
A preliminary checklist of macrofungi of Guatemala, with notes on edibility and traditional knowledge

Flores Arzú R¹, Comandini O² and Rinaldi AC^{2,*}

¹Departamento de Microbiología, Facultad de CCQQ y Farmacia, Universidad de San Carlos de Guatemala, Ciudad Universitaria zona 12, 01012, Guatemala

²Department of Biomedical Sciences and Technologies, University of Cagliari, I-09042 Monserrato (CA), Italy

Flores Arzú R, Comandini O, Rinaldi AC 2012 – A preliminary checklist of macrofungi of Guatemala, with notes on edibility and traditional knowledge. *Mycosphere* 3(1), 1-21, Doi 10.5943/mycosphere/3/1/1

Despite its biological wealth, current knowledge on the macromycetes inhabiting Guatemala is scant, in part because of the prolonged civil war that has prevented exploration of many ecological niches. We provide a preliminary literature-based checklist of the macrofungi occurring in the various ecological regions of Guatemala, supplemented with original observations reported here for the first time. Three hundred and fifty species, 163 genera, and 20 orders in the Ascomycota and Basidiomycota have been reported from Guatemala. Many of the entries pertain to ectomycorrhizal fungal species that live in symbiosis with the several *Pinus* and *Quercus* species that form the extensive pine and mixed forests of the highlands (up to 3600 m a.s.l.). As part of an ongoing study of the ethnomycology of the Maya populations in the Guatemalan highlands, we also report on the traditional knowledge about macrofungi and their uses among native people. These preliminary data confirm the impression that Guatemala hosts a macrofungal diversity that is by no means smaller than that recorded in better studied neighboring Mesoamerican areas, such as Mexico and Costa Rica.

Key words – Ectomycorrhizal fungi – Ethnomycology – Macromycetes – Neotropical fungi – Regional list

Article Information

Received 16 November 2011

Accepted 26 November 2011

Published online 13 January 2012

*Corresponding author: Andrea C. Rinaldi – e-mail – rinaldi@unica.it

Introduction

Despite its relatively small area (108,889 sq km), Guatemala is one of the richest biodiversity hotspots in the world (Tolisano & López 2010). This is due to the variety of its territory and ecosystems that occur from sea level up to more than 4,000 meters above sea level, from subtropical and tropical rain forests to wetlands, from dry forests to scrublands, from cloud forests to mixed forests and pine–fir forests in the highlands. Despite this wealth, however, our knowledge on the mycobiota of the

country is very poor. There are several reasons for this, primarily the prolonged civil war (1960–1996) and related political and social instability that have severely hampered field work in the country. The lack of trained local mycologists has certainly also delayed the detailed investigation of the rich mycota inhabiting the highly diversified Guatemalan ecological niches.

In order to contribute to the knowledge of the mycoflora of Guatemala, and in the hope that what is reported here will stimulate other researchers to study the Guatemalan mycolo-

gical diversity, we have assembled a checklist of the macrofungi recorded to date. Concomitantly, we provide relevant information on the traditional knowledge about mushrooms and their uses among native Maya people.

Materials and methods

Compilation of data

Our data set on the macrofungi of Guatemala contains information collated mainly from published sources. Most of the quoted works are the result of field research by Guatemalan mycologists, although a small number of reports are due to foreign investigators. The list in Table 1 also includes a few species reported here for the first time for Guatemala. The systematic arrangement and the nomenclature used are those of the *Dictionary of Fungi* (Kirk et al. 2008), including its web-based version (www.indexfungorum.org). The checklist is organized alphabetically by order, genus, and species. No herbaria data are reported, unless these have been published and explicitly quoted as sources (e.g. Roberts 2008). However, it must be noted that several mycological herbaria, especially those based in North America (e.g. US National Fungus Collection–BPI, New York Botanical Garden–NY) and Europe (Royal Botanic Gardens at Kew–K), contain a significant number of entries from Guatemala. Also, with a few exceptions, we have not listed species classified in the original sources only to genus level (e.g. *Entoloma* sp.), or tentatively identified (e.g. *Lactarius* cfr. *subpurpureus*), as this might generate confusion when these incomplete classifications are rechecked and eventually corrected; we also excluded all material published only in theses and not subsequently confirmed by more reliable studies.

Despite all efforts to browse all relevant bibliographic sources, our literature survey might well have overlooked some existing information on the macro-mycobiota of Guatemala. However, we are confident that the data matrix assembled includes the vast majority of the information currently available on the topic.

Ethnomycological notes

Fieldwork, developed and carried out in the last 20 years or so by researchers from the Universidad de San Carlos de Guatemala, involved repeated visits to a number of localities of the central, western, and northern Guatemalan highlands, mainly in the departments of Alta Verapaz, Baja Verapaz, Chimaltenango, El Quiché, El Progreso, Guatemala, Huehuetenango, Quetzaltenango, Sacatepéquez, San Marcos, Sololá, and Totonicapán (Fig 1). During these surveys, mushrooms were purchased at municipal markets and from vendors along main routes (like the interdepartmental Carretera Panamericana), or obtained from hired local harvesters. Information on common names of mushrooms in the local idioms, traditional uses and edibility, methods of cooking, the period of the year mushrooms are found, the locations where they are found and the prices at which they are sold in the community, were collected through interviews with vendors and harvesters. In each interview, fresh mushrooms and field guides were shown as stimuli and reference.

Results and Discussion

Diversity of Guatemala macromycetes

‘Macromycetes’ is by no means a systematic category, but larger fungi are of particular interest because of their importance as food resources and as a component of traditional culture. Moreover, many basidiomycetes and ascomycetes with conspicuous sporocarps often play an important role as ectomycorrhizal mycobionts of trees and shrubs of boreal forests in the northern hemisphere and are important elements in many areas of the southern hemisphere (Rinaldi et al. 2008).

Table 1 lists 350 (31 ascomycetes and 319 basidiomycetes) species of macromycetes occurring in 163 genera and 20 ascomycetous and basidiomycetous orders, reported as occurring in Guatemala on the basis of published information and personal observations (Fig 2). The relevant original information is contained in about 60 papers (see References), many with only limited (national) distribution and availability. Most of the recent information has been collected in

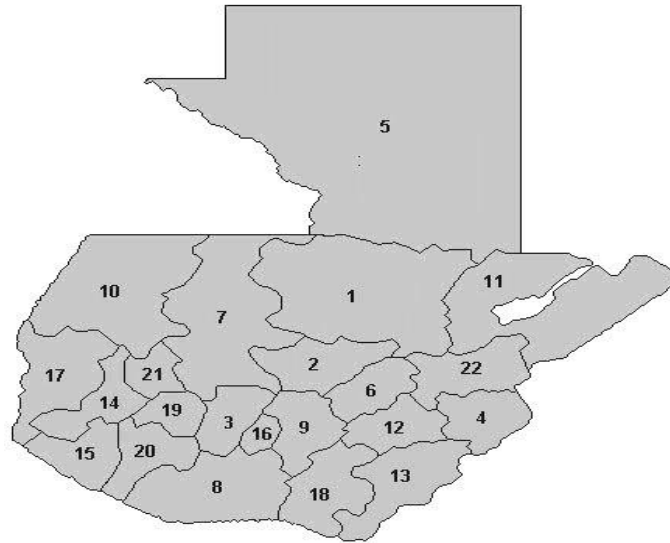


Fig 1 – Departments of Guatemala. Guatemala is divided into 22 administrative departments: 1 Alta Verapaz, 2 Baja Verapaz, 3 Chimaltenango, 4 Chiquimula, 5 Petén, 6 El Progreso, 7 El Quiché, 8 Escuintla, 9 Guatemala, 10 Huehuetenango, 11 Izabal, 12 Jalapa, 13 Jutiapa, 14 Quetzaltenango, 15 Retalhuleu, 16 Sacatepéquez, 17 San Marcos, 18 Santa Rosa, 19 Sololá, 20 Suchitepéquez, 21 Totonicapán, 22 Zacapa.

the field during the last two decades or so thanks to the work of the ‘Unidad de biodiversidad, aprovechamiento y tecnología de hongos–UBIOTAH’, based at the Facultad de Ciencias Químicas y Farmacia of the Universidad de San Carlos de Guatemala, Guatemala City, Guatemala,. The geographical distribution of the reports covers 21 of the 22 administrative departments of the country (see Fig 1); only for the department of Retalhuleu, flanking the Pacific Ocean, there are no published records. Most observations pertain to the highlands in the departments of Alta Verapaz, Baja Verapaz, Chimaltenango, El Quiché, Guatemala, Huehuetenango, and Quetzaltenango. At the order level, *Agaricales* has the highest number of species (111), hosting almost one third of the entire set, followed by *Polyporales* (60) and *Boletales* (53). The most represented genera are *Amanita* with 18 species, *Russula* (13), *Lactarius* (11), *Laccaria* (9), *Suillus* (8), all genera ectomycorrhizal with the several *Pinus* and *Quercus* species that form extensive pine and mixed forests on the highlands (Vivero et al. 2006), and/or with the endangered *Abies*

guatemalensis (pinabete), most abundant between 2800–3200 m elevation on the Sierra de los Cuchumatanes in western Guatemala (Flores et al. 2002). The mycorrhizal biology of selected fungal species (in particular *Lactarius* spp. and *Boletus* spp.) and of their host trees in Guatemala has received some attention recently (Flores et al. 2005, Flores et al. 2008a, Flores et al. 2008b, Che & Flores 2010, Díaz et al. 2007, Díaz et al. 2009, Comandini et al. 2012), and further research on the topic is under way. Ectomycorrhizal species comprise 43.7% of the total records (153 entries), while 191 (54.6%) of the recorded species are saprobic and only 6 (1.7%) are parasitic.

Although the list displayed in Table 1 might appear extensive, needless to say it presumably covers only a small part of the macrofungi diversity in Guatemala. Most researchs have concentrated in a limited, accessible portion of the country, rich in forests and thus hosting a varied mycoflora. The wide lowland Petén region, for example, has been scantily explored, despite the fact that it accounts for about one third of Guatemala's



Figs 2 (A–D) – Diversity of Guatemala macromycetes. **A** *Hypomyces lactifluorum*. **B** *Wynnea americana*. **C** *Lactarius indigo*. **D** ‘medida’ (portion) of mixed edible mushrooms on sale at the municipal market of Tonicapán.

area and, together with adjacent areas of Belize and southern Mexico, comprise the largest unbroken tract of tropical forest north the Brazilian Amazon. In a survey of 0.1 ha in the Cordillera Talamanca, Costa Rica, Gregory Mueller and Roy Halling have reported some 200 species of macrofungi in a parcel of native forests hosting only 20–25 species of vascular plants and just two ectomycorrhizal angiosperms (Halling & Mueller 2002). There is no reason to believe that Guatemala forests would be any less diversified.

In general, a significant part of material collected is difficult to classify at species level, often because the available mycofloras for surroundings areas and North America report many European epithets that have been used to name American taxa, but in reality the problem of whether this situation reflects real conspecificity or superficial resemblance still awaits clarification in most cases. According to the curator of macrofungi and agaricales at BIGU, one the four official herbaria in the country and the only one with

a mycological section¹, hosted at the Universidad de San Carlos de Guatemala, their collection includes approximately 2,500 specimens, which are only partially classified (Maura Liseth Quezada Aguilar, personal communication). Most of these are from the tropical rain forest of ‘Eco–región Lachuá’, a protected area noted for its biodiversity, northwest of Cobán, Alta Verapaz. The most represented families at BIGU are *Agaricaceae*, *Coprinaceae*, *Entolomataceae*, *Hygrophoraceae*, *Hymenochaetaceae*, *Marasmiaceae*, and *Polyporaceae*. Many of the *Polyporaceae* species listed in Table 1 were collected by Aaron Sharp in 1945–1946 (see Sharp 1948) and have not been reported since, which testifies for the intermittent nature of mycological research in Guatemala (Sharp’s collections are kept in TENN, herbarium of the University of Tennessee at Knoxville).

¹ The Micoteca de Macromicetos de Guatemala ‘Lic. Rubén Mayorga’, has been established in the Departamento de Microbiología de la Escuela de Química Biológica de la Facultad de Ciencias Químicas y Farmacia of the Universidad de San Carlos de Guatemala (see Bran et al. 2002). This collection hosts very valuable material, most of which is currently under study, but has not received international recognition as yet

Despite our rudimentary knowledge of the macrofungi diversity in Guatemala it is possible to make some comments on some of its distinctive patterns, especially for the ectomycorrhizal mushrooms. Several notable species occurring in the Guatemalan highlands (e.g., *Amanita* cfr. “*costaricensis*”, *Lactarius indigo*, *L. rimosellus*, *Laccaria amethystina*, *Russula nigricans*, *Strobilomyces strobilaceus*, *Tylopilus violatinctus*) belong to the guild of obligate ectomycorrhizal fungal species that are believed to have migrated from north to south from the North Temperate zone with their associated phanerogams, in particular *Quercus*, through Mexico and Guatemalan highlands, down to the montane areas of Costa Rica and in some instances to southern Colombia (Halling & Mueller 2002). A certain level of local endemism might also be present among the ectomycorrhizal taxa in the Guatemalan highlands, as was noted in Costa Rica (Halling & Mueller 2002). A relevant example for Guatemala could be *Boletus luteoloincrustatus*. However, the ‘endemism issue’ should be treated with caution, as further research in undersurveyed areas could well extend the range of many species. This is the case of *Boletus guatemalensis*, originally known only from Guatemala but recently reported also for Belize (Ortiz-Santana et al. 2007), and *Amanita “costaricensis”* and *Phylloporus aurantiacus*, previously thought to be restricted to the Cordillera Talamanca and to one site in Cartago Province of Costa Rica, respectively, and now reported also from Guatemala (Table 1).

Traditional knowledge and use

Some 131 entries listed in Table 1 (37.4% of the total) were identified as edible species, most of which are actually sold in local markets or along roadsides, especially in the highlands. A few species (e.g., *Tricholoma magnivelare*, *Heimioporus betula*) are considered edible in other countries, but are not consumed in Guatemala. It is not rare that species of edible mushrooms belonging to different genera (e.g., *Amanita*, *Lactarius*, *Helvella*) are offered mixed together, and sold in form of ‘medida’, i.e. a fixed amount, which equals the content of a small basket

(Fig 2). However, the more popular and valuable species are usually sold separately. *Lactarius deliciosus* and *L. indigo* – known as ‘Shara’ (or ‘Xara’) ‘amarilla’ and ‘Shara’ (or ‘Xara’) ‘azul’, respectively, or ‘Cabeza de Xara’ in local Spanish (Sharas, also known as ‘urracas’ are birds, variously coloured, living in different parts of the country) – *Amanita caesarea* complex (hongo de San Juan), and *Cantharellus cibarius* (anacate), are among the most appreciated edible mushrooms among Maya. The gathering and consumption of some species are apparently restricted to a few, if not one single community; relevant examples in this case are *Hydnum umbilicatum* in Comalapa (Chimaltenango) and *Lactarius rimosellus* in Jacaltenango (Huehuetenango). Many, but by no means all, edible species are identified through common vernacular names that have been sometimes recorded in several Maya idioms (Bran et al. 2002, Bran et al. 2003a, Bran et al. 2005, Morales et al. 2002, Flores unpublished results). Generally, mushrooms are gathered and sold by women, often in family groups spanning three generations. The use of macrofungi in Guatemala other than for human consumption is limited to a few instances (Table 1). The spores and dried mycelia of *Calvatia lilacina* and *C. cyathiformis* are locally used as wound healing and hemostatic substances, and for preventing infections (Sommerkamp 1994, Bran et al. 2005). In the Sierra de los Cuchumatanes, sporocarps of *Geastrum* and *Lycoperdon* are used as cicatrizing substances to treat burns in children (Flores et al. 2002). Similarly, dried specimens of *Lycoperdon marginatum* are used to heal and disinfect wounds, and to treat bee stings (Bran et al. 2005). The ceremonial/religious role played by *Amanita muscaria* and *Psilocybe mexicana* is mentioned below. These observations are part of a more general, ongoing study of the ethnomycological knowledge of the Maya populations in the Guatemalan highlands that will be published elsewhere.

“The Mesoamerican tradition of eating wild edible fungi continues from Mexico to west Guatemala then is absent from much of Honduras and Nicaragua, even though both

Table 1 Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
Ascomycota			
<u>Helotiales</u>			
<i>Chlorociboria aeruginascens</i> (Nyl.) Kanouse	Sro	sapro	this study
<u>Hypocreales</u>			
<i>Cordyceps melolonthae</i> (Tul. & C. Tul.) Sacc.	Chi	parasitic	this study
<i>C. militaris</i> (L.) Link	Chi, Sac	parasitic	this study
<i>Hypomyces hyalinus</i> (Schwein.) Tul. & C. Tul.	Sac	parasitic	Sommerkamp & Guzmán 1990 (as <i>Apiocrea hyalina</i>)
* <i>H. lactifluorum</i> (Schwein.) Tul. & C. Tul.	Chi, Qui, Qtz, Tot	parasitic	Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b, Boa 2004, this study
<u>Leotiales</u>			
<i>Leotia lubrica</i> (Scop.) Pers.	Avz, Hue, Sac, Sro	sapro	Sommerkamp & Guzmán 1990, Flores et al. 2002, this study
<u>Pezizales</u>			
<i>Aleuria aurantia</i> (Pers.) Fuckel	Sac	sapro	Sommerkamp & Guzmán 1990, Flores et al. 2002
<i>Cookeina sulcipes</i> (Berk.) Kuntze	Sro	sapro	Sommerkamp & Guzmán 1990
* <i>Gyromitra infula</i> (Schaeff.) Quél.	Tot	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2002
* <i>Helvella crispa</i> (Scop.) Fr.	Chi, Gua, Hue, Qui, Qtz	ecto	Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004,
* <i>H. elastica</i> Bull.	Qtz, Sac	ecto	Sommerkamp & Guzmán 1990
* <i>H. lacunosa</i> Afzel.	Avz, Chi, Gua, Hue Qtz, Sac, Tot	ecto	Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004
* <i>H. macropus</i> (Pers.) P. Karst.	Chi, Gua, Hue, Sac, Tot	ecto	Sommerkamp & Guzmán 1990 (as <i>Macropodia m.</i>), Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, this study
<i>Melastiza chateri</i> (W.G. Sm.) Boud.	Hue	sapro	Flores et al. 2002
* <i>Morchella costata</i> (Vent.) Pers.	Gua	sapro	Sommerkamp & Guzmán 1990
* <i>M. elata</i> (Fr.)	Tot	sapro	Bran et al. 2003b
* <i>M. esculenta</i> (L.) Pers.	Gua, Tot	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b, Boa 2004
* <i>M. guatemalensis</i> Guzmán, M.F. Torres & Logem.	Chi, Gua, Sac	sapro	Guzmán et al. 1985, Sommerkamp & Guzmán 1990, Guzmán & Tapia 1998, Bran et al. 2003b
<i>M. vulgaris</i> (Pers.) Boud.	Hue	sapro	Flores et al. 2002 (as <i>M. conica</i>)
<i>Otidea onotica</i> (Pers.) Fuckel	Hue	sapro	Flores et al. 2002
<i>Phillipsia guatemalensis</i> Paden [¶]	Sro	sapro	Paden 1977
<i>Pithya cupressina</i> Fuckel	Gua	sapro	Sommerkamp & Guzmán 1990
<i>Scutellinia scutellata</i> (L.) Lambotte	Gua	sapro	Sommerkamp & Guzmán 1990
<i>Trichoglossum farlowii</i> (Cooke) E.J. Durand	Chi, Hue, Sac, Tot	sapro	Flores et al. 2002, this study
<i>Wynnea americana</i> Thaxt.	Chi, Hue	sapro	Flores et al. 2002, this study
<u>Xylariales</u>			
<i>Annulohypoxylon thouarsianum</i>	nr	sapro	Sharp 1948 (as <i>Hypoxylon malleolus</i>)

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
Lév.) Y.M. Ju, J.D. Rogers & H.M. Hsieh <i>Daldinia fissa</i> Lloyd	Chi	sapro	Bran et al. 2002, Bran et al. 2003b (as <i>D. vernicosa</i>), Morales et al 2006
<i>Phylacia poculiformis</i> (Mont.) Mont.	Sro	sapro	Sommerkamp & Guzmán 1990
<i>Xylaria cubensis</i> (Mont.) Fr.	nr	sapro	Sharp 1948
<i>X. multiplex</i> (Kunze) Fr.	Bvz	sapro	Sommerkamp & Guzmán 1990
<i>X. polymorpha</i> (Pers.) Grev.	Esc, Sam	sapro	this study
Basidiomycota			
<u>Agaricales</u>			
* <i>Agaricus campestris</i> L.	Chi, Qtz	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b, Boa 2004
<i>A. silvaticus</i> Schaeff.	Gua	sapro	Sommerkamp & Guzmán 1990
<i>A. xanthodermus</i> Genev.	Gua, Sro	sapro	Sommerkamp & Guzmán 1990
* <i>Agrocybe aegerita</i> (V. Brig.) Singer	Chi, Sac, Sam	sapro	Bran et al. 2002, Bran et al. 2003b, Boa 2004, this study
<i>Amanita brunnescens</i> G.F. Atk.	Bvz	ecto	Sommerkamp & Guzmán 1990
* <i>A. caesarea</i> (Scop.) Pers.	Avz, Chi, Gua, Hue, Jal Qui, Qtz, Sac, Tot	ecto	Sharp 1948, Lowy 1974, Logemann et al. 1987, Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, this study
* <i>A. aff. calyptroides</i> Peck	Chi, Gua, Qui	ecto	Bran et al. 2002
* <i>A. calyptroderma</i> G.F. Atk. & V.G. Ballen	Chi, Qui	ecto	Bran et al. 2002, Boa 2004
<i>A. chlorinosma</i> (Peck) Lloyd	nr	ecto	Sharp 1948
<i>A. citrina</i> (Schaeff.) Pers.	Hue	ecto	Flores et al. 2002
<i>A. cokeri</i> (E.-J. Gilbert & Kühner) E.-J. Gilbert	Bvz, Gua	ecto	Sommerkamp & Guzmán 1990
<i>A. cfr. "costaricensis"</i> Tulloss, Halling, G. M. Muell. & Singer	Gua, Qui	ecto	this study
* <i>A. crocea</i> (Quél.) Singer	Chi, Gua	ecto	Sommerkamp & Guzmán 1990, this study
* <i>A. fulva</i> Fr.	Gua, Hue, Jal, Sam, Tot	ecto	Logemann et al. 1987, Sommerkamp & Guzmán 1990, Flores et al. 2002, Bran et al. 2003b
* <i>A. gemmata</i> (Fr.) Bertill.	Jal, Qtz, Sac	ecto	Logemann et al. 1987, Sommerkamp & Guzmán 1990
* <i>A. hemibapha</i> (Berk. & Broome) Sacc.	Chi, Gua, Jut, Qui, Sac	ecto	Bran et al. 2002, Boa 2004, this study
* <i>A. magnivelaris</i> Peck	Jal	ecto	Sommerkamp & Guzmán 1990, Logemann et al. 1987
§ <i>A. muscaria</i> (L.) Lam.	Chi, Hue, Qui, Sam, Sol, Tot	ecto	Sharp 1948, Lowy 1974, Logemann et al. 1987, Sommerkamp 1994, Flores et al. 2002
<i>A. pantherina</i> (DC.) Krombh.	Gua, Sam	ecto	Flores et al. 2002, this study
* <i>A. rubescens</i> Pers.	Hue, Gua, Sac, Sam, Tot	ecto	Sharp 1948, Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004
* <i>A. vaginata</i> (Bull.) Lam.	Gua, Hue, Jal, Qtz, Sam, Tot	ecto	Sharp 1948 (as <i>Amanitopsis vaginata</i>), Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002,

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
<i>A. verna</i> (Bull.) Lam.	Gua, Sac	ecto	Bran et al. 2003b
* <i>Armillaria mellea</i> (Vahl) P. Kumm.	Sac	parasitic	Sharp 1948, Sommerkamp & Guzmán 1990
* <i>A. obscura</i> (Schaeff.) Herink	Avz, Hue	parasitic	Sommerkamp & Guzmán 1990 (as <i>Armillariella m.</i>), Sommerkamp & Guzmán 1990 (as <i>Armillariella polymyces</i>), Bran et al. 2002, Bran et al. 2003b
<i>Bolbitius titubans</i> (Bull.) Fr.	Chi, Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>B. vitellinus</i>)
§* <i>Calvatia cyathiformis</i> (Bosc) Morgan	Gua, Hue, Tot	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2005, Morales et al. 2009
§ <i>C. lilacina</i> (Mont. & Berk.) Henn.	Esc, Sro	sapro	Sommerkamp 1994
* <i>Catathelasma ventricosum</i> (Peck) Singer	Hue	sapro (?)	Flores et al. 2002, Boa 2004
<i>Chlorophyllum molybdites</i> (G. Mey.) Masee	Esc, Gua, Sro, Zac	sapro	Sommerkamp & Guzmán 1990
* <i>Clavaria argillacea</i> Fr.	Chi, Qtz	sapro	Bran et al. 2002, Bran et al. 2003b, Bran et al. 2005
* <i>C. fragilis</i> Holmsk.	Bvz, Gua, Hue, Sol	sapro	Sommerkamp & Guzmán 1990 (as <i>C. vermicularis</i>), Flores et al. 2002
* <i>Clitocybe clavipes</i> (Pers.) P. Kumm.	Tot	sapro	Bran et al. 2002, Bran et al. 2003b
* <i>C. gibba</i> (Pers.) P. Kumm.	Sac	sapro	Sommerkamp & Guzmán 1990
* <i>Collybia polyphylla</i> (Peck) Singer ex Halling	Chi, Gua, Sac	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b
<i>Cortinarius alboviolaceus</i> (Pers.) Fr.	Qtz	ecto	Sommerkamp & Guzmán 1990
<i>C. odorifer</i> Britzelm.	Hue	ecto	Flores et al. 2002
* <i>C. praestans</i> Cordier	Chi	ecto	Boa 2004, this study
<i>C. violaceus</i> (L.) Gray	Bvz, Hue	ecto	Sommerkamp & Guzmán 1990, Flores et al. 2002
* <i>Cortinarius</i> sp.	nr	ecto	Boa 2004
<i>Crepidotus mollis</i> (Schaeff.) Staude	Qtz	sapro	Sommerkamp & Guzmán 1990
<i>Crucibulum laeve</i> (Huds.) Kambly	nr	sapro	Sharp 1948 (as <i>C. vulgare</i>), Morales et al. 2009
<i>Cyathus olla</i> (Batsch) Pers.	Avz, Bvz, Esc, Pet, Qtz, Sac	sapro	Sommerkamp & Guzmán 1990, Morales et al. 2009, this study
* <i>Flammulina velutipes</i> (Curtis) Singer	Gua	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2003a
<i>Gymnopus confluens</i> (Pers.) Antonín, Halling & Noordel.	Sac	sapro	Sommerkamp & Guzmán 1990 (as <i>Collybia c.</i>)
* <i>G. dryophilus</i> (Bull.) Murrill	Chi, Gua, Sac, Tot	sapro	Sommerkamp & Guzmán 1990 (as <i>Collybia dryophila</i>), Bran et al. 2002, Bran et al. 2003b (as <i>Collybia</i> group <i>dryophila</i>)
<i>G. underwoodii</i> (Peck) Murrill	Gua	sapro	Guzmán-Dávalos 1996
* <i>Hohenbuehelia petaloides</i> (Bull.) Schulzer	Gua, Sro	sapro	Sommerkamp & Guzmán 1990, this study
<i>Hygrophorus chrysodon</i> (Batsch) Fr.	Hue	ecto	Flores et al. 2002 (as <i>H. chrysenteron</i>)
* <i>H. pudorinus</i> (Fr.) Fr.	Hue	ecto	Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b
* <i>H. russula</i> (Schaeff.) Kauffman	Chi, Hue, Sac	ecto	Bran et al. 2002, Bran et al. 2003b, Boa 2004, this study
<i>Hypholoma fasciculare</i> (Huds.) P. Kumm.	Hue	ecto	Flores et al. 2002
<i>Inocybe asterospora</i> Quél.	Gua	ecto	Sommerkamp & Guzmán 1990
<i>I. geophylla</i> (Fr.) P. Kumm.	Gua, Sac	ecto	Sommerkamp & Guzmán 1990, this study

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
<i>I. rimosa</i> (Bull.) P. Kumm.	Gua, Sac	ecto	Sommerkamp & Guzmán 1990 (as <i>I. fastigiata</i>), this study
* <i>Laccaria amethystina</i> (Huds.) Cooke	Chi, Hue, Jal, Qui, Sam, Tot	ecto	Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Morales et al. 2003, Boa 2004
* <i>L. bicolor</i> (Maire) P.D. Orton	Hue, Sam	ecto	Flores et al. 2002, Morales et al. 2003, Boa 2004
<i>L. gomezii</i> Singer & G.M. Muell.	Bvz, Qui	ecto	Morales et al. 2003
* <i>L. laccata</i> (Scop.) Cooke	Bvz, Chi, Esc, Gua, Hue, Qui, Sam, Tot	ecto	Sharp 1948, (as <i>Clitocybe l.</i>), Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Morales et al. 2003, Boa 2004, this study
* <i>L. major nom. prov.</i> G.M. Muell.	Jal, Qui	ecto	Bran et al. 2003b, Morales et al. 2003
<i>L. nobilis</i> A.H. Sm.	Chi, Qui	ecto	Morales et al. 2003
* <i>L. ohiensis</i> (Mont.) Singer	Chi, Tot	ecto	Bran et al. 2003b, Morales et al. 2003
<i>L. proxima</i> (Boud.) Pat.	Chi	ecto	Morales et al. 2003
<i>L. trichodermophora</i> G.M. Muell.	Hue	ecto	Morales et al. 2003
<i>Lentinus crinitus</i> (L.) Fr.	Avz, Gua, Izb	sapro	Sommerkamp & Guzmán 1990 (as <i>Panus c.</i>)
* <i>L. levis</i> (Berk. & M.A. Curtis) Murrill	Avz, Chi, Hue, Sac, Sol, Sro	sapro	Sommerkamp & Guzmán 1990 (as <i>Pleurotus l.</i>), Bran et al. 2002, Bran et al. 2003b, Bran et al. 2005
<i>L. strigosus</i> Fr.	Bvz, Sro	sapro	Sommerkamp & Guzmán 1990 (as <i>Panus rudis</i>)
* <i>Lepista nuda</i> (Bull.) Cooke	Chi, Gua, Sac, Sol	sapro	Bran et al. 2002, Bran et al. 2003b, this study
<i>Leucoagaricus leucothites</i> (Vittad.) Wasser	Qtz	sapro	Sommerkamp & Guzmán 1990 (as <i>L. naucinus</i>)
<i>Lycoperdon candidum</i> Pers.	Qtz	sapro	Sommerkamp & Guzmán 1990, Morales et al. 2009
<i>L. echinatum</i> Pers.	Hue	sapro	Flores et al. 2002, Morales et al. 2009
§* <i>L. marginatum</i> Vittad.	Hue, Qtz, Sam	sapro	Bran et al. 2005, Morales et al. 2009
* <i>L. perlatum</i> Pers.	Chi, Gua, Hue, Sam, Tot	sapro	Sommerkamp & Guzmán 1990, Morales et al. 2009
* <i>Lyophyllum decastes</i> (Fr.) Singer	Chi, Gua, Qtz	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2005
<i>Macrolepiota mastoidea</i> (Fr.) Singer	Gua	sapro	Sommerkamp & Guzmán 1990
* <i>M. procera</i> (Scop.) Singer	Gua, Hue, Sro	sapro	Sharp 1948 (as <i>Lepiota p.</i>), Bran et al. 2003a, this study
<i>Marasmius cladophyllus</i> Berk.	Avz	sapro	Sommerkamp & Guzmán 1990
<i>M. ramealis</i> (Bull.) Fr.	Gua	sapro	Sommerkamp & Guzmán 1990
<i>Megacollybia platyphylla</i> (Pers.) Kotl. & Pouzar	nr	sapro	Sharp 1948 (as <i>Collybia p.</i>)
<i>Melanoleuca melaleuca</i> (Pers.) Murrill	Hue	sapro	Flores et al. 2002
* <i>Mycena pura</i> (Pers.) P. Kumm.	Gua, Hue	sapro	Flores et al. 2002, Sommerkamp & Guzmán 1990
<i>Omphalotus olearius</i> (DC.) Singer	Hue	sapro	this study
<i>Panaeolus antillarum</i> (Fr.) Dennis	Gua, Sac	sapro	Sommerkamp & Guzmán 1990
<i>P. papilionaceus</i> (Bull.) Quéf.	Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>P. sphinctrinus</i>)
<i>Panellus pusillus</i> (Pers. ex Lév.) Burds. & O.K. Mill.	Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>Dictyopanus p.</i>)
<i>Phaeocollybia kauffmanii</i> (A.H. Sm.) Singer	Hue	sapro	Flores et al. 2002
<i>Pholiota squarrosa</i> (Vahl) P. Kumm.	Chi, Hue	sapro	Flores et al. 2002, this study
<i>Phyllotopsis nidulans</i> (Pers.) Singer	Chi, Sac	sapro	Sommerkamp & Guzmán 1990, this study

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
* <i>Pleurocybella porrigens</i> (Pers.) Singer	Hue, Sro	sapro	Bran et al. 2003a, this study
* <i>P. djamor</i> (Rumph. ex Fr.) Boedijn	Avz, Gua, Hue, Pro, Sol	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2003b, Bran et al. 2005
* <i>P. ostreatus</i> (Jacq.) P. Kumm.	Gua, Sro, Zac	sapro	Sharp 1948, Sommerkamp & Guzmán 1990, Bran et al. 2002
* <i>P. smithii</i> Guzmán	Qui	sapro	Bran et al. 2002, Bran et al. 2003b
* <i>Pleurotus</i> sp.	nr	sapro	Boa 2004
<i>Pluteus chrysophlebius</i> (Berk. & M.A. Curtis) Sacc.	Gua	sapro	Sommerkamp & Guzmán 1990
* <i>Pseudofistulina radicata</i> (Schwein.) Burds.	Gua, Hue, Sac, Sol	sapro	Guzmán 1987, Sommerkamp & Guzmán 1990, Bran et al. 2003b, this study
<i>Psilocybe caeruleascens</i> Murrill	nr	sapro	Guzmán et al. 1998
<i>P. cubensis</i> (Earle) Singer	Avz, Gua, Sro	sapro	Sommerkamp & Guzmán 1990, Sommerkamp 1994, Guzmán et al. 1998
<i>P. cyanescens</i> Wakef.	Avz, Gua	sapro	Sommerkamp 1994
§ <i>P. mexicana</i> R. Heim	Avz, Gua, Sro	sapro	Lowy 1974, Guzmán 1986, Sommerkamp & Guzmán 1990, Sommerkamp 1994, Guzmán 1995
<i>P. subtropicalis</i> Guzmán	Gua	sapro	Guzmán 1995
<i>P. zapotecorum</i> R. Heim	Zac	sapro	Sommerkamp & Guzmán 1990, Sommerkamp 1994
* <i>Rhodocollybia butyracea</i> (Bull.) Lennox	Tot	sapro	Bran et al. 2003b (as <i>Collybia b.</i>)
* <i>Schizophyllum commune</i> Fr.	Avz, Bvz, Esc, Gua, Hue, Izb, Pet, Qui, Sac	sapro	Sharp 1948, Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b, Boa 2004, Vargas et al. 2010, this study
* <i>Tricholoma equestre</i> (L.) P. Kumm.	Chi, Gua, Sac, Sam	ecto	Sommerkamp & Guzmán 1990 (as <i>T. flavovirens</i>), Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004, this study
* <i>T. magnivelare</i> (Peck) Redhead	Qui	ecto	Bran et al. 2003a (as <i>T. ponderosum</i>)
<i>Tricholomopsis decora</i> (Fr.) Singer	nr	ecto	Flores et al. 2002
<i>T. rutilans</i> (Schaeff.) Singer	Bvz	sapro	Sommerkamp & Guzmán 1990
* <i>Trogia</i> sp.	Chi	sapro	Bran et al. 2002, Boa 2004
<i>Tulostoma brumale</i> Pers.	Hue	sapro	Flores et al. 2002, Morales et al. 2009
* <i>Vascellum intermedium</i> A.H. Sm.	Gua	sapro	Sommerkamp & Guzmán 1990, Morales et al. 2009
* <i>Volvariella bakeri</i> (Murrill) Shaffer	Suc	sapro	Sommerkamp & Guzmán 1990
* <i>V. bombycina</i> (Schaeff.) Singer	Gua	sapro	Bran et al. 2003a
<u>Auriculariales</u>			
* <i>Auricularia auricula-judae</i> (Bull.) Quél.	Avz, Bvz, Esc	sapro	Sommerkamp & Guzmán 1990, Sommerkamp 1994 (in both as <i>A. auricula</i>), this study
* <i>A. cornea</i> Ehrenb.	Hue	sapro	Bran et al. 2003b, Roberts 2008
* <i>A. delicata</i> (Mont.) Henn.	Bvz, Chi, Gua, Hue, Izb	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b, Boa 2004, Roberts 2008
* <i>A. fuscossuccinea</i> (Mont.) Henn.	Avz, Gua, Hue, Izb	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2003b, Roberts 2008
* <i>A. polytricha</i> (Mont.) Sacc.	Sac	sapro	Sommerkamp & Guzmán 1990

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
<i>Ductifera exidioidea</i> Lowy	Gua	sapro	Lowy 1964a
<i>Exidia ambipapillata</i> Lowy	Sol	sapro	Lowy 1964a
<i>E. antiquae</i> Lowy	Gua	sapro	Lowy 1964a
<i>E. lutea</i> Lowy	Sac	sapro	Lowy 1964a
<i>E. maya</i> Lowy	Sac	sapro	Lowy 1964a
<i>Guepinia helvelloides</i> (DC.) Fr.	Hue	sapro	Flores et al. 2002 (as <i>Phoglotis h.</i>)
<i>Heterochaete shearii</i> (Burt) Burt	nr	sapro	Roberts 2008 and references therein
* <i>Pseudohydnum gelatinosum</i> (Scop.) P. Karst.	Chi, Hue	sapro	Flores et al. 2002, Bran et al. 2002, Bran et al. 2003b
Boletales			
<i>Astraeus hygrometricus</i> (Pers.) Morgan	Gua	ecto	Sommerkamp & Guzmán 1990, Morales et al. 2009
<i>Aureoboletus</i> cfr. <i>auriporus</i> (Peck) Pouzar	nr	ecto	Ortiz-Santana et al. 2007 (as <i>Boletus a.</i>) and references therein
<i>Astroboletus gracilis</i> (Peck) Wolfe	Jal, Gua, Sac	ecto	Flores et al. 2002 (as <i>Aureoboletus g.</i>), this study
<i>A. viridis</i> (Peck) Wolfe	Gua	ecto	this study
* <i>Boletellus ananas</i> (M.A. Curtis) Murrill	Avz, Gua, Pet	ecto	Sommerkamp & Guzmán 1990, Flores & Simonini 2000
<i>B. coccineus</i> (Sacc.) Singer	nr	ecto	Ortiz-Santana et al. 2007 and references therein
<i>B. russellii</i> (Frost) E.-J. Gilbert	Chi, Gua, Sac	ecto	Flores & Simonini 2000, Díaz et al. 2009, this study
<i>Boletinellus rompelii</i> (Pat. & Rick) Watling	Gua	sapro	this study
* <i>Boletus edulis</i> Bull.	Hue, Qtz, Sam, Tot	ecto	Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004, Díaz et al. 2009,
<i>B. guatemalensis</i> R. Flores & Simonini	Pet	ecto	Flores & Simonini 2000
* <i>B. luteoloincrustedatus</i> R. Flores & Simonini	Chi, Gua	ecto	Flores & Simonini 2000, Bran et al. 2003b, Díaz et al. 2009
* <i>B. pinophilus</i> Pilát & Dermek	Qui, Qtz, Tot	ecto	Bran et al. 2003a, Díaz et al. 2009, Che & Flores 2010
<i>B. pseudoboletinus</i> (Murrill) Murrill	Pet	ecto	Flores & Simonini 2000 (as <i>Xerocomus p.</i>)
<i>B. pulverulentus</i> Opat.	Tot	ecto	Flores et al. 2002
<i>B. variipes</i> Peck	Gua, Sac	ecto	this study
<i>Calostoma cinnabarinum</i> Corda	Bvz, Qui	ecto	Sharp 1948, Sommerkamp & Guzmán 1990, Morales et al. 2009
<i>Chalciporus piperatus</i> (Bull.) Bataille	Hue, Qtz, Sam, Tot	ecto	Flores et al. 2002, this study
* <i>C. trinitensis</i> (Heinem.) Singer, I.J. Araujo & M.H Ivory	Chi, Qui	ecto	Flores & Simonini. 2000 Bran et al. 2002, Bran et al. 2003b,
* <i>Chroogomphus jamaicensis</i> (Murrill) O.K. Mill.	Chi, Sac	ecto	Bran et al. 2003b, this study
* <i>C. rutilus</i> (Schaeff.) O.K. Mill.	Gua, Hue, Sac, Sam, Tot	ecto	Sommerkamp & Guzmán 1990 (as <i>Gomphidius r.</i>), Flores et al. 2002
* <i>C. vinicolor</i> (Peck) O.K. Mill.	Chi	ecto	Bran et al. 2002
* <i>Gyroporus castaneus</i> (Bull.) Quéf.	Gua, Jal, Sac	ecto	Sommerkamp & Guzmán 1990, this study
* <i>Heimioporus betula</i> (Schwein.) E. Horak	Chi, Gua, Qui	ecto	Bran et al. 2003a (as <i>Astroboletus b.</i>), this study
* <i>Hygrophoropsis aurantiaca</i> (Wulfen) Maire	Chi, Gua, Qui, Sac, Tot	sapro	Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b
<i>Phylloporus centroamericanus</i> Singer & L.D. Gómez	Gua, Sac	ecto	this study

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
<i>P. cfr. aurantiacus</i> Halling & G.M. Muell.	Pro	ecto	this study
<i>Pisolithus arhizus</i> (Scop.) Rauschert	Chq, Chi, Esc, Gua	ecto	Sommerkamp & Guzmán 1990 (as <i>P. tinctorius</i>), Morales et al. 2009, this study
* <i>Pulveroboletus ravenelii</i> (Berk. & M.A. Curtis) Murrill	Chi, Jut, Qui, Qtz	ecto	Bran et al. 2003a and references therein, Ortiz-Santana et al. 2007, this study
<i>Retiboletus griseus</i> (Frost) Manfr. Binder & Bresinsky	Gua, Pet, Qtz, Sro	ecto	Flores & Simonini 2000 (as <i>Boletus g.</i>), this study
<i>Rhizopogon</i> spp.	Gua, Hue, Pet, Sam	ecto	Flores et al. 2002, this study
<i>Scleroderma areolatum</i> Ehrenb.	Esc	ecto	Morales et al. 2009
<i>S. bovista</i> Fr.	Gua, Izb	ecto	Guzmán 1986 (as <i>S. texense</i>), Sommerkamp & Guzmán 1990, Morales et al. 2009
<i>S. leptopodium</i> Pat. & Har.	Avz	ecto	Calonge et al. 2008
<i>S. polyrhizum</i> (J.F. Gmel.) Pers.	Gua, Esc, Sro, Tot	ecto	this study
<i>S. texense</i> Berk.	Gua, Izb	ecto	Sommerkamp & Guzmán 1990
<i>S. verrucosum</i> (Bull.) Pers.	Gua, Izb, Sac, Tot	ecto	Sommerkamp & Guzmán 1990, Morales et al. 2009
* <i>Strobilomyces strobilaceus</i> (Scop.) Berk.	Bvz, Gua, Sac	ecto	Sommerkamp & Guzmán 1990 (as <i>S. floccopus</i>), Flores & Simonini 2000
* <i>Suillus americanus</i> (Peck) Snell	Gua, Qtz, Tot	ecto	Sommerkamp & Guzmán 1990, this study
<i>S. bovinus</i> (Pers.) Roussel	Hue, Sam	ecto	Flores et al. 2002, Díaz et al. 2009
<i>S. brevipes</i> (Peck) Kuntze	nr	ecto	Ortiz-Santana et al. 2007 and references therein
<i>S. decipiens</i> (Berk. & M.A. Curtis) Kuntze	nr	ecto	Ortiz-Santana et al. 2007 and references therein
* <i>S. granulatus</i> (L.) Roussel 1806	Gua, Hue, Qtz, Sac, Sam, Tot	ecto	Sommerkamp & Guzmán 1990, Flores et al. 2002, this study
* <i>S. luteus</i> (L.) Roussel	Chi, Gua, Qtz, Tot	ecto	Sommerkamp & Guzmán 1990, Sommerkamp 1994, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, this study
<i>S. subluteus</i> (Peck) Snell	Chi	ecto	Sommerkamp & Guzmán 1990
* <i>S. tomentosus</i> (Kauffman) Singer	Chi, Gua, Sam, Tot	ecto	Sommerkamp & Guzmán 1990, Flores et al. 2002, Díaz et al. 2009
<i>Tapinella panuoides</i> (Batsch) E.-J. Gilbert	Gua	ecto	Sommerkamp & Guzmán 1990 (as <i>Paxillus p.</i>)
<i>Tylopilus balloui</i> (Peck) Singer	nr	ecto	Ortiz-Santana et al. 2007 and references therein
* <i>T. chromapes</i> (Frost) A.H. Sm. & Thiers	Chi, Hue, Qui, Sam	ecto	Flores et al. 2002, Bran et al. 2003a
<i>T. leucomycelinus</i> (Singer & M.H. Ivory) R. Flores & Simonini	Pet	ecto	Flores & Simonini 2000
<i>T. plumbeoviolaceus</i> (Snell & E.A. Dick) Snell & E.A. Dick	Gua, Pet, Sac	ecto	Flores & Simonini 2000, this study
<i>T. porphyrosporus</i> (Fr. & Hök) A.H. Sm. & Thiers	Sam, Tot	ecto	Flores et al. 2002 (as <i>Porphyrellus p.</i>)
<i>T. violatinctus</i> T.J. Baroni & Both	nr	ecto	Ortiz-Santana et al. 2007 and references therein
Cantharellales			
<i>Cantharellus atrolilacinus</i> Eyssart., Buyck & Halling	Gua, Sac	ecto	Flores et al. 2008c, this study
* <i>C. cibarius</i> Fr.	Bvz, Chi, Gua, Hue, Izb,	ecto	Sharp 1948, Sommerkamp & Guzmán 1990, Bran et al.

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
	Qui, Sac, Sam, Tot		2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004, Flores et al. 2008c
<i>C. cinnabarinus</i> (Schwein.) Schwein.	Bvz	ecto	Flores et al. 2008c
* <i>C. ignicolor</i> R.H. Petersen	Chi, Sac	ecto	Bran et al. 2002, Bran et al. 2003b, Boa 2004, Flores et al. 2008c (as <i>Craterellus i.</i>), this study
* <i>C. lateritius</i> (Berk.) Singer	Gua, Sac	ecto	Sommerkamp & Guzmán 1990 (as <i>C. odoratus</i> [#]), Bran et al. 2002, Bran et al. 2003b, Boa 2004, Flores et al. 2008c, this study
<i>C. minor</i> Peck 1872	Chi, Gua, Qui	ecto	Flores et al. 2008c, this study
* <i>Clavulina cinerea</i> (Bull.) J. Schröt.	Chi, Sac, Tot	ecto	Bran et al. 2003b, Boa 2004, this study
* <i>C. coralloides</i> (L.) J. Schröt.	Qui	ecto	Bran et al. 2003a (as <i>C. cristata</i>)
* <i>Clavulina sp.</i>	nr	ecto	Boa 2004
<i>Craterellus boyacensis</i> Singer	Jal	ecto	Flores et al. 2008c
<i>C. cornucopioides</i> (L.) Pers.	nr	ecto	Flores et al. 2008c
<i>C. lutescens</i> (Fr.) Fr.	Chi, Gua, Jal, Sac	ecto	Flores et al. 2002, Flores et al. 2008c (as <i>C. aurora</i>), this study
<i>C. tubaeformis</i> (Fr.) Quél.	Chi, Gua, Hue, Sac	ecto	Flores et al. 2008c, this study
* <i>Hydnum repandum</i> L.	Chi, Gua, Hue, Jal	ecto	Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004
* <i>H. umbilicatum</i> Peck	Chi	ecto	Bran et al. 2002, Bran et al. 2003b
<i>Pseudocraterellus calyculus</i> (Berk. & M.A. Curtis) D.A. Reid	Gua, Sac	ecto	Flores et al. 2008c (as <i>Craterellus c.</i>), this study
<i>Pseudotulasnella guatemalensis</i> Lowy	Sac	sapro	Lowy 1964b
<i>Sistotrema confluens</i> Pers.	Gua	ecto	this study
<u>Corticiales</u>			
<i>Dendrothele candida</i> (Schwein.) P.A. Lemke	nr	sapro	Sharp 1948 (as <i>Aleurodiscus candidus</i>)
<u>Dacrymycetales</u>			
<i>Calocera cornea</i> (Batsch) Fr.	nr	sapro	Roberts 2008 and references therein
<i>C. viscosa</i> (Pers.) Fr.	Avz, Hue	sapro	Sommerkamp & Guzmán 1990, Flores et al. 2002
<i>Dacryopinax spathularia</i> (Schwein.) G.W. Martin	Bvz	sapro	Sommerkamp & Guzmán 1990, Roberts 2008 and references therein
<i>Ditiola radicata</i> (Alb. & Schwein.) Fr.	Bvz	sapro	Sommerkamp & Guzmán 1990
<u>Geastrales</u>			
<i>Geastrum fimbriatum</i> Fr.	Pet	sapro	Morales et al. 2009
<i>G. pectinatum</i> Pers.	Chi, Gua	sapro	Sommerkamp & Guzmán 1990, Morales et al. 2009
<i>G. quadrifidum</i> DC. ex Pers.	Esc	sapro	Morales et al. 2009
<i>G. saccatum</i> Fr.	Gua, Sac	sapro	Guzmán 1986, this study
<i>G. triplex</i> Jungh.	Hue, Sam, Tot	sapro	Bran et al. 1998, Flores et al. 2002, Morales et al. 2009
<u>Gomphales</u>			
<i>Clavariadelphus pistillaris</i> (L.) Donk	Hue, Sac	ecto	Flores et al. 2002, this study

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
* <i>C. truncatus</i> (Quél.) Donk	Hue, Sac	ecto	Sommerkamp & Guzmán 1990, Flores et al. 2002
<i>Gomphus clavatus</i> (Pers.) Gray	Gua	ecto	this study
<i>G. floccosus</i> (Schwein.) Singer	Hue, Jal, Sam, Tot	ecto	Sharp 1948 (as <i>Cantharellus f.</i>), Flores et al. 2002, this study
* <i>Ramaria araiospora</i> Marr & D.E. Stuntz	Chi, Sac	ecto [§]	Bran et al. 2002, Bran et al. 2003b, Boa 2004, this study
* <i>R. botrytis</i> (Pers.) Ricken	Chi, Gua, Sac	ecto	Sommerkamp & Guzmán 1990, Bran et al. 2002, Bran et al. 2003b, Boa 2004, this study
* <i>R. flava</i> (Schaeff.) Quél.	Gua	ecto	Bran et al. 2002, Bran et al. 2003b, Boa 2004
* <i>R. flavobrunnescens</i> (G.F. Atk.) Corner	Chi	ecto	Bran et al. 2003b
* <i>R. stricta</i> (Pers.) Quél.	Avz, Gua, Qui	ecto	Sommerkamp & Guzmán 1990, Bran et al. 2002
* <i>R. xanthosperma</i> (Peck) Corner	Chi	ecto	Bran et al. 2003b
<i>Phallales</i>			
<i>Laternea pusilla</i> Berk. & M.A. Curtis	Bvz	sapro	Sommerkamp & Guzmán 1990, Morales et al. 2009
<i>L. triscapa</i> Turpin	Sac	sapro	Morales et al. 2009
<i>Mutinus caninus</i> (Huds.) Fr.	nr	sapro	Flores et al. 2002
<i>Phallus impudicus</i> L.	Bvz	sapro	this study
<i>Polyporales</i>			
<i>Abortiporus biennis</i> (Bull.) Singer	nr	sapro	Sharp 1948 (as <i>Polyporus distortus</i>)
<i>Albatrellus cristatus</i> (Schaeff.) Kotl. & Pouzar	nr	ecto	Sharp 1948 (as <i>Polyporus c.</i>)
<i>Antrodia albida</i> (Fr.) Donk	nr	sapro	Sharp 1948 (as <i>Trametes sepium</i>)
<i>A. malicola</i> (Berk. & M.A. Curtis) Donk	nr	sapro	Sharp 1948 (as <i>Trametes m.</i>)
<i>Antrodiella semisupina</i> (Berk. & M.A. Curtis) Ryvarden	Sac	sapro	Sommerkamp & Guzmán 1990 (as <i>Polyporus semisupinus</i>)
<i>Bjerkandera adusta</i> (Willd.) P. Karst	nr	sapro	Sharp 1948 (as <i>Polyporus adustus</i>)
<i>Coltricia cinnamomea</i> (Jacq.) Murrill	Chi, Gua, Hue, Sac, Sro	ecto	Sharp 1948 (as <i>Polyporus cinnamomeus</i>), Sommerkamp & Guzmán 1990, this study
<i>C. montagnei</i> (Fr.) Murrill	Hue, Sam	ecto	Flores et al. 2002
<i>C. perennis</i> (L.) Murrill	Avz	ecto	Sharp 1948 (as <i>Polyporus p.</i>), Sommerkamp & Guzmán 1990
<i>Cymatoderma caperatum</i> (Berk. & Mont.) D.A. Reid	Bvz	sapro	Sommerkamp & Guzmán 1990
<i>C. fuscum</i> (Cooke) D.A. Reid	Bvz	sapro	Sommerkamp & Guzmán 1990
<i>Daedalea quercina</i> (L.) Pers.	Chi	sapro	Sharp 1948, Sommerkamp & Guzmán 1990
<i>Diplomitoporus dilutabilis</i> Log.-Leite & J.E. Wright	Hue	sapro	Kout & Vlasák 2010
* <i>Favolus tenuiculus</i> P. Beauv.	Sol	sapro	Sommerkamp & Guzmán 1990 (as <i>Favolus brasiliensis</i>), Sommerkamp 1994
* <i>F. velutipes</i> Fr.	nr	sapro	Sommerkamp & Guzmán 1990
<i>Fomitopsis feei</i> (Fr.) Kreisel	nr	sapro	Sharp 1948 (as <i>Fomes f.</i>)
<i>F. pinicola</i> (Sw.) P. Karst.	nr	sapro	Sharp 1948 (as <i>Fomes p.</i>)
<i>F. rosea</i> (Alb. & Schwein.) P. Karst.	nr	sapro	Sharp 1948 (as <i>Fomes roseus</i>)
<i>Fuscocerrera portoricensis</i> (Fr.) Ryvarden	nr	sapro	Sharp 1948 (as <i>Irpex farinaceous</i>)

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
<i>Fuscoporia senex</i> (Nees & Mont.) Ghob.-Nejh.	nr	sapro	Sharp 1948 (as <i>Fomes</i> s.)
<i>Ganoderma australe</i> (Fr.) Pat	nr	sapro	Sharp 1948 (as <i>Polyporus australis</i>)
<i>G. curtisii</i> (Berk.) Murrill	Gua	sapro	Sharp 1948 (as <i>Polyporus</i> c.), Sommerkamp & Guzmán 1990
<i>G. lobatum</i> (Schwein.) G.F. Atk.	Gua	sapro	Sommerkamp & Guzmán 1990
<i>G. lucidum</i> (Curtis) P. Karst	Izb, Sro	sapro	Sharp 1948 (as <i>Polyporus lucidus</i>), Sommerkamp & Guzmán 1990
<i>G. resinaceum</i> Boud.	Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>G. sessile</i>)
<i>Gloeophyllum sepiarium</i> (Wulfen) P. Karst.	Gua	sapro	Sharp 1948 (as <i>Lenzites saepiaria</i>), Sommerkamp & Guzmán 1990
<i>G. striatum</i> (Sw.) Murrill	Izb	sapro	Sommerkamp & Guzmán 1990 (as <i>Lenzites striata</i>)
<i>Gloeoporus dichrous</i> (Fr.) Bres	nr	sapro	Sharp 1948 (as <i>Polyporus</i> d.)
<i>Heterobasidion annosum</i> (Fr.) Bref.	nr	sapro	Sharp 1948 (as <i>Fomes annosus</i>)
<i>Hexagonia hirta</i> (P. Beauv.) Fr.	Gua, Sac, Sro	sapro	Sommerkamp & Guzmán 1990, this study
<i>H. hydnooides</i> (Sw.) M. Fidalgo	Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>Polyporus</i> h.)
* <i>Hydnopolyporus fimbriatus</i> (Fr.) D.A. Reid	Hue	sapro	Bran et al. 2003b
* <i>H. palmatus</i> (Hook.) O. Fidalgo	Gua	sapro	Sommerkamp & Guzmán 1990
<i>Inonotus cuticularis</i> (Bull.) P. Karst	nr	sapro	Sharp 1948 (as <i>Polyporus</i> c.)
<i>Irpex lacteus</i> (Fr.) Fr.	nr	sapro	Sharp 1948 (as <i>Polyporus tulipiferae</i>)
<i>Laetiporus sulphureus</i> (Bull.) Murrill	Chi	sapro	Sharp 1948 (as <i>Polyporus</i> s.), this study
<i>Lenzites betulina</i> (L.) Fr.	nr	sapro	Sharp 1948
<i>L. elegans</i> (Spreng.) Pat.	Gua, Sro	sapro	Sommerkamp & Guzmán 1990 (as <i>Daedalea</i> e.)
<i>Meripilus tropicalis</i> Guzmán & Pérez-Silva	Sro, Zac	sapro	Sommerkamp & Guzmán 1990, Sommerkamp 1994
<i>Merulius tremellosus</i> Schrad.	Gua, Sac	sapro	Sommerkamp & Guzmán 1990
* <i>Neolentinus lepideus</i> (Fr.) Redhead & Ginns	Tot	sapro	Bran et al. 2003b
* <i>N. ponderosus</i> (O.K. Mill.) Redhead & Ginns	Hue	sapro	Bran et al. 2003b, Bran et al. 2008
<i>Panellus pusillus</i> (Pers. ex Lév.) Burds. & O.K. Mill.	nr	sapro	Sharp 1948 (as <i>Polyporus rhipidium</i>)
<i>Phaeolus schweinitzii</i> (Fr.) Pat.	Gua	sapro	Sharp 1948 (as <i>Polyporus</i> s.), Sommerkamp & Guzmán 1990
<i>Phellinus gilvus</i> (Schwein.) Pat.	Sac	sapro	Sharp 1948 (as <i>Polyporus</i> g. and <i>P. licnoides</i>), Sommerkamp & Guzmán 1990
<i>Polyporus arcularius</i> (Batsch) Fr.	Gua	sapro	Sharp 1948, Sommerkamp & Guzmán 1990
<i>P. azureus</i> Fr. [£]	Sac	sapro	Sommerkamp & Guzmán 1990
<i>P. pocula</i> (Schwein.) Berk. & M.A. Curtis	nr	sapro	Sharp 1948
* <i>P. umbellatus</i> (Pers.) P. Karst.	Chi	sapro	Bran et al. 2002, Bran et al. 2003b
<i>P. tricholoma</i> Mont.	Chi, Esc, Gua, Sac	sapro	Sommerkamp & Guzmán 1990, this study
<i>Postia caesia</i> (Schrad.) P. Karst	Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>Polyporus caesius</i>)
<i>Pycnoporus sanguineus</i> (L.) Murrill	Avz, Esc, Gua, Izb, Sro, Suc, Zac	sapro	Sharp 1948 (as <i>Polyporus</i> s.), Sommerkamp & Guzmán 1990, this study
<i>Skeletocutis nivea</i> (Jung.) Jean Keller	nr	sapro	Sharp 1948 (as <i>Polyporus semipileatus</i>)
<i>Trametes hirsuta</i> (Wulfen) Lloyd	Bvz, Gua	sapro	Sharp 1948 (as <i>Polyporus hirsutus</i>), Sommerkamp & Guzmán 1990

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
<i>T. maxima</i> (Mont.) A. David & Rajchenb	Izb	sapro	Sommerkamp & Guzmán 1990 (as <i>Polyporus maximus</i>)
<i>T. pubescens</i> (Schumach.) Pilát	Sac	sapro	Sommerkamp & Guzmán 1990 (as <i>Polyporus p.</i>)
<i>T. versicolor</i> (L.) Lloyd	nr	sapro	Sharp 1948 (as <i>Polyporus v.</i>)
<i>T. villosa</i> (Sw.) Kreisel	Gua, Sac	sapro	Sharp 1948 (as <i>Polyporus pinsitus</i>), Sommerkamp & Guzmán 1990 (as <i>Polyporus villosus</i>)
<i>Trichaptum abietinum</i> (Dicks.) Ryvardeen	Sac	sapro	Sharp 1948 (as <i>Polyporus abietinus</i>), Sommerkamp & Guzmán 1990
<i>T. trichomallum</i> (Berk. & Mont.) Murrill	Izb	sapro	Sommerkamp & Guzmán 1990 (as <i>Polyporus trichomallus</i>)
Russulales			
<i>Artomyces pyxidatus</i> (Pers.) Jülich	Gua	sapro	Sommerkamp & Guzmán 1990 (as <i>Clavicornia pyxidata</i>)
<i>Auriscalpium vulgare</i> Gray	Chi, Gua, Hue, Sac, Sam	sapro	Sommerkamp & Guzmán 1990, this study
<i>Lactarius chrysorrheus</i> Fr.	Chi, Gua, Qtz, Sac	ecto	this study
* <i>L. deliciosus</i> (L.) Gray	Avz, Chi, Gua, Hue, Qui, Qtz, Sam, Tot	ecto	Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004, Comandini et al. 2012
<i>L. fragilis</i> (Burl.) Hesler & A.H. Sm.	Sac	ecto	Sommerkamp & Guzmán 1990
* <i>L. indigo</i> (Schwein.) Fr.	Avz, Bvz, Chi, Gua, Hue, Jal, Qui, Qtz, Sam, Sro	ecto	Sharp 1948, Logemann et al. 1987, Sommerkamp & Guzmán 1990, Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004, Comandini et al. 2012, this study
<i>L. mexicanus</i> A. Kong & Estrada	Chi, Hue, Tot	ecto	Flores et al. 2002, this study
<i>L. peckii</i> Burl.	nr	ecto	Sharp 1948
* <i>L. rimosellus</i> Hesler & A.H. Sm.	Gua, Hue, Sac	ecto	Bran et al. 2003a, Comandini et al. 2012, this study
* <i>L. rubrilacteus</i> Hesler & A.H. Sm.	Qui, Qtz	ecto	Boa 2004, Flores et al. 2008b, Comandini et al. 2012
* <i>L. salmonicolor</i> R. Heim & Leclair	Hue, Qui, Tot	ecto	Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b, Boa 2004, Flores et al. 2008b, Comandini et al. 2012
* <i>L. aff. sanguifluus</i> (Paulet) Fr.	Qui	ecto	Bran et al. 2002
* <i>L. volemus</i> (Fr.) Fr.	Qui	ecto	Sommerkamp & Guzmán 1990, Montoya et al. 1996, Bran et al. 2002, Bran et al. 2003b, Boa 2004 (as <i>L. corrugis</i>), Comandini et al. 2012
* <i>Russula alutacea</i> (Fr.) Fr.	Sac	ecto	Sommerkamp & Guzmán 1990
* <i>R. brevipes</i> Peck.	Chi, Jal, Qui, Tot	ecto	Sommerkamp & Guzmán 1990, Logemann et al. 1987, Bran et al. 2002, Bran et al. 2003b
* <i>R. delica</i> Fr.	Qtz	ecto	Boa 2004, this study
* <i>R. emetica</i> (Schaeff.) Pers.	Jal	ecto	Logemann et al. 1987
* <i>R. foetens</i> (Pers.) Pers.	Jal, Sac	ecto	Sharp 1948, Logemann et al. 1987, Sommerkamp & Guzmán 1990
* <i>R. lutea</i> (Huds.) Gray	Qui	ecto	Sommerkamp & Guzmán 1990
<i>R. nigricans</i> Fr.	Gua, Tot	ecto	this study
<i>R. olivacea</i> (Schaeff.) Fr.	Hue	ecto	Flores et al. 2002
<i>R. queletii</i> Fr.	Hue	ecto	Flores et al. 2002

Table 1 Continued. Species of macrofungi reported for Guatemala

Species	Distribution [†]	Ecology [‡]	References
* <i>R. rosea</i> Pers.	Qui	ecto	Sommerkamp & Guzmán 1990 (as <i>R. lepida</i>), Sommerkamp 1994
* <i>R. sanguinaria</i> (Schumach.) Rauschert	Hue	ecto	Bran et al. 2002 (as <i>R. rosacea</i>)
<i>R. sanguinea</i> (Bull.) Fr.	Chi	ecto	Sommerkamp & Guzmán 1990
* <i>R. virescens</i> (Schaeff.) Fr.	Chi, Gua	ecto	Bran et al. 2002, Bran et al. 2003b, this study
<i>Stereum ochraceoflavum</i> (Schwein.) Sacc.	nr	sapro	Sharp 1948
<i>S. ostrea</i> (Blume & T. Nees) Fr.	Chi, Gua, Sac	sapro	Sommerkamp & Guzmán 1990, this study
<i>S. rameale</i> (Schwein.) Burt	nr	sapro	Sharp 1948
<i>Xylobolus illudens</i> (Berk.) Boidin	Iza	sapro	Welden 1967 (as <i>Stereum i.</i>)
<i>X. subpileatus</i> (Berk. & M.A. Curtis) Boidin	nr	sapro	Sharp 1948 (as <i>Stereum sepium</i>)
<u>Sebacinales</u>			
* <i>Sebacina concrescens</i> (Schwein.) P. Roberts	Chi, Gua, Sac	sapro	Bran et al. 2003a (as <i>Tremella c.</i>), this study
<i>Tremellodendron merismatoides</i> (Schwein.) Burt	nr	sapro	Sharp 1948
<u>Thelephorales</u>			
<i>Telephora palmata</i> (Scop.) Fr.	Chi, Gua, Sac	ecto	this study
<i>T. terrestris</i> Ehrh.	Chi, Gua, Hue, Tot	ecto	Flores et al. 2002, this study
<u>Tremellales</u>			
<i>Myxarium atratum</i> (Peck) Ginns & M.N.L. Lefebvre	nr	sapro	Lowy 1971b (as <i>Exidia nucleata</i>)
* <i>Tremella mesenterica</i> Schaeff	Gua, Hue	sapro	Sommerkamp & Guzmán 1990 (as <i>T. lutescens</i>), Bran et al. 2002, Flores et al. 2002, Bran et al. 2003b
* <i>T. reticulata</i> (Berk.) Farl.	Chi, Gua, Qui, Sac	sapro	Bran et al. 2002, Bran et al. 2003b, Boa 2004, this study
<i>T. rubromaculata</i> Lowy	Sam	sapro	Lowy 1964a
<i>T. volcanaqua</i> Lowy	Sol	sapro	Lowy 1964a
<u>Ustilaginales</u>			
* <i>Ustilago maydis</i> (DC.) Corda	Sol	sapro	Sommerkamp & Guzmán 1990

nr = not reported

* = species locally used as food and as such sold in markets, or considered edible.

§ = species locally used for their medicinal properties, or linked to ceremonial/religious practices.

† Guatemala Departments (see Fig 1): Avz = Alta Verapaz, Bvz = Baja Verapaz, Chi = Chimaltenango, Chq = Chiquimula, Esc = Escuintla, Gua = Guatemala, Hue = Huehuetenango, Izb = Izabal, Jal = Jalapa, Jut = Jutiapa, Pet = Petén, Pro = El Progreso, Qui = El Quiché, Qtz = Quetzaltenango, Sac = Sacatepéquez, Sam = San Marcos, Sol = Sololá, Sro = Santa Rosa, Suc = Suchitepéquez, Tot = Totonicapán, Zac = Zacapa.

‡ Ecto = Ectomycorrhizal, Sapro = Saprobitic.

‡ Possibly mixotrophic (see Rinaldi et al. 2008).

¶ Anamorphic state is *Molliardiomyces* (see Paden 1984).# According to Flores et al. 2008c, all previous records of *Cantharellus odoratus* (Bran et al. 2002, Bran et al. 2003b, Boa 2004) should be reassigned to *C. lateritius*.

\$ Both mycorrhizal and non-mycorrhizal species are known to occur in the genus.

£ Taxon not recorded in Index Fungorum (www.indexfungorum.org)

contain forest areas that in theory support production of edible fungi,” remarked Eric Boa in his reference volume on worldwide wild edible fungi (Boa 2004, see also www.wildusefulfungi.org/). This deep mycophily of Mesoamerican indigenous people is not limited to the widespread use of macrofungi as highly appreciated food, but also extends to the ancient involvement of mushrooms within the complex network of religious beliefs that linked ancient Mesoamericans with their natural surroundings. Before attention started to be devoted in recent times to ascertaining the mycological knowledge of contemporaneous Guatemalan indigenous people (Sommerkamp 1990), most ethnomycological efforts in Guatemala had focused on the study of Maya mycolatry in the preclassic and classic periods (approx. 1500 BC – 900 AD). This was carried out either through the investigation of the meaning and origin of the artifacts now known as ‘mushroom stones’ – sculptures of pre-hispanic origin probably associated in Maya culture with religious ceremonies wherein hallucinogenic fungi played a major role (de Borhegyi 1961, Lowy 1968, Lowy 1971a, Lowy 1977, Lowy 1980, Lowy 1981, Ohi & Torres 1994) – and of the sacred use of mushrooms as depicted in Maya codices (Lowy 1972, Lowy 1974, Guzmán 2001, Guzmán 2003). In particular, Bernard Lowy has clearly shown the central role played by *Amanita muscaria* in the mycolatry of the Maya people inhabiting current Guatemala. This poisonous species, depicted in several Maya codices in what appear to be ceremonial offerings, either as a death symbol and/or possibly because of its hallucinogenic properties, is linked to the ‘thunderbolt legend’ (Lowy 1972, Lowy 1974) – in many cultures, some fungi were believed to spring from the ground in places struck by a thunderbolt. An autochthonous hallucinogenic mushroom culture (Wasson 1980) among present day Guatemala Mayas is not proved, but Lowy has reported the occurrence of *Psilocybe mexicana* in Guatemala, either growing in the meadows and offered for sale in at least one location (Lowy 1977). These fragments of an ancient past suggest that a mushroom cult existed in Guatemala that disappeared with time, and it is thus possible to envisage that there may be “a kinship between such a cult and the surviving divinatory rite of

the inebriating mushrooms in Mexico” (Wasson & Wasson 1957).

Conclusions

Hopefully, the information gathered here will serve both as a reference and stimulus for further work aimed at disclosing the diversity of macromycetes in a number of ecological niches in Guatemala. In our opinion, future work should be focused along two main directions. Firstly, the in-depth study of single, important genera (e.g., *Amanita*, *Boletus*, *Russula*, *Lactarius*), carried out with the help of specialists, so to correctly classify (or re-classify) the abundant but perhaps misdetermined material and to produce reliable checklists, while possible identifying new taxa and ascertaining the relationships with those occurring in better studied areas (North America, Mexico, Costa Rica, Europe). Secondly, the mycota of restricted areas (e.g., national parks or protected sites), or well defined and ecologically-homogenous plant communities, should be preferentially studied in detail, in order to provide useful insight on the diversity and ecology of macromycetes in at least a fraction of Guatemala’s highly diversified landscape. Another interesting research avenue would be investigating selected ectomycorrhizal associations, as was done recently for *Lactarius rimosellus* (Comandini et al. 2012), characterizing this key symbiosis from both the mycobiont and host plant point of view and thus acquiring information that could be important on a number of fronts, such as phylogeographic reconstructions or potential usefulness for reforestation programmes.

References

- Boa E 2004 – Wild edible fungi. A global overview of their use and importance to people. FAO. Rome, Italy.
- de Borhegyi SF 1961 – Miniature mushroom stones from Guatemala. *American Antiquity* 26, 498-504.
- Bran MC, Flores R, Rodríguez E, Culajay F 1998 – Hongos ectomicorrízicos asociados a *Abies guatemalensis*, *Pinus rudis* y *P. ayacahuite* de la Sierra de Los Cuchumatanes y su aprovechamiento en la producción de planta forestal micorrizada (Fase I). Dirección General de Investigación-DIGI.

- Universidad de San Carlos de Guatemala. Guatemala City, Guatemala.
- Bran MC, Morales O, Cáceres R, Flores R, de Ariza J, Rodríguez E, García F, Alarcón D 2002 – Hongos comestibles de Guatemala: diversidad, cultivo y nomenclatura vernácula (Fase II). Informe Técnico Final. Dirección General de Investigación, Universidad de San Carlos de Guatemala. Guatemala City, Guatemala.
- Bran MC, Morales O, Flores R, Cáceres R, Meza N, Arriola H, Alarcón D, Rodríguez E, Salazar J 2003a – Hongos comestibles de Guatemala: diversidad, cultivo y nomenclatura vernácula (Fase III). Informe Técnico Final. Dirección General de Investigación–DIGI. Universidad de San Carlos de Guatemala. Guatemala City, Guatemala.
- Bran MC, Morales O, Cáceres R, Flores R 2003b – Contribución al conocimiento de los hongos comestibles de Guatemala. IIQB–USAC. Revista Científica, special issue, 1-24.
- Bran MC, Morales O, Cáceres R, Flores R, Andrade C, Quezada A, Carranza C, Ariza J, Rodríguez E, Alarcón D 2005 – Hongos comestibles de Guatemala: diversidad, cultivo y nomenclatura vernácula (Fase IV). Industria y Alimentos, July–September, 46-50.
- Bran MC, Morales O, Cáceres R, Blanco R, Flores R 2008 – Caracterización de cepas nativas de *Neolentinus ponderosus* (Miller) Redhead & Ginns. IIQB–USAC. Revista Científica, special issue, 30-35.
- Calonge FD, Moreno–Arroyo B, Gómez J 2008 – Estudios sobre hongos tropicales. Algunas especies colectadas en Ecuador y Guatemala. Boletín de la Sociedad Micológica de Madrid 32, 97-100.
- Che G, Flores R 2010 – Descripción y comparación de estructuras microscópicas de *Boletus pinophilus* Pilát & Dermek, de distintas procedencias de Guatemala, respecto a las descritas para Europa. IIQB–USAC. Revista Científica 19, 86-91.
- Comandini O, Erős–Honti Z, Jakucs E, Flores Arzú R, Leonardi M, Rinaldi AC 2012 – Molecular and morpho–atomical description of mycorrhizas of *Lactarius rimosellus* on *Quercus* sp., with ethnomycological notes on *Lactarius* in Guatemala. Mycorrhiza, in press (DOI: 10.1007/s00572–011–0401–3).
- Díaz G, Flores R, Honrubia M 2007 – *Lactarius indigo* and *L. deliciosus* form mycorrhiza with Eurasian or Neotropical pine species. Sydowia 59, 32-45.
- Díaz G, Flores R, Honrubia M 2009 – Descripción de cultivos miceliarios de Boletales neotropicales y europeos (*Boletus* grupo *edulis*, *Boletellus* y *Suillus*) y formación de primordios de *B. edulis* en cultivo puro. Revista Mexicana de Micología 30, 1-7.
- Flores R, Simonini G 2000 – Contributo alla conoscenza delle *Boletales* del Guatemala. Rivista di Micologia 2, 121-145.
- Flores R, Bran MC, Rodríguez E, Morales O, Berdúo O, Montes L 2002 – Hongos micorrícicos de bosques de pino y pinabete. Dirección General de Investigación–DIGI. Universidad de San Carlos de Guatemala, Guatemala.
- Flores R, Díaz G, Honrubia M 2005 – Mycorrhizal synthesis of *Lactarius indigo* (Schw.) Fr. with five Neotropical pine species. Mycorrhiza 15, 563-570.
- Flores R, Díaz G, Honrubia M 2008a – Mycorrhizal synthesis and basidioma primordium formation between *Abies guatemalensis* and *Laccaria bicolor*. Nova Hedwigia 87, 153-160.
- Flores R, Honrubia M, Díaz G 2008b – Caracterización de cepas de *Lactarius* sección *Deliciosi* de Guatemala y su comparación con cepas europeas de *L. deliciosus*. Revista Mexicana de Micología 26, 51-55.
- Flores R, Che G, García J, Maldonado M, Bran M, Morales O, Cáceres R 2008c – *Cantharellus* y *Craterellus* en Guatemala: diversidad y análisis microscópico de siete especies representativas en el país. IIQB–USAC. Revista Científica, special issue, 36-41.
- Guzmán G 1986 – Distribucion de los hongos en la region del Caribe y zonas vecinas. Caldasia 15, 103-120.
- Guzmán G 1987 – Distribución y etnomicología de *Pseudofistulina radicata* en Meso-

- mérica, con nuevas localidades en México y su primer registro en Guatemala. *Revista Mexicana de Micología* 3, 29-38.
- Guzmán G 1995 – Supplement to the monograph of the genus *Psilocybe*. In: Petrini O, Horak E, eds. *Taxonomic Monographs of Agaricales*. *Bibliotheca Mycologica* 159, 91-141.
- Guzmán G 2001 – Hallucinogenic, medicinal, and edible mushroom in México and Guatemala: traditions, myths and knowledge. *International Journal of Medicinal Mushrooms* 3, 399–408.
- Guzmán G 2003 – Fungi in the Maya culture: past, present and future. In: *The Lowland Maya area: three millennia at the human-wildland interface*. Gómez-Pompa A, Allen MF, Fedick SL, Jimenéz-Osornio JJ, eds. Pp. 315–325. Food Products Press/The Haworth Press. Binghamton, NY, USA.
- Guzmán G, Tapia F 1998 – The known morels in Mexico, a description of a new blushing species, *Morchella rufobrunnea*, and new data on *M. guatemalensis*. *Mycologia* 90, 705–714.
- Guzmán G, Torres MF, Logemann H, Argueta J, Sommerkamp Y 1985 – Fungi from Guatemala, I. A new species of *Morchella*. *Mycologia Helvetica* 1, 451–459.
- Guzmán G, Allen JW, Gartz J 1998 – A worldwide geographical distribution of the neurotropic fungi, an analysis and discussion. *Annali del Museo Civico di Rovereto, Sezione: Archeologia, Storia, Scienze Naturali* 14, 189–280.
- Guzmán-Dávalos L 1996 – Primer registro de *Gymnopilus* (Agaricales, Cortinariaceae) de Guatemala y un análisis de las especies Centroamericanas y del Caribe. *Revista Mexicana de Micología* 12, 89–96.
- Halling RE, Mueller GM 2002 – Agarics and boletes of Neotropical oakwoods. In: *Tropical Mycology*. Vol. 1, Macromycetes. Watling R, Frankland JC, Ainsworth AM, Isaac S, Robinson CH, eds. Pp. 1–10. CAB International. Wallingford, UK.
- Kirk PM, Cannon PF, David JC, Stalpers JA, eds 2008 – *Ainsworth and Bisby's Dictionary of the Fungi*. 10th Edition. CABI Publishing. Wallingford, UK.
- Kout J, Vlasák J 2010 – Notes on two species of *Diplomitoporus* (Basidiomycota, Polyporaceae) of Central America. *Revista Mexicana de Biodiversidad* 81, 9–14.
- Logemann H, Argueta J, Guzman G, Montoya-Bello L, Bandala-Munoz VM, de León-Chocooj R 1987 – Lethal poisoning by mushrooms in Guatemala. *Revista Mexicana de Micología* 3, 211–216.
- Lowy B 1964a – New species of Tremellales from Guatemala. *Journal of the Elisha Mitchell Scientific Society* 80, 65–70.
- Lowy B 1964b – A new genus of the Tulasnellaceae. *Mycologia* 56, 696–700.
- Lowy B 1968 – Un hongo de piedra preclasica de Mixco Viejo, Guatemala. *Boletín de la Sociedad Mexicana de Micología* 2, 9–15.
- Lowy B 1971a – New records of mushroom stones from Guatemala. *Mycologia* 63, 983–993.
- Lowy B 1971b – Tremellales. *Flora Neotropica* 6. Hafner. New York, NY, USA.
- Lowy B 1972 – Mushroom symbolism in Maya codices. *Mycologia* 64, 816–821.
- Lowy B 1974 – *Amanita muscaria* and the Thunderbolt legend in Guatemala and Mexico. *Mycologia* 66, 189–191.
- Lowy B 1977 – Hallucinogenic mushrooms in Guatemala. *Journal of Psychedelic Drugs* 9, 123–125.
- Lowy B 1980 – Ethnomycological inferences from mushroom stones, Maya Codices, and Tzutuhil Legend. *Revista Review Interamericana* 11, 94–103.
- Lowy B 1981 – Were mushroom stone potter molds? *Revista Review Interamericana* 11, 231–237.
- Montoya L, Bandala VM, Guzmán G 1996 – New and interesting species of *Lactarius* from Mexico including scanning electron microscope observations. *Mycotaxon* 57, 411–424.
- Morales O, Flores R, Samayoa B, Bran MC 2002 – Estudio etnomicológico de la cabecera municipal de Tecpán Guatemala, Chimaltenango. IIQB-USAC. *Revista Científica* 15, 10–20.
- Morales O, Bran MC, Cáceres R, Flores R 2003 – Las especies del género *Laccaria* (Agaricales) en Guatemala. IIQB-USAC. *Revista Científica* 16, 89–94.
- Morales O, Medel R, Guzmán G 2006 – Primer registro de la comestibilidad de una especie

- de *Daldinia* (Ascomycota). *Revista Mexicana de Micología* 23, 103–105.
- Morales O, García E, Cáceres R, Bran MC, Gurriarán N, Flores R 2009 – Gasteromycetes de Guatemala: especies citadas en el período de 1948 a 2008. IIQB–USAC. *Revista Científica*, special issue, 27–33.
- Ohi K, Torres MF, eds 1994 – Piedras Hongo. Museo de Tabaco y Sal. Tokyo, Japan.
- Ortiz–Santana B, Lodge DJ, Baroni TJ, Both EE 2007 – Boletes from Belize and the Dominican Republic. *Fungal Diversity* 27, 247–416.
- Paden JW 1977 – Two new species of *Phillipsia* from Central America. *Canadian Journal of Botany* 55, 2685–2692.
- Paden JW 1984 – A new genus of hyphomycetes with teleomorphs in the Sarcoscyphaceae (Pezizales: Sarcoscyphineae). *Canadian Journal of Botany* 62, 211–218.
- Roberts P 2008 – Heterobasidiomycetes from Belize. *Kew Bulletin* 63, 87–99.
- Rinaldi AC, Comandini O, Kuyper TW 2008 – Ectomycorrhizal fungal diversity: separating the wheat from the chaff. *Fungal Diversity* 33, 1–45.
- Sharp AJ 1948 – Some fungi common to the high lands of Mexico, Guatemala and Eastern United States. *Mycologia* 40, 499–502.
- Sommerkamp Y 1990 – Hongos comestibles en los mercados de Guatemala. Dirección General de Investigación–DIGI. Universidad de San Carlos de Guatemala. Guatemala City, Guatemala.
- Sommerkamp Y 1994 – Los hongos macromicetos de Guatemala. In: Piedras Hongo. Ohi K, Torres MF, eds. Pp. 67–72. Museo de Tabaco y Sal. Tokyo, Japan
- Sommerkamp Y, Guzmán G 1990 – Hongos de Guatemala. II. Especies depositadas en el herbario de la Universidad de San Carlos de Guatemala. *Revista Mexicana de Micología* 6, 179–197.
- Tolisano J, López MM 2010 – Guatemala biodiversity and tropical forest assessment. United States Agency for International Development. Washington, DC, USA.
- Vargas C, Bran M, Morales O, Cáceres R. Huitz P, Chamalé W 2010 – Producción de cuerpos fructíferos de cepas nativas del hongo comestible Asam (*Shizophyllum commune* Fr.). *Revista Científica* 19, 92–97.
- Vivero JL, Szejner M, Gordon J, Magin V 2006 – The red list of trees of Guatemala. Fauna & Flora International. Cambridge, UK.
- Wasson RG 1980 – The wondrous mushroom: Mycolatry in Mesoamerica. McGraw Hill. New York, NY, USA
- Wasson VP, Wasson RG 1957 – Mushrooms, Russia and history. Pantheon Books. New York, NY, USA
- Welden AL 1967 – Two species of *Stereum*, one old, one new. *Brittonia* 19, 328–332.
-