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FUNGI (MACROMYCETES) IN VARIOUS TYPES OF MEDITERRANEAN FOREST ECOSYSTEMS (TUSCANY, ITALY)

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Abstract: The results of mycocoenological research conducted over a period of nearly 30 years in central southern Tuscany (Italy) are reported. The 599 fungal species found in 11 permanent plots include ubiquitous taxa and taxa linked preferentially or exclusively to certain types of forest ecosystems. Fungal[1] biodiversity was particularly high in evergreen oak forests of the Grosseto coast. Classification of samples brought out affinities and differences between the various fungal communities. Ordering by detrended correspondence analysis revealed that the relevés were disposed along a climate-altitude gradient. The health status of the forests, evaluated according to criteria proposed by Central European authors, was generally found to be good. The period of major fungal fruiting was autumn, though the duration of fruiting varied between different environments: in high altitude and coastal environments, the fungal mycelium produced carpophores nearly all year round, whereas no carpophores were found for many months in the hill belt.

Key words: mycocoenology, biodiversity, trophic groups, periodicity, classification, ordination

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INTRODUCTION

Mycocoenological research by the Department of Environmental Sciences, Siena University, has proceeded in various forest ecosystems of central southern Tuscany for many years (Barluzzi *et al.* 1983, 1987, 1992; Comandini *et al.* 1993; De Dominicis & Barluzzi 1983; Perini *et al.* 1989, 1993, 1995; Salerni *et al.* 1995, 2000, 2001; Laganà *et al.* 1996, 1999, 2001). This type of research is most effective for obtaining information on the ecology and spatiotemporal distribution of fungal species, topics of prime interest in recent years with the increase in public awareness on questions of conservation. Threatened species worthy of protection can only be identified if their ecological requirements and distribution are known. This information is available for many taxa in Central and Northern European countries, but not for mycobiota of the Mediterranean area.

This work was intended to obtain information on the ecology of individual species, and as complete a picture as possible of fungal communities developing in the main forest ecosystems of the study area. A further aim was to examine similarities and/or differences between these communities.

STUDY AREA

Geographically and climatically, Tuscany is a transitional region, situated as it is between the peninsular and continental parts of Italy. The terrain is largely hilly and mountainous, with only a minor area of alluvial plains. Forests are a major resource, measuring 900,000 ha, 120,000 ha of which is regional government property.

The study area has varied orography, extending from the sandy or rocky Tyrrhenian coast, through river flats and a wide hill belt, to the central Apen-

[1] The term fungi refers here to macroscopic ascomycetous and basidiomycetous fungi usually called macromycetes.

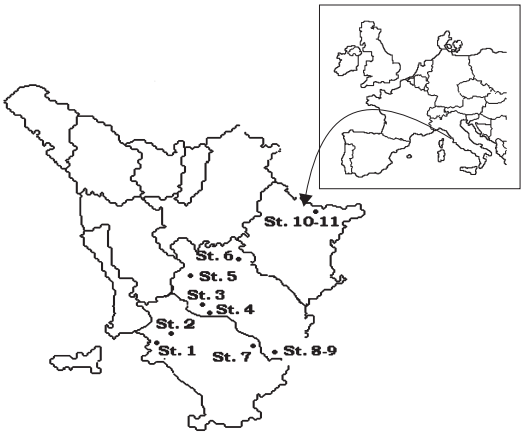

Fig. 1. Studied area: stations 1 and 2 – evergreen oak woods of the coastline; stations 3 and 4 – evergreen oak woods of the inland hills; stations 5, 6 and 7 – chestnut coppices; stations 8 and 9 – fir woods of Mt. Amiata; stations 10 and 11 – fir woods in the Parco Naturale delle Foreste Casentinesi.

nines (Fig. 1). The permanent plots for the present research were chosen to create a transect of the various forest types of the region, from coast to mountains. The main features of the plots are summarized in Table 1.

MATERIALS AND METHODS

The data reported here were obtained in research which has been underway for different periods in the various forest ecosystems. The periods range from four to six years, not all continuous, consisting of data from 1998–1999 and earlier data.

Sampling was done monthly and sometimes fortnightly (in major fruiting periods), and involved recording all fungal species and counting the number of carpophores.

The species found in the 11 plots are listed in Table 2 and Appendix 1 (sporadic species). The first column of Table 2 indicates the trophic group (GT) to which the species was assigned, largely according to the criteria of Arnolds *et al.* (1995). Two groups or one group with a question mark are indicated for some species, as it is sometimes difficult to determine the preferential substrate.

Nomenclature is based on Arnolds *et al.* (1995) where possible, otherwise on various texts and monographs (Antonín & Noordeloos 1997; Bon 1997; Courtecuisse & Duhem 1994; Jülich 1989; Moser 1983; Romagnesi 1967, etc.). Abbreviations of authors' names are according to Brummitt and Powell (1992). The authors of fungal names are given in Table 2 and Appendices 1–4.

Columns 3–13 of Table 2 show the maximum abundance of each species during the study period (maximum carpophore density per visit, mCDv) and the number of years in which it fruited (FY), plot by plot. The actual number of carpophores counted was transformed to CDv using the scale given by Arnolds (1981). The respective specimens are in the Herbarium Universitatis Senensis (SIENA). Nomenclature of plant species is according to Pignatti (1982).

Correlations between variables were tested by Pearson's linear coefficient. Comparisons between small samples were done by the nonparametric Mann-Whitney U test. Processing was done with STATISTICA 5.0 software (StatSoft Inc.). Samples were classified with the Syn-tax 5.0 program (Podani 1993), using the d index (d = 1-s, where s is the index of Jaccard 1901) as the dissimilarity measure and the mean link as the clustering function. Samples were ordered by detrended correspondence analysis (DCA) using CANOCO for Windows® (Ter Braak & Šmilauer 1998).

RESULTS AND DISCUSSION

A total 429 fungal species (Table 2) plus 170 sporadic fungal species (species found in one plot in one year only, with mCDv < 2; Appendix 1) were found during the study period. The data in the table provides insights into the ecological requirements of each species and its presence or otherwise in the different plots or environments. A few examples follow.

Group I contains the 25 species found in all plots; examples are *Laccaria laccata*, *Mycena galopus*, *M. pura*, *M. vitilis* and *Xylaria hypoxylon*. This ubiquity confirms reports by other authors of the broad ecological spectrum of these species.

Group II contains 29 species absent in fir woods on Mt. Amiata (plots 8 and 9) and the Parco Naturale delle Foreste Casentinesi (plots 10 and 11). The 21 species not found in plots 10 and 11 seem to avoid high altitudes and the cold conditions associated with them.

Table 1. Information about the studied permanent plots.

Plot	Plot surface	Altitude (m a.s.l.)	Slope (°)	Exposure	Dominant tree species	Other species	Climatic belt (Thornthwaite 1948)	Geological substratum
St. 1	2000 m^2	50	5	N	*Quercus ilex* L.	*Arbutus unedo* L., *Cyclamen repandum* S. & S., *Phyllirea latifolia* L., *Rubia peregrina* L., *Smilax aspera* L., *Viburnum tinus* L.	C_1 (subarid, $-33.3<I_m<0$)	sandstone
St. 2	2000 m^2	150	5	S	*Quercus ilex*	*Arbutus unedo, Cyclamen repandum, Phyllirea latifolia, Rubia peregrina, Smilax aspera, Viburnum tinus*	C_2 (subhumid, $-0<I_m<20$)	sandstone
St. 3	2000 m^2	210	15	NE	*Quercus ilex*	*Arbutus unedo, Cyclamen repandum, Phyllirea latifolia, Rubia peregrina, Smilax aspera, Viburnum tinus*	B_1 (humid, $20<I_m<40$)	limestone ('calcare cavernoso')
St. 4	2000 m^2	275	10	N	*Quercus ilex*	*Arbutus unedo, Cyclamen repandum, Phyllirea latifolia, Rubia peregrina, Smilax aspera, Viburnum tinus*	B_1 (humid, $20<I_m<40$)	polygenic conglomerates
St. 5	2000 m^2	525	5	NNE	*Castanea sativa* Miller	*Luzula forsteri* (Sm.) DC., *Pteridium aquilinum* (L.) Khun.	B_1 (humid, $20<I_m<40$)	polychromes sericitic schists
St. 6	2000 m^2	550	30	NE	*Castanea sativa*	*Luzula forteri, Melica uniflora, Pteridium aquilinum*	B_1 (humid, $20<I_m<40$)	sandstone
St. 7	2000 m^2	870	5	W	*Castanea sativa*	*Luzula forsteri, Melica uniflora, Pteridium aquilinum*	$B_{3,4}$ (humid, $60<I_m<100$)	metasandstones, phyllites and metaconglomerates ('Verrucano')
St. 8	500 m^2	770	15	N	*Abies alba* Miller, *Fagus sylvatica* L.	*Cyclamen hederifolium* Aiton, *Hedera helix* L., *Ostrya carpinifolia* Scop., *Ruscus aculeatus* L.	$B_{3,4}$ (humid, $60<I_m<100$)	sandstones of the type 'Pietraforte'
St. 9	800 m^2	860	2	N	*Abies alba*	*Cyclamen hederifolium, Hedera helix, Ostrya carpinifolia, Ruscus aculeatus*	$B_{3,4}$ (humid, $60<I_m<100$)	sandstones of the type 'Pietraforte'
St. 10	360 m^2	1115	3	SSE	*Abies alba*	*Galium laevigatum* L., *Luzula nivea* (L.) Lam., *Milium effusum* L., *Prenanthes purpurea* L.	A (very humid, $I_m>100$)	turbiditic sandstone alternating with grey marly-schist
St. 11	900 m^2	1210	15	NNE	*Abies alba, Fagus sylvatica*	*Galium laevigatum, Luzula nivea, Milium effusum, Prenanthes purpurea*	A (very humid, $I_m>100$)	turbiditic sandstone alternating with grey marly-schist

Table 2. Synthesis of mycocoenological samplings done in the 11 studied permanent plots (GT – trophic group; M – mycorrhizal species; Sh – humicolous saprotrophes; Sl – saprotrophes on litter; Sw – saprotrophes on wood; Sc – saprotrophes on dung; P – parasites; Li – lichenized).

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
Sl	*Mycena galopus* (Pers.: Fr.) P. Kumm.	4.3	4.4	2.3	3.2	4.4	3.3	1.1	6.6	3.3	3.1	2.1	
Sl	*Mycena pura* (Pers.: Fr.) P. Kumm.	4.3	3.6	1.3	2.3	3.2	1.1	2.3	7.6	6.6	3.4	4.5	
Sh(M)	*Clavulina coralloides* s.l.	2.1	2.2	1.2	3.1	1.2	2.3	2.2	6.6	5.5	6.4	7.5	
M	*Russula fragilis* (Pers.: Fr.) Fr.	2.5	2.6	2.4	1.4	1.2	1.3	1.1	2.1	1.1	4.2	3.1	
M	*Laccaria laccata* s.l.	4.3	5.5		1.2	1.2	5.4	3.2	5.2	4.6	5.5	5.6	
M	*Cortinarius duracinus* Fr.	2.2	3.6	1.2	2.2	3.2	3.2	1.3	2.1		3.1	3.1	
Sw	*Mycena vitilis* (Fr.) Quél.	4.2	5.4	3.2	2.2	1.3	3.3	1.1	4.4	1.2		1.2	
Sl	*Collybia butyracea* (Bull.: Fr.) P. Kumm.	4.3	4.5	1.2	2.2	1.2	1.1	1.1	2.2	2.2		2.2	
Sl	*Marasmius androsaceus* (L.: Fr.) Fr.	2.1	5.1	1.1		4.2	1.1		4.3	3.2	1.1	5.5	
Sl(Sw)	*Mycena leptocephala* (Pers.: Fr.) Gillet	3.1	1.1		1.1	1.2	2.1		4.4	1.1	4.5	4.5	
M	*Inocybe geophylla* (Fr.: Fr.) P. Kumm.		3.3	1.2	1.3	1.1	2.3		4.6	3.4	5.6	2.1	
M	*Cortinarius infractus* (Pers.: Fr.) Fr.	3.3	3.3	2.4	1.3			1.4	2.2		5.6	3.1	
M	*Cortinarius lividoochraceus* (Berk.) Berk.	2.3	2.6		1.1	2.3	2.2		3.5	3.2	2.1		I
Sl	*Clitocybe gibba* (Pers.: Fr.) P. Kumm.	2.4	3.5		1.2	2.1		1.2	4.2	3.1		3.2	
Sl	*Mycena rosea* Gramberg	5.4	4.6		3.4	1.2		2.2	7.4	6.2	2.2		
Sh	*Lycoperdon perlatum* Pers.: Pers.	1.1	2.5		1.1		2.3	2.3	4.4	4.4		3.2	
M	*Inocybe fuscidula* Velen.	1.1		1.1			1.1	2.1	5.4	3.2	5.6	1.1	
M	*Inocybe flocculosa* (Berk.) Sacc.	2.1		2.1	1.2	1.2	1.1	3.1	1.1		5.2		
Sw	*Mycena erubescens* Höhn.	1.2			1.1	1.1	2.1		5.6	3.1	3.2	3.2	
M	*Hygrophorus discoxanthus* (Fr.) Rea		4.5	2.1	2.3	2.1		1.1	3.5		1.1	2.1	
Sw	*Xylaria hypoxylon* (L.: Fr.) Grev.	4.2	2.2	2.2				1.1	6.6		4.2	6.6	
M	*Cantharellus tubaeformis* Fr.: Fr.		3.3		1.1	3.5	3.5	4.2		3.2		6.1	
Sl	*Mycena sanguinolenta* (Alb. & Schwein.: Fr.) P. Kumm.		1.1		1.2	1.2	2.3		1.2		2.2	2.2	
M	*Tricholoma saponaceum* (Fr.: Fr.) P. Kumm.		1.2		1.4	1.2	3.2		2.1	2.1		3.3	
M	*Boletus chrysentheron* Bull.	2.3			1.1		1.1			2.5		1.1	
M	*Cortinarius trivialis* J. E. Lange	1.1	1.4	2.3	2.3	1.2	2.4	3.3	3.3	1.1			
M	*Lactarius chrysorrheus* Fr.	3.5	2.5	3.2	2.4	1.2	2.2	1.1	1.2				
Sh(M?)	*Entoloma rhodopolium* (Fr.: Fr.) P. Kumm. f. *nidorosum* (Fr.) Noordel.	1.1	2.3	2.1	1.1	3.2	1.2	2.2	3.1				
M	*Tricholoma atrosquamosum* (Chevall.) Sacc.	2.1	1.2	3.3	2.4	1.1	1.2		1.1				
Sw(Sl)	*Hemimycena cucullata* (Pers.: Fr.) Singer	2.1	3.2	4.2	1.1	1.1		1.1	4.2				
M	*Russula luteotacta* Rea	2.1	2.2	1.2	1.2	3.1		2.1	1.1				
M	*Cortinarius calochrous* (Pers.: Fr.) Fr.	2.2	1.2	2.4	1.4		1.1	1.1	1.1				II
M	*Amanita pantherina* (DC.: Fr.) Krombh.	3.4	2.6		1.1	1.1	1.2	3.2	2.1				
M	*Lactarius decipiens* Quél.	2.4	2.4		1.1	1.2	2.2	1.2	3.1				
Sl	*Collybia erythropus* (Pers.: Fr.) P. Kumm.	1.1	2.4		1.1	1.1	3.1	2.1		2.2			
M	*Cortinarius paleaceus* Fr.		1.1	1.1	2.1	1.1	2.2	1.2	4.4				
Sh	*Lyophyllum deliberatum* (Britzelm.) Kreisel		1.1	1.3	1.2	1.3	2.2	1.1	1.2				
M	*Cortinarius torvus* (Bull.: Fr.) Fr.		1.2		1.2	1.2	3.2	1.1	5.1	2.1			
M	*Cortinarius anomalus* (Fr.: Fr.) Fr.	1.1			1.1	1.1	1.1	1.2	2.2				

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Tricholoma argyraceum* (Bull.: Fr.) Sacc.		3.1	1.1	1.1	1.1		1.1	1.1				
Sl	*Collybia dryophila* (Bull.: Fr.) P. Kumm.		4.2	1.1	3.2		1.1	2.2		3.1			
Sh	*Leotia lubrica* (Scop.: Fr.) Pers.		2.3	2.2		1.4	1.3	1.1	4.2				
Sl(Sw)	*Mycena abramsii* (Murrill) Murrill	2.2	1.1		1.1		3.2		2.2				
Sl/Sw	*Mycena pelianthina* (Fr.: Fr.) Quél.		4.4	1.2			1.1		3.4	1.2			
Sw	*Pluteus plautus* (Weinm.) Gillet	1.1		1.1		1.1			1.1				
Sl	*Clitocybe nebularis* (Batsch: Fr.) P. Kumm.		2.1		2.2			1.1	4.2				II
Sh(M?)	*Clitopilus prunulus* (Scop.: Fr.) P. Kumm.		1.2	1.1	1.1	2.4	1.2	1.1			2.1		
M	*Hydnum repandum* L.: Fr.		1.1	1.2	3.1	3.5	3.4	2.3				2.3	
M	*Cortinarius uraceus* Fr.		1.2	2.2	2.2	1.1	1.1				3.2	4.1	
M	*Tricholoma sulphureum* (Bull.: Fr.) P. Kumm.	1.1	1.4		1.2		1.1	4.2				2.1	
M	*Boletus ferrugineus* Schaeff.	3.4	3.3	2.1			1.1					2.1	
M	*Inocybe splendens* R. Heim	2.1			2.1	2.1		1.1			2.1		
Sh	*Hygrocybe virginea* (Wulfen: Fr.) P. D. Orton & Watling		4.5	1.2	3.2		1.1					1.1	
M	*Cortinarius rufoolivaceus* (Pers.: Fr.) Fr.		1.1	2.2				2.1			2.1		
M	*Russula delica* Fr.	2.4	2.5			1.1	3.3	1.1	2.1	4.5	3.5	3.6	
M	*Amanita rubescens* Pers.: Fr.	4.5	2.6			1.4	2.2	3.4	3.3	2.2		2.1	
M	*Russula cyanoxantha* Schaeff.: Fr.	1.1	2.3			3.3	2.2	1.1		3.4		2.4	
Sl	*Mycena metata* (Fr.: Fr.) P. Kumm.	2.2	2.1				1.1	1.1		5.2	4.2	4.2	
M	*Laccaria amethystina* Cooke	1.1	1.1					1.1	4.4	2.3	4.3	6.5	
M	*Russula chloroides* (Krombh.) Bres.		3.2				3.1		1.1	3.2	5.2		
Sh	*Entoloma juncinum* (Kühner & Romagn.) Noordel.	2.1						1.1	3.1			2.1	
M	*Inocybe rimosa* (Bull.: Fr.) P. Kumm.	1.1						1.1	1.1		1.1		III
Sh(M?)	*Entoloma rhodopolium* (Fr.: Fr.) P. Kumm.		2.2			2.1			3.1			4.1	
Sl	*Mycena epipterygia* (Scop.: Fr.) Gray			1.1	1.1			1.1	4.3	4.3	3.4	6.6	
Sw	*Crepidotus cesatii* (Rabenh.) Sacc.			2.1			1.1	3.1	5.3			2.1	
Sl	*Mycena pura* (Pers.: Fr.) P. Kumm. f. *alba* (Gillet) Kühner			1.2				1.2		2.2	2.1	2.2	
Sw(P?)	*Xerula radicata* (Relhan: Fr.) Dörfelt				2.1	1.1			3.5		2.1	3.5	
Sl	*Mycena sepia* J. E. Lange			1.1				1.1	4.5			3.2	
M	*Cortinarius erythrinus* (Fr.) Fr.				1.1		1.1		5.1			4.2	
M	*Amanita phalloides* (Fr.: Fr.) Link	4.4	3.3				2.1	1.1	4.4	2.1			
M	*Amanita citrina* (Schaeff.) Pers.	2.4	4.5			1.2	1.4		1.1				
M	*Russula foetens* Pers.: Fr.	1.3	1.1			1.2	1.1		1.1				
Sl	*Clitocybe phaeophthalma* (Pers.) Kuyper	2.1	3.2			2.2			3.1				
Sh	*Cystolepiota seminuda* (Lasch) Bon	1.1	2.2			1.1			3.2				
Sw	*Micromphale foetidum* (J. Sowerby: Fr.) Singer	3.2					1.1		4.1				
M	*Inocybe flavella* P. Karst.		2.1			1.1			3.1				
M	*Russula romellii* Maire		1.1					1.1	1.1				
M	*Craterellus cornucopioides* (L.: Fr.) Pers.	2.2	5.5			3.1	4.2	3.2				5.1	
Sh	*Macrolepiota procera* (Scop.: Fr.) Singer	2.4	1.4				1.2					1.1	
M	*Cantharellus cibarius* Fr.: Fr.		3.5			3.4	2.3	1.3				4.2	

(cont.)

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Russula melliolens* Quél.		1.1			1.1						2.1	
M	*Cortinarius cristallinus* Fr.			1.2	1.1	3.3	1.1	1.1		1.1			
Sw(P?)	*Xerula pudens* (Pers.) Singer				2.2	1.3	2.3	1.2	1.2	1.1			
Sh	*Rhodocybe nitellina* (Fr.) Singer			2.1			5.4		5.4	1.1			
Sw	*Mycena galericulata* (Scop.: Fr.) Gray			2.2	1.2	3.1	2.3	1.1			1.1		
M	*Cortinarius diosmus* Kühner			1.1	1.1		1.2					2.1	
Sw	*Marasmius rotula* (Scop.: Fr.) Fr.			1.1			1.2	4.2			4.2		
M	*Hebeloma sinapizans* (Fr.) Gillet	1.2	4.3	3.4	3.4	2.3	1.1	5.2					
M	*Hydnum rufescens* Fr.: Fr.	2.4	2.2	3.3	2.1	1.2	2.1	4.3					
M	*Hydnellum concrescens* (Pers.) Banker	2.2	3.4	3.3	2.1	4.4	4.3						
M	*Russula risigallina* (Batsch) Sacc.	2.4	2.2		1.2	1.3	3.5	2.4					
M	*Amanita vaginata* (Bull.: Fr.) Lamoure	1.3	2.5		1.1	1.2	2.2	1.2					
Sw	*Mycena polygramma* (Bull.: Fr.) Gray	3.2	1.2		2.4	1.3	1.2	1.1					
Sh	*Coprinus plicatilis* (M. A. Curtis: Fr.) Fr.		1.1	1.1	1.1	1.1	1.1	1.3					
M	*Hebeloma crustuliniforme* (Bull.) Quél.		2.3	1.1	2.1	1.2	1.2	3.1					
M	*Tricholoma ustaloides* Romagn.		1.2	3.3	2.3	3.4	2.4	3.3					
M	*Boletus edulis* Bull.: Fr.		1.3		1.1	1.2	1.1	1.2					
Sl	*Hymenoscyphus fructigenus* (Bull.: Fr.) Gray	4.2	3.1	1.1	2.1		2.1						
Sl	*Lepista nuda* (Fr.: Fr.) Cooke	2.2	2.1	1.1	1.1			1.1					
Sl	*Marasmius quercophilus* Pouzar	2.1	4.2	1.1		4.2		4.2					
Sl(Sw)	*Marasmius epiphyllus* (Pers.: Fr.) Fr.	2.1	3.2	2.1			3.2	5.4					
M	*Cortinarius decipiens* (Pers.: Fr.) Fr.		1.1	1.1	1.1		2.1	3.1					
M	*Tricholoma ustale* (Fr.: Fr.) P. Kumm.		1.1	2.1		2.2	2.1	2.1					
Sh(M?)	*Entoloma sinuatum* (Bull. *ex* Pers.: Fr.) P. Kumm.		4.4		1.1	1.1	1.1	4.3					
M	*Russula persicina* Krombh.		2.1		1.1	1.1	1.1	1.1					IV
Sw	*Marasmiellus ramealis* (Bull.: Fr.) Singer	4.2	3.1	3.1			1.1						
Sh	*Ramaria decurrens* (Pers.) R. H. Petersen	3.1	3.5	2.1				2.1					
M	*Humaria hemisphaerica* (Wigg.: Fr.) Fuckel	2.1	1.1		1.1		1.1						
Sw	*Sarcoscypha coccinea* s. l.	1.1	1.2		1.1			1.1					
M	*Russula decipiens* (Singer) Svrček		2.2	1.2	1.2	2.2							
M	*Tricholoma album* (Schaeff.: Fr.) P. Kumm.		3.2	1.1	1.1		1.1						
M	*Phellodon niger* (Fr.: Fr.) P. Karst.		4.3	4.3	4.2		2.1						
M	*Cortinarius venetus* (Fr.: Fr.) Fr.		1.1	1.1	2.2			1.1					
M	*Inocybe tenebrosa* Quél.		2.1	1.1	1.1			1.1					
M	*Cortinarius anserinus* (Velen.) Rob. Henry		1.2	1.1		1.1		2.1					
M	*Russula densifolia* Gillet		3.2	1.1			2.2						
Sh	*Clavaria fragilis* Holmsk.: Fr.		4.3	3.1			1.1						
M	*Cortinarius cinnamomeus* L.: Fr. var. *cinnamofulvus* Rob. Henry		1.1	1.2				1.1					
M	*Cortinarius olidus* J. E. Lange		1.1	1.1				1.2					
M?	*Ramaria flava* (Schaeff.: Fr.) Quél.		2.2		1.1		1.1						
M	*Tricholoma sejunctum* (J. Sowerby: Fr.) Quél.		3.3		3.2		1.2						

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Russula rosea* Pers.	1.1	1.2			1.4	4.3	1.1					
Sl	*Mycena olivaceomarginata* (Massee) Massee	1.1	1.2			1.1	1.1						
M	*Russula vesca* Fr.	2.5	2.5			1.2	1.2						
Sl	*Flammulaster carpophilus* (Fr.) Earle	3.3	2.2			1.1	2.1						
M	*Boletus luridus* Schaeff.: Fr.	1.3	1.2			1.1		1.2					
Sw	*Lycoperdon pyriforme* Schaeff.: Pers.	2.4	2.2			2.2		4.2					
Sh(M?)	*Entoloma sericatum* (Britzelm.) Sacc.	1.1	2.1				3.2	2.1					
M	*Cantharellus cinereus* (Pers.: Fr.) Fr.		4.2			2.1	2.1	3.1					
Sh	*Entoloma hirtipes* (Schumach.: Fr.) M. M. Moser		2.3			1.1	1.1	1.3					
Sh	*Hygrocybe obrussea* (Fr.: Fr.) Wünsche	1.1	2.3			1.1							
Sh	*Macrolepiota mastoidea* (Fr.: Fr.) Singer	1.1	1.2			1.1							
M	*Boletus aereus* Bull.: Fr.	1.1	1.2				1.1						
Sh	*Hygrocybe pratensis* (Pers.: Fr.) Murrill	1.1	3.3				1.1						
M	*Russula alutacea* (Pers.: Fr.) Fr.	1.1	1.1				1.1						
M	*Inocybe asterospora* Quél.	1.1	2.4					1.2					
M	*Inocybe obscurobadia* (J. Favre) Grund & D. E. Stuntz	2.1	2.2					1.1					
M?(Sh)	*Otidea alutacea* (Pers.) Massee	2.1	3.1					1.1					
M	*Cortinarius safranopes* Rob. Henry		4.1			1.2	1.1						
Sw	*Mycena maculata* P. Karst.		2.2			1.1	3.1						
M	*Pseudocraterellus undulatus* (Pers.: Fr.) Rauschert		3.3			1.1	1.1						
M?	*Ramaria formosa* (Pers.: Fr.) Quél.		1.1			1.1	4.2						
Sw	*Crepidotus variabilis* (Pers.: Fr.) P. Kumm.		2.1			1.2		2.1					
Sh	*Lepiota clypeolaria* (Bull.: Fr.) P. Kumm.		1.2			1.2		1.1					
M	*Cortinarius castaneus* Fr.		2.1				2.1	2.1					
M	*Russula minutula* Velen.	1.1				1.1							
Sh	*Clavulinopsis laeticolor* (Berk. & M. A. Curtis) R. H. Petersen	3.2					1.1						
M	*Lactarius azonites* (Bull.) Fr.	1.1					1.1						
M	*Scleroderma verrucosum* (Bull.: Pers.) Pers.	2.1						1.1					
Sh	*Conocybe brunnea* Watling	1.1						1.1					
M	*Amanita spissa* (Fr.) P. Kumm var. *excelsa* (Fr.: Fr.) Dörfelt & I. L. Roth		1.1			1.1							
M	*Boletus calopus* Pers.: Fr.		1.1				1.1						
M?	*Ramaria botrytis* (Pers.: Fr.) Ricken		1.1				2.1						
M	*Lactarius violascens* (J. Otto: Fr.) Fr.		1.2				1.1						
P	*Omphalotus olearius* (DC.: Fr.) Fayod		1.2				1.3						
M?(Sh)	*Otidea cochleata* (L.: Fr.) Fuckel		1.1				2.1						
M	*Tricholoma bresadolanum* Clemençon		3.3				1.2						
M	*Boletus rhodoxanthus* (Krombh.) Kallenb.		2.2					1.1					
M	*Tricholoma acerbum* (Bull.: Fr.) Quél.			3.2	1.2	2.2	1.3	2.2					
M	*Hebeloma hiemale* Bres.			1.1	1.1	1.1	1.1						
M	*Cortinarius acutus* (Pers.: Fr.) Fr.			3.2		2.2	1.1	1.2					

(cont.)

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Cortinarius aprinus* Melot			1.1	2.2		1.1						
Sw(Sl)	*Tubaria furfuracea* (Pers.: Fr.) Gillet			2.1	1.1		1.1						
Sh	*Lyophyllum paelochroum* Clemençon			1.1	1.2		1.1						
M	*Cortinarius hinnuleus* Fr.			1.1	1.1			2.2					
M	*Tricholoma scalpturatum* (Fr.) Quél.			2.3	2.3			1.1					
M	*Lactarius zonarius* (Bull.) Fr. f. *scrobipes* (Kühner & Romagn.) Quadr.			1.1		2.2		3.1					
M	*Cortinarius obtusus* (Fr.: Fr.) Fr.				2.3	1.2	1.4						
M	*Inocybe cincinnata* (Fr.: Fr.) Quél.				2.2	1.1	1.1						
M	*Russula aurea* Pers.				1.1	1.1	1.2						
M	*Inocybe glabripes* Ricken				1.1	1.1	1.1						
M	*Cortinarius coerulescens* (Schaeff.) Fr.			1.1		1.1							
Sh	*Entoloma incanum* (Fr.: Fr.) Hesler			1.2		1.1							
M	*Hygrophorus lindtneri* M. M. Moser			2.1				1.1					
M	*Scleroderma areolatum* Ehremb.			2.2				1.1					
M	*Tricholoma myomyces* (Pers.: Fr.) J. E. Lange			2.1				1.1					
M	*Boletus subtomentosus* L.: Fr.			1.1			1.1						
M	*Inocybe splendens* R. Heim. var. *phaeoleuca* (Kühner) Kuyper				1.1	1.1							
Sw	*Tremella foliacea* Pers.: Fr.				1.1		1.1						
Sh	*Lyophyllum transforme* (Britzelm.) Singer				1.2		1.1						
M	*Inocybe cincinnata* (Fr.: Fr.) Quél. var. *major* (S. Petersen) Kuyper				1.1		1.1						
Sh	*Entoloma nitens* (Velen.) Noordel.				1.1			1.1					
Sw	*Tremella mesenterica* Retz.: Fr.	1.5	2.5	1.1	1.2						2.1	1.1	
Sl	*Mycena flavoalba* (Fr.) Quél.			1.1	1.1				5.5	6.4	2.4	3.3	
Sh	*Lepiota castanea* Quél.	1.1	1.3	1.1	1.2				2.1				
M	*Tricholoma squarrulosum* Bres.	2.2	3.3	2.2	2.1				1.1				
Sw	*Mycena haematopus* (Pers.: Fr.) P. Kumm.	2.1	1.2						3.1		4.4	4.1	
M	*Inocybe geophylla* (Fr.: Fr.) P. Kumm. var. *lilacina* (Peck) Gillet		1.1						3.5	1.1	4.6	2.1	
Sl	*Clitocybe trullaeformis* (Fr.: Fr.) Quél.				1.1				3.3	5.4	2.3	3.3	
Sl	*Mycena stylobates* (Pers.: Fr.) P. Kumm.	1.1	3.2	3.1					4.2	2.1			
M	*Russula albonigra* (Krombh.) Fr.	1.1	1.2	1.1								2.1	
P(Sw)	*Armillaria mellea* s.l.	2.3	4.1		2.1				1.1	1.1		6.4	
Sw	*Hemimycena cephalotricha* (Joss.) Singer	4.1	4.1		6.1				1.1				
M	*Russula olivacea* (Schaeff.) Pers.	1.2		2.1	1.1				2.1				
Sh	*Lycoperdon atropurpureum* Vittad.	1.2	2.1						2.1			3.1	
M	*Cortinarius dionysae* Rob. Henry		2.1	2.3					4.3		4.5		
Sw(Sl)	*Mycena arcangeliana* Bres.	1.2	4.1						1.1				
Sh	*Chamaemyces fracidus* (Fr.) Donk	1.1		1.1							1.1		
Sl	*Marasmius alliaceus* (Jacq.: Fr.) Fr.	1.1		2.1								2.4	
M	*Inocybe mixtilis* (Britzelm.) Sacc.	1.1			1.1					1.1			

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
Sh	*Sarcosphaera crassa* (Santi ex Steud.) Pouzar		1.1	1.1	1.1				2.1				
M	*Cortinarius bulliardi* (Pers.: Fr.) Fr.		2.1	1.1					2.1				
Sl	*Collybia peronata* (Bolton: Fr.) P. Kumm.		3.3		1.1				3.1				
M	*Cortinarius flexipes* (Pers.: Fr.) Fr.		1.1						4.4	2.2			
M	*Inocybe cervicolor* (Pers.) Quél.		1.1						1.1		6.4		
Sw	*Bisporella citrina* (Batsch: Fr.) Korf & Carpenter		3.1						7.2			5.1	
M	*Amanita gemmata* (Fr.) Bertillon	2.3								3.2			
Sh	*Clavulinopsis corniculata* (Schaeff.: Fr.) Corner		3.1						2.1				
M	*Inocybe furfurea* Kühner		1.1						4.1				
M	*Lactarius pterosporus* Romagn.		1.1						1.1				
Sw	*Mycena acicula* (Schaeff.: Fr.) P. Kumm.		1.1						3.2				
M	*Russula violeipes* Quél.		2.2						1.1				
M	*Inocybe sindonia* (Fr.) P. Karst.		1.1							3.1			
Sh	*Lycoperdon echinatum* Pers.: Pers.		1.1							1.1			
Sl	*Mutinus caninus* (Huds.: Pers.) Fr.	1.1	1.2								1.1		V
M	*Russula amoenicolor* Romagn.	2.2	2.1									1.1	
Sw	*Panellus violaceofulvus* (Batch: Fr.) Singer	1.1									5.2	5.4	
Sw	*Gerronema strombodes* (Berk. & Mont.) Singer		1.1								1.1	3.3	
Sl	*Mycena citrinomarginata* Gillet	2.1									1.1		
Sw	*Coprinus micaceus* (Bull.: Fr.) Fr.		2.2									6.2	
M	*Inocybe griseolilacina* J. E. Lange			1.1	2.1				1.1				
M	*Cortinarius dibaphus* Fr. var. *nemorosus* (Rob. Henry) Rob. Henry			1.1					2.1				
Sh	*Entoloma serrulatum* (Fr.: Fr.) Hesler			1.1					3.1				
Sh	*Conocybe tenera* (Schaeff.: Fr.) Fayod			1.1								2.1	
M	*Cortinarius aleuriosmus* Maire				1.1				2.1				
M	*Cortinarius auroturbinatus* (Secr.) J. E. Lange				1.1						1.1		
M	*Hygrophorus persoonii* Arnolds var. *fuscovinosus* (Bon) Bon	1.1	1.3	1.1	2.2								
M	*Hygrophorus russula* (Fr.: Fr.) Quél.	3.2	3.4	3.4	5.4								
M	*Leccinum lepidum* (Bouchet *ex* Essette) Quadr.	2.4	1.5	1.2	1.3								
Sw	*Mycena meliigena* (Berk. & Cooke) Sacc.	5.1	5.2	5.1	4.1								
M	*Russula vinosobrunnea* (Bres.) Romagn.	1.2	2.1	1.1	1.1								
Sh	*Hygrocybe conica* (Schaeff.: Fr.) P. Kumm. f. *pseudoconica* (J. E. Lange) Arnolds	1.1	3.3	1.1									
M	*Lactarius zonarius* (Bull.) Fr.	1.1	1.2	1.1									VI
Sh	*Hygrocybe acutoconica* (Clemençon) Singer	1.1	1.2		1.1								
Sl	*Lepista flaccida* (J. Sowerby: Fr.) Pat.	3.4	2.3		1.1								
Sh	*Leucopaxillus amarus* (Alb. & Schwein.: Fr.) Kühner	5.4	4.2		4.4								
M	*Russula acrifolia* Romagn.	1.1	2.1		1.1								
M	*Russula maculata* Quél.	2.4	4.2		1.2								
M	*Aureoboletus gentilis* (Quél.) Pouzar	1.2		1.2	1.1								
Sh(Sw)	*Hohenbuehelia petalodes* (Bull.: Fr.) Schulzer	1.2		1.1	1.1								

(cont.)

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Cortinarius sodagnitus* Rob. Henry		2.1	2.2	1.1								
Sw	*Hydropus scabripes* (Murrill) Singer		1.1	1.1	2.1								
M	*Russula heterophylla* (Fr.: Fr.) Fr.	1.1		2.1									
M	*Cortinarius salor* Fr.	2.1		3.2									
Sw	*Mycena algeriensis* Maire	1.1			1.1								
M	*Boletus satanas* Lenz		1.1	1.1									
M	*Cortinarius alborufescens* Imler		1.1	1.1									
M	*Cortinarius multiformis* Fr.		2.2	2.2									
Sh	*Entoloma mougeotii* (Fr.) Hesler		1.1	1.2									
Sh	*Entoloma undatum* (Gillet) M. M. Moser		1.1	1.1									VI
M	*Gomphidius glutinosus* (Schaeff.: Fr.) Fr.		1.1	1.1									
M	*Hygrophorus nemoreus* (Pers.: Fr.) Fr.		2.2	1.1									
M	*Inocybe bongardii* (Weinm.) Quél.		1.1	1.1									
M	*Lactarius atlanticus* Bon		2.4	1.1									
Sl(Sw)	*Mycena rorida* (Fr.: Fr.) Quél.		2.1	4.2									
M	*Russula grisea* Fr.		1.1		2.1								
M	*Amanita franchetii* (Boud.) Fayod		1.1		1.1								
Sh(P?)	*Collybia racemosa* (Pers.: Fr.) Quél.		2.1		1.1								
M	*Sarcodon cyrneus* Maas Geest.		1.2		3.2								
P	*Hirneola auricula-judae* (Bull.: Fr.) Berk.		1.1		1.1								
M	*Tricholoma equestre* (L.: Fr.) P. Kumm.		1.1		1.1								
Sl	*Rickenella fibula* (Bull.: Fr.) Raithelh.					3.5	3.3	2.1	3.2			3.1	
M	*Russula nigricans* Fr.					1.2	1.2			6.5		4.1	
M	*Lactarius vellereus* (Fr.: Fr.) Fr.					2.2	3.1				1.1	2.1	
Sl	*Marasmius bulliardii* Quél.						1.1	5.2	3.1			4.3	
Sl(Sw)	*Mycena filopes* (Bull.: Fr.) P. Kumm.						1.1	1.1			3.1	3.2	
Sw	*Hymenoscyphus serotinus* (Pers.: Fr.) W. Phillips						3.1		5.3		4.1	6.4	
M	*Russula laurocerasi* Melzer var. *fragrans* (Romagn.) Kuyper & Vuure					1.1	1.1					1.2	
Sl	*Marasmius cohaerens* (Pers.: Fr.) Cooke & Quél.					1.1		1.1			1.1		
M	*Lactarius subdulcis* (Bull.: Fr.) Gray					1.1			3.2			2.2	
Sw	*Psilocybe fascicularis* (Huds.: Fr.) Noordel.						1.1	3.1				6.2	
M	*Inocybe petiginosa* (Fr.: Fr.) Gillet						1.1		1.1			2.1	
Sh	*Mycena flavescens* Velen.							1.1	6.2	4.1			
Sl(Sw)	*Marasmius torquescens* Quél.							1.1	3.1		2.1		
Sw	*Coprinus atramentarius* (Bull.: Fr.) Fr.					1.1					2.1		
Sh	*Helvella crispa* (Scop.: Fr.) Fr.					1.1					4.4		
M	*Cortinarius cinnamomeus* (L.: Fr.) Fr.					1.1						3.2	
Sw/Sl	*Mycena xantholeuca* Kühner					2.1						2.2	
M	*Lactarius subumbonatus* Lindgr.						1.1		1.1				
Sh	*Helvella elastica* Bull.: Fr.						1.1				3.2		
Sw	*Galerina badipes* (Fr.) Kühner						1.1					2.1	

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
Sl	*Marasmius wynnei* Berk. & Broome							2.1				2.1	
M	*Cortinarius rigidus* Fr.							1.1		2.1			
Sw	*Galerina marginata* (Batsch) Kühner								3.3	3.4	4.2	3.4	
Sw(Sl)	*Galerina stylifera* (G. F. Atk.) A. H. Sm. & Singer								4.4	4.5	4.4	5.6	
Sl	*Hemimycena gracilis* (Quél.) Singer								6.4	2.2	4.1	1.1	
M	*Lactarius salmonicolor* R. Heim & Leclair								4.4	3.3	5.5	4.2	
Sl	*Mycena amicta* (Fr.: Fr.) Quél.								2.2	2.2	2.1	3.2	
Sw	*Pseudohydnum gelatinosum* (Scop.: Fr.) P. Karst.								3.4	4.5	1.1	4.6	
Sw	*Xerula melanotricha* Dörfelt								2.2	2.4	3.6		
Sl	*Clitocybe fragrans* (With.: Fr.) P. Kumm.								2.1	3.1	1.1		
Sl(P?)	*Collybia tuberosa* (Bull.: Fr.) P. Kumm.								1.1	3.1	2.1		
Sh	*Mycena zephirus* (Fr.: Fr.) P. Kumm.								7.5	4.4		2.1	
M	*Russula viscida* Kudrna								2.1	1.2		4.5	
Sw	*Calocera viscosa* (Pers.: Fr.) Fr.								5.3		3.5	5.6	
Sl	*Mycena polyadelpha* (Lasch) Kühner								4.2		3.1	7.2	
Sw	*Dacrymyces stillatus* Nees: Fr.								4.3		6.4	6.4	VII
M	*Hygrophorus pudorinus* (Fr.: Fr.) Fr.								3.4		1.1	5.5	
Sl	*Mycena aurantiomarginata* (Fr.: Fr.) Quél.									1.1	1.1	4.4	
Sw	*Pluteus cervinus* (Schaeff.) P. Kumm.									1.3	2.5	2.3	
Sw	*Tricholomopsis rutilans* (Schaeff.: Fr.) Singer									1.1	3.2	4.1	
Sh	*Agaricus luteomaculatus* (F. H. Möller) F. H. Möller									1.3		2.1	
Sh	*Conocybe pilosella* (Pers.: Fr.) Kühner								3.2		2.3		
M	*Cortinarius odorifer* Britzelm.								2.2		1.1		
M	*Russula urens* Romell								1.1		1.2		
Sw	*Mycena crocata* (Schrad.: Fr.) P. Kumm.								2.1			2.3	
Sw(Sl)	*Tubaria hiemalis* Bon								2.1			2.1	
M	*Inocybe assimilata* (Britzelm.) Sacc.									2.2	2.1		
M	*Russula queletii* Fr.									3.2	4.4		
M	*Inocybe whitei* (Berk. & Broome) Sacc.									1.1	1.2		
Sl	*Mycena epipterygia* (Scop.: Fr.) Gray var. *viscosa* (Maire) Ricken									1.1		5.1	
Sw	*Mycena corynephora* Maas Geest.	6.1	6.2										
Sw	*Marasmiellus omphaliformis* (Kühner) Noordel.	4.1	3.1										
Sh	*Agaricus praeclaresquamosus* A. E. Freeman	4.5	1.5										
Sh	*Leucoagaricus serenus* (Fr.) Bon & Boiffard	3.2	1.1										
M	*Boletus rubellus* Krombh.	3.1	1.1										
M	*Russula amoenicolor* Romagn. var. *stenocystidiata* Sarnari	3.1	1.1										VIII
Sw	*Armillaria tabescens* (Scop.: Fr.) Emeland	2.1	4.3										
Sh	*Coprinus picaceus* (Bull.: Fr.) Gray	2.5	2.4										
M	*Lactarius rugatus* Kühner & Romagn.	2.5	2.3										
M	*Gyroporus castaneus* (Bull.: Fr.) Quél.	2.2	1.2										
Sw	*Marasmiellus virgatocutis* Robich *et al*.	2.1	2.1										

(cont.)

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Russula maculata* Quél. var. *bresadoliana* (Singer) Romagn.	2.2	2.1										
Sw	*Simocybe centunculus* (Fr.: Fr.) P. Karst.	2.1	1.1										
Sh	*Volvariella plumulosa* (Lausch *ex* Oudem.) Singer s.str. J. E. Lange	1.1	1.1										
Sh	*Agaricus xanthoderma* Genev. var. *griseus* (A. Pearson) Bon & Cappelli	2.1	2.1										
M	*Boletus queletii* Schulzer	1.1	1.1										
Sh	*Helvella lacunosa* Afzel: Fr.	2.1	2.3										
Sw	*Hydropus floccipes* (Fr.) Singer	1.1	2.1										
Sh	*Hygrocybe reai* (Maire) J. E. Lange	1.1	2.4										
Sh	*Rhodocybe gemina* (Fr.) Kuyper & Noordel.	2.2	1.1										
M	*Russula pectinatoides* Peck.	2.1	1.2										
Sh	*Clavulinopsis luteoalba* (Rea) Corner	1.1	1.1										
Sl	*Micromphale brassicolens* (Romagn.) P. D. Orton	2.1	3.2										
Sw	*Pluteus romellii* (Britzelm.) Sacc.	1.1	1.1										
Sl	*Mycena galopus* (Pers.: Fr.) P. Kumm. var. *nigra* Rea	4.1											VIII
Sh	*Agaricus silvaticus* Schaeff.: Fr.	2.4											
M	*Inocybe maculata* Boud.	3.1											
Sw	*Marasmiellus candidus* (Bolton) Singer	6.2											
Sl	*Marasmius corbariensis* (Roum.) Singer		6.1										
Sw	*Dasyscyphella nivea* (Hedw.: Fr.) Raitv.		4.1										
Sh	*Clavariadelphus flavoimmaturus* R. H. Petersen		5.5										
Sh	*Hygrocybe russocoriacea* (Berk. & O. K. Mill.) P. D. Orton & Watling		1.2										
M	*Hygrophorus penarius* Fr.		1.2										
M	*Cortinarius candelaris* Fr.		1.2										
Sh	*Conocybe vexans* P. D. Orton		1.2										
M	*Scleroderma polyrhizum* J. F. Gmel.: Pers.		1.2										
M?(Sh)	*Otidea onotica* (Pers.: Fr.) Fuckel		2.3										
Sh	*Peziza badia* Pers.: Fr.		2.2										
M	*Russula lilacea* Quél.		1.3										
Sw	*Clitocybula lenta* (Maire) Malençon & Bertault		2.2										
M	*Hygrophorus arbustivus* (Fr.) Fr.			2.1	2.1								
M	*Inocybe similis* Bres.			1.1	1.1								
Sh	*Lyophyllum crassifolium* (Berk.) Singer			1.1	1.1								
M	*Suillus bellini* (Inzenga) Kuntze			1.1	1.1								
Sh	*Macrothyphula juncea* (Alb. & Schwein.: Fr.) Berthier			6.1									IX
M	*Amanita ovoidea* (Bull.: Fr.) Link			1.2									
M	*Hydnum albidum* Peck			1.2									
M	*Tricholoma sulphurescens* Bres.			1.3									
M	*Lactarius sanguifluus* (Paulet: Fr.) Fr.				5.1								
M	*Cantharellus lutescens* Pers.: Fr.				4.1								

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Lactarius deliciosus* (L.: Fr.) Gray				3.3								
M	*Suillus collinitus* (Fr.) Kuntze				2.2								
Sw	*Mycena inclinata* (Fr.) Quél.					5.4	5.4	5.3					
Sw	*Psathyrella piluliformis* (Bull.: Fr.) P. D. Orton					3.2	2.1	2.1					
Sl	*Rutstroemia echinophila* (Bull.: Fr.) Höhn.					3.2	1.2	1.1					
P(Sw?)	*Collybia fusipes* (Bull.: Fr.) Quél.					2.1	2.2	1.1					
Sh	*Agaricus silvicola* (Vittad.) Sacc.					2.1	1.1	1.1					
Sw	*Coprinus lagopus* (Fr.: Fr.) Fr.					1.1	1.1	1.1					
Sl	*Galerina hypnorum* (Schrank: Fr.) Kühner					2.1	2.1						
M	*Hebeloma fastibile* (Pers.: Fr.) P. Kumm.					1.1	2.1						
M	*Cortinarius croceocoeruleus* (Pers.: Fr.) Fr.					1.1	1.1						IX
M	*Lactarius controversus* (Pers.: Fr.) Fr.					2.2	1.2						
Sl	*Clitocybe odora* (Bull.: Fr.) P. Kumm.					2.2		3.2					
Sw	*Panellus stipticus* (Bull.: Fr.) P. Karst.					2.1		2.1					
Sl	*Marasmius epiphylloides* (Rea) Sacc. & Trotter					3.1							
Sh	*Mycena albidolilacea* Kühner & Maire					1.2							
M?	*Ramaria fennica* (P. Karst.) Ricken					1.2							
M	*Boletus reticulatus* Schaeff.						1.1	1.1					
M	*Cortinarius alboviolaceus* (Pers.: Fr.) Fr.						1.1	1.2					
M	*Cortinarius olivaceofuscus* Kühner						1.1	1.2					
Sl (P?)	*Collybia amanitae* (Batsch) Kreisel						3.1						
M	*Amanita caesarea* (Scop.: Fr.) Pers.						2.2						
M?	*Ramaria flavescens* (Schaeff.) R. H. Petersen						1.2						
Sl	*Collybia confluens* (Pers.: Fr.) P. Kumm.								4.2	4.4			
M	*Russula puellaris* Fr.								2.3	3.5			
Sw	*Megacollybia platyphylla* (Pers.: Fr.) Kotl. & Pouzar								3.1	2.2			
Sl	*Clitocybe vibecina* (Fr.) Quél.								2.1	2.1			
M	*Russula laurocerasi* Melzer								2.1	1.1			
Sl	*Micromphale perforans* (Hofm.: Fr.) Gray								5.2				
M	*Cortinarius croceus* (Schaeff.) Fr.								4.4				
Sw	*Rutstroemia luteovirescens* (Roberge) V. S. White								4.3				
Sw	*Crucibulum crucibuliforme* (Scop.) V. S. White								4.2				
Sh	*Lacrymaria lacrymabunda* (Bull.: Fr.) Pat.								4.2				X
Sh	*Clavaria falcata* Pers.: Fr.								4.1				
Sl	*Clitocybe foetens* Melot								4.1				
Sl	*Clitocybe pseudoobbata* (J. E. Lange) Kuyper								4.1				
Sh	*Clitocybe vermicularis* (Fr.) Quél.								4.1				
Sl	*Collybia alcalivirens* Singer								3.1				
Sh	*Entoloma hebes* (Romagn.) Trimbach								3.1				
M	*Inocybe leiocephala* D. E. Stuntz								3.1				
M	*Lactarius mitissimus* (Fr.: Fr.) Fr.								3.1				
Sw	*Macrotyphula fistulosa* (Holmsk.: Fr.) R. H. Petersen								3.1				

(cont.)

Table 2. *Continued.*

GT	Species	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	Group
M	*Tricholoma stans* (Fr.) Sacc.								3.1				
M	*Russula cavipes* Britzelm.								2.2				X
M	*Russula mairei* Singer								2.2				
M	*Russula violeipes* Quél. f. *citrina* Quél.									3.3			
Sw	*Lachnellula subtilissima* (Cooke) Dennis										9.2	9.4	
Sw	*Bertia moriformis* (Tode: Fr.) De Not.										4.1	7.1	
Sw	*Panellus mitis* (Pers.: Fr.) Singer										4.4	6.5	
Sw	*Ascocoryne cylichnium* (C. Tul.) Korf										3.2	4.1	
Sh	*Clitocybe sinopica* (Fr.: Fr.) P. Kumm.										2.1	3.1	
Sl	*Pseudoclitocybe cyathiformis* (Bull.: Fr.) Singer										2.2	2.1	
M	*Hygrophorus chrysodon* (Batsch: Fr.) Fr.										5.5		
M	*Cortinarius elegantior* (Fr.) Fr.										5.1		
Sl(P?)	*Collybia cookei* (Bres.) J. D. Arnold										3.2		
M	*Lactarius ichoratus* (Batsch) Fr.										3.1		
Sw	*Lachnum bicolor* (Bull.: Fr.) P. Karst.											7.2	
Sw	*Gymnopilus sapineus* (Fr.: Fr.) Maire											5.5	
Sw	*Exidia thuretiana* (Lév.) Fr.											5.1	
Sw	*Mycena epipterygia* (Scop.: Fr.) Gray var. *lignicola* A.H. Sm.											5.1	
Sw(Sl)	*Psilocybe aeruginosa* (M. A. Curtis: Fr.) Noordel.											4.5	
Sh	*Cystoderma carcharias* (Pers.) Fayod											4.4	
Sw	*Bisporella subpallida* (Rehm) Dennis											4.1	
Sl	*Hymenoscyphus scutula* (Pers.: Fr.) W. Phillips											4.1	
P	*Pleurotus ostreatus* (Jacq.: Fr.) P. Kumm.											3.4	
M	*Lactarius piperatus* (L.: Fr.) Pers.											3.2	
Sw	*Pholiota lenta* (Pers.: Fr.) Singer											3.2	
Sh	*Cystoderma amianthinum* (Scop.) Fayod											2.2	

Group III contains 15 species found everywhere except in evergreen oak woods of the Grosseto coast (plots 1 and 2) and the Siena hills (plots 3 and 4). Species absent from coastal evergreen oak woods (plots 1 and 2) seem to avoid drier stations, preferring moister environments. No confirmation of this was found in the literature, because this aspect of fungal ecology is often not considered.

Group IV contains 34 species common to all broadleaf woods; among these, only *Cortinarius anserinus*, *C. decipiens*, *Entoloma sinuatum*, *Hymenoscyphus fructigenus*, *Marasmius quercophilus*, *Ramaria decurrens*, *Russula decipiens*, *Sarcoscypha coccinea* and *Tricholoma sejunctum* result from the literature (Antonín & Noordeloos 1993; Brandrud *et al*. 1990–1998; Breitenbach & Kränzlin 1981–2000; Courtecuisse & Duhem 1994; Jülich 1989; Marchand 1971–1986; Noordeloos 1992; Riva 1988; Romagnesi 1967; Sarnari 1998) as really linked to this type of habitat.

Group V contains 6 species never present in the hilly woods, seeming to prefer extreme climatic conditions.

Group VI contains the 35 species common to hill-belt and coastal evergreen oak woods. The literature links *Leccinum lepidum* and *Sarcodon cyrneus* with *Quercus ilex* L. (Alessio 1985; Galli

1998; Jülich 1989; Orsino 1991). Many of the species we found in coastal and hill-belt evergreen oak woods are reported in the literature (Alessio 1985; Bas *et al*. 1988–1995; Basso 1999; Bertault 1982; Bon 1988; Candusso 1997; Courtecuisse & Duhem 1994; Galli 1983; Maas Geesteranus 1992; Romagnesi 1967) merely as linked with oak woods or more generally broadleafs (*Amanita franchetii*, *Aureoboletus gentilis*, *Hygrophorus nemoreus*, *Lactarius zonarius*, *Mycena meliigena*, *Russula grisea*, *R. heterophylla*, *R. vinosobrunnea*). In his recent monograph on the genus *Russula*, however, Sarnari (1998) reports that *Russula grisea* and *R. heterophylla* are species typically linked with hot dry environments and are therefore frequent in the Mediterranean area. *Boletus satanas*, *Cortinarius salor* and *C. sodagnitus*, often cited in the literature as thermophilous calcicolous species (Bon 1983; Bujakiewicz 1992; Courtecuisse & Duhem 1994; Darimont 1973; Heinemann & Darimont 1956; Lisiewska 1974; Watling 1970), were abundant in our evergreen oak woods. This was to be expected since these woods are typically thermophilous; however, the reference to soil type seems strange. Indeed, *Boletus satanas* and *Cortinarius sodagnitus* were found not only in plot 3 on 'calcare cavernoso' but also in plots 1 and 2 on sandstone. *Gomphidius glutinosus* and *Tricholoma equestre* are special cases, mentioned in the literature as preferential (the former) from *Picea* forests and exclusive (the latter) to pine woods (Bertault 1982; Breitenbach & Kränzlin 1981–2000; Malençon & Llimona 1980; Termorshuizen 1990; Watling 1970). In line with Perini and Barluzzi (1987), these species are considered alien, because they are linked to an introduced plant (i.e., pines).

Group VII contains 28 species found in fir woods on Mt. Amiata and in the Casentine Forests. According to the literature (Brandrud *et al.* 1990–1998; Breitenbach & Kränzlin 1981–2000; Cappelli 1984; Courtecuisse & Duhem 1994; Maas Geesteranus 1992; Marchand 1971–1986; Papetti *et al.* 1999; Romagnesi 1967; Sarnari 1998), *Agaricus luteomaculatus*, *Calocera viscosa*, *Cortinarius odorifer*, *Hemimycena gracilis*, *Mycena amicta*, *M. aurantiomarginata*, *M. epipterygia* var. *viscosa*, *M. zephirus*, *Pseudohydnum gelatinosum*, *Russula queletii*, *R. urens*, *R. viscida* and *Tricholomopsis rutilans* are linked with conifer woods or mixed woods with conifers, in line with the present findings. On the other hand, *Lactarius salmonicolor* (Basso 1999; Bon 1988; Courtecuisse & Duhem 1994; Kost & Haas 1989) is a mycorrhizal species exclusive to *Abies alba* Miller, which we found abundantly and frequently in these plots. A special case is *Mycena crocata*, which according to the literature (Breitenbach & Kränzlin 1981–2000; Lisiewska 1974; Maas Geesteranus 1992) is linked with beech. We found the species in the two natural fir woods (plots 8 and 11) where beeches are abundant, but not in planted fir woods (plots 9 and 10), where a few specimens of *Fagus sylvatica* L. had indeed become established.

Groups VIII, IX and X contain species found in only one type of environment. Together with those of group VI (common to coastal and hill-belt evergreen oak woods) and VII (common to fir woods of Mt. Amiata and Casentine Forests), they can be regarded as differential (preferential or exclusive) species of evergreen oak, chestnut and fir woods. When these results are compared with those published by Barluzzi *et al*. (1986) for heathlands of the Merse valley (southern Tuscany) and especially those of Laganà *et al.* (1996, 1999a, b, 2001), Perini *et al.* (1999) and Salerni *et al*. (1995, 1998, 2000), for deciduous oak woods of central southern Tuscany the number of exclusive species is much less. Indeed, as mentioned above, many species in Group VI are linked with the genus *Quercus*, not only with *Quercus ilex* L. Similarly, specimens of chestnut occur in some deciduous oak woods of southern Tuscany (Laganà *et al*. 2001; Salerni *et al.* 1995, 1998, 2000); in heathlands, many species mycorrhizal of conifers have been found due to the presence of pines; some are also present in fir woods, but are not absent from plots 6 and 7 where young plants of *Abies alba* were found.

Species proving to be differential of evergreen oak woods, chestnut woods and fir woods on the basis of these comparisons are listed in Appendices 2, 3 and 4, respectively. Some of the species

(asterisks) present in Appendix 2 are mycorrhizal of conifers; as said before, for *Tricholoma equestre*, these species should be considered alien. The greatest number (56) of differential species was found in fir woods, followed by evergreen oak woods (38) and chestnut woods (6). It should be recalled that the environments richest in exclusive species (fir woods and evergreen oak woods) represent the two extremes of the range of vegetation investigated, as observed by Laganà *et al.* (2001). Indeed, evergreen oak woods are the most thermoxerophilous and fir woods are the most mezophilous.

FUNGAL BIODIVERSITY

In line with Arnolds (1981) and Dighton (1994), the number of species found in each plot was taken as a measure of fungal biodiversity. The independence of fungal biodiversity from plot size was confirmed by statistical analysis; specifically, Pearson's linear correlation was not significant ($p > 0.05$).

Figure 2 shows the number of fungal species found in each forest community. The highest fungal biodiversity was found in coastal evergreen oak woods and the least in fir woods (Casentine Forests followed by Mt. Amiata). The Mann-Whitney U test gave similar results, with the median number of species in plots with broadleaf woods significantly greater than in plots with woods dominated by conifers ($U = 2.5$; $p < 0.05$).

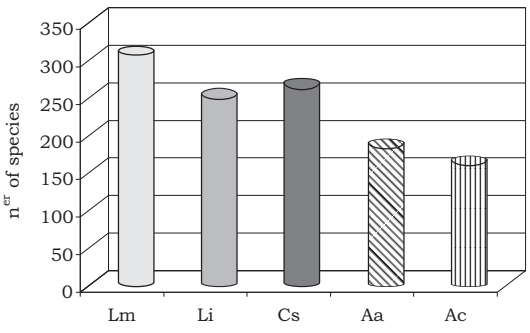

Fig. 2. Fungal biodiversity in the different studied forest ecosystems (Lm – evergreen oak woods of the coastline; Li – evergreen oak woods of the inland hills; Cs – chestnut coppices; Aa – fir woods on Mt. Amiata; Ac – fir woods in the Parco Naturale delle Foreste Casentinesi.

CLASSIFICATION AND ORDERING OF SAMPLES

Figure 3 was plotted to get a better understanding of the relations between fungal communities in the various forest ecosystems. The first plots showing a link (linkage distance just over 0.5) were the coastal evergreen oak woods (plots 1 and 2). Plots

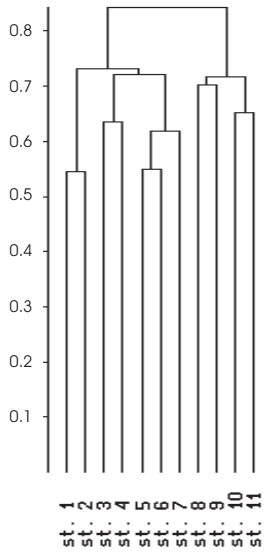

Fig. 3. Classification of samples (st. 1–11) by fungal species.

5 and 6 (hill-belt chestnut woods) were linked at a slightly larger distance, whereas chestnut wood at higher altitude (plot 7) linked at 0.6. The fir woods of the Casentine Forests (plots 10 and 11) and those of Mt. Amiata were linked at a distance of almost 0.7.

The fungal communities are probably affected to a considerable extent by the difference in vegetation between natural and artificial fir woods. The latter are initially poor in species diversity but evolve towards a more natural state. A general trend in Fig. 3 is the presence of two large groups which correspond to broadleaf and conifer communities. A surprising aspect is that inland evergreen oak woods have a closer link with chestnut

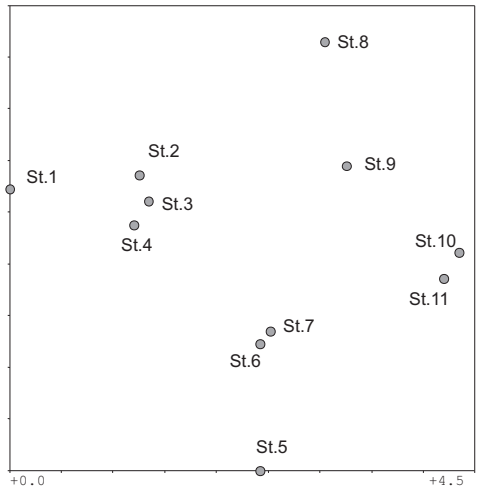

Fig. 4. Ordination (DCA) by fungal species found in the 11 studied permanent plots (St. 1–11).

woods than with coastal evergreen oak woods. Evidently climate and plot features (such as altitude) have a greater influence than vegetation in this case. Although evergreen oak woods and chestnut woods of the Siena hills have many plants in common, coastal and hill-belt evergreen oak woods have more.

Figure 4 shows the samples ordered by DCA. The horizontal axis can be interpreted as a climate/altitude gradient giving an order going from evergreen oak woods (plots 1–4) through chestnut woods (plots 5–7) to fir woods of Mt. Amiata (plots 8 and 9) and finally those of the Casentine Forests (plots 10 and 11).

TROPHIC GROUPS

Many studies in Central and Eastern European countries have shown damage to forest ecosystems, especially near industrial areas, in recent years. It has been shown that mycobiota, especially symbionts, decrease in abundance in declining forests (Arnolds 1987; Fellner 1993; Schlechte 1987). Authors in Central European countries (Fellner 1993; Schlechte 1987, 1991) have tried to find a relation between pollution and fungal communities. They found that a parameter, the mycorrhizal ratio (the percentage of mycorrhizal with respect to total fungal species), was 40–60% in unpolluted areas, 20–40% in intermediate areas and < 20% in heavily polluted areas. According to Fellner (1993), the number of lignicolous species increases significantly in polluted areas.

Figure 5 shows the percentages of the various trophic groups of the fungal species found in the 11 plots. According to the above criteria, forest health seemed to be good, since the percentage of mycorrhizal species was nearly always above 40%. The only exception was in the Casentine Forests, where this ratio was 30–40% and the percentage of lignicolous saprotrophs as high as 30%.

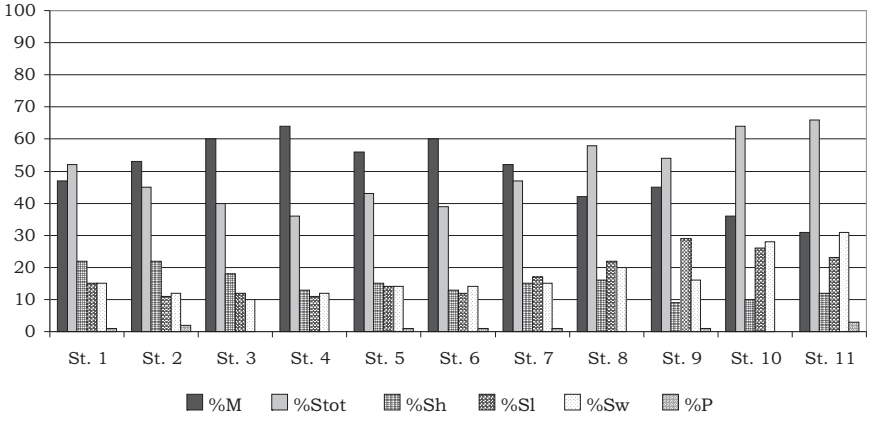

Fig. 5. Percentage of each trophic group in each of the studied permanent plots (St. 1–11). M – mycorrhizal species; Stot – total saprotrophs; Sh – humicolous saprotrophs; Sl – saprotrophs on litter; Sw – saprotrophs on wood; P – parasites.

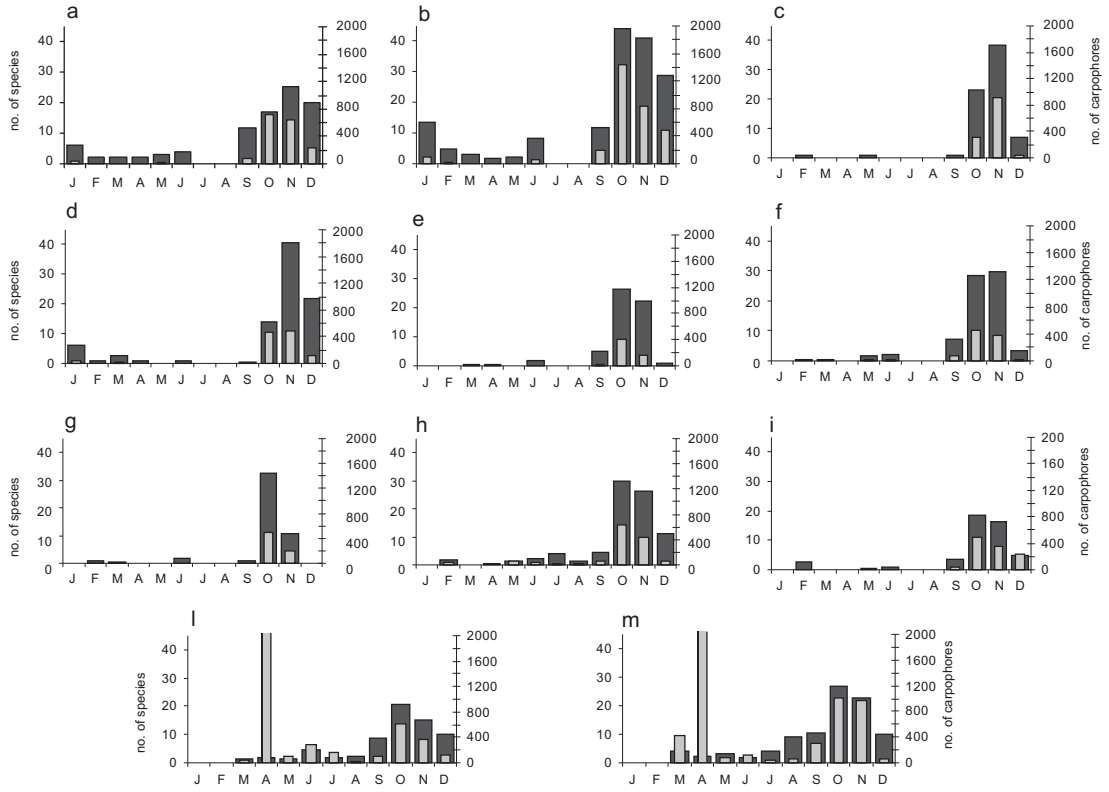

Fig. 6. Number of fungal species (wide bars) and number of carpophores (narrow bars) found in the permanent plots in each month. a – Station 1, b – Station 2, c – Station 3, d – Station 4, e – Station 5, f – Station 6, g – Station 7, h – Station 8, i – Station 9, l – Station 10, m – Station 11.

This seems strange because these plots are in a nature reserve and a protected area with low human impact, distant from industrial centers. In line with the observation of Loppi *et al.* (1989), the proportions of fungi in the different trophic groups vary with altitude and thus with climate. As shown by Laganà *et al.* (1999c), the number of symbionts decreases with increasing altitude. With regard to lignicolous saprotrophs, these authors found a relation between the quantity of wood on the ground available for attack by fungi and the quantity of fungi attributed to this trophic group.

PERIODICITY

It is well established that fungal fruiting is a seasonal event that depends closely on weather, especially temperature and rainfall. High rainfall and mild temperatures in summer and autumn are generally regarded as favoring carpophore formation by fungal mycelia (Arnolds 1981). Many studies have been undertaken to address this question and to find direct relationships between fungi and climatic parameters, especially in Northern European countries. A fairly complete list of the literature is given in Ohenoja (1993). What emerges from most of these studies is the extreme complexity of relations between fungal fruiting and weather variables, complicated, moreover, by their interactions with the environment and the difficulty of finding simple correlations.

Figure 6 shows the mean number of fungal species and mean number of carpophores counted in each plot, month by month during the observation period. In general, the period of greatest fruit-

body production by mycelia was autumn (September–December), especially the months of October and November. The duration of fruiting varied widely in the different environments: in extreme environments (fir woods and coastal evergreen oak woods; Figs 6l, 6m, 6a) the mycelia produced carpophores in almost all months of the year, whereas in the hill-belt (plots 3–7, Figs 6c–g) carpophores were not produced in many months of the year. This is easily explained on the basis of the results in Loppi *et al*. (1989) and Perini *et al*. (1996): where climate is characterized by a single critical season, mycelia fruit more continuously; where there are two critical periods, fruiting is less regular. At high altitudes (plots 10 and 11) the only limiting factor for fungal fruiting is winter cold, as shown by the total absence of carpophores in January and February. In coastal evergreen oak woods (plots 1 and 2), the critical months are July and August, with drought and high temperatures. At intermediate altitudes there are two limiting periods, cold winters and arid summers, making fruiting discontinuous, albeit in different ways in the different plots.

At high altitudes (plots 10 and 11), fruiting therefore begins in March, increasing to a peak in October and declining in November and December. On the coast (plots 1 and 2), the mycelia begin to fruit in September, reaching a peak in November and ending in June. At intermediate altitudes, excluding the occasional carpophore in spring, production is practically limited to autumn.

The columns for number of carpophores and species show a similar pattern in almost all plots. The only major exception is high spring production in Casentine Forest fir woods (Figs 6l, 6m; plots 10 and 11) due to the presence of small lignicolous ascomycetes and basidiomycetes that fruit abundantly (*Dacrymyces stillatus*, *Lachnellula subtilissima*, *Lachnum bicolor*, *Panellus violaceofulvus*).

CONCLUSIONS

The present research provides further insights into the ecology of fungi in Mediterranean environments. Data on the preferential environments of many taxa, in terms of forest community, substrate and climatic range, emerges from Table 1. With regard to climatic range, the graphs of monthly fungal fruiting provide insights into the phenology of certain taxa and the influence of weather variables on carpophore production at a local level. The classification and ordering of samples were fundamental to identifying the main factors determining the establishment of a particular fungal community in the environments considered.

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APPENDIX 1

List of the sporadic species found in each permanent plot (for abbreviations see Table 2).

STATION 1. M – *Boletus splendidus* C. Martin, Sh – *Bovistella radicata* (E. J. Durand & Mont.) Pat., Sh(Sw) – *Coprinus silvaticus* Peck, Sh – *Entoloma chalybaeum* (Fr.: Fr.) Noordel., Sh – *Entoloma majaloides* P. D. Orton, Sh – *Helvella atra* Oeder: Fr., M – *Inocybe godeyi* Gillet, M – *I. tjallingiorum* Kuyper, M – *Lactarius cimicarius* (Batsch) Gillet, M – *Leccinum crocipodium* (Letell.) Watling, Sl(Sw) – *Marasmius scorodonius* (Fr.: Fr.) Fr., Sh – *Mycena aetites* (Fr.) Quél., M – *Pisolithus arhizus* (Scop.: Pers.) Rauschert, M – *Russula amoenolens* Romagn., Sh – *Tarzetta catinus* (Holmsk.: Fr.) Korf & D. P. Rogers s.str., M – *Tricholoma columbetta* (Fr.: Fr.) P. Kumm.

STATION 2. M – *Amanita citrina* (Schaeff.) Pers. var. *alba* (Gilb.) Gilb., M – *A. crocea* (Quél.) Singer, M – *A. fulva* (Schaeff.: Pers.) Fr., P – *Asterophora lycoperdoides* (Bull.: Fr.) Ditmar, M – *Astraeus hygrometricus* (Pers.: Pers.) Morgan, Sh – *Clathrus ruber* Pers.: Pers., Sw – *Coprinus echinosporus* Buller, Sw – *C. lagopides* P. Karst., Sc – *C. radiatus* (A. T. Bolton: Fr.) Gray, M – *Cortinarius rufoolivaceus* (Pers.: Fr.) Fr. var. *pallidus* M. M. Moser, Sh(M?) – *Entoloma lividoalbum* (Kühner & Romagn.) Kubička, Sh(M?) – *E. myrmecophilum* (Romagn.) M. M. Moser, Sh – *Helvella acetabulum* (L.: Fr.) Quél., Sh – *Hygrocybe coccinea* (Schaeff.: Fr.) P. Kumm., Sh – *H. conica* (Schaeff.: Fr.) P. Kumm., Sh – *H. psittacina* (Schaeff.: Fr.) P. Kumm., M – *Inocybe fraudans* (Britzelm.) Sacc., M – *Lactarius camphoratus* (Bull.: Fr.) Fr., M – *L. rubescens* Bres., Sh – *Lepiota felina* Quél., Sh – *Peziza badioconfusa* Korf, Sh – *Peziza badiofusca* (Boud.) Dennis, M – *Phellodon melaleucus* (Sw.: Fr.) P. Karst., Li – *Phytoconis ericetorum* (Pers.: Fr.) Redhead & Kuyper M – *Russula cicatricata* Romagn. *ex* Bon, M – *R. cyanoxantha* Schaeff.: Fr. f. *peltereaui* Singer, M – *R. monspeliensis* Sarnari, M – *Russula pectinata* Fr. s.str.

STATION 3. M – *Boletus lupinus* Fr., M – *Cortinarius arquatus* Fr., M – *Cortinarius vernus* Lindstrom & Melot, M – *C. chevassutii* Rob. Henry, M – *C. hinnuloides* Rob. Henry, M – *C. ionochlorus* Maire, M – *C. pseudosulphureus* P. D. Orton, M – *C. rapaceus* Fr., M – *C. splendens* Rob. Henry, Sh – *Entoloma sericellum* (Fr.: Fr.) P. Kumm., M(P) – *Gomphidius roseus* (Nees: Fr.) Fr., M – *Hebeloma senescens* (Batsch) Berk. & Broome, Sh – *Hygrocybe conica* (Schaeff.: Fr.) P. Kumm. var. *chloroides* (Malençon) Bon, M – *Hygrophorus roseodiscoideus* Bon & Chevassut, M – *Lactarius mairei* Malençon, Sh? – *Lyophyllum emiliae* Consiglio, Sh – *L. semitale* (Fr.: Fr.) Kühner, Sl – *Mycena olivaceomarginata* (Massee) Massee f. *roseofusca* (Kühner) Maas Geest., Sl – *M. vulgaris* (Pers.: Fr.) P. Kumm., Sw(Sh) – *Mycenella lasiosperma* (Bres.) Singer, M – *Tricholoma basirubens* (Bon) Riva & Bon, M – *T. lascivum* (Fr.: Fr.) Gillet, M – *T. orirubens* Quél., Sh – *Tulostoma brumale* Pers.: Pers.

STATION 4. Sh – *Bovista plumbea* Pers.: Pers., Sw(Sh) – *Coprinus flocculosus* (DC.: Fr.) Fr., Sw – *C. xanthothrix* Romagn., M – *Cortinarius argillopallidus* Schaeff., M – *C. biformis* Fr., M – *C. brunneus* (Pers.: Fr.) Fr., M – *C. cedretorum* Maire, M – *C. cotoneus* Fr., M – *C. flavovirens* Rob. Henry, M – *C. fulmineus* Fr., M – *C. holophaeus* J. E. Lange, M – *C. odoratus* (Jouget ex M. M. Moser) M. M. Moser, M – *C. stemmatus* ss. Henry, M – *C. subfulgens* P. D. Orton, M – *C. suillus* Fr. ss. J. E. Lange, M – *C. urbicus* Fr., M – *Inocybe amethystina* Kuyper, M – *I. flocculosa* (Berk.) Sacc. var. *crocifolia* (Herink) Kuyper, M – *I. pusio* P. Karst., M – *Lactarius roseozonatus* (H. Post) Bataille, M – *Leccinum quercinum* (Pilat) E. E. Green & Watling, Sh – *Lepiota subgracilis* Kühner, Sw – *Mycena seynii* Quél., Sh(Sw) – *Pluteus hispidulus* (Fr.: Fr.) Gillet, M? – *Ramaria aurea* (Schaeff.: Fr.) Quél., M – *Russula undulata* Velen., M – *Suillus granulatus* (L.: Fr.) Roussel, M – *Tricholoma aurantium* (Schaeff.: Fr.) Ricken

STATION 5. M – *Boletus queletii* Schulzer, M – *B. rhodopurpureus* Smotl., Sh – *Clavariadelphus pistillaris* (Fr.: Fr.) Donk, Sh – *Clitocybe brumalis* (Fr.: Fr.) P. Kumm., M – *Cortinarius boudieri* Rob. Henry, Sh(Sl) – *Galerina laevis* (Pers.) Singer, M – *Inocybe leptophylla* G. F. Atk., M – *Phellodon confluens* (Pers.) Pouzar, Sh – *Psathyrella obtusata* (Pers.: Fr.) A. H. Sm., Sh – *Psilocybe coronilla* (Bull.: Fr.) Noordel., Sw(Sl) – *P. inquilina* (Fr.: Fr.) Bres.

STATION 6. M – *Boletus appendiculatus* Schaeff., Sh – *Conocybe semiglobata* Kühner & Watling, M – *Cortinarius dibaphus* Fr., M – *C. nemorensis* (Fr.) J. E. Lange, M – *C. purpurascens* (Fr.: Fr.) Fr., M – *C. xanthophyllus* (Cooke) Maire, M – *Inocybe glabrescens* Velen., M – *I. praetervisa* Quél., Sh – *Macrolepiota konradii* (P. D. Orton) M. M. Moser, Sw – *Phaeomarasmius erinaceus* (Fr.: Fr.) Singer, Sw(Sh) – *Pluteus nanus* (Pers.: Fr.) P. Kumm., Sw – *Poculum firmum* (Pers.: Fr.) Dumont, Sw – *Strobilurus tenacellus* (Pers.: Fr.) Singer

STATION 7. Sh – *Agaricus niveolutescens* Huijsman, M – *Boletus erythropus* Pers.: Fr., Sl – *Clitocybe costata* Kühner & Romagn., Sw – *Collybia inodora* (Pat.) P. D. Orton, M – *Cortinarius coerulescentium* Rob. Henry, M – *C. evernius* (Fr.: Fr.) Fr., Sh – *Lycoperdon mammiforme* Pers., Sh – *Macrolepiota excoriata* (Schaeff.: Fr.) Wasser, M – *Paxillus involutus* (Batsch: Fr.) Fr., Sw – *Psathyrella ocellata* (Romagn.) M. M. Moser, Sh(Sw) – *P. prona* (Fr.) Gillet, Sw – *Psilocybe sublateritia* Fr., M – *Russula pseudointegra* Maire

STATION 8. Sh – *Conocybe brunneola* Kühner & Watling, Sw – *Crepidotus pubescens* Bres., Sh – *Entoloma occultopigmentatum* Arnolds & Noordel., Sh – *E. sericeum* (Bull.) Quél. var. *cinereopacum* Noordel., M – *Hebeloma subsaponaceum* P. Karst., M – *Lactarius circellatus* Fr., Sh(Sw) – *Pluteus ephebeus* (Fr.: Fr.) Gillet, Sl – *Ramaria flaccida* (Fr.: Fr.) Bourdot, M – *Russula amethystina* Quél., Sl – *Tephrocybe coracina* (Fr.) M. M. Moser, M – *Tricholoma fulvum* (DC.: Fr.) Sacc., Sh – *Trichophaea hemisphaerioides* (Mouton) Graddon, Sl – *Typhula erythropus* Pers.: Fr.

STATION 9. M – *Cortinarius malicorius* Fr., Sh – *Entoloma sericeum* (Bull.) Quél. f. *nolaniforme* (Kuhner & Romagn.) Noordel., M – *Inocybe jacobi* Kühner, Sh(Sw) – *Psathyrella multipedata* (Peck) A. H. Sm., M – *Russula adulterina* Fr., M – *R. badia* Quél., M – *R. cessans* A. Pearson

STATION 10. M? – *Caloscypha fulgens* (Pers.) Boud., Sl(Sh) – *Clitocybe geotropa* (Lam. & DC.) Quél., Sh – *Conocybe rickeniana* P. D. Orton, M – *Cortinarius glaucopus* (Schaeff.: Fr.) Fr., M – *C. multiformis* Fr. var. *coniferarum* M. M. Moser, Sh – *Macrocystidia cucumis* (Pers.: Fr.) Joss., M – *Russula cuprea* Krombh., Sw – *Xylaria longipes* Nitschke

STATION 11. Sl – *Clitocybe marginella* Harmaja, Sh – *C. rivulosa* (Pers.: Fr.) P. Kumm. ss. str., Sl – *Hemimycena lactea* (Pers.: Fr.) Singer, Sl(Sw) – *Hygrophoropsis aurantiaca* (Wulfen: Fr.) Maire, M – *Lactarius volemus* (Fr.: Fr.) Fr., Sw – *Omphalina grossula* (Pers.) Singer, M? – *Ramaria obtusissima* (Peck) Corner, M – *Russula fragilis* (Pers.:Fr.) Fr. f. *viridilutea* Bon, Sw – *Sphaerobolus stellatus* Tode: Pers.

APPENDIX 2

Species resulting here as preferentially or exclusively differential of the studied evergreen oak woods.

Agaricus praeclaresquamosus A. E. Freeman, *A. xanthoderma* Genev. var. *griseus* (A. Pearson) Bon & Cappelli, *Amanita ovoidea* (Bull.: Fr.) Link, *Clavariadelphus flavoimmaturus* R. H. Petersen, *Clavulinopsis luteoalba* (Rea) Corner, *Clitocybula lenta* (Maire) Malençon & Bertault, *Collybia racemosa* (Pers.: Fr.) Quél., *Conocybe vexans* P. D. Orton, *Cortinarius alborufescens* Imler, *C. candelaris* Fr., *C. salor* Fr., *Entoloma undatum* (Gillet) M. M. Moser, **Gomphidius glutinosus* (Schaeff.: Fr.) Fr., *Hemimycena cephalotricha* (Joss.) Singer, *Hygrocybe russocoriacea* (Berk & O. K. Miller) P. D. Orton & Watling, *Inocybe maculata* Boud., *Lactarius rugatus* Kühner & Romagn., **L. sanguifluus* (Paulet: Fr.) Fr., *Lyophyllum crassifolium* (Berk.) Singer, *Marasmiellus candidus* (Bolton) Singer, *M. omphaliformis* (Kühner) Noordel., *M. virgatocutis* Robich *et al*., *Marasmius corbariensis* (Roum.) Singer, *Mycena corynephora* Maas Geest., *Otidea onotica* (Pers.: Fr.) Fuckel, *Peziza badia* Pers.: Fr., *Phellodon niger* (Fr.: Fr.) P. Karst., *Ramaria decurrens* (Pers.) R. H. Petersen, *Rhodocybe gemina* (Fr.) Kuyper & Noordel., *Russula amoenicolor* Romagn. var. *stenocystidiata* Sarnari, *R. lilacea* Quél., *R. maculata* Quél. var. *bresadoliana* (Singer) Romagn., *Scleroderma polyrhizum* J. F. Gmel.: Pers., *Simocybe centunculus* (Fr.: Fr.) P. Karst., **Suillus bellini* (Inzenga) Kuntze, **S. collinitus* (Fr.) Kuntze, *Tricholoma squarrulosum* Bres., *T. sulphurescens* Bres.

APPENDIX 3

Species resulting here as preferentially or exclusively differential of the studied chestnut coppices.

Collybia amanitae (Batsch) Kreisel, *Cortinarius croceocoeruleus* (Pers.: Fr.) Fr., *Galerina hypnorum* (Schrank: Fr.) Kühner, *Hebeloma fastibile* (Pers.: Fr.) P. Kumm., *Lactarius controversus* (Pers.: Fr.) Fr., *Mycena inclinata* (Fr.) Quél.

APPENDIX 4

Species resulting here as preferentially or exclusively differential of the studied fir woods.

Ascocoryne cylichnium (C. Tul.) Korf., *Bertia moriformis* (Tode: Fr.) De Not., *Bisporella subpallida* (Rehm) Dennis, *Calocera viscosa* (Pers.: Fr.) Fr., *Clavaria falcata* Pers.: Fr., *Clitocybe foetens* Melot, *C. pseudoobbata* (J. E. Lange) Kuyper, *C. sinopica* (Fr.: Fr.) P. Kumm., *C. trullaeformis* (Fr.: Fr.) Quél., *C. vermicularis* (Fr.) Quél., *C. vibecina* (Fr.) Quél., *Collybia alcalivirens* Singer, *Cortinarius croceus* (Schaeff.) Fr., *C. elegantior* (Fr.) Fr., *C. flexipes* (Pers.: Fr.) Fr., *C. odorifer* Britzelm., *Crucibulum crucibuliforme* (Scop.) V. S. White, *Cystoderma amianthinum* (Scop.) Fayod, *C. carcharias* (Pers.) Fayod, *Dacrymyces stillatus* Nees: Fr., *Entoloma hebes* (Romagn.) Trimbach, *Exidia thuretiana* (Lév.) Fr., *Galerina stylifera* (G. F. Atk.) A. H. Sm. & Singer, *Gymnopilus sapineus* (Fr.: Fr.) Maire, *Hemimycena gracilis* (Quél.) Singer, *Hygrophorus chrysodon* (Batsch: Fr.) Fr., *H. pudorinus* (Fr.: Fr.) Fr., *Inocybe assimilata* (Britzelm.) Sacc., *Inocybe geophylla* (Fr.: Fr.) P. Kumm. var. *lilacina* (Peck) Gillet, *I. whitei* (Berk. & Broome) Sacc., *Lachnellula subtilissima* (Cooke) Dennis, *Lachnum bicolor* (Bull.: Fr.) P. Karst., *Lacrymaria lacrymabunda* (Bull.: Fr.) Pat., *Lactarius ichoratus* (Batsch) Fr., *L. mitissimus* (Fr.: Fr.) Fr., *L. salmonicolor* R. Heim & Leclair, *Macrotyphula fistulosa* (Holmsk.: Fr.) R. H. Petersen, *Micromphale perforans* (Hofm.: Fr.) Gray, *Mycena amicta* (Fr.: Fr.) Quél., *M. epipterygia* (Scop.: Fr.) Gray var. *lignicola* A.H. Sm., *M. flavoalba* (Fr.) Quél., *M. zephirus* (Fr.: Fr.) P. Kumm., *Panellus mitis* (Pers.: Fr.) Singer, *P. violaceofulvus* (Batch: Fr.) Singer, *Pholiota lenta* (Pers.: Fr.) Singer, *Pleurotus ostreatus* (Jacq.: Fr.) P. Kumm., *Pseudohydnum gelatinosum* (Scop.: Fr.) P. Karst., *Russula cavipes* Britzelm., *R. mairei* Singer, *R. puellaris* Fr., *R. queletii* Fr., *R. urens* Romell, *R. violeipes* Quél. fo. *citrina* Quél., *R. viscida* Kudrna, *Rutstroemia luteovirescens* (Roberge) V. S. White, *Xerula melanotricha* Dörfelt