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Lichens on burnt wood in Estonia: a preliminary assessment

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Abstract: According to available published, herbarium and recent inventory data at least 48 (and potentially over 80) species of lichenized and allied fungi can inhabit burnt areas and/or charred wood in Estonia. Most of these are widespread epiphytes and terrestrial lichens but the list also includes all five species considered 'fire-dependent' in Fennoscandia. Future studies should assess the specificity of species for charred wood, and analyse the features that make it a quality habitat for lichen species.

Kokkuvõte: Samblikud põlenud puidul Eestis: esialgne hinnang

Avaldatud, hiljutiste inventuuride ja herbaariumi andmete põhjal tehti kindlaks, et põlendikke, põlenud kasvupindu ja/või söestunud puitu võib Eestis asustada vähemalt 48 (potentsiaalselt üle 80) lihheniseerunud ja neile lähedase seene liiki. Enamik neist on laialt levinud puudel ja maapinnal kasvavad samblikud, kuid nimekiri sisaldab ka viit Fennoskandias „põlengust sõltuvaks" peetavat liiki. Edasised uuringud on vajalikud, et hinnata, millised liigid vajavad kasvupinnana söestunud puitu ning selgitada omadusi, mis muudavad antud kasvupinna samblikele väärtuslikuks.

INTRODUCTION

Burnt wood (trees) can be found abundantly in many regions and vegetation types all over the world where intensive burns take place, but also as solitary and partly burnt trees, stumps and other woody items in forests, mires and anthropogenic habitats. In the boreal vegetation zone, wildfires have been a major natural disturbance regime historically, later complemented by slash-and-burn techniques of early farming (Esseen et al., 1992). In such areas, charred wood provides specific habitat for several organisms, including lichens. For taxa as some *Hypocenomyce* species (*H. anthracophila*, *H. castaneocinerea*, *H. friesii*, *H. scalaris*) and *Hertelidea botryosa* (Timdal, 1984; Esseen et al., 1992) fire is nessessary for colonization and establishment, and they have been termed 'fire-dependent' by Esseen et al. (1997). Other organisms ('fire related' sensu Esseen et al., 1997) are not restricted to but have a preference for post-fire successional stands; for example, some lecideoid lichens usually inhabit burnt ground soon after fire (Ahti, 1977).

Despite the widespread occurrence of burnt areas and substrata in the boreal zone, very few studies of their lichen richness and composition have been carried out. This is particularly unfortunate because several species of fire-created habitats are suspected to be threatened nowadays – fire management has dramatically reduced the frequency and extent of fires in northern Europe, including Estonia, during the last 100 years (Esseen et al., 1997; Lõhmus et al., 2004). Three of four investigations known to us (Nguyen-Xuan et al., 2000; Uotila & Kouki 2005; Ruokolainen & Salo, 2006) explore lichen communities on burnt ground. Only Johansson et al. (2006) explored also charred wood finding 32 lichen taxa eight years post fire. Altogether, these four studies list 67 taxa, mostly macrolichens. In contrast, the catalogue of lichen-forming and lichenicolous fungi of Fennoscandia (Santesson et al., 2004) only notes six taxa as inhabitants of burnt places (*Cladonia cariosa*, *Peltigera didactyla*) or charred wood (the four 'fire-dependent' taxa listed above).

In Estonia, burnt wood is one of the least studied lichen substrata (Lõhmus, 2003). The published data only include nine species reported on burnt wood in quantitative lichen studies (Lõhmus 2003) and additional four taxa (*Hypocenomyce anthracophila*, *H. friesii*, *H. scalaris*, *Hertelidea botryosa*) mentioned in the key books of the lichen biota (Trass & Randlane 1994; Randlane & Saag 2004). Because the total number of such species is obviously much higher, we (1) present a preliminary list of lichens growing in burnt areas and/or on charred wood in Estonia based on available published, herbarium and recent inventory data, and (2) assess the need for future studies on fire-dependent taxa in this paper.

MATERIALS AND METHODS

To compile the list of lichens (i.e. lichen-forming, lichenicolous and allied fungi) found from burnt substrata in Estonia, we used two datasets. First, the database of the Estonian lichenological herbarium at the University of Tartu (TU; http://elurikkus.ut.ee/, accessed December 18, 2009) was scanned using key words "*põlendik*" (burnt area), "*söestunud*" (charred), "*tulease*" (fireplace) and "*põlenud*" (burned). The resulting habitat and substratum data were critically checked (in doubtful cases inspecting also the specimens in TU), i.e. whether the specimen had been collected from charred wood or bark and/or in a burnt area (in forests or bogs). The second dataset includes the results of recent fixed-area fixed-effort surveys in 2-ha plots in Estonia (see Lõhmus & Lõhmus, 2009 for details). The 92 plots represented, in a balanced design, 4 site types and 4 management types (old growth, mature commercial forest, clear-cut with and without retention trees). In each plot, lichens were searched and recorded from all substrata, including charred wood. Finally, the nine species noted to inhabit burnt wood by Lõhmus (2003) were also included in the list according to the raw data of that study.

The nomenclature follows Randlane et al. (2008); species found from fewer than six localities in Estonia are considered as 'nationally rare' and red listed status of the species is reported based on Randlane et al. (2008).

RESULTS

Altogether, 84 herbarium records and 72 original-survey records (from 15 plots) were accepted for inclusion into the list. Those records represent a total of 48 lichen taxa (including 11 microlichens) found in burnt areas and/or on burnt substrata in forests and semi-open habitats in Estonia (Table 1). Seven species (*Chaenotheca ferruginea*, *Cladonia coniocraea*, *C. digitata*, *Hypocenomyce anthracophila*, *H. scalaris*, *Micarea melaena*, *Trapeliopsis granulosa*) appeared frequent (5–20 records). The list includes one nationally rare species (*Hypocenomyce castaneocinerea*), but no red listed taxa. Most records were from burnt stumps, snags and ground, but some were also from logs and live trees. Among tree species, records from Scots pine (*Pinus sylvestris*) comprised 60%; additional 34% were from unspecified tree species (possibly including deciduous trees also) and the rest were from Norway spruce (*Picea abies*). Based on the data from other studies of boreal burnt areas, 34 additional lichen-forming species could potentially inhabit burnt areas and/or charred wood in Estonia (see the footnote of Table 1).

DISCUSSION

Our preliminary assessment shows that at least 48 lichen-forming and allied fungi can inhabit burnt substrata and/or areas in Estonia. Potentially (considering studies from the boreal zone) this number exceeds 80 species. Most of these are common and widespread epiphytic, epixylic and epigaeic species that inhabit forest and semi-open areas in Estonia (Randlane & Saag, 1999; Lõhmus, 2003). Therefore, charred wood is a generally suitable substratum for the colonization of many species after fire. This concurs with the findings by Romagni and Gries (2000) who showed that, by creating more free space and eliminating competition, severe fire may positively affect the (re-)colonization of epiphytic lichens in oak woodlands.

Almost half of the species on the Estonian list (46%; especially *Cladonia* spp.) overlap with those known from burnt areas or charred wood in Fennoscandia (see Introduction and Table 1). Most importantly, all 'fire-dependent' lichens distinguished by Esseen et al. (1992) also occurred on charred wood in Estonia, although only two such species (*H. anthracophila* and *H. scalaris*) were frequent. Considering that the list of species obviously varies because of the small samples, it seems that lichen composition on burnt substrata does not vary considerably across northern Europe. However, the reasons of rarity of some 'fire-dependent' species deserve further study.

The preliminary list does not allow to assess the specificity of species for charred wood in Estonia, and datasets representative of all main woody substrata should be collected for that purpose. More generally, it is unknown which features of charred wood, in addition to its being a competitor-free surface for colonization, make it a quality habitat for lichen species. One possibility is that, because of its dark colour, burnt wood may create warm microhabitats necessary for thermophilous species, which obviously is

Table 1. Occurrence (no. of records) of lichen-forming and allied fungi (marked +) on burnt substrata and/or charred wood found at different habitats in Estonia. (Semi)open habitats include clear-cuts, retention-cuts and alvars. Substrata marked with * refer to charred bark. Other studies: A – Johansson et al. (2006); B – Nguyen-Xuan et al. (2000); C – Ruokolainen & Salo (2006); D – Uotila & Kouki (2005)

Species	Habitat			Burnt substrata	Occurrence in other studies[1]
	Burnt area	Forest	(Semi)open habitat		
Bryoria sp.		1		tree*	A
Cetraria aculeata (Schreb.) Fr.	1			ground	
Chaenotheca ferruginea (Turner & Borrer) Mig.		6		stump, log	
Chaenotheca trichialis (Ach.) Th. Fr.		1		stump	
Chaenothecopsis pusilla (Ach.) A. F. W. Schmidt +		1		stump	
Cladina arbuscula (Wallr.) Hale & W. L. Culb.			1	stump	CD
Cladina mitis (Sandst.) Hustich	1		1	log, stump	ABD
Cladina rangiferina (L.) Nyl.	1		1	log, stump	ABD
Cladonia bacilliformis (Nyl.) Glück		1	1	log, stump	
Cladonia botrytes (K. G. Hagen) Willd.	1		1	log, stump	AD
Cladonia cenotea (Ach.) Schaer.	1	3		log, stump	BD
Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.	1			ground	D
Cladonia coniocraea (Flörke) Spreng.	1	2	2	log, snag*, stump	A
Cladonia cornuta (L.) Hoffm.	1			ground	BCD
Cladonia deformis (L.) Hoffm.	1	2		ground, stump	BCD
Cladonia digitata (L.) Hoffm.		5	2	log, snag*, stump	D
Cladonia fimbriata (L.) Fr.	1	1	2	log, stump	
Cladonia gracilis (L.) Willd.	2	1		stump	ABD
Cladonia macilenta Hoffm.		1		snag	
Cladonia polydactyla (Flörke) Spreng.	1			log	
Cladonia squamosa Hoffm.	1			ground	
Hertelidea botryosa (Fr.) Printzen & Kantvilas		4		snag, stump	
Hypocenomyce anthracophila (Nyl.) P. James & Gotth. Schneid.	1	13	1	snag*, stump, (tree)	
Hypocenomyce caradocensis (Leigth. ex Nyl.) P. James & Gotth. Schneid.		2		stump, tree*	
Hypocenomyce castaneocinerea (Räsänen) Timdal		1		snag	
Hypocenomyce friesii (Ach.) P. James & Gotth. Schneid.		4		snag, tree	
Hypocenomyce scalaris (Ach.) M. Choisy		19	1	log, snag, stump, tree	
Hypocenomyce sp.		3		stump, tree	
Hypogymnia farinacea Zopf		1		snag	
Hypogymnia physodes (L.) Nyl.			1	stump	AD
Imshaugia aleurites (Ach.) S. L. F. Meyer			1	log	
Lecanora sp.		1		tree	
Lepraria incana (L.) Ach.		2		stump	
Micarea melaena (Nyl.) Hedl.		11		snag*, stump	
Micarea prasina Fr.		1		stump	

Table 1 (continued)

Species	Habitat: Burnt area	Habitat: Forest	Habitat: (Semi)open habitat	Burnt substrata	Occurrence in other studies[1]
Ochrolechia androgyna (Hoffm.) Arnold		1		tree roots	
Parmeliopsis ambigua (Wulfen) Nyl.		1	1	stump	D
Parmeliopsis hyperopta (Ach.) Arnold			1	stump	D
Peltigera canina (L.) Willd.			1	fine woody debris	
Peltigera degenii Gyeln.	1			ground	
Peltigera didactyla (With.) J. R. Laundon	1			ground	A
Peltigera lepidophora (Nyl. ex Vain.) Bitter	2			ground	
Peltigera neckeri Hepp ex Müll. Arg.		1		fine woody debris	
Peltigera polydactylon (Neck.) Hoffm.	2		1	log, ground	
Peltigera praetextata (Flörke ex Sommerf.) Zopf	1			ground	
Peltigera rufescens (Weiss) Humb.	2			ground	
Placynthiella icmalea (Ach.) Coppins & P. James	1	1	1	stump, log	
Trapeliopsis flexuosa (Fr.) Coppins & P. James	2	1	1	stump, log	A
Trapeliopsis granulosa (Hoffm.) Lumbsch	1	3	1	ground, log, stump, tree	BD
Usnea hirta (L.) F. H. Wigg.		1		tree	
Vulpicida pinastri (Scop.) J.-E. Mattsson & M. J. Lai			1	stump	ACD

[1]Additional species found in studies A–D and known to occur in Estonia: *Baeomyces carneus* Flörke (study D), *Caloplaca holocarpa* (Hoffm. ex Ach.) A. E. Wade (A), *Candelariella xanthostigma* (Ach.) Lettau (A), *Catillaria nigroclavata* (Nyl.) Schuler (A), *Cetraria islandica* (L.) Ach. (C), *Cladina stellaris* (Opiz) Brodo (CD), *Cladonia borealis* S. Stenroos (D), *C. carneola* (Fr.) Vain. (D), *C. cervicornis* (Ach.) Flot. (D), *C. coccifera* (L.) Willd. (D), *C. crispata* (Ach.) Flot. (BD), *C. furcata* (Huds.) Schrad. (D), *C. grayi* G. Merr. ex Sandst. (D), *C. macrophylla* (Schaer.) Stenh. (D), *C. phyllophora* Hoffm. (D), *C. pleurota* (Flörke) Schaer. (D), *C. pyxidata* (L.) Hoffm. (D), *C. sulphurina* (Michx.) Fr. (D), *C. turgida* Hoffm. (D), *C. uncialis* (L.) F. H. Wigg. (D), *Evernia mesomorpha* Nyl. (A), *Flavoparmelia caperata* (L.) Hale (A), *Melanelia subaurifera* (Nyl.) Essl. (A), *Micarea misella* (Nyl.) Hedl. (A), *Nephroma arcticum* (L.) Torss. (D), *Ochrolechia arborea* (Kreyer) Almb. (A), *Parmelia sulcata* Taylor (A), *Peltigera neopolydactyla* (Gyeln.) Gyeln. (A), *Physcia adscendens* (Fr.) H. Olivier (A), *Placynthiella dasaea* (Stirt.) Tonsberg (A), *Platismatia glauca* (L.) W. L. Culb. & C. F. Culb. (D), *Pseudevernia furfuracea* (L.) Zopf (D), *Scoliciosporum chlorococcum* (Stenh.) Vezda (A), *Stereocaulon paschale* (L.) Hoffm. (D).

more important in northern areas. Another problem with the current studies appears to be their short time frame. 'Fire-dependent' *Hypocenomyce* species have been observed on burnt pine snags as long as nearly 300 years post burning (Esseen et al., 1992). Therefore, the first decade after burning – the main target of the studies performed – does not necessarily reflect the importance of charred wood for its specific species.

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