

Macromycetes within *Cistaceae*-dominated ecosystems in Cyprus

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ABSTRACT— An inventory of macromycetes associated with *Cistaceae* plants, including *Cistus*, *Helianthemum*, *Tuberaria* and *Fumana* species in Cyprus is presented, following a ten-year survey between 2007 and 2016. One-hundred-and-twenty-seven taxa are identified, sixty-five of which are reported for the first time from Cyprus. Of these, some recently described or rarely reported species are noteworthy, such as *Agaricus iesu-et-marthae*, *Astraeus telleriae*, *Fomitiporia rosmarini*, *Gymnopus bisporus*, *Lepiota farinolens*, *Lepiota locquinii*, *Ombrophila rivulorum*, *Peziza muscicola*, *Pholiota gallica*, *Tremella dactylobasidia* and *Xeromphalina cornui*. The taxonomical problems associated with a number of insufficiently clarified taxa, such as *Clitocybe font-queri*, *Cortinarius caligatus*, *Leccinellum corsicum*, *Lyophyllum fumosum*, *Peziza moseri*, *Peziza subviolacea*, *Plectania zugazae* and *Terfezia aphroditis* are discussed, and the role of *Cistus* communities in Mediterranean ecosystems is evaluated, particularly in view of accelerated climate changes. Selected imagery and notes about the fruiting season, host-plant, altitude and estimated abundance are provided.

KEY WORDS— Mediterranean, island ecosystem, *Cistus*, *Helianthemum*, *Tuberaria*

Introduction

Cistaceae plants constitute one of the most prominent components of the Mediterranean landscape, large areas of which have been heavily eroded and degraded due to prolonged periods of drought, fire, grazing and various anthropogenic activities. Several hypogeous members of *Pezizales* J. Schröt., commonly referred to as ‘desert truffles’, are known to form mycorrhizal associations with *Helianthemum* Mill. and *Tuberaria* (Dunal) Spach plants, in semi-arid and arid regions of the Mediterranean basin, North Africa and the Middle East. These include mostly desert specialists from the genera *Terfezia* (Tul. & C. Tul.) Tul. & C. Tul., *Tirmania* Chatin, *Picoa* Vittad. and *Delastria* Tul. & C. Tul., but also species from cosmopolitan genera such as *Mattirolomyces* E. Fisch. (Trappe 1979, Montecchi & Sarasini 2000, Trappe *et al.* 2008, Loizides *et al.* 2012, Kovács & Trappe 2014). A greater number of fungi (over 200) are known to form both ectomycorrhizal (ECM) and arbuscular mycorrhizal (AM) associations with various *Cistus* L. shrubs, with members of *Cortinariaceae* R. Heim ex Pouzar and *Russulaceae* Lotsy being the most frequently recorded (Lavorato 1991, Vila & Llimona 1999, 2002, 2006, 2010; Comandini *et al.* 2006, Torrejón 2009, Campos *et al.* 2010, Loizides & Kyriakou 2011).

Cistus shrubs’ remarkable ability to rapidly propagate and colonize large areas after fire, is crucial for the prevention of soil erosion and degradation during the post-fire succession stages (Andreu *et al.* 1998, Corgan *et al.* 2000, Buscardo *et al.* 2012, Loizides & Kyriakou 2011, Hernández-Rodríguez *et al.* 2012). Moreover, the presence of *Cistus* communities in semi-arid and treeless environments (known as thermo-Mediterranean maquis or matorral), supports considerable diversity in hostile and barren areas, where fungi would otherwise find impossible to survive. The shrubs’ dense formations and thick litter provide valuable shelter, enrich the soil with organic matter and preserve vital moisture by modifying the microclimate underneath and around the canopy (Breshears *et al.* 1998, Gratani *et al.* 2003, Simões *et al.* 2009). It is hardly

surprising, therefore, that apart from mycorrhizal species, a number of saprotrophic and parasitic fungi are thriving in these environments.

Mediterranean *Cistus* matorral and semi-arid *Helianthemum/Tuberaria* scrub occupy extended areas of the island of Cyprus, where five species of *Cistus*, four species of *Helianthemum*, two species of *Tuberaria* and two species of *Fumana* can be found (Tsintides *et al.*, 2002). Most common and widespread of the *Cistus* shrubs are *C. creticus* L. and *C. salvifolius* L., which are present at most elevations throughout the island, forming pure or mixed stands and frequently occupying the undercanopy of *Pinus brutia* and *P. nigra* forests. *Cistus parviflorus* Lam., is usually found at elevations below 500 meters, while *C. monspeliensis* L. is less widespread and confined to the westernmost parts of the island, mostly the Akamas peninsula. The rare *C. ladanifer* L. is an introduced species only restricted to a handful of localities.

Out of the *Helianthemum* species, the endemic *H. obtusifolium* Dunal is of special interest and occupies both lowland scrubland as well as rocky terrain at higher elevations up to 900 m. *H. stipulatum* (Forssk.) C. Christens. is common but restricted to elevations below 200 m mainly at coastal and inland dunes, while *H. syriacum* (Jacq.) Dum.-Cours. is also common and present at coastal dunes and rocky slopes up to 750 m. *Helianthemum ledifolium* subsp. *lasiocarpum* (Jacq. & Hérincq) Nyman is very rare and endangered (Tsintides *et al.* 2007). The annual *Tuberaria guttata* (L.) Fourr. and *T. inconspicua* (Thib. ex Pers.) Willk. are present at elevations below 1000 m, while three *Fumana* Spach species can also be seen: *F. arabica* (L.) Spach, *F. laevis* (Cav.) Pau and *F. thymifolia* (L.) Verl.

The first record of a *Cistaceae*-associated fungus from Cyprus can be traced back to the late XIX Century, when *Terfezia claveryi* Chatin was reported (Bull. Soc. Bot. France, 1895) from collections sent to G. A. Chatin by botanist P. G. Gennadios. Chatin also described *Terfezia aphroditis* from Cyprus (Bull. Soc. bot. Fr. 44: 290, 1897), an enigmatic species which has not featured in literature since. This species was separated from the similar *T. boudieri*, by its apparently stronger aroma, darker colour of its gleba and its larger spores, with its taxonomical status remaining uncertain to this day (Loizides *et al.* 2012). *Terfezia boudieri* Chatin, was reported in the first checklist of Cyprus fungi (Natrass 1937), in a pioneering work listing 145 species of basidiomycetes, 37 species of ascomycetes and 164 species of anamorphic fungi, including plates.

In the early XXI Century, a number of publications reported various *Cistaceae*-associated fungi: Viney (2005) listed over 200 macromycetes, out of which *Polyporus meridionalis* (A. David) H. Jahn and *Colus hirudinosus* Cavalier & Séchier are typical *Cistus* matorral inhabitants. In 2010 Loizides & Kyriakou reported twelve more species associated with *Cistus*: *Amanita cistetorum* Contu & Pacioni, *Amanita torrendii* Justo (as "*Torrendia pulchella*"), *Astraeus telleriae* M.P. Martín, Phosri & Watling (as "*A. hygrometricus*"), *Cortinarius caligatus* Malençon, *Hebeloma cistophilum* Maire, *Helvella semiobruta* Donadini & Berthet., *Hygrophorus chrysodon* var. *cistophilus* Pérez-De-Greg., Roqué & Macau (as "*H. chrysodon*"), *Hygrophorus pseudodiscoideus* var. *cistophilus* Bon & G. Rioussset, *Lactarius tesquorum* Malençon, *Russula insignis* Quél., and *Thelephora caryophyllea* (Schaeff.) Pers. Over 200 species of macromycetes were presented the following year by Loizides *et al.* (2011), including *Lepista sordida* (Schumach.) Singer, *Terfezia olbiensis* Tul. & C. Tul. and *T. oligospermum* (Tul. & C. Tul.) Trappe, which are frequently encountered in *Cistus* matorral. In a presentation of five desert truffles from Cyprus and Greece (2012), Loizides *et al.*, reported *Tirmania nivea* (Desf.) Trappe for the first time from Cyprus and only for the second time from Europe. Finally, in a recent contribution listing 79 species of micro- and macromycetes, Torrejón (2013) reported a number of species from *Cistus* habitats, such as *Alternaria*

mouchaccae E. G. Simmons, *Torula herbarum* (Pers.) Link, *Capitotricha bicolor* (Bull.) Baral (as *Lachnum bicolor*), *Glonium lineare* (Fr.) De Not., *Cucurbitaria spartii* (Nees ex Fr.) Ces. & De Not., *Trematosphaeria cisti* Naumov & Dobrozh., *Eutypa scabrosa* (Bull.) Auersw., *Rectipilus cistophilus* Esteve-Rav. & Vila, *Thanatephorus sterigmaticus* (Bourdot) P. H. B. Talbot, *Vuilleminia macrospora* (Bres.) Horstam and *Peniophora lycii* (Pers.) Höhn. & Litsch.

This is the first comprehensive survey focusing on macromycetes associated with *Cistus*, *Helianthemum*, *Tuberaria* and *Fumana* plants (*Cistaceae*) in Cyprus. It includes fungi recorded in low-altitude *Helianthemum/Tuberaria* scrubland, low to middle-altitude *Cistus* matorral and middle- to high-altitude *Pinus brutia* and *P. nigra* forests, where *Cistus* is commonly encountered at the undercanopy. A wide diversity of species are included, from mycorrhizal to saprotrophic and parasitic, in an effort to improve our understanding of these mycologically and ecologically significant, yet poorly understood ecosystems.

Materials & Methods

The studied material was collected between 2007 and 2016, from several localities in Cyprus where *Cistus*, *Helianthemum*, *Tuberaria* and *Fumana* shrubs are present. The majority of collections were harvested from pure matorral or forest clearings. Material collected from mixed habitats, where *Cistus* or *Helianthemum* were present together with *Pinus* or *Quercus*, has been included in the list only when the fungus was found growing directly on *Cistaceae* debris, or when the species identified is known to be a *Cistaceae* associate. All specimens were photographed *in situ* and detailed macroscopical notes were taken from fresh material. Iron sulfate (FeSO₄), Guaiac tincture and Phenol were used to observe chemical reactions on the flesh of species of the genus *Russula*. Chemical reactions on the pileus and flesh of *Cortinarius* species were observed using 5% potassium hydroxide (KOH). Microscopic studies were performed under a Leica BM E binocular microscope at ×40 and ×100 magnifications and all diagnostically important microscopic characters were observed. Normal tap water was mainly used as a mounting medium for spore study. Melzer's reagent was used to observe possible amyloid or dextrinoid reactions, where applicable. Congo Red in 10% ammonia (NH₃) solution, lactophenol cotton blue (LPCB), and aqueous Phloxine were also used as necessary, to highlight further microscopic structures. The data recorded is presented in the form of an annotated checklist, arranged in two sections: *Ascomycota* and *Basidiomycota*. Taxa are listed in alphabetical order under each section. Specimens identified only to genus have not been included in the list. Species reported from Cyprus for the first time are marked with an asterisk (*). Exsiccatae are kept in the private collection of the author.

Results

A total of 127 species belonging to 76 genera were identified in the survey. Of these, 106 belong to basidiomycetes and 21 to ascomycetes. Sixty-five of the taxa included in the list are reported from Cyprus for the first time. A collection of *Terfezia claveryi* under the endemic *Helianthemum obtusifolium*, represents a first record of this species with this host. With very few exceptions, the fruiting season spans between September and April, with the most productive period occurring between November and February, largely corresponding to the months of highest precipitation on the island (Department of Meteorology official website). Of the species recorded, the most common and widespread appear to be *Polyporus meridionalis*, *Helvella semiobruta*, *Hebeloma cistophilum*, *Lactarius tesquorum*, *Capitotricha bicolor* and *Thelephora caryophyllea*. Out of the taxa recorded in Cyprus for the first time, a number of little known and rarely reported species are noteworthy, such as *Agaricus iesu-et-marthae*, *Astraeus telleriae*, *Fomitiporia rosmarini*, *Gymnopus bisporus*, *Lepiota farinolens*, *Lepiota locquinii*, *Ombrophila rivulorum*, *Peziza muscicola*, *Pholiota gallica*, *Tremella dactylobasidia* and *Xeromphalina cornui*.

Collections previously reported by Loizides & Kyriakou (2010) as “*Astraeus hygrometricus* (Pers.) Morgan”, are in this work attributed to the recently described taxon *Astraeus telleriae* M.P. Martín, Phosri & Watling, which was introduced subsequently to the above records (Phosri *et al.* 2013). Collections previously reported as “*Tricholoma gausapatum* (Fr.) Quél.” by Loizides *et al.* (2011), are here listed as *Tricholoma terreum* (Schaeff.) P. Kumm., following the recent synonymy of the two taxa based on ITS data (Christensen & Heilmann-Clausen 2013). Collections previously reported by Loizides *et al.* (2011) as “*Peziza praetervisa sensu* Breitenbach & Kranzlin (1984)”, are here listed as *P. subviolacea* Svrček, following Svrček (1977). *Leccinellum corsicum* (Rolland) Bresinsky & Manfr. Binder, and *L. lepidum* (H. Bouchet ex Essette) Bresinsky & Manfr. Binder, considered by Bertolini (2014) to be conspecific, are here treated as distinct species, based on morphological and phenological data, as well as previously published molecular inferences by Binder & Besl (2000), Bresinsky & Besl (2003), and den Bakker & Noordeloos (2005). Collections reported as “*Picoa lefebvrei* (Pat.) Maire” by Loizides *et al.* (2011, 2012), are in this work provisionally listed as *Picoa* aff. *lefebvrei*, until their identity is fully resolved by molecular studies, following the recent confirmation of cryptic speciation and multiple phylogenetic lineages within this genus (Zitouni-Haouar *et al.* 2015).

It is further worth noting that, following a number of molecular studies in recent years, genera such as *Clitocybe* (Fr.) Staude *sensu lato* (Maheny *et al.* 2006, Alvarado *et al.* 2015), *Lepista* (Fr.) W.G. Sm. *sensu lato* (Alvarado *et al.* 2015), and *Peziza* Dill. ex Fr. *sensu lato* (Hansen *et al.* 2001, 2002, 2005), have revealed to be polyphyletic. Consequently, some of the taxa reported here (e.g. *Clitocybe cistophila*, *C. font-queri*, *C. herbarum*, *Lepista sordida*, *Peziza moseri*, *P. musicola*, *P. subviolacea*) will likely undergo significant taxonomic revisions in the not too distant future.

Ascomycota

Arachnopeziza aurelia (Pers. : Fr.) Fuckel *

Only two collections recorded so far: Prastio, ca 520 m a.s.l., on *Cistus salvifolius* twig, 6-III-2012, Trimiklini, ca 550 m a.s.l., on *C. salvifolius* twig, 28-II-2014. Seemingly rare, but perhaps overlooked.

Capitotricha bicolor (Bull. : Fr.) Baral

= *Lachnum bicolor* (Bull.) P. Karst.

Common on fallen *Cistus* twigs and one of just a handful of fungi that can be seen throughout the year in Cyprus, sometimes even during the hot and dry summer months. Several collections, such as: Kakomallis, ca 500 m a.s.l., on fallen *Cistus* sp. twig, 31-X-2009. Saittas, ca 650 m a.s.l., on fallen *Cistus salvifolius* twig, 24-XII-2010. Platania, ca 1100 m a.s.l., on fallen *Cistus* sp. twig, 24-XI-2011. Troodotissa, ca 1300 m a.s.l., on fallen *Cistus* sp. twig, 25-VII-2012. *Ibid.* ca 1300 m a.s.l., on fallen *Cistus* sp. twig, 7-VIII-2012. *Ibid.* ca 1300 m a.s.l., on fallen *Cistus* sp. twig, 22-V-2014.

Helvella juniperi M. Filippa & Baiano

Mostly associated with *Juniperus*, this Mediterranean species has been previously reported from coastal dunes under *J. phoenicea* (Loizides 2012a). At least two collections under *Cistus* also appear to match the description: Pera Pedi, ca 570 m a.s.l., under *C. salvifolius*, 9-IV-2011. *Ibid.* ca 570 m a.s.l., under *C. salvifolius*, 1-III-2013. The *H. lacunosa* complex likely consists of several cryptic species, which are far from clarified (Nguyen *et al.* 2013). *Helvella juniperi* is macroscopically characterised by its rather small ascocarps usually featuring a strongly lacunose stipe, and microscopically, by the capitate to subcapitate paraphyses, the relatively wide spores measuring (17–) 18–23 (–24) × (10–) 12–14 (–15.5) μm, and the globose structure of the ectal excipulum (Filippa & Baiano 1999).

Helvella semiobruta Donadini & Berthet

A little known Mediterranean species, yet one of the most prolifically occurring and widespread fungi in Cyprus, appearing in very large numbers from winter to early spring, mostly (though not exclusively) under *Cistus*. Numerous collections, such as: Asgata, ca 200 m a.s.l., under *Cistus* sp. 7-III-2009. Kelefos, ca 500 m a.s.l., under *C. salvifolius*, 28-I-2010. Asgata, ca 200 m a.s.l., under *C. salvifolius*, 2-II-2010. Prastio, ca 560 m a.s.l., under *C. salvifolius*, 14-III-2011. *Ibid.* ca 530 m a.s.l., under *Cistus* sp. 14-III-2011. *Ibid.* ca 560 m a.s.l., under *Cistus* sp. 22-III-2011. Akamas, ca 200 m a.s.l., under *Cistus* sp. and *Cupressus sempervirens*, 11-II-2012. Souni, ca 450 m a.s.l., under *C. parviflorus*, 7-III-2014. Pera Pedi, ca 550 m a.s.l., under *C. salvifolius*, 9-II-2016. Akamas, ca 160 m a.s.l., under *C. monspeliensis*, 23-II-2016. Much smaller than species in the *H. lacunosa* complex, scarcely exceeding 2 cm in diameter and 3 cm in height, and further differing in its smooth to weakly lobed charcoal-grey stipe. Microscopically, it is characterised by the subcapitate to nodulose paraphyses and large spores measuring (20–) 22–24 (–24.5) × (12.5–) 13–14 (–16) μm (Loizides & Kyriakou 2011, Loizides 2012a, Filippa *et al.* 2013).

Morchella dunalii Boud.

= *M. fallax* Clowez & Luc Martin

= *M. purpurascens sensu* Loizides *et al.* (Edible & Toxic Fungi of Cyprus. p. 224, 2011)

This is the most widespread and frequently occurring morel in the Mediterranean basin, mostly associated with *Pinus brutia* or *Quercus ilex*, but recently also confirmed from *Cistus matorral* (Loizides *et al.* 2016). Trimiklini ca 600 m a.s.l., under *Cistus* sp. 30-III-2015.

Morchella tridentina Bres.

= *M. elatoides* Jacquet.

= *M. elatoides* var. *elegans* Jacquet.

= *M. quercus ilicis* Clowez, Ballester & L. Romero

= *M. frustrata* M. Kuo

= *M. conica* var. *pseudoeximia* Clowez

A cosmopolitan and widespread species reported under several hosts (Loizides *et al.* 2015a). Its diverse ecology is here further expanded to include a collection from *Cistus salvifolius*/*C. creticus* matorral: Trimiklini ca 600 m a.s.l., under *Cistus* sp. 30-III-2015.

***Ombrophila rivulorum* Velen. ***

A rare species, only recorded twice in *Cistus* litter: Prastio ca 500 m a.s.l., under *C. salvifolius*, 8-III-2012. Lythrodontas ca 300 m a.s.l., under *C. salvifolius*, 27-XI-2014, fitting the concept of this poorly known taxon (Velenovský 1934), as well as subsequent interpretations by H.-O. Baral (unpubl. data). The Cypriot collections have glabrous, creamy-white to pinkish-white ascomata (< 0.8 cm wide), which are disk or saucer shaped and tapering to an indistinct stalk. The spores are fusiform, (11–) 11.5–16 (–18) × (3.5–) 4–5 (–5.5) μm, guttulate, occasionally one-septate at maturity, and the asci are 80–125 × 8–12 μm, biseriolate, with a weakly amyloid apical pore. Paraphyses are narrowly cylindrical to filiform, < 2 (–3) μm wide and sparsely septate.

***Peziza moseri* Aviz.-Hersh. & Nemlich ***

Akrotiri ca 80 m a.s.l., under *Fumana thymifolia*, 23-I-2012. One of a number of *Peziza* species with violet-lilac hymenium, characterised by its smooth, biguttulate spores measuring 13–15 × 8–9 μm. *Peziza pseudoviolacea* Donadini is reported to have non-guttulate spores (Donadini 1979, Medardi 2006), and it is yet unclear whether it is a synonym. See also comments under *P. subviolacea*.

***Peziza muscicola* Donadini ***

A rarely reported and poorly known species, which appears to be locally frequent in Cyprus. So far collected in lowland dunes and matorral directly under *Cistus*: Akrotiri ca 50 m a.s.l., under *Cistus* sp. 12-I-2015. *Ibid.* under *Cistus* sp. 14-I-2015. Souni ca 400 m a.s.l., under *C. parviflorus*, 21-II-2015. Very similar to *Peziza saniosa* Schrad., also recorded in Cyprus (e.g. Ayia Paraskevi ca 530 m a.s.l., under *Pinus brutia*, 6-IV-2011), from which it differs in its absence of latex and slightly larger, truncated spores, often displaying interconnecting warts. The spores, measuring 15–21 × 8–11.5 μm, are slightly larger than the dimensions given by Donadini (13.5–18 × 7.5–9 μm, in Donadini, 1977), but otherwise Cypriot collections fit well the original description. Asci are 8-spored, weakly to moderately amyloid, 235–365 × 10–17 μm. Paraphyses are clavate to subcapitate, < 7 μm wide, septate, with refractive granulose content.

***Peziza succosella* (Le Gal & Romagn.) M. M. Moser ex Aviz.-Hersh. & Nemlich ***

This belongs to a complex of morphologically similar taxa, all secreting yellowish or greenish juice, which may include cryptic speciation. Several collections from middle- to low-altitude calcareous *Pinus brutia* forests and matorral, many of them directly under *Cistus*: Prastio ca 550 m a.s.l., under *P. brutia* and *C. salvifolius*, 25-II-2011. *Ibid.* 14-III-2011. Akrotiri ca 5 m a.s.l., under *P. brutia* and *C. salvifolius*, 28-IV-2014. *Ibid.* ca 30 m a.s.l., under *C. salvifolius* and *Juniperus phoenicea* 11-II-2016.

***Peziza subviolacea* Svrček ***

- = *P. praetervisa sensu* Dennis (Brit. Ascom. p. 21, tab. IV B, 1968)
- = *P. praetervisa sensu* Breitenbach & Kränzlin (Fungi of Switz. Vol. 1: Ascom. p. 49, 1984)
- = *P. praetervisa sensu* Loizides *et al.* (Edible & Toxic Fungi of Cyprus. p. 257, 2011)

Few collections from coastal and inland dunes and scrub, such as: Akrotiri ca 5 m a.s.l., near *Cistus parviflorus*, *Fumana thymifolia* and *Juniperus phoenicea*, 28-I-2014. Akrotiri ca 5 m a.s.l., near *Fumana thymifolia*, 31-I-2015. A variously interpreted taxon, here treated as conspecific to *Peziza praetervisa sensu* Dennis, and *sensu* Breitenbach & Kränzlin. A few members of *Peziza* with a violet-lilac or violet-brown hymenium can be seen in Cyprus, whose exact taxonomical status is not yet fully clarified. Collections attributed to this taxon have biguttulate, weakly warted spores at maturity measuring 13–16 × 8–9 μm, and often hooked paraphyses, best matching the description of *P. subviolacea* given by Svrček (1977), which is the least ambiguous. The original description of *P. praetervisa* Bres. (as *Aleuria praetervisa*, Iconographia Mycologica 25: 1214, 1933) displays a deeply cup-shaped, brownish fungus with smaller spores (11–14 × 5–7 μm), which might correspond to *P. petersii* Berk. or another species. *Peziza pseudoviolacea* Donadini, is reported to have smooth spores measuring 13–15 × 8–9 μm, while *P. moseri* Aviz.-Hersh. & Nemlich, has smooth biguttulate spores also measuring 13–15 × 8–9 μm. *Peziza tenacella* W. Phillips, sometimes linked to the above taxa, is a species originally described from Australia with 'umber-brown' colours (Cooke 1887) and unlikely to be related.

***Peziza vesiculosa* Bull.**

Occasionally seen on dung and hay, with one record coming from *Cistus* matorral, on a sandy path edge: Kalavassos, ca 190 m a.s.l., under *Cistus* sp., 23-I-2016.

Picoa* aff. *lefebvrei (Pat.) Mair

Locally common in *Helianthemum* scrub, with several collections, such as: Geri, ca 150 m a.s.l., under *H. stipulatum*, 20-II-2010. *Ibid.* ca 150 m a.s.l., under *H. stipulatum*, 4-III-2010. *Ibid.* ca 175 m a.s.l., under *H. stipulatum*, 12-II-2013. According to Moreno *et al.* (2000), Montecchi & Sarasini (2000), and Sbissi *et al.* (2010), the mature spores of *P. lefebvrei* exhibit indistinct cyanophylous warts; this feature, however, has not been observed in the Cypriot collections, suggesting these might belong to one of the newly identified phylogenetic lineages (Zitouni-Haouar *et al.* 2015).

Plectania zugazae Calonge & A. García

Three records of this rare species, previously known only from the type collection in Spain. All Cypriot collections were found directly under *Cistus*: Ayia Paraskevi, ca 550 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 3-III-2010. Prastio, ca 450 m a.s.l., under *Cistus* sp., 8-III-2012. Pera Vasa, ca 650 m a.s.l., under *Cistus* sp. and *P. brutia*, 8-II-2015. The prominent orange granules, previously thought to be present only in *Plectania melastoma* (Sowerby) Fuckel, and used as a discriminating character, can also be seen in some collections of *P. zugazae*, making the two species macroscopically indistinguishable (Carbone *et al.* 2015). The two taxa can be separated by the size, and most importantly, the quotient of their mature ascospores: [(17.5–) 19–22 (–24) × (12–) 12.5–15 (–15.5) μm, Q = 1.8–2.2 for *P. zugazae*, and 21.8–25 × 10–12.4 μm, Q = 1.45–1.6 for *P. melastoma*, respectively]. Most Mediterranean collections so far identified as *P. melastoma*, may in the future prove to belong to *P. zugazae* instead.

Propolis farinosa (Pers.) Fr.

Prastio, ca 500 m a.s.l., on *Cistus salvifolius* twig, 24-II-2014. Also recorded by the author on *Olea europaea* (Pera Pedi, 14.II.14) and *Pinus brutia* (Panayia, 17.II.15), and by Torrejón (2013) on *Arbutus andrachne*. Probably widespread but overlooked.

Terfezia arenaria (Moris) Trappe

= *T. leonis* (Tul. & C. Tul.) Tul. & C. Tul.

Reported from several Mediterranean countries, as well as North Africa, Asia Minor and the Middle East, usually found in association with *Tuberaria guttata*. One tentatively identified collection from Cyprus, but its estimated abundance and distribution are not yet understood: Geri, ca 150 m a.s.l., under *T. guttata* and *Helianthemum stipulatum*, det. C. Hobart, 20-II-2010.

Terfezia boudieri Chatin

One of the more frequently encountered desert truffles on the island, usually found with *Helianthemum stipulatum*. It remains unclear whether *Terfezia aphroditis*, originally described from Cyprus over a century ago (Chatin 1897) and not confirmed since, is a later synonym or a distinct species. In the original descriptions of the two species, Chatin reported spores of 28–32 μm for *T. aphroditis* and 20–26 μm for *T. boudieri*. Most modern authors give similar spore sizes for *T. boudieri* (e.g. Montecchi & Sarasini: 17–24 μm; Díez *et al.*: 18–22 μm), which are consistent with all Cypriot collections so far: Geri, ca 150 m a.s.l., under *H. stipulatum*, leg. Y. Yiangou, 20-II-2010. *Ibid.* ca 150 m a.s.l., under *H. stipulatum*, leg. Y. Yiangou, 4-III-2010. *Ibid.* ca 150 m a.s.l., under *H. stipulatum*, 12-II-2013. Topotypical collections from the original collection area of *T. aphroditis* are needed to clarify its exact taxonomical status.

Terfezia claveryi Chatin

Perhaps the most frequently occurring desert truffle in Cyprus, usually found under *Helianthemum stipulatum*, but here also recorded under the endemic *H. obtusifolium*. Few collections, such as: Lefkosia, ca 140 m a.s.l., under *H. stipulatum*, leg. Y. Yiangou, 17-III-2010. Kalavassos, ca 80 m a.s.l., under *H. obtusifolium*, leg. S. Stavrou, det. C. Hobart, 21-III-2010. Geri, ca 170 m a.s.l., under *H. stipulatum*, leg. M. Loizides, 12-II-2013. Distinguished by its globose reticulate spores, measuring 16–23 μm.

Terfezia olbiensis Tul. & C. Tul.

Occasional under *Cistus*, in dunes and open *Pinus brutia* forests: Pera Pedi, ca 550 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 17-II-2010. Prastio, ca 510 m a.s.l., under *C. salvifolius* and *P. brutia*, 6-III-2012. Kellaki, ca 620 m a.s.l., under *C. salvifolius* and *P. brutia*, 15-III-2012. Akrotiri, ca 70 m a.s.l.,

under *Cistus* spp. and *Juniperus phoenicea*, 17-I-2015. Separated by the very similar *T. leptoderma* by the size of its spores and the length of their warts: 16–21 µm (incl. warts up to 3 µm long) in *T. olbiensis*, and 20–24 µm (incl. warts up to 5 µm long) in *T. leptoderma*.

Tirmania nivea (Desf.) Trappe

A predominantly Middle-Eastern and North-African desert specialist, whose record from Cyprus (Loizides *et al.* 2012) was only the second reported from Europe (first reported from Spain by Moreno *et al.* 2000). Recorded a few times since, always under *Helinathemum stipulatum*: Geri, ca 180 m a.s.l., under *H. stipulatum*, leg. Y. Yiangou, det. C. Hobart & G. Konstandinides, 4-III-2010. *Ibid.* ca 180 m a.s.l., under *H. stipulatum*, leg. Y. Yiangou, 27-II-2011. *Ibid.* ca 180 m a.s.l., under *H. stipulatum*, leg. Y. Yiangou, 22-II-2013. Occasional, easily recognised by its amyloid asci and hyaline to pale yellowish spores measuring 14–18 × 10–14 µm. Often fully surfacing at maturity.

Tuber oligospermum (Tul. & C. Tul.) Trappe

= *T. asa* Tul. & C. Tul.

A Mediterranean truffle often associated with *Cistaceae* plants. Few collections so far, one from an open *Pinus brutia* forest, directly under *Cistus*: Pera Pedi, ca 550 m a.s.l., under *C. salvifolius*, det. C. Hobart, 17-II-2010. According to Alvarado *et al.* (2012), *Tuber asa* Lesp. ex Tul. & C. Tul., is a later synonym of this species. Perhaps widespread but overlooked.

Basidiomycota

Agaricus cupreobrunneus (Jul. Schäff. & Steer) Pilát *

Occasional in dry grasslands and pastures, but rarely also seen in grassy *Cistus matorral*, such as: Akamas, ca 220 m a.s.l., among *C. monspeliensis* litter, 17-VI-2011. Asgata, ca 180 m a.s.l., among grass and *C. salvifolius* litter, 17-VI-2011.

Agaricus iesu-et-marthae L.A. Parra *

= *A. lutosus* var. *macrosporus* L.A. Parra

Apparently rare, with only one collection from *Cistus* and *Olea europaea* matorral: Kalavassos, ca 160 m a.s.l., on well-drained sandy soil, among *Cistus* sp. 27-VII-2014. This is a member of sect. *Minores*, characterised by the intense yellowing of its fruitbodies, often featuring purplish-brown scales at the pileus disk and a strong almond smell. Microscopically it has abundant, apically capitate, pyriform or catenulate cheilocystidia and relatively large spores, measuring 5.5–7 × 4–5.5 µm (Parra Sánchez 2013). Some reddening on the stipe beneath the annulus, not mentioned in the original description, has been observed in most fruitbodies of the Cypriot collection. This could prove a useful character to discriminate this species from similar taxa, like *A. pseudolutosus* (G. Moreno, Esteve-Rav., Illana & Heykoop) G. Moreno *et al.* and *A. comtulus* Fr., and should be further evaluated from additional collections.

Agaricus pseudopratensis (Bohus) Bohus

Common under *Cupressus sempervirens*, but occasionally also encountered in unimproved grasslands and *Cistus matorral*: Kalavassos, ca 160 m a.s.l., under *Cistus* sp. 27-VII-2014. *Ibid.* ca 170 m a.s.l., under *Cistus* sp. 23-I-2016.

Amanita cistetorum Contu & Pacioni

Locally frequent in some years, usually appearing early in the season under *Cistus salvifolius*, in *Pinus brutia* forest clearings as well as pure *Cistus matorral*. Several collections, such as: Amiantos, ca 1150 m a.s.l., under *C. salvifolius*, 15-X-2008. *Ibid.* ca 1150 m a.s.l., under *C. salvifolius*, 3-X-2009. *Ibid.* ca 1100 m a.s.l., under *C. salvifolius*, 10-X-2009. Kelefos, ca 500 m a.s.l., under *C. salvifolius*, 29-X-2012. *Ibid.* ca 500 m a.s.l., under *C. salvifolius*, 31-X-2012. *Ibid.* ca 500 m a.s.l., under *C. salvifolius*, 2-XI-2012. Trimiklini, ca 620 m a.s.l., under *C. salvifolius*, 10-XI-2012. Pera Pedi, ca 550 m a.s.l., under *C. salvifolius* in *P. brutia* forest, 29-XI-2015.

Amanita torrendii Justo= *Torrendia pulchella* Bres.

A very rare species, previously placed in the genus *Torrendia* Bres. and reported as such by Loizides & Kyriakou (2011). Despite its secotioid ecology, recent molecular studies have shown that this species nests within the *Amanita* Dill. ex Boehm. genus (Justo *et al.* 2010). Only one collection so far: Ayia Paraskevi, ca 600 m a.s.l., under *Cistus salvifolius*, leg. Y. Yiangou, 17-II-2010. Also reported from Spain, Portugal, France, Italy, Turkey, Morocco and Algeria (Neville & Poumarat 2004, Justo *et al.* 2010).

Arrhenia acerosa (Fr. : Fr.) Kühner *

Uncommon to rare, with one of the records coming from a fallen *Cistus* twig: Saittas, ca 620 m a.s.l., on *C. salvifolius* twig, 20-XII-2009.

Arrhenia rickenii (Hora) Watling *

A common species thought to be associated with mosses, frequently encountered in *Cistus* communities during the winter months. Several collections, such as: Mosfiloti, ca 220 m a.s.l., under *C. salvifolius*, 16-I-2011. Akrotiri, ca 5 m a.s.l., under *C. parviflorus* and *Juniperus phoenicea*, 9-I-2013. *Ibid.* ca 5 m a.s.l., under *Cistus* sp, 26-XII-2014. *Ibid.* 31-I-2015.

Arrhenia spathulata (Fr. : Fr.) Redhead *

Associated with mosses and occasionally recorded from *Cistus* matorral during the winter months: Kalavassos, ca 170 m a.s.l., under *C. salvifolius*, 26-XII-2013. Akrotiri, ca 10 m a.s.l., under *C. parviflorus* and *Juniperus phoenicea*, 9-I-2013. *Ibid.* ca 10 m a.s.l., under *Cistus* spp, 31-I-2015. Frequent.

Astraeus telleriae M.P. Martín, Phosri & Watling *= *A. hygrometricus sensu* Loizides & Kyriakou [Field Mycol. 12 (1) p. 21, 2011]

A recently described taxon, likely to represent many Mediterranean collections of *Astraeus*, previously undifferentiated from *A. hygrometricus* (Pers.) Morgan. The new species is reported to have a 'very pubescent or minutely woolly' inner layer of the outer peridium (Phosri *et al.* 2013), a feature consistent with most Cypriot collections. Frequently seen in *Cistus* matorral, but also under *Quercus coccifera* ssp. *calliprinos* and in *Pinus brutia* forest clearings. Trimiklini, ca 550 m a.s.l., under *C. salvifolius*, 14-III-2009. *Ibid.* ca 550 m a.s.l., under *C. salvifolius*, 19-III-2009. *Ibid.* ca 550 m a.s.l., under *C. salvifolius*, 26-II-2010.

Boletus aereus Bull. : Fr.

Surprisingly rare in Cyprus, despite having a predominantly Mediterranean distribution, common in Greece and neighboring countries (Zervakis *et al.* 1998, Konstantinidis 2009, Athanasiou 2010, Papadimitriou 2015). Although primarily associated with broadleaved trees, it has also been reported with *Cistus* (Alessio 1985, Lavorato 1991, Comandini *et al.* 2006, Galli 2007). In Cyprus, it is mostly seen under the endemic *Quercus alnifolia*, but also under *Arbutus andrachne* and *Cistus creticus* in high altitude ophiolitic *Pinus nigra* forests: Troodos, ca 1550 m a.s.l., under *C. creticus* and *P. nigra*, 15-IX-2009. *Ibid.* ca 1550 m a.s.l., under *C. creticus* and *P. nigra*, 8-XI-2011. *Ibid.* ca 1550 m a.s.l., under *C. creticus* and *P. nigra*, 26-VIII-2014. *Ibid.* ca 1600 m a.s.l., under *C. creticus* and *P. nigra*, 4-XI-2014.

Chamaemyces fracidus (Fr.) Donk

Only one collection under *Cistus*: Ayia Paraskevi ca 500 m a.s.l., under *C. salvifolius*. 14-XI-2009. Rare.

Clavaria fragilis Holmsk. : Fr. *= *C. vermicularis* Batsch

Only two collections, one from pure *Cistus* matorral: Drousia ca 550 m a.s.l., under *C. monspeliensis*. 24-XII-2014. Apparently rare.

Clavulina coralloides (L. : Fr.) J. Schröt.= *C. cristata* (Holmsk.) J. Schröt

Several records from mixed forests, with one large collection from pure *Cistus* matorral: Drousia ca 550 m a.s.l., under *C. monspeliensis*. 24-XII-2014. Locally frequent.

Clitocybe cistophila Bon & Contu *

One of a number of *Clitocybe* species with a strong aniseed odour occurring in Cyprus, with spores measuring $4.5\text{--}6.5 \times 3\text{--}3.5 \mu\text{m}$ (Bon & Contu 1985). Several collections, such as: Lysos, ca 600 m a.s.l., under *Cistus* sp. 18-I-2009. Asgata, ca 180 m a.s.l., under *C. salvifolius*. 3-II-2009. *Ibid.* ca 180 m a.s.l., under *C. salvifolius*. 3-II-2009. Drousia ca 550 m a.s.l., under *C. monspeliensis*. 24-XII-2014. Collections matching the concept of *Clitocybe anisata* Velen. are also found under *Cistus* in open *Pinus brutia* forests, but produce more robust fruitbodies with a pruinose, non-striate pileus and similar spores measuring $4\text{--}6 \times 3\text{--}3.5 \mu\text{m}$. *Clitocybe obsoleta* (Batsch) Quél. can occur in the same habitats, but has a darker, pinkish-brown non-striate pileus and larger spores measuring $6.5\text{--}8.5 \times 3.5\text{--}4.5 \mu\text{m}$. *Clitocybe fragrans* (With.) P. Kumm., another member of *Fragrantes*, is mostly seen in *Pinus brutia* and *P. nigra* forests, and has a strongly striate margin extending halfway to the centre of the pileus and spores measuring $6.5\text{--}9.5 \times 4\text{--}5.5 \mu\text{m}$ (Moser 1983, Singer 1986, Bas 1990, Breitenbach & Kränzlin 1991, Courtecuisse & Duhem 1995).

Clitocybe font-queri R. Heim *

A variously interpreted taxon, often confused with similar-looking, insufficiently clarified taxa, such as *Clitocybe trulliformis* (Fr.) P. Karst., *C. herbarum* Romagn. and *C. collina* (Velen.) Klán, some of which are sometimes considered conspecific. Since more than one species of small, greyish *Clitocybes* appear to be present under *Cistus* in Cyprus, the name *C. font-queri* is provisionally applied to slender collections with a funnel-shaped pileus and deeply decurrent lamellae, best matching the original drawing by Heim (1934). Future molecular studies will probably result in significant taxonomic revisions within this group, both at species and generic level (Alvarado *et al.* 2015). Few collections, such as: Saittas, ca 700 m a.s.l., under *C. salvifolius*. 9-XII-2007. Kelefos, ca 500 m a.s.l., under *C. salvifolius* and *P. brutia*, 27-XII-2008. *Ibid.* ca 500 m a.s.l., under *C. salvifolius* and *P. brutia*, 27-XI-2009.

Colus hirusinosus Cavalier & Séchier

A Mediterranean and subtropical member of the *Phallales* order, commonly encountered in *Cistus* communities (Loizides & Kyriakou 2011). Although traditionally regarded as saprotrophic and sometimes reported from manured substrates and dunes, this species' abundance under *Cistus* may be indicative of a facultative endophytic or mycorrhizal lifestyle. Several collections from various altitudes and localities, all directly under *Cistus*, such as: Asgata, ca 200 m a.s.l., under *Cistus* sp. 3-II-2009. Pelendri, ca 800 m a.s.l., under *C. salvifolius*, 14-III-2009. Asgata, ca 200 m a.s.l., under *Cistus* sp., 2-II-2010. Mosfiloti, ca 250 m a.s.l., under *C. salvifolius*, 23-I-2011. Asgata, ca 200 m a.s.l., under *Cistus* sp. 31-I-2012. *Ibid.* ca 200 m a.s.l., under *Cistus* sp., 29-VI-2012. Drousia ca 550 m a.s.l., under *C. monspeliensis*. 24-XII-2014. Kalavassos, ca 180 m a.s.l., under *C. salvifolius*, 27-VII-2014.

Coprinellus radians (Desm. : Fr.) Vilgalys, Hopple & Jacq. Johnson

= *Coprinus radians* (Desm.) Fr.

Frequent in lowland scrub, unimproved grasslands and suburban areas, with one record under *Cistus* in a forest clearing: Pera Pedi, ca 600 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 28-III-2011.

Coprinopsis cortinata (J.E. Lange) Gminder *

= *Coprinus cortinatus* J.E. Lange

Recorded twice among *Cistus* debris and twigs: Asgata, ca 170 m a.s.l., under *Cistus* sp., 9-II-2009. Kellaki, ca 650 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 15-III-2012. Apparently rare, but perhaps overlooked.

Cortinarius caligatus Malençon

Occasional to locally frequent under *Cistus salvifolius*: Mesa Potamos, ca 850 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 20-XII-2007. Saittas, ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 24-XII-2008. Palechori, ca 850 m a.s.l., under *C. salvifolius*, 2-XI-2009. Kalavassos, ca 180 m a.s.l., under *C. salvifolius*, 23-I-2016. The interpretations of *Cortinarius caligatus*, *C. variiformis* and *C. crustulinus* are far from clear: all three species were originally described from Morocco under oak (Malençon & Bartault 1970) and are macroscopically and microscopically very similar. Moreover, the plates and descriptions provided by Malençon & Bartault are ambiguous. Over the years, some authors have used the name *C. caligatus* for Mediterranean collections under *Cistus* and *Quercus* (e.g. Courtecuisse & Duhem 1995, Boccardo *et al.*

2008), while other authors have used the name *C. variiformis* (e.g. Vila & Llimona 2006, Bellù & Veroi 2014). Meanwhile, authors like Brandrud (1996), interpreted *C. variiformis* in a very broad sense, applying the name to nemoral frondose collections under *Quercus*, *Corylus* and *Carpinus* from northern and central Europe, further confusing the situation. Brandrud interpreted *C. variiformis* as a small species, with a pileus not exceeding 4–7 cm in diameter and considered *C. crustulinus* to be conspecific to *C. caligatus*. The latter is provisionally adopted here as the most suitable Linnean name for Cypriot collections under *Cistus*, because the original plate depicts a fungus with a partially uplifted, somewhat undulating pileal margin and a rooting stipe, features seen in nearly all collections in Cyprus (Loizides *et al.* 2011, Loizides & Kyriakou 2011). By contrast, collections under the evergreen *Quercus alnifolia* (e.g. Platania, ca 1050 m a.s.l., 1-XII-2009, Loizides 2011), are much rarer and tend to have a darker, more regularly convex pileus and a ±clavate stipe with a rounded base, features which are more consistent with Malençon's depiction of *C. variiformis*. Given the fact Malençon mentions no *Cistus* in his original description for neither *C. caligatus*, nor for *C. variiformis* or *C. crustulinus*, the possibility that pure matorral collections from Cyprus and southern Italy may belong to a distinct, as yet undescribed *Cistus*-exclusive species cannot be ruled out. On the other hand, any *Cistus* shrubs which may have been present in the original collection area may have been overlooked, as has initially been the case with *Lactarius tesquorum*. The debate can ultimately be settled only by the molecular testing of the holotypes, or, in the event that is not feasible, by the appointment of topotypical epitypes from the original collection areas in Morocco.

Cortinarius mahiquesii Vila, A. Ortega & Suár.-Sant. *

A recently described taxon (Vila *et al.* 2008) exclusively associated with *Cistus*. Several collections, such as: Platres, ca 1050 m a.s.l., under *C. salvifolius*, 3-XII-2008. *Ibid.* under *C. salvifolius*, 25-XI-2009. Platania, ca 1100 m a.s.l., under *Cistus* sp, 1-XII-2009. Spilia, ca 1000 m a.s.l., under *C. salvifolius*, 1-XII-2012. *Ibid.* 1200 m a.s.l., under *C. salvifolius*, 30-XI-2015. Probably widespread.

Cortinarius scobinaceus Malençon & Bertault *

Appearing gregariously in *Cistus* communities during late winter and early spring. Several collections, such as: Asgata, ca 180 m a.s.l., under *C. salvifolius*, 4-II-2011. Pera Pedi, ca 550 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 18-II-2011. Asgata, ca 180 m a.s.l., under *C. salvifolius*, 13-II-2012. Locally common.

Cortinarius xerophilus Rob. Henry & Contu *

Only one tentatively identified collection so far: Drousia ca 550 m a.s.l., under *Cistus monspeliensis*. 24-XII-2014. Distribution not yet understood.

Crepidotus epibryus (Fr. : Fr.) Quél. *

= *C. herbarum* (Peck) Sacc.

Seemingly frequent on *Cistus monspeliensis*, but not seen elsewhere. One large collection: Drousia ca 550 m a.s.l., on *C. monspeliensis* twigs and litter, 24-XII-2014.

Crinipellis scabella (Alb. & Schwein. : Fr.) Murrill

= *C. stipitaria* (Fr. : Fr.) Pat.

Sometimes encountered in large numbers in unimproved grasslands, scrub and open forests, but also in *Cistus* matorral, e.g. Akamas ca 300 m a.s.l., under *C. monspeliensis*, 18-XII-2014. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014.

Cyathus olla (Batsch : Pers.) Pers.

Frequent on various herbal debris and occasionally seen under *Cistus*: Kelefos, ca 500 m a.s.l., on under *C. salvifolius* in *Pinus brutia* forest clearing, 20-XI-2009.

Cyathus stercoreus (Schwein.) De Toni *

Much rarer than *Cyathus olla*, with only two collections so far, one from *Cistus* debris, with the other coming from a recently burned area: Asgata, ca 200 m a.s.l., on *Cistus* sp. 13-I-2010. Probably rare.

Entoloma cistophilum Trimbach *

Only one collection, directly under *Cistus*, in *Pinus brutia* forest opening: Mavra Dasi, ca 1100 m a.s.l., under *C. salvifolius*, 3-XII-2012. Distribution not yet understood.

Entoloma sericeum var. ***cinereoopacum*** Noord. *

Two collections directly under *Cistus*: Saittas, ca 650 m a.s.l., under *Cistus* sp. in *Pinus brutia* forest opening, 9-XII-2007. Troodos, ca 1600 m a.s.l., under *C. creticus* in *P. nigra* forest opening, 27-XI-2011. Uncommon.

Entoloma serrulatum (Fr. : Fr.) Hesler *

Two collections so far, one from a *Cistus* matorral in a *Pinus brutia* forest opening. Akamas, ca 300 m a.s.l., under *C. monspeliensis*, 18-XII-2014. Uncommon.

Entoloma undatum (Gillet) M.M. Moser var. ***undatum*** *

Frequently encountered in mixed forests, as well as pure *Cistus* matorral: Asgata, ca 180 m a.s.l., under *Cistus* sp., 2-II-2010. The variety *E. undatum* var. *aciosterilis* Vila & Llimona (Vila & Llimona 2009), reported to produce larger basidiocarps up to 8 cm in diam., has also been recorded from mixed forests under *Quercus coccifera* ssp. *calliprinos* (e.g. Moniatis, 13-XII-2007, 3-XII-09).

Flammulaster carpophilus (Fr.) Earle ex Vellinga *

One collection so far: Amiantos, ca 1000 m a.s.l., in *Cistus* sp. litter, on a loamy bank, 9-VI-2009.

Fomitiporia punctata (P. Karst.) Murrill

= *Phellinus punctatus* (P. Karst.) Pilát

Only one record so far, but perhaps overlooked. Previously reported from Cyprus on *Olea europaea* (Viney, 2005). Akamas, ca 200 m a.s.l., on *Cistus monspeliensis*, 4-I-2011.

Fomitiporia rosmarini (Bernicchia) Ghob.-Nehj. & Y.C. Dai *

= *Phellinus rosmarini* Bernicchia

A rare Mediterranean species, so far only reported from Italy, France, Portugal, Iran, the former Yugoslavia and more recently from Greece (Polemis *et al.* 2013). Associated with various sclerophyllous plants including *Cistus*, with one collection so far: Kelefos, ca 500 m a.s.l., on *C. salvifolius* branch, 4-IV-2011. Distinguished by its small, globose to subglobose spores measuring (5-) 5.5-6.5 (-7) × (-4) 4.5-6 (-6.5) µm and long subulate setae (Bernicchia 2005).

Galerina graminea (Velen.) Kühner *

= *G. laevis* Singer

Occasional to frequent in a wide range of Mediterranean habitats, with some records under *Cistus* and *Helianthemum*: Politikon, ca 200 m a.s.l., under *Helianthemum* sp., 3-II-2012. Asgata, ca 180 m a.s.l., under *Cistus* sp., 10-I-2014.

Geastrum campestre Morgan

Four collections so far, one of which under *Cistus* in a forest clearing: Mosfiloti, ca 250 m a.s.l., under *Cistus* sp. and *Cupressus sempervirens*, 23-I-2011. Uncommon.

Geastrum elegans Vittad.

= *G. badium* Pers.

Occasionally encountered under *Cistus*: Kelefos, ca 500 m a.s.l., under *C. salvifolius*, 28-I-2010. Asgata, ca 180 m a.s.l., under *C. salvifolius*, 2-II-2010. Kelefos, ca 500 m a.s.l., under *C. salvifolius*, 8-I-2011.

Geastrum minimum Schwein.

Rather common in *Cistus* litter sometimes forming fairy rings around the shrub, with several collections from various localities, such as: Mosfiloti, ca 250 m a.s.l., under *C. salvifolius* and *Cupressus sempervirens*, 23-I-2011. Prastio, ca 560 m a.s.l., under *C. salvifolius*, 25-II-2011. Asgata, ca 170 m a.s.l., under *Cistus* sp., 29-XI-2012. *Ibid.* ca 180 m a.s.l., under *Cistus* sp., 23-II-2016. *Ibid.* 27-II-2016.

Geastrum nanum Pers.= *G. schmidelii* Vittad.

Three collections so far, one directly under *Cistus*: Prastio, ca 555 m a.s.l., under *C. salvifolius* and *Ceratonia siliqua*, 5-III-2012.

Geastrum pseudolimbatum Hollós

Only one collection of this apparently rare species: Germasogeia, ca 160 m a.s.l., under *Cistus* sp. and *Ceratonia siliqua*, 25-II-2012. Also recorded by Viney (2005) on bare soil. Similar to *G. coronatum* Pers., with which is often confused, but differing in its hygroscopic rays and spores with thick, blunt warts ~ 6-7 µm (Loizides 2012b).

Gymnopus bisporus (J. Carbó & Pérez-De-Greg.) J. Carbó & Pérez-De-Greg. *

Only two collections of this rare species, previously known only from Catalonia (Vila & Llimona, 2006): Asgata, ca 170 m a.s.l., under *Cistus* sp., det. M. Noordeloos, 28-I-2011. *Ibid.*, ca 170 m a.s.l., under *Cistus* sp., 4-II-2011. Distinguished by its garlic odour, 2-spored basidia, glabrous stipe and elliptical spores measuring (7-) 9-11 (-12) × (3.5-) 4-5 (-5.5) µm.

Gymnopus dryophilus var. ***lanipes*** (Malençon & Bertault) A. Ortega, Antonín & Esteve-Rav. *= *G. lanipes* (Malençon & Bertault) Vila & Llimona

Previously regarded as a distinct species, this common *Cistus* matorral inhabitant has been recently recombined as a variant based on molecular data (Antonín *et al.* 2013). Several collections, such as: Asgata, ca 180 m a.s.l., under *C. salvifolius*, 28-I-2011. Kellaki, ca 450 m a.s.l., under *Cistus* sp., 25-I-2011. Asgata, ca 200 m a.s.l., on *Cistus* sp., 30-I-2014. Separated from the type variety by its pruinose stipe.

Gymnopus impudicus (Fr.) Antonín, Halling & Noordel. *

One of a number of *Gymnopus* species with a strong phoetid odour, with only two collections, one from pure *Cistus* matorral: Fini, ca 930 m a.s.l., under *Cistus* sp., 21-XI-2011. Rare.

Hebeloma cavipes Huijsman *

One collection under *Cistus*, in a *Pinus brutia* forest opening: Mavra Dasi, ca 1100 m a.s.l., under *C. salvifolius* 5-XII-2012. Probably rare.

Hebeloma cistophilum Maire

One of the commonest fungi in Cyprus, appearing in large numbers between late autumn and late winter, almost invariably where *Cistus* is present. Numerous collections, such as: Agros, ca 1150 m a.s.l., under *C. salvifolius*, 27-XI-2007. Saittas, ca 650 m a.s.l., under *C. salvifolius*, 13-XII-2007. Troodos, ca 1500 m a.s.l., under *C. creticus*, 3-X-2008. Pera Pedi, ca 550 m a.s.l., under *C. salvifolius*, 7-X-2008. Asgata, ca 200 m a.s.l., under *Cistus* sp., 5-XI-2009. Pera Pedi, ca 550 m a.s.l., under *C. salvifolius*, 23-XI-2010. Ayios Mamas, ca 500 m a.s.l., under *C. salvifolius*, 23-XI-2011.

Hygrocybe coccineocrenata (P.D. Orton) M.M. Moser *

One small collection fitting the description of this rather cosmopolitan species: Akamas ca 250 m a.s.l., in *Cistus monspeliensis* litter, 18-XII-2014. Rare.

Hygrocybe conica (Schaeff. : Fr.) P. Kumm. *sensu lato*

Drousia ca 550 m a.s.l., under *Cistus monspeliensis*, 24-XII-2014. A species complex, with several forms, variants and satellite taxa described in literature, but far from clarified, with both the macro- and micromorphological features variously reported by different authors. Basidia are reported occasionally as 2-spored or 4-spored, while spores are reported to be 9-12 × 6-8 µm by Moser (1983); 8-14 (-15) × 4.5-8 (-9) µm by Arnolds (1990); 8.4-9.5 × 5.2-6.1 µm by Breitenbach & Kränzlin (1991); and 8-10 (-14) × (4.5-) 5-7.5 µm by Candusso (1997). The Cypriot collections under *Cistus* have uniformly 4-spored basidia and considerably wider spores measuring 11-15 × 7.5-10 µm, suggesting they may belong to a different lineage to northern European collections described so far.

Hygrocybe russocoriacea (Berk. & T.K. Mill.) P.D. Orton & Watling *

Rare, with only one record so far: Drousia ca 550 m a.s.l., under *Cistus monspeliensis*, 24-XII-2014. Characterised by its strong aromatic odour, often described as reminiscent of Cedar wood.

Hygrophorus chrysodon var. ***cistophilus*** Pérez-De-Greg., Roqué & Macau

Previously reported as "*H. chrysodon* (Batsch) Fr." (Loizides & Kyriakou 2010), but may in the future be recombined as a distinct, *Cistus*-specific species. Cypriot collections are consistently smaller in size (< 5 cm in diam.) than the dimensions given in literature for *H. chrysodon* var. *chrysodon* (Batsch : Fr.) Fr. (< 10 cm in diam., Candusso 1997) and occur exclusively under *Cistus* conforming to the description of this variant (Pérez-De-Gregorio *et al.* 2009). Appearing gregariously locally, but infrequently, such as: Moniatis ca 600 m a.s.l., under *C. salvifolius*, 23-XII-2007. Saittas ca 700 m a.s.l., under *C. salvifolius*, 24-XII-2008. Palechori ca 850 m a.s.l., under *C. salvifolius*, 2-XI-2009. Saittas ca 700 m a.s.l., under *C. salvifolius*, 12-XII-2011. Kalavassos ca 180 m a.s.l., under *C. salvifolius*, 23-I-2016.

Hygrophorus pseudodiscoideus var. ***cistophilus*** Bon & G. Rioussset

A *Cistus* specialist, frequent under *C. monspeliensis* but much rarer under *C. salvifolius*. Saittas ca 700 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 20-XII-2009. *Ibid.* ca 700 m a.s.l., under *C. salvifolius* and *P. brutia*, 3-XII-2012. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014. Kalavassos ca 180 m a.s.l., under *C. salvifolius*, 23-I-2016.

Inocybe arenicola (R. Heim) Bon *

Only one record so far: Kalavassos ca 170 m a.s.l., under *Cistus salvifolius*, 29-XI-2012. One of a number of species in section *Rimosae*, lacking metuloid cystidia. Characterised by its xerophyllic habitus and large smooth spores, measuring 12–17 × 7–9 µm. Probably rare.

Inocybe flocculosa Sacc. *sensu lato*

Mostly found in *Pinus brutia* forests, but occasionally also in *Cistus* matorral, such as: Asgata ca 170 m a.s.l., under *C. salvifolius*, 2-II-2010. *Ibid.* ca 180 m a.s.l., under *Cistus* sp., 29-XI-2012. Most likely a species complex.

Inocybe furfurea Kühner *

A spring species, occasionally seen under *Quercus* as well as *Cistus*, in mixed middle-altitude forests and matorral: Pera Pedi ca 550 m a.s.l., under *C. salvifolius* in *Pinus brutia* forest edge, 30-III-2011.

Inocybe obscurobadia (J. Favre) Grund & D.E. Stuntz

= *I. tenuicystidiata* E. Horak & Stangl

Frequent under *Cistus* in late winter and early spring, such as: Asgata ca 170 m a.s.l., under *C. salvifolius*, 13-I-2010. *Ibid.* ca 170 m a.s.l., under *C. salvifolius*, 9-IV-2011.

Inocybe pruinosa R. Heim *

Found under *Cistus* in dunes and matorral during late winter and spring: Trimiklini ca 500 m a.s.l., under *C. salvifolius*, 8-III-2011. Akrotiri ca 5 m a.s.l., under *C. salvifolius*, *Fumana thymifolia* and *Juniperus phoenicea*, 16-I-2012. Uncommon.

Inocybe rufuloides Bon *

Rather common in the dune zone under *Cistus* and *Fumana*: Akrotiri ca 5 m a.s.l., on dunes under *F. thymifolia* and *Juniperus phoenicea*, 16-I-2012. *Ibid.* ca 5 m a.s.l., on dunes under *F. thymifolia* and *J. phoenicea*, 7-II-2012. *Ibid.* ca 5 m a.s.l., on dunes under *F. thymifolia* and *J. phoenicea*, 9-I-2013. *Ibid.* ca 5 m a.s.l., on dunes under *F. thymifolia* and *J. phoenicea*, 16-I-2014. *Ibid.* ca 50 m a.s.l., on dunes under *F. thymifolia* and *Cistus* spp., 17-I-2015.

Inocybe vulpinella Bruyl. *

Occasionally seen in open *Pinus brutia* forests and *Cistus* matorral, in late winter and spring: Asgata ca 180 m a.s.l., under *C. salvifolius*, 2-X-2010.

Lactarius cistophilus Bon & Trimbach *

Locally frequent under *Cistus monspeliensis*, but only once recorded under *C. salvifolius*: Lythrodontas ca 300 m a.s.l., under *C. salvifolius*, leg. & det. M. Chelides, 27-XI-2014. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014.

Lactarius tesquorum Malençon

A common *Cistus*-exclusive associate, found throughout the island under *C. salvifolius* and *C. monspeliensis*. Numerous collections, such as: Saittas ca 650 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 13-XII-2007. Platres ca 800 m a.s.l., under *C. salvifolius* and *P. brutia*, 13-XI-2008. Asgata ca 180 m a.s.l., under *C. salvifolius*, 3-II-2009. Saittas ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 13-XII-2007. Kakomallis ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 31-X-2009. Moniatis ca 700 m a.s.l., under *C. salvifolius* and *P. brutia*, 9-XII-2009. Saittas ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 20-XII-2009. Asgata ca 170 m a.s.l., under *C. salvifolius*, 13-I-2010. *Ibid.* ca 180 m a.s.l., under *C. salvifolius*, 2-II-2010. Akamas ca 200 m a.s.l., under *C. monspeliensis* and *P. brutia*, 14-XII-2014. *Ibid.* ca 230 m a.s.l., under *C. monspeliensis* and *Juniperus phoenicea*, 18-XII-2014. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014. Kalavastos ca 180 m a.s.l., under *C. salvifolius*, 23-I-2016.

Leccinellum corsicum (Rolland) Bresinsky & Manfr. Binder

A *Cistus* specialist, occasional in pure *Cistus* matorral, but sometimes also present in *Pinus brutia* forests with a *Cistus* understory. Very similar to *L. lepidum* (H. Bouchet ex Essette) Bresinsky & Manfr. Binder, which is associated with Mediterranean evergreen oaks (*Quercus ilex*, *Q. coccifera*, *Q. alnifolia*). Several collections, such as: Saittas, ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 24-XII-2008. *Ibid.* ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 20-XI-2009. Asgata, ca 180 m a.s.l., under *Cistus* sp. 29-XI-2012. *Ibid.* ca 200 m a.s.l., under *Cistus* sp., 23-I-2013. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014. Akamas ca 150 m a.s.l., under *C. monspeliensis*, 23-II-2016.

Lepiota farinolens Bon & G. Rioussat *

A Mediterranean species originally described from southern France (Bon & Rioussat 1992), but rarely reported in the literature, with two records in Cyprus from pure *Cistus* matorral: Kalavastos, ca 180 m a.s.l., under *C. salvifolius*, 29-XI-2012. *Ibid.* 23-I-2016. Characterised by its small fruitbodies with pinkish tinges not exceeding 2–2.5 cm in diameter, its farinaceous odour, the transient but well-formed ring on the stipe, the variably shaped cheilocystidia and the spores measuring 7.5–10 (–11) × 5–6 (–6.5) µm.

Lepiota locquinii Bon *

= *L. gracilis* Peck *sensu* Locquin (1945)

= *L. heimii* Locq. *nomen nudum* [Bon, in Doc. Mycol. 11 (43): p. 43, 1981]

One collection of this rarely reported species, originally published invalidly as "*L. heimii*" (Bon 1981) and later validated under the current name (Bon 1985): Kalavastos ca 170 m a.s.l., under *C. salvifolius*, 23-I-2016. This is a small exannulate species, with an ochraceous-pink fibrillose to squamulose pileus < 2.5 cm, a slender concolorous stipe, ovoid to elliptical thick-walled spores (6–8 × 4–5 µm), 2-spored (or occasionally 4-spored) basidia, and numerous, fasciculate, clavate to utriform cheilocystidia (20–30 × 7–10 µm). Probably rare, but easily confused in the field with similar, small *Lepiota* species.

Lepiota sublaevigata Bon & Boiffard *

Occasional in open *Pinus brutia* forests and *Cistus* matorral: Kelefos, ca 500 m a.s.l., under *C. salvifolius*, 11-XII-2007. Pera Pedi, ca 550 m a.s.l., under *C. salvifolius*, 7-XI-2009. Kelefos, ca 500 m a.s.l., under *C. salvifolius*, 9-XI-2009.

Lepista sordida (Schumach.) Singer

Common in grassy *Pinus brutia* forests and *Cupressus sempervirens* groves, but frequently also encountered in pure *Cistus* matorral, such as: Asgata, ca 200 m a.s.l., under *C. salvifolius*, 13-I-2010. *Ibid.* ca 220 m a.s.l., under *C. salvifolius*, 6-XII-2014. As suggested by Alvarado *et al.* (2015), more than one species are likely involved under this name.

Leucoagaricus melanotrichus (Malençon & Bertault) Trimbach *

Two records, one of them directly under *Cistus* in an open *Pinus brutia* and *Cedrus brevifolia* forest: Tripilos, ca 1100 m a.s.l., under *C. salvifolius*, 18-XI-2009. Rare.

Lycoperdon atropurpureum Vittad. *

Rare, only one collection so far: Agios Mamas, ca 500 m a.s.l., under *Cistus* sp. and *Pinus brutia*, 10-III-2012. Characterised by the violaceous-purple colour of the mature spores, well-developed subgleba, the fragile, brownish exoperidial aculei and the globose coarsely warted spores ~ 4–6 µm.

Lycoperdon perlatum Pers. : Pers.

Rather common in middle- to high altitude pine forests, but also encountered in *Cistus* matorral, such as: Asgata, ca 170 m a.s.l., under *Cistus* sp. and *Ceratonia siliqua*, 14-II-2011. *Ibid.* ca 180 m a.s.l., under *Cistus* sp. 23-II-2016.

Lycoperdon pratense Pers. : Pers.

= *Vascellum pratense* (Pers.) Kreisel

Occasional in dry grasslands and scrub, with some records from *Cistus* matorral, such as: Prastio, ca 500 m a.s.l., under *C. salvifolius* and *Ceratonia siliqua*, 5-III-2011.

Lyophyllum fumosum (Pers. : Fr.) P.D. Orton *sensu lato*

Frequently encountered at various altitudes, in both mixed forests and pure *Cistus* matorral, such as: Saittas, ca 650 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 3-XII-2008. *Ibid.* ca 630 m a.s.l., under *C. salvifolius* and *P. brutia*, 1-XII-2011. Asgata, ca 190 m a.s.l., under *C. salvifolius*, 26-XII-2011. *Ibid.* ca 195 m a.s.l., under *C. salvifolius*, 6-XII-2014. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014. Multigene phylogenetic analyses (Bellanger *et al.* 2015) have revealed considerable ecological and morphological plasticity within the *L. fumosum* clade (Vb-7), which may in the future result in the recognition of several infraspecific variants or synonymies. The collections reported here all appear to grow directly under *Cistus* even when found in mixed woodland, and correspond to the ecological/morphological concepts of *Lyophyllum cistophilum* Vila & Llimona, *L. phaeophyllum* Vila & Llimona, and *L. subglobisporum* Consiglio & Contu, so far phylogenetically unresolved. Specimens display the typical features of fleshy basidiocarps, dry, often concentrically guttulate pilei, buff to greyish lamellae, siderophilous basidia and globose to subglobose spores ~ 6–7.5 µm.

Marasmius ventalloi Singer *

= *M. anomalus* f. *ventalloi* (Singer) Esteve-Rav. & G. Moreno

Common Mediterranean species found during the winter months on various plant debris, occasionally also on *Cistus*: Asgata, ca 160 m a.s.l., under *Cistus* sp., 9-II-2009. *Ibid.* ca 180 m a.s.l., under *Cistus* sp., 2-II-2010. Kalavassos, ca 140 m a.s.l., under *C. salvifolius* sp., 19-II-2009. Akamas, ca 200 m a.s.l., under *C. monspeliensis*, 14-XII-2014. Morphologically very close to *M. anomalus* Lasch ex Rabenh., from which it differs in its smaller, darker basidiocarps and greenish tinges upon drying. *Marasmius mediterraneus* Corriol. is also similar, but has a reddish lamellae edge with dimorphic cheilocystidia, lacks of caulocystidia and has smaller spores, measuring 12–15 × 3.5–4.5 µm (Noordeloos 1995, Breitenbach & Kränzlin 1991, Corriol 2006). The spores of the Cypriot collections measure 15–19 × 4–5.5 µm.

Melanoleuca excissa (Fr. : Fr.) Singer

Occasionally encountered in forest edges among grasses and herbs, but also recorded in grassy *Cistus* matorral: Pera Pedi, ca 580 m a.s.l., under *Cistus* sp., 1-III-2013.

Melanoleuca pseudoluscina Bon *

Often reported from dunes and *Cistus* matorral, but only one record so far in Cyprus: Souni, ca 400 m a.s.l., under *C. parviflorus* in *Pinus brutia* forest clearing, 25-II-2013. Perhaps overlooked.

Montagnea arenaria (DC.) Zeller *

Geri, ca 170 m a.s.l., at inland dunes, near *Helianthemum* and *Tuberaria* spp., 17-III-2010. A secotioid desert specialist, with remarkably variable spores measuring (7.5–) 15.5–20 (–27) × (4.5–) 11.5–14 (–21)

µm (Moser 1983, Sarasini 2005). Probably rare. *Montagnea haussknechtii* Rabenh. has also been reported from the island (Viney 2005) but has much smaller spores measuring 6–7 × 3–4 µm.

Mycena galopus (Pers. : Fr.) P. Kumm. var. *galopus*

One collection from a *Cistus* branch in a *Pinus brutia* forest: Trimiklini, ca 550 m a.s.l., on *C. salvifolius*, 31-XII-2013.

Mycena olivaceomarginata (Masse) Masee *

A couple of collections from *Cistus* matorral: Lythrodontas, ca 190 m a.s.l., in open *Pinus brutia* forest, among *Cistus salvifolius* litter, 27-XI-2011. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014. Occasional, also seen in *Pinus* forests and grassy forest clearings.

Myriostoma coliforme (Dicks. : Pers.) Corda

Three records of this extremely rare species (included in the proposed list of 33 threatened fungi in Europe, Bohlin 2004), with one of the records directly under *Cistus*, in *Pinus brutia* forest clearing: Prastio, ca 460 m a.s.l., under *C. salvifolius*, 31-III-2011.

Myxomphalia maura (Fr.) H.E. Bigelow

One collection from an old burned matorral: Asgata, ca 170 m a.s.l., on several years' old burned ground, among *Cistus salvifolius* litter, 31-XII-2007.

Omphalina subhepatica (Batsch) Murrill *

= *O. hepatica* (Batsch) P.D. Orton

Recorded twice in *Cistus* matorral: Mosfiloti, ca 260 m a.s.l., under *C. salvifolius*, 6-I-2009. Asgata, ca 180 m a.s.l., under *C. salvifolius*, 18-I-2011. Uncommon to rare.

Panaeolus acuminatus Quél. *

= *P. caliginosus* (Jungh.) Gillet

Occasional in Cyprus, recorded from various grassy habitats, with one collection coming from pure *Cistus* matorral: Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014.

Peniophora lycii (Pers. : Fr.) Höhn. & Litsch.

= *P. caesia* Bres.

Two records, one from a fallen *Cistus* twig: Trimiklini ca 500 m a.s.l., on fallen *Cistus* sp. twig, 28-II-2014. Also recorded on *C. creticus* by Torrejón (2013). Perhaps not uncommon but overlooked.

Phallus impudicus L. : Fr.

Uncommon in Cyprus, with most records so far harvested directly under *Cistus*: Saittas, ca 700 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 20-XII-2009. Kellaki, ca 700 m a.s.l., under *C. salvifolius* and *P. brutia*, 21-XII-2009. Saittas, ca 700 m a.s.l., under *C. salvifolius* and *Pistacia lentiscus*, 12-XII-2011. Asgata, ca 180 m a.s.l., under *C. salvifolius*, 21-II-2011. Kelefos, ca 650 m a.s.l., under *C. salvifolius* and *P. brutia*, 9-XII-2012.

Phellinus erectus A. David, Dequatre & Fiasson *

= *Fomitiporia erecta* (A. David, Dequatre & Fiasson) Fiasson

Frequently seen on *Cistus* and other sclerophyllus plants, such as: Prastio, ca 500 m a.s.l., on *C. salvifolius* branch 5-III-2012. *Ibid.*, ca 500 m a.s.l., on *C. salvifolius* branch 24-II-2013. Kalavastos, ca 170 m a.s.l., on *Cistus* branch 23-I-2016.

Pholiota gallica Holec & M. Kolařík *

= *P. lubrica* var. *obscura* Bon & Chevassut

= *P. highlandensis* var. *citriosquamulosa* Maire ex Bidaud & Borgarino

A recently described taxon proposed to accommodate Mediterranean collections previously identified as “*Pholiota brunnescens* A.H. Sm. & Hesler” (an extra-European species), “*P. lubrica* var. *obscura*”, or “*P. highlandensis* var. *citriosquamulosa*” (Holec & Kolařík 2014). This appears to be a facultatively

anthracophilous species, found in old burned areas as well as xerophilic woodland and matorral: Asgata ca 170 m a.s.l., in old burned area under *Cistus* sp. 30-XII-2007. Akamas, ca 150 m a.s.l., under *Cistus* sp. 14-I-2009. Asgata ca 170 m a.s.l., in old burned area under *Cistus* sp. 3-II-2009. *Ibid.* 4-II-2011. Akrotiri, ca 50 m a.s.l., under *Cistus* sp. 27-I-2012. Occasional.

Polyporus meridionalis (A. David) H. Jahn

One of the most widespread fungi on the island, common on wooden debris of *Cistus*, *Genista*, *Rosmarinus* and other Mediterranean shrubs. Numerous collections, such as: Mosfiloti, ca 230 m a.s.l., on *Cistus* sp., 6-I-2009. Akamas, ca 200 m a.s.l., on *C. mospeliensis*, 14-I-2009. Asgata, ca 200 m a.s.l., on *Cistus* sp., 3-II-2009. Trimiklini, ca 550 m a.s.l., on *C. salvifolius*, 26-II-2010. *Ibid.* ca 550 m a.s.l., on *C. salvifolius*, 3-III-2010. Prastio, ca 500 m a.s.l., on *C. salvifolius*, 25-II-2011.

Pseudoclitocybe obbata (Fr.) Singer *

One small collection in *Cistus* litter, fitting the concept of this rarely reported species: Troodos ca 1550 m a.s.l., under *C. creticus* and *Pinus nigra*, 10-XI-2011. Rare.

Psilocybe crobula (Fr.) Singer

A rare species with only a handful of records, one coming from fallen *Cistus* twigs in pure matorral: Drousia ca 550 m a.s.l., on *C. mospeliensis* twig, 24-XII-2014.

Radulomyces confluens (Fr. : Fr.) M.P. Christ. *

= *Cerocorticium confluens* (Fr. : Fr.) Jülich & Stalpers

Only two collections, one on a *Genista* branch and another on a *Cistus* twig in the same locality. Trimiklini, ca 550 m a.s.l., on *C. salvifolius* twig, 31-XII-2013. Perhaps widespread but overlooked.

Resupinatus trichotis (Pers.) Singer *

Very similar to *R. applicatus* (Batsch : Fr.) Gray. Occasionally encountered on twigs and branches of sclerophyllous shrubs: Trimiklini, ca 560 m a.s.l., on branch of *Cistus salvifolius*, 31-XII-2013. Also recorded on *Olea europaea*, Pera Pedi, ca 580 m a.s.l., 14-II-2014.

Rhizocybe vermicularis (Fr.) Vizzini, G. Moreno, P. Alvarado & Consiglio

= *Clitocybe vermicularis* (Fr.) Quél.

A common spring species, found in open *Pinus brutia* forests, but occasionally also under *Cistus*, such as: Souni ca 400 m a.s.l., under *C. salvifolius*, 28-II-2015. Episkopi ca 160 m a.s.l., under *C. salvifolius* and *Juniperus phoenicea*, 1-III-2015. Recently separated from the genus *Clitocybe* based on molecular data (Alvarado *et al.* 2015).

Rhizopogon vulgaris (Vittad.) M. Lange

A common species in coastal and middle-altitude *Pinus brutia* forests, *P. halepensis* plantations, sometimes also in suburban areas under scattered *P. pinea*. Comandini *et al.* (2006), considered reports of *Rhizopogon* spp. from pure *Cistus* matorral to be spurious. However, collections conforming to the concept of *R. vulgaris* are not infrequently encountered in treeless *Cistus* communities in Cyprus, such as: Asgata, ca 180 m a.s.l., under *Cistus salvifolius*, 21-XII-2011. Drousia ca 550 m a.s.l., under *C. mospeliensis*, 24-XII-2014. Souni ca 400 m a.s.l., under *Cistus* sp., 2-III-2015. Kalavastos ca 180 m a.s.l., under *Cistus* sp., 23-I-2016. *Rhizopogon roseolus* (Corda) Th. Fr., is also common in Cyprus, but found earlier in the season at higher elevations above 1000 m., mostly under *P. nigra*. By contrast, *Rhizopogon luteolus* Fr. is very rare, and only once recorded by the author (Prodromos ca 1400 m a.s.l., under *P. nigra*, 22-IX-2009). Previous reports of *R. luteolus* from Cyprus (Natrass 1937, Wynei 2005, Torrejón 2014), some of them describing it as 'fairly common', likely represent misidentified collections of *R. vulgaris* or a different species.

Ripartites metrodii Huijsman *

An uncommon species, found in dry grasslands and forest clearings, with one record from *Cistus* matorral: Palechori, ca 850 m a.s.l., under *C. salvifolius*, 2-XI-2009. Similar to *R. tricholoma* (Alb. & Schwein.) P. Karst., but producing larger basidiocarps (< 6 cm in diam.) with indistinct hairs at the pileus margin, and with slightly larger spores (4–6 × 3–5.5 µm).

Russula insignis Quél.= *R. pectinata* var. *insignis* (Quél.) Maire

Occasional in mixed forests under *Quercus* and *Cistus*: Platres ca 800 m a.s.l., under *C. salvifolius* and *Pinus brutia*, 3-X-2008. Pera Pedi ca 600 m a.s.l., under *C. salvifolius*, *Q. coccifera* and *P. brutia*, 13-X-2008. Troodos ca 1500 m a.s.l., under *C. creticus* and *P. nigra*, 24-IX-2009. Kelefos ca 540 m a.s.l., under *C. salvifolius*, *Q. coccifera* and *P. brutia*, 2-XI-2012.

Russula monspeliensis Sarnari *

Two collections so far: Prodromos ca 1350 m a.s.l., under *Cistus creticus* and *Quercus alnifolia*, 18-XI-2012. Drousia ca 550 m a.s.l., under *C. monspeliensis*, 24-XII-2014.

Russula sanguinaria (Schumach.) Rauschert= *R. sanguinea sensu auct.*

Occasional under *Pinus* but seldomly also recorded in pure *Cistus* matorral: Asgata, ca 180 m a.s.l., under *C. salvifolius*, 10-II-2011. *Ibid.* ca 180 m a.s.l., under *Cistus salvifolius*, 6-XII-2014. Kalavastos, ca 180 m a.s.l., under *C. salvifolius*, 23-I-2016. For more, see "Discussion".

Russula tyrrhenica Sarnari *

A typical *Cistus* matorral inhabitant, yet apparently rare in Cyprus, with only one record so far: Drousia ca 550 m a.s.l., under *Cistus monspeliensis*, 24-XII-2014.

Sphaerobolus stellatus Tode : Pers.*

Three records so far, all from *Cistus* twigs and litter: Kelefos, ca 500 m a.s.l., on fallen *C. salvifolius* leaves, 2-I-2009. Ayia Paraskevi, ca 540 m a.s.l., on *C. salvifolius* twigs, 11-II-2009. Kelefos, ca 500 m a.s.l., on *C. salvifolius* twigs, 21-I-2015. Seemingly uncommon but probably overlooked.

Stereum ochraceoflavum (Schwein.) Sacc.

Drousia ca 550 m a.s.l., on fallen *Cistus monspeliensis* twig, 24-XII-2014. Previously recorded by Torrejón (2013) on the endemic *Quercus alnifolia*. Perhaps frequent but overlooked, often confused with the very similar *Stereum hirsutum* (Willd.) Pers., which is common in Cyprus (Natrass 1937, Viney 2005).

Stereum reflexulum Lloyd *

Pera Pedi ca 550 m a.s.l., on fallen *Cistus salvifolius* twig, 24-II-2010. Distribution not yet understood, but also recorded on the endemic *Quercus alnifolia* (Spilia ca 1100 m a.s.l., 28-XI-2115, det. P.A. Moreau).

Stropharia coronilla (Bull.) Quél.

Common in coastal and inland grasslands, but occasionally also seen in *Cistus* matorral: e.g. Drousia ca 550 m a.s.l., in *C. monspeliensis* litter, 24-XII-2014.

Thelephora caryophyllea (Schaeff. : Fr.) Pers.

Common under *Cistus* in winter and spring. Several records, such as: Pera Pedi ca 580 m a.s.l., in *C. salvifolius* litter, 24-III-2009. Trimiklini ca 550 m a.s.l., in *C. salvifolius* litter, 1-III-2010. *Ibid.* ca 550 m a.s.l., in *C. salvifolius* litter, 24-III-2011. Prastio ca 510 m a.s.l., in *C. salvifolius* litter, 8-III-2012.

Tremella dactylobasidia J.C. Zamora *

A recently described species (Zamora 2009), characterized by its striking hypobasidial elements, comprised of 2–4 finger-like segments. It grows parasitically on the corticioid fungus *Vuilleminia macrospora* (Bres.) Hjortstam, common on *Cistus* branches and twigs. Two records so far: Archimandrita, ca 700 m a.s.l., on *C. salvifolius*, 16-II-2013. Prastio, ca 560 m a.s.l., on *C. salvifolius*, 24-II-2014. The spores of the Cypriot collections are ±globose, measuring 9–11 × 8.5–10.5 µm.

Tricholoma terreum (Schaeff. : Fr.) P. Kumm.= *T. myomyces* (Pers. : Fr.) J.E. Lange= *T. gausapatum* (Fr. : Fr.) Quél.

Very common in *Pinus nigra* and *P. brutia* forests, but sometimes also seen in pure *Cistus* matorral: e.g.

Kalavassos, ca 170 m a.s.l., under *C. salvifolius*, 6-XII-2014. Akrotiri, ca 70 m a.s.l., under *Cistus* sp., 17-I-2015. See “Discussion” for more notes.

Tubaria hiemalis Romagn. ex Bon *

Often considered synonymous to *T. furfuracea* (Pers.) Gillet, which has also been reported from Cyprus (Viney 2005, Loizides *et al.* 2011), but here treated as a distinct species to accommodate grassland, scrubland and matorral collections with capitate cystidia, occurring later in the season: Kellaki, ca 520 m a.s.l., on *C. salvifolius* debris, 23-XII-2013. Kelefos, ca 470 m a.s.l., in *C. salvifolius* litter, 21-I-2015. Frequent.

Tulostoma fimbriatum Fr. : Pers.*

Two collections, both directly under *Cistus*: Pelendri, ca 750 m a.s.l., in *Cistus* litter, 4-I-2009. Moniatas, ca 820 m a.s.l., in *Cistus* litter, 4-III-2009. Rare.

Tulostoma squamosum (J.F. Gmel. : Pers.) Pers.

Only one collection in *Pinus brutia* forest opening: Prastio, ca 500 m a.s.l., on sandy ground among *C. salvifolius* litter, 5-III-2012. Sometimes considered synonymous to *T. brumale* Pers. but here treated as distinct. Rare.

Vuilleminia macrospora (Bres.) Hjortstam

= *Dendrothele macrospora* (Bres.) P.A. Lemke

= *Laeticorticium macrosporum* (Bres.) J. Erikss. & Ryvar den

Forming whitish resupinate patches on various substrates, including *Cistaceae* plants. Commonly seen on *Cistus* twigs and branches, such as: Archimandrita, ca 700 m a.s.l., on *Cistus* sp., 16-II-2013. Saïttas, ca 650 m a.s.l., on *Cistus* sp., 12-II-2014. Prastio, ca 560 m a.s.l., on *C. salvifolius* twig, 24-II-2014. Kalavassos, ca 160 m a.s.l., on *C. salvifolius* twig, 28-I-2016.

Xeromphalina cornui (Quél.) J. Favre *

A rarely reported species, with only one collection so far: Souni, ca 400 m a.s.l., on *Cistus parviflorus* branch, 13-III-2014. At least two more species of *Xeromphalina*, *X. caudicinalis* (Fr. : Fr.) Kühner & Maire and *X. brunneola* O.K. Mill., are present in Cyprus, both of which are commonly encountered in high-altitude *Pinus brutia* and *P. nigra* forests. Both species have abundant caulocystidia, while *X. cornui* has only scant caulocystidia, mostly confined to the stipe apex: clavate to utriform in the case of *X. brunneola*, irregularly clavate to coralloid in *X. caudicinalis* (Antonín & Noordeloos 2004). The spores of the Cypriot collection measure $5.5\text{--}8 \times 3\text{--}4.2 \mu\text{m}$.

Discussion

As is evident from the results of this 10-year survey, significant diversity is present within *Cistaceae*-dominated ecosystems, with *Cistus* being by far the most prolific host. Of the taxa identified in *Cistus*-dominated ecosystems, about 45 or more, are confirmed or suspected to be ectomycorrhizal (following Tedersoo *et al.* 2010). It should be noted, however, that several collections from mixed habitats, or collections only identified at generic level, have been excluded from the present checklist; both the species richness and number of ECM species, therefore, are considerably higher than the number of taxa reported here.

Based on preliminary above-ground surveys and below-ground molecular studies, the number of ECM fungi associated with *Cistus* appears to be lower than the number of fungi associated with ‘high profile’ tree-hosts such as *Fagus*, *Eucalyptus*, *Pinus*, *Pseudotsuga*, or *Quercus* (Trappe 1977, Comandini *et al.* 2006, Taudière *et al.* 2015). On the other hand, the numbers of *Cistus* ECM partners appear to be similar or higher to the numbers of fungi associated with *Alnus*, *Corylus*, *Populus*, and *Salix* (Taudière *et al.* 2015). Considering *Cistus* is routinely encountered at the undercanopy of Mediterranean pine and oak forests, the number of *Cistus*-associated fungi, at least as far as above-ground surveys are concerned, may in fact be

underestimated (Loizides & Kyriakou 2011). It is further worth considering, that since the exact trophic status for a number of fungi still remains unclear (Tedersoo *et al.* 2010), a number of previously presumed saprotrophs, such as *Helvella* or *Morchella* species for instance, may have a mycorrhizal/endophytic lifestyle instead (Dahlstrom *et al.* 2000, Baynes *et al.* 2012, Nguyen *et al.* 2013). Given *Cistus*' potential to form both ectomycorrhizal and arbuscular mycorrhizal partnerships, comprehensive surveys dealing with the full spectrum of mycodiversity within these ecological niches (to include ECM, AM, biotrophic and saprotrophic fungi) are, in fact, surprisingly scarce.

Interestingly, a number of collections in Cyprus come from several years' old burned areas where pine used to grow, with a number of typically pine-associated fungi, such as *Tricholoma terreum* or *Russula sanguinaria*, persisting under *Cistus* many decades following the extinction of pine. These species' long prevalence in pure *Cistus* matorral, well past the post-fire succession stages, is unlikely to be the result of resistant spores or sclerotia-infected root tips (as postulated by Cairney & Bastias 2007). In more recent studies, Buscardo *et al.* (2012), found that roughly one third of mycorrhizal species encountered with pine are also present with *Cistus*, while Hernández-Rodríguez *et al.* (2013) reported fungal richness in post-fire ecosystems dominated by *Cistus ladanifer*, to be similar or higher than that found in tree-dominated ecosystems. These findings are indicative of considerable diversity, but also ecological plasticity within Mediterranean mycobiota, where several fungi may have developed specific adaptation strategies to cope with disturbance phenomena, such as fire and drought. In this scenario, *Cistus* may act as a substitute host, sustaining a portion of the original mycobiota during the post-fire succession stages (following Hernández-Rodríguez *et al.* 2013), but more crucially, perhaps even after trees become extinct. Host overlap for ECM fungi involving trees and *Cistaceae* plants has indeed been documented, for instance between *Quercus* and *Helianthemum* (Dickie *et al.* 2004), *Cistus* and *Pinus* (Buscardo *et al.* 2012), or *Cistus* and *Quercus* (Taudière *et al.* 2015). If *Cistus* matorral can accommodate significant numbers of migrating, tree-associated fungi, then *Cistus* communities become all the more significant for the conservation and sustainability of fungal diversity in Mediterranean ecosystems, where forest fires are common and large areas have been stripped of tree populations.

Even though Mediterranean ecoregions host 10% of the world's vascular plants in an area occupying less than 2% of the global land mass (Médail & Quézel 1997, Mittermeier *et al.* 2005, Médail 2013), surprisingly little is being done for the conservation of these biodiversity hotspots. Instead, many Mediterranean habitats have long been considered economically and ecologically unimportant, and have been under constant assault from anthropogenic activities such as agriculture, farming, mass tourism, industrial and residential expansion and, more recently, accelerated climate changes and population increase (Médail & Quézel 1997, Myers *et al.* 2000, Behrens *et al.* 2010, Shoukri & Zachariadis 2012). Cyprus itself, is one of the ten regional hotspots within the Mediterranean basin, accommodating over 1900 plant species, subspecies and varieties, 140 of which (7.3%), are endemic to the island (Tsintides *et al.* 2002, 2007, Merlo & Croitoru 2005, Hadjikyriakou 2007). Fungal diversity within these rich, yet vulnerable ecosystems, however, remains fragmentarily documented and poorly understood (Natrass 1937, Loizides 2008, Loizides *et al.* 2011).

As demonstrated in recently published studies (Loizides & Kyriakou 2011, Loizides 2011, Loizides *et al.* 2015a,b, 2016), considerable diversity is present within niche ecosystems in Cyprus, including *Quercus alnifolia* and *Arbutus andrachne* stands, coastal and inland dunes, halophytic wetlands, and, of course, *Cistus* matorral. Nowadays, widely available molecular tools can be utilized to establish the exact mycorrhizal symbiont of fungi found in mixed habitats, explore below-ground interactions, or detect cryptic speciation where morphological

characters are inconclusive or overlap. Studies on plant-fungi dynamics could also provide valuable insights in identifying urgent conservation priorities, as would National and regional checklists, including, eventually, the drafting of a National Red List of threatened fungi. All of the above, however, will require the State's co-operation, funding and support.

To this day, no effective legislation exists in Cyprus regarding the conservation and sustainable management of fungi (Loizides *et al.* 2011). Moreover, Cyprus is plagued by major human-induced erosion, which has severely degraded over one third (38%) of the island's coastline, while global climate changes are predicted to have a devastating impact over the next few decades (Giorgi 2006, IPCC 2007, Behrens *et al.* 2010, Shoukri & Zachariadis 2012). Since Cyprus is situated at the south-easternmost corner of the Mediterranean basin, it is more imminently threatened by accelerated climate changes, temperature increases and prolonged periods of drought. As the island's forests may find themselves under increased pressure and gradually recede, a portion of the existing mycobiota may seek refuge in *Cistus*-dominated ecosystems, where the next available plant-host and favorable microclimatic conditions can be found. Given the unique geophysical and ecological position *Cistus* matorral occupies, between wet mountainous forests at one end of the spectrum and semi-arid lowland scrub at the other, but also *Cistus*' potential to putatively act as a substitute host, these little-valued habitats may prove critical in sustaining much of the island's mycobiota during climate changes. The authorities' will and ability to draft and implement effective conservation policies, especially with regards to the protection of such long-neglected niche ecosystems, will likely be decisive for the conservation of the island's mycodiversity in the years to come.

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FIGURE 1:

1 *Arachnopeziza auerelia*; 2 *Helvella semiobruta*; 3 *Ombrophila rivulorum*; 4 *Peziza muscicola*; 5 *Peziza subviolacea*;
6 *Plectania zugazae*; 7 *Terfezia claveryi*; 8 *Tirmania nivea*.



FIGURE 2:

9 *Agaricus cupreobrunneus*; 10 *Agaricus iesu-et-marthae*; 11 *Amanita cistetorum*;
12 *Arrhenia rickenii*; 13 *Astraeus telleriae*; 14 *Clitocybe cistophila*; 15 *Clitocybe font-queri*;
16 *Colus hirudinosus*.



FIGURE 3:

- 17** *Cortinarius caligatus*; **18** *Cortinarius mahiquesii*; **19** *Cortinarius scobinaceus*;
20 *Entoloma cistophilum*; **21** *Entoloma sericeum* var. *cinereoopacum*;
22 *Entoloma undatum* var. *undatum*; **23** *Fomitiporia rosmarini*; **24** *Geastrum elegans*.



FIGURE 4:

25 *Gymnopus bisporus*; 26 *Gymnopus dryophilus* var. *lanipes*; 27 *Hebeloma cavipes*;
28 *Hygrocybe russocoriacea*; 29 *Hygrophorus chrysodon* var. *cistophilus*;
30 *Hygrophorus pseudodiscoideus* var. *cistophilus*; 31 *Inocybe arenicola* 32 *Inocybe pruinosa*.



FIGURE 5:

- 33** *Inocybe rufuloides*; **34** *Lactarius cistophilus*; **35** *Lactarius tesquorum*;
36 *Leccinellum corsicum*; **37** *Lepiota farinolens*; **38** *Leucoagaricus melanotrichus*;
39 *Lyophyllum fumosum* **40** *Melanoleuca pseudoluscina*.



FIGURE 6:

41 *Polyporus meridionalis*; 42 *Russula monspeliensis*; 43 *Russula sanguinaria*;
44 *Russula tyrrhenica*; 45 *Sphaeroporus stellatus*;
46 *Vuilleminia macrospora* + *Tremella dactylobasidia*; 47 *Tricholoma terreum*
48 *Xeromphalina cornui*.

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