

**Biodiversity of Agaricales in Pine, Cypress, Mixed Oak and Natural  
Forests of an Andean reserve in Colombia**

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**Trabajo de grado para optar el título de Bióloga**

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## Biodiversity of Agaricales in Pine, Cypress, Mixed Oak and Natural Forests of an Andean reserve in Colombia\*

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**Key words:** Tripartite similarity index, Eastern Andean Cordillera, Tropical moist forest, Colombia

Abstract:

Agaric fungi were collected over a 9 month collection period from four habitat types occurring in a natural reserve in Santander, Colombia located on the western slope of the Eastern Andean Cordillera. A total of 46 species were collected from permanent plots. Two species, *Amanita cruzii* and *Clitocybula azureae*, are new records for Colombia. The four habitats studied are pine plantation, cypress plantation, native Subandean forests and native Subandean forest oak mix. Species diversity was analysed with Simpson's Inverse Index of Diversity, as well as species accumulation curves and rank-abundance plots. Tulloss tripartite similarity index was used to compare the sites. Results show the cypress plantation as most diverse, as well as having more unique species than any other habitat type. The most frequently encountered and pervasive species from the entire collection sites are *Inocybe rimoso* and *Laccaria laccata*. Basidiocarps of ectomycorrhizal fungi typically associated with oak were not encountered in the native Subandean forest with oak, however presence of mycelia cannot be ruled out based solely on this information. We suspect the large amounts of decomposing leaf litter serve as the ideal habitat for leaf saprotroph *Mycena*, *Marasmius*, *Entoloma* species.

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\*Research Project.

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## Biodiversidad de Agaricales en bosques de una reserva Andina en Colombia\*

Cristina Eugenia Rodríguez Caycedo\*\*

**Palabras clave:** Índice tripartito de similaridad, Cordillera Oriental, bosque tropical andino

Resumen:

Hongos agaricales fueron colectados en un periodo de 9 meses en cuatro tipos de hábitat que ocurren en una reserva natural en Santander, Colombia. Este se ubica en la ladera occidental de la Cordillera Oriental de los Andes Colombianos. Un total de 46 taxa fueron colectados en parcelas permanentes. Dos especies, *Amanita cruzii* y *Clitocybula azurea* son nuevos registros para Colombia. Los cuatro tipos de hábitat estudiados fueron una plantación de ciprés, una plantación de pino, un bosque nativo subandino y un bosque nativo subandino con presencia de roble. La diversidad de especies se analizó con el índice inverso de Simpson, por medio de curvas de acumulación y curvas de rango-abundancia. El índice tripartito de similaridad de Tulloss se utilizó para comparar entre los cuatro hábitats. Los resultados indican que la plantación de ciprés era la más diversa, y a su vez presentó un mayor número de especies únicas con respecto a los demás hábitats estudiados. Las especies encontradas con mayor frecuencia son *Inocybe rimosa* y *Laccaria laccata*. Los basidiocarpos de hongos ectomicorrizicos típicamente asociados con el roble no se encontraron en el bosque nativo con presencia de roble, sin embargo no se puede descartar la posible presencia de micelios para estos hongos. Se cree que las grandes cantidades de hojarasca acumulada y en descomposición son el hábitat ideal para saprótrofos de hoja como *Mycena*, *Marasmius*, y *Entoloma*.

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## 1. Introduction

The Agaricales comprises a diverse order of fungi, mostly noted for the conspicuous and intriguing nature of their fruiting bodies. Globally they have been subject of study for quite some time. Taxonomic and biodiversity analysis including the fungi require long periods of time, and extensive surveys have only been carried out in few areas around the globe. Taking into consideration that countries that have undergone serious planned inventory of fungal taxa for several years are still encountering a significant amount of new species, it is overwhelming to consider how many fungal species remain undiscovered. For the tropics alone, the diversity of fungi is estimated to be 1.5 million of which 5% are known worldwide (Hawksworth and Rossman, 1997; Hawksworth, 2001).

In the Neotropics, countries like Colombia have contributed to mycological research since the turn of the twentieth century. Much of the present studies focus on fungal diversity found in the Andes, which according to Armenteras *et al* (2003) efforts need to be made to conserve what is left of the original pre-Colombian Andean forests, especially on the Eastern Cordillera.

At the moment the Central and Western Cordillera of the Colombian Andes have been targets for biodiversity, ecologic and taxonomic studies in the past with works from Singer (1963), Carpenter and Dumont (1978), Pulido (1983), Guzman (1987), Tulloss *et al* (1992), Horak and Halling (1991), Müller and Singer (1988), Franco *et al* (2000), Franco and Calle (2000), and Franco *et al* (2005). Considering the promising richness and diversity already shown from Andean forests, the Eastern Cordillera however has not shared the same history. Therefore our research was centered in a tropical moist forest and

tropical wet forest (Holdridge, 1967) found in the Eastern Cordillera. Four habitats within these particular ecologic zones were considered for this study.

The four habitats chosen as collection sites for Agaric basidiocarps were Patula pine and cypress plantations, and a native subandean forest with and without presence of oak. *Pinus patula* Schiede ex Schltdl. & Cham. and *Cupressus lusitanica* Mill. plantations were initiated not long ago for the easy growing, self sustainable nature of these conifers. Lumber utilized in construction and resin productions are just a few of the many advantages of these species of trees. Fragmented forests with *Quercus humboldtii* Bonpl. can still be found at the lower altitudes, and may be affected by newly introduced plantations (Gonzales, 2006). In the Pine plantations, ectormycorrhizal fungi may have traveled with the host tree, assuring its resilience with the native forests. Little is known about the possible effects on the native fungi, or the forest floor. The aim of this study is to begin to comprehend the fungal diversity of the four different habitats and perhaps give us an idea of what positive or negative outcomes could be expected due to the introduced softwood species.

## **2. Materials and methods**

### **2.1 Sampling site**

The Centro de Educación Ambiental “El Diviso”, Santander, Colombia is located on the western slope of the Eastern Cordillera of the Colombian Andes. It can be found between 7° 6' 44" N y 73° 01' 48" W covering altitudes from 1,700 – 2,400 m. “El Diviso” has an area of 85 ha. 69 ha of these are native sub Andean forests and 15 ha are *C. lusitanica* and *P. patula*

plantations (CDMB, 1985). The Subandean vegetation occurring within the 69 ha of native forest are trees of the Podocarpaceae family known as Colombian Pine, Bromelaid species, woody vines of the Ericaceae family, with presence of oak (*Q. Humboldtii*). The latter can be found between 2000 – 3200 m (Rodríguez *et al*, 2005). For sake of clarity the *P. patula* plantation, the *C. lusitanica* plantation, the Native Subandean Forests, and Native Subandean Forest with presence of *Q. humboldtii* will be referred to from here on as pine plantation, cypress plantation, native forest, and oak mix respectively.

## **2.2 Data collection**

Sampling was carried out using fixed-size plots (Mueller *et al*, 2004) where the vascular plants species composition and vegetation structure were visually homogeneous. Mushroom fungi (Basidiomycota: Agaricales) were observed and collected on 28 occasions within a nine month collecting period, beginning June 2006 and finalizing February 2007. Random sampling was also used when encountering fungi not previously collected in the plots to better assess species composition. Basidiomata were photographed in the field, and macroscopic features including color characteristics were recorded later in the day. Color designations follow Kornerup & Wanscher (1983). All agaric fungi found within the plots were removed and dried using a vertical air flow dehydrator and later placed in resealable plastic bags containing small bead silica gel. Sections were mounted in 3% KOH, Congo Red, and Melzer's Reagent and viewed under oil immersion. A minimum of 25 measurements were taken of basidiospores found in mature basidiomata. If less than 7 spores were found, specimen was left undetermined at genus. Collections are currently deposited in the Herbario de la Universidad de Antioquia (HUA).

### **2.3 Data analysis**

For purposes of comparison between the habitats, species richness was determined as species density, using circular plots as the fungal unit. R (2008), vegan (Oksanen *et al*, 2005), and BiodiversityR packages (Kindt and Coe, 2005) were used for analysis of fungal diversity. To compare species richness among the four habitats, a species accumulation curve using rarefaction methods for each habitat type were calculated, as the species densities obtained were unequal across habitats. Rank-abundance curves using relative abundance values were calculated to analyse patterns of diversity of each forest type. Simpson's Inverse Index of Diversity was used to compare species evenness in the habitat types. Species similarity from the different forest types were compared using Tulloss and Tullos (2008) Tripartite Similarity Calculator.

## **3. Results**

### **3.1 Fungal Species Richness**

A total of 34 species were recorded from all sites combined, additional 12 taxa could only be identified to genus, mainly because conditions of the basidiocarps were of insufficient quality for reliable identification at the species level. All 46 taxa were included in the results analysis (Table 1). Within plots where no sporocarps of Agaricales were found, other fungi such as puffballs and earthstars took their place. Fruiting bodies of the Ascomycete and Polyporaceae groups were also frequently encountered. The ecological roles of the fungi collected were mycorrhiza-forming, soil saprotrophs, leaf saprotrophs, and wood saprotrophs (Fig 1). Percentages of wood saprotroph species were highest for all habitats, almost matched by soil saprotrophs in the cypress plantation. Leaf saprotrophs were slightly higher in

the native forest and oak mix as expected in any deciduous forest. Even though the percentages of mycorrhiza-forming fungi were not greater than saprotrophs, the most frequently encountered species *Inocybe rimosa* (Bull.) P. Kumm and *Laccaria laccata* (Scop.) Cooke are known to form mycorrhizal associations.

### **3.2 Pine plantation**

Of the 200 plots placed for this plantation, only 41 over all the collection period recovered Agaricales species. Twenty three species were found in the pine plantation, where the two most frequent species were *I. rimosa* and *L. laccata*. Their frequencies were the highest of all the species among all the sites; 27% and 10% respectively. *Schizophyllum commune* Fr. was found only in the pine plantation growing on already cut wood. A possible new record of *Amanita cruzii* O.K. Mill. & Lodge for Colombia was also found here, but did not fall within one of the two-hundred plots placed in the area. Unique species for this plantation are: *Agaricus silvaticus* Schaeff., *Macrolepiota colombiana* Franco-Mol, *Rhodocollybia turpis* (Halling) Halling, *Gymnopus confluens* (Pers.) Antonín, Halling & Noordel. and *Rhodocollybia maculata* (Alb. & Schwein.) Singer.

### **3.3 Native Subandean forest**

This collection site had a slightly lower number of species sample, for a total of 20 species. Again *I. rimosa* and *L. laccata* were the predominant species in the area. Their frequency was 10.5% and 8.5% respectively. The sampling covered slightly a bit more of the total area, as 63 of the 200 plots were surveyed successfully throughout the collection period. One new record for Colombia was found here as well, a bright blue beautiful member of

the *Clitocybula* genus. The latter was found several times and fruiting periods were observed. Unique species for this forest type are: *Leucocoprinus fragilissimus* (Berk. & M.A. Curtis) Pat, *Stropharia aurantiaca* (Cooke) M. Imai, and *Marasmius sp 4*.

### **3.4 Cypress plantation**

For this site, species richness matched that of the Native sub Andean forest for a total of 26 species found in 53 of the 200 plots. Notice the amount of plots that yield Agaricoid basidiocarps was less for this forest than that of the native forest at 63 but gave a higher number of species. Species found only within this plantation were *Pleurotus ostreatus* (Jacq)P. Kumm, *Entoloma sp 1*, *Entoloma sp 2*, *Nolanea murrayi* (Berk. & Curt.) Dennis, *Hydropus sp 1* and *Hygrocybe cantharellus* (Schwein.) Murrill. One species was relatively predominant for the cypress plantation; *Agrocybe sp 2*. Several species just underneath the same frequency of collections/observations are *Entoloma sp 2*, *Hypholoma sublateritum* (Cooke) Sacc, *I .rimosa*, *Leucoagaricus rubrotinctus* (Peck) Singer and *N. murrayi*.

### **3.5 Native Subandean forest with presence of Oak**

In this habitat there was an unexecpted low number of Agaricoid species; nineteen. The basidiocarps were far more scattered than the previous forests. Of the nineteen species, there were 51 collections made, from 48 different plots in the grid. The status of the forests was always very humid and muddy, even when the pine plantations seemed dry and arid at times. The canopy covered the light very well, and the moisture was kept in. *L. laccata* once more showed higher frequencies than any other species collected, however not as high as for pine and natural forest. *I. rimosa* in this

case was not as abundant. Many decaying fungi were found, and the majority was in foul conditions, where no structure was worth preserving for microscopic identification.

### **3.6 Rank-abundance curves:**

Of the four rank-abundance curves obtained (Fig 2), the Cypress plantation was the most diverse (i.e. richest and even). It has the least number of species represented by only one individual. The pine plantation showed a very long tail, with many species represented by one individual. The relative abundance was the highest for *I. rimosa*, not only for the pine plantation but for the native forest and native forest oak mix. In the cypress plantation the relative abundance of this species was the second highest, only preceded by *Agrocybe sp.* The native forest and oak mix showed similar patterns, but in the latter species collected only once were predominant.

### **3.7 Species accumulation curves**

Species richness in the cypress plantation and oak mix was substantially higher than in the rest (Fig 3). Richness values obtained are 25.750, 25.418, 22.577, and 18.714 for cypress plantation, oak mix, pine plantation and native forest respectively. Comparing all the habit types at sample size 15, the cypress plantation has greater species richness, decreasing in order from the oak mix, native forest and pine plantation with values of:  $20.777 > 17.566 > 16.169 > 14.159$ . Considering the data, species seem to accumulate more rapidly for the cypress plantation.

### **3.8 Simpson's Inverse Index of Diversity**

All four habitats showed values for this index that support the rank-abundance curves obtained. Presented in descending order the cypress plantation showed the highest value of 19.253, the oak mix showed 12.876, native forest had 6.818 and the pine plantation showed 1.722 for Simpson's Inverse Index of Diversity. These values indicate that fungal units appear to be distributed among species in such a manner that in the cypress plantation 19 species are equally common, 14 species for the oak mix, 7 species for the native forest, and only 2 for the pine plantation.

### **3.9 Tulloss Tripartite Similarity Index**

Using Tulloss (1997) Tripartite Similarity Index, the four types of habitats were compared for species similarity. A data matrix (Table 2) with T values shows the index of similarity comparing each of the 4 lists pairwise. A value of 1 indicates a set is identical and therefore with the highest similarity possible. The native forest and the oak mix gave the highest index value out of any comparison, meaning they were the most similar habitat type. By comparison the two least similar pairs were the pine plantation and the cypress plantation, followed by the pine plantation and the native forest.

## **4. Discussion**

Observing the data alone, the cypress plantation seemed to yield a large diversity of fungal species, however the species collected were not numerous and not consistently encountered with every sampling effort. The number of individuals found at this site was rarely one. From this we can conclude that the cypress plantation is a very unique habitat for agaric fungi in this reserve.

Species abundance was not very high, but not as low as the other three habitat types. Basidiocarps of the species could be found with certainty given enough sampling effort. *I. rimosa* appears to be widely distributed among all the habitat types showing it has adapted very well to the different conditions of the habitats. Taking into consideration the fungal unit, it is possible that many of the basidiocarps belonged to one mycelium and would not count as several units. It is not intended to signify that one mycelium would also be responsible for fruiting bodies in the different forest types, however possible it may be. *I. rimosa* and *L. laccata* were observed the most which could mean the species have developed strong mycorrhizal associations even the under varying conditions and has spread to a great extent.

Species collected in the cypress plantation were consistently new (*i.e.* not collected previously), but highly periodic. Because of this species accumulation curves show faster increase. The underlying factors responsible for the periodic nature of the fungi growing in this plantation are not known. Variables such as precipitation and temperature could be influential along with many other abiotic and biotic factors. In contrast the pine plantation only had a few common species (*i.e.* *I. rimosa* and *L. laccata*). By common we mean very abundant as well as consistently encountered during the nine month collection period. Hence the values of 1 for relative abundance for the majority of species sampled there.

The native forest and native forest oak mix showed great similarity in all aspects of diversity analysed here. This was expected as the major plant component was the same for both habitat types. Surprisingly however, ectomycorrhizal species with oak were not encountered in this study. A large number was not expected but complete absence of fruiting bodies of ectomycorrhizal (EM) fungi typically found with oak can possibly be due to

fungus species not adapting to the mixed forest or because it may be in an early successional stage where oak EM fungi cannot settle due to competition with other species (Trappe & Luoma, 1992).

It is very possible that EM fungi associated with oak can be found in the reserve where only oak is the dominant vegetation. *Q.humboldtii* does not appear to have much influence in EM fungi in the area of collection at the altitude of the inventory. The status of the mixed forest seemed to require and therefore harbor more leaf and soil saprotrophs such as *Marasmius* and *Mycena*, than EM associations between the large oaks. However the utilization of oak leaves by leaf saprotrophs as growth substrate could explain their presence over that of EM fungi in this habitat. Marasmioid fungi do not seem constrained to one habitat and currently undergoing the process of colonizing the diverse ecosystem in the reserve. The availability of leaf litter and plant debris to break down and for nutrient intake appear highly abundant and seem an adequate medium for such species to colonize through spores or mycelial growth throughout the forests. In which case dead leaves appear to be a key substrate that is a determining factor in the production of colonizing spores by leaf saprotrophs.

For mycorrhiza-forming fungi such as *I. rimosa* and *L. laccata*, their abundance seems to depend on the host or tree species but certainly adaptability to varying conditions in the soil. This was also seen by Müller and Halling in association with *Pinus* and *Quercus* species (1995). It does not explain however the incidence of these two species in the cypress plantation. First, spore dispersal may be the primary mechanism used by these two species. Besides the typical short distance dispersal of spores (*i.e.* in proximity to the basidiocarp), for long distance dispersal to be possible the spores must be UV resistant and tolerate dehydration (Deacon, 1997). Most

species have hyaline spores that are viable for short periods of time which reduces the effectiveness to disperse long distances (Olsson, 2008). Second, dispersal by mycelia growth can occur within the substrate of one forest type and from one forest type to the next given both are suitable for the fungi. Even when crossing unfavorable territory is required to colonize new areas (Carlile, 1994). The extension of one or several mycelium from one forest type to its adjacent habitat remains a strong possibility for the widespread and frequent occurrence of fruiting bodies from these two species.

The number of species collected within the 800 total plots is influenced by various factors. Widely dispersed genera most likely will be found first over other species. The resulting number of species richness and composition can only be taken as a preliminary inventory of agaric fungi. This is why the group of fungi included in this survey are not believed to have reached their maximum diversity. Plots that are placed for species richness units are not always predictive of where the fruiting bodies actually may appear. Many basidiocarps were found out of the plotted areas and were not considered when analyzing the species richness of each forest type. Of the two more significant finds for Colombia one (*i.e.* *Amanita cruzii* O.K. Mill. & Lodge) was not counted within the analysis because it was not found within the sampling plots. Random sampling was done as well of agaric fungi when it was suspected they had not already been collected within the plots. As this was the case for *A. cruzii*, many species may be present but easily missed. The majority of fungi seen with random sampling were the same species. If random sampling is carried out with greater effort for this reserve it is very likely that richness of agarics known for this reserve will greatly increase. Change in the diversity of agaricales remains highly probable not only from

analyzing specimens collected coming from habitats in their totality, but with a more extended collection period.

Fragmentation of the forests, due to human influence, especially introduction of foreign species can cause great stress on native forests and species inhabiting these forests. Collection efforts during inventories influence the results or the apparent condition of a forest as well. The two new records for Colombia may have been introduced from foreign areas from which the planted trees came. The impact of introduced species is not yet known however these results highlight the current importance of plantations as a habitat for the native fungi reported. The plantations proximity to natural subandean forest fragments may be further enhanced through an increase in areas of non-intervention within the reserve (Humphrey *et al*, 2000). Yet a slow replacement of natural woods may be occurring. And new species, stronger, more adapted to severe conditions can proliferate easily and decrease the appearance of native fungi as they are substituted by introduced species (Kost, 2002). A complete assessment cannot be conducted based solely on this study. As shown from studies in Switzerland, a sufficient inventory period such as twenty years can still recover new species never observed before and that it takes years in order to establish strong results and comparisons of the sites (Straatsma *et al*, 2001). Species diversity of agaric fungi in particular, correlate with the collection efforts, the presence of mycologist in an area, and rarely are studies successful enough where a broad analysis may be done. The effort to describe new species and record presence of fungi new to an area will hopefully increase with time.

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## 7. Annexes

### 7.1 Annexes 1.

**Table 1** Letters indicate values for rank-abundance curves. Pine represents the *P. patula* plantation, native represents the native forest, cypress is the *C. lussitanica* plantation and N/Oak represent the native forest with presence of *Q. humboldtii*.

Species	Forest Type			
	Pine	Native	Cypress	N/Oak
A <i>Agaricus silvaticus</i> Schaeff.	1	0	0	0
B <i>Agrocybe</i> sp 1	2	0	2	1
C <i>Agrocybe</i> sp 2	4	0	8	2
D <i>Cantharellus guyanensis</i> Mont.	1	0	0	1
E <i>Clitocybula azurea</i> Singer	0	7	1	0
F <i>Collybia plectophyla</i> (Mont.) Singer	0	0	0	1
G <i>Cortinarius violaceus</i> (L.) Gray	0	0	3	0
H <i>Collybia aurea</i> (Beeli) Pegler	1	0	1	1
I <i>Coprinellus disseminatus</i> (Pers.) J.E. Lange	1	2	1	2
J <i>Entoloma</i> sp 1	0	0	4	0
K <i>Entoloma</i> sp 2	0	0	5	0
L <i>Gymnopus confluens</i> (Pers.) Antonín, Halling & Noordel	1	0	0	0
M <i>Gymnopus macropus</i> Halling	1	3	2	1
N <i>Hydropus</i> sp	0	0	1	0
O <i>Hyrdopus cavipes</i> (Pat & Gaill.) Dennis	0	1	0	2
P <i>Hygrocybe cantharellus</i> (Schwein.) Murrill	0	0	4	0
Q <i>Hygrocybe chlorophana</i> (Fr.) Wünsche	0	1	0	1
R <i>Hypholoma fasciculare</i> (Fr.) Wünsche	0	3	2	3
S <i>Hypholoma sublateritium</i> (Scaeff) Quel.	2	0	5	2
T <i>Inocybe rimosa</i> (Bull)p. Kumm	54	21	5	11
U <i>Laccaria lacata</i> (Scop.) Cooke	20	17	4	3
V <i>Lenitnellus</i> sp	0	0	2	1
W <i>Leucocoprinus cepistipes</i> (Sowerby) Pat	1	0	3	1
X <i>Leucoagaricus rubrotinctus</i> (Peck) Singer	0	0	5	4
Y <i>Leucocoprinus fragillissimus</i> (Berk. & M.A. Curtis) Pat	0	2	0	0
Z <i>Maccrolepiota colombiana</i> Franco-Mol.	2	0	0	0
A1 <i>Marasmius androsaceus</i> (L.) Fr.	0	0	0	1

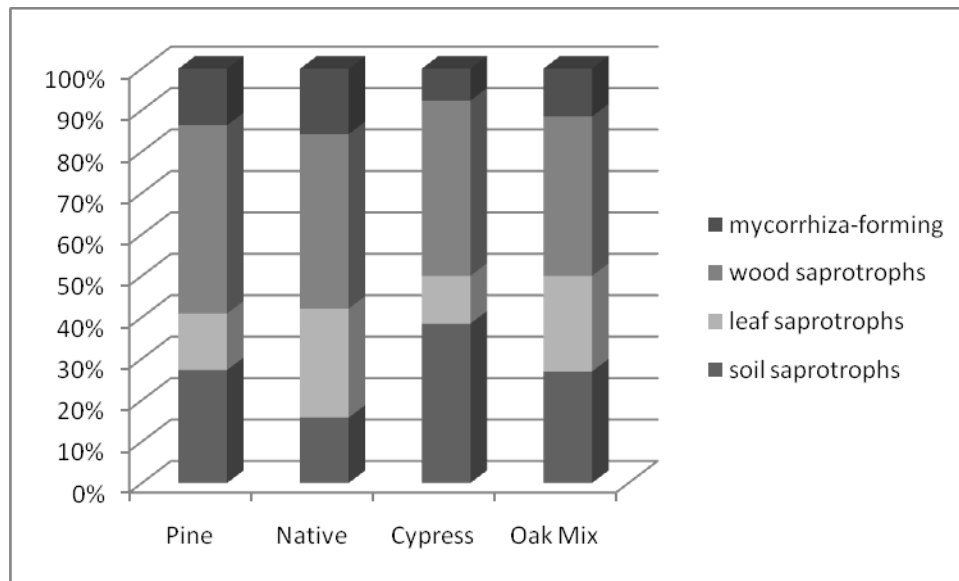
B1	<i>Marasmius sp 1</i>	0	0	0	1
C1	<i>Mycena holoporphyra</i> (Berk & M.A. Curtis) Singer	1	3	3	4
D1	<i>Marasmius sp 2</i>	0	2	2	0
E1	<i>Marasmius perlongispermus</i> Singer	1	1	0	2
F1	<i>Marasmius sp 3</i>	0	1	0	0
G1	<i>Marasmius cohaerens</i> (Albertini & Schweinitz:Fries)	0	1	0	1
H1	<i>Mycena sp 1</i>	0	0	1	0
I1	<i>Mycena sp 2</i>	2	0	0	1
J1	<i>Nolanea murrayi</i> (Berk. & Curt.) Dennis	0	0	5	0
K1	<i>Omphalina sp</i>	0	0	0	1
L1	<i>Megacollybia platyphylla</i> (Pers.) Kotl. & Pouzar	1	2	1	0
M1	<i>Oudemansiella canarii</i> (Jungh.(Höhn	0	1	1	0
N1	<i>Pholiota sp</i>	1	1	0	1
O1	<i>Pleurotus ostreatus</i> (Jacq)P. Kumm	0	0	3	0
P1	<i>Rhodocollybia maculata</i> (Alb & Schwein) Singer	1	0	0	0
Q1	<i>Rhodocollybia turpis</i> (Halling)Halling	5	0	0	0
R1	<i>Russula emetica</i> (Schaeff.) Pers	0	1	0	1
S1	<i>Schizophyllum commune</i> Fr.	2	0	0	0
T1	<i>Stropharia aurantiaca</i> (Cooke)M. Imai	0	5	0	0
		107	78	77	51

**Table 2 Tulloss Tripartite Similarity Index results.**

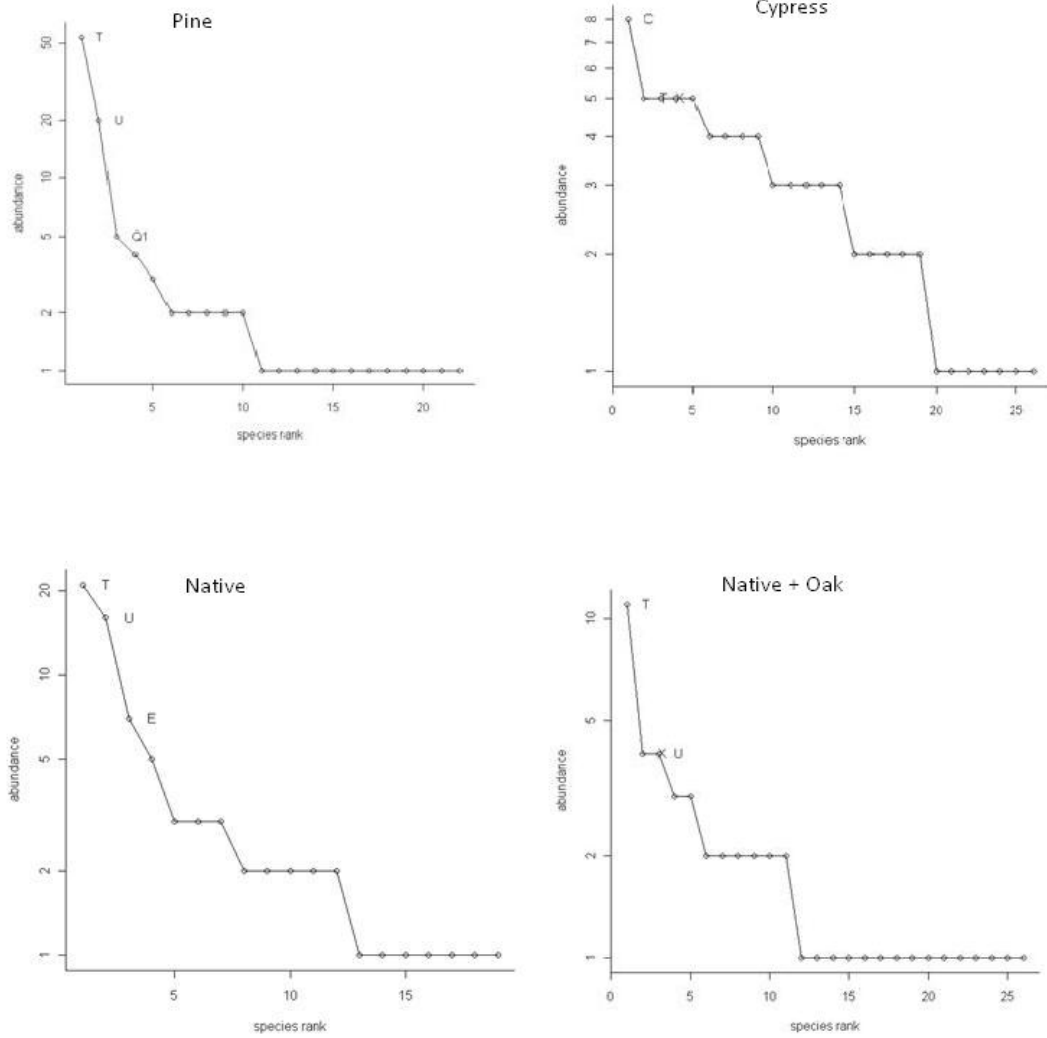
	<b>Pine Plantation</b>	<b>Native forests</b>	<b>Cypress Plantation</b>	<b>Oak</b>
<b>Pine plantation</b>		0.5710442	0.46850297	0.61751638
<b>Native forest</b>			0.649122767	0.68496229
<b>Cypress plantation</b>				0.59566568
<b>Oak Mix</b>				

## 7.2 Annexes 2

**Figure 1 Percentage of species recorded belonging to one of four trophic groups.**



**Figure 2 Rank-abundance curves for all four habitat types.**



**Figure 3 Species accumulation curves for all habitat types.**

