

Wood-inhabiting macrofungi: substrate preferences and indicator species in West Hungary

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Wood-inhabiting fungi and tree hosts: which ones are associated?

Introduction

This study has been carried out in Órség National Park, West Hungary, Central Europe. We aimed to explore the substrate preferences of the most frequent wood-inhabiting macrofungi in managed forest stands with special attention to the species identity of their host trees.

Results

- We found 216 wood-inhabiting species and fixed 2,441 records in total. A large number of recorded species (177) had low frequency for Chi-square tests, that is represented by less than 14 specimens. We found 39 fungi species (1,758 records) for carrying out Chi-square tests (Table 1).
- We applied 99 wood-inhabiting species (2,246 records, with more than 4 fixed specimens) for practicing indicator species analysis. The 9 significant ($\alpha = 0.05$) connections among certain host trees and fungi species are detailed in Table 2.

Table 2. Results of indicator species analysis

Species	Cluster	Indicator value
<i>Phellinus viticola</i>	Ps	0.5263**
<i>Daedaleopsis confragosa</i>	Prunus avium	0.2944***
<i>Stereum sanguinolentum</i>	Pa	0.2203**
<i>Skeletocutis nivea</i>	Fs/Cb	0.2053**
<i>Schizopora flavipora</i>	Qp/Qr	0.2053**
<i>Schizopora paradoxa</i> s.l.	Qp/Qr	0.1715*
<i>Lentinellus ursinus</i>	Populus tremula	0.1568**
<i>Piptoporus betulinus</i>	Betula pendula	0.1131**
<i>Fuscoporia contigua</i>	Qp/Qr	0.0633*

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

- According to our contingency tables and Chi-square tests (Table 1), we found 7 wood-inhabiting fungi species (highlighted as host generalists) with significantly ($\alpha = 0.01$) „dependent” relationships between their observed and expected number of specimens. These species were called as „host generalists” (regarding groups of tree taxa, see Column 5), because they preferred our 4 studied groups of host trees by significantly the same proportions as it was expected based on the tree species proportions of all registered specimens. In accordance with these, we defined 32 „host specialist” wood-inhabiting fungi species (in most cases, they were specialists of deciduous trees).
- As can be seen in Column 6 of Table 1, the majority of tested fungi species belong to the ecological guild called „early ruderals” or „combative invaders” according to Boddy (1999) and Boddy & Heilmann-Clausen (2008). Connectedly, 4 fungi species out of the 39 tested ones are defined as „late stage specialist” only.
- In Appendix 1, we suggest some fungi species (with too low frequencies to be analyzed) from Órség National Park.

Conclusions

Our results corroborate with the general opinion: managed forests provide suitable habitats mainly for „generalist” wood-inhabiting fungi species in Órség National Park; moreover, managed forests harbour less late stage specialist fungi (present with considerable frequencies) compared to their natural references.

Materials and methods

- Thirty-five, 70–100 years old, managed forest stands, 30 m × 30 m plots, 3 field surveys: in August and May 2009, and during autumn 2010;
- Species identity of host trees and wood-inhabiting fungi were registered;
- Contingency tables (using the number of fixed specimens and the following 4 host tree categories: *Fs*, *Ps/Pa*, *Cb*, *Qp/Qr*, see Table 1 for abbreviations); application of Chi-square tests to characterize the connection between observed and expected values of fixed specimens;
- Indicator Species Analysis (Dufrene & Legendre 1997) to find significant connections among certain fungi species and host trees.

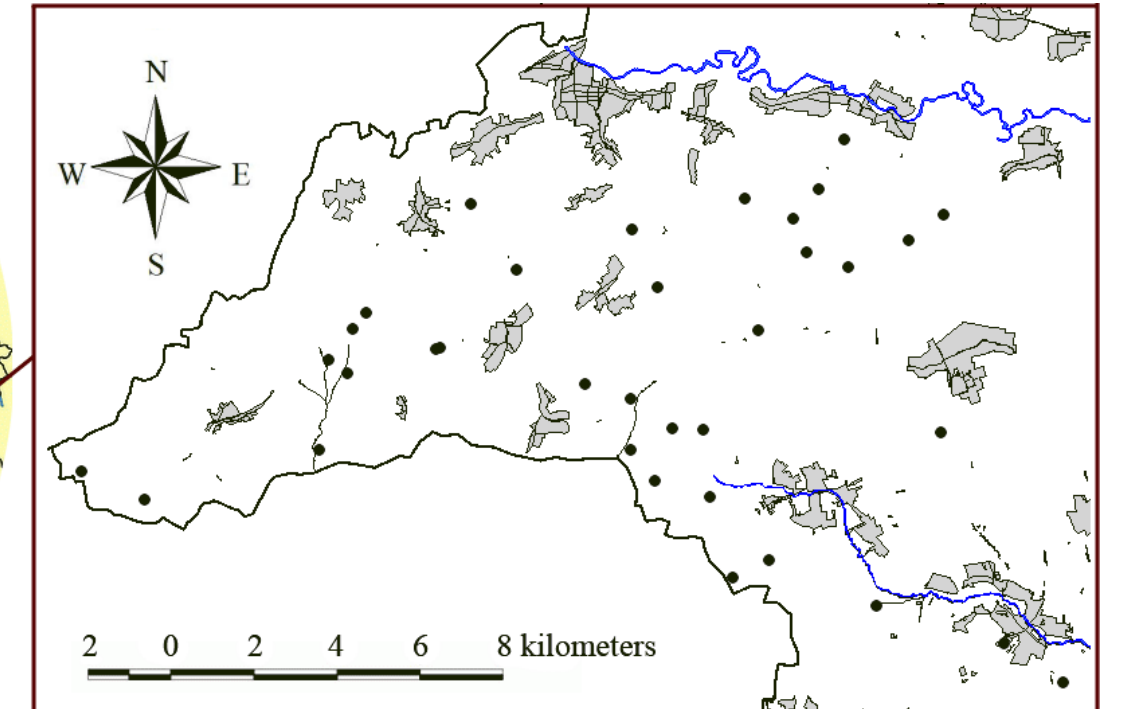


Table 1. Results of Chi-square tests

Species	p-value	Connection between expected and observed values	Preference type G: generalist, S: specialist	Putative host preferences (based on the contingency table of observed specimens)	Ecological guilds (Boddy 1999, Boddy & Heilmann-Clausen 2008)	Number of specimens
<i>Calocera furcata</i>	0.5577	D	G	deciduous trees	unknown/different	18
<i>Trametes versicolor</i>	0.1604	D	G	deciduous trees	combative invader	28
<i>Steccherinum ochraceum</i>	0.1279	D	G	deciduous trees	combative invader	68
<i>Auricularia auricula-judae</i>	0.0626	D	G	deciduous trees	early ruderal	19
<i>Exidia glandulosa</i>	0.0450	D	G	deciduous trees (most preferred: Qp/Qr)	early ruderal	15
<i>Diatrype stigma</i>	0.0171	D	G	deciduous trees (most preferred: Fs)	unknown/different	16
<i>Hypoloma fasciculare</i>	0.0155	D	G	no significant preference of angiosperms or gymnosperms	cord-forming	18
<i>Steccherinum fimbriatum</i>	0.0100	I	S	deciduous trees (most preferred: Fs)	cord-forming	20
<i>Cyathus striatus</i>	0.0055	I	S	deciduous trees (most preferred: Fs)	cord-forming	16
<i>Panellus stipticus</i>	0.0026	I	S	deciduous trees (most preferred: Qp/Qr)	early ruderal	17
<i>Pastia subcaesia</i>	0.0025	I	S	deciduous trees (most preferred: Fs)	late stage specialist	25
<i>Schizophyllum commune</i>	0.0023	I	S	deciduous trees (most preferred: Fs)	early ruderal	36
<i>Exidia nigricans</i>	0.0015	I	S	deciduous trees (most preferred: Fs)	early ruderal	86
<i>Biscogniauxia nummularia</i>	0.0014	I	S	deciduous trees (most preferred: Fs)	unknown/different	21
<i>Xylaria hypoxylon</i>	0.0007	I	S	deciduous trees (most preferred: Fs)	unknown/different	37
<i>Laxitextum bicolor</i>	0.0005	I	S	deciduous trees (most preferred: Fs)	combative invader	20
<i>Fuscoporia contigua</i>	0.0004	I	S	deciduous trees (most preferred: Qp/Qr)	unknown/different	14
<i>Stereum ochraceoflavum</i>	0.0004	I	S	deciduous trees (most preferred: Qp/Qr)	combative invader	65
<i>Antrodia malicola</i>	0.0002	I	S	preferring Fs only	unknown/different	18
<i>Trametes hirsuta</i>	0.0002	I	S	deciduous trees (most preferred: Fs)	early ruderal	19
<i>Hypocrea citrina</i>	4.35E-05	I	S	deciduous trees (most preferred: Fs)	unknown/different	23
<i>Schizopora paradoxa</i> s.l.	1.89E-05	I	S	deciduous trees (most preferred: Qp/Qr)	early ruderal	100
<i>Mycena polygramma</i>	1.11E-05	I	S	preferring Qp/Qr only	late stage specialist	16
<i>Polyporus varius</i>	7.08E-06	I	S	deciduous trees (most preferred: Fs)	combative invader	27
<i>Galerina marginata</i>	6.4E-06	I	S	most preferred: Qp/Qr and Ps/Pa, no significant preference of angiosperms or gymnosperms	late stage specialist	19
<i>Aleurodiscus disciformis</i>	2.31E-06	I	S	preferring Qp/Qr only	unknown/different	18
<i>Antrodiella fragrans</i>	4.69E-07	I	S	deciduous trees (most preferred: Fs)	unknown/different	56
<i>Hypoxylon fragiforme</i>	8.1E-08	I	S	deciduous trees (most preferred: Fs)	early ruderal	31
<i>Skeletocutis nivea</i>	1.16E-08	I	S	deciduous trees (most preferred: Fs)	unknown/different	83
<i>Schizopora flavipora</i>	9.22E-09	I	S	deciduous trees (most preferred: Qp/Qr)	unknown/different	91
<i>Crepidotus cesatii</i>	4.38E-09	I	S	deciduous trees (preferring Fs and Cb only)	unknown/different	14
<i>Stereum subtomentosum</i>	6.18E-11	I	S	deciduous trees (most preferred: Qp/Qr)	combative invader	53
<i>Stereum hirsutum</i>	3.17E-11	I	S	deciduous trees	combative invader	430
<i>Crepidotus variabilis</i>	6.95E-13	I	S	deciduous trees (most preferred: Fs and Cb)	unknown/different	40
<i>Byssomerulius corium</i>	2.94E-14	I	S	deciduous trees (most preferred: Cb)	early ruderal	14
<i>Pastia stiptica</i>	3.16E-16	I	S	coniferous trees (most preferred: Ps/Pa)	late stage specialist	14
<i>Hymenochaete rubiginosa</i>	2.2E-16	I	S	deciduous trees (most preferred: Qp/Qr)	combative invader	98
<i>Stereum sanguinolentum</i>	2.2E-16	I	S	coniferous trees (preferring Ps/Pa only)	combative invader	30
<i>Heterobasidion annosum</i> s.l.	2.2E-16	I	S	coniferous trees (preferring Ps/Pa only)	root pathogen	25

Cb: *Carpinus betulus*, **Fs:** *Fagus sylvatica*, **Pa:** *Picea abies*, **Pi:** *Pinus sylvestris*, **Qp:** *Quercus petraea*, **Qr:** *Quercus robur*
D = dependent, I = independent

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Appendix 1. Suggested indicators of habitat quality from Órség National Park: wood-inhabiting fungi with too low frequency values to be analyzed in our present study were linked to the European indicator species lists: Ainsworth (2004), Christensen et al. (2004), Nitare (2000).

Serial no. of species in Ainsworth (2004)	Species name	Serial no. of species included in the European list of 21 indicators (Christensen et al. 2004)	Included in Signalarter (Nitare 2000)	Órség National Park, West Hungary
ASCOMYCETES				
1	<i>Camarops polysperma</i>			
2	<i>Camarops tubulina</i>	1		
3	<i>Eutypa spinosa</i>			
GILLED FUNGI				
4	<i>Flammulaster muricatus</i>	2		
5	<i>Flammulaster limulatus</i> s.l.	3		×
6	<i>Hohenbuehelia auriscalpium</i>	4		
7	<i>Hohenbuehelia mastrucata</i>			
8	<i>Lentinellus ursinus</i>	5		×
9	<i>Lentinellus vulpinus</i>	6		
10	<i>Ossicaulis lignatilis</i>	7	×	
11	<i>Pholiota squarrosoides</i>	8		
12	<i>Phyllotopsis nidulans</i>			
13	<i>Pluteus umbrosus</i>	9	×	
14	<i>Volvariella bombycina</i>			
POROID FUNGI				
15	<i>Aurantiporus alborubescens</i>	10		
16	<i>Aurantiporus fissilis</i>			×
17	<i>Ceriporiopsis gilvescens</i>	11		×
18	<i>Gelatoporia pannocincta</i>	12		×
19	<i>Coriolopsis gallica</i>			
20	<i>Ganoderma cupreolaccatum</i>	13		
21	<i>Inonotus cuticularis</i>	14		
22	<i>Mensularia nodosa</i>			
23	<i>Ischnoderma resinosum</i>	15		×
24	<i>Oxyporus latemarginatus</i>			×
25	<i>Phellinus cavicola</i>			
26	<i>Spongipellis delectans</i>	16		
27	<i>Spongipellis pachyodon</i>			
OTHERS				
28	<i>Climacodon septentrionalis</i>	17		
29	<i>Dentipellis fragilis</i>	18	×	×
30	<i>Hericium cirrhatum</i>			
31	<i>Hericium coralloides</i>	19	×	
32	<i>Hericium erinaceum</i>	20		
33	<i>Hypochnicium analogum</i>			
34	<i>Mycoacia nothofagi</i>	21		
35	<i>Phleogena faginea</i>			
36	<i>Scytinostroma portentosum</i>			

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