EKOLOGIJA. 2006. Nr. 4. P. 22–30

Diversity of fungi on decaying common oak coarse woody debris

Reda Iršėnaitė[1],

Ernestas Kutorga[1, 2]

[1] Laboratory of Mycology,
Institute of Botany,
Žaliųjų ežerų 49, LT-08406 Vilnius,
Lithuania
E-mail: reda@botanika.lt

[2] Department of Botany and Genetics,
Faculty of Natural Sciences,
Vilnius University,
M. K. Čiurlionio 21/27, LT-03101 Vilnius,
Lithuania
E-mail: ernestas.kutorga@gf.vu.lt

The species diversity and distribution of fungi on decaying common oak (*Quercus robur*) coarse woody debris (CWD) was investigated in 50 circular study plots (each 0.1 ha in size) within oak stands of different age. A total of 203 fungal species was recorded on oak CWD. Among the 49 recorded ascomycetes, the most frequent were *Eriopezia caesia*, *Humaria hemisphaerica*, *Mollisia cinerea* and *Nemania serpens*. The largest part of fungi comprised basidiomycetes (154 species) among which *Hymenochaete rubiginosa*, *Hyphodontia quercina*, *Phanerochaete velutina* and *Schizopora paradoxa* were most common. Analysis of species composition based on the presence of fruit bodies on wood of different decay stages (DS) has shown a change of fungal community structure among slightly (DS I–II) and strongly (DS IV–V) decayed wood, though no strong preference of most fungi for wood of particular decay stage was observed.

Key words: ascomycetes, basidiomycetes, wood decay stages, *Quercus robur*, Lithuania

INTRODUCTION

Dead wood is a critical component in forest ecosystems, storing carbon in the long term and providing the habitat and food for many organisms, including fungi (Harmon et al., 1986). The quality of deadwood and its usefulness for different species depends on how long it has been decaying (Allen et al., 2000; Lange, 1992; Runge, 1975) and also on tree species (Lindhe et al., 2004), position (Boddy, 2001) and size (Heilmann-Clausen, Christensen, 2004; Rubino, McCarthy, 2003). As coarse woody debris (CWD) decompose, they pass through various stages, from solid wood to material of soft structure. The enzymatic and physical actions of wood-inhabiting fungi chemically and structurally change the wood, resulting in numerous habitats and food resources for other organisms (Niemelä et al., 1995; Renvall, 1995).

The importance of CWD in Lithuanian forests has been largely unrecognized, apart from a few studies. Gricius et al. (1999) investigated fungi destruction of dead trunks of various tree species during a nine-year period. They identified 105 fungi species on 70 logs and determined most characteristic species of the initial, optimal and final phases of wood decomposition. However, oak logs were not included in this study. Vasiliauskas et al. (2004) investigated the accumulation of dead trees and CWD relation to tree species, the edaphic conditions and age of a stand. They found the volume of CWD of different tree species to be larger in older stands than in younger ones, demonstrated the variation of structural characteristics of CWD and recorded 41 species of wood-decomposing polypores. Nevertheless, their sampling of oak CWD was too limited to draw conclusions about distribution patterns, and the oak wood-decomposing fungi were not specified. In the present study, we examined the composition of wood-inhabiting fungi on CWD of common oak in oak stands of different age. The aims of this work were to compile a species list of fungi inhabiting dead oak wood and to investigate the differences of fungal composition based on decay stages of CWD. The results of a comparison of wood-inhabiting fungi in oak stands of different age will be presented in a special publication.

MATERIALS AND METHODS

Ten study sites were selected in different parts of Lithuania (Fig. 1) according to the forest management documents and maps. All study sites contained forests dominated by common oak (*Quercus robur*). The co-existing tree species were *Picea abies*, *Pinus sylvestris, Populus tremula*, *Tilia cordata* and *Fraxinus excelsior*. The bush layer was moderately thick and consisted mainly of *Corylus avellana*, *Lonicera xylosteum*, *Frangula alnus* and *Sorbus aucuparia*. The study involved oak

Fig. 1. Location of the study sites in Lithuania: 1 – Kreivišk ės, 2 – Plikoji sala, 3 – Minijos kilpa, 4 – Šilas, 5 – Gojus, 6 – Drausgiris, 7 – Subartonys, 8 – Ąžuolija, 9 – Ginučiai, 10 – Dūkštos

stands of various age groups from maturing (50–120 years) to mature (over 120 years). Depending on the size of a study site, from one to nine circular study plots of 0.1 ha were randomly selected. In total, we surveyed 50 plots.

Within each plot, all fallen and standing dead oak wood pieces with the base of 5 cm and more in diameter and over 30 cm in length was investigated. Five CWD decay stages were defined following a modified classification of Renvall (1995). CWD decay stages were defined as follows: (I) Wood hard, bark sound; trunk or branch is a solid piece; (II) Wood hard, bark usually present but not firmly attached; trunk or branch is a solid piece (though decay may be present); (III) Heartwood fairly hard, small areas of sapwood already decomposed; less than half bark present on a big trunk, branches usually without bark or sapwood; (IV) Wood surface may flack off, heartwood already softened, but some chunks of it remain; big trunk usually without bark or remnants of bark loosely attached; small branch usually without bark; (V) Wood very soft throughout, when lifted usually crushes; trunk or branch covered with ground floor cryptogams; small pieces of bark may be left on the ground near trunk or branch. If the stage of decomposition varied in different parts of a trunk, an average decay stage was considered.

The fieldwork was undertaken in 2001–2002 during the main period of fruit body production (August–October) in both years. The taxonomic position of fungi was determined according to "Dictionary of the Fungi" (Kirk et al., 2001). A species found on a single unit of wood was considered as one record, regardless of the number of fruit bodies. Voucher specimens are preserved at the Herbarium of the Institute of Botany, Vilnius (BILAS). The species concepts of taxa mostly follow Hansen & Knudsen (1992, 1997, 2000), but Kõljalg (1996) for *Tomentella* and Eriksson et al. (1984) for *Schizopora* collections.

RESULTS

Taxonomic structure of fungi on CWD

In total, 1350 records of 203 species were collected over the period of investigation in all study plots (Table 1). The species belong to 119 genera, 24 orders and 2 phyla (Table 2). The largest part of fungi found on CWD of *Quercus robur* belong to the phylum

Table 1. **Abundance (number of records) / frequency (number of study plots in which a species occurs) of wood-inhabiting species in different age stands and relative frequency (%) of occurrence on CWD of different decay stages**

Species	Fungal taxonomic group (order)	Stand age group		Total	Decay stage				
		I	II		I	II	III	IV	V
Achroomyces effusus	*Incertae sedis*	0	1/1	1/1	-	-	-	100	-
Amphinema byssoides	*Polyporales*	1/1	8/6	9/7	-	-	56	44	-
Ascocoryne sarcoides	*Helotiales*	6/6	7/6	13/12	-	31	15	46	8
Athelia arachnoidea	*Polyporales*	3/2	1/1	4/3	-	50	25	25	-
Athelia decipiens	*Polyporales*	1/1	6/5	7/6	-	57	29	14	-
Athelia epiphylla	*Polyporales*	5/4	7/6	12/10	-	25	17	42	17
Bertia moriformis	*Coronophorales*	0	1/1	1/1	-	-	-	100	-
Bisporella citrina	*Helotiales*	7/7	18/16	25/23	-	4	80	16	-
Bjerkandera adusta	*Polyporales*	0	1/1	1/1	-	100	-	-	-
Botryobasidium candicans	*Cantharellales*	1/1	0	1/1	-	-	-	100	-
Botryobasidium confluens	*Cantharellales*	0	1/1	1/1	-	-	-	100	-
Botryobasidium conspersum	*Cantharellales*	1/1	3/3	4/4	-	-	-	100	-
Botryobasidium intertextum	*Cantharellales*	1/1	3/3	4/4	-	-	-	-	100
Botryobasidium laeve	*Cantharellales*	6/5	6/6	12/11	-	-	42	58	-
Botryobasidium obtusisporum	*Cantharellales*	0	1/1	1/1	-	-	-	100	-
Botryobasidium subcoronatum	*Cantharellales*	2/2	2/2	4/4	-	-	-	100	-

Table 1 (continued)

Botryohypochnus isabellinus	*Cantharellales*	1/1	1/1	2/2	-	-	100	-	-
Bulgaria inquinans	*Helotiales*	0	4/4	4/4	75	25	-	-	-
Calocera cornea	*Dacrymycetales*	2/2	3/3	5/5	-	40	40	20	-
Camarops polysperma	*Boliniales*	0	1/1	1/1	-	100	-	-	-
Ceraceomyces microsporus	*Polyporales*	1/1	2/2	3/3	-	-	-	100	-
Ceraceomyces sublaevis	*Polyporales*	1/1	1/1	2/2	-	50	50	-	-
Ceratostomella ampullasca	*Incertae sedis*	0	2/2	2/2	-	-	-	100	-
Ceriporia reticulata	*Poryporales*	2/1	4/4	6/5	-	-	33	67	-
Ceriporia viridans	*Poryporales*	0	2/2	2/2	-	-	-	100	-
Chlorociboria aeruginascens	*Helotiales*	3/3	4/4	7/7	-	-	-	57	43
Chondrostereum purpureum	*Polyporales*	0	2/2	2/2	-	-	100	-	-
Claussenomyces prasinulus	*Helotiales*	1/1	1/1	2/2	-	-	-	50	50
Clavulicium delectabile	*Cantharellales*	2/1	0	2/1	-	-	-	100	-
Clitopilus pleurotelloides	*Agaricales*	0	1/1	1/1	-	-	100	-	-
Coniophora puteana	*Boletales*	1/1	1/1	2/2	-	-	-	100	-
Crepidotus calolepis	*Agaricales*	0	1/1	1/1	-	-	-	100	-
Crepidotus variebilis	*Agaricales*	0	1/1	1/1	-	-	100	-	-
Cristinia helvetica	*Polyporales*	0	4/3	4/3	-	-	50	50	-
Cyathus striatus	*Agaricales*	3/3	0	3/3	-	-	33	67	-
Cylindrobasidium laeve	*Polyporales*	0	1/1	1/1	100	-	-	-	-
Dacrymyces stillatus	*Dacrymycetales*	1/1	3/3	4/4	-	-	25	75	-
Daedalea quercina	*Polyporales*	2/2	3/2	5/4	-	60	20	20	-
Daedaleopsis confragosa	*Polyporales*	0	1/1	1/1	-	-	-	100	-
Dasyscyphella nivea	*Helotiales*	8/5	18/13	26/18	-	4	69	23	4
Diatrype flavovirens	*Xylariales*	2/2	5/4	7/6	-	14	57	29	-
Diatrype stigma	*Xylariales*	0	1/1	1/1	-	100	-	-	-
Diatrypella quercina	*Xylariales*	6/6	2/2	8/8	-	88	-	12	-
Durella atrocyanea	*Helotiales*	0	1/1	1/1	-	-	100	-	-
Durella commutata	*Helotiales*	2/2	0	2/2	-	-	50	50	-
Endoxyla cirrhosa	*Boliniales*	7/5	12/11	19/16	-	-	-	100	-
Endoxyla vestita	*Boliniales*	0	1/1	1/1	-	-	-	100	-
Entoloma byssisedum	*Agaricales*	0	2/2	2/2	-	-	-	100	-
Entoloma depluens	*Agaricales*	1/1	2/2	3/3	-	-	33	33	33
Eriopezia caesia	*Helotiales*	11/10	23/12	34/22	-	3	47	50	-
Eutypa lata	*Xylariales*	1/1	0	1/1	-	-	-	100	-
Exidia truncata	*Tremellales*	2/2	1/1	3/3	67	-	-	33	-
Fistulina hepatica	*Agaricales*	0	1/1	1/1	-	-	-	100	-
Flagelloscypha minutissima	*Agaricales*	0	2/2	2/2	-	-	50	-	50
Galerina triscopa	*Agaricales*	1/1	2/2	3/3	-	-	33	33	33
Ganoderma lipsiense	*Polyporales*	2/1	4/4	6/5	-	-	33	67	-
Gloniopsis curvata	*Hysteriales*	1/1	4/4	5/5	-	-	20	60	20
Hapalopilus rutilans	*Polyporales*	1/1	0	1/1	-	100	-	-	-
Helvella lacunosa	*Pezizales*	0	2/2	2/2	-	-	100	-	-
Helvella macropus	*Pezizales*	0	1/1	1/1	-	-	-	-	100
Helvella nigricans	*Pezizales*	0	1/1	1/1	-	-	-	-	100
Henningsomyces candidus	*Agaricales*	5/3	13/8	18/11	-	-	50	50	-
Henningsomyces mutabilis	*Agaricales*	0	3/2	3/2	-	-	33	33	33
Hohenbuehelia myxotricha	*Agaricales*	1/1	0	1/1	-	100	-	-	-
Humaria hemisphaerica	*Pezizales*	9/6	22/12	31/18	-	-	16	61	23
Hyaloscypha daedalea	*Helotiales*	2/2	17/12	19/14	-	-	47	47	5
Hymenochaete cinnamomea	*Hymenochaetales*	0	3/3	3/3	-	-	33	33	33
Hymenochaete rubiginosa	*Hymenochaetales*	9/7	39/20	48/27	-	-	42	44	15
Hyphoderma argillaceum	*Polyporales*	2/2	0	2/2	-	-	-	100	-
Hyphoderma definitium	*Polyporales*	2/2	0	2/2	-	-	-	100	-
Hyphoderma praetermissum	*Polyporales*	2/1	11/11	13/12	-	8	38	54	-
Hyphoderma puberum	*Polyporales*	8/5	11/9	19/14	-	-	-	100	-

Table 1 (continued)

Hyphoderma setigerum	*Polyporales*	7/6	4/4	11/10	-	100	-	-	-
Hyphoderma subclavigerum	*Polyporales*	0	1/1	1/1	-	-	100	-	-
Hyphodontia arguta	*Hymenochaetales*	2/2	0	2/2	-	-	-	100	-
Hyphodontia barba-jovis	*Hymenochaetales*	2/2	3/3	5/5	-	-	-	100	-
Hyphodontia breviseta	*Hymenochaetales*	1/1	1/1	2/2	-	-	50	50	-
Hyphodontia crustosa	*Hymenochaetales*	5/5	6/5	11/10	-	9	18	73	-
Hyphodontia nespori	*Hymenochaetales*	4/3	0	4/3	-	75	25	-	-
Hyphodontia pallidula	*Hymenochaetales*	2/2	1/1	3/3	-	-	-	33	67
Hyphodontia pruni	*Hymenochaetales*	5/4	6/6	11/10	-	36	9	55	-
Hyphodontia quercina	*Hymenochaetales*	17/11	34/16	51/27	-	6	31	63	-
Hyphodontia rimosissima	*Hymenochaetales*	9/7	18/13	27/20	-	-	26	67	7
Hyphodontia subalutacea	*Hymenochaetales*	4/4	0	4/4	-	-	25	75	-
Hypholoma fasciculare	*Agaricales*	2/2	1/1	3/3	-	-	-	33	67
Hypholoma lateritium	*Agaricales*	0	3/2	3/2	-	-	33	67	-
Hypochniciellum ovoideum	*Polyporales*	1/1	0	1/1	-	-	100	-	-
Hypocrea gelatinosa	*Hypocreales*	6/3	13/10	19/13	-	-	26	74	-
Hypocrea rufa	*Hypocreales*	4/3	7/5	11/8	-	-	-	100	-
Hypoxylon cohaerens var. *microspora*	*Xylariales*	0	1/1	1/1	-	-	-	-	100
Hypoxylon howeianum	*Xylariales*	1/1	2/2	3/3	-	100	-	-	-
Hypoxylon rubiginosum	*Xylariales*	1/1	2/2	3/3	-	-	33	67	-
Hysterium pulicare	*Hysteriales*	1/1	6/5	7/6	-	14	14	57	14
Laccaria amethystea	*Agaricales*	0	1/1	1/1	-	-	-	-	100
Lachnum brevipilosum	*Helotiales*	0	1/1	1/1	-	-	100	-	-
Laetiporus sulphureus	*Polyporales*	0	2/2	2/2	-	-	-	50	50
Lasiosphaeria hirsuta	*Sordariales*	0	1/1	1/1	-	-	-	100	-
Lasiosphaeria spermoides	*Sordariales*	0	1/1	1/1	-	-	-	-	100
Lindtneria flava	*Polyporales*	1/1	0	1/1	-	-	100	-	-
Lophiostoma myriocarpum	*Pleosporales*	0	1/1	1/1	-	-	100	-	-
Lycoperdon pyriforme	*Agaricales*	0	2/2	2/2	-	-	-	50	50
Marasmiellus ramealis	*Agaricales*	0	2/2	2/2	-	-	50	50	-
Mollisia cinerea	*Helotiales*	40/19	40/19	80/38	-	1	51	46	1
Mollisia ligni	*Helotiales*	4/3	11/9	15/12	-	-	53	40	7
Moristroma quercinum	*Pleosporales*	9/4	21/11	30/15	-	3	87	10	-
Mycena epipterygia	*Agaricales*	1/1	0	1/1	-	-	-	-	100
Mycena galericulata	*Agaricales*	5/3	11/9	16/12	-	-	19	81	-
Mycena haematopus	*Agaricales*	3/3	15/9	18/12	-	-	6	72	22
Mycena inclinata	*Agaricales*	3/2	18/12	21/14	-	-	19	62	19
Mycena meliigena	*Agaricales*	0	3/3	3/3	-	-	33	33	33
Mycena mirata	*Agaricales*	0	1/1	1/1	-	-	-	100	-
Mycena polygramma	*Agaricales*	1/1	0	1/1	-	-	-	100	-
Mycena speirea	*Agaricales*	1/1	0	1/1	-	-	-	100	-
Mycoacia uda	*Polyporales*	0	1/1	1/1	-	-	100	-	-
Myxarium sphaerosporum	*Tremellales*	1/1	0	1/1	-	-	-	100	-
Nemania serpens	*Xylariales*	11/8	20/13	31/21	-	-	10	77	13
Orbilia delicatula	*Orbiliales*	7/5	10/9	17/14	-	-	18	82	-
Orbilia inflatula	*Orbiliales*	8/6	11/11	19/17	-	-	26	63	11
Orbilia xanthostigma	*Orbiliales*	2/2	0	2/2	-	-	-	100	-
Panellus stypticus	*Agaricales*	2/2	3/3	5/5	-	-	60	40	-
Patinellaria sanquinea	*Helotiales*	1/1	1/1	2/2	-	50	50	-	-
Paxillus involutus	*Boletales*	1/1	0	1/1	-	-	-	100	-
Peniophora cinerea	*Russulales*	0	1/1	1/1	-	-	-	100	-
Peniophora incarnata	*Russulales*	1/1	0	1/1	-	-	100	-	-
Peniophora quercina	*Russulales*	7/6	1/1	8/7	-	75	25	-	-
Phanerochaete calotricha	*Polyporales*	0	1/1	1/1	-	-	100	-	-
Phanerochaete filamentosa	*Polyporales*	0	1/1	1/1	-	-	-	100	-
Phanerochaete laevis	*Polyporales*	1/1	9/6	10/7	-	-	40	60	-

Table 1 (continued)

Phanerochaete sordida	*Polyporales*	3/2	3/3	6/5	-	-	67	33	-
Phanerochaete velutina	*Polyporales*	13/10	18/12	31/22	-	10	29	61	-
Phlebia radiata	*Polyporales*	2/2	10/6	12/8	-	25	33	42	-
Phlebia rufa	*Polyporales*	0	3/2	3/2	-	-	100	-	-
Phlebia tremellosa	*Polyporales*	0	2/2	2/2	-	-	100	-	-
Phlebiella ardosiaca	*Polyporales*	0	1/1	1/1	-	-	-	100	-
Phlebiella vaga	*Polyporales*	3/3	5/4	8/7	-	13	63	25	-
Pholiota alnicola	*Agaricales*	1/1	0	1/1	-	-	-	100	-
Physisporinus sanquinolentus	*Polyporales*	0	1/1	1/1	-	-	100	-	-
Pluteus atricapillus	*Agaricales*	7/7	6/5	13/12	-	-	-	85	15
Pluteus salicinus	*Agaricales*	0	1/1	1/1	-	-	-	100	-
Polydesmia pruinosa	*Helotiales*	0	1/1	1/1	-	-	-	100	-
Polyporus badius	*Polyporales*	0	1/1	1/1	-	-	-	-	100
Polyporus varius	*Polyporales*	1/1	0	1/1	-	-	100	-	-
Postia subcaesia	*Polyporales*	0	1/1	1/1	-	-	-	100	-
Propolis versicolor	*Rhytismatales*	0	5/5	5/5	-	-	80	20	-
Psathyrella hydrophila	*Agaricales*	1/1	2/2	3/3	-	-	-	67	33
Psathyrella pygmea	*Agaricales*	1/1	0	1/1	-	-	-	100	-
Pseudoclitocybe cyathiformis	*Agaricales*	0	2/2	2/2	-	-	50	50	-
Radulomyces confluens	*Polyporales*	1/1	1/1	2/2	-	-	-	100	-
Radulomyces molaris	*Polyporales*	1/1	0	1/1	-	-	-	100	-
Ramaria stricta	*Phallales*	1/1	1/1	2/2	-	-	-	100	-
Resinicium bicolor	*Polyporales*	2/2	1/1	3/3	-	-	33	33	33
Resupinatus applicatus	*Agaricales*	0	1/1	1/1	-	-	-	100	-
Rhizodiscina lignyota	*Patellariales*	0	2/2	2/2	-	-	50	50	-
Rutstroemia firma	*Helotiales*	1/1	0	1/1	-	-	-	100	-
Schizopora paradoxa	*Hymenochaetales*	26/16	29/20	55/36	-	11	31	58	-
Scleroderma verrucosum	*Boletales*	0	1/1	1/1	-	-	-	-	100
Scopuloides rimosa	*Polyporales*	3/2	11/9	14/11	-	-	7	86	7
Sebacina epigea	*Tremellales*	1/1	1/1	2/2	-	50	-	50	-
Sistotrema oblongisporum	*Polyporales*	1/1	0	1/1	-	-	100	-	-
Sphaerobolus stellatus	*Phallales*	1/1	0	1/1	-	-	-	100	-
Steccherinum fimbriatum	*Polyporales*	4/4	0	4/4	-	-	-	100	-
Steccherinum nitidum	*Polyporales*	3/3	0	3/3	-	-	67	33	-
Steccherinum ochraceum	*Polyporales*	6/4	2/2	8/6	-	13	63	25	-
Stereum gausapatum	*Russulales*	3/3	4/2	7/5	-	29	14	43	14
Stereum hirsutum	*Russulales*	15/12	13/13	28/25	-	50	18	29	-
Stereum rugosum	*Russulales*	0	2/2	2/2	-	-	50	50	-
Stigmatolemma urceolatum	*Agaricales*	0	1/1	1/1	-	-	-	100	-
Stropharia aeruginosa	*Agaricales*	0	4/4	4/4	-	-	-	25	75
Subulicystidium longisporum	*Polyporales*	0	1/1	1/1	-	-	-	100	-
Tapesia fusca	*Helotiales*	7/6	6/6	13/12	-	-	62	38	-
Thanatephorus ochraceus	*Ceratobasidiales*	2/1	1/1	3/2	-	33	-	67	-
Thelephora terrestris f. *resupinata*	*Thelephorales*	1/1	0	1/1	-	-	100	-	-
Tomentella badia	*Thelephorales*	1/1	2/2	3/3	-	-	-	67	33
Tomentella bryophila	*Thelephorales*	2/1	6/6	8/8	-	-	25	75	-
Tomentella cinerascens	*Thelephorales*	1/1	1/1	2/2	-	-	50	50	-
Tomentella coerulea	*Thelephorales*	1/1	0	1/1	-	-	-	100	-
Tomentella ellisii	*Thelephorales*	0	2/2	2/2	-	-	-	100	-
Tomentella ferruginea	*Thelephorales*	0	4/3	4/3	-	-	75	25	-
Tomentella fibrosa	*Thelephorales*	0	2/2	2/2	-	-	-	50	50
Tomentella galzinii	*Thelephorales*	1/1	0	1/1	-	-	-	100	-
Tomentella lapida	*Thelephorales*	4/4	3/3	7/7	-	-	43	43	14
Tomentella lilacinogrisea	*Thelephorales*	1/1	2/2	3/3	-	-	-	67	33
Tomentella punicea	*Thelephorales*	7/6	17/12	24/18	-	8	33	42	17
Tomentella radiosa	*Thelephorales*	1/1	2/2	3/3	-	-	-	100	-

Table 1 (continued)

Tomentella stuposa	*Thelephorales*	7/5	11/8	18/13	-	-	17	61	22
Tomentella sublilacina	*Thelephorales*	2/2	2/2	4/4	-	-	-	75	25
Tomentella subtestacea	*Thelephorales*	1/1	1/1	2/2	-	-	50	50	-
Tomentella viridula	*Thelephorales*	1/1	0	1/1	-	-	-	-	100
Tomentellopsis echinospora	*Polyporales*	1/1	1/1	2/2	-	50	50	-	-
Trametes versicolor	*Polyporales*	3/2	1/1	4/3	-	75	25	-	-
Trechispora confinis	*Polyporales*	3/3	4/4	7/7	-	14	14	71	-
Trechispora farinaceae	*Polyporales*	8/7	15/11	23/18	-	-	22	61	17
Trechispora microspora	*Polyporales*	0	1/1	1/1	-	-	-	100	-
Trechispora mollusca	*Polyporales*	3/3	0	3/3	-	-	-	100	-
Trechispora nivea	*Polyporales*	0	2/2	2/2	-	-	-	100	-
Trechispora stevensonii	*Polyporales*	4/4	6/6	10/10	-	-	20	70	10
Tremella mesenterica	*Tremellales*	0	1/1	1/1	-	-	-	100	-
Tubulicrinis gracillimus	*Polyporales*	1/1	0	1/1	-	-	-	100	-
Tyromyces chioneus	*Polyporales*	0	2/2	2/2	-	-	-	100	-
Ustulina deusta	*Xylariales*	1/1	1/1	2/2	-	-	-	100	-
Vuilleminia comedens	*Polyporales*	7/5	4/4	11/9	-	100	-	-	-
Xylaria hypoxylon	*Xylariales*	1/1	4/4	5/5	-	-	20	80	-
Xylobolus frustulatus	*Russulales*	0	1/1	1/1	-	-	100	-	-

Basidiomycota (76%), whereas the phylum *Ascomycota* (24%) comprises a smaller part.

Of the collected ascomycetes, 49 species were distributed among 39 genera in 12 orders. The *Helotiales* and *Xylariales* were the most species-rich orders of ascomycetes. *Eriopezia caesia, Humaria hemisphaerica, Mollisia cinerea* and *Nemania serpens* were the most frequent ascomycetes. Of the collected basidiomycetes, 154 species were distributed among 80 genera and 11 orders. The dominant orders (considering the number of species) of basidiomycetes were *Polyporales, Agaricales* and *Thelephorales* (Fig. 2). *Hymenochaete rubiginosa, Hyphodontia quercina, Phanerochaete velutina* and *Schizopora paradoxa* were most frequently recorded basidiomycetes species on oak CWD (Table 1).

Table 2. **The taxonomic structure of fungi on *Quercus robur* CWD of**

Taxa (phyla, orders)	Number of genera	Number of species
ASCOMYCOTA		
Boliniales	2	3
Coronophorales	1	1
Helotiales	15	17
Hypocreales	2	2
Hysteriales	2	2
Orbiliales	1	3
Patellariales	1	1
Pezizales	2	4
Pleosporales	2	2
Rhytismatales	1	1
Sordariales	1	2
Xylariales	7	10
Incertae sedis	2	2
BASIDIOMYCOTA		
Agaricales	22	35
Boletales	3	3
Cantharellales	3	9
Ceratobasidiales	1	1
Dacrymycetales	2	2
Hymenochaetales	3	13
Phallales	2	2
Polyporales	35	60
Russulales	3	7
Thelephorales	2	17
Tremellales	4	4
Total:	**119**	**203**

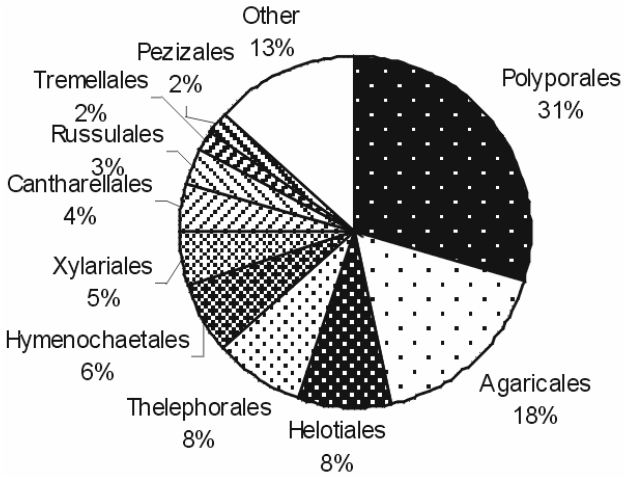

Fig. 2. Distribution of species according to fungi orders (percentage of all species found)

Fungal diversity on CWD of different decay stage

A comparison of fungal composition on wood of different decay stage revealed that the corticioid *Polyporales*, *Hymenochaetales* and *Russulales* species prevailed over the other groups, except wood DS I and V (Table 3). The stage of wood decomposition influenced the changes in the proportion of fungal abundance; e.g., the proportion of *Agaricales* and *Thelephorales* increased

on stage V decay wood, but of *Polyporales* decreased. *Bulgaria inquinans* occurred only on recently fallen wood (DS I–II), and some species also showed a preference for wood of early decay stage, e.g., *Peniophora quercina*, *Vuilleminia comedens*, *Hyphoderma setigerum* (Table 1). The highest number of wood-inhabiting fungi was recorded on moderately decayed CWD (106 species and 413 records on DS III and 155 species and 712 records on DS IV) (Table 3). Those restricted to moderately decayed wood (DS III) were *Bisporella citrina*, *Dasyscyphella nivea*, *Eriopezia caesia, Hyaloscypha daedalea, Mollisia* spp., *Moristroma quercinum, Phanerochaete laevis, P. velutina*. Many species, e.g. *Hyphoderma puberum*, *Hypocrea rufa*, *Mycena inclinata, M. galericulata, Pluteus atricapilus, Orbilia inflatula, Scopuloides rimosa, Trechispora stevensonii,* were observed only on strongly decayed wood (IV–V DS). Some species, such as *Ascocoryne sarcoides*, *Athelia epiphylla* and *Tomentella punicea*, were practically indifferent to the stage of decay.

DISCUSSION

The abudance of wood-inhabiting species on oak CWD detected in our study plots was high and probably not complete. Tofts and Orton (1998) have stated that investigation of all species is hardly achievable in mycological inventories. Although a comparison of the species abudance on oak debris detected in this study with other related data is difficult because of different sampling methods, similar patterns in proportions of taxonomical groups may still be observed. Rubino and McCarthy (2003) detected 100 species of fungi and observed the same proportion of ascomycetes and basidiomycetes (28% and 72% respectively) on 50 moderately decayed *Quercus* spp. logs in Ohio. In Sweden, Lindhe et al. (2004) investigated 58 cut oak woody debris and reported that oak logs in an early stage of decomposition harboured 53 species of basidiomycetes. A survey of fine and coarse woody debris on various trees in temperate broadleaved woodlands in Sweden (Nordén et al., 2004) revealed a higher number of fungi species (411) but the same proportion of ascomycetes (25%) and basidiomycetes (75%) as in our study.

The total species abudance and the number of records showed an increasing trend with wood decay. A comparison of the composition of fungal species based on the presence of fruit bodies on wood of different decay stages revealed a succession of fungi (i.e. of fungal fruiting) on CWD. Recently dead and fallen branches and trunks were not too common in our study, so the number of species recorded on such a substrate was low. *Bulgaria inquinans* was most characteristic on freshly cut or broken branches. Many fallen branches had been already affected by fungal wood rot in a tree crown, as also reported by Boddy (2001), and were inhabited mainly by the following species: *Peniophora quercina*, *Vuilleminia comedens*, *Hyphoderma setigerum*. Species of *Athelia* and *Hysterium pulicare* were most frequently recorded on bark and thus occurred on CWD of various decay stages with at least some bark left. *Thelephorales* species, which could be ectomycorrhizal (Kõljalg 1996) and apparently not strictly specific to substrate quality, were usually found on woody debris in contact with forest litter, as well as on litter itself. The abundant *Tomentella punicea* and *T. stuposa* were indifferent to wood decomposition degree and occurred on moderately or strongly decayed wood. The texture of oak wood, like that of many other trees, is not homogeneous during the process of decay (Schowalter et al., 1998). Though every unit of wood was ascribed to a particular decay stage, zones of stronger and weaker decayed wood were present in the same CWD unit. For example, *Eriopezia caesia*, a fungus characteristic of barkless and hard wood, was found on scattered parts of hard wood in branches/trunks of a late decay stage.

Table 3. **The number and proportions of records by fungal taxonomical groups on oak CWD of different decay stage**

Taxonomical groups	Decay stage									
	I		II		III		IV		V	
	No	%	No	%	No	%	No	%	No	%
Agaricales	0	**0**	1	**1**	31	**8**	88	**12**	24	**25**
Cantharellales	0	**0**	0	**0**	7	**2**	20	**3**	4	**4**
Hymenochaetales	0	**0**	17	**14**	67	**16**	130	**18**	12	**13**
Polyporales	1	**14**	51	**42**	83	**20**	155	**22**	11	**12**
Russulales	1	**14**	22	**18**	11	**3**	13	**2**	1	**1**
Thelephorales	0	**0**	2	**2**	22	**5**	48	**7**	14	**15**
Discomycetes	3	**43**	10	**8**	146	**35**	147	**21**	20	**21**
Pyrenomycetes	0	**0**	15	**12**	43	**10**	95	**13**	8	**8**
Other	2	**29**	4	**3**	3	**1**	16	**2**	1	**1**
Total:	7		122		413		712		95	

Note: Discomycetes include the orders *Helotiales*, *Pezizales*, *Rhytismatales* and *Orbiliales*; Pyrenomycetes – *Boliniales*, *Coronophorales*, *Hypocreales*, *Hysteriales*, *Patellariales, Pleosporales, Sordariales* and *Xylariales.*

Totally decayed wood was not abundant in our sites. Most persistent were large fallen oak trunks and branches affected by brown rot caused by *Laetiporus sulphureus*. The *Mycena* and *Pluteus*, *Humaria hemisphaerica, Hyphodontia puberum*, and *Orbilia inflatula* species were also rather common on such type of substratum. *Botryobasidium* preferred wood of a late decay stage and usually occurred in moist habitats (Eriksson and Ryvarden, 1973). *Agaricales* occurred in higher proportions on strongly decayed wood, and this is in agreement with the statement of von Runge (1975) that the final stage of oak wood decay is characterized by agaricoid species. The latter author has also correctly noted that there is no strict boundary between fungi groups of allied decay stages and that the same species can be found on wood of several decay stages, but with differences in the abundance of fruit bodies.

ACKNOWLEDGEMENTS

We thank Nils Hallenberg (Gothenburg) and Urmas Kõljalg (Tartu) for assistance in determining various critical specimens. We are indebted to anonymous reviewers for suggestions on the manuscript. The study was partly supported by the Lithuanian State Science and Studies Foundation and the Swedish Institute.

Received 20 May 2006
Accepted 20 October 2006

References

1. Allen R. B., Buchanan P. K., Clinton P. W., Cone A. J. 2000. Composition and diversity of fungi on decaying logs in a New Zealand temperate beech (*Nothofagus*) forest. *Canadian Journal of Forest Research*. No. 30. P. 1025–1033.
2. Boddy L. 2001. Fungal community ecology and wood decomposition processes in angiosperms: from standing tree to complete decay of coarse woody debris. *Ecological Bulletins* (Jonsson B. G., Kruys N., eds.). Oxford. P. 43–56.
3. Eriksson J., Hjortstam K., Ryvarden L. 1984. *The Corticiaceae of North Europe* (*Schizopora-Suillosporium*). *Fungiflora (Oslo)*. Vol. 7. P. 1279–1449.
4. Eriksson J., Ryvarden L. 1973. The Corticiaceae of North Europe (*Aleurodiscus-Confertobasidium*). *Fungiflora* (*Oslo*). Vol. 2. P. 60–285.
5. Gricius A., Urbonas V., Kutorga E., Matelis A. 1999. Succession of fungi on dead timber of various trees. *Botanica Lithuanica*. Vol. 5. P. 61–70.
6. Hansen L., Knudsen H. (eds.). 1992. *Nordic Macromycetes, Polyporales, Boletales, Agaricales, Russulales*. Copenhagen: Nordsvamp. Vol. 2. 474 p.
7. Hansen L., Knudsen H. (eds.). 1997. *Nordic Macromycetes, Heterobasidioid, Aphyllophoroid and Gasteromycetoid Basidiomycetes*. Copenhagen: Nordsvamp. Vol. 3. 444 p.
8. Hansen L., Knudsen H. (eds.). 2000. *Nordic Macromycetes, Ascomycetes*. Copenhagen: Nordsvamp. Vol. 1. 309 p.
9. Harmon M. E., Franklin F. J., Swanson F. J., Sollins P., Gregory S. V., Lattin J. D., Anderson N. H., Cline S. P., Aumen N. G., Sedell J. R., Lienkaemper G. W., Cromack K., Cummins K. W. 1986. Ecology of coarse woody debris in temperate ecosystems. *Advances in Ecological Research*. Vol. 15. P. 133–302.
10. Heilmann-Clausen J., Christensen M. 2004. Does size matter? On the importance of various dead wood fractions for fungal diversity in Danish beech forests. *Forest Ecology and Management*. Vol. 201. P. 105–117.
11. Kirk P. M., Cannon P. F., David J. C., Stalpers J. A. 2001. *Ainsworth & Bisby's Dictionary of the Fungi*. 9th edition. UK: CABI Publishing.
12. Kõljalg U. 1996. Tomentella (Basidiomycota) and related genera in temperate Eurasia. *Synopsis Fungorum*. *Fungiflora*. Oslo. Vol. 9. 213 p.
13. Lange M. 1992. Sequence of macromycetes on decaying beech logs. *Persoonia*. Vol. 14. P. 449–456.
14. Lindhe A., Åsenblad N., Toresson H.-G. 2004. Cut logs and high stumps of spruce, birch, aspen and oak – nine years of saproxylic fungi succession. *Biological Conservation*. Vol. 119. P. 443–454.
15. Niemelä T., Renvall P., Pentilla R. 1995. Interaction of fungi at late stages of wood decomposition. *Annales Botanici Fennici*. Vol. 32. P. 141–150.
16. Nordén B., Götmark F., Tönnberg M., Ryberg M. 2004. Dead wood in semi-natural temperate broadleaved woodland: contribution of coarse and fine dead wood, attached dead wood and stumps. *Forest Ecology and Management.* Vol. 194. P. 234-248.
17. Renvall P. 1995. Community structure and dynamics of wood-rotting Basidiomycetes on decomposing conifer trunks in northern Finland. *Karstenia*. Vol. 35. P. 1–51.
18. Rubino D. L., McCarthy B. C. 2003. Composition and ecology of macrofungal and myxomycete communities on oak woody debris in a mixed-oak forest of Ohio. *Canadian Journal of Forest Research*. Vol. 33. P. 2151–2163.
19. Runge A. von. 1975. Pilzsukzession auf Laubholzstümpfen. *Zeitschrift für Pilzkunde*. Bd. 41. S. 31–38.
20. Schowalter T., Zhang Y .L., Sabin T. E. 1998. Decomposition and nutrient dynamics of oak *Quercus* spp. logs after five years of decomposition. *Ecography.* Vol. 21. P. 3–10.
21. Tofts R. J., Orton P. D. 1998. The species accumulation curve for Agarics and Boleti from Caledonian Pinewood. *Mycologists.* Vol. 12. P. 98–102.
22. Vasiliauskas R., Vasiliauskas A., Stenlid J., Matelis A. 2004. Dead trees and protected polypores in unmanaged north-temperate forest stands of Lithuania. *Forest Ecology and Management*. Vol. 193. P. 355–370.

Reda Iršėnaitė, Ernestas Kutorga

GRYBŲ ANT IRSTANČIŲ STAMBIŲ PAPRASTOJO ĄŽUOLO MEDIENOS NUOKRITŲ ĮVAIROVĖ

S a n t r a u k a

Grybų rūšių įvairovė ir paplitimas ant paprastojo ąžuolo irstančių stambių medienos nuokritų tirta 50-yje apskritimo formos tyrimo laukelių (kiekvienas 0,1 ha dydžio) skirtingo amžiaus ąžuolynuose. Ant paprastojo ąžuolo stambių medienos nuokritų nustatytos 203 grybų rūšys. Iš 49 identifikuotų aukšliagrybių rūšių dažniausios buvo *Eriopezia caesia*, *Humaria hemisphaerica*, *Mollisia cinerea* ir *Nemania serpens*. Daugiausia buvo papėdgrybių (154 rūšys). Dažniausiai aptiktos papėdgrybių rūšys buvo *Hymenochaete rubiginosa*, *Hyphodontia quercina*, *Phanerochaete velutina* ir *Schizopora paradoxa*. Skirtingų medienos irimo stadijų (IS) grybų rūšių sudėčių analizė rodo grybų bendrijų kaitą nuo pradinių (I–II IS) iki galutinių (IV–V IS) medienos irimo stadijų. Griežto grybų rūšių prieraišumo kuriai nors medienos irimo stadijai nenustatyta.

Raktažodžiai: aukšliagrybiai, papėdgrybiai, medienos irimo stadijos, *Quercus robur*, Lietuva