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Analysis of diversity of wood-inhabiting fungi retrieved from a Mediterranean forest dominated by *Pinus pinaster* Aiton.

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Abstract

The present paper is focused on the diversity of wood-inhabiting fungi in a poorly investigated habitat: a Mediterranean forest dominated by maritime pine. The sampling area lies in Tocchi biogenetic Reserve, located in the province of Siena (Tuscany, Italy). The monitoring campaign was carried out in 10 permanents plots, taking note of all the fungal species found on each piece of dead wood, irrespective of size and stage of decay. Over one year of surveys, 56 taxa of wood-inhabiting fungi were recorded, among which 39 are corticoids species, 16 polypores and 1 Heterobasidiomycetes. The fungal community seems to be dominated by a small number of species, which are more abundant than the others . Moreover, there are some specific features of deadwood influencing the species composition, such as the presence of coarse woody debris at the first decay stage and fine woody debris at the late decay stages. The results allowed characterizing the wood-inhabiting fungal community in this forest reserve, broadening our knowledge on several species and providing a preliminary database for further studies in Mediterranean areas.

Keywords: biodiversity; species richness; fungal community; environmental variables; maritime pine.

Riassunto

Nel presente lavoro è stata analizzata la diversità dei macromiceti lignicoli in un ambiente tipicamente mediterraneo: una foresta a prevalenza di pino marittimo. L'area in esame è localizzata nella riserva biogenetica di Tocchi, situata in provincia di Siena. Il monitoraggio dei macromiceti lignicoli è stato effettuato in 10 plot permanenti, annotando tutte le specie riscontrate su ogni residuo legnoso ad ogni stadio di decomposizione e di tutte le dimensioni. Lo scopo è quello di valutare la ricchezza e composizione di specie di questo gruppo di funghi in un ambiente tipicamente mediterraneo, cercando di individuare allo stesso tempo quali variabili ambientali possano influire sulla comunità fungina in esame. In totale, durante la primavera e l'autunno 2014 sono stati censiti 56 taxa di macromiceti lignicoli, dei quali 39 sono specie corticoidi, 16 poliporoidi ed 1 eterobasidiomicete (sono stati riportate anche due specie appartenenti ai mixomiceti). La comunità fungina è dominata da un esiguo gruppo di specie molto più abbondanti delle altre. Inoltre, tale composizione di specie è risultata essere influenzata da specifiche caratteristiche della necromassa legnosa: nell' ordinamento eseguito mediante Analisi Canonica delle Corrispondenze (CCA), si collocano infatti da un lato specie influenzate da legno di grosse dimensioni ai primi stadi di decomposizione, dall'altro specie presenti su legni di medie dimensioni negli ultimi stadi di decomposizione. I risultati ottenuti hanno reso possibile inquadrare la comunità dei macromiceti lignicoli in tale riserva, ampliando le conoscenze di questo gruppo di funghi e fornendo un importante data-set di base per futuri studi in ambiente mediterraneo.

Parole chiave: biodiversità; ricchezza di specie; comunità fungina; variabili ambientali; pino marittimo

Introduction

Pinus pinaster (maritime pine) represents the typical Mediterranean pine, widely spread over the western Mediterranean region, the High Atlas and Tunisia in North Africa (CARRIÓN *et al*., 2000). It is an ecologically versatile species, growing in a variety of substrates, in a wide range of elevations and under a range of Mediterranean and Atlantic climate regimes (semiarid to very humid) (GRIVET *et al.*, 2011). Within the Mediterranean basin, this species has a great economic importance (MAJADA *et al*., 2011). It is considered as a main colonizer after fire (LÓPEZ-SÁEZ *et al*., 2009) due to its pyrophytic ecology and its high light regime requirements for regeneration and growth (GIL *et al.*, 1990). Consequently, it has been widely used in the reforestation of infertile, sandy, and slightly acid soils (BARCÎC´ *et al.*, 2006; OLIVEIRA *et al.*, 2012). In Italy, it occurs as scattered nuclei of different size on the western coast, including islands such as Sardinia and Pantelleria (VENDRAMIN *et al.*, 1998). Also in Tuscany various ill chestnut coppices or abandoned shrubby pastures were reforested with the maritime pine, not so common in the past. Now it is able to regenerate spontaneously and principally it grows in heathlands, the so called *Tuberario lignosae-Callunetum* vegetation (DE DOMINICIS, 1993).
Previous scattered works had treated fungal communities in pine forests in Europe (e.g.PERA and ALVAREZ, 1995; TARVAINEN *et al*, 2003; VÁSQUEZ GASSIBE *et al*, 2011) and in Italy (BERNICCHIA, 1997; BERNICCHIA and CAMPADELLI, 1987; BERNICCHIA *et al*., 1981). In a more recent study, BERNICCHIA *et al.* (2007) presented a full list of associated wood-inhabiting aphyllophoraceous fungi growing on pine, including some selected *P. pinaster* forests. Nevertheless, these researches have been focused mainly on the taxonomy of this group of fungi and an extensive ecological study, considering plot-based monitoring approach, is lacking. In order to fill up the mentioned gap of knowledge, an appropriate sampling design was implemented, comprising randomly selected sampling plot. In particular, this study aims to (1) analyse diversity of wood-inhabiting fungi in this forest type, in terms of species richness and composition; (2) evaluate possible influences of environmental variables on fungal community.

Materials and methods

Study area and sampling plots

The selected study site lies in Tocchi biogenetic reserve (43° 08' 34.6''N, 11° 16' 02.0''E). The area is located in Tuscany, in Siena province, at an altitude between 250 and 557 m a.s.l. Biogenetic Reserve is almost entirely covered by forests dominated mainly by maritime pine (about 400 ha) at tree layer and *Erica scoparia*, *Phillyrea angustifolia* and *Calluna vulgaris* forming a dense shrubland; more sporadic is the distribution of *Juniperus commnis* (Fig.1). Considering the available climatic data (1992-2006) the average annual temperature is 14.3 ° C and the average annual rainfall ranges between 992 mm and 1094 mm. Rainfall is distributed mainly in the autumn and winter period. Ten 100 m^2 permanent plots (10×10 m^2, marked by metal stakes in each corner) were randomly placed in the selected area. The plots were previously identified and mapped (scale 1:5000) by photo-interpretation, with a buffer zone of about 20 m around each polygon to reduce possible edge effects.

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Fig. 1. *Pinus pinaster* and underwood in Tocchi Biogenetic reserve.
Fig. 1. *Pinus pinaster* e sottobosco nella Riserva Biogenetica di Tocchi.

Wood-inhabiting fungi assessment

Wood-inhabiting fungi belong to an artificial category represented by a variable mushroom forming fungi (GORJON and BERNICCHIA, 2013), including corticioids, polyporoids, hydnoids, jelly and coralloid fungi, etc. In general these groups, according to current systematics, represent polyphyletic assemblages of fungi with similar ecological function or ''life forms'' rather than taxonomic units (NORDÉN *et al.*, 2004). In this work, we study wood-inhabiting basidiomycetes, in particular:

• Among Homobasidiomycetes: basidiomycetes with smooth to odontioid hymenophore on a soft, resupinate fruitbody (the group of Corticoid fungi) and with a hymenophore in the shape of tubes on the underside of the fruiting body (the group of Polypores) (Fig.2)

• Among Heterobasidiomycetes, basidiomycetes with gelatinous fruit body ("jelly fungi").

Each plot was surveyed four times: May, October, November, and December during 2014, following a standard methodology previously identified. Such methodology results from testing the best timing and the optimal number of surveys in order to have a comprehensive picture of wood-inhabiting fungi biodiversity in Mediterranean area (D'AGUANNO, 2015). In each plot all wood-inhabiting above mentioned fungal species, from all type of woody debris, were detected, following a visual inspection approach. The data were recorded as presence or absence of a species on a woody debris. All fruiting body of the same species on a woody debris were counted as one occurrence, independent of number of fruiting bodies or extension of corticoid ones. Species were identified based on morphology with the help of general analytic keys and monographs (ERIKSSON and RYVARDEN, 1973-1988; BREITENBACH and KRÄNZLIN, 1986–1995; RYVARDEN and GILBERTSON, 1993-1994; KOTIRANTA, 2001; BERNICCHIA, 2005; BERNICCHIA and GORJÓN, 2010).

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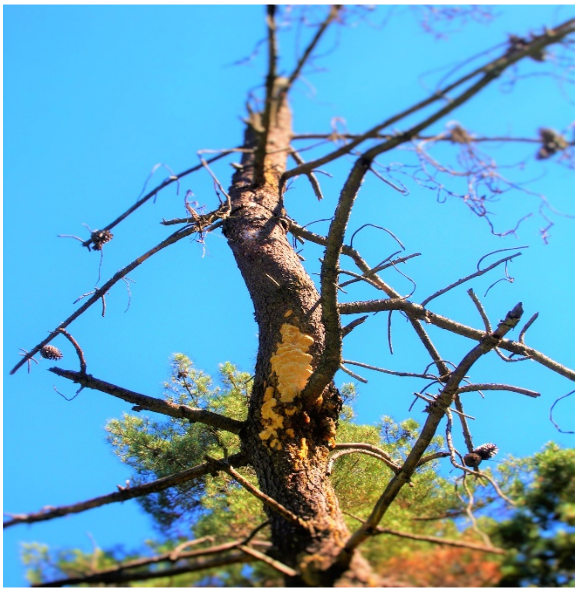

Fig. 2. Polypore species on standing maritime pine deadwood, in Tocchi Biogenetic reserve.
Fig. 2. Un esempio di specie poliporoide presente su legno morto in piedi di pino marittimo nella riserva biogenetica di Tocchi

Environmental variables

For each sampling plot, the quantity of woody debris (number of pieces) in different diameter and decay classes were registered (Tab. 1). Woody debris were classified in the following diameter categories according to KÜFFER and SENN-IRLET (2005) and ABREGO and SALCEDO (2013): (1) Very Fine Woody Debris (VFWD): branches and twigs with ≤ 5 cm diameter; (2) Fine Woody Debris (FWD): logs with diameter between 5 and 10 cm; (3) Coarse Woody Debris (CWD): logs or snags with diameter ≥10 cm.
The decay stages of dead wood pieces were measured, using a knife, for each woody debris piece: (a) the earliest stages-recently dead or cut trunk/piece of wood; wood hard, bark and phloem fresh - knife penetrates only a few mm into the wood (DS1); (b) the intermediate decomposition stage - wood partly decayed, usually large pieces of bark loosened- knife penetrates 2±5 cm into the wood. (DS2); and (c) the late stages of the decomposition process - most of the wood soft throughout - the whole blade of the knife penetrates easily into the wood (DS3). Stumps are only in decay stage 1 and 2, according to ALBRECHT (1990). In addition, the altitude and the tree coverage of each sampling plot were also considered in the analyses.

Tab. 1. Environmental variable records for each sampling plot.
Tab. l. Valori delle variabili ambientali per ogni plot di campionamento

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
DS1	18	7	17	6	5	4	5	8	3	7
DS2	7	5	10	6	2	3	1	2	5	2
DS3	2	5	4	2	5	3	4	1	4	6
VFWD	14	8	5	8	2	3	0	8	1	1
FWD	6	6	6	9	6	6	6	3	7	3
CWD	9	4	21	2	5	1	2	0	7	6
Altitude (a.s.l.)	446	414	434	422	415	420	420	397	390	375
Tree covarage (%)	25.0	22	15	10	18	20	20	30	35	20

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Data analysis

First, a main data matrix (56x10) of abundance of each species, with species in column and plots in raw, was prepared. Then, in order to estimate species diversity for each plot, the following parameters were calculated:

- Richness (S) = number of non-zero elements in row (total number of taxa for each plot)
- Diversity (H) = sum (Pi*ln(Pi)) = Shannon`s diversity index of species in a sample unit.
- D = 1 - sum (P*i**P*i*) Simpson`s diversity index of species diversity in a sample unit.

Where P*i* = importance probability in element *i* (element *i* relativized by row total).

A "Dominance–diversity curve"was constructed, based on the data of the different sampling plots, to reveal the dominant species; then, to evaluate the community distribution, this curve was compared as suggested by WHITTAKER (1970).

A thorough analysis of single species was also carried out, analysing: frequency, distribution, host range (according to BERNICCHIA, 2005) and its possible presence in the European Red-List.

Canonical correspondence analysis (CCA) was used to show the distribution of the plot, with the environmental variables (second matrix 8x10, Tab.1) superimposed over the fungal community composition data as vectors. The significance of the vectors is shown by their length and direction from the origin. Relationships between environmental variables and the ordination axes were identified according to the Pearson's r^2 value. CCA was run with Monte Carlo mean squares, 999 permutations and manual settings. All analyses were performed using PC-ORD 6.0 (MCCUNE and MEFFORD, 2011).

Results

A total of 172 occurrences comprising 56 taxa (51 identified at species level, 4 at genus level, 1 at family level) were collected from the 10 plots. Among them, 39 are corticoids fungi, 16 are polypores and 1 Heterobasidiomycetes (Supplementary table1S). Two myxomycetes (*Ceratiomyxa fruticulosa* and *Lycogala epidendrum*) detected during sampling are also reported (indicated in table 1S with *).

Maximum number of species was found in P1, while maximum Shannon's index (H) and Simpson's index (D') values were found in P4. Minimum species richness was detected in P6 with also lower values of Shannon's index and Simpson index. (Tab.2).

Tab. 2. Species richness (S), Shannons's index (H) and Simpson's index (D') values for each sampling plot.
Tab. 2. Valori di ricchezza di specie (S), indice di Shannon (H) e indice di Simpson (D') per ogni plot di campionamento.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
S	16	12	13	13	8	6	7	9	11	10
H	2.546	2.303	2.200	2.513	1.951	1.605	1.906	2.098	2.274	2.210
D'	0.8999	0.88	0.84	0.9141	0.8402	0.7692	0.8438	0.8639	0.8828	0.875

Two species (*Trichaptum fuscoviolaceum* and *Botryobasidium subcoronatum*) were found in more than 5 plots and 30 in only one plot (Tab. 1S).

As shown by dominance-diversity curve (Fig. 3), which follows a log-normal distribution, *Trichaptum fuscoviolaceum* and *Botryobasidium subcoronatum* are also the most abundant species with respectively 21 and 14 fruiting bodies recorded,followed by *Stereum ochraceoflavum* with 13 record. On the other hand, 26 species were collected only once.

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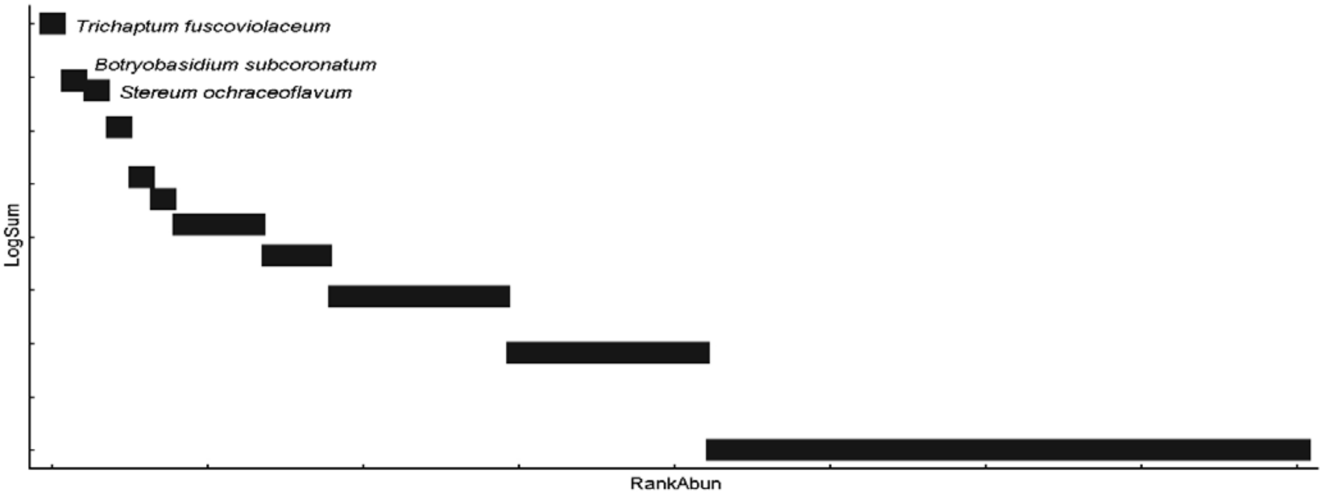

Fig. 3. Dominance–diversity curve for species detected in all plots. Left to right, most abundant to less abundant species.
Fig. 3. Curva di dominanza-diversità per le specie rinvenute nel totale dei plot campionati. Da sinistra a destra, dalla specie più abbondante a quella meno abbondante.

The distribution of species and the correlations between fungal community and structural characteristics of the plots are shown in the CCA analysis (Fig. 4).

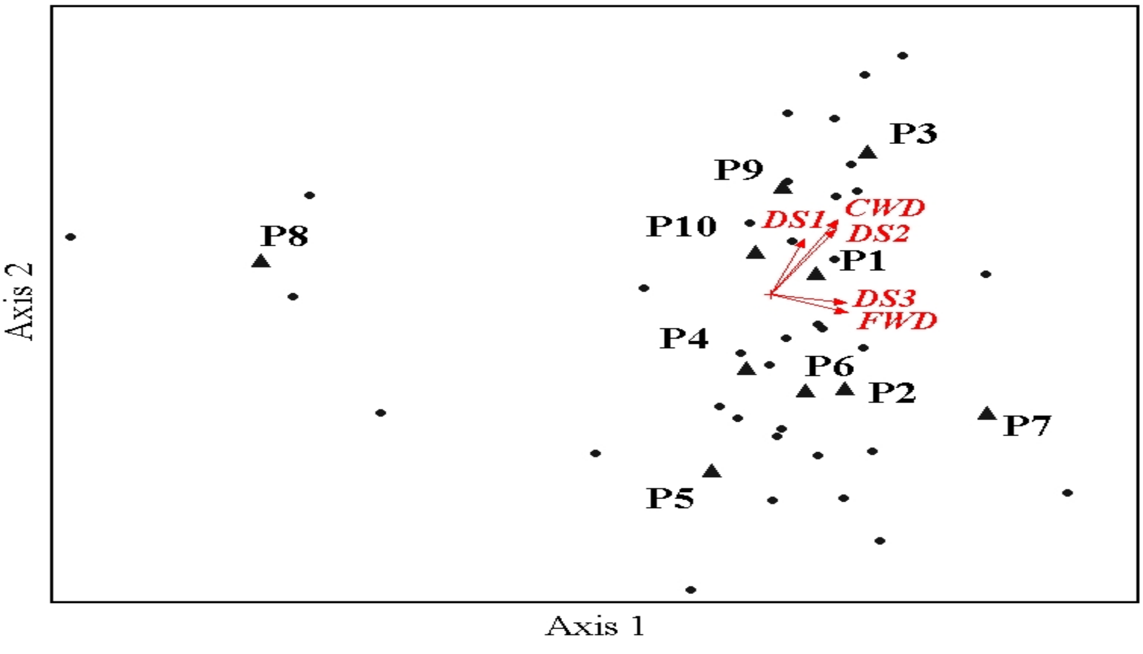

Fig. 4. Plot placement according to CCA. Tot variance explained 48% (37.4% axis 1, 10.6% axis 2). Environmental variables significant correlated with first two axes are also reported. In particular FWD and DS3 are correlated with axis 1(R^2 0.246 and 0.262) and CWD, DS2 e DS1 with axis 2($R^2$0.360, 0.296 and 0.442).
Fig. 4. Posizionamento dei plot secondo la tecnica della CCA. Totale varianza spiegata 48% (37.4%) asse1, 10.6% asse 2). Sono riportate anche le variabili ambientali significativamente correlate con i primi due assi. In particolare FWD e DS3 sono correlate con l'asse 1 (R^2 0.246 e 0.262) e CWD, DS2 e DS1 con l'asse 2 ($R^2$0.360, 0.296 e 0.442)

Along axis 1 the species are displayed according to a gradient influenced by woody debris in a middle diameter class (FWD, correlation with axis 1 R^2 0.246) and in a late decay stage (DS3$R^2$0.262). On the other

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side, mainly coarse deadwood pieces (CWD correlation $R^2$0.360) and woddy debris in the first stages of decomposition (DS1 R^2 0.296 and DS2 R^2 0.442) are correlated with axis 2.

Discussion

The total species richness found in Tocchi biogenetic reserve was relatively consistent, comparing with others studies in coniferous forest: POUSKA *et al.*, (2011) for example, collected 63 species in Czech Republic.Moreover, 21 species are currently known as growing in *P. pinaster* dominated forests in Italy (BERNICCHIA *et al.,* 2007). In this survey twice over fungal species (62% more species) were found in comparison to the previous study. According to ABREGO and SALCEDO (2015), the main reason why so many new records were found lies in the sampling method used: the plots were randomly located and every plot was sampled in a systematic manner, recording all species groups. In a taxonomic survey, researchers usually look for groups in which they are specialized, and often the sampling sites, if there are sites, are not randomly chosen. On the other hand, the high species richness, confirmed by high values of Shannon's index for each plot, could be due to the presence of a great quantity of deadwood in the plots, since these were established in protected areas, where timber extraction is forbidden. The presence of large amounts of deadwood in forest ecosystems is often due to low anthropic disturbances (HANSEN *et al.*, 1991; LOMBARDI *et al.,* 2008). Where human activities in forests are reduced, it is expected that naturalness progressively increase in time and space, indeed it is well documented that more dead wood sustains more wood-living species (e.g. MARTIKAINEN *et al*., 2000; GROVEN *et al.*, 2002; ÓDOR *et al*., 2006).

Regarding the species composition, after a specific literature analysis, 11 species resulted rare or very rare, 15 are sporadic or not common, 27 are common or very common. Furthermore, among all species detected,14, have a circumboreal or cosmopolitan distribution, 29 have an European distribution, 6 are typical Mediterranean species and 1, *Phlebia capitata*, is recorded only from Tuscany. Ten species represent a first record in Tuscany and, in reference to European Red-list, 2 of detected species, *Hyphoderma orphanellum* and *Physisporinus rivulosus* are relevant (Tab. 1S).

A log-normal distribution fited the distributions of wood-inhabiting fungi, similar to previous studies (CLINE *et al.* 2005; COURTY *et al.* 2008), although the dominance/diversity curve of the individual species and the high values of Simpson's index, show few most abundant species. The uneven distribution of species, with a few dominating and a majority represented with less than five specimens, is typical for studies in fungal ecology (TOFTS and ORTON, 1998).On the other hand, for the overall fungal community, there were distinctive discontinuities in the distribution of the macrofungi between the plots, and these were shown by CCA. The main factor affecting this distribution is the quantity of CWD; it is evident that the diversity of wood-inhabiting fungi is related to the presence of coarse deadwood pieces. In particular several studies demonstrated that polypores fungi depends on woody debris of large dimension (NORDÉN *et al*., 2004; YLISIRNIÖ *et al.,* 2012; ABREGO and SALCEDO, 2013). Further, larger logs contain more core-wood, which supports a specialised biota of polypores with conk-shaped fruiting bodies (RAYNER and BODDY, 1997). Likewise, even the decay stage affects the fungal community, in particular the first decay stage together with the presence of CWD. This is due to their large and perennial fruiting bodies requiring CWD, which is larger and has longer degradation time than FWD (SÖDERSTRÖM, 1988).

On the other hand, as highlighted by the CCA ordination, a different group of species is linked to the presence of deadwood in the middle diameter class (FWD) and at the last decay stage of decomposition (DS3). Growing on small size substrates is a common characteristic of the species resistant to drought (JUNNINEN *et al.,* 2006). Most of species linked to fine woody debris show various adaptations in the xerothermic conditions prevalent in Mediterranean area through the colonization of plant twigs and small stems (rarely exceeding 5 cm), which are particularly exposed to solar radiation and rapid drying. At the

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same time, fungi situated in the exterior of the woody debris are more affected by exterior temperature changes, thus they need specific adaptations. Woody debris in later decay stages may contain a fungal community with different responses to heat (ERIKSSON *et al.*, 2013). Thus, in forest management terms, probably it is not sufficient to simply increase the amount of dead wood, but it is also important to realize that type of deadwood (notably at the landscape level), with different dimension classes and different decay stages, should be taken into account in deadwood monitoring.

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Tab. 1S. List of species found in the sampling plot, their frequency (according to literature, C= common NC=no common, ,S=sporadic, R=rare, RR=very rare) and their Distribution (Eu= Europe, Circumb=circumboreal, NEu= north Europe, Med= metiterranean, Am=America, Cosmop= cosmopolite). It is also reported when the species was never found before in Tuscany or in Italy.

Tab. 1S. Lista delle specie trovate nei plot di campionamento, la loro frequenza (in accordo con la letteratura C=comune, NC=non comune, S=sporadica, R= rara, RR=molto rara) e la loro distribuzione (in accordo co la letteratura Eu= Europa, Circumb= circumboreale, Neu nord Europa, Med= mediterranea, Am= America, Cosmop= cosmopolita)

Gr	Species CABI-List)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Fr	Distr	Note
C	*Amyloxenasma allantosporum* (Oberw.) Hjortstam & Ryvarden		4		1	3		2				**S**	Eu	No Tusc
P	*Antrodia xantha* (Fr.) Ryvarden		1		2							**S**	Circumb.	
C	*Aphanobasidium pseudotsugae* (Burt) Boidin & Gilles									1		**R**	NEu	No Italy
C	*Athelia acrospora* Jülich	2										**C**	Eu	
C	*Athelia decipiens* (Höhn. & Litsch.) J. Erikss.		1									**C**	Eu	No Tusc
C	*Botryobasidium candicans* J. Erikss.					1					1	**R-S**	Eu	No Tusc
C	*Botryobasidium cfr subcoronatum*			1										
C	*Botryobasidium conspersum* J. Erikss.					1		1				**R**	Eu	No Tusc
C	*Botryobasidium* sp.1							1						
C	*Botryobasidium* sp.2					1								
C	*Botryobasidium* sp.3		1											
C	*Botryobasidium subcoronatum* (Höhn. & Litsch.) Donk	2	4	2			4	1		1		**C**	Eu.	
C	*Botryohypochnus isabellinus* (Fr.) J. Erikss.								1			**C**	Eu	
C	*Cabalodontia subcretacea* (Litsch.) Piątek			1								**R**	.	No Tusc
M	*Ceratiomyxa fruticulosa* (O.F. Müll.) T. Macbr.											**C**		
P	*Ceriporiopsis mucida* (Pers.) Gilb. & Ryvarden									1		**C**	Circumb.	
C	*Coniophora arida* (Fr.) P. Karst.						1					**C**	Eu	
C	*Coniophora olivacea* (Fr.) P. Karst.		1	3	1					1	1	**S**	Eu	No Tusc
E	*Craterocolla cerasi* (Schumach.) Sacc.	1				3			1			**R**	Eu	No Italy
P	*Dichomitus campestris* (Quél.) Domański & Orlicz					1			1			**C**	Circumb.	
P	*Fomitopsis iberica* Melo & Ryvarden	1		2						3		**RR**	Medit.	No Tusc
P	*Gloeoporus taxicola* (Pers.) Gilb. & Ryvarden										1	**NC**	Circumb.	
C	*Hymenochaete spreta* Peck	1										**C (?)**	Eu	
C	*Hyphoderma orphanellum* (Bourdot & Galzin) Donk	1										**R**	Eu	No Tusc
C	*Hyphoderma setigerum* (Fr.) Donk			1								**C**	Eu	
C	*Hyphodontia alutaria* (Burt) J. Erikss.	2		1								**C**	Eu	

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	Tab. 1 (Continues)													
C	*Hyphodontia aspera* (Fr.) J. Erikss.				1				3			**C**	Eu	
C	*Hyphodontia nespori* (Bres.) J. Erikss. & Hjortstam		2									**C**	Eu-As	
C	*Leucogyrophana mollusca* (Fr.) Pouzar										1	**C**		
M	*Lycogala epidendrum* (J.C. Buxb. ex L.) Fr.											**C**		
C	*Peniophorella tsugae* (Burt) K.H. Larss.	1										**RR**	Eu	
P	*Perenniporia ochroleuca* (Berk.) Ryvarden								2	1		**C**	Medit.	
C	*Phanerochaete sanguinea* (Fr.) Pouzar										1	**C**	Eu	
C	*Phlebia capitata* Bernicchia & Gorjón								1			**R**	End. Tusc	
C	*Phlebia lilascens* (Bourdot) J. Erikss. & Hjortstam	1									1	**S**	Eu	
C	*Phlebia livida* (Pers.) Bres.				1		1					**S**	Circumb.	
C	*Phlebia subserialis* (Bourdot & Galzin) Donk							1				**R**	Circumb.	No Italy
P	*Physisporinus rivulosus* (Berk. & M.A. Curtis) Ryvarden									1		**S**	Medit	
P	*Polyporaceae*				1					3				
P	*Postia rennyi* (Berk. & Broome) Rajchenb.							1				**NC**		
C	*Pseudomerulius aureus* (Fr.) Jülich			1							3	**NC**	Eu	
CP	*Schizopora flavipora* (Berk. & M.A. Curtis ex Cooke) Ryvarden	1			1							**C**	Medit.-Tropic.	
P	*Schizopora paradoxa* (Schrad.) Donk	1			2							**CC**	Cosmop.	
P	*Sidera lenis* (P. Karst.) Miettinen						1					**NC**	Cosmop.,	
P	*Sidera vulgaris* (Fr.) Miettinen				2						1	**C**	Medit.,	
P	*Skeletocutis amorpha* (Fr.) Kotl. & Pouzar			4								**C**	Circumb.,	
P	*Skeletocutis carneogrisea* A. David				1							**S**	Circumb..	
P	*Skeletocutis nivea* (Jungh.) Jean Keller		1		1				1	1	1	**CC**	Circumb.	
C	*Stereum hirsutum* (Willd.) Pers.	1		1	1		2					**CC**	Eu	
C	*Stereum ochraceoflavum* (Schwein.) Sacc.	5	1		1		4			2		**S**	Eu	
C	*Stereum reflexulum* Lloyd	1										**RR**	Medit.	
C	*Stereum sanguinolentum* (Alb. & Schwein.) Fr.			2						1		**C**	Eu	
C	*Trechispora farinacea* (Pers.) Liberta		1									**CC**	Eu	
P	*Trichaptum fuscoviolaceum* (Ehrenb.) Ryvarden	5	1	10		1				3	1	**CC**	Circumb.	
C	*Tubulicrinis borealis* J. Erikss.		2		1	2						**S**	NEu,	No Tusc
C	*Tubulicrinis calothrix* (Pat.) Donk			1				1				**S**	Eu	
C	*Xylodon crustosus* (Pers.) Chevall.	1										**CC**	Eu	
C	*Xylodon pruni* (Lasch) Hjortstam & Ryvarden								3			**CC**	Eu	