacent to Tapionaho. The site is dry, and delimited on its northern side by a drained mire. The tree-species composition is monotonic in comparison to Tapionaho, but dead pines are present. The sites surrounding Niemijärvi are not as good as those near Tapionsuo. The main finds from Niemijärvi were two endangered polypores (Bondartseva et al. 1997). In addition to the finds by Bondarceva et al. (1997), Junninen (1996) found a polypore – *Antrodia mellita* – from Niemijärvi. This was only the eighth recorded occurrence of *A. mellita* in Finland.

Koitajoki is a small and peculiar site near the river. Due to the constant repetition of floods in the site and the abundance of dead wood, the diversity of polypores on the site was one of the best encountered: 68 species, eight of which are endangered. Several rare or endangered insects were also found there.

Lahnavaara (Lahnavaara, Liekkuaho) is a strange site. It was rich in polypores, but lacking in insects. Unfortunately, an analysis of dead wood was not conducted and so one cannot compare Lahnavaara to the other sites. However, the composition of polypore species is diverse, and it is considered to be one of the best sites studied, and eight endangered species were encountered there. Lahnavaara is quite dry apart from a moist depression on the actual Lahnavaara site, and pine is the predominant tree species. Draining of the nearby mire may have done harm to the moisture balance of the mineral-soil areas.

The area appears to be under strong pressure from forestry, but concurrently with this, nature values may receive emphasis following the development efforts directed at the most easternly point of the European Union, which is located nearby. Lahnavaara has also been included in the proposed Koitajoki National Park in ”alternative” plans put forward by conservationists. The powerful development dilemma overshadowing the area, and the diversity of polyporaceous fungi call for caution in the treatment of the forests.

Pampalo served as a reference site consisting of two quite different entities – Pampalo, a moist site, and Pampalo (slope), a dry slope (although the studied site was in the richest end of the dry slope). Pampalo was studied only in 1996. The amount of dead wood then was quite large, and Bondartseva et al. (1997) regarded Pampalo to be in the best class of natural forests. The number of polypores found at Pampalo was quite low, but diverse. Only two Red Data species were found, and two rare species not previously recorded in North Karelia. When taking into account that the year 1996 was very unfavourable year (cold, dry) for fungi, these results are fairly good. Savola (1995, unpublished results, Regional Environment Centre of North Karelia) found several Red Data polypores in the site. Insect studies have not yet been concluded, but Yakovlev (pers. comm.) has reported having found some endangered beetles in the course of the first brief inspection of the material.

Syväjärvi–Hoikka–Kotavaara was also a reference locality. At least Syväjärvi and Pieni Kotavaara are considered valuable in the light of the polyporaceous fungi found there (Bondartseva et al. 1997)

7.4 Old-growth forests at Koitajoki: Jewels in the crown or mediocre leftovers?

Practically all of the studied sites should be considered biologically valuable according to our results. Their biological value seems to be cumulative, and one of the fundamental features is dead wood: the amount and quality of decomposing wood, and the succession of decomposition (whether or not there are all stages of decay present; e.g. Renvall & Niemelä 1994). This is understandable taking into account that about half of the endangered insects in the Nordic countries are forest-dwelling insects (see Uhanalaisten... 1992), primarily dependent on decomposing wood. Thus, polyporaceous fungi, for example, are excellent indicators of the diversity (or lack of it) of the decomposing system (e.g. Niemelä & Renvall 1994).

The situation with regard to decomposing wood is – according to our quite extensive background material – excellent on several of the studied sites (over 200 dead fallen trunks per hectare, several tree species), and reasonable on most of the sites (see Hokkanen & Vuorio 1997). Actually, this has been the goal of the studies: the best sites deserve to be studied and evaluated as regards their biota.

The difference between managed forests and old-growth forests is striking in terms of the amount and succession of decomposing wood. Junninen (1996), in her study on managed forests and old-growth forests, stated that the fundamental difference lies in the succession of dead wood; especially the number of standing, dead trees was very low in managed forests (about 20 per hectare vs. 200 per hectare in old-growth forests). The number of fallen, dead trunks in managed forests was about one third of that in old-growth forests (Junninen 1996). This inevitably results in the discontinuation of succession in decomposition. Compared to managed forests, the situation with regard to decaying wood was good on the study sites.

The amount and quality of dead wood is one prerequisite when determining the biological value of a site. Another, often overlooked, feature is the history of the site: how has it evolved to its present state? The history of North Karelian forests can be traced back to the beginning of the present century. In the early decades of the century, the forests in the easternmost corner of Finland were, indeed, the best in the country from the biological point of view: the amount of wood per hectare was higher than elsewhere, and the age structure of the forests was skewed in favour of old age classes (Ilvessalo 1962). Also the number of dead, standing trees was high (Kalliola 1966).

Another, equally important, factor is that the forests in the easternmost corner have been ”in contact” with one another for a long time, and with the extensive forest areas on the Russian side of the border (see Kalliola 1966). In southern Finland, the fragmentation of the forests has, thus, begun considerably earlier than in the remote parts of the country. The fragments of old-growth forests in southern Finland – though nowadays carrying higher timber volumes per hectare – are not biologically as valuable as those in eastern Finland: there is no continuation of dead, fallen or standing trees, and the said forests have been isolated for a long time without connections to untouched (natural) forests. The longer the distance from the border, the more difficult it is to find biologically valuable areas.

The forests in remote areas were saved from being cut for as long as the technology applied did not facilitate intensive cutting. Though there had been substantial logging operations in Ilomantsi already in the 19th century, the situation was radically changed following World War II, when extensive cutting operations were launched in the area. The area of ”over-aged” stands began to decrease. At present, only fragments of old-growth forests remain, and the connection between Finnish and Russian forests has – in the main – been lost. However, the value of the sites still uncut is greater than ever. According to the latest national forest inventory (NFI 8) conducted in Finland, the difference between North Karelia and other parts of southern Finland is increasing. The more criteria defining old-growth forest are set (age, amount of dead wood, growth, uncut for over 30 years, etc), the better the situation is in Karelia (NFI 8). When considering an extensive area – e.g. Koitajoki, which is thousands of hectares in size – biological diversity seems to be quite high still. About 45 % of the polypores known to occur in Finland have been found within the relatively small area of Tapionaho, and this percentage rises to as high as 80 % when all the sites studied are taken into consideration (Bondartseva et al. 1997). These figures on polypores are rather high compared, for example, to the results obtained by Kotiranta & Niemelä (1981) and Anttila et al. (1995). Kotiranta & Niemelä (1981) found a total of ninety-seven species in the course of inventories covering some hundreds of hectares of diverse forests (four forest areas) in southern Finland. In individual forests, the number of species varied between 57 and 70. Anttila et al. (1995) used a different method and studied only species growing on spruce trunks; their inventory consisted of three 120 m lines along which they found 15–37 species per area from a total of eight areas, located mainly in Kainuu, northern Finland. Junninen (1996), using quite small sampling sites, found 16 to 23 species in old-growth forests sites, and only eight species in managed forests.

Also the number of endangered or rare insects at Tapionaho, for example, was high. Thus, biotic indicators gave a high biological value for the studied sites. However, the picture becomes very complicated when trying to take into account the total, patchy environment where the species live. Hanski et al. (1995), for the first time in the history of ecology, showed consistently how the metapopulations of an endangered butterfly species became extinct and also spread to new, favourable areas. The rate of extinction within the fifty-one thoroughly studied metapopulations was much higher than the spreading of the species to new areas. For the said butterfly species, metapopulation dynamics would appear to be the correct way to explain changes in its population, and Hanski et al. (1995) suggest that the metapopulation dynamics model works with many other endangered species, too.

The critical factors in metapopulation studies are patch density and patch area. Haila et al. (1994) suggest that the composition and configuration of habitats within a forest preserve is an issue more important than the area of the forest. Their data suggest that a patch size of 5 to 50 hectares is enough for birds and Coleoptera (Carabids). This suggested size range also covers the differentiation of natural forest stands, which vary due to topography, soil, moisture, microclimate, etc. The suggestion of Haila et al. (1994) is, however, only valid if the same mosaic scale is extended over a regional scale. An isolated patch of pristine forest – an island in a sea of managed forests – is of doubtful importance for fauna conservation (Haila et al. 1994). The environmental changes within one site are so wide that local extinction is a conceivable alternative over a short period of time. Even in managed reserves, several cases of extinction have been observed within the past twenty years in connection with work on butterfies (Warren 1992). Butterflies have been studied at great depth and they are rather easy insects to work with, whereas endangered Coleoptera are (relatively speaking) impossible to deal with.

The number of biotopes suitable for the most demanding Coleoptera is very low, and the sites rarely form a feasible network. Moreover, our biological knowledge of the species to be worked with is next to nothing. Thus, we have to follow the rough guidelines formulated as results of ecological studies on polypores and insects: the amount of dead wood, especially of thick trunks, is essential for polypores (Anttila et al. 1995). Also, all other kinds of dead wood are needed for polypores, standing dead trees, small-diameter spruces, windthrows, wood in advanced stage of decay, broadleaves as admixtures in coniferous forests, natural stumps (compared to stumps created in the course of logging), forest fires, variable tree stands, succession (see Niemelä & Renvall 1994). Polyporaceous fungi, although a compact group of species, are important as indicators of the decomposition part of the nutrient circulation (Niemelä & Renvall 1994). Sites supporting a diverse polypore flora also provide a diversity of niches for all kinds of insects (see Heliövaara & Väisänen 1984).

Koitajoki is of immense value. Taking into account the suggestions of Haila et al. (1994), and the results of Hanski et al. (1995), it is reasonable to assume that isolated forest fragments are quite limited as to their possibilities of maintaining their present rich fauna without further actions on the part of man due to the dearth of sites and the sparseness of their distribution pattern. As a means of improving the situation, the connection from Finland over to cross-border areas in Russia should be restored, and the best fragments should be connected by means of spreading corridors and protected by buffer zones. The key factor is to identify the scale of operation: how large are the areas needed and where are they needed, so that spatial and temporal homogeneity and heterogeneity might be ensured. More data about the environment and the biota are needed. meticulous inventorying of areas, combined with combining and grouping of suitable sites to form adequate entities are alternatives worth considering. These are means to maintaining, and even improving, the unquestionable value of the present areas.

7.5 Acknowledgements

Veli-Matti Sorvari and Ville Vuorio from the Regional Environment Centre of North Karelia provided valuable comments on the history and development of forest stands in Finland.

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FOREST STAND DESCRIPTION FORM

North Karelian Biosphere Reserve 1996

Inventory done by: ________________________ Date ________

Site: ________________________

Forest use: ________________________

____

stand characteristics: forest type: ________________

Alive trees, hight ________ m, volume: ________ m^3

	Scots pine	Norway spruce	White birch	Aspen	Salix caprea	
percentage						
diameter						

Dead trees on soil_______ pcs/ha

	Scots pine	Norway spruce	White birch	Aspen	Salix caprea	
percentage						
diameter						
degree of decomposition						

Dead trees (standing) ________ pcs/ha remarks, as related to alive trees

____

____

Specific features: ________________________

____

____

Species inventories: ________________________

____

____

Surrounding areas: ________________________

____

____

other: ________________________

____

____

Sample sites' growing stock and field inventory data

(N=north, E=east, W=west, S-W= south-west, N-E=north-east, Kotav=Kotavaara, P-Kotav=Pieni-Kotavaara, Lakonj=Lakonjärvi, Tap=Tapionaho, Nie=Niemijärvi, Pah=Pahkavaara, Ukon=Ukonsärkkä, Koi=Koitajoki, Ver=Verkkojärvi, Väär=Väärälampi, Pii=Piilopirtinaho, Pää=Päävaara, Sär=Särkilamminkangas, Pais=Paistinvaara, Sal=Salmivaara)

		Hoikka	Hoikka	Kotav	P-Kotav	Lakonj	Lakonj
Forest use		11, 12	12, 16	12, 15	12, 15	11, 13, 15	14, 15, 17
Growing stock parameters							
Forest site type		13	13	13	13	13	12
Height		24	24	24	22	22	24
Volume (m^3)		240	220	300	280	170	260
Pine	%	20	1	10	20	10	5
	Diameter		17				14
Spruce	%-portion	60	90	80	70	80	90
	Diameter		12				12
Birch	%-portion	20	10	10	10	5	5
	Diameter		12				20
Aspen	%		1		1	5	1
	Diameter		12				20
Goat-willow	%		1				1
	Diameter		11				16
White alder	%						
Snags max n/ha		350	300	200	100	250	150
Pine	%	10	1	10	10		1
	Diameter	20	10	11	17		11
	Stage of decay	10	10	10	10		10
Spruce	%	80	90	60	80	40	80
	Diameter	11	12	11	10	12	12
	Stage of	10	10	10	10	10	10
Birch	%	10	10	30	10	10	10
	Diameter	20	11	11	16	11	11
	Stage of decay	10	10	10	10	10	10
Aspen	%-portion			1	1	50	10
	Diameter			17	12	21	21
	Stage of decay			10	12	12	10
Goat-willow	%						
	Diameter						
	Stage of decay						
White alder	%						
	Diameter						
	Stage of decay						
Dead standing trees n/ha		60	100	70	30	20	70
Deviation		12					
Special characteristics		27, 31, 34	23, 31	10, 23, 34	23	33, 34	12, 34
Species inventories		19	19	12	19	10	15
Other							
Age		126	166	166	156	126	156
Stage of development		11, 15	14	14	14	17	14
Growth		3	1	1	1	3	2

		K-Pam	S-Pam	Koi	Tap E	Tap D
Forest use		11, 12, 15	12, 13, 15	12	11, 12	11, 13
Growing stock parameters						
Forest site type		12	13	13	13	13
Height		22	24	25	25	26
Volume (m^3)		300	210	160	230	320
Pine	%	5	5	1	20	20
	Diameter	15	20	16	24	24
Spruce	%	90	85	95	80	70
	Diameter	13	13	14	13	13
Birch	%	5	10	5	1	5
	Diameter	12	20	12	13	20
Aspen	%	1	1	1	1	5
	Diameter	25	18	15	24	23
Goat-willow	%					
	Diameter					
White alder	%-portion					
Snags max n/ha		300	250	200	150	270
Pine	%-portion	5	1	1	20	50
	Diameter	13		25	21	21
	Stage of decay	10		13	10	10
Spruce	%	70	60	90	70	30
	Diameter	13	12	15	12	12
	Stage of decay	10	10	10	10	12
Birch	%	15	40	10	10	10
	Diameter	13	20	13	12	20
	Stage of decay	10	10	10	10	10
Aspen	%	10				10
	Diameter	15				12
	Stage of decay	10				10
Goat-willow	%					
	Diameter					
	Stage of decay					
White alder	%					
	Diameter					
	Stage of decay					
Dead standing trees n/ha		100	50	70	50	100
Deviation		10				11
Special characteristics		18, 39, 41, 43	15, 27	18, 22, 29, 38	17, 22, 24, 34	10, 24, 29, 33
Species inventories		19	12, 13	15	13	13
Other						
Age		166	166	116	140	150
Stage of development		14	14	11	14	14
Growth		2	2	3	1	1

		Tap C	Tap B	Tap A	Nie
Forest use		11, 12	11, 12	11, 12	11, 15
Growing stock parameters					
Forest site type		13	13	13	14
Height			23	24	
Volume (m^3)					
Pine	%	40	5	5	50
	Diameter	21	21	23	17
Spruce	%	50	75	75	50
	Diameter	11	13	13	12
Birch	%	10	15	20	1
	Diameter	20	20	12	16
Aspen	%	1	5	1	
	Diameter	20	21	13	
Goat-willow	%-portion				
	Diameter				
White alder	%				
Dead stand. trees max n/ha		250	200	300	250
Pine	%-portion	50		1	90
	Diameter	12		23	20
	Stage of decay	10		10	10
Spruce	%	30	60	50	5
	Diameter	11	13	13	10
	Stage of decay	10	10	10	12
Birch	%	15	20	50	5
	Diameter	20	11	12	16
	Stage of decay	10	10	10	10
Aspen	%	5	20		
	Diameter	20	12		
	Stage of decay	10	10		
Goat-willow	%		1		
	Diameter		10		
	Stage of decay		14		
White alder	%				
	Diameter				
	Stage of				
Dead standing trees n/ha		70	40	40	70
Deviation					
Special characteristics		11, 22,	10, 23,	10, 23,	23, 24,
Species inventories		14	14	14	14
Other					
Age				120	
Stage of development					
Growth					

		Pah	Pah	Pah	Ukon	Ukon	Ukon
Forest use		13	13	12, 13, 15	11, 13	12, 13, 15	11, 15
Growing stock parameters							
Forest site type		13	13	13	13	11	13
Height		21	23	16	23	24	22
Volume (m^3)		178			228	263	
Pine	%	1	20	10	20	1	30
	Diameter			21			
Spruce	%-portion	90	65	80	70	90	60
	Diameter			13			
Birch	%-portion	10	15	10	10	10	10
	Diameter			21			
Aspen	%				1		
	Diameter						
Goat-willow	%						
	Diameter						
White alder	%						
Dead stand. trees max n/ha		200	200	180	100	250	150
Pine	%-portion	20	1	1	10	1	40
	Diameter	24	17	25	18	17	17
	Stage of decay	11	15	13	15	15	10
Spruce	%	70	90	90	85	85	30
	Diameter	11	11	13	11	12	11
	Stage of decay	10	10	10	10	10	10
Birch	%	10	10	5	5	15	30
	Diameter	16	16	12	16	16	20
	Stage of decay	10	10	10	15	10	10
Aspen	%			5			
	Diameter			20			
	Stage of decay			11			
Goat-willow	%						
	Diameter						
	Stage of decay						
White alder	%						
	Diameter						
	Stage of						
Dead standing trees n/ha		10	30	20	70	80	70
Deviation				14			
Special characteristics		22, 27, 35	23, 27	10, 26	21, 34	20, 23	17, 22
Species inventories		12	11, 14	17	10	10	10
Other							
Age		133	143		145	150	145
Stage of development		11	11, 13	10, 12	11	11	11
Growth			3	4			

		Ukon (IV)	Ukon (V)	Pää (I)	Pää (II)	Sär	Mur
Forest use		11, 12, 15	11, 12, 15	11, 13	11, 12	11, 15	13, 15, 17
Growing stock parameters							
Forest site type		13	13	12	13	11	13
Height		23	22	22	21	20	19
Volume (m^3)		303	241	241	287	5	1
Pine	%	5	20	10	15		17
	Diameter	14			15	80	95
Spruce	%	95	60	80	80		13
	Diameter	13			13	15	1
Birch	%	1	20	10	5		13
	Diameter	20			20	1	1
Aspen	%	1	1	1	1		13
	Diameter	24			20	1	1
Goat-willow	%	1			1		16
	Diameter	16			10		1
White alder	%						10
	Diameter						
Dead stand. timber max n/ha		150	200	100	250	160	200
Pine	%	10	20	1	10	5	
	Diameter	14	22	24	22	12	
	Stage of decay	10	10	15	10	10	
Spruce	%	80	50	80	70	80	50
	Diameter	13	12	11	13	12	13
	Stage of decay	10	10	10	10	10	10
Birch	%	10	20	10	10	5	10
	Diameter	12	16	20	20	20	20
	Stage of decay	10	10	10	10	10	10
Aspen	%	1	10	10	10	10	40
	Diameter	12	23	12	21	13	24
	Stage of decay	10	10	10	10	10	10
Goat-willow	%						
	Diameter						
	Stage of decay						
White alder	%			1			
	Diameter			10			
	Stage of decay			11			
Dead standing trees n/ha		50	60	50	70	70	30
Deviation			10			10	
Special characteristics		10, 22, 26, 29, 33, 34, 42	32	22, 14	23, 27, 34, 35	35	17, 22, 29, 34
Species inventories		15	10	10	16	15	19
Other							
Age		140	145	160	150	130	144
Stage of development		11	11	11	11	11	11, 13
Growth							3

		Mur (W)	Koir	Sor	Kiv (S-W)	Kiv (N-E)	Sal
Forest use		11, 13	11	13	11, 12	13, 15	11, 12
Growing stock parameters							
Forest site type		13	13	13	13	13	10
Height		18	19	18	19	18	
Volume (m^3)							
Pine	%	10	1	1	20	1	15
	Diameter	16		16	17	17	
Spruce	%	85	80	95	60	95	60
	Diameter	16	16	16	17	13	
Birch	%	5	15	5	20	1	15
	Diameter	16	16	16	17	20	
Aspen	%		5		1	5	10
	Diameter				17	21	
Goat-willow	%						1
	Diameter						
White alder	%						
	Diameter						
Dead stand. trees max n/ha		100	300	60	150	130	110
Pine	%	1		1	10		15
	Diameter	25		12	24		23
	Stage of decay	15		15	15		10
Spruce	%	90	50	90	50	70	55
	Diameter	12	12	13	13	13	12
	Stage of decay	10	10	10	10	10	10
Birch	%	10	30	10	40	10	20
	Diameter	16	20	16	20	20	20
	Stage of decay	11	10	10	10	10	10
Aspen	%		20		1	20	10
	Diameter		21		12	20	21
	Stage of decay		10		10	10	10
Goat-willow	%						1
	Diameter						10
	Stage of decay						10
White alder	%						
	Diameter						
	Stage of decay						
Dead standing trees n/ha		30	100	30	70		100
Deviation							
Special characteristics		27S, 34	22, 25, 27, 42	16W, 22, 34	15, 19	14, 22	27, 34, 35, 39, 40
Species inventories		10	20	12	11	10, 14	10
Other							
Age		134	144	143	135-145	142	
Stage of development		11, 13	11, 12	11, 13	11, 13	11, 13	
Growth		0	3	3	3	3	

		Väär	Pii	Pii (N)	Pais (N)
Forest use		10	11, 12	13, 15	12, 13, 15, 19
Growing stock parameters					
Forest site type		11	14	12	10
Height			15	20	15
Volume (m^3)					
Pine	%	1	10	1	
	Diameter		16	17	
Spruce	%	50	80	95	70
	Diameter	13	16	12	16
Birch	%	30	10	5	30
	Diameter	12		20	16
Aspen	%	20		1	
	Diameter	14		16	
Goat-willow	%			1	
	Diameter			13	
White alder	%				
	Diameter				
Dead stand. trees max n/ha		200	250	150	150
Pine	%		5		
	Diameter		18		
	Stage of		15		
Spruce	%	50	90	70	70
	Diameter	13	12	12	12
	Stage of decay	10	10	10	10
Birch	%	30	5	15	30
	Diameter	20	16	20	20
	Stage of decay	10	10	10	10
Aspen	%	20		15	
	Diameter	20		21	
	Stage of decay	10		10	
Goat-willow	%			1	
	Diameter				
	Stage of decay				
White alder	%				
	Diameter				
	Stage of decay				
Dead standing trees n/ha		80	70	50	70
Deviation					
Special characteristics		35	23, 25	14, 22, 23, 28, 30, 34	23, 34, 35, 39
Species inventories		10	10	15	10
Other					
Age			162	112	133
Stage of development			11,13	11, 12	11, 13
Growth			4	3	3

		Pai (WMS)
Forest use		11, 13
Growing stock parameters		
Forest site type		12
Height		18
Volume (m^3)		
Pine	%	1
	Diameter	
Spruce	%	85
	Diameter	13
Birch	%	15
	Diameter	20
Aspen	%	
	Diameter	
Goat-willow	%	
	Diameter	
White alder	%	
Dead stand. trees max n/ha		150
Pine	%	1
	Diameter	
	Stage of decay	15
Spruce	%	80
	Diameter	13
	Stage of decay	10
Birch	%	20
	Diameter	20
	Stage of decay	10
Aspen	%	1
	Diameter	14
	Stage of decay	13
Goat-willow	%	
	Diameter	
	Stage of decay	
White alder	%	
	Diameter	
	Stage of decay	
Dead standing trees n/ha		50
Deviation		
Special characteristics		15, 22, 23,
Species inventories		15
Other		
Age		154
Stage of development		11, 13
Growth		4

Appendix 3. 1(48) 134

Appendix 3. 1(48) 134

135 Appendix 3. 2(48)

Appendix 3. 3(48) 136

137 Appendix 3. 4(48)

Appendix 3. 5(48) 138

139 Appendix 3. 6(48)

Appendix 3. 7(48) 140

141 Appendix 3. 8(48)

Appendix 3. 9(48) 142

143 Appendix 3. 10(48)

Appendix 3. 11(48) 144

145 Appendix 3. 12(48)

Appendix 3. 13(48) 146

147 Appendix 3. 14(48)

Appendix 3. 15(48) 148

149 Appendix 3. 16(48)

Appendix 3. 17(48) 150

151 Appendix 3. 18(48)

Appendix 3. 19(48) 152

153 Appendix 3. 20(48)

Appendix 3. 21(48) 154

155 Appendix 3. 22(48)

Appendix 3. 23(48) 156

157 Appendix 3. 24(48)

Appendix 3. 1(48)

Appendix 3. 25(48) 158
159 Appendix 3. 26(48)
Appendix 3. 27(48) 160
161 Appendix 3. 28(48)
Appendix 3. 29(48) 162
163 Appendix 3. 30(48)
Appendix 3. 31(48) 164
165 Appendix 3. 32(48)
Appendix 3. 33(48) 166
167 Appendix 3. 34(48)
Appendix 3. 35(48) 168
169 Appendix 3. 36(48)
Appendix 3. 37(48) 170
171 Appendix 3. 38(48)
Appendix 3. 39(48) 172
173 Appendix 3. 40(48)
Appendix 3. 41(48) 174
175 Appendix 3. 42(48)
Appendix 3. 43(48) 176
177 Appendix 3. 44(48)
Appendix 3. 45(48) 178
179 Appendix 3. 46(48)
Appendix 3. 47(48) 180
181 Appendix 3. 48(48)

A list of Coleoptera species collected with window and polypore traps on all the sample sites in Koitajoki area in 1993–1995

(Koi= Koitajoki, Nie=Niemijärvi, Lah=Lahnavaara, win=window trap, pol=trunk trap)

Coleoptera species	Number of individuals												
	Tapionaho						Koi	Ni	Lah		Total		TOT
	A	B	C	D	E	F			A	B	win	pol	
CARABIDAE													
Dromius agilis (F.)	15	13	11	19	21	6		2		1	78	10	88
HYDROPHILIDAE													
Anacaena globulus (Payk.)				1							1		1
Hydrobius fuscipes (L.)								1					1
Cercyon haemorrhoidalis (F.)					2						2		2
LEIODIDAE													
Anisotoma humeralis (F.)	26	5	14	11	47	14	2				47	72	119
Anisotoma axillaris Gyll.		2	8	2							4	8	12
Anisotoma castanea (Hbst.)	3	3	13	8	6						22	11	33
Anisotoma glabra (Kugel.)	29	13	36	87	51	6	3	2			90	137	227
Anisotoma orbicularis (Hbst.)				2							2		2
Amphicyllis globus (F.)				3							2	1	3
Agathidium varians Beck	6	1	3	5	13						16	12	28
Agathidium confusum Bris.	21	6	8	10	19	1					38	27	65
Agathidium nigrinum Sturm				1							1		1
Agathidium arcticum Thoms.					1							1	1
Agathidium discoideum Er.	1		1	25	8	2					34	3	37
Agathidium nigripenne (F.)	8	5	1		4						11	7	18
Agathidium seminulum (L.)	20	35	51	76	32	6	3		3	1	138	89	227
Agathidium laevigatum Er.				1	1							2	2
Agathidium badium Er.	7	3	2	8	13						14	19	33
Agathidium pisanum Bris.	3	11	10	19	22	3	1				46	23	69
SILPHIDAE													
Nicrophorus vespilloides Hbst.		1			3						4		4
Nicrophorus vespillo (L.)	1		2	3	4	2					10	2	12
Oiceoptoma thoracica (L.)				2	1						3		3
CHOLEVIDAE													
Sciodrepoides watsoni (Spence)	4	3	2	1	1	2					10	3	13
Catops nigrita Er.		1	2	19							22		22
STAPHYLINIDAE													
Oxyporus maxillosus F.	1		3	8	59						56	15	71
Scaphisoma agaricinum (L.)	2	3	2	4	3						10	4	14
Scaphisoma inopinatum Löbl	1											1	1
Scaphisoma boleti (Panz.)	1			2	10						4	9	13
Scaphisoma subalpinum Rtt.	6	1	17	5	48						32	45	77
Scaphisoma boreale (Lundb.)	2		1								2	1	3

SPHAERITIDAE													
Sphaerites glabratus (F.)		1				1					2		2
HISTERIDAE													
Plegaderus vulneratus (Panz.)				1							1		1
Gnathoncus buyssoni Auzat			1	1	1						2	1	3
Dendrophilus pygmaeus (L.)			1		1						1	1	2
Platysoma angustatum (Hoff.)				1							1		1
Platysoma lineare Er.				1								1	1
EUCINETIDAE													
Eucilodes caucasicus Rtt.				1							1		1
SCIRTIDAE													
Microcara testacea (L.)							1				1		1
Cyphon coarctatus Payk.	2	2		2	1		1				7	1	8
Cyphon palustris Thoms.				1	1						2		2
Cyphon variabilis (Thunb.)	8	2	2	4	2	1					18	1	19
Cyphon punctipennis Sharp	7	10	6	4	2	1					29	1	30
Cyphon padi (L.)	3	2	2		2						8	1	9
SCARABAEIDAE													
Geotrupes stercorosus Scriba	1				2						3		3
Aphodius putridus (Geoffr.)				2							2		2
Aphodius rufipes (L.)	14	3	1	3	11	1	1	6	10	7	55	2	57
Aphodius depressus (Kugel.)	1	1	1								3		3
Aphodius tenellus Say				1	2						3		3
Aphodius borealis Gyll.		1									1		1
Aphodius nemoralis Er.	1	2							1		4		4
Aphodius lapponum Gyll.	1										1		1
Trichius fasciatus (L.)				4							4		4
LUCANIDAE													
Platycerus caprea (Deg.)	2	3	3	8	2	2					20		20
LYCIDAE													
Dictyoptera aurora (Hbst.)	3	5	2	7	6	2					25		25
Pyropterus nigroruber (Deg.)	5	2		6	1						14		14
Lygistopterus sanguineus (L.)	2		2	3	4	2					13		13
LAMPYRIDAE													
Lampyrus noctiluca (L.)				1							1		1
CANTHARIDAE													
Podabrus alpinus (Payk.)	3			2	2						7		7
Cantharis quadripunctata (Müll.)		2	1	2							5		5
Rhagonycha testacea (L.)				1	1						2		2
Rhagonycha atra (L.)	17	10	15	41	19	4		2	1		101	8	109
Absidia schoenherri (Dej.)	17	1	2	16	19				1		49	7	56
Malthinus biguttatus (L.)	5	1	2	3	3	1					14	1	15

Malthodes fuscus (Waltl)	1										1		1
Malthodes guttifer Kiesw.	4		1	1							4	2	6
ELATERIDAE													
Lacon conspersus (Gyll.)				1							1		1
Lacon fasciatus (L.)					1						1		1
Athous subfuscus (Müll.)	26	19	11	88	82	24	3	16		1	242	28	270
Harminius undulatus (Deg.)	2			9	1	1	1				13	1	14
Denticollis linearis (L.)	7	4	5	24	35	3	5			1	83	1	84
Ctenicera pectinicornis (L.)				1							1		1
Liotrichus affinis (Payk.)	5	2	3	21	9	4	2				45	1	46
Orithales serraticornis (Payk.)				9	3	1					12	1	13
Selatosomus impressus (F.)			1	6	12	2	3	1	1	1	24	3	27
Selatosomus cruciatus (L.)													
Selatosomus melancholicus (F.)	2	1		3	7	1					13	1	14
Eanus costalis (Payk.)	5	2	3	136	66	8					206	14	220
Ampedus balteatus (L.)	1		2	4	5						11	1	12
Ampedus tristis (L.)		1	4	8	4						8	9	17
Ampedus erythrogonus (Müll.)				8	16		1				22	3	25
Ampedus nigrinus (Hbst.)			4	49	28	5		4			77	13	90
Sericus brunneus (L.)	2		1	33	8	1					43	2	45
Melanotus castanipes (Payk.)	46	23	34	88	64	36	4	1			263	33	296
THROSCIDAE													
Trixagus carinifrons (Bonv.)				1							1		1
BUPRESTIDAE													
Buprestis rustica L.				1							1		1
BYRRHIDAE													
Cytilus sericeus (Forst.)				1							1		1
Byrrhus fasciatus (Forst.)				1							1		1
DERMESTIDAE													
Anthrenus museorum (L.)		1									1		1
ANOBIIDAE													
Ernobius explanatus (Mann.)				10							10		10
Ernobius mollis (L.)			1								1		1
Ernobius angusticollis (Ratz.)		1									1		1
Anobium rufipes F.	1		1	8	7	1					18		18
Anobium thomsoni (Kr.)				2	5		1				8		8
Microbregma emarginata (Duft.)			2	9	6						17		17
Hadrobregmus pertinax (L.)	2	3	3	9	9	3		1			26	4	30
Hadrobregmus confusus (Kr.)					1						1		1
Ptilinus fuscus Geoffr.				3							2	1	3
Dorcatoma punctulata Muls. & Rey				8	6		2				15	1	16
Dorcatoma dresdenis Hbst.	27	31	18	64	31	12	5	2		2	125	67	192
Dorcatoma robusta Strand	1	5		18	2		4		1	1	13	19	32

LYMEXYLIDAE													
Hylecoetus dermestoides (L.)	20	32	5	14	8	9					81	7	88
Hylecoetus flabellicornis (Schn.)	1										1		1
TROGOSSITIDAE													
Peltis grossa (L.)			2		3						2	3	5
Ostoma ferruginea (L.)	9	6	2	11	12						37	3	40
CLERIDAE													
Thanasimus formicarius (L.)	2	5		13	5	1					21	5	26
Thanasimus femoralis (Zett.)	1	2		3	2						7	1	8
NITIDULIDAE													
Epuraea concurrens Sjöb.	2	1	4	1		1					3	6	9
Epuraea laeviuscula (Gyll.)	1	1	1	3	1	3					9	1	10
Epuraea rufobrunnea Sjöb.		2		1							3		3
Epuraea deubeli Rtt.				1							1		1
Epuraea thoracica Tourn.					1						1		1
Epuraea angustula Sturm	6	2	10	3	12						24	9	33
Epuraea oblonga (Hbst.)				3							1	2	3
Epuraea boreella (Zett.)	2		1	7	4						11	3	14
Epuraea marseuli Rtt.	1	9	3	22	10	1					30	16	46
Epuraea pygmaea (Gyll.)	13	10	9	14	22		1				66	3	69
Epuraea binotata Rtt.				8							8		8
Epuraea terminalis (Mann.)	2		1									3	3
Epuraea biguttata (Thunb.)	13	6	2	8	8						14	23	37
Epuraea unicolor (Oliv.)	1		3		1						3	2	5
Epuraea variegata (Hbst.)	1		7	3	4						7	8	15
Epuraea silacea (Hbst.)	3	2	33	16	10						5	59	64
Epuraea aestiva (L.)	14		4	8	16	2		1			34	11	45
Epuraea melina (Er.)					1						1		1
Epuraea rufomarginata (Steph.)	1		1	14	5						7	14	21
Soronia punctatissima (Ill.)	1										1		1
Ipidia binotata Rtt.		2		7	5				1	2	8	9	17
Pocadius ferrugineus (F.)	4		3	3							4	6	10
Thalycra fervida (Oliv.)							1				1		1
Cyllodes ater (Hbst.)			2	4	11						8	9	17
Glischrochilus hortensis (Geoffr.)	1	3		3	12						8	11	19
Glischrochilus quadripunctatus (L.)	5	4	1	19	15	3	2				29	20	49
Pityophagus ferrugineus (L.)			3	18	6						22	6	28
SPHINDIDAE													
Arpidiphorus orbiculatus (Gyll.)					1						1		1
MONOTOMIDAE													
Rhizophagus grandis Gyll.				2							2		2
Rhizophagus depressus (F.)	5		8	25	2	9					34	15	49
Rhizophagus ferrugineus (Payk.)	77	9	117	119	72				1		368	27	395
Rhizophagus dispar (Payk.)	19	17	17	22	5	7	5				54	38	92

Rhizophagus bipustulatus (F.)		1			2						2	1	3
Rhizophagus nitidulus (F.)	20	24	9	13	3	10	3				69	13	82
Rhizophagus parvulus (Payk.)	1	4									4	1	5
Rhizophagus cribratus Gyll.	1	6	11	14	7	3	3				29	16	45
CUCUJIDAE													
Silvanoprus fagi (Guér.)	1										1		1
Dendrophagus crenatus (Payk.)	2	1	2	9	8						21	1	22
Cryptolestes abietis (Wank.)		1									1		1
CRYPTOPHAGIDAE													
Pteryngium crenatum (F.)			21	1		1					23		23
Cryptophagus abietis (Payk.)	4	3		6	4						14	3	17
Cryptophagus lapponicus Gyll.	9	13	8	57	39	14					74	66	140
Cryptophagus fuscicornis Sturm					1						1		1
Cryptophagus labilis Er.	1		1								1	1	2
Cryptophagus dorsalis Sahlb.			1								1		1
Cryptophagus scanicus (L.)	4	6	7	14	17	3					32	19	51
Atomaria morio Kol.	1			1							2		2
Atomaria affinis (F.Sahlb.)		1									1		1
Atomaria atrata Rtt.		3	1	1	1						6		6
EROTYLIDAE													
Triplax aenea (Schall.)	1	1	7	15	8						24	8	32
Triplax russica (L.)	119	15	131	118	74		1			1	221	238	459
Triplax scutellaris Char.	3	6	6	26	18					4	40	23	63
Triplax rufipes (F.)			2	1	2						2	3	5
Dacne bipustulata (Thunb.)	1		2	3	2						4	4	8
CERYLONIDAE													
Cerylon fagi Bris.	1	1	5	1	1						9		9
Cerylon histeroides (F.)	10	11	6	18	6	1				1	41	12	53
Cerylon ferrugineum Steph.	3	1	15	7	2						21	7	28
ENDOMYCHIDAE													
Leiestes seminigra (Gyll.)					2	1					3		3
COCCINELLIDAE													
Myzia oblongoguttata (L.)				1							1		1
Coccinella septempunctata L.				1							1		1
LATRIDIIDAE													
Latridius hirtus Gyll.	3	2	5	6	1	1					11	7	18
Latridius consimilis Mann.					1						1		1
Enicmus fungicola Thoms.	1		3	1	6	1					10	2	12
Enicmus planipennis Strand	6	7	7	14	9						34	9	43
Enicmus apicalis J.Sahlb.				1							1		1
Enicmus rugosus (Hbst.)	16	22	25	16	4	1	2				78	8	86

Stephostethus pandellei (Bris.)	1	2	1		3						3	4	7
Stephostethus alternans (Mann.)	3	4			2						8	1	9
Cartodere constricta (Gyll.)		1										1	1
Corticaria lapponica (Zett.)	31	16	43	23	50		9				84	88	172
Corticaria serrata (Payk.)	2	1	1	1	1						4	2	6
Corticaria interstitialis Mann.	1										1		1
Corticaria foveola (Beck)			1	1								2	2
Corticaria rubripes Mann.	1		1	1	1						4		4
Corticaria lateritia Mann.				1	1						2		2
CISIDAE													
Cis lineatocribratus Mell.	1				1						2		2
Cis alter Silfv.	4	9	7	3	6		2				11	20	31
Cis jacquemartii Mell.	2		5	7	3		1				5	13	18
Cis comptus Gyll.			1		1						1	1	2
Cis hispidus (Payk.)	1		1	6	2	1					3	8	11
Cis boleti (Scop.)	4	3	5	4	6						11	11	22
Cis punctulatus Gyll.		4	2		1						6	1	7
Cis castaneus Mell.				1							1		1
Ennearthron cornutum (Gyll.)						1					1		1
Ennearthron laricinum (Mell.)	1	1									1	1	2
Orthocis alni (Gyll.)	1			4	4						5	4	9
Ropalodontus strandi Lohse	3	1	5	4	4						2	15	17
COLYDIDAE													
Lasconotus jelskii (Wank.)		2									2		2
MYCETOPHAGIDAE													
Litargus connexus (Geoffr.)			1									1	1
Mycetophagus quadripustulatus (L.)	1		1		5						5	2	7
Mycetophagus multipunctatus F.	1		4	1	4	1					9	2	11
Mycetophagus fulvicollis F.			2		2						4		4
OEDEMERIDAE													
Calopus serraticornis (L.)					2						2		2
PYTHIDAE													
Pytho depressus (L.)				2	2						4		4
Pytho abieticola J.Sahlb.				2							2		2
SALPINGIDAE													
Rabocerus foveolatus (Ljungh)		1		6	1						6	2	8
Salpingus ruficollis (L.)	2	6	1	4	5	1	1				15	5	20
ANTHICIDAE													
Anthicus ater (Panz.)				1							1		1
MELOIDAE													
Meloe violaceus Marsh.						1							1

TENEBRIONIDAE													
Bolitophagus reticulatus (L.)	20	10	17	48	16					1	26	86	112
Diaperis boleti (L.)				1								1	1
Bius thoracicus (F.)			2	2							2	2	4
Corticeus suturalis (Payk.)				1							1		1
Mycetochara flavipes (F.)	1		2	4							5	2	7
Mycetochara obscura (Zett.)	1		2	2	1	1					7		7
ANASPIDAE													
Anaspis frontalis (L.)					1						1		1
Anaspis marginicollis Lind.	3		11	9	5			1			24	5	29
Anaspis arctica Zett.	31	24	15	67	35	12	1		1		120	66	186
MORDELLIDAE													
Tomoxia bucephala Costa			1	1								2	2
TETRATOMIDAE													
Tetratoma ancora F.		3		7							9	1	10
MELANDRYIDAE													
Hallomenus binotatus (Quens.)			2	2	4	1				1	9	1	10
Hallomenus axillaris (Ill.)			1					1			2		2
Orchesia micans (Panz.)	20	2	38	21	38	4		1			58	66	124
Orchesia fasciata (Ill.)				1							1		1
Abdera flexuosa (Payk.)	1			2	2						5		5
Abdera triguttata (Gyll.)		1	1								2		2
Xylita laevigata (Hell.)	36	23	28	58	88	12	2	3		2	221	31	252
Zilora ferruginea (Payk.)										1	1		1
Zilora elongata J.Sahlb.				2		1					3		3
Melandrya dubia (Schall.)	2	2		2	2					1	7	2	9
CERAMBYCIDAE													
Arhopalus rusticus (L.)									1		1		1
Asemum striatum (L.)		1		2							3		3
Tetropium castaneum (L.)	2	2		4							8		8
Tetropium fuscum (F.)	1	3		2	1						7		7
Rhagium mordax (Deg.)	2	4	1	4	9	4	1	3			25	4	29
Rhagium inquisitor (L.)		1		10	3	2					15	1	16
Oxymirus cursor (L.)		3	1	6	4	1					14	1	15
Allosterna tabacicolor (Deg.)	2	2			1						5		5
Anoplodera virens (L.)				2	1						3		3
Judolia sexmaculata (L.)		3		4	4	1					11	1	12
Leptura nigripes Deg.				3	3						6		6
Necydalis major L.				1								1	1
Molorchus minor (L.)			1	4							4	1	5
Callidium coriaceum Payk.					1						1		1
Monochamus urussovi (Fisch.)					1						1		1
Monochamus sutor (L.)				3							3		3
Pogonocherus fasciculatus (Deg.)	1	1			2	1					5		5
Acanthocinus aedilis (L.)				3							3		3

CHRYSOMELIDAE													
Lilioceris merdigera (L.)				1							1		1
Syneta betulae (F.)				3	2	1	2				8		8
Gonioctena viminalis (L.)				1							1		1
Luperus flavipes (L.)			1								1		1
NEMONYCHIDAE													
Cimberis attelaboides (F.)				1								1	1
ATTELABIDAE													
Byctiscus betulae (L.)		1									1		1
APIONIDAE													
Apion simile Kirby	1		1	3	1						6		6
CURCULIONIDAE													
Otiorhynchus scaber (L.)	3	2	11	6	6			1	1		23	7	30
Polydrosus undatus (F.)	20		3								15	8	23
Polydrosus ruficornis (Bonsd.)	5	1	1		1		6		1		14	1	15
*Strophosoma ca*pitatum (Deg.)	1	3	9	5	2			2	1		12	11	23
Anthonomus phyllocola (Hbst.)		1	1	5	2			1	1		10	1	11
Rhyncolus elongatus (Gyll.)			2	5	8						5	10	15
Rhyncolus ater (L.)		1		1								2	2
Rhyncolus sculpturatus Waltl			1		1						2		2
Magdalis duplicata Germ.	1										1		1
Hylobius piceus (Deg.)	1				1						2		2
Hylobius abietis (L.)	1	1	7	44	10						43	20	63
Hylobius pinastri (Gyll.)				1	1						1	1	2
Pissodes pini (L.)			6	8	7	4					23	2	25
Pissodes harcyniae (Hbst.)	2	6		8	1		4				19	2	21
Pissodes piniphulus (Hbst.)			2								2		2
SCOLYTIDAE													
Hylurgops glabratus (Zett.)	18	24	3	9	6	2	1				56	7	63
Hylurgops palliatus (Gyll.)	4	2	99	2323	105						2298	235	2533
Hylastes brunneus Er.	21	24	2	223	104		1				324	31	355
Hylastes cunicularius Er.	375	380	70	1224	315	74	12				2381	86	2467
Xylechinus pilosus (Ratz.)	38	53	17	35	35	1	4	1			157	27	184
Tomicus minor (Hart.)				30	6						30	6	36
Tomicus piniperda (L.)				64	5						56	13	69
Dendroctonus micans (Kugel.)					22						21	1	22
Phloeotribus spinulosus (Rey)	1	3		1	1						6		6
Polygraphus subopacus Thoms.				1							1		1
Polygraphus poligraphus (L.)				1			1				2		2
Polygraphus punctifrons Thoms.					1						1		1
Scolytus ratzeburgi Janson	1										1		1
Pityogenes chalcographus (L.)	22	28	1	138	9		3				197	4	201
Pityogenes bidentatus (Hbst.)			5	4							7	2	9
Orthotomicus longicollis (Gyll.)			1								1		1

Orthotomicus proximus (Eichh.)				2							2		2
Orthotomicus suturalis (Gyll.)		2									1		2
Orthotomicus laricis (F.)				1							1		1
Ips duplicatus (Sahlb.)				1							1		1
Ips typographus (L.)				13	3						16		16
Drycoetes autographus (Ratz.)	278	127	162	297	214	31	3			1	1083	35	1118
Drycoetes hectographus Rtt.	9	10	4	13	9	3			3		44	7	51
Crypturgus cinereus (Hbst.)	3	12		1							16		16
Trypodendron lineatum (Oliv.)	146	7	101	254	217	76	11		2	1	732	79	811
Trypodendron signatum (F.)	46	68		156	172	31	7		2		402	82	484
Cryphalus saltuarius Weise		1			2						3		3
Pityophthorus lichtensteinii (Ratz.)				1							1		1
Total sum	1974	1382	1552	7017	2929	500	133	52	33	31	12967	2636	15603

List of Diptera, collected within Koitajoki area during the study period (1993–1996)

Species new to Finnish fauna marked with asterisk. ♀ = female and ♂ = male

CYLINDROTOMIDAE	
Diogma glabrata (Mg.)	Pirhu-1♂; Tapionaho-4♂♂.
TIPULIDAE	
Tipula limbata Zett.	Tapionaho-1♂.
Tipula lunata L.	Pirhu-2♂♂.
Tipula meigeni Mannheims	Pirhu-2♂♂.
Tipula rubripes Schumm.	Koitajoki-1♂.
Tipula subnodicornis Zett.	Pirhu-1♂; Tapionaho-2♂♂.
Tipula variicornis Schumm.	Pirhu-1♂; Tapionaho-6♂♂, 3 ♀♀.
Dictenidia bimaculata (L.)	Tapionaho-1♂, 1 ♀.
Tanyptera atrata L.	Tapionaho-1 ♀.
LIMONIIDAE	
Metalimnobia bifasciata (Schrank)	Hoikka-2♂♂, 2 ♀♀; Koitajoki-1 ♀; Lahnavaara-1♂, 1 ♀; Pirhu-5♂♂, 3 ♀♀; Tapionaho-2♂♂, 1 ♀.
Metalimnobia quadrinotata (Mg.)	Pirhu-19♂♂, 9 ♀♀.
Libnotes ladogensis Lack.	Tapionaho-3♂♂, 1 ♀.
Dicranomyia caledonica (Edw.)	Tapionaho-1♂.
Discobola caesarea (Osten Sacken)	Tapionaho-3♂♂, 2 ♀♀.
Rhipidia maculata Mg.	Pirhu-1 ♀.
Pedicia rivosa (L.)	Pirhu-1 ♀; Tapionaho-1♂.
Tricyphona immaculata Mg.	Koitajoki-1♂; Pirhu-1♂; Tapionaho-1♂, 1 ♀.
Tricyphona schummeli Edw.	Tapionaho-10♂♂.
**Ula bolitophila* Lw.	Tapionaho-1♂.
Ula sylvatica (Mg.)	Pirhu-5♂♂; Tapionaho-5♂♂.
**Elephantomyia krivosheinae* Savchenko	Tapionaho-1♂.
Idioptera fasciata (L.)	Koitajoki-1♂.
Idioptera pulchella (Mg.)	Pirhu-3♂♂.
Erioptera lutea Mg.	Pirhu-17♂♂; Tapionaho-1♂.
Rhypholopus haemorhoidalis (Zett.)	Pirhu-2♂♂.
Ormosia depilata Edw.	Syväjärvi-1♂.
Ormosia ruficauda Ztt.	Niemijärvi-1♂; Tapionaho-16♂♂.
Phylidorea phaeostigma (Schumm.)	Tapionaho-2♂♂.
PACHYNEURIDAE	
Pachyneura fasciata Zett.	Pirhu-3♂♂.
BOLITOPHILIDAE	
Bolitophila aperta Lundstr.	Pirhu-1♂; Tapionaho-2♂♂.
**Bolitophila austriaca* Mayer	Pirhu-6♂♂; Tapionaho-1♂.
Bolitophila basicornis (Mayer)	Pirhu-4♂♂.
Bolitophila cinerea Mg.	Pirhu-4♂♂; Tapionaho-2♂♂.
Bolitophila dubia Siebke	Pirhu-2♂♂.
Bolitophila fumida Edw.	Pirhu-2♂♂.

Bolitophila hybrida (Mg.)	Pirhu-43♂♂.
**Bolitophila limitis* Polevoi	Pirhu-2♂♂.
Bolitophila modesta Lack.	Pirhu-8♂♂.
**Bolitophila nigrolineata* Landr.	Pirhu-2♂♂.
**Bolitophila obscurior* Stack.	Pirhu-3♂♂.
Bolitophila rossica Landr.	Tapionaho-1♂.
Bolitophila saundersi (Curt.)	Pirhu-1♂.
Bolitophila tenella Winn.	Pirhu-4♂♂.
KEROPLATIDAE	
Macrocera angulata Mg.	Pirhu-1♂.
Macrocera pilosa Landr.	Pirhu-3♂♂.
Macrocera stigmoides Edw.	Tapionaho-2♂♂.
Macrocera vittata Mg.	Pirhu-1♂.
Macrocera zetterstedti Lundstr.	Pirhu-8♂♂.
Keroplatus tipuloides Bosc	Tapionaho-4 ♀♀.
Macrorrhyncha flava Winn.	Hoikka-1♂; Niemijärvi-1♂; Pirhu-1♂.
**Neoplatyura flava* (Macq.)	Pirhu-1♂; Tapionaho-1♂.
**Orfelia falcata* A.Zaitzev	Pirhu-1♂; Tapionaho-2♂♂.
Orfelia fasciata (Mg.)	Tapionaho-1♂.
Orfelia nemoralis (Mg.)	Pirhu-3♂♂.
Orfelia unicolor (Staeg.)	Pirhu-1♂; Tapionaho-2♂♂.
Urytalpa ochracea (Mg.)	Pirhu-1♂.
DIADOCIDIIDAE	
Diadocidia ferruginosa (Mg.)	Tapionaho-1♂.
Diadocidia spinosula Tollet	Pirhu-1♂; Tapionaho-1♂.
**Diadocidia trispinosa* Polevoi	Pirhu-1♂.
MYCETOPHILIDAE	
Mycomya annulata (Mg.)	Hoikka-1♂; Koitajoki-33♂♂; Kotavaara-3♂♂; Lahnavaara-8♂♂; Pirhu-15♂♂; Syväjärvi-4♂♂; Tapionaho-82♂♂.
Mycomya bicolor (Dz.)	Tapionaho-1♂.
Mycomya cinerascens (Macq.)	Pirhu-3♂♂; Tapionaho-3♂♂.
Mycomya circumdata (Staeg.)	Hoikka-1♂; Koitajoki-2♂♂; Kotavaara-2♂♂; Lahnavaara-6♂♂; Niemijärvi-1♂; Pirhu-177♂♂; Syväjärvi-2♂♂; Tapionaho-228♂♂.
Mycomya confusa Väisänen	Koitajoki-3♂♂; Kotavaara-7♂♂; Lahnavaara-1♂; Niemijärvi-6♂♂; Pirhu-2♂♂; Syväjärvi-1♂; Tapionaho-28♂♂.
Mycomya denmax Väisänen	Pirhu-1♂; Tapionaho-2♂♂.
Mycomya disa Väisänen	Pirhu-1♂.
Mycomya egregia (Dz.)	Pirhu-1♂.
Mycomya fasciata (Zett.)	Pirhu-2♂♂.
Mycomya festivalis Väisänen	Hoikka-2♂♂; Niemijärvi-1♂; Tapionaho-11♂♂.
Mycomya fimbriata (Mg.)	Tapionaho-13♂♂.
Mycomya humida Garrett	Niemijärvi-5♂♂; Pirhu-3♂♂; Tapionaho-11♂♂.
Mycomya insignis (Winn.)	Pirhu-1♂.
Mycomya maculata (Mg.)	Pirhu-1♂; Tapionaho-3♂♂.
Mycomya neohyalinata Väisänen	Pirhu-2♂♂; Tapionaho-2♂♂.

Mycomya nitida (Zett.)	Hoikka-2♂♂; Koitajoki-2♂♂; Lahnavaara-1♂; Pirhu-9♂♂; Syväjärvi-2♂♂; Tapionaho-31♂♂.
Mycomya ornata (Mg.)	Pirhu-1♂.
Mycomya pectinifera Edw.	Pirhu-1♂.
Mycomya penicillata Dz.	Pirhu-2♂♂.
Mycomya permixta Väisänen	Pirhu-3♂♂.
Mycomya prominens (Lundstr.)	Pirhu-1♂.
Mycomya pseudoapicalis Landrock	Tapionaho-3♂♂.
Mycomya pulchella (Dz.)	Pirhu-47♂♂; Tapionaho-6♂♂.
Mycomya ruficollis (Zett.)	Pirhu-1♂; Syväjärvi-1♂; Tapionaho-14♂♂.
Mycomya shermani Garrett	Hoikka-1♂; Koitajoki-4♂♂; Niemijärvi-1♂; Pirhu-32♂♂; Tapionaho-105♂♂.
Mycomya sigma Joh.	Koitajoki-1♂; Tapionaho-2♂♂.
Mycomya storai Väisänen	Pirhu-1♂.
Mycomya subarctica Väisänen	Tapionaho-1♂.
Mycomya trilineata (Zett.)	Hoikka-2♂♂; Koitajoki-17♂♂; Kotavaara-1♂; Lahnavaara-21♂♂; Pirhu-68♂♂; Syväjärvi-6♂♂; Tapionaho-45♂♂.
Mycomya trivittata (Zett.)	Hoikka-1♂; Koitajoki-8♂♂; Lahnavaara-1♂; Pirhu-2♂♂; Syväjärvi-1♂; Tapionaho-7♂♂.
Mycomya vittiventris (Zett.)	Koitajoki-3♂♂, 1 ♀; Pirhu-1♂; Tapionaho-21♂♂, 7 ♀♀.
Mycomya wankowiczii (Dz.)	Hoikka-1♂; Pirhu-7♂♂; Tapionaho-1♂.
Mycomya winnertzi (Dz.)	Pirhu-3♂♂.
Neoempheria pictipennis Hal.	Pirhu-1♂.
Neoempheria striata (Mg.)	Pirhu-4♂♂; Tapionaho-5♂♂.
Neoempheria tuomikoskii Väisänen	Pirhu-1♂; Tapionaho-1♂.
**Acnemia angusta* A.Zaitzev	Tapionaho-2♂♂.
**Acnemia falcata* A.Zaitzev	Tapionaho-1♂.
**Acnemia longipes* Winn.	Koitajoki-2♂♂; Tapionaho-2♂♂.
Acnemia nitidicollis (Mg.)	Koitajoki-1♂; Pirhu-15♂♂; Tapionaho-1♂.
Allocotocera pulchella (Curt.)	Hoikka-1♂; Kotavaara-1 ♀; Tapionaho-11♂♂, 9 ♀♀.
Azana anomala (Staeg.)	Pirhu-1♂.
**Leptomorphus quadrimaculatus* Matsumura	Pirhu-1♂; Tapionaho-1 ♀.
Megalopelma nigroclavatus (Strobl)	Pirhu-1♂; Tapionaho-1♂.
**Monoclona braueri* (Strobl)	Tapionaho-2♂♂.
Monoclona rufilatera (Walk.)	Pirhu-1♂.
Neuratelia nemoralis (Mg.)	Pirhu-4♂♂; Tapionaho-1♂.
**Paratinia sciarina* Mik	Pirhu-2♂♂.
**Phthinia congenita* Plassmann	Tapionaho-1♂.
Phthinia humilis Winn.	Pirhu-1♂; Tapionaho-4♂♂.
Polylepta borealis Lundstr.	Lahnavaara-1♂; Syväjärvi-1♂; Tapionaho-18♂♂, 11 ♀♀.
**Sciophila buxtoni* Freeman	Tapionaho-1♂.
Sciophila fenestella Curt.	Tapionaho-1♂.
Sciophila geniculata Zett.	Koitajoki-4♂♂; Niemijärvi-1♂; Tapionaho-15♂♂.
Sciophila hirta Mg.	Pirhu-1♂.
**Sciophila quadriterga* Hutson	Pirhu-3♂♂.
**Sciophila jakutica* Blagoderov	Tapionaho-2♂♂.
**Sciophila* n.sp.	Syväjärvi-1♂; Tapionaho-1♂.

Syntemna daisetsusana Okada	Koitajoki-2♂♂; Pirhu-1♂; Tapionaho-3♂♂.
Syntemna hungarica (Lundstr.)	Hoikka-1♂; Tapionaho-2♂♂.
**Syntemna stylata* Hutson	Syväjärvi-1♂; Tapionaho-9♂♂.
**Syntemna stylatoides* A.Zaitzev	Syväjärvi-1♂; Tapionaho-2♂♂.
Boletina basalis (Mg.)	Pirhu-60♂♂; Syväjärvi-3♂♂; Tapionaho-6♂♂.
Boletina cincticornis Walk.	Pirhu-46♂♂.
**Boletina dissipata* Plassmann	Hoikka-1♂; Koitajoki-3♂♂; Lahnavaara-1♂; Niemijärvi-1♂; Syväjärvi-4♂♂; Tapionaho-33♂♂.
Boletina erythropyga Holmgren	Pirhu-1♂; Tapionaho-1♂.
Boletina gripha Dz.	Hoikka-4♂♂; Lahnavaara-4♂♂; Niemijärvi-1♂; Pirhu-15♂♂; Syväjärvi-4♂♂; Tapionaho-64♂♂.
Boletina griphoides Edw.	Pirhu-1♂.
Boletina lundbecki Lundstr.	Pirhu-2♂♂.
Boletina lundstroemi Landr.	Pirhu-4♂♂.
Boletina moravica Landr.	Pirhu-1♂.
Boletina nigricans Dz.	Hoikka-4♂♂; Lahnavaara-1♂; Niemijärvi-5♂♂; Pirhu-2♂♂; Syväjärvi-12♂♂; Tapionaho-128♂♂.
Boletina nigricoxa Staeg.	Pirhu-1♂.
**Boletina nitiduloides* A.Zaitzev	Koitajoki-1♂; Lahnavaara-1♂; Pirhu-1♂; Syväjärvi-7♂♂.
**Boletina onegensis* Polevoi	Hoikka-8♂♂; Koitajoki-2♂♂; Kotavaara-1♂; Lahnavaara-14♂♂; Niemijärvi-5♂♂; Syväjärvi-12♂♂; Tapionaho-24♂♂
**Boletina populina* Polevoi	Pirhu-1♂.
Boletina plana (Walk.)	Pirhu-3♂♂; Tapionaho-10♂♂.
Boletina rejecta Edw.	Koitajoki-2♂♂.
Boletina silvatica Dz.	Koitajoki-1♂.
Boletina trivittata (Mg.)	Pirhu-57♂♂.
Boletina villosa Landr.	Tapionaho-1♂.
**Boletina* sp1 n.sp.	Tapionaho-9♂♂.
**Boletina* sp2 n.sp.	Koitajoki-1♂; Tapionaho-2♂♂.
**Coelophthinia thoracica* (Winn.)	Pirhu-1♂.
Coelosia silvatica Landr.	Pirhu-1♂; Syväjärvi-6♂♂.
Coelosia tenella (Zett.)	Pirhu-3♂♂; Tapionaho-1♂.
Coelosia truncata Lundstr.	Koitajoki-1♂; Kotavaara-1♂; Niemijärvi-2♂♂; Pirhu-5♂♂, 1 ♀; Tapionaho-5♂♂, 2 ♀♀.
Dziedzickia marginata (Dz.)	Koitajoki-3♂♂; Lahnavaara-1♂; Syväjärvi-1♂; Tapionaho-2♂♂.
Gnoriste bilineata Zett.	Pirhu-9♂♂.
Grzegorzekia collaris (Mg.)	Pirhu-3♂♂; Tapionaho-2♂♂.
Hadroneura palmeni Lundstr.	Hoikka-19♂♂, 1 ♀; Koitajoki-10♂♂, 3 ♀♀; Kotavaara-2♂♂; Lahnavaara-4♂♂; Pirhu-1♂; Syväjärvi-5♂♂, 4 ♀♀; Tapionaho-8♂♂.
**Hadroneura* n.sp.	Tapionaho-2♂♂.
**Acomoptera difficilis* Dz.	Tapionaho-1♂.
Palaeodocosia janickii (Dz.)	Tapionaho-2♂♂.
Synapha vitripennis (Mg.)	Tapionaho-1♂.
Ectrepesthoneura bucera Plassmann	Hoikka-1♂.
Ectrepesthoneura colyeri Chand.	Tapionaho-4♂♂.
Ectrepesthoneura hirta (Winn.)	Pirhu-1♂; Tapionaho-3♂♂.
Ectrepesthoneura pubescens (Zett.)	Hoikka-1♂; Koitajoki-1♂; Pirhu-2♂♂; Tapionaho-12♂♂.

**Ectrepesthoneura referta* Plassmann	Pirhu-3♂♂; Syväjärvi-3♂♂; Tapionaho-4♂♂.
**Greenomyia baikalica* A.Zaitzev	Tapionaho-2♂♂.
Leia subfasciata (Mg.)	Pirhu-9♂♂; Tapionaho-28♂♂.
Leia winthemi Lehmann	Hoikka-1♂; Koitajoki-1♂; Pirhu-11♂♂; Tapionaho-11♂♂.
Rondaniella dimidiata (Mg.)	Niemijärvi-1♂; Pirhu-1♂, 1 ♀; Tapionaho-3♂♂, 2 ♀♀.
**Tetragoneura ambigua* Grzegorzek	Koitajoki-1♂; Syväjärvi-4♂♂.
**Tetragoneura obirata* Plassmann	Tapionaho-1♂.
**Dynatosoma dihaeta* Polevoi	Lahnavaara-1♂.
Dynatosoma fuscicorne (Mg.)	Koitajoki-1♂; Pirhu-1♂; Tapionaho-7♂♂.
**Dynatosoma norwegiense A.Zaitzev et Økland*	Tapionaho-1♂.
Dynatosoma nigromaculatum Lundstr.	Tapionaho-1♂.
Dynatosoma reciprocum (Walk.)	Pirhu-1♂; Tapionaho-3♂♂.
Dynatosoma thoracicum (Zett.)	Tapionaho-11♂♂.
Epicypta aterrima (Zett.)	Tapionaho-2♂♂.
**Mycetophila abiecta* (Last.)	Pirhu-9♂♂; Tapionaho-6♂♂.
**Mycetophila assimilis* Matile	Pirhu-11♂♂.
Mycetophila attonsa (Laffoon)	Pirhu-2♂♂; Tapionaho-12♂♂.
Mycetophila bialorussica Dz.	Pirhu-1♂.
Mycetophila blanda Winn.	Pirhu-3♂♂; Tapionaho-2♂♂.
Mycetophila bohemica Last.	Pirhu-9♂♂; Tapionaho-20♂♂.
Mycetophila brevitarsata Last.	Pirhu-6♂♂; Tapionaho-7♂♂.
Mycetophila caudata Staeg.	Pirhu-3♂♂.
Mycetophila confluens Dz.	Pirhu-9♂♂; Tapionaho-8♂♂.
**Mycetophila curviseta* Lundstr.	Pirhu-1♂.
Mycetophila dentata Lundstr.	Pirhu-1♂.
**Mycetophila estonica* Kurina	Pirhu-1♂.
Mycetophila evanida Last.	Pirhu-2♂♂.
Mycetophila finlandica Edw.	Pirhu-2♂♂; Tapionaho-3♂♂.
Mycetophila flava Winn.	Pirhu-3♂♂.
Mycetophila formosa Lundstr.	Tapionaho-1♂.
Mycetophila fungorum De Geer	Koitajoki-8♂♂, 7 ♀♀; Lahnavaara-1♂; Niemijärvi-3♂♂, 1 ♀; Pirhu-30♂♂, 25 ♀♀; Syväjärvi-1 ♀; Tapionaho-38♂♂, 32 ♀♀.
Mycetophila gratiosa Winn.	Pirhu-1♂; Tapionaho-1♂.
Mycetophila hetschkoi Landr.	Koitajoki-1♂; Lahnavaara-1♂; Pirhu-3♂♂; Tapionaho-16♂♂.
Mycetophila ichneumonea Say	Pirhu-16♂♂; Tapionaho-3♂♂.
Mycetophila laeta Walk.	Tapionaho-2♂♂.
Mycetophila lubomirskii Dz.	Pirhu-1♂; Tapionaho-4♂♂.
Mycetophila luctuosa Mg.	Pirhu-30♂♂; Tapionaho-2♂♂.
Mycetophila lunata Mg.	Pirhu-2♂♂.
Mycetophila morosa Winn.	Tapionaho-1♂.
Mycetophila ocellus Walk.	Pirhu-11♂♂; Tapionaho-7♂♂.
**Mycetophila stricklandi* Laffoon	Pirhu-1♂.
Mycetophila strigatoides (Landr.)	Pirhu-2♂♂.
Mycetophila strobli Last.	Pirhu-5♂♂; Tapionaho-3♂♂.
Mycetophila stylata (Dz.)	Pirhu-2♂♂; Tapionaho-4♂♂.
Mycetophila unipunctata Mg.	Pirhu-2♂♂.

**Mycetophila* n.sp.	Pirhu-1♂.
Phronia biarquata Becker	Pirhu-4♂♂.
Phronia bicolor Dz.	Pirhu-1♂.
Phronia braueri Dz.	Pirhu-4♂♂.
Phronia caliginosa Dz.	Pirhu-13♂♂; Tapionaho-25♂♂.
Phronia cinerascens Winn.	Pirhu-12♂♂; Tapionaho-8♂♂.
Phronia digitata Hack.	Pirhu-5♂♂; Tapionaho-4♂♂.
Phronia disgrega Dz.	Tapionaho-2♂♂.
Phronia distincta Hack.	Pirhu-1♂.
**Phronia dubioides* Matile	Pirhu-2♂♂.
Phronia egregia Dz.	Pirhu-17♂♂.
Phronia elegantula Hack.	Tapionaho-2♂♂.
Phronia exigua (Zett.)	Pirhu-3♂♂.
Phronia flavicollis Winn.	Pirhu-15♂♂; Tapionaho-13♂♂.
Phronia flavipes Winn.	Pirhu-2♂♂.
Phronia forcipata Winn.	Pirhu-33♂♂; Tapionaho-1♂.
**Phronia gagnei* Chand.	Pirhu-1♂.
Phronia nigricornis (Zett.)	Pirhu-3♂♂.
Phronia nigripalpis Lundstr.	Hoikka-2♂♂; Koitajoki-6♂♂; Niemijärvi-2♂♂; Pirhu-8♂♂; Tapionaho-27♂♂.
Phronia nitidiventris v.d.Wulp	Pirhu-3♂♂.
Phronia obscura Dz.	Pirhu-7♂♂; Tapionaho-3♂♂.
Phronia siebeckii Dz.	Pirhu-1♂.
Phronia n.sp.	Pirhu-2♂♂; Tapionaho-3♂♂.
Platurocypta punctum (Stann.)	Pirhu-4♂♂; Tapionaho-2♂♂.
Platurocypta testata (Edw.)	Pirhu-4♂♂; Tapionaho-3♂♂.
**Sceptonia costata* v.d.Wulp	Tapionaho-1♂.
**Sceptonia fumipes* Edw.	Tapionaho-7♂♂.
**Sceptonia fuscipalpis* Edw.	Kotavaara-1♂.
**Sceptonia membranacea* Edw.	Pirhu-1♂; Tapionaho-2♂♂.
Sceptonia nigra (Mg.)	Pirhu-1♂.
Trichonta atricauda (Zett.)	Pirhu-2♂♂.
Trichonta concinna Gagne	Pirhu-1♂; Tapionaho-1♂.
Trichonta conjungens Lundstr.	Pirhu-1♂; Tapionaho-2♂♂.
Trichonta facilis Gagne	Pirhu-9♂♂.
Trichonta falcata Lundstr.	Pirhu-2♂♂.
Trichonta girshneri Landr.	Pirhu-1♂; Tapionaho-3♂♂.
Trichonta hamata Mik	Pirhu-1♂.
Trichonta icenica Edw.	Pirhu-1♂.
Trichonta melanura (Staeg)	Tapionaho-1♂.
Trichonta terminalis (Walk.)	Pirhu-14♂♂.
Trichonta venosa (Staeg.)	Pirhu-21♂♂; Tapionaho-2♂♂.
Trichonta vitta (Mg.)	Pirhu-6♂♂.
Trichonta vulcani Dz.	Pirhu-2♂♂; Tapionaho-2♂♂.
? *Trichonta vulgaris* Lw.	Pirhu-1♂.
**Trichonta* n.sp.	Tapionaho-1♂.
Zygomyia kiddi Chand.	Tapionaho-3♂♂.
Zygomyia pseudohumeralis Caspers	Pirhu-4♂♂; Tapionaho-8♂♂.
Zygomyia semifusca (Mg.)	Pirhu-1♂, 1 ♀; Tapionaho-4♂♂, 1 ♀.
**Allodia adunca* A.Zaitz.	Pirhu-2♂♂.
Allodia alternans (Zett.)	Pirhu-3♂♂.

Allodia anglofennica Edw.	Pirhu-21♂♂.
Allodia barbata (Lundstr.)	Pirhu-10♂♂.
Allodia czernyi (Landr.)	Pirhu-3♂♂.
**Allodia embla* Hack.	Pirhu-8♂♂.
Allodia lugens (Wied.)	Pirhu-13♂♂; Tapionaho-2♂♂.
Allodia lundstroemi Edw.	Pirhu-2♂♂.
Allodia mendly Plassmann	Pirhu-6♂♂.
Allodia neglecta Edw.	Pirhu-18♂♂.
Allodia ornaticollis (Mg.)	Pirhu-1♂.
Allodia pyxidiiformis A.Zaitzev	Pirhu-63♂♂; Tapionaho-2♂♂.
Allodia septentrionalis Hack.	Pirhu-60♂♂; Tapionaho-3♂♂.
**Allodia simplex* A.Zaitz.	Pirhu-1♂.
Allodia triangularis Strobl.	Pirhu-2♂♂.
Allodia truncata Edw.	Pirhu-16♂♂; Tapionaho-1♂.
Allodia tuomikoskii Hackman	Pirhu-2♂♂.
Allodiopsis cristata (Staeg.)	Pirhu-2♂♂; Tapionaho-3♂♂.
Allodiopsis domestica (Mg.)	Pirhu-1♂; Tapionaho-1♂.
Allodiopsis maculosa (Mg.)	Tapionaho-2♂♂.
**Anatella aquila* A.Zaitzev	Pirhu-1♂.
**Anatella bremia* Chandler	Pirhu-1♂
**Anatella ciliata* Winn.	Pirhu-2♂♂; Tapionaho•2♂♂.
Anatella flavicauda Wiinn.	Pirhu-1♂.
**Anatella flavomaculata* Edw.	Pirhu-5♂♂.
**Anatella lenis* Dz.	Pirhu-2♂♂.
**Anatella maritima* Ostroverhova	Pirhu-2♂♂.
Anatella minuta (Staeg.)	Pirhu-3♂♂.
**Anatella setigera* Edw.	Pirhu-2♂♂.
Anatella simpatica Dz.	Pirhu-2♂♂.
**Anatella turi* Dz.	Pirhu-1♂.
**Anatella crispa* A.Zaitzev	Pirhu-1♂.
**Brachypeza armata* Winn.	Tapionaho-1♂.
Brachypeza bisignata Winn.	Koitajoki-1 ♀; Pirhu-2♂♂; Tapionaho-2♂♂.
**Brevicornu beatum* (Joh.)	Pirhu-1♂.
**Brevicornu bellum* (Joh.)	Tapionaho-2♂♂.
**Brevicornu bipartitum* Last. ♀ Matile	Pirhu-1♂; Syväjärvi-1♂.
Brevicornu boreale Lundstr.	Pirhu-1♂.
**Brevicornu foliatum* Edw.	Pirhu-1♂.
Brevicornu griseicolle (Staeg.)	Pirhu-19♂♂.
Brevicornu griseolum (Zett.)	Pirhu-2♂♂.
**Brevicornu improvisum* A. Zaitzev	Pirhu-2♂♂.
Brevicornu ruficorne (Mg.)	Pirhu-1♂.
Brevicornu serenum (Winn.)	Pirhu-1♂.
Brevicornu sericoma (Mg.)	Pirhu-6♂♂.
**Brevicornu setulosum* A.Zaitzev	Pirhu-3♂♂.
Cordyla brevicornis (Staeg.)	Pirhu-1♂; Tapionaho-3♂♂.
Cordyla fasciata Mg.	Tapionaho-1♂.
**Cordyla sixi* Bar.	Pirhu-1♂.
**Cordyla nitens* Winn.	Tapionaho-12♂♂.
**Cordyla styliforceps* Bukowski	Syväjärvi-1♂.
Cordyla murina Winn.	Tapionaho-2♂♂.
**Cordyla nitidula* Edw.	Tapionaho-5♂♂.

**Cordyla parvipalpis* Edw.	Hoikka-7♂♂; Koitajoki-2♂♂; Kotavaara-2♂♂; Lahnavaara-1♂; Niemijärvi-1♂; Pirhu-10♂♂; Syväjärvi-7♂♂; Tapionaho-133♂♂.
Cordyla semiflava (Staeg.)	Hoikka-1♂; Pirhu-7♂♂; Tapionaho-7♂♂.
**Cordyla sixi* (Barendrecht)	Pirhu-2♂♂.
Exechia confinis Winn.	Pirhu-1♂.
Exechia contaminata Winn.	Koitajoki-1♂; Pirhu-7♂♂; Tapionaho-8♂♂.
Exechia cornuta Lundstr.	Pirhu-2♂♂; Tapionaho-1♂.
Exechia dorsalis (Staeg.)	Pirhu-6♂♂; Tapionaho-6♂♂.
Exechia exigua Lundstr.	Pirhu-1♂.
Exechia frigida Holm.	Pirhu-1♂.
Exechia fusca (Mg.)	Pirhu-1♂.
Exechia lucidula (Zett.)	Pirhu-9♂♂.
Exechia lundstroemi Landr.	Tapionaho-2♂♂.
Exechia nigroscutellata Landr.	Pirhu-4♂♂; Tapionaho-9♂♂.
Exechia parva Lundstr.	Pirhu-7♂♂; Syväjärvi-1♂; Tapionaho-1♂.
Exechia parvula (Zett.)	Pirhu-1♂; Tapionaho-1♂.
**Exechia pectinivalva* Stack.	Pirhu-1♂.
Exechia repanda Joh.	Pirhu-27♂♂.
Exechia separata Lundstr.	Pirhu-1♂.
Exechia seriata (Mg.)	Pirhu-3♂♂.
Exechia spinuligera Lundstr.	Pirhu-5♂♂; Tapionaho-2♂♂.
Exechiopsis crucigera (Lundstr.)	Pirhu-2♂♂.
Exechiopsis distendens (Lack.)	Pirhu-1♂.
Exechiopsis fimbriata (Lundstr.)	Pirhu-2♂♂.
Exechiopsis leptura (Mg.)	Pirhu-1♂.
Exechiopsis ligulata (Lundstr.)	Pirhu-1♂.
Exechiopsis pseudopulchella (Lundstr.)	Tapionaho-3♂♂.
Exechiopsis pulchella (Winn.)	Pirhu-2♂♂.
**Exechiopsis sagittata* Last. ♀ Matile	Pirhu-1♂.
Exechiopsis subulata (Winn.)	Pirhu-1♂.
**Pseudexechia aurivernica* Chand.	Pirhu-2♂♂.
Pseudexechia trivittata (Staeg.)	Pirhu-2♂♂.
Rymosia fasciata (Mg.)	Kotavaara-1♂; Pirhu-7♂♂.
Rymosia placida Winn.	Pirhu-1♂; Tapionaho-1♂.
**Rymosia fraudatrix* Dz.	Tapionaho-1♂.
Tarnania tarnanii (Dz.)	Pirhu-1♂; Tapionaho-1♂.

BIBIONIDAE

Bibio clavipes Mg.	Koitajoki-1♂; Pirhu-2♂♂.
Bibio nigriventris Hal.	Pirhu-24♂♂, 16 ♀♀.
**Bibio siebkei* Mik.	Koitajoki-1 ♀.

ANISOPODIDAE

Sylvicola cinctus F.	Pirhu-1♂.

RHAGIONIDAE

Rhagio lineola F.	Hoikka-1 ♀; Kotavaara-3 ♀♀; Lahnavaara-2♂♂; Niemijärvi-1 ♀; Pirhu-2♂♂, 2 ♀♀; Syväjärvi-1 ♀; Tapionaho-5♂♂, 4 ♀♀.
Rhagio scolopaceus (L.)	Pirhu-1♂, 1 ♀; Tapionaho-7♂♂, 8 ♀♀.

XYLOPHAGIDAE	
Xylophagus ater Mg.	Hoikka-2♂♂; Syväjärvi-1♂; Tapionaho-1♂.
Xylophagus cinctus De Geer	Koitajoki-1 ♀; Syväjärvi-2 ♀♀.
Xylophagus compeditus Wied.	Tapionaho-1♂.
Xylophagus junki Szilady	Tapionaho-1♂.
STRATIOMYIIDAE	
Sargus cuprarius L.	Pirhu-1♂.
Sargus rufipes Wahlberg	Hoikka-3 ♀♀; Koitajoki-1 ♀; Pirhu-1 ♀; Syväjärvi-3 ♀♀; Tapionaho-1 ♀.
Zabrachia minutissima (Zett.)	Pirhu-1 ♀.
ASILIDAE	
Lasiopogon cinctus F.	Koitajoki-1♂; Tapionaho-2♂♂, 2 ♀♀.
Cyrtopogon lateralis (Fall.)	Tapionaho-10♂♂, 4 ♀♀.
Cyrtopogon luteicornis Zett.	Tapionaho-2♂♂, 1 ♀.
Neoitamus socius (Lw.)	Pirhu-1♂, 1 ♀; Tapionaho-6 ♀♀.
HYBOTIDAE	
Tachypeza nubila (Mg.)	Hoikka-2 ♀♀; Tapionaho-4♂♂, 5 ♀♀.
Tachypeza truncorum (Fall.)	Tapionaho-1♂, 1 ♀.
Platypalpus boreoalpinus Frey	Syväjärvi-1 ♀.
Platypalpus ciliaris (Fall.)	Koitajoki-1 ♀; Pirhu-1♂; Tapionaho-3♂♂, 4 ♀♀.
Platypalpus confinis Zetterstedt	Koitajoki-1♂.
Platypalpus ecalceatus (Zett.)	Pirhu-5♂♂, 3 ♀♀.
Platypalpus longicornis (Mg.)	Pirhu-1♂, 1 ♀.
Platypalpus luteus (Mg.)	Hoikka-2 ♀♀; Pirhu-1♂, 1 ♀; Tapionaho-2 ♀♀.
Platypalpus maculus (Zett.)	Syväjärvi-1♂; Tapionaho-2♂♂, 4 ♀♀.
Platypalpus nigricoxa (Mik)	Pirhu-1♂.
Platypalpus stigmatellus (Zett.)	Hoikka-1 ♀; Koitajoki-2 ♀♀; Lahnavaara-1 ♀; Syväjärvi-6 ♀♀; Tapionaho-4♂♂, 6 ♀♀.
Hybos grossipes (L.)	Hoikka-1♂, 3 ♀♀; Koitajoki-6 ♀♀; Lahnavaara-1♂, 1 ♀; Pirhu-13♂♂, 12 ♀♀; Syväjärvi-1 ♀; Tapionaho-6♂♂, 5 ♀♀.
Bicellaria intermedia Lundbeck	Pirhu-1♂.
Bicellaria nigra (Mg.)	Koitajoki-1♂; Tapionaho-8♂♂.
Leptopeza borealis Zett.	Hoikka-1♂; Koitajoki-1♂; Tapionaho-1 ♀.
Leptopeza flavipes (Mg.)	Hoikka-1 ♀; Lahnavaara-1 ♀; Pirhu-1 ♀; Tapionaho-2 ♀♀.
Trichina bilobata Collin	Pirhu-2♂♂; Syväjärvi-1♂.
Oedalea stigmatella Zett.	Tapionaho-3 ♀♀.
EMPIDIDAE	
Rhamphomyia albidiventris Strobl	Koitajoki-1 ♀.
Rhamphomyia anomalina Zett.	Syväjärvi-8♂♂, 6 ♀♀; Tapionaho-8♂♂, 4 ♀♀.
Rhamphomyia lapponica Frey	Tapionaho-1♂.
Rhamphomyia poplitea Wahlberg	Koitajoki-1 ♀; Syväjärvi-1 ♀; Tapionaho-1♂.
Rhamphomyia spinipes (Fall.)	Pirhu-1♂.
Rhamphomyia umbripennis Mg.	Pirhu-1♂.
Empis borealis L.	Hoikka-6♂♂, 6 ♀♀; Koitajoki-4 ♀♀; Kotavaara-3 ♀♀; Lahnavaara-1 ♀; Pirhu-1♂; Syväjärvi-4♂♂, 4 ♀♀; Tapionaho-72♂♂, 58 ♀♀.

Empis hyalipennis Fall.	Pirhu-1♂.
Empis lucida Zett.	Pirhu-1♂.
Empis nigripes F.	Pirhu-1♂.
Empis pennipes L	Pirhu-1♂.
Empis stercorea L.	Pirhu-1♂.
Empis tessellata F.	Pirhu-3♂♂.
Chelipoda albiseta Zett.	Tapionaho-6♂♂, 3 ♀♀.
Phyllodromia melanocephala (F.)	Tapionaho-1♂, 1 ♀.
DOLICHOPODIDAE	
Dolichopus annulipes Zett.	Hoikka-7♂♂, 4 ♀♀; Koitajoki-3♂♂; Pirhu-4♂♂, 1 ♀; Syväjärvi-1♂, 2 ♀♀; Tapionaho-37♂♂, 29 ♀♀.
Dolichopus fraterculus Zett.	Pirhu-1♂.
Dolichopus longitarsis Mg.	Pirhu-3♂♂.
**Dolichopus nigricornis* Mg.	Hoikka-1♂, 1 ♀; Koitajoki-3♂♂, 1 ♀; Kotavaara-2 ♀♀; Pirhu-3♂♂, 5 ♀♀; Syväjärvi-2 ♀♀; Tapionaho-44♂♂, 47 ♀♀.
Dolichopus plumipes Scopoli	Pirhu-1♂.
Dolichopus popularis Wied.	Pirhu-1♂.
Dolichopus rupestris Hal.	Tapionaho-1♂.
Hercostomus aerosus Fall.	Pirhu-2 ♀♀.
Neurigona quadrifasciata (F.)	Pirhu-2♂♂, 2 ♀♀.
PLATYPEZIDAE	
Polyporivora picta (Mg.)	Pirhu-1 ♀.
SYRPHIDAE	
Baccha elongata (F.)	Pirhu-1 ♀.
Melanostoma mellinum (L.)	Pirhu•10♂♂, 5 ♀♀; Tapionaho-1 ♀.
Leucozona lucorum (L.)	Pirhu-1 ♀.
Dasysyrphus tricinctus (Fall.)	Lahnavaara-1♂; Pirhu-1 ♀.
Sphaerophoria menthastri (L.)	Hoikka-1♂; Pirhu-3♂♂.
Chrysotoxum arquatum (L.)	Kotavaara-1 ♀; Lahnavaara-1 ♀; Pirhu-1 ♀; Tapionaho-1♂.
Chrysotoxum bicinctum (F.)	Pirhu-1♂.
Chrysotoxum fasciolatum (De Geer)	Pirhu-3♂♂, 2 ♀♀; Tapionaho-1♂.
Rhingia campestris (Mg.)	Pirhu-1 ♀.
Hammerschmidtia ferruginea (Fall.)	Pirhu-1♂; Tapionaho-1 ♀.
Sphegina sibirica Stack.	Pirhu-3♂♂.
Ferdinandea cuprea (Scopoli)	Pirhu-1 ♀.
Volucella bombylans (L.)	Pirhu-3♂♂, 2 ♀♀.
Volucella pellucens (L.)	Pirhu-1 ♀.
Sericomyia lappona (L.)	Pirhu-1♂; Tapionaho-1♂, 1 ♀.
Sericomyia silentis (Harris)	Pirhu-1 ♀; Syväjärvi-1 ♀; Tapionaho-2♂♂, 1 ♀.
Helophilus affinis Wahlberg	Pirhu-1♂.
Helophilus lunulatus Mg.	Pirhu-1♂.
Criorrchina asilica (Fall.)	Pirhu-2♂♂, 3 ♀♀.
Syritta pipiens (L.)	Pirhu-1♂.
Temnostoma vespiforme (L.)	Pirhu-1 ♀.

CONOPIDAE	
Conops quadrifasciatus De Geer	Tapionaho-1♂.
Myopa testacea L.	Hoikka-4♂♂; Koitajoki-1♂; Tapionaho-5♂♂.
CALOBATIDAE	
Compsobata commutata Czerny	Pirhu-2♂♂, 3 ♀♀.
Calobata petronella (L.)	Tapionaho-1♂, 2 ♀♀.
PSILIDAE	
Chamaepsila humeralis (Zett.)	Pirhu-1♂, 1 ♀.
Chamaepsila limbatella (Zett.)	Pirhu-1 ♀.
Chamaepsila nigromaculata (Strobl)	Pirhu-1 ♀.
Chamaepsila pectoralis (Mg.)	Pirhu-5 ♀♀.
Psila fimetaria L.	Pirhu-4 ♀♀.
Psila merdaria Collin	Pirhu-3 ♀♀.
Psilosoma lefebvrei (Zett.)	Pirhu-7♂♂, 5 ♀♀.
Loxocera aristata (Panzer)	Pirhu-1 ♀.
Loxocera silvatica Mg.	Tapionaho-2 ♀♀.
TEPHRITIDAE	
Oplocheta pupillata Fall.	Pirhu-2 ♀♀.
DRYOMYZIDAE	
Dryomyza flaveola (F.)	Koitajoki-3♂♂, 3 ♀♀; Pirhu-7♂♂, 3 ♀♀; Syväjärvi-1♂; Tapionaho-9♂♂, 5 ♀♀.
Dryomyza analis Fall.	Pirhu-2♂♂, 3 ♀♀.
SEPSIDAE	
Nemopoda nitidula Fall.	Pirhu-2♂♂.
SCIOMYZIDAE	
Pherbellia albocostata Fall.	Hoikka•1 ♀; Tapionaho-1 ♀.
Pherbellia dubia Fall.	Pirhu-2 ♀♀.
Pherbellia griseola Fall.	Pirhu-1♂.
Renocera pallida Fall.	Pirhu-1♂.
Tetanocera elata F.	Pirhu-2♂♂.
Tetanocera phyllophora Melander	Pirhu-3♂♂, 3 ♀♀; Tapionaho-1 ♀.
Tetanocera silvatica Mg.	Pirhu-1♂.
Limnia paludicola Elberg	Pirhu-2 ♀♀.
LAUXANIIDAE	
Minettia lupulina (F.)	Pirhu-1♂.
Sapromyza hyalinata (Mg.)	Hoikka-1 ♀; Syväjärvi-1 ♀.
Lauxania cylindricornis F.	Pirhu-1♂, 3 ♀♀.
PIOPHILIDAE	
Mycetaulus bipunctatus Fall.	Koitajoki-7♂♂, 11 ♀♀; Syväjärvi-2♂♂, 3 ♀♀.
Amphipogon flavum (Zett.)	Hoikka-2 ♀♀; Lahnavaara-2 ♀♀; Tapionaho-1 ♀.

PALLOPTERIDAE	
Palloptera laetabilis Zett.	Tapionaho-1 ♀.
Palloptera usta Mg.	Hoikka-1 ♀; Kotavaara-1 ♀; Pirhu-1 ♀.
**Palloptera venusta* Lw.	Tapionaho-2 ♀♀.
CLUSIIDAE	
Hendelia beckeri Czerny	Pirhu-1 ♀; Tapionaho-1 ♀.
Clusiodes albimanus (Mg.)	Tapionaho-1♂.
Clusiodes geomyzinus (Fall.)	Syväjärvi-1 ♀; Tapionaho-2♂♂, 2 ♀♀.
**Clusiodes microcerca* Stack.	Tapionaho-5♂♂.
Clusiodes pictipes (Zett.)	Tapionaho-1♂.
Clusia flava (Mg.)	Hoikka-1 ♀; Koitajoki-1♂; Niemijärvi-1♂; Syväjärvi-1 ♀; Tapionaho-5♂♂, 3 ♀♀.
HELEOMYZIDAE	
Scoliocentra scutellaris (Zett.)	Syväjärvi-1♂.
Tephrochlamys flavipes Zett.	Pirhu-1 ♀.
Suillia apicalis (Lw.)	Lahnavaara-1♂, 1 ♀; Tapionaho-1♂.
Suillia bicolor (Zett.)	Koitajoki-4♂♂, 5 ♀♀; Pirhu-20♂♂, 7 ♀♀; Syväjärvi-2♂♂, 3 ♀♀; Tapionaho-10♂♂, 1 ♀.
Suillia flava (Mg.)	Tapionaho-5♂♂.
Suillia flavifrons (Zett.)	Pirhu-1♂; Tapionaho-2 ♀♀.
Suillia fuscicornis (Zett.)	Koitajoki-1♂; Lahnavaara-1♂; Pirhu-9♂♂; Tapionaho-12♂♂.
Suillia inornata (Lw.)	Hoikka-3♂♂; Koitajoki-3♂♂, 2 ♀♀; Kotavaara-1 ♀; Lahnavaara-1♂, 1 ♀; Pirhu-9♂♂, 9 ♀♀; Syväjärvi-1♂, 1 ♀; Tapionaho-27♂♂, 19 ♀♀.
Suillia laevifrons (Lw.)	Pirhu-2♂♂; Tapionaho•2♂♂.
Suillia mikii (Pokorny.)	Koitajoki-6♂♂; Pirhu-2♂♂; Syväjärvi-11♂♂; Tapionaho-10♂♂.
Suillia nemorum (Mg.)	Koitajoki-1♂; Syväjärvi-1 ♀; Tapionaho-3♂♂, 3 ♀♀.
Suillia parva Lw.	Pirhu-1♂.
Suillia vaginata Lw.	Pirhu-4♂♂.
Allophyla atricornis (Mg.)	Hoikka-4♂♂, 6 ♀♀; Koitajoki-10♂♂, 15 ♀♀; Kotavaara-4♂♂, 4 ♀♀; Lahnavaara-4♂♂, 8 ♀♀; Niemijärvi-1♂, 1 ♀; Pirhu-23♂♂, 14 ♀♀; Syväjärvi-6♂♂, 7 ♀♀; Tapionaho-19♂♂, 15 ♀♀.
CHLOROPIDAE	
Elachiptera cornuta (Fall.)	Syväjärvi-1 ♀.
Cetema myopina (Lw.)	Tapionaho-1♂.
Chlorops rufescens Old.	Tapionaho-1♂.
Chlorops scalaris Mg.	Tapionaho-1♂.

SCATHOPHAGIDAE	
Parallelomma paridis Hering	Pirhu-1♂.
Parallelomma vittatum Mg.	Koitajoki-1♂; Pirhu-2♂♂, 2 ♀♀; Tapionaho-2♂♂, 2 ♀♀.
Parallelomma sellatum Hack.	Koitajoki-1 ♀; Tapionaho-7♂♂, 3 ♀♀.
Delina nigrita (Fall.)	Pirhu-3♂♂, 1 ♀.
Micropselapha filiformis (Zett.)	Koitajoki-1♂; Pirhu-3♂♂; Syväjärvi-1♂; Tapionaho-1 ♀.
Cordilura albipes (Fall.)	Pirhu-1♂, 1 ♀; Tapionaho-1♂.
Cordilura ciliata Mg.	Tapionaho-1 ♀.
Cordilura rufimana Mg.	Tapionaho-1♂.
Megaphthalma pallida (Fall.)	Hoikka-1 ♀; Koitajoki-1♂; Kotavaara-1 ♀; Lahnavaara-1♂; Pirhu-5♂♂, 4 ♀♀; Tapionaho-10♂♂, 7 ♀♀.
Hexamitocera loxocerata (Fall.)	Pirhu-5♂♂, 2 ♀♀.
Scathophaga furcata (Say)	Pirhu-1♂; Syväjärvi-1♂, 1 ♀.
Scathophaga inquinata Mg.	Koitajoki-2♂♂; Tapionaho-67♂♂.
Scathophaga pictipennis Oldenberg	Hoikka-2♂♂; Syväjärvi-2♂♂, 4 ♀♀; Tapionaho-5♂♂, 4 ♀♀.
Scathophaga stercoraria (L.)	Tapionaho-1♂.
Scathophaga suilla (F.)	Hoikka-1♂; Koitajoki-1♂; Lahnavaara-1♂; Pirhu-3♂♂; Syväjärvi-69♂♂; Tapionaho-148♂♂.
Microprosopa haemorrhoidalis (Mg.)	Syväjärvi-1♂.
ANTHOMYIIDAE	
**Paraprosalpia denticauda Zett.*	Hoikka-1♂; Tapionaho-2♂♂.
MUSCIDAE	
Alloeostylus diaphanus (Wied.)	Koitajoki-1♂; Pirhu-3♂♂, 5 ♀♀; Tapionaho-14♂♂, 15 ♀♀.
Hydrotaea pandellei Stein	Tapionaho-1♂.
Mesembrina mystacea (L.)	Pirhu-1 ♀; Syväjärvi-1 ♀.
CALLIPHORIDAE	
Calliphora loewi Enderlein	Koitajoki-1♂; Pirhu-2♂♂; Tapionaho-1 ♀.
Calliphora subalpina Ringd.	Pirhu-2♂♂.
Calliphora vomitoria (L.)	Pirhu-1♂, 1 ♀.
Cynomya mortuorum (L.)	Tapionaho-1♂.
SARCOPHAGIDAE	
Sarcophaga carnaria L.	Pirhu-1♂.

List of Hymenoptera, Apocrita species collected within the North Karelian Biosphere Reserve with Malaise traps in 1993–1996

(Tap=Tapionaho, Koi=Koitajoki, Nie=Niemijärvi, Lah=Lahnavaara, Hoi=Hoikka, Syv=Syväjärvi, Kot=Kotavaara, Pir=Pirhu, ? = taxonomy uncertain)
*´-species new to the Finnish fauna identification dubious

Species	Tap	Koi	Nie	Lah	Hoi	Syv	Kot	Pir
DRYINIDAE								
Lonchodryinus ruficornis Dalm.	7	0	0	0	0	0	1	0
Anteon jurineanum Latr.	0	0	0	0	0	0	0	2
POMPILIDAE								
Priocnemis perturbator Harris	1	0	0	0	0	0	0	0
Priocnemis exaltata F.	1	0	0	0	0	0	0	0
Anoplius viaticus L.	1	0	0	0	0	0	0	0
VESPIDAE								
Vespula austriaca Pz.	0	1	0	0	1	1	0	1
Vespula rufa L.	6	5	0	1	1	1	0	0
Vespula vulgaris L.	5	5	0	0	1	0	0	2
Dolichovespula norwegica F.	4	12	5	2	0	0	0	10
Dolichovespula media Retz.	0	0	0	0	0	0	0	2
Dolichovespula sylvestris Scop.?	0	0	0	0	0	1	0	0
PEMPHREDONIDAE								
Passaloecus monilicornis Dhlb.	1	0	0	0	0	0	0	0
CRABRONIDAE								
Crossocerus cinxius (Dhlb.)	0	0	0	0	0	0	0	6
Crossocerus heydeni Kohl.	0	1	0	0	0	0	0	0
Rhopalum clavipes L.	1	0	0	0	0	0	0	0
NYSSONIDAE								
Nysson spinosus Förster	0	0	0	0	0	0	0	1
Argogorytes mystaceus L.	0	0	0	0	0	0	0	2
Alysson ratzeburgi Dahlbom	1	0	0	0	0	0	0	0
HALICTIDAE								
Evylaeus fratellus Perez	0	0	0	0	0	1	0	0
Lasioglossum sp.	0	1	0	0	0	0	0	0
MEGACHILIDAE								
Osmia parietina Curtis	0	0	0	0	0	0	0	1
APIDAE								
Bombus hortorum L.	0	1	0	0	0	0	0	2
Bombus hypnorum L.	1	0	0	0	0	2	0	0
Bombus jonellus Kirby	2	0	0	0	0	0	0	3
Bombus lucorum L.	1	0	0	1	0	0	0	7
Bombus pascuorum Scop.	1	1	0	0	0	0	0	1

Bombus pratorum L.	2	0	0	0	1	0	0	3
Bombus sporadicus Nyl.	2	2	0	0	0	0	0	0
Psythirus campestris Pz.	0	0	0	0	0	0	0	2
PROCTOTRUPIDAE								
Exallonyx sp.	1	0	1	0	0	0	0	0
Cryptoserphus aculeator Hal.	2	0	0	1	0	3	0	2
Phaenoserphus calcar Hal.	2	2	0	0	0	0	0	6
Phaenoserphus dubiosus Nixon	1	7	0	0	5	3	0	0
Phaenoserphus pallipes Latr.	0	0	0	0	0	0	0	0
Codrus (Eoc.) brevicornis Hal.	1	0	0	0	0	0	0	0
Disogmus nigripennis Thoms.?	1	0	0	0	0	0	0	0
ICHNEUMONIDAE								
Paxylommatinae								
Hybrizon buccatus Breb.	0	0	0	0	0	0	0	1
Pimplinae								
Iseropus stercorator F.	0	0	0	0	0	0	0	2
Scambus arundinator F.	0	0	0	0	0	0	0	1
Scambus eucosmidarum Perkins	0	0	0	0	0	1	0	0
Scambus nigricans Thoms.	0	0	0	0	0	0	0	1
Scambus sp.	0	0	0	0	0	2	0	0
Dolichomitus aciculatus Hellen	1	0	0	0	0	0	0	0
Dolichomitus terebrans (Ratz.)	0	0	0	0	0	0	0	1
Dolichomitus sp.	0	1	0	0	0	0	0	0
Acrodactyla degener Hal.	1	0	0	0	0	0	0	0
Acrodactyla quadrisculpta Grav.	1	1	0	0	0	0	0	0
Polysphincta tuberosa Grav.	3	0	0	0	0	0	0	0
Apechtis compunctor L.	0	0	0	0	0	0	0	3
Apechtis quadridentata Thoms.	0	0	0	0	0	0	0	2
Pimpla aquilonia Cresson	0	3	0	0	0	0	0	6
Pimpla arctica Zetterstedt	0	0	0	0	0	1	0	0
Delomerista laevis Grav.	0	0	0	0	0	2	0	0
Delomerista strandi Ulbr.	0	0	0	0	1	0	0	0
TRYPHONINAE								
Netelia virgata Geoffr.	0	0	0	0	0	0	0	2
Thymaris collaris (Thoms.)	1	0	0	0	0	0	0	0
Tryphon obtusator Thunb.	0	0	0	0	0	0	0	21
Hercus fontinalis Holmgr.	0	1	0	1	0	1	0	0
Polyblastus subalpinus Holmgr.	2	0	1	0	2	0	0	0
Polyblastus stenhammari Holmgr.	0	0	1	0	0	0	0	0
Polyblastus westringi Holmgr.	1	0	1	0	0	1	0	0
Polyblastus varitarsus Grav.	1	0	0	0	0	0	0	0
Ctenochira gelida Kasp.	1	0	0	0	0	0	0	0
Ctenochira propinqua Grav.	2	0	0	0	0	0	0	0
Ctenochira marginata Holmgr.	0	0	0	0	0	0	0	5
Ctenochira angulata Thoms.	0	0	0	0	0	0	0	2
Ctenochira infesta Holmgr.	0	1	0	0	0	1	0	0
Ctenochira xanthopyga Holmgr.	0	0	0	0	0	1	0	0
Erromenus punctatus Woldst.	7	0	2	0	0	0	0	0
Erromenus bibulus Kasp.	0	1	0	0	0	0	0	0

Exenterus abruptorius Thunb.	40	0	0	0	0	2	0	0
Exenterus amictorius Pz	0	0	0	0	0	1	0	0
Eridolius basalis Steph.	0	0	0	0	0	0	0	6
Eridolius dorsator (Thunb.)	0	0	0	0	0	0	0	1
Eridolius flavomaculatus (Grav.)	0	1	0	0	1	2	0	1
Eridolius sp.1	1	0	0	0	0	1	0	0
Eridolius sp.2	0	1	0	0	0	0	0	0
Eridolius sp.3	0	0	0	0	1	1	0	0
XORIDINAE								
Odontocolon punctulatus Thoms.	0	1	0	0	0	0	0	0
Odontocolon dentipes Gmel.	2	0	2	0	0	0	0	0
Odontocolon spinipes Grav.	0	1	0	0	0	0	0	0
ADELOGNATHINAE								
Adelognathus brevicornis Holmgr.	0	0	0	0	0	0	1	0
PHYGADEUONTINAE								
Gelis sp.1	0	0	0	0	1	0	0	0
Gelis sp.2	0	1	0	0	0	0	0	0
Gelis sp.3	0	2	0	0	0	0	0	0
Bathytrix pellucidator Grav.	0	0	0	1	0	0	0	0
Phygadeuon rugulosus Grav.	3	4	0	0	0	0	0	0
Phygadeuon geniculatus Kriechb.	1	1	0	0	0	0	0	0
Phygadeuon thomsoni Roman	0	1	0	0	0	0	0	0
Phygadeuon nitidus Grav.	3	0	0	0	0	0	0	0
Phygadeuon hercynicus Grav.	1	0	0	0	0	0	0	0
Mesoleptus scrupator Hal.	1	0	0	0	0	0	0	0
Pleolophus basizonus Grav.	2	5	0	0	0	1	0	0
Pleolophus cursitans Kriechb.	1	0	0	0	0	0	0	0
Pleolophus sperator Muell.	0	0	0	0	0	1	0	0
Pleolophus sericans Grav. ?	0	1	0	0	5	1	0	0
Pleolophus brachypterus Grav.	1	0	0	0	0	0	0	0
Hemiteles similis Gmel.	1	0	0	0	0	0	0	0
Orthizema boreophila Hellen	2	0	0	0	0	0	0	0
Orthizema pallidicarpus Thoms.	1	0	0	0	0	0	0	0
Aclastus caudatus Aubert	1	0	0	0	0	0	0	0
Aclastus setosus Hellen	1	0	0	0	0	0	0	0
Aptesis sp.	2	1	0	0	0	0	0	0
Oresbius subalpinus Roman	0	1	0	0	0	0	0	0
Schenkia opacula Thoms.	4	0	0	0	2	1	0	0
Schenkia crassicornis Kriechb.	1	0	0	0	0	0	0	0
Theroscopus hemipterus F.	0	0	0	0	1	0	0	0
Theroscopus sp.	4	0	0	0	0	0	0	0
Atractodes sp.	4	0	0	0	0	0	0	2
Ischnus migrator F. ?	0	1	0	0	1	0	0	1
Ischnus alternator Grav.	0	0	0	0	0	1	0	0
Ischnus punctiger Thoms. ?	0	0	0	0	0	2	0	0
Ethelurgus platygaster Schmied.	1	0	0	0	0	0	0	1
Stibeutes longigenus Thoms.?	0	0	1	0	0	0	0	1
Arotrephes parvipennis Thoms.	1	1	14	0	0	0	0	14
Itoplectis armator F.	0	0	0	0	1	0	0	0
Caenocryptus inflatus Thoms. ?	0	0	0	0	1	0	0	0

BANCHINAE								
Teleutaea brischkei Holmgr.	0	0	0	0	0	0	0	2
Glypta femorator Desv.	0	0	0	0	0	0	0	1
Glypta lapponica Holmgr.	0	0	0	0	0	0	0	4
Glypta caudata Thoms.	3	0	0	0	0	0	0	9
Glypta ceratites Grav.	2	0	0	0	0	0	0	0
Glypta consimilis Holmgr.	0	0	0	0	0	1	0	0
Lissonota buccator Thunb. - errabunda Holmgr. complex	1	0	0	0	0	0	0	0
Lissonota errabunda Holmgr.	0	0	0	0	0	1	0	0
Lissonopta nigridens Thoms.	0	0	0	0	0	1	0	0
Lissonota tenerrima Thoms.?	0	0	0	0	0	1	0	0
Lissonota sp.	0	14	0	4	0	5	0	0
Lissonopta maculata Br-ke?	1	0	0	0	0	0	0	1
Lissonota catenator Panzer	0	0	0	0	0	0	0	2
Alloplasta piceator Thunb.	0	0	0	0	0	1	0	0
Cryptopimpla helvetica Brauns	2	0	0	1	1	2	0	1
CTENOPELMATINAE								
Ctenopelma sp.	0	1	0	0	0	0	0	0
Xenoschesis fulvipes (Grav.)	0	1	0	0	0	0	0	0
Rhorus sp.	0	0	0	0	0	1	1	0
Pion crassipes Holmgr.	0	0	0	0	0	0	0	4
Pion fortipes Grav.	1	0	0	0	0	0	0	6
Saotis emarginata Thoms.?	0	1	0	0	0	0	0	0
Himerta *sp*.	0	2	0	0	0	0	0	0
Mesoleptidea sp.	0	1	0	0	0	0	0	0
Syntactus delusor L.	0	1	0	0	0	0	0	0
Sympherta sp.	0	0	0	0	0	0	0	1
Synoecetes tenuicornis (Grav.)	0	1	0	0	0	0	0	0
Absyrtus vicinator (Thunb.)	0	1	0	0	0	0	0	0
Lathrolestes abdominalis Br-ke	0	1	0	0	0	0	0	0
Scolobates auriculatus F.	0	2	0	0	0	0	0	0
Mesoleius aulicus Grav.?	0	0	0	1	0	1	0	0
Mesoleius dubius Holmgr.	2	0	0	0	0	0	0	0
Mesoleius geniculatus Holmgr.	3	1	0	0	0	2	0	0
Synomelix albipes Grav.	1	0	0	0	0	0	0	0
Saotis emarginata Thoms.?	0	0	1	0	0	0	0	0
Neostroblia ruficollis Holmgr.	2	3	0	0	0	0	0	0
Lamachus eques Htg.	2	0	0	0	0	0	0	0
Campodorus sp.	10	0	0	0	0	0	0	0
Anoncus sp.	1	4	0	0	0	0	0	4
Syndipnus conformis Holmgr.	1	0	0	0	0	0	0	0
Campodorus alticola Holmgr.	2	4	0	1	0	0	0	1
Trematopygus sp.1	0	0	0	0	0	0	0	2
Trematopygus sp.2	0	0	0	0	0	0	0	2
Trematopygus sp.3	0	0	0	0	0	0	0	1
TERSILOCHINAE								
Diaparsis jucundus Holmgr.	0	1	0	0	0	0	0	0

CAMPOPLEGINAE								
Sinophorus sp.1	1	0	0	0	0	0	0	0
Sinophorus sp.2	2	1	0	0	0	0	0	0
Dusona sp.	9	2	0	0	0	0	0	2
Campoplex sp.	1	0	0	0	0	0	0	0
Diadegma exareolator Aubert	1	0	0	0	0	0	0	0
Diadegma claripennis Thoms.	0	0	0	0	0	0	0	1
Hyposoter sp.	1	1	0	0	0	0	0	0
Campoplex viennensis Grav.	0	0	0	0	0	0	0	1
OPHIONINAE								
Ophion pteridis Kriechb.	0	1	0	0	2	1	1	1
Ophion slaviceki Kriechb.	1	0	0	0	0	0	0	0
ANOMALONINAE								
Erigorgus villosus Grav.	0	1	0	0	0	0	0	1
Agrypon flaveolatum Grav.	3	9	0	0	3	17	0	6
Agrypon flexorius Thunb.	0	3	0	0	0	1	0	0
Agrypon hilaris Tosq.	0	1	0	0	0	0	0	0
Agrypon rugifer Thoms.	1	0	0	0	0	0	0	0
METOPIINAE								
Exochus prosopius Grav.	2	0	0	0	0	0	0	0
Exochus gravipes Grav.	1	0	0	0	0	0	0	0
Exochus decoratus Holmgr. ?	0	1	0	0	0	0	0	0
Chorinaeus flavipes Bridgman	0	0	0	0	0	0	0	2
Triclistus longicalcar Thoms.	0	0	0	0	0	0	0	1
Spudaeus scaber Grav.	0	0	0	0	0	0	0	1
MESOCHORINAE								
Mesochorus sp.1	0	0	0	0	0	0	0	1
Mesochorus sp.2	0	0	0	0	0	0	0	1
Astiphromma sp.1	0	1	0	0	0	1	1	1
Astiphromma sp.2	0	0	0	0	0	0	0	1
OXYTORINAE								
Hemiphanes flavipes Först.	0	0	0	0	0	0	0	1
**Hemiphanes townesi* Rossem	0	0	0	0	0	2	0	0
Cylloceria melancholica (Grav.)	0	19	0	0	0	1	0	0
Helictes borealis (Holmgr.)	0	15	0	0	1	1	1	4
**Helictes conspicuus* (Först.)	0	0	0	0	0	0	0	1
Helictes erythrostoma (Gmelin)	0	0	0	0	0	0	0	1
Megastylus orbitator Schiødte	1	0	0	0	0	0	0	0
Megastylus cruentator Schiødte	0	1	0	0	0	0	0	0
Eusterinx tenuicincta Först.	1	0	0	0	0	0	0	0
Eusterinx trichops (Thoms.)	4	0	0	0	0	0	0	0
**Eusterinx inaequalis* Rossem	1	0	0	0	0	0	0	0
Symplecis bicingulata (Grav.)	1	0	0	0	0	0	0	0
Symplecis breviuscula Roman	1	0	0	0	0	0	0	0
**Catastenus femoralis* Först.	2	0	0	0	0	0	0	0
Gnathochorisis crassula (Thoms.)	0	0	0	0	0	0	0	5
Gnathochorisis dentifer (Thoms.)	3	0	0	0	0	0	0	1
**Proeliator proprius* Rossem	0	0	0	0	0	1	0	0

Pantisarthrus dispar Rossem	0	0	0	0	0	0	0	1
Pantisarthrus lubricus (Först.)	1	0	0	0	0	1	0	0
Pantisarthrus luridus Först.	0	0	0	0	0	0	0	1
Proclitus ardentis Rossem	0	0	0	0	0	0	0	1
Proclitus attentus Först.	1	0	0	0	0	0	0	0
Proclitus comes (Hal.)	1	1	0	0	0	0	0	0
Proclitus paganus (Hal.)	0	0	0	0	0	1	0	0
Aperileptus albipalpus Först.	1	0	0	0	0	0	0	0
Aperileptus vanus Förster	0	1	0	0	0	0	0	2
Aperileptus infuscatus Först.	1	0	0	0	0	1	0	0
Aperileptus microspilus Förster	1	1	0	0	0	0	0	1
Plectiscidea collaris (Grav.)	0	0	0	0	0	0	0	1
Plectiscidea canaliculata Thoms.	1	0	0	0	1	0	0	2
Plectiscidea moerens Förster	0	0	0	0	0	0	0	1
Plectiscidea nava Förster	0	0	0	1	0	0	0	1
Plectiscidea sp.1	2	0	0	0	0	1	0	0
Plectiscidea sp.2	1	0	0	0	0	1	0	0
Plectiscidea sp.3	1	1	0	0	0	0	0	0
Aniseres pallipes Först.	1	0	0	0	0	0	0	0
**Aniseres caudatus* Humala	0	1	0	0	0	0	0	0
ORTHOCENTRINAE								
Orthocentrus frontator Zett.	1	0	0	0	0	0	0	0
Orthocentrus marginatus Holmgr.	1	0	0	0	0	0	0	1
Orthocentrus patulus Holmgr.	0	0	0	0	0	0	0	1
Orthocentrus petiolaris Thoms.	0	0	0	0	0	0	0	1
Orthocentrus protervus Holmgr.	1	0	0	0	0	0	0	0
Orthocentrus radialis Thoms.	1	0	0	0	0	0	0	0
Orthocentrus spurius Grav.	2	0	0	0	0	0	0	1
Orthocentrus sannio Holmgr.	0	0	0	0	0	2	0	0
Orthocentrus stigmaticus Holmgr.	0	1	0	0	0	0	0	0
Orthocentrus corrugatus Holmgr.?	1	0	0	0	0	0	0	0
Orthocentrus sp.	3	0	0	0	0	0	0	0
Picrostigeus sp.	2	0	0	0	0	0	0	0
Stenomacrus sp.	13	0	0	0	0	0	0	0
Plectiscus (Leipaulus) sp.	1	1	0	0	1	1	0	1
Plectiscus sp.	13	0	0	0	0	0	0	1
DIPLAZONTINAE								
Diplazon laetatorius F.	1	0	0	0	1	0	0	1
Diplazon pectoratorius Thunb.	0	0	0	0	0	0	0	5
Diplazon tetragonus Thunb.?	1	0	0	0	0	0	0	0
Diplazon *sp.1*	1	0	0	0	0	0	0	0
Diplazon sp.2	1	0	0	0	0	0	0	0
Diplazon sp.3	1	0	0	0	0	0	0	0
Syrphoctonus pallipes Grav.	0	0	0	0	0	0	0	1
Syrphoctonus tarsatorius Panz.	0	0	0	0	0	0	0	1
Woldstedtius biguttatus Grav.	0	1	0	0	0	0	0	0
Syrphophilus bizonarius Grav.	0	0	0	0	0	0	0	5
Phthorima compressa Desv.	0	0	0	0	0	0	0	1
Promethes sulcator Grav.	0	0	0	0	0	0	0	1
Sussaba cognata Holmgr.	0	0	0	0	0	0	0	2
Sussaba punctiventris (Thoms.)	0	0	0	0	0	0	0	1
Sussaba pulchella Holmgr.	0	0	0	0	0	0	0	1

ICHNEUMONINAE								
Alomya debellator F.	0	0	0	0	0	0	0	10
Alomya pygmaea Heinrich	0	0	0	0	0	0	0	1
Misetus oculatus Wesm.	13	20	3	7	22	48	1	0
Phaeogenes melanogonos Gmel.	0	1	0	0	0	0	0	1
Ichneumon gracilentus Wesm.	1	13	0	1	2	0	0	0
Ichneumon iocerus Grav.	0	0	0	0	0	0	0	1
Colpognathus jucundus Wesm.	1	0	0	0	0	0	0	0
Aoplus pulchricornis Grav.	0	1	0	0	0	0	0	0
Cratichneumon viator Scop.	0	1	0	0	0	0	0	0
TOTAL CATCH	287	208	32	23	60	136	7	250

List of aphyllophoraceous fungi

Rare, endangered, poorly known and old growth forest indicator species are boldfaced in the species list.

Sites/localities:

1 Tapionaho
2 Kitsi, natural forest
3 Kitsi, burned forest
4 Lahnavaara
5 Syväjärvi:
    5 Syväjärvi
    5a Hoikka
    5b Hoikanpuro
    5c Hoikka E
    5d Syväjärvi S
6 Koitajoki
7 Niemijärvi
8 Patvinsuo
9 Pieni Kotavaara:
    9 Pieni Kotavaara
    9a Kotavaara
    9b Pyötikönkosket
10 Petkeljärvi
11 Pampalo:
    11a Pampalo
    11b Pampalo (slope)
12 Lakonjärvi:
    12a Lakonjärvi S
    12b Lakonjärvi SW
13 Pahkavaara:
    13a Pahkavaara E
    13b Pahkavaara W
    13c Pahkavaara VMS
14 Ukonsärkkä:
    14a Ukonsärkkä–Aittalampi
    14b Ukonsärkkä–Suolammin-vaara
    14c Ukonsärkkä–Mustalampi
    14d Ukonsärkkä–Pieni Haukilampi
    14e Ukonsärkkä–Ukonkangas
15 Valtimo:
    15a Murtovaara
    15b Murtojärvi W
    15c Koiravaara
    15d Sormusenvaara
    15e Kivimäki
    15f Salmivaara
    15g Väärälampi S
    15h Alimmainen Verkkojärvi Nikara
    15i Alimmainen Verkkojärvi Iso-Kuohu
    15j Piilopirtinaho Murtopuro
    15k Piilopirtinaho N
    15l Paistinvaara N
    15m Paistinvaara VMS
16 Päävaara:
    16a Majakangas
    16b Haukilahti
17 Särkilammenkangas:
    17a Särkipuro
    17b Särkipuro NW

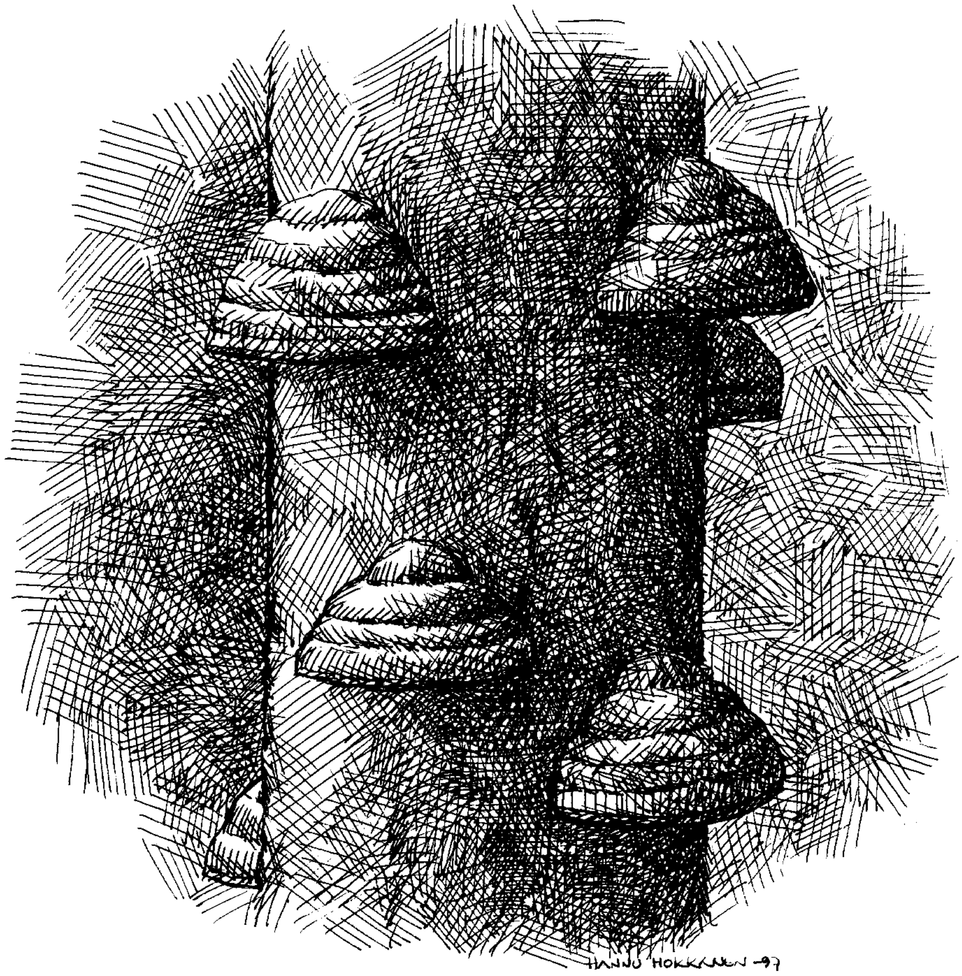
APHYLLOPHORALES	
Albatrellus confluens (Alb. & Schwein.: Fr.) Kotl. & Pouzar	9, 10
A. ovinus (Schaeff.: Fr.) Kotl. et Pouzar	5, 8, 11a, 15 d, 16a
Amphynema byssoides (Pers.: Fr.) J. Erikss.	1, 2, 4, 5, 5b, 5c, 6, 9, 9a, 10, 11b, 12a,13a, 15b, 15e,15l
Amylocorticium subincarnatum (Peck) Pouzar	14d, 15e
Amylocystis lapponica (Romell) Singer	1, 4, 5c, 6, 7, 8, 9, 9b, 11a, 11b, 13a, 14a, 14e, 15a, 15c, 15d, 15l, 17a
Amyloporia xantha (Fr.: Fr.) Bondartsev et Singer	1, 2, 3, 4, 5a, 5c, 6, 7, 8, 9a, 10, 11b, 13b, 14a, 14e, 15e, 15f, 15h, 15i, 16a, 16b
Antrodia albobrunnea (Romell) Ryvarden	1, 9, 9a
A. macra (Sommerf.) Niemelä	1, 6, 8
A. mellita Niemelä et Penttilä	4, 7, 15e
A. pulvinascens (Pilát) Niemelä	6
A. serialis (Fr.) Donk	1, 2, 4, 5, 5a, 5d, 6, 7, 8, 9, 9a, 9b, 11a, 11b, 12a, 12b, 13a, 13b, 13c, 14a, 14b, 14e, 15a, 15c, 15d, 15e, 15g, 15h, 15i, 15j, 15l, 15m, 16b, 17a, 17b
A. sinuosa (Fr.) P. Karst.	1, 2, 3, 4, 5, 5a, 5c, 6, 7, 8, 9, 9a, 10, 11a, 11b, 13c, 14a, 14d, 15e, 15g, 15h, 15i, 15j, 15m, 17a
Antrodiella romellii (Donk) Niemelä	4, 5, 9
A. semisupina (Berk. et M.A. Curtis) Ryvarden	5, 6, 11b
Asterodon ferruginosus Pat.	1, 2, 4, 5, 7, 8, 9, 9a, 12a, 12b, 15g, 15i, 16b
Bjerkandera adusta (Willd.:Fr.) P. Karst.	1, 4, 5, 8, 9, 9b, 11a, 12b, 13a, 14d
Botryobasidium vagum (Bres.) J. Erikss.	2, 3, 5, 9
B. candicans J.Erikss.	15b
Botryohypochnus isabellinus (Fr.) J. Erikss.	1, 9a,
Cantharellus cibarius Fr.	1, 4, 5, 8, 9, 10
Ceraceomyces borealis (Romell) J. Erikss. et Ryvarden	4
C. serpens (Tode : Fr.) Ginns	1, 2, 6, 9, 15e
C. sublaevis (Bres.) Julich	9
Ceriporia reticulata (Hoffm.: Fr.) Domañski	11b
C. viridans (Berk. et Broome) Donk	1
Ceriporiopsis pannocincta (Romell) Gilb. & Ryvarden	6, 9a, 10, 13b
C. resinascens (Romell) Domañski	1, 5, 5d, 6, 11a, 12a
Cerrena unicolor (Bull.: Fr.) Murrill	1, 2, 3, 5, 6, 8, 9, 10, 11b,12a, 14d, 15c, 15e, 15k
Chaetoderma luna (Romell in Rogers et H.S. Jacks.) Parmasto	6, 14d
Chondrostereum purpureum (Pers.: Fr.) Pouzar	1, 2, 3, 6
Clavaria zollingeri Lév.	8
Clavicorona pyxidata (Pers.: Fr.) Doty	1, 6
Coltricia perennis (L.: Fr.) Murrill	1, 3, 4, 6, 10 , 13c ,14d
Columnocystis abietina (Pers.: Fr.) Pouzar	1

Coniophora arida (Fr.) P. Karst.	1, 2, 3, 4, 5b, 6, 8, 11a, 11b, 12b,13b, 13c, 14d, 15a,15b, 15f, 15l, 15m, 16a , 16b
C. olivacea (Pers.: Fr.) P. Karst.	1, 2, 4, 5a, 5a, 7, 8, 9, 10, 11a, 12b, 13a, 13b, 14a, 14d, 15j, 15l
Creolophus cirrhatus (Pers.: Fr.) P. Karst.	4
Cytidia salicina (Fr.) Burt	6
Datronia mollis (Sommerf.: Fr.) Donk	6, 15a
Dentipellis fragilis (Pers.: Fr.) Donk	5
Dichomitus squalens (P. Karst.) D.A. Reid	1
Diplomitoporus crustulinus (Bres.) Domañski	9
D. lindbladii (Berk.) Gilb. et Ryvarden	5
Fomes fomentarius (L.:Fr.) Fr.	in all sites
Fomitopsis pinicola (Sw.: Fr.) P. Karst.	in all sites, besides 12a, 15f, 15h
F. rosea (Alb. et Schwein.: Fr.) P. Karst.	1, 2, 4, 5, 6, 7, 8, 9, 9a, 9b, 11a, 12b, 13a,14a, 14d,14e, 15a, 15c, 15d, 15j, 15m, 16b
Ganoderma lipsiense (Batsch) G.F. Atk.	1, 2, 3, 4, 6, 9, 12a, 13c, 15a
Gloeophyllum odoratum (Wulfen : Fr.) Imaz.	1
G. protractum (Fr.) Imaz.	1
G. sepiarium (Wulfen : Fr.) P. Karst.	1, 3, 4, 5, 6, 7, 8, 9, 13c, 15d, 15f, 15k, 17a
Gloeoporus dichrous (Fr.: Fr.) Bres.	1, 3, 4, 6, 9a, 11a
G. taxicola (Pers.: Fr.) Gilb. et Ryvarden	6
Hapalopilus rutilans (Pers.: Fr.) P. Karst.	1, 4, 5, 9, 14d
Haploporus odorus (Sommerf.: Fr.) Bondartsev et Singer	4
Hericium coralloides (Scop.: Fr.) Pers.	1, 4, 5, 9a, 10, 14e, 15m
Hydnellum aurantiacum (Batsch : Fr.) P. Karst.	6
H. coeruleum (Hornem.) P. Karst.	10
H. concrescens (Pers.) Banker	1, 4, 7
H. ferrugineum (Fr.: Fr.) P. Karst.	1, 4, 6, 8, 9, 10, 15i, 15k
H. suaveolens (Scop.: Fr.) P. Karst.	1, 6, 9
Hydnum repandum L.: Fr.	5, 15d, 15f, 15m
Hymenochaete tabacina (Sowerby : Fr.) Lév.	5, 13a, 15a, 15f
Hyphoderma radula (Fr.: Fr.) Donk	15e
Hyphodontia aspera (Fr.) J. Erikss.	1
Inonotus obliquus (Pers.: Fr.) Pilát	1, 2, 4, 5, 5a, 5b, 5c, 5d, 6, 7, 8, 9, 9a, 9b, 10,11a,11b,12a, 12b, 14e, 15a, 15b, 15c, 15d, 15e, 15f, 15g, 15h, 15i, 15j, 15k, 16a, 16b, 17a
I. radiatus (Sowerby : Fr.) P. Karst.	1, 6, 8, 9,12a, 15d, 15h
I. rheades (Pers.) Bondartsev et Singer	1, 4, 5, 7, 11a, 14d, 15e, 16a
Ischnoderma benzoinum (Wahlenb.: Fr.) P. Karst.	4, 6
Junghuhnia collabens (Fr.) Ryvarden	8, 9a, 11a
J. luteoalba (P. Karst.) Ryvarden	3, 4
J. separabilima (Pouzar) Ryvarden	12b
Laeticorticium polygonioides (P. Karst.) Donk	1, 15a
L. roseum (Fr.) Donk	1, 4, 5d, 6, 7, 8, 9a, 12a, 15e, 15k
Laxitextum bicolor (Pers.: Fr.) Lentz	9, 15f
Lenzites betulinus (L.: Fr.) Fr.	1, 3, 5b, 15b, 15g

Leptoporus mollis (Pers. : Fr.) Pilát	11b, 15k
Leucogyrophana sororia (Burt) Ginns	5
Meruliopsis albostraminea (Torrend) Julich et Stalpers	1, 5
Merulius tremellosus Schrad.:	1, 3, 4, 6
Mycoacia aurea (Fr.) J. Erikss. et Ryvarden	10
M. fuscoatra (Fr.: Fr.) Donk	10
Oxyporus corticola (Fr.) Parmasto	4, 5, 6, 7, 8, 9, 9a, 11a, 11b, 12a, 12b, 13b, 14d, 14e, 15a, 15e, 15f, 15k, 15m, 16a
O. populinus (Schumach.: Fr.) Donk	5c, 9, 13b, 14d
Peniophora incarnata (Pers.: Fr.) P. Karst.	1, 4, 5
P. rufa (Fr.) Boidin	10
Phanerochaete laevis (Fr.) J. Erikss. et Ryvarden	1, 2
Ph. sanguinea (Fr.) Pouzar	1, 2, 4, 5a, 6, 8, 9, 10, 11a, 12b, 13a,13b, 13c, 15a, 15b, 15c, 15d, 15e, 15j, 15k, 16a, 17b
Ph. sordida (P. Karst.) J. Erikss.	1, 11b
Phellinus alni (Bondartsev) Parmasto	9, 13b
Ph. chrysoloma (Fr.) Donk	1, 2, 4, 5, 5b, 5c, 5d, 6, 7, 8, 9, 9a, 9b, 11a, 11b, 12b, 13a,13b, 13c, 14a,14c, 14d, 14e, 15a, 15b, 15c, 15d, 15e, 15f, 15h, 15i, 15j, 15k, 15l, 15m, 16a, 16b, 17a
Ph. conchatus (Pers.: Fr.) Quél.	1, 2, 6, 10, 12a
Ph. ferrugineofuscus (P. Karst.) Bourdot et Galzin	1, 4, 5, 6, 7, 8, 9, 9a, 10, 11b, 12b, 13a,13b, 13c, 14a, 14d, 14e, 15a, 15c, 15j, 15l, 15m, 16a, 17a
Ph. igniarius (L.: Fr.) Quél.	1–9, 5a,5b, 5c, 5d, 9a, 9b, 10, 11a, 11b, 12a, 12b, 13a, 13b, 13c, 14b, 14c, 14d, 14e, 15a, 15b, 15c, 15d, 15f, 15h, 15i, 15j, 15k, 15l, 15m, 16a, 16b, 17a
Ph. laevigatus (Fr.) Bourdot et Galzin	1, 2, 4, 5, 5a, 5d, 6, 9, 10, 11a, 11b, 13a, 13b, 15b, 15c, 15h, 15j, 15k, 15l, 16b
Ph. lundellii Niemelä	1, 2, 4, 5, 5b, 5c, 5d, 6, 7, 8, 9a, 11b, 12a, 12b, 13b, 15b, 15c, 15e, 15f, 15i, 15j, 15k, 15l, 16a, 16b, 17a
Ph. nigrolimitatus (Romell) Bourdot et Galzin	1, 6, 7, 8, 11a, 15c, 15d, 15m
Ph. pini (Brot.: Fr.) A. Ames	1, 2, 3, 4, 5, 5a, 6, 7, 8, 9, 10, 11a, 11b, 12a, 13c, 14e, 15i, 16b
Ph. populicola Niemelä	1, 2, 5, 6, 9, 10, 15a
Ph. punctatus (Fr.) Pilát	12a, 14e
Ph. tremulae (Bondartsev) Bondartsev et Borisov	1, 2, 4, 5, 5b, 5d, 6, 7, 8, 9, 9a, 11a,11b,12a, 12b, 14c, 14d, 14e, 15a, 15c, 15e, 15f, 15h, 15i, 16a, 16b, 17a
Ph. viticola (Schwein.: Fr.) Donk	1, 2, 4, 5, 5b, 6, 7, 8, 9, 9a, 9b, 10, 11b, 15a, 15c, 15d, 15e
Phellodon connatus (Schultz : Fr.) P. Karst.	1
Ph. niger (Fr.: Fr.) P. Karst.	1, 10
Ph. tomentosus (L.: Fr.) Banker	4, 12b, 13c
Phlebia centrifuga P. Karst.	6, 8, 11b

Ph. radiata Fr.	1, 4, 8
Ph. rufa (Pers.: Fr.) M.P. Christ.	1
Phlebiella sulphurea (Pers.: Fr.) Ginns & Lefebvre	1, 2, 4, 5, 5a, 5b, 5c, 5d, 9, 9a, 10, 11a, 12a, 13a, 13b, 15e, 15h, 15j, 15l, 16b
Phlebiopsis gigantea (Fr.: Fr.) Julich	2, 3, 5, 5d, 6, 8, 9, 10, 12a, 13b, 14e, 15h, 15i, 15m, 17a
Piloderma fallax (Liberta) Stalpers	1, 2, 3, 4, 5, 5a, 5b, 5c, 7, 8, 9, 9a, 9b, 10, 11a, 11b,12a, 12b, 13a, 13b, 13c, 14b, 14d, 15b, 15c, 15d, 15e, 15h, 15i, 15j, 15k, 15m, 16a, 17b
Piptoporus betulinus (Bull.: Fr.) P. Karst.	1, 2, 3, 4, 5, 5a, 5c, 5d, 6, 7, 8, 9, 9b, 10, 11b, 13a, 13c, 14c, 14e, 15a, 15b, 15d, 15e, 15i, 15j, 15k, 16a, 16b, 17a
Plicatura nivea (Sommerf.: Fr.) P. Karst.	1, 6
Polyporus badius (Pers.) Schwein.	2, 3, 6
P. brumalis Pers.: Fr.	1, 3, 6, 8
P. ciliatus Fr.	1
P. pseudobetulinus (Pilát) Thorn, Kotiranta et Niemelä	4, 11a, 12b
P. varius Fr.	3, 4, 5, 5b, 6, 9, 9a, 11a, 14d, 15a, 15d, 15k, 16a, 16b, 17a
Postia caesia (Schrad.: Fr.) P. Karst.	1, 2, 4, 5, 6, 9, 15k
P. fragilis (Fr.) Julich	1, 2, 4, 5c, 6, 17a
P. guttulata (Peck) Julich	4
P. hibernica (Berk. et Broome) Julich	7
P. laterita Renvall	9
P. leucomallella (Murrill) Julich	5, 7
P. placenta (Fr.) M.J. Larsen et Lombard	1, 2, 10
P. rennyi (Berk. et Broome) Rajchenb.	11a
P. sericeomollis (Romell) Julich	1, 10
P. stiptica (Pers.: Fr.) Julich	1, 4, 11b, 13c
P. subcaesia (A. David) Julich	1, 5, 12b, 15k
P. tephroleuca (Fr.) Julich	1, 4, 5, 8, 11b, 12b
Protomerulius caryae (Schwein.) Ryvarden	14e
Pseudomerulius aureus (Fr.) Julich	1
Pycnoporus cinnabarinus (Jacq.: Fr.) P. Karst.	1, 3, 7, 15a
Pycnoporellus fulgens (Fr.) Donk	4
Ramaria flava (Schaeff.: Fr.) Quél.	10
R. formosa (Pers.: Fr.) Quél.	10
Resinicium bicolor (Alb. et Schwein.: Fr.) Parmasto	10, 11a
R. furfuraceum (Bres.) Parmasto	10
Sarcodon imbricatus (L.: Fr.) P. Karst.	1, 6, 7
S. scabrosus (Fr.) P. Karst.	4
Schizopora paradoxa (Schrad.: Fr.) Donk	7, 9
Scytinostroma odoratum (Fr.) Donk	1
Serpula himantioides (Fr.: Fr.) P. Karst.	6, 9
Sistotrema brinkmannii (Bres.) J. Erikss.	10
Skeletocutis amorpha (Fr.: Fr.) Kotl. et Pouzar	1, 4, 5, 6
S. brevispora Niemelä	5
S. kuehneri A. David	7
S. lenis (P. Karst.) Niemelä	1

S. odora (Sacc.) Ginns	4
S. subincarnata (Peck) Jean Keller	9, 10
Steccherinum fimbriatum (Pers.: Fr.) J. Erikss.	5, 8
S. ochraceum (Pers.: Fr.) S.F. Gray	1, 11a
Stereopsis vitellina (Plowr.) D.A. Reid	1
Stereum gausapatum (Fr.) Fr.	9a
S. hirsutum (Willd.: Fr.) Gray	1, 3, 4, 5, 5c, 6, 7, 9, 9a, 11a, 11b, 13a, 13b, 15a, 15b, 15f, 15k
S. rugosum (Pers.: Fr.) Fr.	4, 5, 5a, 6, 7, 9, 10, 15d, 16a
S. sanguinolentum (Alb. et Schw.: Fr.) Fr.	1, 2, 3, 4, 5, 6, 7, 15a, 15f, 15h, 15k, 17b
S. subtomentosum Pouzar	6
Stromatoscypha fimbriatum (Pers.: Fr.) Donk	12a
Thelephora terrestris Ehrh.: Fr.	1, 3, 5, 6, 7, 10
Trametes hirsuta (Wulfen : Fr.) Pilát	1, 2, 4, 5, 5a, 6, 7, 9, 9a, 11a, 15c, 15d, 15e
T. ochracea (Pers.) Gilb. et Ryvarden	1, 2, 3, 4, 5, 5a, 5b, 5c, 5d, 6, 7, 8, 9a, 11a, 12a, 13b, 14a, 14d, 15a, 15e, 15f, 15h, 15i, 15j, 15k, 16b, 17a
T. pubescens (Schumach.: Fr.) Pilát	1, 2, 4, 5, 15h
Trechispora mollusca (Pers.: Fr.) Liberta	7
Trichaptum abietinum (Pers.: Fr.) Ryvarden	1, 2, 3, 4, 5a, 5b, 5c, 5d, 6, 7, 8, 9a, 9b, 10,11a, 11b, 12b, 13a, 13b, 13c, 14a, 14b, 14d, 14e, 15a, 15c, 15d, 15e, 15h, 15i, 15j, 15k, 15l, 15m, 16a, 16b, 17a, 17b
T. fuscoviolaceum (Ehrenb.: Fr.) Ryvarden	1, 5
T. laricinum (P. Karst.) Ryvarden	4, 15l
T. pargamenum (Fr.) G. Cunn.	1, 3, 4, 5, 5a, 6, 8, 9, 10, 12a, 14e
Tyromyces chioneus (Fr.) P.Karst.	3, 5
Vararia investiens (Schwein) P. Karst.	10, 15b
ASCOMYCETES	
Daldinia concentrica (Fr.) Ces. et de Not.	2, 3, 7
Gyromytra infula (Schaeff.: Fr.) Quél.	3
Rhizina inflata (Schaeff.) P. Karst.	3
HETEROBASIDIOMYCETES	
Calocera cornea (batsch: Fr.) Fr.	1
C. viscosa (Fr.) Fr.	3, 7
Exidia saccharina Fr.	3
HYMENOMYCETES	
Pleurotus ostreatus (Jacq.: Fr.) Kumm.	3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Vuonna 2001 ilmestyneet Metsähallituksen luonnonsuojelu-julkaisut

Sarja A

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