CORTICIOID FUNGI (*AGARICOMYCETES*, *BASIDIOMYCOTA*) OF LIGURIA (NW ITALY): FIRST CONTRIBUTION

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ABSTRACT
Corticioid fungi are essential organisms in forest ecosystems due to the key role played in the decomposition process of dead organic matter, nutrient cycle and soil formation. Despite their functional and ecological importance, this group of fungi is particularly overlooked in the Mediterranean area and information about species diversity and distribution are very fragmented. The present work constitutes the first study in Liguria (Northwestern Italy), unsurveyed region by "corticioids viewpoint". Surveys were performed in 40 plots located in two different broadleaf forests: 20 plots characterized by the presence of *Fagus sylvatica*, and 20 by *Castanea sativa*. A total of 25 and 17 *taxa* were respectively recorded in the studied sites. Among these, 21 species are new records in Liguria. It is worth noting the presence of the rare species *Scotomyces subviolaceous* that is included in the draft European red list. Statistical performed analyses show that both wood debris volume and class of decomposition are positively correlated with the observed species richness.

KEY WORDS
Diversity; Distribution; *Fagus sylvatica*; *Castanea sativa*.

INTRODUCTION

Corticioid fungi (*Agaricomycetes*, *Basidiomycota*) are essential organisms in forest ecosystems due to the crucial role played in the decomposition process of organic matter, nutrient cycle and soil formation. This group of fungi is characterized by effused basidiomata, a smooth, merulioid or hydnoid hymenophore, and holobasidia (Larsson, 2007), and together with poroid fungi (*Polyporaceae* s.l.), constitutes one of the main wood decomposer organisms. Most of corticioids are saprotrophs or parasites, more or less specialized in their substratum requirements and host-plant specificity. Some species are able to establish mutualistic symbiosis with forest trees and use dead woods as substrate to develop their basidiomata (Huhndorf et al., 2004; Küffer & Senn-Irlet, 2005; Bernicchia & Gorjón, 2010). Thanks to the wide range of ecological roles and living strategies covered, corticioid fungi are considered a useful tool for the establishment of habitat conservation. In fact, several authors (Heilmann-Clausen & Christensen, 2005; Lindner et al., 2006; Lonsdale et al. 2008; Pouska, 2011; Blaser et al., 2013; Juutilainen et al., 2011, 2014) suggest that the study of the community composition (i.e. species richness and diversity) may allow to investigate the habitat or the forest structure in which they occur. However, corticioid fungi are usually overlooked in conservation planning studies, especially in the Mediterranean area, because of the difficulty of field detection [small size and ephemeral reproductive structures], as well as the paucity of experts for taxonomical identification. The recent molecular studies by Larsson (2007) and Binder et al. (2010) pointed out the polyphyletic status of this group of fungi. The analyzed species have been distributed among all the major clades within *Agaricomycetes*. At present only few genera would be included in the "traditional" family of *Corticiaceae* Herter.

One of the major gaps on corticioid fungi is due to the lack of information about species diversity and distribution. While several areas (i.e. Northern Europe) have been well investigated by a "corticioids viewpoint" (i.e. Finland, Kotiranta et al., 2009), some others (i.e. Central and Southern Europe) are still not well explored. The check-listing and description of species from unsurveyed areas may surely provide a more accurate estimation of species richness and improve the knowledge of their geographical distribution.

Available data on Italian corticioid fungi highlight the aspects mentioned in the above lines. Although the contribution given by several papers (Bernicchia, 1992, 1999, 2000, 2001; Mayrhofer, et al. 2001; Onofri et al., 2005; Gorjón et al., 2006; 2013; Bernicchia et al., 1987, 1990a, b, 1991, 2007a, b, c, 2008, 2011) and the specific monograph by Bernicchia & Gorjón (2010), not all Italian regions have been taken into account. For instance, Bernicchia & Gorjón (2010) listed a total of 453 corticioid species, which were collected (throughout several years of field surveys) in selected sites of some Italian regions (e.g. in Calabria, Emilia-Romagna, Friuli-Venezia Giulia, Lazio, Sardinia, Sicily, Trentino Alto Adige, Tuscany, and, Veneto). Such data, concerning Basilicata, Lombardy, Piedmont, Puglia, and, Valle d'Aosta records, were also obtained by herbarium checklists (data available online, see HUBO Herb website). In other cases (e.g. records for Abruzzo), the species records were taken from unpublished species lists. But, as previously stated, some Italian regions (e.g. Campania, Liguria, Marche and Umbria), are very poor known from a corticioid point of view and no records were included in the Bernicchia & Gorjón (2010) checklist. Hence, it is reasonable to suppose that the number of 456 corticioid species reported by Saitta et al. (2011), which included also new records for Italy (viz. *Arrasia rostrata* by Bernicchia et al. (2011)), could increase.

In Liguria, a coastal Mediterranean region in Northwestern Italy, only 18 species have been recorded till now (Zotti & Orsino, 2001; Zotti et al., 2008). The paucity of the data is substantially affected by the fact that this group of fungi was particularly neglected in previous mycological investigations. Liguria represents a very interesting region from a mycological point of view. It has been estimated that more than 40% of Italian macrofungi (Onofri et al., 2005; Venturella et al., 2011) occur in its territory. Several papers (Zotti, 2002; Zotti & Zappatore, 2006; Zotti et al., 2013) have highlighted the high level of mycodiversity, as well as the presence of interesting and rare *taxa* (Vizzini & Zotti, 2002; Zotti et al., 2010). Therefore, it is reasonable to hypothesize that a wide diversity of corticioid species could still be detected.

The main goals of the present study, carried out as part of the PhD in "Applied Botany to the Agriculture and the Environment" (DISTAV - University of Genoa), are i) to start a checklist of corticioid fungi of Liguria; ii) to update the data from the previous macrofungal regional checklist; iii) to find possible relationships between species richness and wood parameters.

MATERIALS AND METHODS

STUDY AREA

Mycological investigations were carried out during the year 2012 in two different woods of Liguria: the former dominated by *Fagus sylvatica* L. (Loc. Veirera, Sassello, SV), the latter by *Castanea sativa* Mill. (Loc. Badani, Sassello, SV). These two sites are about 23 km far from the Mediterranean Sea, at respectively 919 m a.s.l. and 375 m a.s.l. In both stands some sporadic individuals of *Alnus glutinosa* L. and *Fraxinus ornus* L. can be found, especially in the lower and more humid zones of the sites. The two sites differ as regard the forest management: the beech is a high forest, the chestnut a coppice wood.

The climate of both areas is ascribed to the Temperate Oceanic sub-Mediterranean type (Rivas-Martinez, 2008). The annual temperature varies from 21°C (Max in July) to 1.4°C (min in January); while, the annual mean rainfall is of 300 mm (data available at www.scia.sinanet.apat.it). Geologically, Sassello is characterized by different soil types, such as Serpetinites (Spagnolo et al., 2007).

SURVEY METHODS

Surveys were performed in 20 circular plots (radius of 4m) selected along a line transect for each site. The sampling design follows the scheme used by Feest (2006) for Agarics, Boletes and Gasteromycetes. The total sampled area amounted to 2000 m^2. All plots were georeferenced in WGS-84 Global Position System (GPS) and coordinates expressed as decimal degrees.

In each plot all dead wood debris, i.e. twigs, branches and logs were examined. The detected wood debris was characterized according to the following parameters: size (length and diameter) and degree of decomposition. The latter was evaluated according to three decay classes (Mueller et al. 2004): Class 1 – Relatively newly, usually retaining its bark; Class 2 – Medium rotten, bark fallen off; knife can penetrate 2 cm into the wood without undue pressure; Class 3 – Thoroughly rotten, knife can penetrate into the wood without much pressure, the wood can be partly destroyed with the finger. The volume of dead wood found in each plot was estimated by personal observation and following an increasing scale from 1 (low presence of wood debris) to 5 (high presence of wood debris).

TAXONOMICAL IDENTIFICATION

The fungal specimens collected on wood debris were analyzed in laboratory. Sections of the specimens were mounted in different media: in distilled water, in 5% potassium hydroxide, in a 0.1% Congo Red ammonium solution, Cotton Blue and Melzer's reagent. Spores and other structures (i.e. basidia, cystidia, hyphae...) were observed and measured. For taxonomical identification a series of monographs and keys were used (i.e. Breitenbach & Kränzlin, 1986; Bernicchia & Gorjón, 2010; Larsson, 2012).

The nomenclature and authors names were referred to CABI (www.indexfungorum.org), CBS (www.cbs.knaw.nl), and IMA (www.mycobank.org). Data concerning the collected fungi were inserted in the specific database A.L.C.E (Advanced Liguria Check-list of Ectomycorrhizal and other fungi) in order to map their distribution. The relevant specimens were deposited at GDOR (Herbarium of the Museo Civico di Storia Naturale Giacomo Doria, Mycology Section, Genoa, Italy).

DATA ANALYSIS

Jaccard index (J), based on the presence/absence of data, was chosen as measure of similarity between the two communities (Magurran, 2004; Zak & Willig, 2004). Unlike many other similarity measures, the Jaccard index does not score two communities as similar based solely on the absence of the same species in both communities. This is important, as we cannot be sure that a species is truly absent from a community just because it has not been detected so far (Schmit et al. 2005). The general formula of the index is given below:

$$J = \frac{a}{a + b - c}$$

where

a is the total number of species in the first community,

b is the total number of species in the second community,

c is the number of species present in both communities (Magurran, 2004; Zak & Willig, 2004).

In our study we used presence/absence of data of all 40 plots from the two different studied forests.

Pearson's correlation (r) was used to interpret the relationships between the observed species richness and recorded wood parameters. This coefficient indicates how well the two data set are interconnected. The value lies between -1 to +1. The positive and negative values denote respectively positive or negative linear correlation. If the coefficient is zero, there is no correlation between the two given variables.

The general formula of the Pearson correlation coefficient (r) is given by:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

where
x = values in the first set of data,
y = values in the second set of data,
n = total number of values.

RESULTS

Altogether 115 specimens were collected, and among them 107 were identified to the species level (34 sp. in total). Among them, 25 *taxa* are associated with dead wood of beech and 17 with dead wood of chestnut. Among these collections, 21 species [which are displayed in appendix with the symbol *], are new records in Liguria (Zotti & Orsino, 2001; Zotti et al., 2008).

All recorded *taxa* belong to 20 different genera, nine families and nine orders. The most representative genera are *Botryobasidium* Donk, *Peniophora* Cooke, and, *Phanerochaete* P.Karst. *Stereum ochraceoflavum*, *Tulasnella violacea*, and, *Vuilleminia comedens* are the most frequent species. In Table 1 are listed all the recorded *taxa* and the relative wood parameters (size and class of decomposition) on which they were found.

The species richness observed per plot is shown in Figure 1. Plot 12 (selected in the beech forest), and plot 3 (in the chestnut coppice), have showed the highest number of species: respectively 11 sp. and 8sp.. In plots 1, 9 and 16 of the chestnut wood no species were observed. Nine species were found in both the two studied sites, such as: *Botryobasidium leave*, *Corticium confine*, *Irpex lacteus*, *Phanerochaete velutina*, *Phlebiopsis ravenelii*, *Stereum hirsutum*, *S. ochraceoflavum*, *Tulasnella violacea*, and, *Vuilleminia comedens*.

Species	**Lengthht[cm]**	**Diameter [cm]**			**Class of decomposition**			**Volume of dead wood**					**Frequency**
		<5	**>5<10**	**>10**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**#**
Athelia decipiens	200		X				X			X			1
Athelia epiphylla	400		X				X		X				3
	15	X				X			X				
	30		X			X				X			
Botryobasidium laeve	200		X			X				X			4
	500		X		X					X			
	100		X		X					X			
	130		X		X					X			
***Botryobasidium* sp. 1**	20	X					X			X			1
***Botryobasidium* sp. 2**	50	X				X			X				1
***Botryobasidium* sp. 3**	10	X			X					X			1
***Botryobasidium* sp. 4**	200	X				X				X			1
Byssomerulius corium	30	X			X					X			2
	50		X			X		X					
Coniophora puteana	300		X		X				X				1
***Coniophora* sp.**	10	X			X			X					1
Corticium confine	30	X			X					X			4
	30	X					X			X			
	400		X		X					X			
	150	X				X				X			
	170	X			X					X			

Cylindrobasidium laeve	50		X		X					X			2
	25		X			X				X			
Hyphodontia radula	200	X			X					X			1
Hypochniciellum ovoideum	50		X				X		X				3
	500		X			X			X				
	500		X			X				X			
Irpex lacteus	20	X			X				X				2
	300		X			X				X			
Leptosporomyces raunkiaeri	20	X			X					X			2
	300		X		X					X			
Mutatoderma mutatum	30	X			X					X			2
	20	X					X	X					
Peniophora cinerea	180	X			X				X				1
Peniophora incarnata	20	X				X			X				1
Peniophora lycii	30	X	X			X		X					1
Peniophorella pubera	20		X			X				X			1
Phanerochaete laevis	150	X					X	X					3
	10	X			X					X			
	20		X		X					X			
Phanerochaete sp.	30	X					X			X			1
Phanerochaete velutina	10	X			X			X					6
	50	X			X					X			
	250	X			X				X				
	10	X			X				X				
	160	X			X					X			
	60	X			X					X			
***Phlebia* sp.1**	40	X			X				X				1
***Phlebia* sp.2**	300		X		X				X				1

Phlebiopsis ravanelii	150	X					X		X				4
	20	X				X				X			
	20	X			X				X				
	50	X				X			X				
Scotomyces subviolaceus	30	X					X			X			1
Steccherinum ochraceum	10	X			X					X			1
Stereum hirsutum	40	X				X			X				13
	10	X			X				X				
	300			X	X					X			
	30	X			X					X			
	10	X			X					X			
	300		X		X					X			
	10	X			X			X					
	300		X		X				X				
	300		X		X			X					
	300		X			X				X			
	200		X		X				X				
	10	X			X				X				
	10	X			X					X			
	200	X			X				X				
	10	X			X				X				
	400		X				X		X				
Stereum ochraceoflavum	500		X		X					X			9
	20	X			X					X			
	10	X			X			X					
	50		X		X				X				
	15	X				X				X			
	400		X		X					X			
	200	X			X					X			

	10	X			X				X				
	10	X			X				X				
	10	X			X				X				
	150		X		X				X				
	100	X				X				X			
	15	X			X				X				
	200	X			X				X				
	20	X			X					X			
Tulasnella violacea	50	X			X					X			13
	150		X		X				X				
	50		X		X					X			
	10	X			X				X				
	600			X	X				X				
	10	X			X				X				
	200	X			X					X			
	200		X		X				X				
	200	X			X					X			
	150	X					X			X			
	100	X			X					X			
	100	X			X				X				
	200	X			X				X				
	10	X			X					X			
	10	X			X				X				
	20	X			X					X			
	50	X			X				X				
Tulasnella violea	400		X		X					X			1
Vuilleminia comedens	30	X			X				X				8
	10	X			X				X				
	30	X			X					X			
	200	X			X				X				

	200		X		X					X			
	100	X				X				X			
	600		X		X					X			
	100	X			X				X				
	200	X			X					X			
	150		X		X					X			
	150	X			X					X			

Table 1. List of the recorded *taxa* and the correspondent wood debris parameters (length, diameter, class and volume) and frequency (as number of plots).

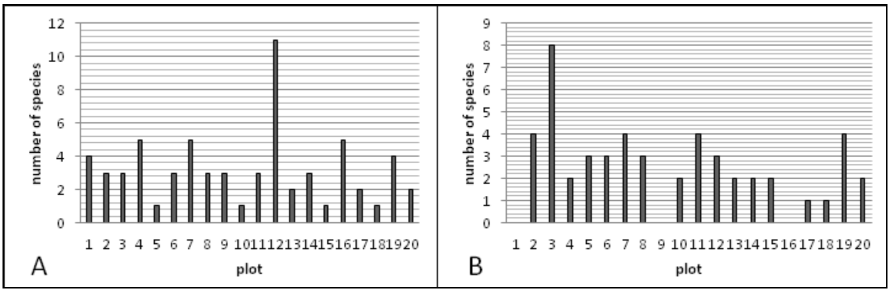

Figure 1. Species richness observed in each plot (1-20). Histogram “A” refers to the beech forest; “ B” for the chestnut coppice.

In Figure 2 are summarized the wood parameters observed in each surveyed plot. The beech forest showed higher values (i.e. the number of logs and the volume of dead wood) than the chestnut coppice, where no wood debris were observed in plots 1, 9 and 16.

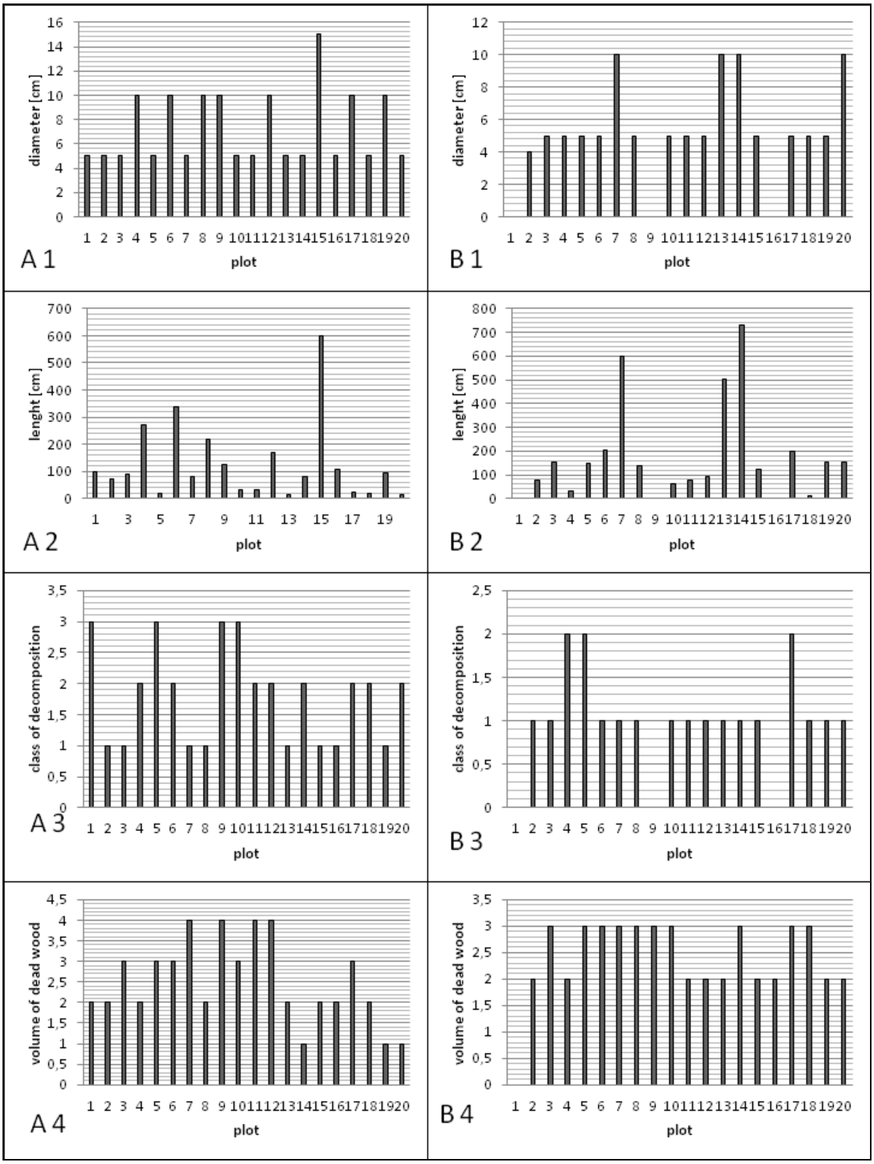

Figure 2. Wood parameters observed in each plot (1-20). Histograms "A1", "A2", "A3", "A4" refer to beech forest; "B1", "B2", "B3", "B4" refer to chestnut coppice.

The results of Jaccard index [calculated among all 40 plots] are displayed in Figure 3. Values range from 0.2 (the lowest value) to 0.9 (the highest value).

	1C	2C	3C	4C	5C	6C	7C	8C	9C	10C	11C	12C	13C	14C	15C	16C	17C	18C	19C	20C
1C	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
2C		1	0,3	0,5	0,4	0,4	0,5	0,5	1	0,7	0,3	0,5	0,5	0,5	0,7	1	0,7	0,7	0,4	0,5
3C			1	0,6	0,5	0,6	0,6	0,6	1	0,8	0,3	0,6	0,6	0,6	0,8	1	0,8	0,8	0,5	0,6
4C				1	0,4	0,4	0,5	0,5	1	0,6	0,2	0,3	0,5	0,5	0,6	1	0,6	0,6	0,3	0,5
5C					1	0,5	0,5	0,6	1	0,7	0,2	0,6	0,6	0,7	0,7	1	0,7	0,7	0,5	0,6
6C						1	0,5	0,6	1	0,6	0,3	0,6	0,6	0,6	0,6	1	0,7	0,5	0,3	0,5
7C							1	0,5	1	0,5	0	0,5	0,5	0,5	0,5	1	0,6	0,5	0,2	0,5
8C								1	1	0,6	0,3	0,3	0,3	0,3	0,6	1	0,6	0,6	0,4	0,5
9C									1	0	0	0	0	0	0	1	0	0	0	0
10C										1	0	0,3	0,3	0,3	0	1	0,5	0	0	0,3
11C											1	0,6	0,6	0,6	0,7	1	0,8	0,7	0,4	0,6
12C												1	0,3	0,6	0,6	1	0,6	0,6	0,2	0,5
13C													1	0	0,6	1	0,6	0,6	0,4	0,5
14C														1	0,6	1	0,6	0,6	0,5	0,5
15C															1	1	0,5	0	0	0,3
16C																1	0	0	0	0
17C																	1	0,5	0,2	0,3
18C																		1	0	0,3
19C																			1	0,5
20C																				1
1F																				
2F																				
3F																				
4F																				
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20F																				

Fig. 3 (continued on next page).

	1F	2F	3F	4F	5F	6F	7F	8F	9F	10F	11F	12F	13F	14F	15F	16F	17F	18F	19F	20F
1C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2C	0,4	0,4	0,6	0,4	0,8	0,6	0,4	0,6	0,5	0,8	0,5	0,2	0,6	0,6	0,8	0,4	0,6	0,8	0,4	0,6
3C	0,5	0,5	0,6	0,3	0,8	0,5	0,4	0,6	0,6	0,8	0,6	0,2	0,6	0,6	0,8	0,5	0,6	0,8	0,4	0,6
4C	0,2	0,4	0,5	0,2	0,6	0	0,3	0,5	0,4	0,6	0,4	0,1	0,5	0,5	0,6	0,2	0,5	0,6	0,2	0,5
5C	0,4	0,4	0,6	0,3	0,7	0,5	0,3	0,6	0,5	0,7	0,5	0,1	0,6	0,6	0,7	0,4	0,6	0,7	0,4	0,6
6C	0,3	0,4	0,5	0,4	0,7	0,5	0,3	0,5	0,5	0,7	0,4	0,2	0,5	0,5	0,5	0,2	0,6	0,7	0,3	0,6
7C	0,3	0,2	0,3	0,2	0,6	0,4	0,3	0,3	0,2	0,6	0,4	0,1	0,3	0,5	0,5	0,2	0,5	0,6	0,3	0,5
8C	0,3	0,4	0,5	0,3	0,6	0,4	0,3	0,5	0,4	0,6	0,4	0,2	0,3	0,5	0,6	0,3	0,5	0,6	0,2	0,5
9C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10C	0,2	0,2	0	0,2	0,5	0,2	0,2	0	0	0,5	0,2	0,1	0	0,3	0	0	0,3	0,5	0,2	0,3
11C	0,5	0,4	0,6	0,3	0,8	0,5	0,4	0,6	0,5	0,8	0,6	0,1	0,6	0,6	0,7	0,4	0,6	0,8	0,4	0,6
12C	0,3	0,4	0,5	0,2	0,6	0,2	0,3	0,5	0,4	0,6	0,4	0,1	0,5	0,5	0,6	0,3	0,5	0,6	0	0,5
13C	0,3	0,4	0,5	0,3	0,6	0,4	0,3	0,5	0,4	0,6	0,4	0,1	0,5	0,5	0,6	0,3	0,5	0,6	0,2	0,5
14C	0,3	0,4	0,5	0,6	0,6	0,4	0,3	0,5	0,4	0,6	0,4	0,1	0,5	0,5	0,6	0,3	0,5	0,6	0,2	0,5
15C	0,2	0,2	0	0,2	0,2	0,2	0,1	0	0	0,5	0,2	0,1	0	0,3	0	0	0,3	0,5	0,2	0,3
16C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17C	0,2	0,2	0,3	0,2	0,5	0,2	0,2	0,3	0,2	0,5	0,2	0,1	0,3	0,3	0,5	0,2	0,3	0,5	0,2	0,3
18C	0,2	0,2	0	0,2	0,5	0,2	0,2	0	0	0,5	0,2	0,1	0	0,3	0,5	0	0	0,5	0,2	0,3
19C	0,3	0,4	0,5	0,3	0,7	0,4	0,3	0,5	0,2	0,7	0,4	0,1	0,5	0,5	0,6	0,2	0,6	0,7	0,2	0,6
20C	0,2	0,2	0,5	0,3	0,6	0,4	0,2	0,5	0,2	0,6	0,6	0,1	0,5	0,3	0,6	0,2	0,5	0,6	0,2	0,5
1F	1	0,5	0,6	0,4	0,8	0,4	0,3	0,6	0,5	0,8	0,5	0,2	0,6	0,6	0,8	0,3	0,6	0,8	0,4	0,6
2F		1	0,6	0,3	0,7	0,5	0,3	0,6	0,4	0,7	0,4	0,1	0,6	0,5	0,8	0,3	0,6	0,8	0,3	0,6
3F			1	0,3	0,6	0,4	0,3	0,3	0	0,6	0,4	0,2	0,3	0,5	0,5	0,2	0,5	0,6	0,3	0,5
4F				1	0,8	0,4	0,4	0,6	0,6	0,8	0,6	0,2	0,6	0,6	0,8	0,4	0,6	0,6	0,4	0,6
5F					1	0,2	0,2	0,3	0,2	0,5	0,2	0,1	0,3	0,3	0,5	0,2	0,3	0,5	0,2	0,3
6F						1	0,4	0,6	0,5	0,8	0,5	0,2	0,6	0,6	0,8	0,3	0,6	0,8	0,3	0,6
7F							1	0,7	0,6	0,8	0,6	0,2	0,7	0,6	0,8	0,5	0,7	0,8	0,4	0,6
8F								1	0,2	0,6	0,4	0,2	0,3	0,5	0,5	0,2	0,5	0,6	0,3	0,5
9F									1	0,7	0,4	0,2	0,5	0,5	0,6	0,2	0,6	0,7	0,3	0,6
10F										1	0,2	0,1	0,3	0,3	0,5	0,2	0,3	0,5	0,2	0,3
11F											1	0,1	0,6	0,5	0,7	0,3	0,6	0,7	0,3	0,6
12F												1	0,8	0,7	0,9	0,6	0,8	0,9	0,6	0,8
13F													1	0,5	0,3	0,2	0,5	0,6	0,3	0,5
14F														1	0,6	0,2	0,5	0,6	0,2	0,5
15F															1	0	0,3	0,5	0,2	0,3
16F																1	0,6	0,8	0,4	0,6
17F																	1	0,6	0,3	0,5
18F																		1	0,2	0,3
19F																			1	0,6
20F																				1

Figure 3. Jaccard similarity coefficient results. Letters C and F indicates plots selected in chestnut wood and beech forest, respectively

Pearson correlation results are summarized in Figure 4. The highest correlation (r= 0.30) was found between the species richness and the class of decomposition observed in the chestnut wood.

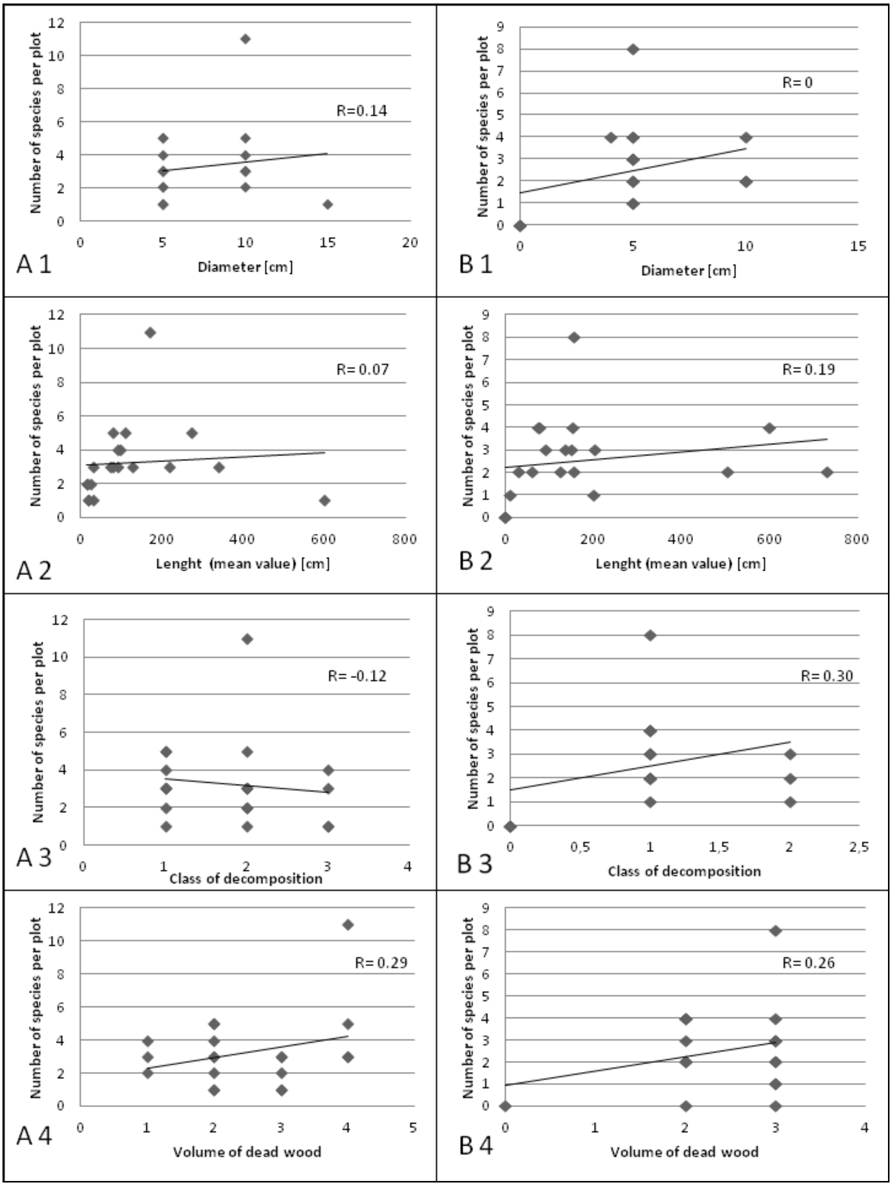

Figure 4. Pearson's correlation between species richness and wood debris paramentres. Diagrams "A1", "A2", "A3", "A4" refer to beech forest; "B1", "B2", "B3", "B4" refer to chestnut coppice.

In both the two communities, the species richness was positive correlated with the wood debris volume (r= 0.29 for beech forest; r= 0.26 for chestnut wood).Negative (r= -0.12) and no correlations (r= 0) were found between species richness, class of decomposition (for beech forest) and diameter of logs (for the chestnut wood), respectively.

Appendix displays the list of recorded species with the geographic location and the growth substratum. In this list identifications made only at genus level have not been included.

DISCUSSION

The result achieved by the present study (with the total number of 34 *taxa* recorded), suggests that many corticioid species occur in Ligurian woods, in spite of the low number of records listed in the regional macrofungal checklist (Zotti & Orsino, 2001; Zotti et al., 2008). By these previous inventories, only nine corticioid species were found (Tab. 2) associated to beech and chestnut woods (or generally found on wood of broadleaved trees).

The reasonable number of new records found highlights the importance of sampling unsurveyed areas, as well as the study of overlooked fungal groups.

Investigations carried out for longer periods and in older and woody richer forests of Italy have allowed to increase the number of rare corticioid species at national scale (Bernicchia, pers. com.; Saitta et al., 2011). However, thanks to the present work, it is worth noting the presence of two rare or interesting species in Liguria too, such as: *Leptosporomyces raunkiaeri* and *Scotomyces subviolaceous*. The former has been described by Bernicchia & Gorjón (2010) as very infrequent in Europe and very rare in Italy (known once from Veneto region). The latter species was found only in two Italian regions (Trentino Alto-Adige and Calabria), and, at European level, it was observed in United Kingdom, Germany and Sweden (Bernicchia & Gorjón, 2010). Taking into account the distributional data, *S. subviolaceous* has been included in the draft European red list (http://www.wsl.ch/eccf/; Saitta et al., 2011). Hence, its collection in the beech wood of Liguria constitutes an important data for conservational purpose.

Species	**Substratum**
Byssomerulius corium (Pers.) Parmasto	On dead wood of *Quercus ilex*
Chondrostereum purpureum (Pers.) Pouzar	On dead wood of *Fagus sylvatica*
Cotylidia pannosa (Sowerby) D.A. Reid	Beeches and chestnut woods
Hymenochaete fuliginosa (Pers.) Lév.	On dead wood of conifers
Hymenochaete rubiginosa (Dicks.) Lév.	On dead wood of *Quercus sp.* and chestnut
Irpicodon pendulus (Alb. & Schwein) Pouzar	On broadleaved wood
Merulius tremellosus (Schrad.) Burds. & Nakasone	On rotten wood
Peniophora quercina (Pers.) Cooke	On dead wood of *Quercus ilex*
Phanerochaete sanguinea (Fr.) Pouzar	On dead wood of conifers
Serpula lacrymans (Wulfen) J. Schröt.	On rotten wood
Steccherinum ochraceum (Pers.) Gray	On dead wood of *Alnus glutinosa*
Stereum gausapatum (Fr.) Fr.	On dead wood of *Q. cerris* and chestnut
Stereum hirsutum (Willd.) Pers.	On broadleaved wood
Stereum subtomentosum Pouzar	On broadleaved wood
Stereum ochraceoflavum (Schwein.) Sacc.	On broadleaved wood
Stereum reflexulum Lloyd	On wood of *Erica arborea*
Stereum rugosum Pers.	On broadleaved wood
Stereum sanguinolentum (Alb. & Schwein.) Fr.	On conifer wood

Table 2. List of corticioid species mentioned in the first Liguria macrofungal checklist (Zotti & Orsino 2001) and its addendum (Zotti et al. 2008). To each species is reported the growth substratum.

Thanks to the comparison with the checklists of aphyllophoraceous wood-inhabiting fungi on wood of *Fagus sylvatica* (Bernicchia et al., 2007b) and *Castanea sativa* (Mayrhofer et al., 2001) recorded in (some regions of) Italy, several shared species were found, such as: *Athelia epiphylla*, *Botryobasidium leave*, *Coniophora puteana*, *Peniophora cinerea*, *P. lycii*, *Phanerochaete laevis*, *Stereum hirsutum*, *Tulasnella violacea*, *T. violea*, and *Vuilleminia comedens*. The similar species composition may suggest a typical corticioid flora along Italian chestnut and beech forests.

The two studied Ligurian woods have shown a lower species richness than other investigated Italian beech (Bernicchia et al., 2007b) and chestnut woods (Mayrhofer et al., 2001). This aspect can be due to some factors, such as: the structure and forest management, and last but not least, the different number of survey years. The present study was performed over one year, differently from both the studies of Bernicchia et al. (2007b) and Mayrhofer et al. (2001), which were carried out throughout several years (i.e. 25 years in Bernicchia et al. 2007b). Moreover, data on wood parameters (see Fig. 2) confirm that Ligurian stands are young and characterized by few wood debris. For instance, most of the investigated plots in the chestnut wood were characterized by low or no (i.e. plot 1, 9 and 16) dead wood volume. However, the two studied areas have generally shown similarity in species and wood composition. This was confirmed also by Jaccard index values. Only in some plots the observed values (i.e. the number of logs and the volume of dead wood) have been higher in the beech forest than in the chestnut wood.

Correlations analyses performed have shown that the species richness observed in both studied areas is moderate correlated with the volume of dead wood, similarly to Pouska et al. (2010). These authors observed that corticioid species richness was positive correlated with the mean logs volume in old growth mountain spruce of Northern Europe. Therefore, they affirmed that the volume of dead wood constitutes an important factor for species richness increasing.

The low or no correlation between species richness and wood size (length and diameter) is in agreement with the observations made by Heilmenn-Clausen & Christensen (2004). Tree size itself is not important for wood-decaying fungi occurrence, especially for broadleaved trees. Conversely, the negative correlation value obtained between the species richness and the class of decomposition observed in the beech forest, can be scarcely explained. As affirmed by Nordén & Paltto (2001), a possible explanation can be due to the absence of competitive exclusion, but further studies are needed to better clarify the correlation and influence of decomposition classes on species richness.

Further comparisons at European level are difficult to perform, since very few ecological studies have been performed, especially in the Mediterranean basin. Ortega & Lorite (2000) and Gorjón et al. (2009) carried out similar investigations in chestnut stands of central-western and southern Spain. Similarly to our results, these authors found a low number of species (i.e. 15 in total by Ortega & Lorite, 2000) in chestnut wood of Andalusia (Southern Spain), and a similar species composition with the Ligurian chestnut woods. Conversely, no species were found in common between Ligurian and European northern beech forests (Heilmann-Clausen & Christensen, 2003, 2005; Heilmann-Clausen & Walleyn, 2007). More specifically, indicator species selected for northern beech forests (Heilmann-Clausen & Walleyn, 2007) were not found in the studied Mediterranean area. These results may suggest a different corticioid species diversity along northern and southern European forests, as well as the lack of investigations (till now) of corticioid species in southern European forested areas.

CONCLUSION

This first study contributes at improving the knowledge on corticioid fungi in Liguria (Northwestern Italy) and at laying the foundation for a regional checklist. The presence of new records and rare *taxa* provides at increasing the knowledge on their distribution and at establishing the baselines for conservation purposes.

The use of a standardized surveyed method has allowed us to obtain comparable data and to test a sampling protocol for corticioid fungi in the Mediterranean area.

The positive correlation found between species richness and dead wood debris volume, confirms that the latter is an important parameter for species occurrence.

Further investigations are needed in order to define an accurate Italian checklist and to investigate the effect of forest structure and management on corticioid species diversity of the Mediterranean area.

ACKNOWLEDGEMENTS - The authors would like to acknowledge Dr.ssa Annarosa Bernicchia and Dr. Alfredo Vizzini for their constructive comments in the manuscript revision. We also thank Isabella Torre for her linguistic revision.

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Appendix: List of species recorded. To each species is specified the authors' name, geographic location (expressed in WGS-84 Global Position System) and growth substratum. Sign * refers to new record in Liguria. Identification made only at genus level are not included. To all the specie is specified higher taxonomic level (family and order).

AGARICOMYCETES, *BASIDIOMYCOTA*

ATHELIACEAE, *ATHELIALES*
**** Athelia decipiens*** (Höhn. & Litsch.) J. Erikss.
Veirera, Sassello (SV). Long. 8,540197° Lat. 44,452638°. On dead wood of *Fagus sylvatica* L..

* ***Athelia epiphylla*** Pers.
Veirera, Sassello (SV). Long. 8,540197° Lat. 44,452638°. On dead wood of *Fagus sylvatica* L..

BOTRYOBASIDIACEAE, *CANTHARELLALES*
****Botryobasidium laeve*** (J. Erikss.) Parmasto**.**
Badani, Sassello (SV). Long. 8,466858° Lat. 44, 450247°; Long. 8,466866° Lat. 44,450235°; Long. 8,46687° Lat. 44,450237°. On dead wood of *Castanea sativa* Miller.
Veirera, Sassello (SV). Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

PHANEROCHAETACEAE, *POLYPORALES*
Byssomerulius corium (Pers.) Parmasto
Veirera, Sassello (SV). Long. 8,539529° Lat. 44,452743°. On dead wood *Fagus sylvatica* L..

CONIOPHORACEAE, *BOLETALES*
****Coniophora puteana*** (Schumach.) P. Karst.
Veirera, Sassello (SV). Long. 8,539239° Lat. 44,45279°. On dead wood *Fagus sylvatica* L..

CORTICIACEAE, *CORTICIALES*
****Corticium confine*** Bourdot & Galzin
Badani, Sassello (SV). Long. 8,466858° Lat. 44,450241°; Long. 8,466867° Lat. 44,450241°. On dead wood of *Castanea sativa* Miller..
Veirera, Sassello (SV). Long. 8,539529° Lat. 44,452743°; Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

PHYSALACRIACEAE, AGARICALES
***Cylindrobasidium laeve** (Pers.) Chamuris.
Veirera, Sassello (SV). Long. 8,538989° Lat. 44,452727°; Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

SCHIZOPORACEAE, HYMENOCHAETALES
***Hyphodontia radula** (Pers.) Langer & Vesterh.
Badani, Sassello (SV). Long. 8,466858° Lat. 44,450241°. On dead wood of *Castanea sativa* Miller.

ATHELIACEAE, ATHELIALES
***Hypochniciellum ovoideum** (Jülich) Hjortstam & Ryvarden.
Veirera, Sassello (SV). Long. 8,539456° Lat. 44,452500°; Long. 8,540197° Lat. 44,452638°; Long. 8,537891° Lat. 44,452150°. On dead wood of *Fagus sylvatica* L..

MERULIACEAE, POLYPORALES
***Irpex lacteus** (Fr.) Fr.
Badani, Sassello (SV). Long. 8,466865° Lat. 44,450243°. On dead wood of *Castanea sativa* Miller..
Veirera, Sassello (SV). Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

ATHELIACEAE, ATHELIALES
***Leptosporomyces raunkiaeri** (M.P. Christ.) Jülich.
Veirera, Sassello (SV). Long. 8,540512° Lat. 44,452679°; Long. 8,539276° Lat. 44,452749°. On dead wood of *Fagus sylvatica* L..

CORTICIACEAE, CORTICIALES
***Mutatoderma mutatum** (Peck) C.E. Gómez.
Veirera, Sassello (SV). Long. 8,539529° Lat. 44,452743°. On dead wood of *Fagus sylvatica* L..

PENIOPHORACEAE, RUSSULALE
***Peniophora cinerea** (Pers.) Cooke.
Veirera, Sassello (SV). Long. 8,540721° Lat. 44,452661°. On dead wood of *Fagus sylvatica* L..

***Peniophora incarnata** (Pers.) P. Karst.
Veirera, Sassello (SV). Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

Peniophora lycii (Pers.) Höhn. & Litsch.
Veirera, Sassello (SV). Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

INCERTAE SEDIS, *INCERTAE SEDIS*
Peniophorella pubera (Fr.) P. Karst.
Veirera, Sassello (SV). Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

PHANEROCHAETACEAE, *POLYPORALES*
Phanerochaete laevis (Fr.) J. Erikss. & Ryvarden.
Veirera, Sassello (SV). Long. 8,539456° Lat. 44,452500°; Long. 8,539529° Lat. 44,452743°; Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

Phanerochaete velutina (DC.) P. Karst.
Badani, Sassello (SV). Long. 8,466865° Lat. 44,450243°, Long. 8,466865° Lat. 44, 450237°, Long. 8,466866° Lat. 44,450235°, Long. 8,466877° Lat. 44,450237°. On dead wood of *Castanea sativa* Miller..
Veirera, Sassello (SV). Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

PHANEROCHAETACEAE, *POLYPORALES*
Phlebiopsis ravenelii (Cooke) Hjortstam.
Badani, Sassello (SV). Long. 8,466859° Lat. 44,450245°, 7.11.2012. On dead wood of *Castanea sativa* Miller..
Veirera, Sassello (SV). Long. 8,539456° Lat. 44,452500°, Long. 8,537891° Lat. 44,452150°, Long. 8,538847° Lat. 44,452830°, 14.11.2012. On dead wood of *Fagus sylvatica* L..

CERATOBASIDIACEAE, *CANTHARELLALES*
Scotomyces subviolaceus (Peck) Jülich.
Veirera, Sassello (SV). Long. 8,539065° Lat. 44,452626°. On dead wood of *Fagus sylvatica* L..

MERULIACEAE, *POLYPORALES*
Steccherinum ochraceum (Pers.) Gray.
Badani, Sassello (SV). Long. 8,466858° Lat. 44,450247°. On dead wood of *Castanea sativa* Miller..

STEREACEAE, *RUSSULALES*
Stereum hirsutum (Willd.) Pers.
Badani, Sassello (SV). Long.8,466859° Lat. 44,450251°; Long. 8,466861°

Lat. 44,450239°; Long. 8,466857° Lat. 44,450236°. On dead wood of *Castanea sativa* Miller..

Veirera, Sassello (SV). Long. 8,539456° Lat. 44,452500°; Long. 8,540721° Lat. 44,452661°; Long. 8,539529° Lat. 44,452743°; Long. 8,539276° Lat. 44,452749°; Long. 8,538989° Lat. 44,452727°; Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

Stereum ochraceoflavum (Schwein.) Sacc.

Badani, Sassello (SV). On dead wood of *Castanea sativa* Miller, Long. 8,466858° Lat. 44,450247°, Long. 8,466859° Lat. 44,450245, Long. 8,466867° Lat. 44,450241°.

Veirera, Sassello (SV). On dead wood of *Fagus sylvatica* L., Long. 8,540197° Lat. 44,452638°, Long. 8,537891° Lat. 44,452150°, Long. 8,538847° Lat. 44,452830°.

TULASNELLACEAE, CANTHARELLALES

****Tulasnella violacea*** (Johan-Olsen) Juel

Badani, Sassello (SV). Long. 8,466861° Lat. 44,450239°; Long. 8,466865° Lat. 44,45024°; Long. 8,466869° Lat. 44,450242°; Long. 8,466867° Lat. 44,450241°; Long. 8,466870° Lat. 44,45024°; Long. 8,466858° Lat. 44,450235°; Long. 8,466857° Lat. 44,450236°. On dead wood of *Castanea sativa* Miller..

Veirera, Sassello (SV). Long. 8,540512° Lat. 44,452679°; Long. 8,539239° Lat. 44,452791°; Long. 8,539276° Lat. 44,452749°; Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..

****Tulasnella violea*** (Quél.) Bourdot & Galzin

Badani, Sassello (SV). Long. 8,466861° Lat. 44,450251°. On dead wood of *Castanea sativa* Miller..

CORTICIACEAE, CORTICIALES

****Vuilleminia comedens*** (Nees) Maire

Badani, Sassello (SV). Long. 8,466859° Lat. 44,450251°; Long. 8,466858° Lat. 44,450247°; Long. 8,466858° Lat. 44,450241°; Long. 8,466865° Lat. 44,45024°; Long. 8,466867° Lat. 44,450241°. On dead wood of *Castanea sativa* Miller..

Veirera, Sassello (SV). Long. 8,540721° Lat. 44,452661°; Long. 8,540197° Lat. 44,452638°; Long. 8,538847° Lat. 44,452830°. On dead wood of *Fagus sylvatica* L..