FOREST FUNGI IN IRELAND

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FOREWORD

Once found only in speciality shops, edible wild mushrooms or fungi now feature on the fruit and vegetable counters of supermarkets and grocery stores. However, despite their complexity and great variety, most people still regard mushrooms in terms of the cultivated mushroom. Its close relatives, the field and horse mushrooms, are becoming more familiar, and even the more exotic species now feature on many restaurant menus.

In many European countries, collecting mushrooms from the woods in autumn is a traditional activity. Fungal forays are becoming an increasingly popular pastime and provide an opportunity to explore the natural world. In Ireland, the lack of a foraging tradition as well as the absence of information has deterred collection. However, attitudes are changing and many are keen to know more about natural wild foods, especially forest fungi. Furthermore, as our forest estate expands, accompanied by a greater diversity of tree species, including broadleaves, a more extensive range of woodland fungi is presenting greater opportunities for collection.

Forest fungi in Ireland is based on a B.A. dissertation by Louis Smith – *Wild Edible Forest Mushrooms of Ireland* (1999) and the input of the COFORD Working Group on Forest Fungi established in 2006. Louis has collaborated with Dr Paul Dowding, a well-known expert on fungi and related mycological research.

This publication is based on the authors' experience in Ireland, and is aimed at those interested in mushroom collecting and cooking. It includes a general history of edible fungi, information on the role of fungi in nature and the conservation of wild fungi, and guidelines on finding, using and preserving edible mushrooms. The publication outlines 43 edible mushroom species found in Ireland (all of which have been eaten by the authors), 14 mushroom species best avoided (as they may cause gastric upset to some people, or they could be confused with poisonous species) and 13 poisonous mushrooms that must never be eaten. The publication is supported by photographs, most taken by the authors and all taken in Ireland.

This book has been commissioned and published by COFORD, as a guide for students of botany, foresters, caterers and the general public who are interested in learning more about some of the fungi that grow in Ireland's forests, and to help to safely promote an underused national resource. It is hoped that this publication will encourage the use of more wild edible Irish mushrooms on restaurant menus and in homes.

COFORD's intention is to encourage identification, collection and use of fungi and that it leads you to a new interesting and very rewarding pastime.

Dr Eugene Hendrick
Director

Michael Lynn
Chairman

RÉAMHFHOCAL

Earraí nach bhfaightí ach i siopaí speisialtachta tráth, bíonn fungais agus beacáin fhiáine inite le feiceáil anois ar chuntair thorthaí agus glasraí in ollmhargaí agus i siopaí grósaeireachta. In ainneoin a gcuid coimpléascachta agus a n-éagsúlachtaí, áfach, is i dtéarmaí an bheacáin shaothraithe a smaoiníonn an chuid is mó de na daoine ar bheacáin. Tá a ghaolta cóngaracha, na beacáin choiteann agus chapaill, ag éirí níos comónta, agus tá na speicis atá níos andúchasaí ná sin fiú le feiceáil ar bhiachláir in a lán bialanna.

In an-cuid tíortha Eorpacha, is gníomhaíocht traidisiúnta í beacáin a bhailiú sna coillte san fhómhar. Caitheamh aimsire atá ag éirí níos coitinne i gcónaí ná creachadh fungasach agus cuireann sé an deis ar fáil taiscéaladh a dhéanamh ar an dúlra. In Éirinn, ní dhéantar mórán bailiúchán de bharr nach bhfuil traidisiún sealgaireachta ann agus go bhfuil easpa eolais ar fáil. Tá meonta ag athrú, áfach, agus tá dúil ag an-cuid daoine a thuilleadh a fháil amach faoi bhianna fiáine nádúrtha, fungais foraoise go háirithe. Ina theannta sin, faoi mar a mhéadaíonn ár n-eastát foraoise, mar aon le hilíocht níos mó de speicis chrainn, lena n-áirítear crainn leathanduilleacha, tá réimse níos fairsinge de fhungais choillearnaí ag cur deiseanna bailiúcháin níos fearr ar fáil.

Tá *Fungais foraoise in Éirinn* ann mar thoradh ar an obair a rinne Grúpa Oibre ar Fhungais Foraoise de chuid COFORD, a bunaíodh i lár-2006, agus tá sé bunaithe ar staidéar níos luaithe a chomhlíon Louis Smith – *Wild Edible Forest Mushrooms of Ireland* – tráchtas B.A. neamh-fhoilsithe a glacadh mar chúram go déanach sna 1999aidí. Chomhoibrigh sé leis an Dr. Paul Dowding, saineolaí iomráiteach ar fhungais agus taighde míceolaíochta bainteach leo.

Tá an foilseachán seo bunaithe ar thaithí an údair in Éirinn, tá sé dírithe orthu siúd a bhfuil suim acu i mbailiúchán agus i gcócaireacht bheacáin. Áiríonn sé stair ghinearálta na fungas inite, eolas ar ról fungas sa nádúr agus caomhnú fungas fiáine, agus treoirlínte ar conas beacáin inite a aimsiú, a úsáid agus a chaomhnú. Déanann an foilseachán imlíniú ar 43 speiceas beacáin inite atá le fáil in Éirinn (iad ar fad sampláilte ag na húdair), 14 speiceas beacáin gur fearr iad a sheachaint (toisc go bhféadfaidís tiontú goile a chúiseamh i ndaoine áirithe, nó toisc go bhféadfaí iad a mheascadh suas le speicis nimhiúla) agus 13 beacán nimhiúil nár chóir a ithe riamh. Tá grianghraif ag tacú leis an bhfoilseachán seo, an chuid is mó díobh glactha ag na húdair agus iad ar fad glactha in Éirinn.

Choimisiúnaigh agus d'fhoilsigh COFORD an leabhar seo, mar threoir do mhic léinn na luibheolaíochta, foraoiseoirí, lónadóirí agus an pobal i gcoitinne a bhfuil suim acu níos mó a fhoghlaim faoi chuid de na fungais atá ag fás i bhforaoiseacha na hÉireann, agus cúnamh a thabhairt cur chun cinn a dhéanamh ar acmhainn náisiúnta tearcúsáidte, ar bhealach sábháilte. Táthar ag súil go spreagfaidh an foilseachán seo úsáid tuilleadh beacáin fiáine Éireannacha inite ar bhiachláir bhialanna agus i dteaghlaigh.

Tá sé mar chuspóir ag COFORD aithint, bailiúchán agus úsáid fungas a spreagadh agus go ndíríonn sé thú i dtreo caitheamh aimsire nua, suimiúil agus an-sásúil.

Dr Eugene Hendrick
Stiúrthóir

Michael Lynn
Cathaoirleach

PREFACE

The authors hope that this book will stimulate people who like being outdoors, particularly in woodland, and who like to explore naturally-growing 'wild' foods for their different and often superior tastes.

Wild fungi, except for the white field mushroom, have not been traditionally collected for eating in Ireland, and we hope that most of the edible fungi described and illustrated in this book will be eaten by more people in the future. We have included descriptions of inedible fungi that can be confused with edible ones, as well as full descriptions of the deadly poisonous fungi that must never be eaten. As other mycologists have said in the past: there is no excuse for anyone who wants to collect fungi to eat, not to know that death cap fungi are common, and to know what they look like!

Much of the present forests in Ireland have been planted in the last 50 years, many with exotic species, such as Sitka spruce and lodgepole pine. The fungi associated with these plantations are only developing their full variety, and have not yet been systematically documented. A national survey of the distribution and abundance of macro-fungi in plantation woodlands, funded by COFORD, and directed by Dr Tom Harrington (University of Limerick) commenced in 2007. The historical distributions published in Appendix 4 will certainly have to be amended as more information becomes available. The authors hope that people using this book will communicate information on their finds to www.fungus.ie, to the authors, or to the mycologist at the National Botanic Gardens, Glasnevin, Dublin 9, particularly where they extend the distribution of the species into new counties.

It is the intention that this book will be revised as more knowledge on the variety and occurrence of fungi in Irish woodlands becomes available.

Paul Dowding and Louis Smith

RÉAMHRÁ

Tá na húdair ag súil go spreagfaidh an leabhar seo daoine gur maith leo a bheith amuigh faoin aer, go háirithe i gcoillearnacha, agus gur maith leo taiscéaladh a dhéanamh ar bhianna fiáine a fhásann go nádúrtha, dá gcuid blasanna a bhíonn éagsúil agus a mheastar go minic a bhíonn dearscnaitheach.

Níor bailíodh fungais fiáine go traidisiúnta in Éirinn chun iad a ithe, seachas an beacán coiteann bán, agus tá súil againn amach anseo go n-íosfaidh níos mó daoine na fungais inite a bhfuil cur síos déanta orthu agus atá léirithe sa leabhar seo. Tá cur síos san áireamh againn ar fhungais do-ite ar féidir a mheascadh suas le cinn atá inite, chomh maith le tuairiscí iomlána ar na fungais nimhiúla marfacha nár chóir a ithe riamh. Mar a dúirt míceolaithe eile san am atá thart: níl aon leithscéal ann d'aon duine ar mhaith leo fungais a bhailiú chun iad a ithe, gan a fhios a bheith acu go bhfuil fungais chaidhp bháis coitianta, agus aithne a bheith acu ar an gcuma atá orthu!

Is le 50 bliain anuas a plandaíodh an-cuid de na foraoisí eisigh atá in Éirinn, le speicis andúchasacha in an-cuid acu, cosúil le sprús Sitceach agus péine contórtach. Is anois atá na fungais atá bainteach leis na bhfáschoillte seo ag forbairt a gcuid iolarthachtaí iomlána, agus níl doiciméadú córasach déanta orthu fós. Thosaigh suirbhé náisiúnta i 2007 ar dháileadh agus ar fhlúirse mhacra-fhungas i gcoillearnacha fáschoille, maoinithe ag COFORD, agus stiúrtha ag an Dr. Tom Harrington (Ollscoil Luimnigh).

Tá na húdair ag súil go gcuirfidh na daoine atá ag úsáid an leabhair seo eolas faoina gcuid aimsithe ar aghaidh chuig www.fungus.ie, chuig na húdair, nó chuig an míceolaí ag Garraithe Náisiúnta na Lus, Glas Naíon, Baile Átha Cliath 9, go háirithe nuair a shíneann siad dáileadh an speicis go contaetha nua.

Paul Dowding agus Louis Smith

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Paul Dowding would like to thank his wife and partner, Valerie, for her encouragement and for her unerring eye for any unusual mushroom on their forays together. He is also very grateful to his late mother for taking him to see fly agarics when he was just three months old and for many years thereafter, and for teaching him to see detail in everything natural.

Louis Smith wishes to thank Michael Mulholland and Ray Weldon for their support and interest in the many adventures in woods and forests around Ireland over the years, Barbara Buckley in the School of Science at Galway-Mayo Institute of Technology (GMIT) who offered her help and encouragement when he started his research, GMIT for the research grant and support, and the Head of Department in Catering Operations, Robert Dagger, for his encouragement. Thanks are also due to Euro Toques Ireland and to the Panel of Chefs of Ireland who are encouraging their members to improve their knowledge of wild foods, in particular wild edible fungi.

Thanks to Maria Cullen for her contribution on truffles, and to Tom Harrington, Patrick McClelland, Sinead McMahon and Brendan Murran who contributed photographs.

Finally, special thanks to John Herbert of the National Poisons Information Centre at Beaumont Hospital, Dublin, for his advice on poisonous mushrooms in Ireland.

Fly agaric by K. Dowding

DEDICATIONS

(from Paul Dowding)

To Valerie

(from Louis Smith)

To my late wife, Jenny,
and my children Niamh, Eoin and Orla

Lactarius deterrimus, the spruce saffron milk cap, growing under spruce.

GENERAL HISTORY OF EDIBLE MUSHROOMS

Mushrooms have been growing on earth for far longer than man has inhabited it. Undoubtedly, the early hunter-gatherers found by trial and error those that were tasty and edible, those that caused gastric upsets, and those that were deadly poisonous. Some mushrooms were found to have medicinal properties and others hallucinogenic. This knowledge was often the preserve of the tribe's shaman or 'medicine man' who used the power of mushrooms to dispense cures for certain ailments. In the case of hallucinogenic mushrooms, it was thought that their influence allowed the shaman to communicate with the gods and foretell the future. Some native peoples in Central America continue this practice to this day.

The first written evidence of the culinary use of mushrooms comes from Greek and Roman times. Calelius Apicus, in his famous book of Roman cookery, mentions the use of Caesar's mushroom (*Amanita caesarea*) and truffles, which were considered a delicacy at Roman feasts.

According to Dickinson and Lucas (1979) a number of famous historical figures are reputed to have died by mushroom poisoning, including Pope Clement VII, King Charles VI of France and Czar Alexis of Russia. Jordan (1989) considered that the Roman emperor Claudius was poisoned by his wife Agrippina so that her son Nero could take power. It is believed that Agrippina had the juices of death cap (*Amanita phalloides*) poured over a dish of Caesar's mushroom, to which Claudius was partial.

Even though mushrooms were picked and eaten around the world through the centuries, they were still considered to be mysterious because they had no obvious roots or seeds. Many communities felt that they were the result of a mysterious interaction between the earth and the supernatural. The Greeks, Romans and Mexicans believed that lightning hitting the ground helped form mushrooms (Dickinson and Lucas 1979). In other communities, they were considered to arise from the 'vapours' of moist soil because they appeared suddenly without allowing observers see where they originated (Jordan 1989).

It was only after the development of high-quality microscopes that scientists started to demystify mushrooms. In 1710, Italian scientist Peter Anton Micheli made the important discovery of fungal spores, although it was not until Pasteur's work in the 1860s that the reproductive function of fungal spores was demonstrated. Between 1867 and 1884 Elias Fries created a scheme for the classification of fungi when he compiled his book *Icones selectae Hymenomycetae*. The scheme lasted more or less unchanged for over a century (Jordan 1989).

By the 1800s, the sale of wild mushrooms in markets around Europe was so popular that health and safety laws were introduced at different times in countries such as France, Italy and Czechoslovakia to prevent unscrupulous or careless sellers passing on dangerous mushrooms. Each country brought in its own set of laws, listing the species of mushrooms that could be sold. Inspectors were appointed to monitor and police what was being sold.

Mushrooms have been eaten in the orient for thousands of years. Chinese and Japanese people had been cultivating mushrooms like the padi-straw mushroom (*Volvariella volvacea*) and shiitake mushroom (*Lentinus edodes*) for centuries before the French started cultivating species of the *Agaricus* genus in the early 18th century. A large mushroom cultivation industry developed in the caves and disused mines around Paris, and the mushrooms produced were commercially known as Les Champignons de Paris. The techniques pioneered for growing spawn from spores in the caves at that time are now used worldwide.

Wars have taken a terrible toll on civilian populations in mainland Europe over the years and starving people have had to take to the woods to find food. Wild mushrooms were one of the main foods they could find.

Citizens of mainland Europe love their forest mushrooms and both professional and recreational pickers go to the forests each autumn to gather mushrooms to eat fresh and to preserve for the year ahead. When wild mushrooms are in season, restaurants will have them on their menus cooked in a variety of ways.

Mushrooms like the penny bun (*Boletus edulis*) and the chanterelle (*Cantharellus cibarius*) are popular throughout Europe and North America. The pine saffron milk cap (*Lactarius deliciosus*) is prized in Spain, France, and Italy but not rated very highly in Scandinivia. In Finland and some parts of eastern Europe, the false morel (*Gyromitra esculenta*) is highly prized even though it contains toxins that are deadly poisonous if the mushroom is eaten raw. It is boiled in water several times and the water is discarded to get rid of dangerous toxins before it is eaten.

Ireland, and to a lesser extent the United Kingdom, has had a very reserved and conservative approach to eating wild mushrooms. In Ireland all mushrooms, apart from the field mushroom (*Agaricus campestris*), were known as 'pookies' and were absolutely avoided. In the last 20 years or so, there has been a change in our attitude towards edible forest mushrooms. Restaurants are using imported dried and fresh forest mushrooms on their menus. Chef organisations like Euro Toques have been taking their members on an annual foray to the woods of Ireland for nearly 20 years to educate their members. Mushroom forays are now being opened to the general public each autumn.

THE BIOLOGY OF FUNGI

What are fungi?

Fungi are just as numerous and varied as the flowering plants. They range from tiny microscopic organisms to huge solid bodies, from life savers such as *Penicillium*, which produces penicillin, to killers like ergot disease of rye and other cereals, from rusts and mildews which destroy growing crops to yeasts used in the preparation of foods and drinks. Fungi play a vital role as waste-disposers in nature, breaking down and recycling organic waste. In order to grow, fungi require organic matter, moisture and oxygen; they generally thrive in warm and humid conditions.

Nearly all active fungi consist of a network of microscopic threads, which are invisible to the human eye, but which can aggregate into cords large enough to see. Biologists have set fungi apart from green plants, from animals, and from bacteria, because although fungi share attributes with each of the others, they never share enough attributes with any of the other groups to be considered part of any one of them, for the following reasons:

- Fungi, like all animals and most bacteria, depend on carbohydrates and other organic carbon compounds (made by green plants from carbon dioxide and water) for their energy supply and to build their structures.
- Fungi, like plants and bacteria, have rigid walls surrounding their cells and cannot move except by growing into new space, or by forming and releasing propagules (spores). An individual fungus is indeterminate as to its size and its overall shape, like most plants and unlike most animals.

The most basic structure in filamentous fungi (excluding the yeasts and other unicellular fungi) is the hypha. This is a tube, 0.002 – 0.02 mm in diameter, with rigid cell walls, containing internal structures typical of animals and plants (but not bacteria). The hypha has a growing point, which is pushed by internal water pressure into new solid subtrate or across fluid filled spaces. Hyphae usually branch in a pattern that is more influenced by their immediate environment than by their genetic identity. Hyphae of the same individual, as well as

Hyphae of oyster mushroom x 1000.

Individual mycelium of powdery mildew on a poplar leaf. Each ring represents a day's growth.

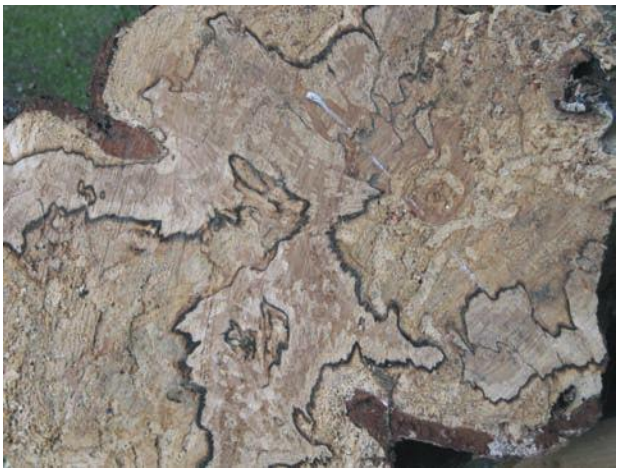
of compatible individuals of the same species, can fuse together to form a net. Hyphae that are broken off from the parent mycelium can grow into new individuals.

A connected set of hyphae is called a mycelium, which is about the nearest one can get to describing an individual fungus. Parts of fungal mycelia can often be seen on buried decaying leaves in woodland. The fungal propensities for casual unions on the one hand, and for fragmenting mycelia which also form large numbers of spores on the other, mean that most estimates of number are little better than guesses. Until the advent of DNA sequencing and related technologies in the second half of the 20th century there was no way of finding out whether adjacent toadstools of the same species belonged to the same parent mycelium or to different mycelia.

Size

While a single hypha is microscopic and invisible to the human eye, aggregations of hyphae into cords (as under puffballs and stinkhorns), strands (as attached to puffballs and stinkhorns) and rhizomorphs, formed by the honey fungus (*Armillaria mellea*) are visible. Such structures are usually formed to cross non-nutritive space. Hyphae are also the fundamental building blocks of the mushrooms, toadstools, puffballs and other fruit bodies described later in this book.

Mycologists have a better idea about the size of fungi that they can cultivate under controlled conditions than they have about fungi growing in nature. Some of the smaller moulds may be no more than 5 mm across when grown on a rich substrate, while the commercial mushroom (*Agaricus bisporus*) forms a three-dimensional network over an area of several square metres. Cutting across a



Birch wood spalted by *Daldinea concentrica* (cramp ball).

decaying hardwood stump displaying brackets of turkey tail (*Trametes versicolor*) or the black hemispheres of the cramp ball (*Daldinea concentrica*), will reveal a complex pattern of black zone-lines, each of which marks the boundary of an individual mycelium. The volume of wood occupied by each individual varies from tens to hundreds of millilitres. The largest fungus is claimed to be a genetically identical clone of honey fungus (*Armillaria mellea*) covering 600 hectares of old second-growth forest in Washington State, USA. (It is unlikely that all parts of this clone are connected, or that they have been connected for much of the thousand+ years claimed to be their age. One could make a similar claim that all apple trees of the same variety are but parts of one individual which came into existence the year the variety was discovered).

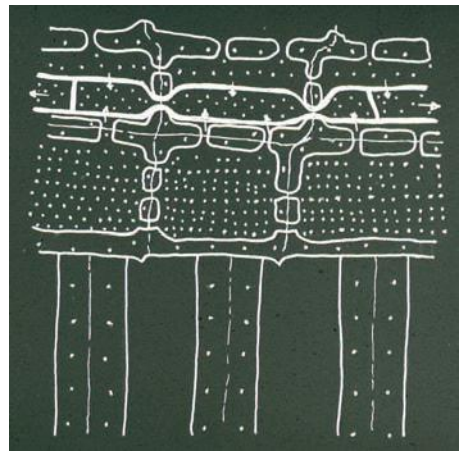
▲ Honey fungus rhizomorphs growing under tree bark.

Longevity

Longevity is inevitably connected with size, but also with the type and size of reproductive structures formed by each species of fungus. A microscopic mould can begin to reproduce when only 24 hours old and its mycelium may not survive more than a week. Toadstool-forming fungi will certainly need weeks, possibly months or even years, of vegetative growth in soil or in wood to gain enough stores to form their fruit bodies. The space and time involved in toadstool formation mean that it has only been successfully carried out under laboratory conditions for a small fraction of the toadstool-forming fungi, usually the smaller types which grow on leaf litter. Lichens, which are mostly fungus (with a few algal cells to provide the sugars by photosynthesis) are small (dimensions in mm) but can be very long-lived (decades). The perennial bracket fungus (*Ganoderma*) forms overlapping annual growth plates, eventually growing a fruit body which weighs several kilogrammes and which is often fifteen to twenty years old. These large hard brown fruit bodies produce so many spores in a year that they need an active mycelium exploiting the resources of several cubic metres of wood to supply the nutrients in the spores alone. Bracket fungus only grows in the heartwood of large trees, where it has plenty of time, space and resources to grow for years before it begins to reproduce and then to continue to do so for one or more decades. As fungi are invisible for most of their lives, it is not known how long an individual mycelium can live, or how large it can become.

▲ Lichens on bark.

Mode of growth



▲ Peg tube formation by an *Ophiostoma* hypha as it grows through the top row of pine ray cells.

Hyphae grow into the material around them by simple extension growth. If the material is fluid or soft, the hyphae are formed at full diameter, but if a hard discontinuity is encountered, the hypha swells at the point of contact and then produces a very narrow peg tube which forces its way by pressure through the hard material. When the peg tube reaches fluid/soft material again it expands to become a normal hypha and the peg tube maintains full contact between the two parts of the mycelium. If the material through which the hypha is growing is not nutritive, hyphae tend not to branch, and if they do branch the angle between the branch hypha and its parent hypha is very small. By contrast, in nutritive material branching is profuse and branch angles are close to right angles.

Means of obtaining nutrition

Fungi (except for slime moulds) cannot ingest the plant-elaborated materials on which they depend, in the ways that animals do. If the material in which a hypha is growing contains substrate(s) which can be digested by the enzymes which the hypha is secreting, then the process of acquisition begins. In woodland and other natural situations most carbon compound substrates are insoluble polymers, such as starch, pectin, hemicelluloses, cellulose, mucopolysaccharides, proteins, waxes, lignins and humic acids. Different species of fungi vary in the types of these compounds they can digest: no single fungus can digest all the compounds in plant materials such as leaves and wood. Consequently, the decay of any natural substrate is carried out by a community of organisms, which will change over time as original substrates disappear and as new substrates appear in dead microbial cells and in faeces of invertebrate animals, and may be different in different places. The colour and texture of decaying wood can give some indication of the preference of the inhabiting fungus; a brown rot with the wood in powdery blocks indicates cellulose destruction, leaving lignins behind. Conversely, a fibrous white rot indicates lignin and possibly hemicellulose destruction, leaving cellulose behind. A few wood decomposing fungi take all (hemicelluloses, lignins and cellulose) and thereby cause shrinkage and softening rather than the more clearcut symptoms of brown and white rots.

Substrate destruction

A single hypha has eventually to exhaust its surroundings of all available substrates, but a mycelium can continue to grow into new substrates until the physical boundaries of the material are reached. The mycelium has to expend the resources it has mined from its substrates on maintenance, as well as on materials laid down in cell walls and cell contents, and on reproductive propagules that can move or be moved to fresh substrates far removed from the parent. Fungi are very good at moving assimilated resources around within the network of hyphae that form the mycelium, but ultimately those resources that were used to build the cell walls of the hyphae have to be abandoned to become substrates in turn for later colonists.

A long-lived mycelium can outlast components of its medium by moving from an old exhausted piece to a newer less exhausted piece. A good example of this type of behaviour can be seen in members of the fungal community on forest leaf litter. Leaves are colonised by both benign and harmful fungi while they are green but these fungi are seldom active in the dead leaf; they die with the leaf. A new set of invaders appear which are tolerant of the exposed position of leaf litter less than a year old, and which require some, if not all, of the substrates in the freshly dead material. Some of these initial substrates disappear rapidly, and with them the micro-fungi which depended on them. When, a year after a leaf has fallen, it is covered by the following year's crop its environment becomes damper and more constant. Under such conditions, mycelia that are growing in leaf litter that is even older can begin to grow into the litter in its second year, thus extending their resource base both in space and in time. Many of the woodland fungi described as saprophytic in this book may behave in this way.

Reproduction

Fungi reproduce by forming spores, which range in complexity from cylindrical fragments of hyphae, through spheres and ovoids formed on specialised hyphae, to complex multicellular shapes. Genetically, the DNA in the spore nucleus or nuclei may be identical to that of its parent mycelium, or to one or more of the genotypes present in the parent mycelium. These types of spores are called vegetative, because the mycelia that arise from them are more or less identical to the parent. Most of the spores produced by moulds are vegetative. Alternatively the genes in the spore's DNA may have gone through a reassortment process called meiosis also found in gamete (egg cells and sperm/pollen) formation in plants and animals. The spores formed in toadstools, cups, puffballs and in brackets are all of this later type. Mycologists have termed these 'sexual' spores, because of the meiosis that immediately preceded their formation. In animals and plants the equivalent 'spores' or gametes (eggs and sperm, pollen and egg cells)

Fungal genetics

Fungal DNA is organised into chromosomes (as in bacteria, plants and animals) and the chromosomes are contained in the cell nucleus, as in plants and animals. Nearly all nuclei in fungal mycelia are haploid (containing one copy of each chromosome), unlike nuclei in animals and most plants, which are diploid (containing two copies of each chromosome).

Some fungal mycelia have no internal divisions except at reproductive structures, but most have cross walls which give the impression of a multicellular organism (like plants and animals). However, these cross walls are perforated except at reproductive structures. In the moulds (Deuteromycota) and in the cup-fungi (Ascomycotina), the central perforation is large enough to let all cytoplasmic organelles, including nuclei, pass through from one compartment to the next. In the toadstool and puffball fungi (Basidiomycotina) the central perforation will not let nuclei through, and each compartment contains two haploid nuclei, each derived from a different haploid parent spore.

In the Basidiomycotina, the consistent presence together of the two parental sets of chromosomes gives the same advantages as the diploid state in plants and animals that is the partial or complete masking of the deleterious effects of incompetent genes. However, in the constantly changing environment of a decomposer organism this can be a disadvantage, and may be one of the reasons behind the association of the Basidiomycotina with stable long-lasting substrata, such as dead wood and the surface layers of woodland and unimproved pasture soils, which are rich in continually replenished organic matter.

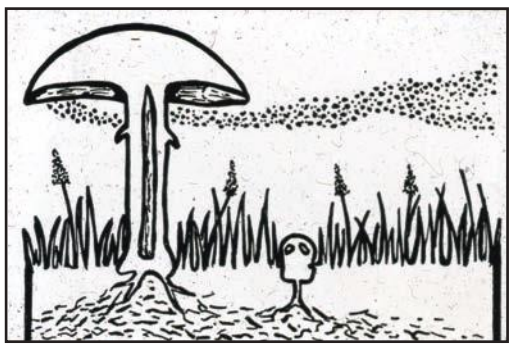
The Ascomycotina have more flexible genetic arrangements than the Basidiomycotina, resulting from the casual fusion of hyphae from different mycelia and from the ability of nuclei to move through compartment walls within the mycelium. A single mycelium can possess more than two different sets of chromosomes, and can alter the ratios of the different types to suit current circumstances, even locally within parts of the mycelium. At the same time the possession of several, possibly different, copies of each gene can confer the same advantages as the diploid state.

can only fuse with and thereby fertilise the gamete of the other sex to form a diploid embryo. In fungi the sexual spores germinate to form independent mycelia, which can form vegetative spores and which only fuse at a later stage. Even though the mycelia have fused, the nuclei do not fuse to form a diploid nucleus until immediately before the meiosis in the ascus initial or in the basidium cell.

Dissemination

Fungal mycelia, like rooted plants, are fixed in their substrate. Both groups use propagules (spores and seeds) to disperse potential new individuals away from the parent, and both groups use wind, water and animals to carry their propagules to new locations. Spores, like seeds, are adapted to their mode of dissemination in terms of size and shape, and in terms of timing, position, and mechanism of release. A single species of fungus often produces more than one type of spore, and often each type is adapted to a different mode of dissemination from the others. The broad characteristics of the spores of terrestrial fungi are as follows:

- Dry-dispersed spores are small (2-20 mm) cylinders ovoids or spheres, often with brown, orange or yellow pigment to protect their vital cytoplasm against ultra-violet radiation in the upper troposphere. Wet-dispersed airborne spores are usually small ovoids (2-10 mm) without pigmentation, and are produced in a water soluble mucilage, which affords some protection against desiccation when a mass of spores dries down hard.
- Insect-dispersed spores are generally small and unpigmented and are produced in a very sticky matrix that is not soluble in water. They are often borne at the top of 1- 2 mm high stalks projecting inwards from the walls of tunnels used by the vector insect. The green spores of stinkhorns are fly dispersed. Insect-dispersed spores are often eaten in considerable quantity by their vector, but the direct transfer to new substrate more than compensates for this loss (cf. pollen and bees). By contrast, it has been estimated that over 99% of dry-dispersed spores never reach their target.
- Mammal-dispersed spores are either transferred by splash or some violent mechanism from the dung on which they are produced onto neighbouring



▲ Basidiospore release.

Diagram © Moira Byrne.

leaves, which are then eaten by the mammalian vector. The spores are activated during the digestion process and germinate once the fresh dung has cooled. The deliquescent caps of ink caps (*Coprinus*) disperse their spores this way. The semi-buried earth balls (*Scleroderma* spp.) and the subterranean truffles (*Tuber* spp. and *Cheiromyces* spp.) have to be eaten to disperse their spores.

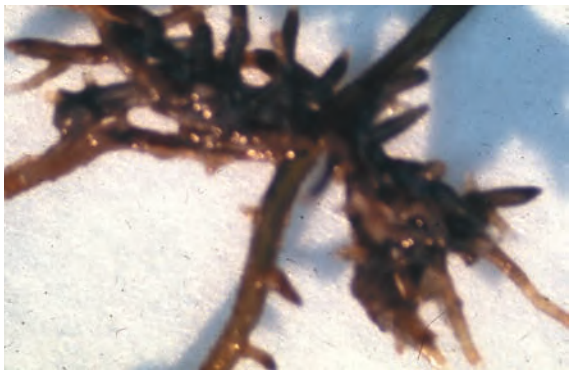
Survival

Fungi which grow in and depend on short-lived or rapidly changing habitats, such as faecal pellets, dung, dying leaves and rotting fruit have either to move immediately (by spores) to fresh habitats, or have to survive as 'resting spores' until a fresh habitat comes into contact and stimulates germination. Some fungi form sclerotia (black-rinded lumps or plaques of reserve-laden hyphae) in or on their old substrate. These sclerotia survive long after the rest of the habitat has rotted away and are used by some small dung fungi and by some Ascomycotina (e.g. black spot on sycamore leaves) to survive the winter. Sclerotia germinate in the spring to form typical fruit bodies and sexual spores for their species. Fungi that grow in long-lasting habitats, such as wood, or in permanent habitats, such as the organic layers in the soil, can grow for years without reproducing and do not need to form special survival structures.

Relationships with plants

Fungi have evolved over millions of years with plants, and depend on both living plants and on dead plant material for their growth and survival. Most diseases of plants are caused by fungi, and fungi are essential in the early stages of decay of all dead plant material on and in soil. Not all plant-fungus relationships are negative, however, as the first category in the following summary of fungus-plant relationships will show.

Symbiotic fungi are found in constant associations with one or more plant species where both can be shown to benefit. The most important in terms of benefit to plants, fungi, ourselves and in the subject organisms in this book is the mycorrhizal (Greek for fungus-root) relationship. Over 80% of plants are normally mycorrhizal, and all plants in extreme and/or nutrient-poor habitats are mycorrhizal. Although the details of the anatomy of the relationship vary, the plant's function is to provide simple (soluble) carbohydrates unavailable in soil to the fungus, while the fungus is able to explore the soil volume far more efficiently (in terms of both capital and running costs in terms of carbohydrates and other nutrients) than roots, and is able to extract phosphates that are chemically unavailable to plants. Mycorrhizae can also extract more water than roots can from a given volume of soil. All trees in Ireland depend on mycorrhizal fungi of one of the three following sorts for their mineral nutrition.



▲ Ectotrophic mycorrhizal roots.

- ectotrophic mycorrhizae form sheaths of mycelium around short stubby roots, from which the hypha network explores the soil and exploits its insoluble phosphate reserves. The fungal sheaths also send hyphae into the root but no plant cells are penetrated, and exchange of carbohydrate and phosphate takes place across the double cell walls (fungus + plant). Most conifer trees (e.g. spruce, pine and fir) and many forest broadleaves (beech, birch, oak, poplar and willow) form ectotrophic mycorrhizae. Most of the fungi involved are Basidiomycotina and form toadstools, and so figure prominently in this book. A single tree species will have several species of fungi associated with its roots, and the associated fungi will be different on acid and neutral soils. A single fungus species may have several tree species as hosts.
- endotrophic mycorrhizae are associated with the heather family (Ericaceae) and are microscopic moulds. Fungal hyphae invade individual plant cells and form a ball of hyphae within the cell, which then appears to kill and digest the ball of hyphae. Orchid seeds also depend on invasion by fungal hyphae to get enough nutrients, including carbohydrates, to germinate. Some colourless (non-photosynthetic) orchids (like the rare bird's nest orchid, *Neottia nigus-avis*) depend on the honey fungus (*Armillaria mellea*) to supply nutrients, including carbohydrates, and water, and could almost be regarded as plants parasitic on the fungus. The strawberry tree (*Arbutus unedo*) is the only native tree in Ireland with this sort of mycorrhiza.
- arbuscular mycorrhizae are also always microscopic. Hyphae form a loose net on normal root surfaces, and send in peg tubes into the outer cells of the root. Inside the cells they form very finely repeatedly branched exchange organs, called arbuscles. The relationship seems to be more stable than that of the endotrophic mycorrhizae. Arbuscular mycorrhizae are extremely common, occurring in nearly three-quarters of plant species. Some woodland trees have arbuscular associates, namely ash, sycamore and other maples, all the Rosaceae (blackthorn, cherry, rowan, whitebeam, whitethorn) and yew. Both the variety and number of mushroom species are lower in woods dominated by trees with arbuscular mycorrhizae, than in those dominated by trees with ectotrophic mycorrhizae.

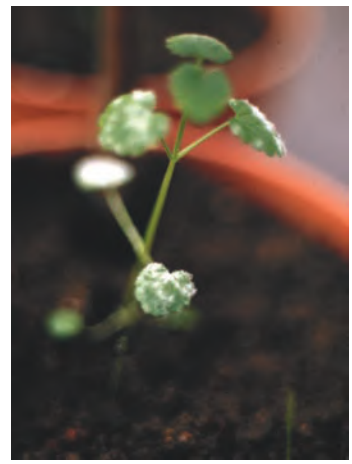
Commensal fungi live in association with plants, from which they derive soluble substrates, such as sugars and minerals, and do not normally appear to benefit or to harm the plant in any way. 'Appear' was carefully chosen, because wherever a commensal relationship has been thoroughly investigated, non-neutral effects on the plant 'host' have been demonstrated. For instance, all plant surfaces are colonised by a variety of micro-organisms, many of which appear to have no effect on their hosts. However, it has been shown that leaf-surface yeasts of the Basidiomycotina genus *Sporobolomyces* can protect apple and grass leaves against invasion by plant pathogens, and that root surface bacteria can both enhance and diminish the rate of soluble phosphate supply to roots, depending on circumstances.

Parasitic fungi (biotrophs) also live in constant, usually specific, association with plants, from which they extract all their nutrition, without causing the premature death of plant cells and tissues. Biotrophic fungi typically infect mature plant parts, and may even delay senescence. Often the only sign of the presence of a biotroph is a mass of fungal spores, such as the yellow-brown spores of rust fungi and the greyish-white spores and mycelium of powdery mildews on infected leaf and stem surfaces. However, the infection takes its toll by reducing root growth and by diminishing the yield of fruit and seed.

Pathogenic fungi (necrotrophs) cause obvious lesions on and within their hosts, by first killing and then digesting host tissues. Necrotrophic fungi are more likely to infect immature, damaged, and senescent plant parts than mature undamaged parts. In forest trees, the heartwood–rotting pathogens, such as root rot (*Heterobasidion (Fomes) annosum*) found on spruce and pine, bracket fungus (*Ganoderma*) species found on beech and other hardwoods and birch polypore fungus (*Piptoporus betulinus*) found on birch, are economically important examples of bracket fungi.

▲ Leaf yeasts on grass leaf.

(photo: Jane Peacock)



▲ *Lamium* experimentally infected with powdery mildew.

▲ Heartwood rot of pine caused by *Heterobasidion*.

- Root rot colonises recently exposed stump surfaces, and grows into neighbouring trees through fused roots. It causes a progressive rot of the heartwood in the most valuable part of the tree, which goes unnoticed for many years before the brown plate-like brackets appear just above the ground surface at the base of the tree.
- Bracket fungi species and birch polypore fungus infect and colonise standing trees through broken branches and through bark scrapes. The heart rot that results (often over many years) firstly diminishes the value of the timber and ultimately destabilises/weakens the trees, causing premature collapse.
- The honey fungus, like root rot, infects fresh stumps by spores, but then uses the substrates in the stump as a food base to fuel a centrifugal exploration of the surrounding area by means of black rhizomorphs. Rhizomorphs are parallel aggregates of hundreds of hyphae, and have enormous infection potential. They were measured travelling at 2 m per year from Douglas fir stumps on a sandy soil in the UK. Any woody plant that is contacted by rhizomorphs is at risk. Honey fungus has a known host range of hundreds of plant species, but generally only individuals weakened by other causes, such as mechanical root damage are successfully attacked and killed.

▲ Honey fungus on oak roots.

Relationships with animals

Fungi form the food source for many animals during all or part of their lives, and are essential for softening and chemically preconditioning most dead plant material (and certainly all woody plant material) for consumption by soil invertebrates. The decay processes that are essential for maintaining soil structure and fertility in natural and in unfertilised managed habitats have been called an 'external rumen' to emphasise the synergy between fungi (primary metabolisers and softeners), invertebrates (mechanical processors and mixers) and bacteria (secondary [faecal] metabolisers). All three components are essential; if any one is slowed or eliminated, by water-logging or by poisoning for example, the whole system is slowed or becomes incomplete. The formation of peat over mineral soils by water-logging or by poisoning with mercuric salts applied to soil or leaf litter as fungicides is a good example.

Above ground, the fruit bodies that form the subject of this book are eaten by fly larvae (maggots) and by slugs and snails. Species that are deadly poisonous to humans are eaten with no ill effect by molluscs! Other mammals, especially sheep and deer, also eat fruit bodies.

Symbiotic relationships between fungi and animals also exist, generally on the basis that the fungus processes the plant material sufficiently to make it the sole food for the animal, which in turn acts as vector and inoculators for the fungus. Good examples exist in woodlands.

Wood wasps (*Sirex* species) carry and inoculate spores of white rot Basidiomycotina fungi when they oviposit, and their larvae consume the growing volume of delignified wood over their two to three-year existence.

▲ *Ophiostoma* colony with associated beetle system in a pine log.

Bark beetles (of genera *Scolytus*, *Dendroctonus* and *Ips*) carry and inoculate spores of the Ascomycotina *Ophiostoma* species into elms, oaks and conifers, where the fungus kills the sapwood causing wilting and more or less rapid death, depending on the tangential extent of the insect attack. The insect larvae eat the recently killed inner bark and do not depend on the fungus as food source.

In Africa, and southern Asia, an even more specialised relationship exists between the termite *Macrotermes* and a genus of edible mushrooms *Termitomyces*. The colonial insects build tall earth 'chimneys' which ventilate the underground chambers that the insects inhabit. The adults forage and eat dead leaf material and deposit their faeces onto specially cultured 'fungus gardens' which can be up to 60 cm across. Adult workers, in addition to foraging, maintain their 'fungus gardens' free of 'weed' fungi, and transfer the asexual spores of *Termitomyces* that cover the surface of the 'garden' to the larvae, soldiers, 'kings' and to the queen termite. Mushrooms are produced above ground around the base of the chimney, only in the wet season.

Pathogens of animals

There are several genera of fungi that are parasitic on, or pathogens of, insects. The Ascomycotina genera, *Cordyceps* and *Elaphomyces* both invade and kill caterpillars and their pupae below ground, ultimately producing small stalked fruit bodies above ground. The Deuteromycotina mould (*Metarrhizium anisopliae*) infects a

wide range of insects via their spiracles and is now being developed as a biocontrol agent against locusts.

Some fungi are pathogenic to birds and to mammals, including humans. *Histoplasma*, *Blastomyces* and *Aspergillus* all cause serious lung diseases. *Arthromyces* and *Trichophyton* cause 'ringworm' in domesticated animals and in humans, and athletes' foot and nail infections respectively. The yeast *Candida* inhabits (as a commensal) as well as causes disease in the mucocutaneous junctions (mouth, anus and genitalia). All are members of the Ascomycotina.

Special relationships with humans

Humans have learned to use fungi as food and as food processors, as well as medicines and as 'recreational' drugs over millennia.

Leavened bakery products are 'aerated' by carbon dioxide either produced by the yeast *Saccharomyces* or by the reaction of tartaric or lactic acids with sodium bicarbonate.

All industrial, medicinal, fuel, and beverage ethanol is produced by the anaerobic fermentation of sugar (at 10-20% initial concentration in water) by the yeast *Saccharomyces*.

Vinegar (acetic acid) is derived by oxidative fermentation of ethanol.

The compressed carbon dioxide used for retail and industrial purposes is derived as a by-product from the production of ethanol.

Most of the vitamins of the B complex, used to supplement food and feed, are produced by extraction from the yeast *Saccharomyces*.

Citric acid, used in beverages, is produced by partial fermentation of molasses by *Aspergillus niger*.

Some cheeses are secondarily fermented by species of *Penicillium* to sharpen their flavour and to increase storage life.

Rice is fermented by *Aspergillus oryzae* to yield sugar for subsequent yeast fermentation to rice wine.

Industrial and fuel ethanol manufacture needs the same initial step for its production from cereal grains, unless excess sugar (cane) and or excess wine have been produced.

Soya bean extract is fermented by *Aspergillus soji* to yield soy sauce.

Penicillium species are used to produce both anti-bacterial and anti-fungal antibiotics.

Tolypocladium is used to produce the immuno-suppressant cyclosporin.

Ergots, which are sclerotia produced by *Claviceps purpurea* in rye heads, are extracted to yield ergometrine, used in obstetrics, and ergotamine, used for migraine-relieving preparations.

Several mushrooms have hallucinogenic properties. Fly agaric (*Amanita muscaria*) and magic mushroom (*Psilocybe semilanceata*) are the most common in Ireland. It is illegal to collect or to possess picked specimens of the latter species.

Fungi also compete with humans for valuable resources, such as crop plants, stored food, and structural timber. Crop diseases and pests have been estimated to reduce yields by 25%, with decay and infestation in stored foods taking another 25% of potential production. Fungicide sprays applied to growing food crops as well as post-harvest fungicidal dips have reduced these losses. Modern chemicals have slowed but not eliminated decay in timber exposed to wet conditions. World supplies of naturally durable timber species, such as teak, oak and western red cedar have been diminished by excessive extraction for use in exposed (e.g. window frames and shingles for wall-cladding) or in essential structural components of buildings (such as the wall and roof framework in historic buildings). Fungal mycelia can grow in aircraft fuel tanks, where their by-products corrode the tanks, and their mycelia and spores clog fuel lines. Glass lenses can be irreparably damaged by even sparse mycelial growths. Increasingly small-scale electronic circuitry is vulnerable to disruptive short circuits caused by single hyphae bridging insulating air gaps.

CLASSIFICATION OF FUNGI

The Fungi form one of five Kingdoms of living organisms. The other Kingdoms are the Prokaryotae (viruses and bacteria), the Protoctista (formerly Protozoa in the Animalia), the Animalia, and the Plantae.

Fungal classification has been through considerable changes in the last forty years, after a long period of relative stability, when it was based on schemata proposed by Fries (an eminent German mycologist) in the 19th century. The mycologists of that era had relatively poor microscopes compared with those a century later, so were unable to see details of reproductive morphology which have been used to reclassify fungi in the second half of the 20th century. In the last ten years, DNA analysis has added another potent force for reclassification, independent of morphological characteristics.

The fungi in this book belong to one or other of two subdivisions: Ascomycotina (sometimes called the cup fungi or the sac fungi), and Basidiomycotina (mushrooms, toadstools, puffballs, brackets, rusts and smuts). Both subdivisions were formerly called 'Ascomycetes' and 'Basidiomycetes' in the 'Higher Fungi'. Most Ascomycotina are so small that they are of no interest for eating, and many are almost microscopic. The classes are:

- Hemiascomycetes which include bakers' and brewers' yeasts, and microscopic plant parasites (e.g. peach leaf curl).
- Laboulbeniomycetes which are insect parasites.
- Plectomycetes which include important tree pathogens (elm disease, oak wilt, sap stain of conifers), dermatophytes (e.g. ringworm, athletes' foot), deer truffles (*Elaphomyces*), and economically important moulds (*Penicillium*, *Aspergillus*).

4. Hymenoascomycetes which have been divided into five subclasses:
    a. Erysiphomycetidae: all the powdery mildew diseases of plants.
    b. Pyrenomycetidae: including the black ergots (*Claviceps purpurea*) in grass heads, candle snuff fungus (*Xylaria hypoxylon*), dead man's fingers (*Xylaria polymorpha*), cramp ball (*Daldinea concentrica*) and other brown and black emanations from dead wood and stumps, and the insect pathogens *Cordyceps* species.
    c. Loculoascomycetidae: including important leaf parasites and some lichens.
    d. Lecanoromycetidae: all are lichens.
    e. Pezizomycetidae: form a disc or cup which may be stalked (as in morels) or completely folded in on itself (as in truffles). Most are large enough to be

▲ Crustose lichens with dark apothecia (dots).

seen without a lens and some are over 5 cm across, and many are brightly coloured (e.g. *Sarcoscypha coccinea*). Apart from some of the morels and some of the truffles, none of the larger species are edible.

The Basidiomycotina eject their basidiospores into the space between the gills or into the lumen of the pore under the cap/bracket of the fruit body. Provided that the free space is vertical, the spores then fall out of the underside of the fruit body into sufficiently turbulent/flowing air to disperse them. The spore-print technique, used to determine spore colour, relies on the lateral ejection and vertical free-fall phases of the dispersal mechanism.

There are currently three classes recognised:

- Teliomycetes: All members are biotrophic plant parasites, namely rusts (Uredinales) and smuts (Ustilaginales).
- Phragmobasidiomycetes: including *Auricularia* and *Tremella mesenterica* which produces soft yellow/orange fruit bodies on dead twigs and small branches, which dry down to small orange-brown lumps.
- Homobasidiomycetes: which have three groups:

  a) Aphyllophoromycetidae (lit. fungi not bearing gills) produce spores from the lining of tubes or spines, or from smooth surfaces on crusts, brackets or clubs. The commonest and most conspicuous members of this sub-class are the pored bracket fungi on trees, the crusts on fallen branches, the clubs, spindles and coral fungi on the ground, and the chanterelles. Apart from the latter, very few are edible.

  b) Agaricomycetidae (lit. field fungi) produce spores on gills, occasionally in pores, under the cap of a 'mushroom'. This group contains most of the fungi described in this book, and includes both some of the best fungi to eat and some of the most poisonous fungi. Many are mycorrhizal partners of the most commercially valuable forest trees.

▲ Rust uredospores on willow.

c) Gasteromycetidae produce spores in a sac, not in a single layer, and do not eject spores. This group contains the puffballs, the earth stars (e.g. *Geastrum*), the earth balls (e.g. *Scleroderma*), the bird's nest fungi (e.g. *Crucibulum*), and the stinkhorns (e.g. *Phallus*). Some are edible, but most are not.

The names of fungi described in this book were initially taken from Phillips (1981) and Courtecuisse and Duhem (1995), and have subsequently been checked against the *British Mycological Society Checklist of British and Irish Basidiomycota* (Legon and Henrici 2005). In the descriptions of the species, the British Mycological Society (BMS) name is included where there may be differences.

Clitocybe flaccida - tawny funnel cap - is an edible species often found in large clusters in conifer forests.

CONSERVATION OF WILD FUNGI AND WOODLAND MANAGEMENT TO PROMOTE FUNGI

Management of woodlands to preserve and enhance the biodiversity of fungi is an inexact science in most countries, and Ireland is in a worse position than most, having lost virtually all of its native and ancient woodlands by the early 19th century. We therefore do not know what we should have had here, and have only very small patches of inoculum from which new woodlands can be colonised. Some new woodlands are composed of non-native tree species, so it is uncertain which of the surviving 'native' fungi will be able to recolonise new woodlands. Most new woodlands are actively managed for wood production, some aspects of which may not be conducive to the re-establishment of native fungi. Outside of woodlands, nearly all farmland, including grassland is also managed in a way that is not ideal for most mushroom species.

The widest range of fungi is found in unmanaged ancient woodlands with the following characteristics:

- mixed species of trees of mixed ages, including ancient trees;
- standing dead trees, and fallen trees left to rot on the ground;
- largely undisturbed litter and soil layers;
- subject to light grazing and rooting pressure from woodland mammals;
- varied spatial structure, with open and closed areas;
- have remained intact for centuries.

These same characteristics maximise biodiversity of flowering plants, ferns, bryophytes, birds, insects and other invertebrate animals, and mammals. Forest Service *Biodiversity Guidelines* (2000) outline practice to conserve and enhance the biodiversity value throughout the entire forest.

The size of the felling coups and the removal of timber for sale or for firewood remove some of the deadwood resource. However, the *Biodiversity Guidelines* stress the importance of the retention of old trees for biodiversity, while the retention of deadwood is also strongly recommended as it represents a further resource for biodiversity. Clearfelling systems will encourage fungi that are tolerant of interrupted woodland cycles. The increasing use of large machines in in tree-felling operations may affect long-lived fungal mycelia in forest soils.

Ireland has been developing such forest fungal biodiversity as it has, and even that is not fully documented, from a virtually blank canvas. A few amenity

woodlands may go on to become ancient woodlands and to develop as rich and varied a fungal flora as is possible, but as stated, most plantations will be managed to produce timber and fuel wood. Woodlands in nature reserves and in national parks can be managed according to the criteria listed above. Muskett and Malone (1980) mention a number of woodlands 'regularly searched for fungi'. These include Avondale Forest Park, Belclare Wood, Brackloon Wood, Derrycunnihy Wood, Glasnevin, Glengarriff , Glendalough, Lota, Muckross, Oak Park, Shelton Forest, Tomies Wood, and Townley Hall, all of which are currently in state ownership.

The most important of these measures in the short term is the retention of deadwood in all its natural forms. In commercial forests, some areas should be left to go post-mature, or even 'pre-ancient', with dead trees left to stand, and fallen trunks left to rot where they fell. Decomposing wood provides a habitat for numerous species of animals and plants, including fungi, which might otherwise be absent from the forest. In the farm woodlands, farmers should always restrict grazing stock by fencing, and to leave a small proportion of fallen timber to rot in situ, rather than removing it as fuel.

Newly planted woodlands, particularly if they are of mixed tree species with ecto-mycorrhizal root symbionts and/or adjoin areas of existing more mature trees, can quite rapidly develop substantial fungal floras, once the young trees have grown sufficiently to shade out the grass. In Scotland, the importance of conifer plantations as a habitat for native fungi has been shown by Humphrey and others in a study which highlights the importance of conifer plantations as a habitat for native fungi (Humphrey et al. 2002).

In 1992, Paul Dowding planted about 2,500 m^2 of birch, willow, poplar, oak, fir, spruce, hazel, larch and several other tree species on hay meadow over a neutral base-rich clay soil and has since recorded over thirty species of saprophytic and mycorrhizal mushrooms in the new wood, with new species appearing almost every year. In contrast, a nearby older plot planted with ash in 1984 and hazel in 1992 has shown only five species, of saprophytic mushrooms. Ash trees have arbuscular mycorrhizae, and very rapidly decaying dead leaves in the autumn, which never form a humus layer on the woodland floor.

FINDING, USING AND PRESERVING WILD EDIBLE MUSHROOMS

Despite the vagaries of many species of fungi, there is undoubtably a mushroom season, and that is the autumn. The end of the season occurs with the first hard frost. Of course, the climate is not the same everywhere and there will be variation across the country. Wild edible mushrooms grow in every county in Ireland and most of these fruit and decay without been noticed or picked. This is largely due to our lack of tradition and expertise in harvesting them and a genuine fear of poisoning through lack of knowledge.

It is hoped that this book will help enlighten readers about edible mushrooms and encourage a responsible interest in a healthy, interesting and rewarding hobby.

The authors have collected and safely eaten over forty varieties of edible mushrooms from different parts of the country over the last seventeen years. They have always erred on the side of caution and have carefully checked their identifications before eating any new species. A saying that mushroom hunters repeat is *there are old mushroom hunters and there are bold mushroom hunters, but there are no old bold mushroom hunters*.

Before you set out to collect and eat wild fungi you should seek training from an experienced collector. Go on several fungal forays in your locality. Never eat a fungus (including ones offered to you by friends) that you cannot positively identify from this or other identification books. Do not let your children eat or taste any mushroom that they collect. There are no short cuts to identification, and folk myths, such as poisonous mushrooms do not peel and that they blacken spoons, are just that – myths.

How to identify a mushroom

This is very important information to read carefully before collecting, and certainly before eating, wild mushrooms.

Cautionary quotation

'Once you have found the closest photograph in the Nature Guide, carefully compare every single characteristic of the description with the actual fungus. If even only one characteristic does not fit you have to assume as a matter of caution that you have not found the mushroom described' (Garnweidner 1994:p5).

This book contains descriptions of 13 species of poisonous mushrooms found in Ireland that should never be eaten. It also describes 14 mushroom species that should be avoided, either because they are known to cause gastric upset in some people or because they are too similar in appearance to poisonous species to take the chance. Forty-three species of edible mushrooms that are found in Ireland are described, all of which have been eaten by the authors. In the descriptions the key features for identification and to distinguish them from confusable species are in italics. All descriptions are supported by photographs, most taken by the authors unless otherwise stated, and all taken in Ireland.

Appendix 1 of this publication provides an illustrated glossary of technical terms, as used in the descriptions of the mushroom species. It also contains a table illustrating fruit body characteristics, to assist in identification.

Appendix 2 provides a dichotomous key as well as a tabular key to assist with identification of mushrooms. The most important characters in both keys are:

- general shape (mushroom, bracket, puffball, etc.).
- stem ornamentation in mushrooms (ring, volva, veil, scales).
- gill attachment in mushrooms (free, adnate, adnexed, sinuate, decurrent).
- spore colour (white, pink, lilac, yellow, brown, purple, black).

followed by more minor characters:

- cap surface characters when wet (sticky, slimy, velvety).
- gill colour, as distinct from spore colour.
- gill shape (thin, thick, forked).
- gill spacing (crowded, distant).
- stem texture (fibrous, brittle, rubbery).

Appendix 3 provides a key to guide in identification of Irish trees in the summer and winter seasons, a table of fungus/tree associations, as well as photographs of common tree species.

Appendix 4 lists recorded occurrences of the forest fungi described, gives a table of fungal distribution by species and county, and presents a useful calendar showing the months when the various species are most likely to be seen.

When picking to identify it is important to get the whole mushroom including the whole stem, so do not cut the stem but remove soil from around its base so the whole mushroom can be lifted intact. Mushrooms change as they move through the stages of growth and decline; some species are so similar to each other at certain stages that it is only when you see them at the different stages of growth that you can clearly separate them.

For example, a young *Cortinarius purpurascens* (bruising web cap) and a mature *Lepista nuda* (wood blewit) could easily be mistaken for one another as they are

similar sizes and the colour, cap and gill shape and stem seem very similar. However, the mature *Cortinarius purpurascens* grows much larger than the mature *Lepista nuda*. Their spore prints (and therefore gills in older specimens) are also a different colour. They smell different. Once you have positively identified each species and have seen them a couple of times you start to easily distinguish them by eye and nose.

Collecting the specimen(s)

It is useful to have knives for digging up and trimming the mushrooms, a hand lens to asist with seeing detail, a notebook and pencil, and an identification manual.

Select or study at least three ages of each species.

Take young fruit bodies to see true gill colour, a veil under the cap, and a universal veil (+volva) over the cap.

Take fully expanded but young fruit bodies to see all the mature but unspoilt characters (this is the best age of mushroom for eating).

Study post-mature fruit bodies and note the spore colour and cap/stem discolouration (after bruising); post-mature fruit bodies are not good to eat, do not travel well and decay very quickly.

Go through the list (cap, gills/pores, stem (+/- volva, +/- ring), flesh, smell) methodically. Make records of your observations under a single collection number (could be date (yymmdd) plus the order number; e.g. the fifth species collected on 5/10/07 would be 7100505.

Dig up at least one whole fruit body, to identify the presence of volva, a rooting stem and mycelial cords. Make notes if you cannot collect the specimen.

Transporting the specimens

Carry the specimens, labelled with their collection number, on their sides in shallow trays or baskets. Ensure that they cannot roll about, by packing them close together, or by using moss between each fruit body. If you have to build up more than one layer, use more moss between layers. Never collect into a polythene bag, as the specimens will be crushed together, may acquire characters that are not theirs, and will sweat.

Storing the specimens

If you have collected and transported carefully, specimens should keep fresh at 5°C for a few days, provided that the box in which they are stored is completely

enclosed in polythene to reduce water loss. Specimens that have to be sent away for identification by more expert persons, should be dried, preferably in special driers which are widely used in continental Europe for preparing edible mushrooms like *Boletus*. If special driers are not available, shallow trays on radiators are satisfactory. Thick specimens should be sliced longitudinally through the cap and down the stem. Take care not to let the specimen and its label get separated. Finally store in paper or cellophane, not polythene bags, complete with original number tag inside and the same number written on the bag.

Identifying the specimen

Describe it on paper, in the standard order; illustrate your notes.

Cap: size, shape, colour(s), surface texture (when dry and when wet), ornaments.

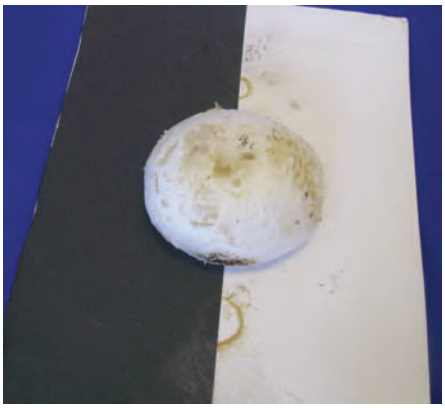
Gills/pores: relationship to stem and to cap, colour, colour change with damage and with age (clue to spore colour), crowdedness, branched/not, thickness.

Stem: length and thickness, +/- volva, +/- ring, colour, changes up/down and with bruising and cutting.

Flesh: thickness at centre of cap, colour and change on cutting, consistency.

Smell: when the smell is present and is not just mushroomy, it can be a useful confirmation of a diagnosis. Not used in the key.

Prepare a spore print: This is an important first step in identifying an unknown fungus. A spore print can be prepared (overnight) from freshly collected specimens which have not dried out. Select a fully expanded (mature) cap. Cut off the stem flush with the gills, and place the cap carefully onto coloured paper (pale blue or pale green are best, as there are no spores of those colours). Place in a polythene bag on a flat surface for at least 12 hours.



Making a spore print.

Using the dichotomous keys in this book

The keys to fungi in appendix 2 are not exhaustive, and only cover the genera named in this book. It is very possible that the specimen you wish to identify (particularly if it is small - under 3 cm across) will not key out.

Two keys have been provided: a tabular key, with a master table directing your search to one of the subsidiary tables, and dichotomous key, where you search through a sequence of choices. Readers who are new to dichotomous keys may find the tabular key easier to use. The dichotomous key includes more characteristics than the tabular key, so discrimination between choices may be easier.

Fit the characteristics of the specimen you want to identify to one of two or three choices in a step-wise process. At the beginning you might find it useful to work with another person; one asking the other questions from the key. Make a note of any difficult points, where neither of the choices seemed to fit. When you have arrived at a possible name, check the specimen with the detailed description(s) of member(s) of that genus in the text. If you get a good (>90% characters agree) match, you have the right identification, but if you do not get a good match go back to the key and try again. As there are many genera in Ireland that are not described in this book, and are therefore not covered by this key, it is very possible that some of the fungi you pick will not match anything in the key.

Locating wild mushrooms within a wood

The majority of wild mushrooms grow in forests and woods, but they can also be found growing in fields, parks, the green areas along paths and driveways, in gardens and in many other locations.

The easiest time to find wild mushrooms in Ireland is from September to November when they are most plentiful; however, there are some to be found in every month of the year, particularly now that winters are becoming much warmer - see the mushroom calendar for Ireland (Appendix 4).

Coillte's woods are open to the public and everyone is free to walk in these woods and pick whatever mushrooms they wish at their own risk. Some forests, including forest parks, are managed by the Office of Public Works and in some instances they do not allow the public to remove flora, including mushrooms, so check the regulations with the local manager/ranger. Always get permission from the land owner to enter as well as to walk over private land. Consult the owner before entering private forest land. It is always advisable to get permission from the owner if you wish to pick mushrooms.

Most people starting to pick mushrooms begin with their local wood or forest. Before the main mushroom growing season begins, find out who the owner is and obtain permission to make a collection. Check the size of the wood and find out what species of trees are growing there and how they are distributed throughout the wood. Try to establish whether it is on neutral, acidic or alkaline soils over shale or limestone, or on acid soils over sandstone, quartz or granite.

Eoin, Orla and Niamh Kelly-Smith with the fruits of a mushroom foray in east Galway.

The ground flora can give clues about the soil. Ferns are particularly good indicators of soil type in woodland. Hard fern (*Blechnum spicant*), buckler ferns (*Dryopteris* spp.) and bracken (*Pteridium aquilinum*) grow on acid soils, while hart's-tongue fern (*Asplenium scolopendrium*) and soft-shield fern (*Polystichum setiferum*) grow on neutral to alkaline soils. Try to find out if the soil varies within the wood. Remember that conifer plantations tend to acidify the surface layers of the soil, so can convert a neutral soil to an acid soil. By knowing the tree and soil types you will be able to guess, using the information contained in this book, what mushrooms you would expect to find in the wood at different times of the year.

For example, in the experience of the authors to date, chanterelles grow with birch, oak, Scots pine and beech trees mainly on acid soils while penny buns (ceps) grow with Scots pine and oaks and a number of other trees mainly on acid soils. Spruce saffron milk caps grow with spruce trees on both limestone and acid soils and fly agarics grow with birch and conifers, most commonly on acid sandy soils, but rarely on neutral or basic soils.

In summer, the best growing periods are when a dry period is followed by a wet period followed by a sunny warm period to bring on growth. The main mushroom growing season is still autumn; however, a long dry autumn with hard ground and an early onset of winter frosts can make for poor harvests.

Two recent years provide good contrasting examples for Ireland:

- The late summer of 2006 was warm and dry until early September, and September was much wetter than average, while staying warm. October was drier than September, but much warmer than average. Crops of wild

mushrooms from late September through to mid November were exceptionally good.

- In 2007, April was warm and dry, with daytime temperatures over 20°C on many days May was average, apart from a severe frost on the last day of the month. June started hot and dry, but from the second week until the middle of August the weather was wet and cold. Soils were saturated by mid July. September and October were warm and remarkably dry. November was warm but with average rain and December was much wetter but warm (several days over 15°C). Autumn-fruiting mushrooms started to appear in early July with some large flushes of chanterelles (or girolles) (*Cantharellus cibarius*) and continued sparsely through August, but disappeared in September and October. Late autumn fungi appeared sporadically through November and December.

The species of mushroom growing in a wood will change continuously through the growing season. You can only expect to see at most a third of the total mushroom flora of any site on a single visit.

Bramble, ivy and woodrush are all hindrances to the mushroom hunter. Bramble can make woods impenetrable. Ivy and woodrush can cover the forest floor and leave no room for the fruit bodies of mushrooms to get through.

Safety in the woods

It is easy to get lost in the unfamiliar surroundings of a wood while picking mushrooms. To avoid getting lost in a wood:

- Mark your entrance point and continue to mark your path as you wander around the wood – in this way you should be able to retrace your steps back to the entrance point. Note the position of the sun.
- Make sure you know what time it gets dark and be out of the woods at least half an hour before the onset of darkness.
- Always tell someone which wood you are visiting and let them know the approximate time you expect to return home.
- Carry a mobile phone, and keep the number of the nearest hospital or emergency service on hand.
- In daylight, a digital compass or Geographic Positioning System will help you relocate the entrance, but remember to take readings on entering the wood.

A hand-held GPS is a useful tool when on a mushroom foray.

- When you enter an unfamiliar part of the wood, travel only in one direction and do not start changing direction when you are within the wood. Always make a note of identification features, such as another path or a dividing forest road as these can help you to retrace your steps.
- Each time you move within the wood, pick new landmarks and temporarily mark them if necessary.
- As you walk around the wood, always make sure that dangerous items such as knives are always carried in a proper and safe way – always keep an open knife sheathed and pointing towards the ground in case you stumble.

Locating new woods

New woods can be located by consulting ordinance survey maps: the OSI Discovery Series 1:50,000 are published by the Ordnance Survey of Ireland in the Irish Republic, and the Ordnance Survey of Northern Ireland covers Northern Ireland. These maps are in a series of 89 sheets and cover the entire country. The maps identify woods and forestry and even distinguish between coniferous and deciduous woodland and show the boundary of the wood as well as roads and tracks within the wood. The historical 1:10,000 (six inch) maps are a record of woods and fields as they were 160 years ago. Changes in these natural features were never updated in later editions of these maps and may not reflect the current situation on the ground.

Collecting mushrooms to eat

When collecting mushrooms to eat, pick the best specimens available and inspect every mushroom for larvae. When collecting mushrooms for eating they should be cut with a knife for two reasons: to leave undisturbed the rooting system (mycelium) in the forest, and to prevent unnecessary dirt and grit getting into your basket and into crevices in the collected mushrooms. Brush any dirt or conifer needles off the mushrooms before putting them into the baskets – this is good hygiene and leaves less work for when you get home. Try to avoid picking mushrooms when they are wet or saturated with water.

Do not put poisonous or unidentified species in the same container as edible species as fragments of poisonous mushrooms can contaminate the edible ones in the collection.

Equipment for collecting edible mushrooms

- Clothing: Wear a strong pair of waterproof walking boots with ankle protection for rocky areas. Always take a change of clothes in case it rains. A dry suit (as

used for sailing, golfing or cycling) can also be useful as it may be worn to protect from rain or wet undergrowth and vegetation: however, they can be very warm in dense forest and restrict movement and are also easily torn and ruined by brambles.

▲ Basket used for collecting fungi.

- Baskets: A basket is the best way to carry mushrooms as they bruise very easily and can be damaged when carried in plastic bags. It is important not to overfill baskets for the same reason. Moss can be used as spacing material, but only pick it if it is abundant.
- Knife: A knife is useful for cutting the mushroom at the base of the stem. This avoids getting soil and dirt into the collection. A penknife is best as it can be safely carried in a pocket when not in use.

▲ A mushroom collection safety knife.

- Small brush: Many mushrooms will have twigs, soil or leaf litter attached to them and a quick cleaning with a brush in the field can save a lot of work later on. A small paint brush is suitable. It is also possible to buy a combined penknife and brush especially designed for mushrooming.
- Disposable gloves: If you do not want to get your hands dirty or contaminated, disposable plastic gloves can be very useful.
- Anti-bacterial wipes: These are useful for cleaning hands at any stage especially before eating. Always remember to dispose of them properly.

Preparing mushrooms for eating

The first step in preparing mushrooms for eating will be to remove twigs, leaves and pine needles that may have fallen into your basket as you worked your way through the wood. Dirt and grit may need to be scraped off the mushrooms with a knife and rechecked for larvae. If only a small part of the mushroom is infested, it may be trimmed off - remember that, once cooked, the larvae are totally

harmless. Some mushrooms need special treatment, like the yellow leg chanterelle which needs to have its stem split to remove grit and pine needles that would have worked their way down through the funnel shaped cap into the hollow stem. Mushrooms such as slippery jack may need to have the cuticle removed if grit, dirt and needles have attached to its sticky cap. Older boletes may need to have the tubes removed and the hedgehog fungus will need to have its spines removed.

Generally speaking, it is not a good idea to wash mushrooms as they will absorb some liquid, and definitely do not steep them in water. Tube fungi absorb water like a sponge and become moist and mushy. Wet fungi will not shallow-fry properly and do not develop a nice colour on cooking. If you really need to wash mushrooms hold the mushroom cap side up one at a time under a slow running tap to prevent water getting into the gills or tubes and dry them immediately. Morel mushrooms are the exception and need to be well washed to get sand and dirt and small insects out of the honeycomb structure of the cap.

The best place to store fresh mushrooms is in the fridge and a shelf life of at least a week for most species can be expected. However, mushrooms are best eaten fresh and as soon after collecting as possible.

Preserving mushrooms

Surplus food from the wild has been preserved by humans for thousands of years for use in times of scarcity. Sun-drying in warm climates and freezing in colder climates are the oldest forms of preservation. Salt, sugar, oil and vinegar were later found to be good ways of preserving foods. Only healthy, fresh mushrooms should be preserved and they should be checked for infestation by larvae. The young tight specimens are generally preserved in oil or brine or individually frozen while the larger healthier specimens are sliced and dried and used in soups, stews and sauces. In this section we will only look at drying and freezing mushrooms.

Drying mushrooms

Small mushrooms like amethyst deceivers (*Laccaria amethystina*) or yellow leg chanterelle (*Cantharellus tubaeformis*) can be dried whole while larger mushrooms should be sliced to allow them to dry much more quickly. Never wash mushrooms before drying, just brush or scrape them as cleanly as you can. In warmer climates, it is easy and cheap to dry them outdoors by spreading them out on trays covered with muslin or clean tea towels and let them dry out in the sun or by threading them with a needle and string and hanging them up to dry.

Irish weather is generally not very suitable for sun-drying outside, but sun-drying inside in conservatories can be very successful. Trays of small or sliced

mushrooms on cloth or greaseproof paper can be placed on tables, in a glass conservatory, or in front of a large window that gets plenty of sunlight in the autumn. Turn the mushrooms from time to time to ensure they are fully dried. Mushrooms can also be dried in a household oven at 50°C for 4-5 hours. In catering establishments, large ovens, hot plates, hot holding cupboards and electric kilns for smoking are used to dry mushrooms. Residue smoke on the sides of electric kilns can leave a light smoked flavour on dried mushrooms even though no smoking was used. Electric household dehumidifiers or fruit dryers are being used more frequently and accelerate the drying process to just a few hours.

It is important that mushrooms are completely dry before they are placed in storage otherwise they may develop moulds or rot. The dried mushrooms can be stored in air-tight jars.

Reconstituting dried mushrooms

Mushrooms can be reconstituted in tepid water for 20-30 minutes for reuse. The water in which mushrooms have been reconstituted can be added to stocks. Drying and reconstituting changes the shape and texture of mushrooms and they will never have the juicy fresh texture of fresh mushrooms. Often the dried mushroom has a unique flavour different from the original fresh mushroom and this needs to be taken into account when using them in recipes. Because dried wild mushrooms lack a juicy fresh texture they can be combined with fresh farmed mushrooms to balance flavour and texture in recipes. Morels reconstitute perfectly and retain their shape, flavour and texture and are highly prized in dried form as well as fresh.

Freezing mushrooms

Enzymes within the mushroom continue to break down the cell walls while they are frozen. On defrosting, many of the nutrients leach from the mushroom and the broken cell walls leave a limp mushroom that is of poor quality. However, the enzymes can be destroyed at 100°C and it is best to blanch and refresh or alternatively to cook mushrooms before freezing.

Blanching and refreshing

This method is very suitable for prized young mushrooms that you may wish to use to garnish plates. The mushrooms should first be plunged into boiling water and left to cook for one minute and then plunged into iced water to quickly cool and stop the cooking process. They can then be dried with a tea towel and frozen on a flat tray lined and covered with cling film so they freeze individually and do

not stick together. When frozen they can be put in plastic containers with lids or plastic bags, labelled and removed from the freezer individually as needed.

Cooking for freezing

Mushrooms that are going to be used for soups, stews and sauces may need to be processed fairly quickly. Put them into a big pot with a lid and turn on the heat. The natural moisture in the mushroom is adequate, so cook them in their own juices for a few minutes then turn off the heat and remove the lid and let them cool. Then strain them and keep the juice for sauces and soups. These mushrooms can be frozen in small plastic bags or containers.

It is better not to use fats when cooking mushrooms for long-term freezing as fats can become rancid if they are left in the freezer for a long time. However, if you are only going to freeze them for a month or two, gently simmering mushrooms in butter before freezing is an excellent way to prepare and preserve them.

A basket of edible chanterelles.

POISONOUS MUSHROOMS

There are comparatively few poisonous fungi, and even less that are deadly poisonous. However, death caused by the consumption of poisonous fungi is usually due to eating one of three closely related species, all members of the *Amanita* family.

There are also genera (families) of fungi that contain a majority of poisonous species, and which are therefore best recognised and avoided. Three of these families – web caps (*Cortinarius*); brittle gills (*Russula*) and fibre caps (*Inocybe*) have been included for general, rather than specific, consideration here.

The majority of poisonous mushroom species found in Ireland grow in woodland. Anecdotally it is claimed that in France alone around twenty deaths are recorded annual from eating death cap (*Amanita phalloides*). Some poisonous fungi, like fly agaric (*Amanita muscaria*), are so large and distinctive that there is no possibility of confusion with any edible species; others are confusable with edible species and this has been indicated where relevant in the descriptions of edible fungi and will be reiterated in the descriptions of some poisonous fungi that follow.

Poisonous fungi cannot be recognised by a special smell or even by their taste. For instance they will not stain cutlery black or express their poisonous properties in any way that is easy to recognise. In reality they often look deceptively harmless and may even have a pleasant smell.

To be completely safe, and because some fungi are poisonous, anyone collecting fungi for eating must be able to identify them correctly.

Poisoning by mushrooms

Short term gastric upsets from eating wild fungi are common, and should you suffer such it will remind you that wild mushrooms are not all good food. We do not recommend mixing different species at one meal, since in the event of a gastric upset or worse, the culprit will be more difficult to identify.

Fortunately, poisoning with potentially lethal mushrooms in Ireland is extremely rare. The severity of the risk and the symptoms that might develop after eating unknown mushrooms cannot be stated with any certainty. If you are feeling unwell after eating wild fungi then you should go to the nearest hospital Emergency Department immediately. If possible, bring a sample of the mushroom with you, wrapped in kitchen paper in a plastic container. A list of registered mycologists is maintained by the National Poisons Information Centre to assist Emergency Department staff in the identification of mushrooms in cases of medical emergency.

Always keep some specimens uneaten when you try something new, so that in the event of poisoning, the A&E unit at the hospital can send specimens to the National Poisons Unit at Beaumont Hospital for identification. This section relies mostly on the excellent discussion of this subject in Courtecuisse and Duhem (1995).

Short term gastric upset

The most frequent type of poisoning, gastric upset, happens quickly, does not last long, and is seldom serious. It is most often as a result of eating too many perfectly edible mushrooms at one sitting.

Fungi contain large quantities of a sugar (trehalose), which many people cannot or have some difficulty to digest, but which gut bacteria can digest. Bacterial fermentation of trehalose can produce sufficient gas and acid in the small intestine to cause diarrhoea. Fungi also contain a sugar alcohol – mannitol – that humans and their bacteria cannot digest. Mannitol behaves, therefore, like an osmotic laxative, and only adds to the problems caused by trehalose.

Some fungi, considered edible by some authors, have been placed in the Mushrooms best avoided section of this book because they contain other compounds that cause gastric upsets in some people after consuming small amounts. Many of the more seriously toxic fungi, however, will also initially cause vomiting and diarrhoea before doing more serious damage.

Other short term effects

Hallucinations can be caused by a wide variety of fungi, notably by liberty caps (*Psilocybe semilanceata*), a small brown mushroom growing in pasture, and by the fly agaric (*Amanita muscaria*). The possession of picked specimens of liberty caps is illegal in Ireland. It should be noted that two people have died in Ireland in the last five years after eating liberty caps.

Fly agaric contains muscarine, wich causes muscarine syndrome, as well as hallucinogens. Muscarine slows the heart, lowers blood pressure, and causes profuse sweating and salivation, as well as diarrhoea. The antidote is atropine. Muscarine also occurs in all the fibre cap (*Inocybe*) species, small white funnel cap (*Clitocybe*) species, and in the lilac bonnet (*Mycena pura*).

Ibotenic acid syndrome is in many ways the opposite of the muscarine syndrome. Cardiac output is increased with risk of heart attack, blood pressure rises with risk of stroke, and mucus membranes dry up. Various species of *Amanita* contain ibotenic acid, but the most dangerous is the panther cap (*Amanita pantherina*).

Haemolytic syndrome, when red blood cells are destroyed at greater than normal rates, is most often associated with eating raw fungi, such as morels (*Morchella*) which are harmless when cooked. The haemolytic effects are preceded by nausea and vomiting. The brown roll rim (*Paxillus involutus*) causes haemolysis as well as, more seriously, hypertension and kidney and liver damage.

Longer term effects, starting between six hours and six days after eating

Death cap syndrome can occur after eating death cap (*Amanita phalloides*), destroying angel (*Amanita virosa*) and some small *Lepiota* species. After early dizziness and shortness of breath, there is a three to four day spell of acute diarrhoea and vomiting with attendant severe dehydration. There is then an apparent remission, until the symptoms of liver failure set in; liver damage is detectable by blood liver enzyme tests very soon after the mushrooms have been eaten. Claims have been made, and disputed, for treatments for death cap poisoning, but the opinion of the authors is that there is no proven antidote for death caps which must therefore be regarded as being deadly poisonous.

Orellanin syndrome is caused by *Cortinarius orellanus* and *C. rubellus*, and possibly by other *Cortinarius* species. These toxins destroy kidney cells, resulting, after a delay of a week or more, in kidney failure.

Gyromitrin syndrome is associated with many *Ascomycotina*. After two days of vomiting and diarrhoea, there is a remission of several days. Then symptoms of progressive kidney, liver and nerve damage become apparent.

Coprinus syndrome occurs after eating some ink caps, *Coprinus* species, and then or later drinking alcohol. The symptoms include discomfort, surface flushing, and palpitations.

Paxillus syndrome from the brown roll rim, *Paxillus involutus*, causes rapid hypertension and delayed kidney and liver damage in many people.

Amanita phalloides (death cap) is known to be poisonous and must never be eaten.

Agaricus xanthodermus
Yellow-staining mushroom

A medium to large mushroom with gills.

Cap	Strongly domed at first, flattening later, 6-15 cm across, *white with beige centre, yellowing quickly wherever touched.*
Gills	Free, crowded, *dirty pinkish white at first*, darkening with purple-brown spores.
Stem	Solid 10-15 cm high by 1 cm wide, *bulbous at base where flesh yellows strongly when cut.*
Ring	*White, simple.*
Flesh	White.
Smell	*Sharp, like ink or iodoform.*
Habitat	Saprotrophic on soil organic matter in woodland glades, old hedgerows, woodland margins and in gardens.
Season	Summer to late autumn.
Confusable species	Other *Agaricus* species, most of which are edible, either *redden* after bruising, or yellow *more slowly*, and most have gills which are *definitely pink*. Pale species of *Amanita* all have *white gills which do not darken* and some form of *volva*; they are all more toxic than the yellow-staining mushroom.

Agaricus xanthodermus found in Co Dublin (bottom) and Co Monaghan (top).

Bottom photo © Pat McClelland

Amanita muscaria

Fly agaric

A medium to large (8-20 cm) mushroom with gills, ring and volva.

Cap	Hemispherical, later flattening, *bright red, fading orange, with white spots that can be washed off.*
Gills	*White, crowded.* Spores white.
Stem	*White, with bulbous base.*
Volva	Fused to bulbous stem base, *appearing as a frill above the bulb.*
Ring	*White, delicate.*
Flesh	White, stained with cap colour close to skin.
Smell	Faint.
Habitat	Mycorrhizal with *birch on light, acid soils*. Also with spruce and oak on sandy soils.
Season	Autumn.
Toxicity	Gastric upset lasting about 48 hours has been reported from eating fresh fly agaric. Most important effects are *hallucinations, loss of muscle co-ordination and twitching*.

Fly agaric found in Co Mayo.

Amanita pantherina

Panther cap

A medium sized (6-10 cm) mushroom with gills, ring and volva.

Cap	Domed, *medium brown with white spots that can be washed or rubbed off.*
Gills	*Crowded, white*. Spores white.
Stem	8-12 cm high by 1-2 cm thick, *white with swollen base.*
Ring	*White, pendulous and moderately thick.*
Volva	*Cup-like, closely fitted to stem base*.
Flesh	*White, unchanging.*
Smell	Faint.
Habitat	In all types of woodland, possibly mycorrhizal with beech.
Season	Late summer – autumn.
Confusable species	The blusher (*Amanita rubescens*) which some people eat, but only after boiling and discarding the water. The blusher has *red-brown scales on a brown cap, a brown stem, a vestigial volva, and the flesh and gills turn pink on cutting/bruising.*
Toxicity	Rapid onset of hypertension with vaso-constriction, followed by hallucinations and neuro-muscular disturbances. *Can be fatal.*

Panther cap found in Co Dublin and Co Wicklow.

Photos © Pat McClelland and Sinead McMahon

Amanita phalloides

Death cap

A medium sized (4-12 cm) mushroom with gills, ring and volva.

Cap	Domed, flattening later, *greenish, smooth, without spots*.
Gills	*White, crowded*. Spores white.
Stem	5-12 cm high by 1-2 cm across, *white to pale green, with bulbous base.*
Ring	*White delicate, persisting more often on cap than on stem.*
Volva	*White, large, sac-like.*
Flesh	White.
Smell	*Sickly sweet.*
Habitat	*Mycorrhizal with oak on neutral well drained soils*, but occurs in mixed woodland as well.
Season	Late summer-autumn.
Confusable species	Other species of *Amanita*, some of which are considered to be edible – see tawny grisette (*Amanita fulva*). Edible species of mushroom (*Agaricus*) with coloured caps all have *brown/purple spores* which colour the gills in older specimens, and *lack a volva* at the stem base.
Toxicity	Delayed onset (6 to 12 hours) of dizziness and difficulties with breathing, followed by severe vomiting and diarrhoea, lasting for three or four days with the risk of consequent dehydration. The principal toxin destroys liver and kidney cells. Symptoms of liver failure set in after six days, and are *always fatal*.

Death caps found growing in Co Galway.

Amanita virosa

Destroying angel

A small to medium sized (5-12 cm) mushroom with gills, ring and volva.

Cap	*White, conical at first, then umbonate, never flat.*
Gills	*White, crowded. Spores white.*
Stem	9-12 cm high by 1-1.5 cm across, *white with small bulb at base.*
Ring	*White, very fragile, often not seen.*
Volva	*Large, whitish and bag-like.*
Flesh	White.
Smell	*Sickly sweet.*
Habitat	Mixed woods, probably mycorrhizal.
Season	Autumn.
Confusable species	Other poisonous *Amanita* species. White-capped species of *Agaricus* all have *brown/purple spores, robust rings* and *no volva*. The snowy wax cap (*Cuphophyllus niveus*) is generally *smaller and flatter, and has widely spaced decurrent gills.*
Toxicity	The same as the death cap (*Amanita phalloides*). *Deadly poisonous.*

Destroying angels found in Co Roscommon.

Boletus calopus
Red-stalked bolete (Bitter beech bolete)

A small to medium sized mushroom with pores under cap.

Cap	4-12 cm across, *strongly domed, olive-grey, velvety, cracking with age.*
Pores	*Pale yellow, greening with age, blueing on cutting.*
Stem	4-8 cm high by 2-4 cm thick, *barrel-shaped, yellow at top, red in the middle and brown at base.*
Flesh	White, *blueing on cutting.*
Smell	*Weak, like fruit or vinegar.*
Habitat	Mycorrhizal with *beech and oak, and with conifers on acid soils.*
Season	Autumn.
Confusable species	Other *Boletus* species with red stems and blueing flesh and should all be avoided.

Boletus calopus growing in Co Dublin.

Photos © Pat McClelland

Cortinarius species

Web caps

(Not all members of this genus are poisonous, but all should be avoided)

Small to medium sized (4-12 cm) mushrooms with gills and a cob-webby veil under the cap.

Cap	Domed then flattened with an *umbo, brightly coloured (brown, yellow, orange, purple).*
Gills	*Coloured similar to cap at first. Spores rusty brown.*
Stem	*Usually stout for the size of cap, and relatively long, brightly coloured.*
Veil	Cobwebby, *coloured* and often appearing as a *stain* on the stem of older specimens. *Best seen under young expanding caps.*
Flesh	Usually whitish, occasionally coloured.
Smell	None to unpleasant.
Habitat	Most are mycorrhizal with trees, and appear early in the life of plantations.
Season	Late summer – winter.
Confusable species	Blewit species (*Lepista*) *do not have a veil and have pink spores.* Deceiver species (*Laccaria*) *do not have a veil and have white spores.*
Toxicity	The edibility of many species is unknown, but there are several seriously toxic species that cause *delayed irreversible kidney failure*, which may not be fatal but usually require life-long dialysis.

Web caps found in Co Kilkenny and Co Galway.

Cortinarius rubellus (speciosissimus)
Tawny web cap

Small to medium sized (3-8 cm) mushrooms with gills and a cobwebby veil under the cap.

Cap	Domed then flattened with an umbo, tawny-brown.
Gills	Pale ochre, turning tawny brown. Spores rusty brown.
Stem	Tapered upwards 5-11 cm high by 0.5-2 cm thick, paler than cap.
Veil	Cobwebby, appearing as a yellow stain on the stem of older specimens.
Flesh	Yellowish.
Smell	Faintly radishy.
Habitat	Damp conifer woods.
Season	Autumn.

Tawny web caps growing in a conifer plantation.

Photos © Tom Harrington

Hygrophoropsis aurantiaca

False chanterelle

A small to medium (2-8 cm) mushroom with gills.

Cap	Orange yellow *convex, later flat or slightly depressed, margin often incurved*.
Gills	*Decurrent, forked, crowded, orange*. Spores *white*.
Stem	3-5 cm high by 0.5-1 cm across, orange, *tough*, without ring. More fibrous than *Cantharellus cibarius*.
Flesh	*Tough, orange.*
Smell	None.
Habitat	On acid soils under conifers and heather.
Season	Autumn.
Confusable species	The chanterelle (*Cantharellus cibarius*) is *yellow*, and has a *more irregularly lobed cap with very pale yellow flesh, wide-spaced gills and smells of apricots*. If placed in white vinegar, the false chanterelle will begin to lose its yellow colour and turn white, while *C. cibarius* will retain its bright yellow colour.
Toxicity	Hallucinogenic.

False chanterelles found in Co Dublin.

Photos © Pat McClelland

Paxillus involutus

Brown roll rim

A medium to large (7-15 cm) mushroom with gills.

Cap	Domed then with depressed centre, *yellowish-brown, viscid when wet, with inrolled rim.*
Gills	*Decurrent, brown, becoming spotted with age.*
Stem	Stout 5-8 cm high by 1-2 cm across, brown.
Flesh	Thick, yellowish, darker in stem than in cap, *becomes brown on cutting.*
Smell	Bitter.
Habitat	Mixed woods on neutral to acid soils, *probably mycorrhizal with birch.*
Season	Summer to late autumn.
Toxicity	Haemolysis as well as, more seriously, hypertension and kidney and liver damage.

Brown roll rims found in Co Tipperary.

Russula species

Brittle gill

(Not all members of this genus are poisonous, but all should be avoided)

Small to large (5-15 cm) mushrooms with gills.

Cap	*Often brightly coloured* (red such as the poisonous *R. emetica* and *R. mairei*, also some yellow, purple, green), *convex at first, then flat*.
Gills	*White to pale yellow, regular, often cross connected/forked. Spores white/cream.*
Stem	*Bright white, cream or pink, stout and cheesy-brittle.*
Flesh	White.
Smell	Various.
Habitat	Mixed as well as single species woods, mycorrhizal.
Season	Autumn.
Confusable species	The combination of texture and colours make this genus unmistakable. Some species are edible, but others are poisonous. Distinguishing one species from another often requires microscopic examination of spores, so these fungi are best identified to genus and avoided.

Brittle gills found in Co Clare.

Russula emetica

The sickener

Small to moderate (3-10 cm) mushroom with gills.

Cap	*Bright red*, convex but finally with depressed centre, *fragile*. Peels easily.
Gills	Adnexed / free, *cream, later ochre*. Some are forked. Spores off-white.
Stem	4-9 cm high by 1-2 cm across, *white, cheesy-brittle*.
Flesh	White, except under cap where it is *pink*.
Smells	Fruity.
Habitat	Mycorrhizal *with pine.*
Season	Autumn.
Confusable species	Other red-capped *Russula* species. Distinguishing one species from another needs microscopic examination of spores, so these fungi are best identified to genus and avoided.
Toxic effects	Violent gastric upset.

Russula emetica - the sickener - found in a Sitka spruce wood in Co Tipperary.

Photo © Tom Harrington

Russula mairei

Beechwood sickener

Small to moderate (3-9 cm) mushroom with gills.

Cap	*Pink to red,* convex then flat, *firm*. Peels *partially*.
Gills	Adnexed/slightly decurrent, *white then cream, crowded at first.* Spores off-white.
Stem	3-5 cm high by 1.5-2 cm wide, *white, hard*.
Flesh	White, except under cap, where it is *pink*.
Smell	Of coconut.
Habitat	Mycorrhizal *with beech.*
Season	Autumn.
Confusable species	Other red-capped *Russula* species. Distinguishing one species from another needs microscopic examination of spores, so these fungi are best identified to genus and avoided.
Toxic effects	Violent gastric upset.

Beechwood sickeners found in Co Galway.

A beech woodland in autumn.

MUSHROOMS BEST AVOIDED

Mushrooms have been included in this section when either of the authors have experienced problems after eating them, or when other authors have different opinions about their edibility, or when (like the blusher) they are very easily confused with deadly poisonous species.

Some mushrooms are deadly poisonous, while others, though not lethal, may result in unpleasant symptoms if eaten. It is important to know which species to avoid. Some edible and poisonous mushrooms are easily confused. Before eating any mushroom, one should be absolutely certain of its identity and whether it is edible or not.

The edibility of many mushrooms is still unknown, and fungi can have different reactions with different people. Again, if there is any doubt about the edibility of a mushroom one should adopt the precautionary principle: If in doubt do not eat.

Even if a mushroom is known to be edible, one should eat only a small amount the first time. When eating wild mushrooms or newly cultivated mushrooms, always place some uncooked ones aside in the refrigerator. If they cause an allergic reaction the uncooked ones can be used to facilitate identification of the mushrooms involved.

The lurid bolete (*Boletus luridus*) is best avoided as some people may experience adverse reactions to eating it.

Agaricus augustus

The prince

Medium-large (10-20 cm diameter) mushroom with gills.

Cap	Egg-shaped at first, domed later. *Yellow brown with a complete cover of brown scales*.
Gills	Free, white then brown with spores.
Stem	10-20 cm high, 2-4 cm diameter, white at first, going yellowish-brown.
Ring	*White, large, hanging down.*
Flesh	White, bruising/ageing *red-brown*.
Smell	Bitter almonds.
Habitat	A decomposer of soil organic matter in coniferous, deciduous and mixed woods. It can sometimes be found in clearings or at the edges of woods. It does not grow in great quantities but appears sporadically.
Season	Late summer to autumn.
Confusable species	*Agaricus xanthodermus* (yellow-staining mushroom) has a whiter cap with only a few scales in the centre, and stains *yellow immediately* on bruising or cutting.
Edibility	It is considered by many to be a very tasty mushroom; however, it can cause stomach upsets. Older specimens tend to be infested by midge larvae so they need to be checked carefully before eating.

Agaricus augustus found growing in Co Galway.

Amanita rubescens

The blusher

A medium to large (5-16 cm) mushroom with gills, ring and volva.

Cap	Domed, later flat, *reddish brown with brown spots that can be washed/rubbed off.*
Gills	Adnexed, crowded, white, bruising red. Spores white.
Stem	8-12 cm high by 1-2 cm thick, *pale brown with swollen base.*
Ring	*Light brown or yellow, pendulous and membranous.*
Volva	*Vestigial, forming a rim at top of swollen stem base.*
Flesh	*White, turning pink after cutting.*
Smell	Faint.
Habitat	Found in all types of woodland, possibly mycorrhizal with oak.
Season	Late summer into autumn.
Confusable species	The panther cap (*Amanita pantherina*) which can be fatally poisonous has *white scales on a brown cap, a white stem and ring, a cup-like volva, and the flesh and gills stay white after cutting/bruising.*
Edibility	Some people eat this after boiling and discarding the water in which it has been cooked. The authors consider it to be too easily confusable with the panther cap to be safe to eat.

Blusher found in Co Wicklow.

Boletus luridus

Lurid bolete

A small to medium mushroom with pores under cap.

Cap	5-12 cm across, *brown but olive/bluish where damaged, smooth and dry.*
Pores	*Orange red, bruising blue.*
Stem	7-12 cm high by 1-3 cm, *orange-yellow with a darker net, bruising blue.*
Flesh	*Lemon yellow, blueing on cutting. A red line above pores.*
Smell	Not distinctive.
Habitat	Mycorrhizal with *beech and oak on alkaline soils.*
Season	Late summer to autumn.
Confusable species	Other *Boletus* species with red stems and blueing flesh should all be avoided.

Lurid boletes growing in Co Dublin.

Photo © Pat McClelland

Clitocybe nebularis

Clouded agaric

A medium to large (5-20 cm) mushroom with gills.

Cap	Convex then flattened, finally slightly depressed, *margin inrolled, light grey with darker, browner centre.*
Gills	*Decurrent, whitish, crowded.*
Stem	5-10 cm high by 1.5-2.5 cm across, *light grey, hollow with swollen base.*
Flesh	White, thick.
Smell	Strong and pleasant.
Habitat	Deciduous and coniferous woods in rings and troops. Probably saprotrophic. Has been observed in mixed deciduous woods especially under ash and hawthorn, on neutral clay soil.
Season	Autumn to early winter.
Confusable species	The deadly poisonous ivory funnel cap (*Clitocybe dealbata*) is much *smaller and whiter.*
Edibility	Is reported to cause stomach upsets in many people.

Clouded agaric found in Co Galway.

Clitocybe odora

Aniseed agaric

A small to medium (3-8 cm) mushroom with gills.

Cap	Domed, *flattening later with wavy margin, grey-green.*
Gills	*Not strongly decurrent, greyish white, spores white.*
Stem	3-6 cm high by 0.5-1cm across, *pale greenish grey.*
Flesh	Whitish.
Smell	*Strong aniseed.*
Habitat	Usually among leaf litter in beech woods.
Season	Summer to late autumn.
Confusable species	The deadly poisonous ivory funnel cap (*Clitocybe dealbata*) is much *whiter* and its caps have *inrolled margins,* and the poisonous verdigris agaric (*Stropharia aeruginosa*) has a *greenish-blue sticky* cap and *brown spores.*
Edibility	This fungus is not poisonous, but too strongly flavoured to use, except as (aniseed) flavouring.

Aniseed agaric found in Co Galway.

Laetiporus sulphureus

Chicken of the woods

A large bracket fungus (20-40 cm) with pores, on broadleaf trees.

Bracket	Tiered, thick, upper side *bright yellow, lumpy*, surface like *suede*.
Pores	Small (less than 1 mm) *lemon yellow*. Spores white.
Stem	None.
Flesh	Whitish, succulent but drying as it ages.
Smell	*Strongly mushroomy*.
Habitat	On trunks of deciduous trees and on yew.
Season	Early summer to late autumn.
Confusable species	The polypore (*Polyporus giganteus*) has a more or less flat top surface, with brown scales.
Edibility	Considered edible by most authors, but stomach upsets after eating have been reported.

Chicken of the woods found in Co Dublin.

Photo © Pat McClelland

Macrolepiota rhacodes

Shaggy parasol

A medium to large mushroom (10-20 cm) with gills and ring.

Cap	*Strongly domed, mouse brown with coarse darker scales*.
Gills	*Free*, off-white, darkening *reddish* with damage. Spores white.
Stem	White with red-brown felty coat, 10-15 cm high by about 1cm thick.
Ring	Large.
Flesh	Soft but tough, *reddening strongly on cutting*.
Smell	*Strongly aromatic.*
Habitat	Woods with thick humus floor.
Season	Summer to early autumn in several flushes.
Confusable species	The parasol mushroom (*Macrolepiota procera*) has a *flatter* cap, and flesh that *does not redden* on cutting.
Edibility	It causes gastric upsets in some people. Cooking methods as for the parasol mushroom are recommended.

Shaggy parasol found in Co Monaghan.

Mycena pura

Lilac bonnet (radish mushroom)

A small (2-5 cm) mushroom with gills.

Cap	Convex with an *umbo, pink/lilac (paler when dry), with striate margin.*
Gills	Barely attached to stem, close packed, *pink*. Spores white.
Stem	5-10 cm high by 0.5-1 cm thick, *pink, stringy.*
Flesh	*White, thin.*
Smell	*Radish-like.*
Habitat	In broadleaf tree leaf litter, especially under beech.
Season	Late summer – winter.
Confusable species	Most species of bonnet are smaller and more delicate than the lilac bonnet (*Mycena pura*). None are worth eating.
Edibility	It is said to reduce cardiac output, causing hypotension, and to cause sweating, excessive salivation and diarrhoea.

Mycena pura - lilac bonnet - found in Co Galway.

Phallus impudicus

Stinkhorn

A medium (10-25 cm long) mushroom without gills.

Fruit body Young: egglike, 5 to 8 cm across, parchment coloured outside, with gelatinous 'white', and green and white 'yolk';

Mature: phallic, with a thick *bright white densely meshed stem*, and a closely fitting 'cap' covered with *dark green slime* containing the spores. The cap, which is soon exposed as flies eat and carry away the slime, is *whitish and has a ribbed pattern.*

Smell *Strong, disgusting* and usually the first indication of the presence of the fungus. Its smell in its mature state can linger for weeks.

Habitat Woodland with a well-developed surface organic layer. Substrate is buried rotten wood, from which mycelial cords feed the fruit body. The connection between the vector flies and the buried wood has never been demonstrated.

Season July to November.

Confusable species The dog stinkhorn (*Mutinus caninus*) is half the size of the stinkhorn, has an *orange stem*, and a *red cap* under the dark green slime, which only has a *faint smell*.

Edibility It is only edible at the egg stage, before the smell has developed. Some cultures consider it to be an aphrodisiac.

Top: Cross-section of a stinkhorn egg.

Bottom: Stinkhorn egg found growing in Co Kilkenny.

Pleurotus cornucopiae
Branching oyster mushroom

A medium to large (6-12 cm) bracket with gills.

Cap *Convex at first, becoming concave*, margin split, *pale beige but browning with age*.

Gills *Decurrent, beige*, darkening with age. Spores *very pale lilac*.

Stem Short (0-3 cm long by 1-2 cm thick), *white, lateral.*

Flesh White.

Smell *Of flour.*

Habitat On dead broadleaves (fallen trees, stumps or logs) in woods, fields, parks and driveways and is particularly fond of damp environments. It is mostly associated with beech. It often grows in large clusters, weighing up to 2 kg.

Season Spring to autumn, but in Ireland it is more common in autumn. It will grow in the same spot year after year so it is worth recording the location where it was found and the time of year.

Confusable species Other species of *Pleurotus*, of which the large ones are edible.

Edibility Like most mushrooms the younger more tender and juicy specimens are the most prized. Older specimens can be fibrous and the stems can be too tough to eat and must be removed. Older specimens are also more likely to be infested with flies or insects.

Branching oyster mushroom growing in Co Galway.

Polyporus squamosus

Dryad's saddle

A large (5-60 cm) bracket fungus with pores, on broadleaf trees.

Bracket	1-5 cm thick, fan-shaped, top surface pale yellow and covered with zoned brown scales,
Stem	Lateral, 3-10 cm high by 2-6 cm thick, cream, appearing before bracket expands.
Pores	Angular, creamy-white. Spores white.
Flesh	White, soft.
Smell	Sharp, mealy.
Habitat	On trunks of ash, beech, elm and sycamore, where it causes a vigorous white rot eventually leading to the collapse of the tree.
Season	Summer.
Confusable species	Other annual brackets appear later in year, and are mostly smaller and darker than dryad's saddle (*Polyporus squamosus*). The two large yellowish species, giant polypore (*Meripilus giganteus*), and chicken of the woods (*Laetiporus sulphureus*), both lack brown scales on the top surface.

Dryad's saddle in Connemara.

Russula cyanoxantha

Charcoal burner

Moderate to large (5-15 cm) mushroom with gills.

Cap *Colour very variable, purple through brown to green, with faint radiating lines,* convex but finally with depressed centre, *firm texture*. Peels *halfway*.

Gills Adnexed / slightly decurrent, *white/cream, firm*. Some are forked. Spores off-white.

Stem 5-10 cm high by 1.5-3 cm wide, *white flushed mauve, firm.*

Flesh White.

Smell Unremarkable.

Habitat Mycorrhizal with broad-leaved trees, including oak.

Season Autumn.

Confusable species Other purple, brown and green-capped *Russula* species, most of which are inedible and some of which are poisonous. Distinguishing one species from another needs microscopic examination of spores, so these fungi are best identified to genus and avoided.

Ediblity Said to be edible and good, but it is difficult to distinguish from other similarly coloured *Russula* species until one is familiar with *all* of them. Neither author has ever eaten any *Russula* species.

Charcoal burners growing in Co Galway.

Sarcoscypha coccinea

Scarlet elf cup

A small (1-5 cm) cup fungus growing on half buried rotting wood.

Cup	Clustered, smooth and *bright red* inside, *whitish with tufted hairs* outside.
Margin	Becoming tattered as it expands.
Flesh	Thin, whitish.
Habitat	Rotting broadleaves branches on or in contact with damp soil, often among moss.
Season	Winter to late spring.
Confusable species	None.

Scarlet elf cups found at Clarin Bridge, east Co Galway.

Tricholomopsis rutilans

Plums and custard

A small to medium (3-10 cm) mushroom with gills.

Cap	Convex , *purple (paler towards margin), with yellowish margin*.
Gills	Adnate, close packed, *pale yellow.* Spores white.
Stem	5-10 cm high by 1-1.5 cm thick, *lilac at top, yellow at base, flexible.*
Flesh	*Yellow, thick.*
Smell	Of *dry wood.*
Habitat	Conifer leaf litter.
Season	Late summer – autumn.

Plums and custard growing in Co Galway.

Chanterelles (also known as girolles) are edible mushrooms often found growing in a beech wood.

GOLDEN RULES:

- NEVER eat any fungus that you cannot positively identify as an edible species.
- ALWAYS keep a specimen of anything you intend eating, just in case it needs to be identified later.
- NEVER mix known edible fungi with questionable species while gathering, since parts may break off and intermix. A single poisonous mushroom can poison an entire basket.
- NEVER partake of a meal of wild mushrooms unless you are certain that there is nothing harmful being served.
- NEVER partake of a mixed grill of wild mushrooms.
- NEVER allow children to gather or eat wild mushrooms.
- IGNORE old wive's tales and 'folklore'.
- GO TO the nearest accident and emergency facility if you think you have eaten a poisonous mushroom, and bring any specimens you have kept.

EDIBLE MUSHROOMS

A large number of fungi are edible and the general opinion as to whether a certain fungus is fit to eat or not depends to some extent on where you reside in the world and on the traditions of collection and utilisation of fungi that exist in that region. In Ireland, most people are highly suspicious of all fungi except for the common mushroom, which is generally the cultivated form. A large variety of fungi are eaten where there is a strong tradition of collecting and utilising mushrooms, such as in eastern Europe and Scandinavia.

Flavour varies a great deal between species. Some fungi like the morel have a very unique flavour and slightly leathery texture and must be cooked before they can be safely eaten; others like the penny buns (ceps) and chanterelles (girolles) are highly prized for their flavour and firm texture and can be eaten raw.

Only the freshest mushrooms should be picked. It is vital to inspect all mushrooms for freshness and infestation before placing in a basket. Most fungi grow quickly and decay with equal or even greater speed. Many insects feed on the flesh of fungi and lay their eggs in the fruiting body, later hatching into larvae that feed off the fungi. Once a mushroom has been attacked in this way, it is

Boletus edulis - an edible mushroom that can be collected from Irish forests.

Photo © Tom Harrington

usually no longer suitable for human consumption. It is not always obvious whether insects have burrowed into the fruit body - the mushroom may appear to be a fine specimen without any blemishes, but if the collector cuts the mushroom in two, or separates the stalk from the top and finds small round holes and burrows in the flesh, this is a sure sign that insects have infested the mushroom. With experience, it is possible to identify infested mushrooms by sight.

A large fungus of any sort is very seldom in perfect condition, although occasionally one may find a parasol mushroom or edible bolete of a fair size that is still quite sound and edible. Generally speaking, fungi collected for food should be gathered while they are still young and blemish-free and should be eaten as soon as possible after collection.

Fungi usually do not disintegrate when cooked and in many instances the flavour improves when cooked. Younger, firmer specimens are generally suitable for shallow frying, deep frying and, if big enough, for grilling. These methods of cooking can retain the juices within the mushroom if they are not over-cooked. Shallow frying in olive oil or butter is particularly suitable for small firm specimens that will be used as garnish.

Mushrooms give flavour to dishes such as stews, casseroles, sauces and vol-au-vent mixes, especially by slow cooking, which tends to extract the juices from mushrooms and improve the taste. Large mushrooms that have been cut up, or

Bay bolete infested with larvae.

A wide variety of edible mushrooms can be found in Irish forests.

soft textured mushrooms like the brown birch bolete, are particularly suitable for moist methods of cooking. Mushrooms picked in wet weather can have so much moisture in them that they are not suitable for frying or grilling and should be used in soups, stews and casseroles. When using mushrooms in white and cream sauces or risottos or egg dishes, only the freshest specimens should be used to prevent dishes turning grey.

Some people are allergic to certain common edible mushrooms, while others may find them difficult to digest and experience a little discomfort. It is a good idea to eat just small amounts when first trying a new species. Do not mix mushrooms in the same meal unless you are sure of all of them.

Agaricus essettei

Large-bulbed mushroom

Small–medium sized (5-10 cm) mushroom with gills.

Cap	Convex at first, then flat, *white turning yellow*.
Gills	Free, pale pinkish-grey, turning dark brown with spores.
Stem	With large abrupt basal bulb, <10 cm high by 2-3 cm wide, white *then yellowing*.
Ring	*White with cogwheel underneath*.
Flesh	*White, but yellowing on cutting*.
Smell	*Aniseed*.
Habitat	Coniferous and mixed woods. It does not grow in large colonies but appears in small groups infrequently. Decomposer of soil organic matter.
Season	Late summer to autumn.
Confusable species	The poisonous *Agaricus xanthodermus* (yellow-staining mushroom) has paler gills and spores, smells of ink, and the cap and bulbous stem base stain *immediately and strongly chrome yellow* on cutting or bruising. The edible *Agaricus silvicola* is considered by British mycologists to be the same species but has a smaller basal bulb and a thinner simple ring.
Edibility	A very tasty mushroom.

Agaricus essettei (large-bulbed mushrooms) found growing below mature trees in Co Cavan.

Agaricus langei
Red-staining wood mushroom

Small –medium sized (5-10 cm) mushroom with gills.

Cap	Convex at first, later flat with wavy edges, *brown in centre, with brown scales on beige background towards edges.*
Gills	Free, pale pink, turning dark brown with spores.
Stem	Stout, 4-6 cm high by 2-4 cm wide, white at top, *brown under ring*.
Ring	*White above, brown below.*
Flesh	*White, but reddening on cutting.*
Smell	Mushroomy.
Habitat	Is found in coniferous and mixed woods; however, it does not grow in large colonies but appears in small groups infrequently. Decomposer of soil organic matter.
Season	Late summer to autumn.
Confusable species	The poisonous *Agaricus xanthodermus* (yellow-staining mushroom) has paler gills and spores, smells of ink, and the cap and stem base stain *immediately and strongly chrome yellow* on cutting or bruising. *Amanita rubescens (best avoided)* also stains red on bruising and cutting, but has white gills and spores, and whitish scales on a brown cap.
Edibility	This tasty wood mushroom has properties very similar to the field mushroom and the same cooking methods are suitable. It is important to check for infestation by fly eggs and larvae.

Agaricus langei - the red-staining wood mushroom - found growing in a mixed wood in Co Roscommon.

Agaricus silvicola

Wood mushroom

Small-medium sized (5-10 cm) mushroom with gills.

Cap	Dome shaped, creamy yellow, *darkening with age, without scales.*
Gills	Free, *dingy pink turning chocolate brown with spores.*
Stem	5-8 cm by 1-1.5 cm, creamy yellow. *Base bulbous*.
Ring	White, large and floppy.
Flesh	Thin and white.
Smell	Pleasant, *aniseed*.
Habitat	It occurs in coniferous, deciduous and mixed woods. It sometimes prospers in open spaces within woods. Decomposer of soil organic matter.
Season	Late summer to autumn. The best time to find them is in early September if the ground is not too dry.
Confusable species	The deadly poisonous *Amanita phalloides* (death cap) has a basal volva, a green cap and white unchanging gills. The poisonous *Agaricus xanthodermus* (yellow-staining mushroom) has paler gills and spores, smells of ink, and the cap and stem base stain *immediately and strongly chrome yellow* on cutting or bruising. The edible *Agaricus essettii* has a much larger basal bulb and a double ring, but is considered to be just a variant of *Agaricus silvicola* by the UK mycologists.
Edibility	This is a delicious mushroom, especially when young before the cap has opened. Older specimens with open caps need to be checked for larval infestation.

Agaricus silvicola - wood mushroom - found growing beside mature spruce trees in Co Galway.

Amanita fulva

Tawny grisette

Small-medium sized (4-9 cm diameter) mushroom with gills.

Cap	Orange brown, ovoid at first, expanding flat with *raised umbo, margin regularly ribbed (over gills). No scales.*
Gills	Adnexed, white, unchanging as spores are white also.
Stem	*Hollow*, white, 10-20 cm high, 1-1.5 cm diameter, tapering towards top.
Ring	*No ring*.
Volva	Large, bag-like white.
Flesh	White.
Habitat	Mixed woods, especially with birch. Probably mycorrhizal.
Season	From mid-summer to autumn.
Confusable species	*Amanita inaurata* (snakeskin grisette) has large scales on cap, and a volva reduced to ridges on the stem base, *Amanita porphyria* (grey veiled amanita) has a ring and a short volva, *Amanita pantherina* (panther cap) has a dark brown cap with scales, a large ring and a cup-like regular volva.
Edibility	This is an edible member of an otherwise poisonous genus. The flesh has a good texture with a pleasant mushroom taste with a hint of natural sweetness. It should only be eaten if one is absolutely sure of identification; wrongly identifying members of the *Amanita* genus can be lethal.

Amanita fulva - tawny grisette - found growing in a mixed wood in Co Wicklow.

Armillaria mellea

Honey fungus

A medium sized (5-10 cm) mushroom with gills, often in clusters.

Cap Domed at first, then flat with slight umbo. Colour is very variable, *from pale ochre to dark brown*, depending on cap age and tree host species. Host trees with low-tannin wood (poplar and birch) produce paler caps than trees with tannin-rich wood (oak and chestnut). *Centre of cap with fibrillose scales*.

Gills Adnate, white, then yellowish, becoming spotty. *Spores white.*

Stem Fibrous, 6-15 cm high by 0.5-1.5 cm wide, pale at first.

Ring *Thick, white then yellow*.

Flesh White, firm.

Smell Strongly mushroomy.

Habitat It is found in all types of woods, as well as gardens and parks. It can be found growing on dead stumps and on live trees, often in very large clusters. It is considered a dangerous parasite because it can attack the roots of healthy trees, first killing the root then causing onset of white rot decay. By the time the fruiting bodies appear the tree is generally in an advanced state of decay. It spreads underground from tree to tree by bootlace-like black rhizomorphs.

Season Throughout summer and autumn.

Confusable species *Pholiota squarrosa* (shaggy scaly cap) which grows in clusters on tree stumps, but is *scalier and yellower* than *Armillaria mellea* (honey fungus), has caps with *inrolled margins*, and *cinnamon coloured spores*. *Hypholoma fasciculare* (sulphur tuft) is *less scaly and more yellow* than *Armillaria mellea*, has only a *black mark* on the stem *where the ring should be*, and has *dark spores*.

Edibility Young specimens are good to eat; the upper part of the stalk can also be eaten. The stalks become very tough, leathery with age and only the caps should be used. It

needs to be fully cooked as it contains toxins that can cause gastric problems. It is important to blanch and refresh before cooking. Eat only in small amounts. Mushrooms growing on poplar tend to be less bitter than those growing on oak.

TOP:
Honey fungus growing from the stump of a dead tree.

BELOW:
Mycelium has spread from the tree stump into nearby grassland.

Auricularia auricula-judae
Jelly ear / Jew's ear fungus

Small bracket without gills or pores.

Bracket 3-8 cm across, *light brown to a dark chocolate* colour, slightly velvety on top but smooth under.

Texture *Rubbery when moist, hard when dry*.

Smell Faint.

Habitat It grows on the fallen stems of deciduous trees *especially elder*. Check out damp areas of woods and in autumn when you spot elder berries growing check the area for fallen stems and visit the area again in the New Year and spring. Jelly ears can be quite plentiful on fallen stems.

When dry it is extremely tough and shriveled, but it reconstitutes perfectly if placed in fresh water. When removing the brackets from the host branch it is easy to pull away part of the rotten bark where they grow so it is a good idea to remove the mushrooms with a sharp knife.

Season Winter to spring, but can be found growing any time of the year if conditions are right.

Confusable species *Bulgaria inquinans* (black bulgar) which grows on oak and beech, and has *black gelatinous discs* and *dark spores*. *Pseudohydnum gelatinosum* (jelly tongue) on *conifers* has *whitish spines* under a *grey to brown* jelly bracket.

Edibility Jelly ears should be eaten young as they become tough and leathery as they get older. Wild Irish species have a better jelly-like texture than imported dried specimens that tend to be more leathery. They are widely used in Asian cooking and intensively farmed in China and other parts of Asia.

▲ Older specimens of jelly ear that have dried out on the tree stem can be reconstituted in water.

Boletus badius

Bay bolete

Medium-large (5-15 cm) mushroom with pores.

Cap	*Bay to dark brown, slightly sticky when moist*.
Pores	*Lemon yellow, bruising blue*. Spores *greenish-brown*.
Stem	Stocky (4-12 cm high by 1-4 cm thick), light brown.
Flesh	*White, becoming faintly blue above tubes after cutting, and turning pink with age under the cap surface*.
Habitat	Found in mixed woodland, probably mycorrhizal in association with oak. Although it can grow in a variety of locations it has been difficult to find in any great quantities in Ireland to date.
Season	Early summer to late autumn.
Confusable species	Other boletes (mushrooms with pores under cap), such as *Leccinum* species. It is best to avoid boletes with *orange/red pores* and in which the *flesh turns blue* on cutting. *Boletus satanus* (devil's bolete) is a very poisonous member of this group.
Edibility	This is a tasty mushroom that can be cooked or eaten raw. When cooked the texture of the flesh is not quite as firm as that of the penny bun. If eaten raw the flesh can have a slightly sweet taste. As it gets older the stem can become tough.

Note the blue staining on the pores of the bay bolete.

Boletus edulis
Penny bun (cep, porcini, steinpilze)

Large (8-25 cm) mushroom with pores.

Cap Domed at first, then flat, *light brown with white margin*, slightly sticky when moist, easily separable from tubes.

Tubes *Whitish at first, turning greenish yellow, not blueing on cutting*.

Pores *White at first, then lemon yellow*. Spores brown.

Stem *Stout, tapering upwards, beige with white network*. 3-20 cm high by 3-8 cm wide.

Flesh *White, unchanging*.

Smell Mushroomy.

Habitat Found mainly with oaks on acid soils. Mycorrhizal. They will also form symbiotic relationships with other trees such as Scots pine and can be found in deciduous, coniferous or mixed woods. On tree lined avenues leading into estates and parks, they can grow openly and unrecognised in public view.

Season Mainly September – October; however, if the summer has been warm with some rainy spells, flushes of this mushroom can appear in late July and August.

Confusable species Two very similar species (*Boletus reticulates* and *Boletus appendiculatus*) are both edible and good. Other boletes (mushrooms with pores under cap) such as *Leccinum* species. It is best to avoid boletes with *orange/red pores* and in which the flesh turns blue on cutting. *Boletus satanus* (devil's bolete) is a very poisonous member of this group.

Edibility The penny bun is a delicious edible mushroom, prized throughout the world, and grows well in many parts of Ireland. *B. edulis* is very variable and a number of varieties and even subspecies have been distinguished in Britain and Ireland. Young, tight specimens are best to eat and can be eaten raw. They have a good firm texture. The white tubes in the cap are edible, and they have an

excellent shape for presentation. Younger specimens are less likely to be infested with larvae. Older specimens are often damaged by slugs and there is a greater chance of larval infestation while the yellowing tubes may need to be scraped off as they tend to gather grit and moisture.

Boletus edulis found in Co Dublin.

Top and left photos © Pat McClelland

Cantharellus cibarius

Chanterelle (girolle)

Small to medium sized mushroom (2-8 cm).

Cap *Egg-yellow*, flat at first with irregular margin, later depressed in centre.

Gills *Strongly decurrent, egg-yellow, shallow, forked and widely spaced.*

Stem Stumpy, 3-8 cm high by 0.5-1.5 cm wide, yellow.

Flesh Pale yellow.

Smell Faintly of apricots.

Habitat All kinds of woodlands on acid soils but mainly associated with birch, beech, oak and Scots pine. Mycorrhizal. Chanterelle tends to favour damp areas of woods, so it is advisable to check the banks of streams or the edges of swampy areas. It has been found throughout Ireland.

Season September and October, but they have been found as early as June.

Confusable species The deadly poisonous *Cortinarius rubellus* has a brown umbonate cap, with brown gills under, and a banded yellow and brown stem. It smells of radish. *Hygrophoropsis aurantiaca* (false chanterelle) is *deeper orange* in all parts, has *thinner, more crowded* gills than *C. cibarius*.

Edibility This is a highly prized mushroom because of its simple pleasant mushroom taste, firmness, bright apricot yellow color and fresh apricot smell. Flies seldom lay eggs on this mushroom so it is generally free of larvae.

Chanterelle in woodland near the Slieve Aughty mountains, Co Galway.

Cantharellus tubaeformis
Winter / Yellow leg chanterelle

Small to medium sized (2-5 cm) mushroom.

Cap *Dark brown with irregular margin, flat at first then funnel shaped.*

Gills *Decurrent, shallow, forked, yellow turning grey.*

Stem *Yellow at first, hollow,* 5-8 cm high by under 1 cm thick.

Flesh Yellowish, tough.

Smell Aromatic.

Habitat Broadleaved, coniferous and mixed woods on both acid and limestone soils. They can cover the mossy floor of the forest like a brown carpet. Ectomycorrhizal.

They can sometimes be difficult to spot amongst the leaf litter as the brown wavy cap can hide the yellow stems. As they grow older the stems lose their bright yellow colour and they become browner, making them even more difficult to find.

Season End of September / early October until the end of December and even into January.

Confusable species This is a member of a rather variable group of species which includes *Cantharellus aurora* which is more uniformly yellow and is said to be edible, but we have not found it in Ireland yet. *Cantharellus cinereus* is grey throughout.

Edibility A tasty mushroom with a mild flavour. Although it has a firm slightly leathery texture when raw, it becomes quite limp and soft textured when cooked.

Grit and pine needles can get into the tubular, hollow stem and it is important to remove this debris before cooking. Those picked in December and January usually contain a lot of moisture.

Bottom left: Yellow variant, *Cantharellus aurora.*
Bottom right: Older specimens with darker caps and stems.

Clitocybe flaccida

(*Lepista flaccida* in BMS checklist)

Tawny funnel cap

Small to medium sized (5-10 cm) mushroom with gills.

Cap *Pale buff brown, darkening with age, broadly funnel-shaped.*

Gills *Very decurrent, off-white, crowded.* Spores white.

Stem 3-8 cm high by 0.5-1 cm across, paler than cap, *becoming hollow, woolly at base.*

Flesh Off white.

Smell Faint.

Habitat Found in large clusters in coniferous woods, especially under spruce. Occassionaly found in deciduous woodland. A litter decomposer.

Season They have a long season from summer to winter, and they thrive in dry periods when other mushrooms struggle.

Confusable species The inedible *Clitocybe clavipes* (club foot) has a *flatter* cap, and a stem that is *swollen towards a smooth base*. The deadly poisonous *Clitocybe dealbata* (ivory funnel cap) and *Clitocybe rivulosa* (fool's funnel cap) have *flatter, paler* caps *2-5 cm across*, and *grow in troops or rings in grassland*.

Edibility The tawny funnel cap is pleasant to eat, but can be dry and a little leathery.

Tawny funnel caps found in a mixed wood in Co Clare.

Clitocybe geotropa

Monk's head

Small to large (4-20 cm) mushroom with gills.

Cap *Flesh-coloured*, umbonate at first, later depressed in centre, *margin inrolled*.

Gills Decurrent, *flesh coloured.* Spores white.

Stem 5-15 cm high by 2-3 cm across, paler than cap, *swollen and downy at base.*

Flesh White.

Smell Faint, sweet.

Habitat Open deciduous or mixed woodland, often in troops or rings. Saprophytic or decomposer on soil organic matter. Monk's head can be plentiful in wooded areas where the trees are well spaced and sunlight can reach the forest floor through the canopy.

Season Summer to autumn.

Confusable species The edible *Leucopaxillus giganteus* (giant funnel cap) is *larger, paler and grows in grassland*, while the possibly poisonous *Clitocybe nebularis* (clouded funnel cap) is *grey*, about the same size, and grows in rings/troops in woodland. Both have caps with inrolled margins.

Edibility This is a good edible mushroom that is substantial even when young with a good texture and pleasant flavour. The stems of young specimens can be eaten but as they get older they become tough.

Monk's head mushrooms found in Co Monaghan.

Clitocybe infundibulformis

(*C. gibba* in BMS checklist)

Common funnel cap

Small-medium sized (3-8 cm) mushroom with gills.

Cap	Pale beige to ochre, smooth, *always funnel-shaped, margin wavy.*
Gills	Decurrent, off-white.
Stem	Tough, 3-8 cm high by 0.5-1 cm thick, pale beige, *slightly thicker at the base.*
Flesh	White in cap, beige in stem.
Smell	Faint, sweet.
Habitat	Deciduous and coniferous woods. Saprophytic.
Season	Summer to late autumn.
Confusable species	The inedible *Clitocybe clavipes* (club foot) has a *flatter* cap, and a stem that is *swollen towards the base*. The deadly poisonous *Clitocybe dealbata* (ivory funnel cap) and *Clitocybe rivulosa* (fool's funnel cap) have *flatter* caps *2-5 cm across*, and *grow in troops or rings in grassland*.
Edibility	The common funnel cap has a much paler colour than the tawny funnel cap and is a little tastier.

Common funnel cap mushrooms found in a mixed wood in Co Clare.

Coprinus comatus
Shaggy ink cap, lawyer's wig

Medium to large mushroom (5-10 cm) with gills.

Cap *White with brown scales, egg shaped at first, then cylindrical (5 cm across by 5-15 cm high), then expanding black at the bottom edge and deliquescing upwards.*

Gills Free, *very crowded*, white at first, then *blackening with spores.*

Stem Tall, stout, 10-33 cm high by 1-2 cm across, white, swollen and rooting at base.

Ring White, loose.

Flesh Thin.

Smell Faint, mushroomy.

Habitat Gardens, parks, grassy verges near pathways beside woods, roads, motorways and on rubbish heaps. Saprotrophic especially on recently buried wood.

The young specimens have an egg or oval shape. As it grows older it begins to darken at the base of the cap and then it begins to self digest from the base of the cap and shrivels from the bottom edge up along the stem to the top of the mushroom. As the older specimens self digest they take on a shape that is often compared to a lawyer's wig.

Season Mid-summer to late autumn.

Confusable species The other species of *Coprinus* (ink cap), which all share the blackening deliquescent gills with *C. comatus* and are all *smaller*. As some are possibly poisonous, and one *Coprinus atramentarius* (common ink cap) causes nausea and palpitations if eaten at the same time as alcohol is consumed, they are best avoided.

Edibility Young specimens not yet showing signs of blackening at the base of the cap and with gills that are still pink are excellent to eat. They deteriorate very rapidly and should be used soon after picking.

Coprinus comatus growing in Co Galway.

Craterellus cornucopioides

Horn of plenty

Small to medium sized mushroom (3-8 cm) without gills, pores or tubes.

Cap	Dark brown to black when young and moist, drying and ageing paler, *deeply tubular with a flared top with irregular margins*. Spore bearing (outer) surface light grey.
Stem	Dark grey, hollow, merging into cap.
Smell	Aromatic.
Habitat	In troops in leaf litter of deciduous woodlands. It is rare in Ireland and can be hard to find hidden beneath fallen leaves.
Season	Late summer to late autumn.
Edibility	This mushroom has a leathery texture and dries well. Its flavour improves when it has been dried and reconstituted. Grit and insects can gather in the hollow stem and it needs to be thoroughly cleaned.

Horn of plenty (*Craterellus cornucopioides*) in an oak woodland, Co Roscommon.

Main photo © Tom Harrington

Cuphophyllus niveus
(*Hygrocybe nivea* in BMS checklist)

Snowy wax cap

Small (1-3 cm) mushroom with gills.

Cap *White, becoming ivory,* convex but flattening with age.

Gills *Decurrent, white, widely spaced*. Spores white.

Stem White 3-5 cm high by 0.2-0.5mm wide, *tapering downwards.*

Flesh White.

Habitat Short unfertilised pasture and hay meadows, and in open grassy areas of woods. Saprotrophic on soil organic matter. They are easily overlooked in long grass.

Season Autumn.

Confusable species The two poisonous grassland species of *Clitocybe* are *never* as white as the snowy wax cap, and have *very crowded, fine gills.*

Edibility A very tasty mushroom.

Snowy wax caps found in green fields in Co Clare.

Cuphophyllus pratensis
(*Hygrocybe pratensis* in BMS checklist)

Meadow wax cap

Small to medium sized (3-8 cm) mushroom with gills.

Cap	Convex then flattening but retaining umbo, yellowish-brown.
Gills	*Very decurrent, beige, widely spaced. Spores white.*
Stem	Pale beige, tapering to base, 2-5 cm high by 1-1.5 cm wide.
Flesh	Pale beige.
Smell	Mushroomy.
Habitat	Short unfertilized grassland and in open grassy areas of woods. Saprophytic on soil organic matter.
Season	Autumn.
Confusable species	The two poisonous grassland species of *Clitocybe* are *never* as dark coloured as the meadow wax cap, and have *very crowded, fine gills*. The edible *Marasmius oreades* (fairy ring champignon) feels *much tougher* and the outer half of its cap is *paler than the central umbo.*
Edibility	A very tasty mushroom.

Meadow wax caps found in green fields in Co Clare.

Fistulina hepatica

Beefsteak fungus

Large (10-25 cm) bracket fungus with pores.

Bracket 2-6 cm thick, broadly tongue-shaped, upper surface *rough and sticky, orange-red*, darkening to purple-brown. Underside paler, but *bruising dark red*, with fine pores. When cut, the beefsteak fungus exudes a red blood-like sap.

Stem Stout and very short, red.

Flesh Coloured and patterned like raw liver.

Smell Mushroomy.

Habitat Trunks and stumps of oak and chestnut trees. It is a parasite that penetrates injured areas of trees, causing a brown rot that eventually damages the trees. It also stains the wood brown and is highly prized by furniture and cabinet makers.

Season Summer to autumn but most common in September.

Edibility Has a tart, acidic flavour and the texture and color of liver. Young specimens are best, and can be eaten raw.

Beefsteak fungus found growing on old oak trees in Co Monaghan.

Flammulina velutipes

Velvet shank

Small (3-8 cm) clustered mushroom with gills.

Cap *Yellow with darker centre, slimy*, convex then flattening.

Gills *Adnexed, distant, pale yellow*. Spores white.

Stem 3-6 cm long by 0.5-1 cm thick, t*ough, dark brown, velvety.*

Flesh *Soft, yellowish.*

Smell Faint.

Habitat A wood decomposer, on stumps (particularly on elm and oak, also on gorse, *Ulex* species) and on fallen trunks. Grows in large clusters.

Season It has a very long season and grows through the winter months. It is one of the few edible mushrooms to be found in the first three months of the year. Can survive freezing conditions in winter.

Confusable species *Pholiota squarrosa* (shaggy scaly cap) grows in clusters on tree stumps, but is *scalier and larger* than *F. velutipes*, has caps with *inrolled margins*, and has cinnamon coloured spores. *Hypholoma fasciculare* (sulphur tuft) has only a *black mark* on the stem *where the ring should be,* and has *dark spores.*

Armillaria mellea (honey fungus) is not as yellow in the *scaly, dry* cap, and has a *pale smooth stem with a ring*.

Edibility A simple tasty mushroom with a firm, slightly leathery texture. The stems are tough and should be discarded.

Velvet shanks found near decaying tree stumps in a garden at Roscam, Co Galway.

Handkea excipuliformis

Pestle puffball

A medium sized puffball.

Fruit body *10-20 cm high by 3-10 cm across, with a definite stalk*, light brown at first but darkening, surface finely warty at first, becoming smooth.

Flesh White and soft at first, becoming dusty and brown/purple in the bulb, brown and spongy in the stem.

Habitat Found in open woods, forest clearings and grassland. It has been associated with poplars and is probably a decomposer. Not as plentiful as the common puffball.

Season Late summer to autumn.

Edibility Is edible and can often be found when other mushrooms are not plentiful. They should not be eaten if the colour of the flesh begins to change to a greenish yellow. They have a distinctive slightly perfumed taste that appeals to some but not all.

Pestle puffball found in Co Galway.

Hydnum repandum
White hedgehog fungus

Small to large (3-17 cm) mushroom with spines under cap.

Cap *Cream with velvety surface*, flat, later depressed in centre. *Margin inrolled.*

Spines *Decurrent, whitish.* Spores white.

Stem *White bruising beige* near base, 3-8 cm high by 1-4 cm thick, thickened at base.

Flesh White.

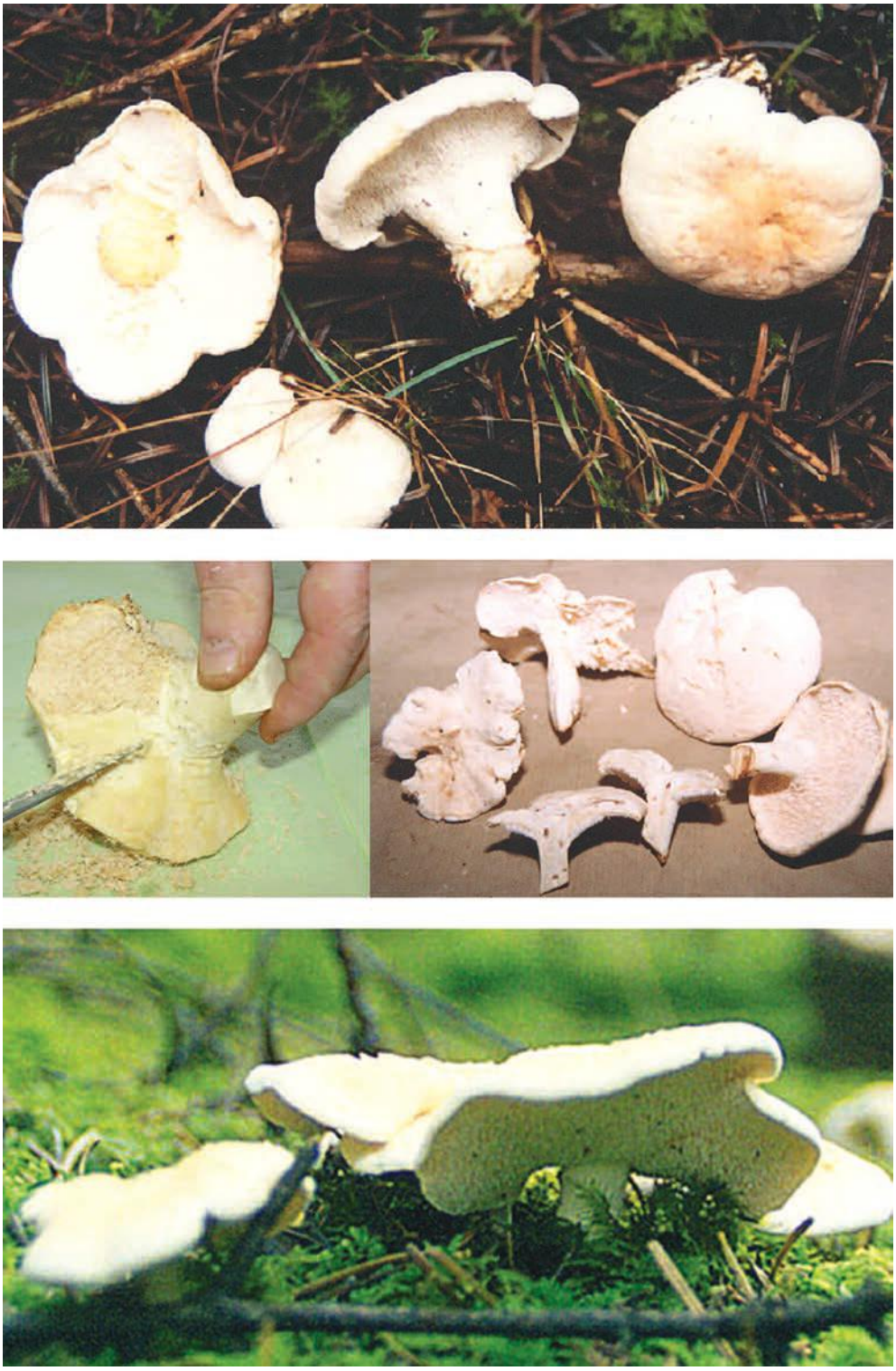
Smell Mushroomy.

Habitat Coniferous and deciduous woods on acid and limestone soils, occasionally in large white troops but more commonly found in small groups or as solitary specimens. Mycorrhizal.

Season Autumn-winter. It can withstand low temperatures, so can last into the frosts of January when it can be cut frozen.

Confusable species The edible *Hydnum rufescens* (reddening hedgehog fungus).

Edibility Older specimens are bitter and are prone to infestation. Has a good firm and slightly leathery texture with an earthy flavour. The spines growing under the cap should be scraped off before cooking as they can taste slightly bitter. Specimens subjected to frost can have a bitter taste. A highly prized species.



White hedgehog fungus growing in a spruce forest in Co Galway.

Hydnum rufescens
Reddening hedgehog fungus

Small-medium sized mushroom with spines under the cap.

Cap	*Orange brown, convex then flat.*
Spines	Whitish. Spores white.
Stem	White bruising beige near base, 5-10 cm high by 1-2 cm thick.
Flesh	White.
Smell	Mushroomy.
Habitat	Coniferous or mixed woods. Mycorrhizal.
Season	September to December.
Confusable species	The edible *Hydnum repandum* (white hedgehog fungus).
Edibility	This mushroom has a good firm and slightly leathery texture with a slightly earthy flavour. The spines growing under the cap need to be scraped off before cooking as they can taste slightly bitter and come away during cooking, which can be unsightly.

Reddening hedgehog fungus found in a mixed wood in Co Roscommon.

Laccaria amethystina

Amethyst deceiver

A small-medium sized (2-6 cm) mushroom with gills.

Cap Rounded, later flattened, even depressed in centre, *deep purple when moist, drying lilac-buff.*

Gills Adnate, *widely spaced, purple, ageing paler*. Spores *white*.

Stem 5-14 cm high by 0.5-1 cm thick, *resilient, purple with whitish 'wool' towards base.*

Flesh *Pale lilac to white.*

Habitat Deciduous, coniferous and mixed woods, particularly beech woods. In some locations it can be found growing in large troops, particularly in woods where the ground is covered with a mossy carpet.

Season Late summer to early winter.

Confusable species The rare *Laccaria purpureo-badia* (purple deceiver) is intermediate in colour of all parts between *L. laccata* (brown deceiver) and *L. amethystina* (amethyst deceiver), is of unknown edibility and grows with birch, alder and willow on damp peaty soil. There are several purple species of *Cortinarius* (web cap) of doubtful edibility, but all have *cinnamon-brown spores, close free/deeply notched gills and a cobwebby veil (cortina) under the cap in young specimens.*

Edibility A tasty mushroom. Only the caps are eaten as the stems are too tough. The purple colour fades during cooking.

Amethyst deceiver found in a spruce forest near Blessington, Co Wicklow. Note the faded colour of older specimens.

Laccaria laccata

Brown deceiver

Small (2-6 cm) mushroom with gills.

Cap Domed at first, then flattened with *central depression and wavy margin, pinkish brown fading with age and drying to straw, remaining darker at the edge.*

Gills *Adnate, pinkish brown, widely spaced*. Spores white.

Stem Pinkish brown, *tough and rubbery*, 5-10 cm high by 0.5-1 cm across.

Flesh Thin, brown.

Smell Very faint.

Habitat Deciduous, coniferous and mixed woods, particularly beech woods. Mycorrhizal. This mushroom can be found growing alongside the amethyst deceiver in most woods in Ireland and in some locations it can be plentiful, growing in large troops, particularly in woods where the ground in covered with a mossy carpet.

Season Late summer to late autumn.

Confusable species There are many other small brown mushrooms, some poisonous, that it can be mistaken with. The texture of the stem is the best unchanging character. Two deadly poisonous species of *Clitocybe* have caps with depressed centres, but are much paler and have more delicate stems and more crowded gills than deceivers. *Cortinarius* species have a *cobwebby veil under the immature cap, free or notched gills, and rusty-brown spores.* Less poisonous *Collybias* have tough stems and free, much more crowded gills than deceivers. The rare *Laccaria purpureo-badia* is intermediate in colour of all parts between *L. laccata* and *L. amethystina*, is of unknown edibility and grows with birch, alder and willow on damp peaty soil.

Edibility Similar to the amethyst deceiver. Only the caps are eaten as the stems are too tough.

Brown deceivers growing in a spruce forest in Co Galway.

Lactarius deliciosus

Pine saffron milk cap

Small to medium sized (3-10 cm) mushroom with gills and bright orange milk.

Cap Convex at first, flattening, becoming depressed in centre, *brick red to salmon orange, with concentric darker rings, and irregular green blotches* as the cap ages.

Gills *Decurrent, close, pale orange,* bruising bright orange, later green.

Stem *Brittle, beige to orange, with bright orange pock marks.*

Flesh *Yellow, rapidly turning orange with the milk, later green.*

Smell Faint.

Habitat Pine woods, mixed woods with pine, beside pine trees on golf courses, parks and driveways. Mycorrhizal.

Season Summer to autumn.

Confusable species *Lactarius deterrimus* (spruce saffron milk cap) with *spruce*, other doubtful/poisonous species of *Lactarius* have *white milk*.

Edibility This species is much less common in Ireland than the spruce saffron milk cap but is considered to be even tastier. Young specimens have a firm texture.

Pine saffron milk cap in the Glen of Aherlow, Co Tipperary. Inset: Note the bright orange pock marks that help differentiate this species from *L. deterrimus*.

Lactarius deterrimus

Spruce saffron milk cap

Small-medium sized (3-10 cm) mushroom with gills.

Cap *Yellow to orange, turning greenish with age*, convex to flat with central depression.

Gills *Decurrent, bright orange*.

Stem Pale orange with green blotches.

Flesh *Pale yellow turning purple with the milk, later wine red*.

Smell Faint.

Habitat Mycorrhizal association with spruce. As spruce is the most common commercially planted tree species in Ireland the spruce saffron milk cap is probably the most abundant of the prized edible forest mushrooms in Ireland. It can be particularly plentiful in young plantations before thinning.

Season Summer to autumn. Fruiting bodies flush when a rainy spell follows a dry spell in late summer. As soon as the first frosts occur it tends to stop growing in any great numbers.

Confusable species *L. deliciosus* (pine saffron milk cap) with *pine*; other doubtful/poisonous species of *Lactarius* have *white milk.*

Edibility A delicious good sized mushroom with a slightly waxy smell, and is suitable for many uses. Young specimens have a firm texture. Flies lay their eggs on this mushroom so it is prone to larval infestation.

Spruce saffron milk caps found in a spruce forest in Co Galway.

Langermannia gigantea

(*Calvatia gigantea* in BMS checklist)

Giant puffball

A large (10-70 cm) puffball.

Fruit body White, smooth, more or less round, turning dusty olive brown when mature.

Contents (gleba) Spongy white at first, then dusty brown with spores.

Smell Slightly sharp.

Habitat Gardens, fields, parkland and in clearings in woods. It is not very common but sometimes many can be found in the same field. It is also very sporadic, with a return period of over twenty years. The best time to find giant puffballs is when a dry sunny period is followed by a rainfall that is sufficient to soften the ground so fruiting body initials have enough water to expand.

Season Summer to autumn, provided soil temperatures remain high.

Young specimens are pure white in the centre when you cut them but as they get older the flesh begins to turn yellow and then brown and bursts into a cloud of spores when trampled on by animals or humans.

Edibility The giant puffball is only edible when the flesh is pure white all the way through.

A fresh giant puffball specimen found growing in countryside near Dublin.
Inset: Compare the size of the giant puffball to a mature chanterelle.

Leccinum scabrum

Brown birch bolete

A medium-large (7-20 cm) mushroom with pores under the cap.

Cap *Dull brown, slightly tacky when wet, convex*.

Tubes/pores *White bruising dull yellow.*

Stem *White, with tiny black scales*, 7-20 cm high by 2-3 cm thick.

Flesh *White unchanging*, very soft.

Smell Mushroomy.

Habitat Mycorrhizal association with birch. It appears in any small or large stand of birch trees on neutral and acid soils.

Season Mid-summer to late autumn.

Confusable species It is often mistaken for a penny bun but on closer examination the dark scales on the stem make it easy to distinguish. A number of *Leccinum* species differ slightly from the brown birch bolete and which grow with birch, spruce and hazel but all are edible and have similar eating qualities. Avoid boletes with red/orange pores and blueing flesh.

Edibility The brown birch bolete has a good flavour, but becomes very mushy on cooking.

Brown birch bolete growing with birch trees in the Dublin mountains.

Main photo © Pat McClelland

Leccinum versipelle

Orange birch bolete

A medium-large (8-20 cm) mushroom with pores under the cap.

Cap	*Dark orange, always domed, margin overhanging the pores.*
Pores	*Grey, bruising yellow, later pinkish.*
Stem	*White with brown scales, bruising grey.*
Flesh	*White, cut surface turning pink in cap and black in stem.*
Smell	Mushroomy.
Habitat	Mycorrhizal association with birch trees on acid soils. Not as common as the brown birch bolete, which it can sometimes be found growing alongside.
Season	Mid-summer to autumn.
Confusable species	Other species of *Leccinum* with orange caps and blackening flesh are mycorrhizal with oaks and aspen and are edible. Avoid boletes with red/orange pores and blueing flesh.
Edibility	It is a more substantial mushroom and firmer and tastier to eat than the brown birch bolete. When cut it stains black. The stalk can be eaten in very young specimens, but gets tougher as it gets older. May cause gastric upsets.

Orange birch bolete growing on the Dublin mountains.

Main photo © Pat McClelland

Lepista nuda

Wood blewit

A medium sized (6-12 cm) mushroom with gills.

Cap *Purple and domed at first*, becoming browner and flattened, finally with depressed centre and wavy margin.

Gills *Notched, crowded, purple, fading later.* Spores *pink*.

Stem 5-9 cm high by 1.5-2.5 cm thick, *purple*, swollen and covered with white mycelium at base.

Flesh Purple, unchanging.

Smell *Strongly perfumed.*

Habitat Woodland, hedgerows and gardens. This is one of the few species of forest mushrooms that is cultivated successfully commercially.

Season Autumn to early winter. This mushroom survives into late autumn and early winter, often until mid December

Confusable species *Cortinarius* species, which should never be eaten, have *rusty-brown spores, and a cobwebby veil* under immature caps. *Laccaria amethystina* is much *more slender, with distant adnate gills and white spores*. The related *Lepista irina* (flowery blewit) is *more earth coloured than purple* and has *white* flesh, while *Lepista saeva* (field blewit) has a *brown* cap, *flesh-coloured gills and flesh, and a pale purple stem.* Both are edible.

Edibility A tasty, firm mushroom popular with cooks throughout Europe. It is important to cook this mushroom thoroughly as it contains toxins that may cause minor stomach upset. It is not prone to infestation by fly larvae, but it is eaten by slugs.

Wood blewits growing near conifers at Oranmore, Co Galway.

Lepista saeva

Field blewit

A medium-sized (5-10 cm) mushroom with gills.

Cap 6-10 cm across, *pale brown*, domed at first, becoming flattened, finally with depressed centre and wavy margin.

Gills *Notched, crowded, flesh coloured*. Spores *pink*.

Stem 3-6 cm high by 1.5-2.5 cm thick, *purple, swollen at base* and often fibrillose.

Flesh *Pinkish-white*, unchanging.

Smell *Strongly perfumed.*

Habitat Found in fields, gardens and sometimes in flower beds.

Season Autumn to early winter. This mushroom survives into late autumn and early winter, often until mid-December.

Confusable species *Cortinarius* species, which should never be eaten, have *rusty-brown spores*, and a *cobwebby veil* under immature caps. *Laccaria amethystina* (amethyst deceiver) is much *more slender, with distant adnate gills and white spores.* The related *Lepista irina* (flowery blewit) is *more earth coloured than purple* and has *white* flesh, while *Lepista nuda* (wood blewit) has a *purple cap, lilac gills and flesh, and a pale purple stem*. Both are edible.

Edibility Tasty fleshy mushroom with an earthy flavour.

Field blewits growing in a garden at Oranmore, Co Galway.

Lycoperdon perlatum

Common puffball

A small puffball.

Fruit body *3-10 cm high by 3-6 cm across, with a short stalk, white* at first but darkening, surface *covered with pyramidal warts which can be rubbed off*.

Flesh White and soft throughout at first, becoming dusty and olive-brown in the bulb, pale brown and spongy in the stem.

Habitat Can be found in coniferous, deciduous and mixed wood and is very common in woods from mid-summer to the end of autumn and early winter. It is one of many species of puffball that can be seen growing on the forest floor. When it appears in woods it is often a sign that the main growing season for fungi is beginning. Saprotrophic.

Season Late summer into autumn.

Confusable species Other small puffballs (*Lycoperdon, Bovista* and *Vascellum*) all of which are edible when young and have bright white flesh.

Edibility Young specimens with white flesh are edible. They have a distinctive perfumed flavour that some may find distasteful.

Common puffball growing in Co Galway.

Lycoperdon pyriforme
Stump / Pear-shaped puffball

A small puffball (3-6 cm).

Fruit body *Inverted pear-shaped, white, turning brown, covered with fine granules.*

Contents *Spongy soft*, white at first, turning green-brown and dusty with spores later.

Habitat *In clusters on dead logs or stumps of trees*. Although it may appear to be growing out of the ground it is connected by white mycelial cords to decaying wood in the ground.

Season Mid-summer to autumn.

Confusable species Other small puffballs which are edible when white inside.

Edibility Similar to the common and pestle puffballs.

Pear-shaped puffballs growing on a tree near Blessington, Co Wicklow.

Macrolepiota (Lepiota) procera
Parasol mushroom

A large (10-25 cm) mushroom with gills and a ring.

Cap	*Pale grey-brown with brown scales*, egg-shaped then domed, finally flattened with a brown umbo.
Gills	Crowded, free from stem, white. Spores white.
Stem	Long 15-30 cm high by 0.8 to1.5 cm thick, *white with fine brown scales, base bulbous.*
Ring	*Thick, white above, brown below, movable on stem.*
Flesh	White, *unchanging*.
Smell	Faint.
Habitat	Mainly found in unfertilised grassland in pastures and at the edge of mixed woods or in open grassy areas within woods.
Season	Summer to autumn.
Confusable species	Smaller *Lepiota* species, some of which are poisonous, and *Macrolepiota rhacodes* (shaggy parasol) which bruises *red-brown* and turns *orange-red on cutting*.
Edibility	The immature cap has a firm texture and slightly nutty flavour. The stalks are too tough to eat.

Parasol mushrooms growing on compost in a garden at Roscam, Co Galway.

Morchella elata

Tall (black) morel

Small to medium sized (5-10 cm across) mushroom with honey-combed caps without gills.

Cap Conical to rounded, with a *network of ridges and deep pits*, yellowish to brown to black.

Stem Whitish, swollen at base, hollow at least in cap.

Smell None or faint.

Habitat Basic to neutral soils rich in organic matter under broadleaved trees and in gardens. Saprotrophic. The edible morels blend into their environment very well. They are one of the few edible spring mushrooms.

Although the morel seems quite scarce in Ireland it can grow in a number of habitats, e.g. near dead or dying elm trees or old ash or rowan trees, old apple orchards, driveways or on woodchip in flower beds. They are associated with sandy and chalk soils and are sometimes plentiful in areas where forest fires have taken place. In Ireland they have been found growing in Co Offaly, Co Kilkenny and Co Galway.

Season Late spring to summer.

Confusable species The false morel (*Gyromitra esculenta*) is *deadly poisonous* if eaten raw. It has a *dark red-brown brain-like cap*, and an *off-white hollow stem, narrowing to its base*. It grows on *acid sandy soils under conifers.* The edible *Morchella esculenta* is broader and paler than *M. elata*, but the authors have not found or eaten it in Ireland.

Edibility Morels are delicious and prized edible mushrooms. They can be dried to preserve. Morels cannot be eaten raw as they contain haemolysins which destroy red blood cells. But when thoroughly cooked through the morel is perfectly edible. Because of its honeycomb structure it is very important to clean them thoroughly by rinsing in water to get rid of wood lice, sand and dirt. Morels are not susceptible to larval attack.

Black morels growing from wood chip in Co Offaly. They have also been found in Co Kilkenny and Co Galway.

Pleurotus ostreatus

Grey oyster mushroom

A medium to large (6-14 cm) bracket with gills.

Cap Shell-like, margin often split and wavy, *grey but browning with age.*

Gills *Decurrent, white,* darkening with age. Spores *purple.*

Stem Short (0-3 cm long by 1-2 cm thick), *white, lateral.*

Flesh White.

Smell Mushroomy.

Habitat On dead broadleaves (fallen trees, stumps or logs) in woods, fields, parks and driveways, particularly in damp environments. It is mostly associated with beech. It often grows in large clusters, weighing up to 2 kg.

The grey oyster mushroom has been successfully farmed in different parts of the world, including Ireland, and is now commonly found in supermarkets.

Season In season all year round, but in Ireland it is more common from autumn into late winter. It will grow in the same spot year after year so it is worth recording the location where it was found and the time of year.

Confusable species Other species of *Pleurotus,* of which the large ones are edible.

Edibility Like most mushrooms the younger more tender and juicy specimens are the most prized. Older specimens can be leathery and the stems can be too tough to eat and must be removed. Older specimens are also more likely to acquire grit and dirt and to be infested with flies or insects.

Grey oyster mushrooms growing on dead oak at Connemara, Co Galway.

Sparassis crispa

Cauliflower / Brain fungus

A large (20-50 cm) irregularly lobed fungus without gills or pores.

Fruit body *Cauliflower-like, pale yellow-brown,* consisting of *repeating crisped lobes on short branching stalks.*

Spores White or pale yellow.

Stem Short, *rooting*.

Flesh White.

Smell Mushroomy.

Habitat Coniferous woods, often at the base of trees or tree stumps, especially spruce or pine. It lives on the dead roots of trees to which it is connected by mycelial cords. It is fairly rare so it is important to cut the very short stem above ground, so that its rooting system is not disturbed. When the rooting system is left intact the mushroom will grow in the same spot year after year.

Season Autumn.

Edibility Must be eaten when young when it has a pleasant and slightly nutty flavour. As it gets older it becomes tougher and unpleasant to eat. Because it grows close to the ground it collects dirt and insects so it needs to be thoroughly cleaned. The quickest way to clean it is to cut it into smaller pieces, quickly rinse in water and vinegar and dry.

A young, firm specimen (top) and an older specimen (bottom) of *Sparassis crispa* found at the base of a pine tree in the Wicklow mountains.

Suillus (Boletus) bovinus

Bovine bolete

A small to moderate (3-10 cm) mushroom with pores under.

Cap	*Cinnamon-pink with white margin, sticky.*
Pores	*Buff to clay* coloured, *large and angular.* Spores brownish-green.
Stem	4-6 cm high by 0.5-1 cm wide, *brownish-yellow*.
Flesh	*Yellowish-white* in cap, *darker* in stem, *pink* in and around stem base.
Smell	Fruity.
Habitat	With conifers, probably mycorrhizal with pine.
Season	Late autumn.
Confusable species	Other orange species of *Suillus* (boletes with sticky caps) most of which are edible. *Suillus tridentinus* is of doubtful edibility and has a r*eddish-brown cap* with *brown scales,* with *orange* sticky material, and has a *ring* on its stem.
Edibility	This is a good edible mushroom with similar qualities to the yellow larch bolete (*Suillus grevillei*).

Bovine boletes growing in Co Galway.

Suillus grevillei

Yellow larch bolete

A small to medium sized (3-10 cm) mushroom with pores and a ring.

Cap	Domed, *bright yellow, sticky when wet.*
Pores	*Lemon yellow flushed brown, bruising rusty brown.*
Stem	5-7 cm high by 1.5-2 cm thick, *yellow with brown* flush below ring.
Ring	Whitish, delicate.
Flesh	*Pale yellow in cap, darker yellow in stem.*
Smell	Faint.
Habitat	It is exclusively mycorrhizal with larch trees and can be very plentiful in both pure and in mixed larch woods.
Season	Mid-summer to autumn.
Confusable species	Other *Suillus* species (boletes with sticky caps and a ring on the stem) are mostly darker or duller in colour. None are poisonous.
Edibility	Like the other edible members of *Suillus* the young specimens are best, with good texture and flavour. Older specimens can contain a lot of moisture, and must be checked for larval infestation. Soil-covered cuticles may need to be peeled off.

Yellow larch bolete growing in a larch forest in Co Galway.

Suillus luteus

Slippery jack / Pine bolete

A small to medium sized (5-10 cm) mushroom with pores and a ring.

Cap *Mid to dark brown, with brown gluten* that is slippery when wet, shining when dry.

Pores *Lemon yellow to ochre*.

Stem 5-10 cm high by 2-3 cm thick, *yellow above ring, white below,* darkening with age.

Ring *Large, white, turning brown*.

Flesh White.

Smell Faint.

Habitat Mycorrhizal with conifers, especially pine. It is often found growing in clumps in pine woods or in grass beside pine trees in parks, golf courses or along tree-lined driveways.

Season Late summer to late autumn.

Confusable species Other *Suillus* species (boletes with sticky caps and a ring on the stem) are mostly darker or duller in colour. None are poisonous.

Edibility Flies lay their eggs on this mushroom and older specimens are likely to be infested by larvae. A good tasty mushroom with a good shape and texture when picked young. Older specimens tend to hold more moisture and go a bit soft or mushy on cooking.

Because of the sticky cuticle, grit and pine needles may stick to the cap and it may be necessary to peel the cuticle from the cap before cooking.

Slippery jack/pine bolete found growing with young pine trees bordering a football pitch in Connemara, Co Galway.

Suillus aeruginascens (viscidus)
Dirty white larch bolete

A small to medium sized (4-9 cm) mushroom with pores and a ring.

Cap	Domed, *sticky, with irregular broad white lines between dull brown patches.*
Pores	*Large, dirty yellow, bruising dull green*.
Stem	5-9 cm high by 1-1.5 cm thick, *white to pale buff, sticky, darker below the ring*.
Ring	Delicate, white, turning brown as it dries and sticks to the stem.
Habitat	Mycorrhizal with larch, sometimes occurs with the yellow larch bolete but not that frequently.
Season	Late summer to late autumn.
Confusable species	Other *Suillus* species (boletes with sticky caps and a ring on the stem) are mostly *brighter* in colour and are *not cracked*. None are poisonous. Several other boletes have caps with a 'cracked' appearance, but none are sticky, and their colour combinations are different.
Edibility	Flesh softer than the yellow larch bolete.

Dirty white larch boletes found in a larch forest in Co Galway.

Tricholoma gambosum

(*Calocybe gambosa* in BMS checklist)

St George's mushroom

A medium to large (5-15 cm) mushroom with gills.

Cap *White, domed with a wavy inrolled margin at maturity.*

Gills *Adnexed/slightly notched, crowded, dull white.* Spores white.

Stem 2-4 cm high by 1-2.5 cm across, white.

Flesh White.

Smell Mealy.

Habitat It tends to grow in small rings beside pathways in forests and parks. It can be found in gardens. The St George's mushroom tends to appear in the same spot annually.

Season A spring mushroom associated in England with St George's day on 23 April. It requires warmth and moisture and is found when the weather is good for the time of year (frosty cold weather may result in a very limited appearance of this mushroom). Generally May and early June is the best time to find it.

Confusable species Other more or less stocky whitish mushrooms generally appear later in the year. The poisonous *Entoloma sinuatum* (fibre cap) has a greyer cap and pale buff gills turning pink with age. The poison pie, *Hebeloma crustuliniforme,* has gills that darken to brown.

Edibility This is a delicious fleshy mushroom, not unlike the field mushroom in flavour but firmer in texture and a slightly mealy odor. Because of the time of year that it appears, when other wild edible mushrooms are scarce, the St George's Mushroom is highly prized.

St George's mushroom found growing in a domestic garden in Roscam, Co Galway.

Top photo © Pat McClelland

Tuber aestivum

Summer truffle

A subterranean globose fungus.

Fruit body *3-6 cm across, black, covered in warts.*

Flesh *Whitish*, darkening to *pale brown, marbled, firm.*

Smell *Strongly aromatic.*

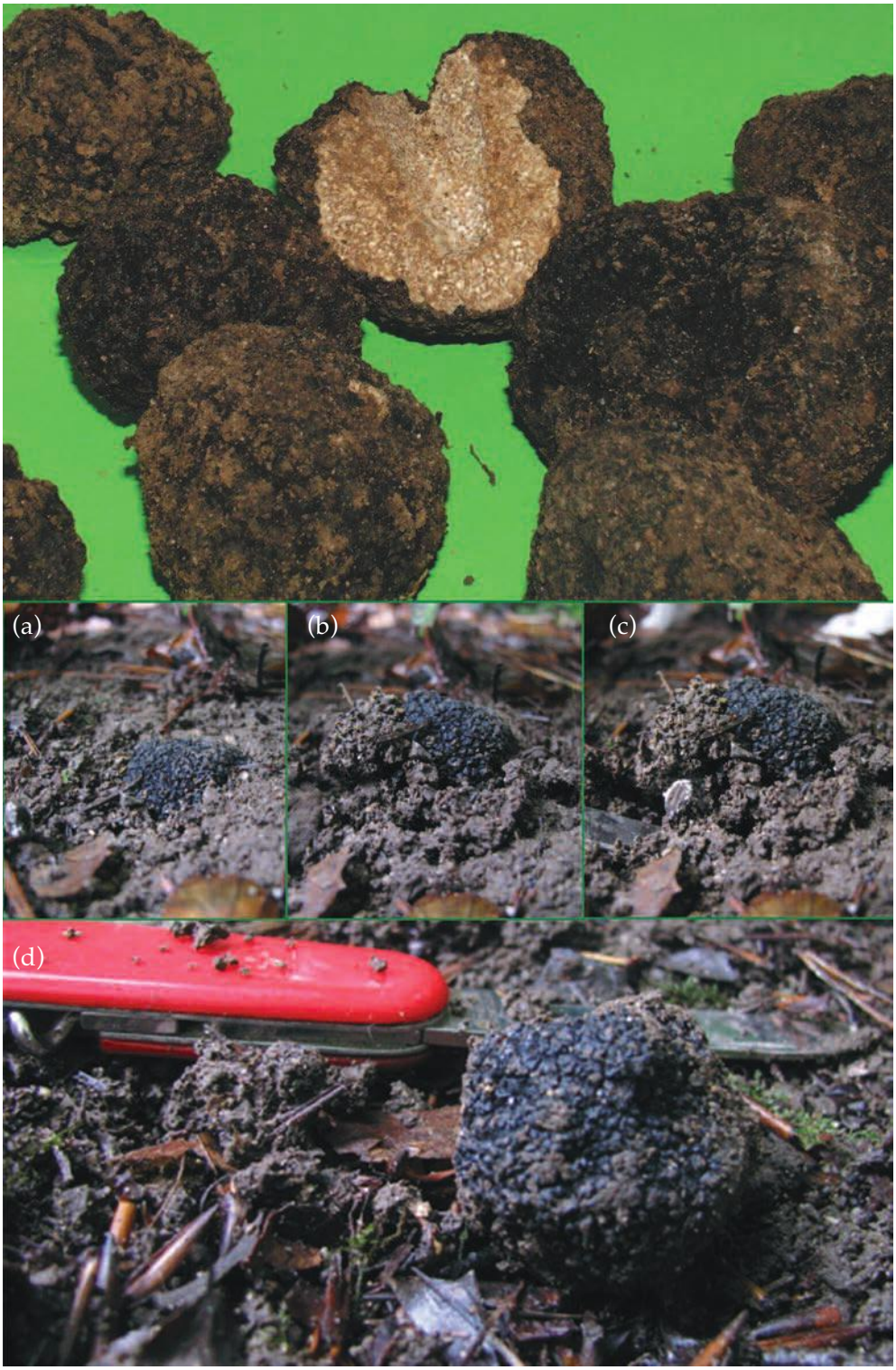
Season Late summer to autumn.

Habitat *Mycorrhizal association with beech on alkaline soils.* It is also associated with sweet chestnut and oak. This mushroom grows underground and is difficult to locate. Occasionally when ripe they break the ground surface.

Edibility The summer truffle is a prized mushroom, although not as highly as the French black winter truffle (*Tuber melanosporum*) or the Italian white truffle (*Tuber magnatum*). When it is fully ripe, in September and October, it has a good strong aroma of earthy musty mushrooms and celeriac. It is at its best when freshly picked and full of its own natural juice. It has a light nutty flavour and a texture that is slightly softer than a water chestnut.

The summer truffle has a tough outer black skin with pyramid shaped warts between which soil can gather. They can take a robust scrubbing under running water with firm nylon brush to remove all soil. The skin is hard and gritty and it is best to peel it before using.

If chilled directly after picking the mushroom can have a shelf life of up to three weeks. However, they tend to dry out as they get older and lose some of their unique flavour.



Fresh summer truffles found in Co Longford. Photos (a) to (d) show a truffle emerging from the ground.

Mixed deciduous and conifer woodland.

REFERENCES AND RECOMMENDED READING

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RECOMMENDED READING

Carluccio, A. 1990. *A passion for mushrooms*. Pavilion. London.

This book written by a successful chef-restaurant owner-mycologist concentrates on the more popular edible species with good photographs, good detail on collecting, cooking and preserving mushrooms and some good recipies.

Dickson, C. and Lucas, J. 1979. *The encyclopedia of mushrooms*. Orbis Publishing. London.

This book has a guide to identification with one-dimensional photos. Its strength is the information and photos on reproduction, the different environments on which fungi grow, how man exploits fungi, hallucinogenic and poisonous mushrooms and history and legend related to mushrooms.

Garnweidner, E. 1994. *Mushrooms and toadstools of Britain and Europe.* Munich.

This is a pocket guide to finding and identifying a good selection of edible and non-edible mushrooms. All the photos have been taken in the wild. However, the photos tend to be of single specimens and it does not show a lot of the small detail. One of the good points about this book is that the author is extra-cautious and deems some species inedible which other authors deem edible. It has a good list of identification characteristics for each species and has a good short synopsis on fungi.

Jordan, M. 1989. *Mushroom magic.* Elm Tree Books. London.

Based on a television series, this is not a guide to identification but instead looks at the history of mushrooms, lore and legend, the use of mushrooms in haute cuisine and provides some recipes.

Jordan, M. 1981. *Edible mushrooms and other fungi*. Cassel Plc. London.

This is a guide to finding, identifying and cooking a limited selection of edible mushrooms. All the photos have been taken in the wild with some very goods ones while others are not so clear.

Jordan, P. 1995. *The new guide to mushrooms*. Anness. London.

This book concentrates on the main edible species and highlights the main poisonous ones. There are good clear photographs taken in the wild and in the studio. Some of the close up shots on the fine detail are excellent. This book also gives good tips on finding, collecting and cooking mushrooms.

Phillips, R. 1981. *Mushrooms and other fungi of Great Britain and Europe*. Pan Books Ltd. London.

This book contains a large selection of species with good clear photos of mushrooms taken indoors at different stages of growth. There are many species from each genus which helps with comparisons. Identification characteristics are clearly laid out and can easily be applied to the photos in the book and fresh specimens.

Pilát, A. and Usak, O. 1952. *Mushrooms*. Spring Books. London.

This is an older book with colored sketches and there are similarities to Mirko Svreck's book which was published more recently.

Polese, J. M. 1999. *The great encyclopedia of mushrooms.* Könemann. Cologne.

The book covers edible and non-edible species and is good on identification and habitat. Photographs of mushrooms are clear and mostly taken in daylight in natural surroundings. Photos of dangerous look-alikes of edible mushrooms are shown so comparisons can be made. It contains information on over a hundred species.

Smith, L. 2001. *Wild edible forest mushrooms of Ireland.* Unpublished B. A. dissertation. H.E.T.A.C.

This dissertation establishes that there are over 30 edible species of mushroom in Irish woods which the author has photographed, cooked and eaten. It also looks at the demand for wild mushrooms in the Galway area and makes recommendation for the development of a small wild mushroom industry that affects producers, consumers and educators.

Svreck, M. 1983. *Mushrooms and fungi*. Artia. Prague.

This book covers edible and non-edible species and discusses the reproduction, growth, study, identification, classification and collection in some detail. It contains beautiful colored sketches of mushrooms and excellent sketches of the spores of individual species.

APPENDIX 1

An illustrated glossary of technical terms

Adnate: gill attachment. Full depth of gill attached at right angles to stem.

Adnexed: gill attachment. Gill narrows into slightly acute angled attachment to stem.

Anastomosing: gills branching and rejoining, to form an irregular network.

Clavate: club-shaped.

Concave: cap. Top surface bowl shaped. see also depressed.

Convex: cap. Edges below centre, cap like an inverted bowl.

Cortina: cobwebby veil connecting stem to cap edge in *Cortinarius.*

Decurrent: gill attachment. Gill fully attached to and running down the stem.

Depressed: cap. Edges slightly higher than centre.

Free: gill attachment. Gills not attached to stem at all.

Funnel-shaped: cap. With a very deep, almost conical depression.

Gill: spore-producing surfaces of most mushrooms, radiating from the stem under the cap to the cap edge. See also adnate, adnexed, decurrent, free, notched, sinuate.

Gluten: cap substance making cap surface sticky (not slimy) when wet.

Grooved: cap edge with deep radial grooves, each above a gill.

Notched: gill attachment. abruptly adnexed, but see also sinuate.

Pore: the open lower end of tubes under the caps of boletes and the brackets of polypores.

Sinuate: gill attachment. Gill narrows before running down the stem a little.

Striate: cap edge with fine radial lines, each above a gill.

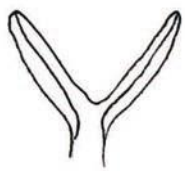
Tubes: the spore-bearing surfaces under caps of boletes and brackets of polypores.

Umbo: cap central swelling on the top of the cap.

Volva: stem base. Ranges from bag like to a circumferential groove above a basal bulb in *Amanita*.

A table of fruit body characteristics

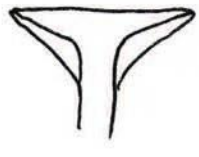
CAPS



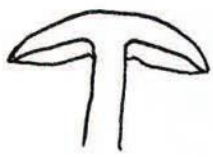
Funnel shaped

Concave

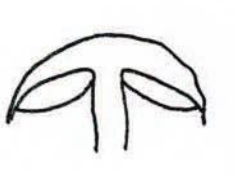
Depressed



Flat



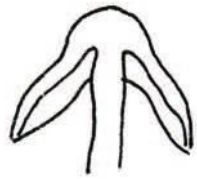
Convex



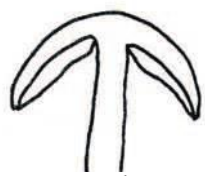
Overhanging margin

CAPS

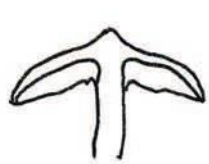
Pointed



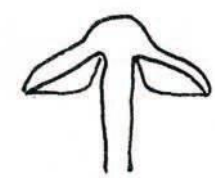
Campanulate



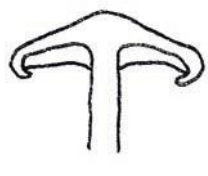
Hemispherical



Sharp umbo

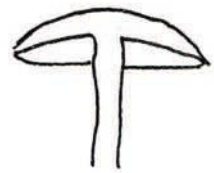


Broad umbo

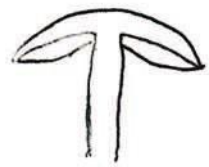


Inrolled margin

GILLS

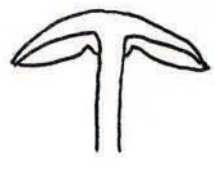


Adnate

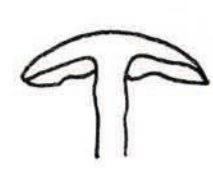


Adnexed

Decurrent



Notched

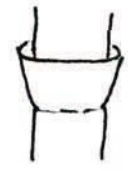


Sinuate

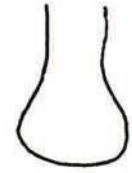
Free

STEMS

Descending ring

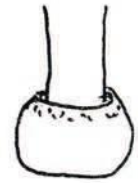


Ascending ring



Bulbous

Volva fleecy



Volva cut off

Volva baglike

APPENDIX 2

Dichotomous key to the genera of fungi named in this book

1a. Mushroom-like, with cap with gills underneath and central stem 2
1b. Not mushroom-like 19

2a. Stem with volva at base, generally with ring halfway down *Amanita*
2b. Stem with ring halfway down, but no volva 3
2c. Stem without ring or volva 6

3a. Gills deliquescing with age to black 'ink' *Coprinus*
3b. Gills free from stem 4
3c. Gills attached to stem 5

4a. Gills white, spores white *Macrolepiota, Lepiota*
4b. Gills white/pink, spores purple-brown *Agaricus*

5a. Gills somewhat decurrent, spores white *Armillaria*
5b. Gills adnate, spores brown *Pholiota*

6a. Gills deliquescing with age to black 'ink' *Coprinus*
6b. Stem/cap margin with veil (in young caps) *Cortinarius*
6c. Not as above. 7

7a. Gills sinuate 8
7b. Gills adnate 9
7c. Gills decurrent 13
7d. Gills free, stem tough 18

8a. Spores white *Tricholoma*
8b. Spores yellow-brown *Hebeloma*
8c. Spores purple-brown *Hypholoma*

9a. Spores brown *Inocybe*
9b. Spores white 10
9c. Spores pink 12

10a. Stem and cap delicate and slender *Mycena*
10b. Stem and cap stout but brittle *Russula*
10c. Stem and cap tough, rubbery 11

11a. Cap slimy and yellow *Flammulina*
11b. Cap not slimy, bleaches when dry *Laccaria*

12a. Gills white, turning pink *Entoloma*
12b. Gills lilac to buff, not turning pink *Lepista*

13a. Gills widely spaced 14
13b. Gills crowded 15

14a. Gills fold-like, strongly forked towards margin *Cantharellus*
14b. Gills leaf-like, waxy, not forked *Cuphophyllus*

15a. Spores white 16
15b. Spores brown *Paxillus*

16a. Gills forked, orange *Hygrophoropsis*
16b. Gills not forked 17

17a. Gills dry when broken *Clitocybe*
17b. Gills exude milk when broken *Lactarius*

18a. Gills crowded, spores white *Collybia*
18b. Gills wide-spaced, spores white *Marasmius*

19a. Fruit body with cap and stem, but without gills 20
19b. Fruit body without distinct cap and stem 27

20a. Fruit body like mushroom, but with pores/spines under cap 21
20b. Cap clasping/fused to stem, with complex outer surface 23

21a. Cap with spines under, stem stout *Hydnum*
21b. Cap with sponge-like pores under, stem stout 22

22a. Cap slimy when wet, sticky when dry *Suillus*
22b. Cap not slimy, stem with dark network on white flesh *Leccinum*
22c. Cap not slimy, stem with light network on beige flesh *Boletus*

23a. Cap dry 24
23b. Cap covered with green slime at first 26

24a. Cap saddle-shaped, smooth on both surfaces 25
24b. Cap deeply pitted, with network of ridges *Morchella*
24c. Cap surface convoluted, brain-like *Gyromitra*

25a. Stem ribbed *Helvella*
25b. Stem smooth *Leptopodia*

26a. Cap white, under green slime with strong disgusting smell *Phallus*
26b. Cap orange, under green slime with faint smell *Mutinus*

27a. Fruit body cauliflower-like *Sparassis*
27b. Fruit body a shelf-like bracket, growing on trees 28
27c. Fruit body cup-like, mostly on soil 31
27d. Fruit body spherical or sack-like (e.g. puffballs, truffles) 35

28a. Bracket with gills under, and a short stem *Pleurotus*
28b. Bracket with pores underneath 29

29a. Bracket yellow on top, with concentric brown scales *Polyporus*
29b. Bracket smooth on top, yellow or reddish 30

30a. Bracket reddish on top, pores white turning red-brown *Fistulina*
30b. Bracket yellow all over *Laetiporus*

31a. Cup growing on trees or branches 32
31b. Cup opening upwards, on soil 33

32a. Cup purple brown, earlike, thin, opening downwards *Auricularia*
32b. Cup rather solid, black inside, brown outside *Bulgaria*

33a. Cup stalkless, directly on soil 34
33b. Cup goblet-like, grey, on stalk *Craterellus*

34a. Cup circular, bright scarlet inside *Sarcoscypha*
34b. Cup often irregular, orange to beige *Aleuria*

35a. Fruit body sub-globose, stemless, often with cords at base 36
35b. Fruit body with stalk 41

36a. Fruit body entirely above the soil surface 37
36b. Fruit body more or less buried in soil/humus 39
36c. Fruit body entirely underground, with black warty rind *Tuber*

37a. Fruit body large (>10 cm), white then olive-brown *Langermannia*
37b. Fruit body small (<8 cm) 38

38a. Fruit body white, peeling to grey or black *Bovista*
38b. Fruit body pale beige, turning brown *Vascellum*

39a. Fruit body flattened, hard, yellow with brown scales *Scleroderma*
39b. Fruit body soft, skin like parchment, with cords underneath 40

40a. Fruit body spherical >5 cm diameter *Phallus*
40b. Fruit body ovoid, at most 2 cm x 4 cm *Mutinus*

41a. Stalk taller than depth of head *Calvatia*
41b. Stalk shorter than depth of head *Lycoperdon*

As an example we will try to identify the fungus in the following photograph, even though we cannot feel it or smell it.

1a. It is mushroom-like. .....Go to 2
2c. It has no volva and no ring. .....Go to 6
6c. It does not have a veil and its gills do not deliquesce to black. .....Go to 7
7c. The gills are decurrent. .....Go to 13
13b. The gills are crowded. .....Go to 15
15a. The spores are most likely white, as the gills have not darkened. .....Go to 16
16b. The gills are not forked. .....Go to 17
17b. The gills exude milk when broken. .....*Lactarius*

Tabular keys to the genera of fungi in this book (Tabkeys)

Master Tabkey	**A.Mushrooms with stem and umbrella-like cap**	
	Stem with ring and/or volva, cap with gills	Tabkey 1
	Stem with cobwebby veil to cap edge	***Cortinarius***
	Stem without ring or volva, cap with gills	Tabkey 2-4
	Gills sinuate	Tabkey 2
	Gills adnate	Tabkey 3
	Gills decurrent	Tabkey 4
	Cap with tubes or spines under, not gills	Tabkey 5
	Cap and gills deliquescing to black 'ink'	***Coprinus***
	B. Fruit bodies not umbrella-like	
	Cap close-fitting/fused to stem	Tabkey 6
	Brackets, mostly on trees	Tabkey 7
	Cups, mostly on soil	Tabkey 8
	Globose fruit bodies	Tabkey 9
	Club- or top-shaped fruit bodies	Tabkey 10

Group A. Fruit bodies mushroom-like, with a central stem and umbrella-like cap

Tabkey 1	**Mushrooms with gills under cap and stem with ring and/or volva**			
		ring only	volva only	ring & volva
	Gills and spores white	***Macrolepiota***	***Amanita***	***Amanita***
	Gills yellow, spores white	***Armillaria***		
	Gills yellow, spores brown	***Pholiota***		
	Gills pink, spores brown	***Agaricus***		
Tabkey 2	**Mushrooms with sinuate gills on stem with no ring or volva**			
	Spore colour	White	Pink	Yellow-brown
	Stem fibrous, not delicate	***Tricholoma***	***Entoloma***	***Hebeloma***
Tabkey 3	**Mushrooms with adnate gills on stem with no ring or volva**			
	Spore colour	White	Pink	Brown
	Cap and stem delicate	***Mycena***		
	Stem & cap flesh thick & brittle	***Russula***		
	Stem fibrous but not tough		***Lepista***	***Inocybe***
	Stem tough, cap dry	***Laccaria***		
	Stem tough, cap slimy	***Flammulina***		
Tabkey 4	**Mushrooms with decurrent gills on stem with no ring or volva**			
	Gill characters	not forked	forked	
	widely spaced, spores white	***Cuphophyllus***	***Cantharellus***	
	Crowded, spores white	***Clitocybe***	***Hygrophoropsis***	
	Crowded, spores brown	***Paxillus***		
	Crowded, exude milk on damage	***Lactarius***		
Tabkey 5	**Mushrooms with pores or spines under, not gills**			
	Stem ornamentation	none	white network	dark network
	Pores under,cap dry		***Boletus***	***Leccinum***
	Pores under, cap slimy	***Suillus***		
	Spines under, cap dry	***Hydnum***		

Group B. Fruit bodies not mushroom-like

Tabkey 6	**Almost mushroom-like, cap tightly fitting/fused to stem**		
	Cap characters	dry	slimy
	Saddle shaped, pale beige	***Helvella***	
	Deeply pitted, network of ridges	***Morchella***	
	Convoluted, brain-like	***Gyromitra***	
	Conical, with smelly green slime		***Phallus***
	Conical. green slime not smelly		***Mutinus***
Tabkey 7	**Large brackets, usually on wood**		
	With gills under, in clusters	***Pleurotus***	
	Reddish, with pores under	***Fistulina***	
	Yellow, with pores under	***Laetiporus***	
	Yellowish with brown scales	***Polyporus***	
Tabkey 8	**Cups, usually on soil**		
	Shape and position	Colour	
	Opening downwards,on elder	purple-brown	***Auricularia***
	Goblet-like, stalked, on soil	grey	***Craterellus***
	Bowl-like, on soil/buried wood	scarlet	***Sarcoscypha***
	Saucer-like, often incomplete	orange/beige	***Aleuria***
	Cauliflower-like, on fallen wood	cream/beige	***Sparassis***
Tabkey 9	**Globose**		
	On soil surface, >10 cm, soft	***Langermannia***	
	On soil surface, <10 cm, soft	***Bovista***	
	Half-buried, hard, yellow	***Scleroderma***	
	Almost fully buried, soft	***Phallus***	
	Fully buried, hard, black	***Tuber***	
Tabkey 10	**Club- or top-shaped**		
	Stalk shorter than head	***Lycoperdon***	
	Stalk longer than head	***Calvatia***	

APPENDIX 3

A key to common Irish trees in summer

(Pinnate=like a feather, with leaflets each side of a central leaf stalk.
Palmate=like a hand, with leaflets all arising at one point at the end of the leaf-stalk)

1a. Leaves scale-like, pressed to twig — *Chamaecyparis, Cupressus, Thuya*
1b. Leaves needle-like — 2
1c. Leaves more or less broad — 7

2a. Needles in groups on short lateral shoots, deciduous or evergreen — 3
2b. Needles borne singly directly on twigs, evergreen — 4

3a. Needles >3 cm long in 2s, 3s, or 5s — Pines, *Pinus*
3b. Needles <3 cm long in whorls — Larches, *Larix (deciduous);* Cedars , *Cedrus*

4a. Needles with sharp tip — 5
4b. Needles blunt-ended — 6

5a. Needles green, white lines under, cones pendant — *Spruces, Picea*
5b. Needles blue-green, cone berry-like — Junipers, *Juniperus*

6a. Needles tough, white lines underneath, cones erect — Firs, *Abies*
6b. Needles soft, green all over, cone a soft red berry — Yew, *Taxus* baccata

7a. Leaves in opposite pairs — 8
7b. Leaves alternately or spirally arranged — 11

8a. Leaves divided pinnately (several lateral pairs + one terminal leaflet) — 9
8b. Leaves lobed or palmately divided — 10

9a. Leaves smell strongly when crushed — Elder, *Sambucus nigra*
9b. Leaves without strong smell — Ash, *Fraxinus excelsior*

10a. Leaves fully divided, large — Horse chestnut, *Aesculus hippocastaneum*
10b. Leaves 5-lobed — Maples, *Acer*, inc. Sycamore, *A. pseudoplatanus*

11a. Twigs spiny or thorny 12
11b. Twigs not thorny 13

12a. Leaves with lobed edge, thorns pale Hawthorn, *Crataegus monogyna*
12b. Leaves oval, with serrated edge, spines dark Sloe, *Prunus spinosa*

13a. Leaves dark green, thick, evergreen 14
13b. Leaves deciduous 15

14a. Leaf edges spiny Holly, *Ilex aquifolium*
14b. Leaves not spiny >10 cm long Cherry laurel, *Prunus laurocerasus*
14c. Leaves not spiny <10 cm long, fruit acorn Holm oak, *Quercus ilex*

15a. Leaves divided pinnately (see 8a) Rowan, *Sorbus aucuparia*
15b. Leaves entire, cordate (heart shaped, broadest near stalk) 16
15c. Leaves entire, ovate (broadest in middle or nearer apex) 19

16a. Leaves and/or young twigs hairy or velvety 17
16b. Leaves and twigs not hairy 18

17a. Leaves smooth, twigs velvety Downy birch, *Betula pubescens*
17b. Leaves and young twigs hairy Hazel, *Corylus avellana*

18a. Leaf stalks flattened, leaves aromatic Poplar, *Populus*
18b. Leaf stalks not flat, trunk silver Silver birch, *Betula pendula*

19a. Leaves rough or with felted hairs underside 20
19b. Leaves smooth 21

20a. Leaves rough, blade sides unequal at base Elm, *Ulmus*
20b. Leaves often narrow, twigs pliant Willow, *Salix*

21a. Leaves with wavy/coarsely serrate margins Oak, *Quercus*
21b. Leaves >10x4 cm, serrate edges Chestnut, *Castanea sativa*
21c. Leaves <10x4 cm. 22

22a. Leaves with serrate edges	Cherry, *Prunus*
22b. Leaves with smooth edges	23
23a. Trunk bark grey, smooth	Beech, *Fagus sylvatica*
23b. Trunk bark brown, flaky	Apple, *Malus sylvestris*

A key to common Irish trees in winter

1a. Twigs with evergreen leaves	2
1b. Twigs bare	8
2a. Leaves broad, glossy dark green	3
2b. Leaves needle-like	4
2c. Leaves scale-like, pressed against stem	*Thuya, Chamaecyparis, Cupressus*
3a. Leaves spiny at margins	Holly, *Ilex aquifolium*
3b. Leaves not spiny	Cherry laurel, *Prunus laurocerasus*
4a. Needles in groups of 2,3,5.	Pine, *Pinus*
4b. Needles mostly in whorls on short side branches	Cedar, *Cedrus*
4c. Needles arising singly from twig	5
5a. Tip of needle with sharp spine	6
5b. Tip of needle rounded, blunt, cones erect	7
6a. Needles green, white lines underside, cones pendant	Spruce, *Picea*
6b. Needles blue-green all round, cone berry-like	Juniper, *Juniperus*
7a. Needles tough, white lines underside	Fir, *Abies*
7b. Needles soft, green all over; cone red, juicy	Yew, *Taxus baccata*
8a. Most buds on short lateral shoots, light brown	Larch, *Larix*
8b. Buds in opposite pairs	9
8c. Buds spirally or alternately arranged on twig	11

9a. Buds sticky, shiny dark brown — Horse chestnut, *Aesculus hippocastaneum*
9b. Buds dry, black — Ash, *Fraxinus excelsior*
9c. Buds green — 10

10a. Twigs with thick pith, all parts smell strongly — Elder, *Sambucus nigra*
10b. Twigs normal, not smelly — Sycamore, *Acer psuedoplatanus*

11a. Buds purple, stalked — Alder, *Alnus incana*
11b. Buds grey, felty; bark smooth, grey-brown — Rowan, *Sorbus aucuparia*
11c. Buds brown — 12
11d. Buds green — 15

12a. Buds light brown, sticky — Balsam poplar, *Populus tacamahaca*
12b. Buds not sticky — 13

13a. Buds yellow-brown, next to prominent leaf scar — Poplar, *Populus*
13b. Buds 4x longer than broad, shiny — Beech, *Fagus sylvatica*
13c. Buds <3x longer than broad — 14

14a. Trunk bark vertically fissured, large trees — Oak, *Quercus*
14b. Trunk bark horizontally striped, shiny — Cherry, *Prunus avium*
14c. Trunk bark flaky, small tree — Crab apple, *Malus sylvestris*
14d. Trunk bark spirally fissured — Sweet chestnut, *Castanea sativa*

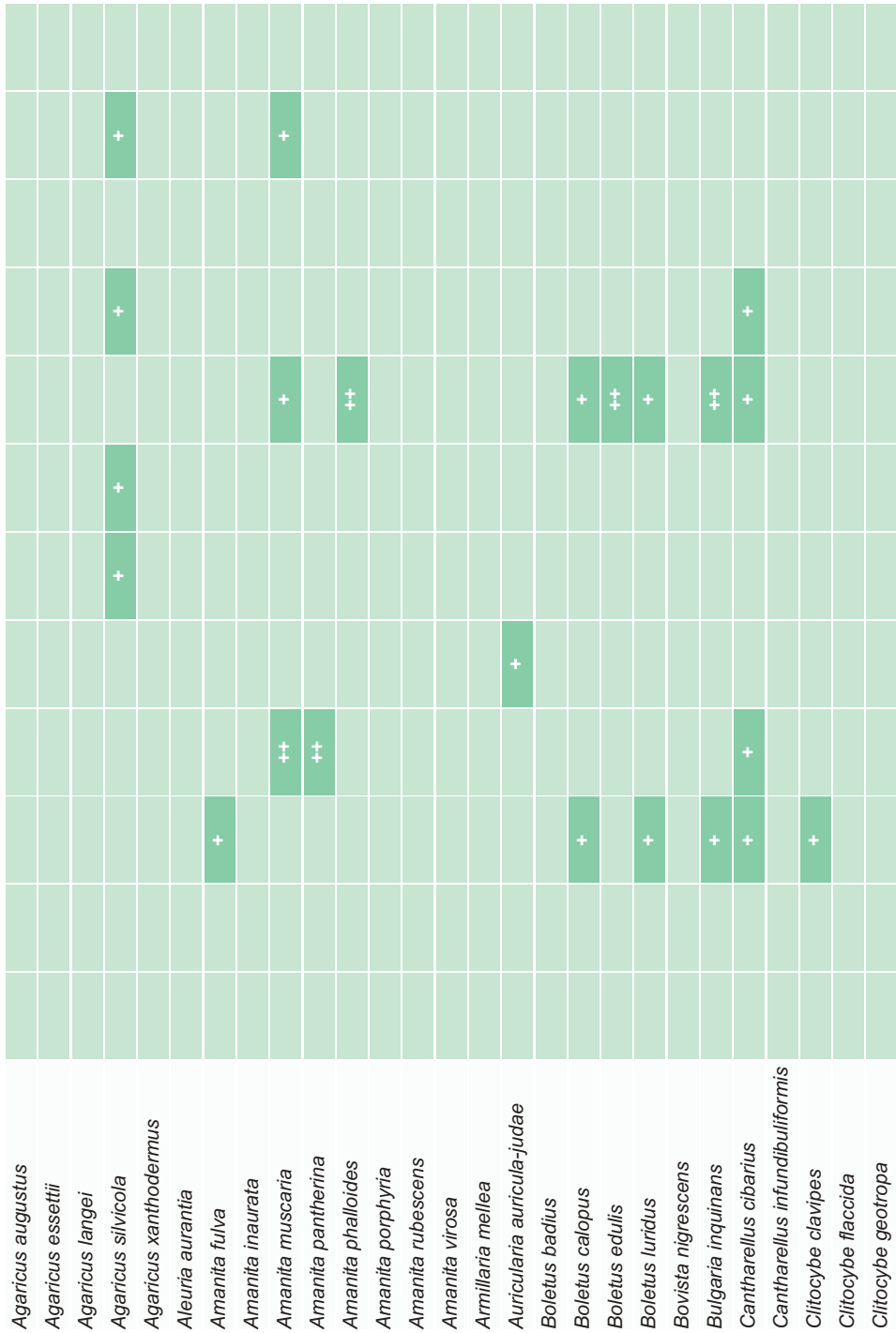
15a. Buds light green, only 1(2) scales visible — Willow, *Salix*
15b. Buds with many scales showing — 16

16a. Twigs with sharp thorns — White-thorn, *Crataegus monogyna*
16b. Twigs purple-black with grey warts — Silver birch, *Betula pendula*
16c. Young twigs hairy — 17

17a. Small tree, many pale brown trunks — Hazel, *Corylus avellana*
17b. Medium tree, silver bark — Downy birch, *Betula pubescens*
17c. Large tree, vertically fissured bark — Wych elm, *Ulmus glabra*

Fungus/tree associations

+ indicates an association between the fungus and tree species, ++ denotes a strong association. These associations are based on the observations of the authors as well as observations described in the documents listed in the reference section.



	Alder	Ash	Beech	Birch	Elder	Fir	Larch	Oak	Pine	Poplar	Spruce	Willow
Clitocybe infundibuliformis												
Clitocybe nebularis												
Clitocybe odora			+									
Coprinus comatus												
Cortinarius species												
Craterellus cornucopioides												
Cuphophyllus niveus												
Cuphophyllus pratensis												
Fistulina hepatica								+				
Flammulina velutipes								+				
Gyromitra esculenta						+	+		++		+	
Handkea excipuliformis										++		
Helvella crispa												
Helvella lacunosa												
Hydnum repandum												
Hydnum rufescens												
Hygrophoropsis aurantiaca						+			+		+	
Hypholoma fasciculare												
Laccaria amethystina			+									
Laccaria laccata												
Laccaria purpureo-badia				+								
Lactarius camphoratus									+			
Lactarius deliciosus									+			
Lactarius deterrimus											+	
Laetiporus sulphureus								++				+
Langermannia gigantea												
Leccinum scabrum				++								

	Alder	Ash	Beech	Birch	Elder	Fir	Larch	Oak	Pine	Poplar	Spruce	Willow
Leccinum versipelle				++								
Lepista nuda												
Lepista saeva												
Lycoperdon perlatum												
Lycoperdon pyriforme												
Macrolepiota procera												
Macrolepiota rhacodes												
Morchella elata												
Mycena pura			+									
Paxillus involutus				++								
Pholiota squarrosa												
Pleurotus cornucopiae												
Pleurotus ostreatus		+	+									
Polyporus squamosus		+	+									
Pseudohydnum gelatinosum						+	+		+		+	
Russula species												
Sarcoscypha coccinea		+										+
Sparassis crispa												
Suillus aeruginascens							+					
Suillus grevillei							+					
Suillus luteus									+			
Tricholoma gambosum												
Tuber aestivum			+					+				

Tree identification photographs

Ash (*Fraxinus excelsior*).

Beech (*Fagus sylvatica*).

Birch (*Betula pendula, Betula pubescens*).

Elder (*Sambucus nigra*).

Elm (*Ulmus procera*).

Horse chestnut (*Castanea sativa*).

Larch (*Larix decidua*).

Oak (*Quercus robur*).

Scots pine (*Pinus sylvestris*).

Sitka spruce (*Picea sitchensis*).

APPENDIX 4

List of recorded occurrences of forest fungi in this book

Note: the botanical vice-county numbers (1-40) used by Muskett and Malone (1980) have been translated, with slight approximations, to county abbreviations used for car registration in the Republic of Ireland, with the addition of AH-Armagh, AM-Antrim, DN-Down, DY-Derry, FH-Fermanagh, TE-Tyrone for the six counties in the UK province of Northern Ireland. The vice counties have been exactly defined by Webb (1980).

Agaricus augustus .....D, DN.
Agaricus essettii ..... Not recorded.
Agaricus langei .....AM, DN.
Agaricus silvicola .....AH, AM, D, DN, TE, WW.
Agaricus xanthodermus .....D, DN, KY, WW.
Aleuria aurantia ..... AM, CK, D, DO, KY, LH, WW.
Amanita fulva .....AM, CK, DN, MO, WW.
Amanita inaurata.....D, DN, DY, KE.
Amanita muscaria .....AH, AM, CK, D, DN, KY, LH, MO, WW.
Amanita pantherina .....D, DN, WW.
Amanita phalloides .....AM, CK, D, DN, MO, TE, WW.
Amanita porphyria ..... D, DN, KE, KY.
Amanita rubescens .....AM, CK, D, DN,DY, GY, KY, MO, TE, WW.
Amanita virosa .....DN.
Armillaria mellea .....All counties 'Very common throughout Ireland'
Auricularia auricula-judae.....AM, CK, D, DN, KE, KK, KY, ME, WH, WW.
Boletus badius .....AM, CK, DN, KY, MO, TE,WW.
Boletus calopus .....CK, DN, KY, TE, WW.
Boletus edulis .....All counties. 'common throughout the country'.
Boletus luridus ..... AH, AM, CK, D, DN, GY, KY, LH, TE, WW.
Boletus satanus .....D, DN, DY, KY, WW.
Bovista plumbea .....D, DN, MO.
Bulgaria inquinans .....AH, AM, CK, D, DO, LH, MO, TE, WW.
Cantharellus cibarius .....AM, CK, D, DN, DY, GY, KY, MO, WW
Cantharellus infundibuliformis .....CK, KY.

Clitocybe clavipes .....MO.
Clitocybe dealbata .....D, TE, WW.
Clitocybe flaccida .....AH, CK, D, DN, WW.
Clitocybe fragrans .....AM, CK, D, DN, KE, KY, MO, WW.
Clitocybe geotropa .....CK, CN, MO, WW.
Clitocybe infundibuliformis .....D, DN, DY, KE, KY, LH, MO, WW.
Clitocybe nebularis .....AM, D, DN, DY, MO, WW.
Clitocybe odora .....DN
Coprinus atramentarius .....AH, AM, CK, D, DN, DY, KY, MO, WW.
Coprinus comatus .....AH, AM, CK, D, DN, DY, KE, KY, LH, MH, MO, TE, WW.
Cortinarius species .....AH, AM, CK, D, DN, KE, LH, MO, TE, WW.
Craterellus cornucopioides .....AM, DN, WW.
Cuphophyllus niveus .....D, DN, MO, WW.
Cuphophyllus pratensis .....AM, CK, D, DN, KY, MO, WW.
Entoloma species..... AH, AM, CK, D, DN, GY, MO, TE, WW.
Fistulina hepatica .....AH, AM, CK, D, DN, KE, KY, MO.
Flammulina velutipes..... AH,AM,CK, D, DN, MO.
Gyromitra esculenta..... CK, D, KK, WW.
Handkea excipuliformis .....AH, CN, D, DN, GY, KY, WW.
Hebeloma crustuliniforme..... AM, D, DN, KE, KY, MO, TE, WW.
Helvella crispa .....AH, CK, D, DL, DN, KE, KY, LH, OY, WW.
Helvella lacunosa .....AM, CW, D, DN, LH, MO.
Hydnum repandum .....AM, CK, D, DN, DY, GY, KY, MO, WW.
Hydnum rufescens .....AM, CK, D, DN, KY, MO.
Hygrophoropsis aurantiaca .....AM, D, DN, KY, MO, WW.
Hypholoma fasciculare .....AH, AM, CK, D, DN, DY, GY, KE, KY, LH, MO, TE, WW.
Inocybe species .....AM, CK, D, DN, KE, KY, MH, MO, TE, WW.
Laccaria amethystina .....AM, D, DN, DY, GY, KY, LH, MO, TE, WW.
Laccaria laccata .....AM , CK, D, DN, DY, KE, KY, MO, TE, WW.
Lactarius camphoratus..... D, DN, MO.
Lactarius deliciosus (+ *L. deterrimus*) .....AH, AM, CK, DN, GY, KY, MO, TE, WW.
Laetiporus sulphureus .....AM, D, DN, MH, MO.
Langermannia gigantea .....AM, CK, CW, D, DN, LH, TE, WW.
Leccinum scabrum .....AH, AM, CK, D, DN, KY, MO, WW.
Leccinum versipelle .....KK, KY, WW.
Lepiota cristata .....AM, D, DN, GY, KE, KY, LH, MO, TE, WW.
Lepista nuda .....AH, D, KE, KY, WW.

Lepista saeva .....AM, D, DN, GY, KY, WW.
Leptopodia atra .....No published records.
Leucopaxillus giganteus .....AH, CK, WW.
Lycoperdon perlatum .....'very common everywhere'.
Lycoperdon pyriforme .....'very common everywhere'.
Macrolepiota procera .....AH, AM, CK, D, DN, DY, LH, WW.
Macrolepiota rhacodes .....AH, AM, D, DN, KE, WW.
Marasmius oreades .....AH, AM, CK, D, DN, DY, GY, KE, KY, LH, MO, TE, WW.
Meripilus giganteus .....AM, CK, D, DN, KE, KY, LH, TE, WW.
Morchella elata .....D, DN, GY.
Mutinus caninus .....D, DN, KE, LH, WW.
Mycena pura .....AM, CK, D, DN, DY, GY, LH, KY, MO, WW.
Paxillus involutus .....AH, AM, CK, D, DN, GY, KE, MO, TE, WW.
Phallus impudicus .....AM, CK, D, DN, DY, FH, GY, KE, KY, LH, MH, TE, WH, WW.
Pholiota squarrosa .....AH, AM, CK, D, DN, GY, KY, MO, WW.
Pleurotus cornucopiae .....AM, DN.
Pleurotus ostreatus .....AH, AM, D, DN, KY, MO.
Polyporus squamosus .....AM, AH, CK, D, DN, GY, KY, LH, MO, TE, WW.
Pseudohydnum gelatinosum .....DN, KE, WW.
Psilocybe semilanceata .....AM, D, DN,GY, KE, KY, MO, TE, WW.
Russula species .....AH, AM, CK, D, DN, DY, GY, KE, LH, MH, MO, TE, WH, WW.
Scleroderma aurantia .....'very common everywhere'.
Sparassis crispa .....D.
Stropharia aeruginosa .....AH, AM, CK, D, DN, DY, KY, MO, TE, WW.
Suillus aeruginascens .....AM, D, DN, GY, KE, KY, MH, WW.
Suillus grevillii .....AM, CK, D, DN, DY, GY, KE, KY, LH, MO, TE, WW.
Suillus luteus .....AH, AM, CK, D, DN, DY, GY, KY, MH, MO, TE, WW.
Tricholoma gambosum .....AH, AM, D, KY, WW.
Tricholomopsis rutilans .....AM, CK, D, DN, GY, KE, KY, LH, MO, TE, WW.
Vascellum pratense..... D, MO.

Calendar of wild edible Irish mushrooms

? This symbol indicates that a mushroom is at the start of its season and its availability may be limited depending on weather conditions.
** This symbol indicates that a mushroom is at the tail end of its season and its availability may be limited depending on weather conditions.

January	February	March	April	May	June
Jelly Ear ** Winter chanterelle	Jelly ear	Jelly ear ? Morel	Morel ? St George's mushroom	Oyster mushroom Morel St George's mushroom	Oyster mushroom **Morel Giant puffball **St George's mushroom
July	**August**	**September**	**October**	**November**	**December**
Parasol mushrooom Oyster mushroom Giant puffball ? Penny bun	? Amethyst deceiver ? Chanterelle ? Pestle puffball Parasol mushroom Oyster mushroom ? Common funnel cap Tawny grisette Bay bolete Honey fungus Meadow wax cap Beefsteak fungus Giant puffball Stump puffball ? Penny bun ? Shaggy ink cap ? Slippery jack Wood mushroom Monk's head ? Horn of plenty Snowy wax cap	Amethyst deceiver Chanterelle Pestle puffball Brown birch bolete Parasol mushroom Saffron milk cap Oyster mushroom Red-staining wood mushroom Larch bolete Tawny funnel cap ? Hedgehog fungus *Wood blewit Cauliflower fungus Common funnel cap Tawny grisette Bay bolete Honey fungus Meadow wax cap ? Winter chanterelle Beefsteak fungus Giant puffball Stump puffball Penny bun Shaggy ink cap Slippery jack The prince Wood mushroom Monk's head Horn of plenty Snowy wax cap	Amethyst deceiver Chanterelle Pestle puffball Brown birch bolete Parasol mushroom Saffron milk cap Oyster mushroom Red-staining wood mushroom Larch bolete Tawny funnel cap Hedgehog fungus Wood blewit Cauliflower fungus Common funnel cap Tawny grisette Bay bolete Winter chanterelle Beefsteak fungus Meadow wax cap Honey fungus Giant puffball Stump puffball Penny bun Shaggy ink cap Slippery jack The prince Wood mushroom Monk's head Horn of plenty Snowy wax cap	**Amethyst deceiver ** Chanterelle Pestle puffball **Brown birch bolete ** Saffron milk cap **Red-staining wood mushroom **Larch bolete Tawny funnel cap Hedgehog fungus Wood blewit Winter chanterelle Honey fungus Stump puffball Snowy wax cap	**Tawny funnel cap **Hedgehog fungus Wood blewit Winter chanterelle

Table of fungal distribution

m- according to Muskett and Malone (as list above), l- found and identified by Louis Smith,
d- found and identified by Paul Dowding,
Category: c-confusable, d-dubious, e-edible, p-poisonous

Fungus species | | County	cat	AH	AM	CE	CK	CN	CW	D	DL	DN	DY	FH	GY	KE	KK	KY
Vice county number see		37	39	9	3	30	13	21	34	38	40	33	15	19	11	1
Webb (1980) for details.					5				35				17			2
Agaricus augustus	e							m		m		l	l			
Agaricus langei	e		m					d		m		l	l			
Agaricus silvicola	e	m	m					m		m		l	l			
Agaricus xanthodermus	cp							m		m			l			m
Aleuria aurantia	cp		m		m			dm		m						
Amanita fulva	e		m		m			m		m		l				
Amanita inaurata	cp							m		m				d		
Amanita muscaria	p	m	m		m		d	dm		m						m
Amanita pantherina	p							dm		m						
Amanita phalloides	p		m		m			m		m						
Amanita porphyria	cp							m		m				m		m
Amanita rubescens	d		m		m		d	dm		m	m		m			m
Amanita virosa	p									m						
Armillaria mellea	e	m	m	m	m	m	dm	dm	m	m	m	lm	lm	dm	dm	m
Auricularia auricula-judae	e		m		m		d	dm		m		l		m	dm	m
Boletus badius	e		m		m	d	d	dl		m			l			l
Boletus calopus	p				m					m						m
Boletus edulis	e	m	m	m	m	m	dm	lm	m	m	m	lm	lm	m	m	lm
Boletus luridus	p	m	m		m			m		m			m			m
Boletus satanus	cp							m		m	m					m
Bovista plumbea	ce						d	m		m						
Bulgaria inquinans	cp	m	m		m			m		m						
Cantharellus cibarius	e		m		m			lm		m	m	l	lm		l	lm
Cantharellus infundibuliformis	e				m			l				l	l			lm
Clitocybe clavipes	c															
Clitocybe dealbata	p							m								
Clitocybe flaccida	e	m			m			m		m		l	l			
Clitocybe geotropa	e									m			l			l
Clitocybe infundibuliformis	e							m		m	m		l	m		lm
Clitocybe nebularis	d		m		d		d	dlm		m	m	l	l	d	l	lm
Clitocybe odora	d							d		m						
Coprinus atramentarius	d	m	m		m		d	dm		m	m					m
Coprinus comatus	e	m	m		m			dm		m	m	l	lm	dm	l	lm
Cortinarius species	p	m	m		dm	d	d	dm		m				m		
Craterellus cornucopioides	e		m							m						
Cuphophyllus niveus	e			l			d	m		m				d		
Cuphophyllus pratensis	e		m	l	m		d	m		m				d		m
Entoloma species	p	m	m					m		m			m			
Fistulina hepatica	e	m	m		m			lm		m				m		m
Flammulina velutipes	e	m	m		m			dm		m						
Gyromitra esculenta	cd				m			m		m					m	
Handkea excipuliformis	e	m				m		m		m			m			m
Hebeloma crustuliniforme	p	m	m		m		d	dm		m						
Helvella crispa	p	m			m			m	m	m				m		m
Helvella lacunosa	p		m				m	m		m						

Fungus species | | County	LH	LK	LM	LS	MH	MN	MO	OY	RN	SO	TE	TN	TS	WD	WH	WW	WX
Vice county number see	31	8	29	14	22	32	26	18	25	28	36	10	7	6	23	20	12
Webb (1980) for details.							27										
Agaricus augustus						l											
Agaricus langei															dl	d	
Agaricus silvicola											m					m	
Agaricus xanthodermus					d											m	
Aleuria aurantia	m															dm	
Amanita fulva							m						l			lm	
Amanita inaurata					d						m						
Amanita muscaria	m						m									dm	
Amanita pantherina																dm	
Amanita phalloides							m				m				d	dm	
Amanita porphyria																	
Amanita rubescens							m				m					dm	
Amanita virosa																d	
Armillaria mellea	dm	m	lm	m	dm	lm	lm	m	m	dm	m	m	dm	dm	dm	dm	dm
Auricularia auricula-judae					dm										m	dm	
Boletus badius							m				m					lm	
Boletus calopus											m					m	
Boletus edulis	m	m	m	m	m	m	lm	m	m	m	m	m	m	m	lm	dm	m
Boletus luridus	m										m					m	
Boletus satanus																m	
Bovista plumbea							m										
Bulgaria inquinans	m						m				m					m	
Cantharellus cibarius							lm									dlm	
Cantharellus infundibuliformis							l		l				d		l	l	
Clitocybe clavipes							m										
Clitocybe dealbata											m					m	
Clitocybe flaccida						l	l		l							m	
Clitocybe geotropa						l	m									m	
Clitocybe infundibuliformis																	
Clitocybe nebularis	l				l	l	lm		l	dl			l	d	l	dlm	
Clitocybe odora																	
Coprinus atramentarius					d		m									dm	
Coprinus comatus	m				dm	l	lm		l	d	m		l		m	dlm	
Cortinarius species	m				d	m				d	m		d			dm	
Craterellus cornucopioides														l	l	m	
Cuphophyllus niveus					d		m									lm	
Cuphophyllus pratensis							m									lm	
Entoloma species							m				m					m	
Fistulina hepatica						l	m		l	l							
Flammulina velutipes					d		m										
Gyromitra esculenta																	
Handkea excipuliformis					d											m	
Hebeloma crustuliniforme					d		m				m					dm	
Helvella crispa	m				d			m								m	
Helvella lacunosa	m						m									dlm	

Fungus species | | County	cat	AH	AM	CE	CK	CN	CW	D	DL	DN	DY	FH	GY	KE	KK	KY
Vice county number see		37	39	9	3	30	13	21	34	38	40	33	15	19	11	1
Webb (1980) for details.					5				35				17			2
Hydnum repandum	e		m		m		d	dlm		m	m	l	lm		l	lm
Hydnum rufescens	e		m		m			m		m		l	l			l
Hygrophorpsis aurantiaca	cp		m					m		m						m
Hypholoma fasciculare	cp	m	m		m		d	dm		m	m		m	m		m
Inocybe species	p		m		m			m		m				m		m
Laccaria amethystina	e		m				d	dlm		m	m		lm		l	lm
Laccaria laccata	e		m		m		d	dlm		m	m	l	l	m		lm
Lactarius camphoratus	d							m		m						
Lactarius deliciosus agg.	e	m	m		m		d	lm		m		l	lm		l	lm
Laetiporus sulphureus	e		m					dm		m						
Langermannia gigantea	e		m		m		m	dlm		m			l			
Leccinum scabrum	e	m	m		m			dl		m	m					lm
Leccinum versipelle	e							dm					lm			lm
Lepiota cristata	cp		m					m		m			m	m		m
Lepista nuda	e	m					d	m					l	m		m
Lepista saeva	e		m					m		m			m			m
Leptopodia atra	cp															
Leucopaxillus giganteus	cd	m			m		d									
Lycoperdon perlatum	e	m	m	m	m	m	dm	dm	m	m	m	m	m	m	m	m
Lycoperdon pyriforme	e	m	m	m	m	m	dm	dm	m	m	m	m	lm	m	m	m
Macrolepiota procera	e	m	m		m			m		m	m		l			
Macrolepiota rhacodes	d	m	m					m		m			l	m		
Marasmius oreades	ce	m	m		m		d	dm		m	m		m	m		m
Meripilus giganteus	cp		m		m			dm		m				m		m
Morchella elata	e							m		m			m			
Mutinus caninus	cd							m		m				m		
Mycena pura	p		m		m		d	dm		m	m		m			m
Paxillus involutus	p	m	m		m		d	dm		m			m			m
Phallus impudicus	d		m		m		d	m		m	m	m		m		m
Pholiota squarrosa	cp	m	m		m		d	dm		m			m			m
Pleurotus cornucopiae	e		m							m			l			
Pleurotus ostreatus	e	m	m				d			m			l			m
Polyporus squamosus	cp	m	m		m		d	dm		m			m			m
Pseudohydnum gelatinosum	cd									m				m		
Psilocybe semilanceata	p		m				d	dm		m			m	m		m
Russula species	p	m	m		dm		d	dm		m	m		m	m	d	m
Scleroderma aurantia	cp	m	m	m	m	m	dm	dm	m	m	m	m	m	m	m	m
Sparassis crispa	e							dm								l
Stropharia aeruginosa	cp	m	m		m			m		m	m					m
Suillus aeruginascens	ce							m					m	m		m
Suillus grevillei	e		m		m			m		m	m	l	lm	m		m
Suillus luteus	e	m	m		m			m		m	m		lm			m
Tricholoma gambosum	e							m					l			m
Tricholomopsis rutilans	cp		m		m			m		m			m	m		m
Vascellum pratense	ce						d	m								

Fungus species | | County	LH	LK	LM	LS	MH	MN	MO	OY	RN	SO	TE	TN	TS	WD	WH	WW	WX
Vice county number see	31	8	29	14	22	32	26	18	25	28	36	10	7	6	23	20	12
Webb (1980) for details.							27										
Hydnum repandum	m		l			l	lm		l	l					l	dlm	
Hydnum rufescens							m								l		
Hygrophorpsis aurantiaca							m									dm	
Hypholoma fasciculare	m				d		m				m					dm	
Inocybe species					dm		m				m					dm	
Laccaria amethystina	l					l	lm		l		m				l	dlm	
Laccaria laccata			l		d	l	lm		l	d	m		l		dl	dlm	
Lactarius camphoratus							m										
Lactarius deliciosus agg.						l	lm		l	dl	m				l	dlm	
Laetiporus sulphureus					dm		m										
Langermannia gigantea	m				d		l				m					dm	
Leccinum scabrum	l				d				l							dlm	
Leccinum versipelle																	
Lepiota cristata					d		m				m					m	
Lepista nuda					d		l									m	
Lepista saeva					d											m	
Leptopodia atra																	
Leucopaxillus giganteus																m	
Lycoperdon perlatum	m	m	m	m	dm	m	m	m	m	dm	m	m	m	m	m	dm	m
Lycoperdon pyriforme	m	m	m	m	dm	m	lm	m	m	m	m	m	m	m	m	dm	m
Macrolepiota procera	m															dm	
Macrolepiota rhacodes					d	dl										m	
Marasmius oreades	m				d		m				m					m	
Meripilus giganteus	m				d						m					dm	
Morchella elata																	
Mutinus caninus	m				d											m	
Mycena pura	m				d		m			d						dm	
Paxillus involutus					d		m			d	m					dm	
Phallus impudicus	m				m					d	m				m	dm	
Pholiota squarrosa					d		m									dm	
Pleurotus cornucopiae																	
Pleurotus ostreatus							m										
Polyporus squamosus	m				d		m				m					dm	
Pseudohydnum gelatinosum																m	
Psilocybe semilanceata							m				m					m	
Russula species	m		d		dm		m			d	m	d	d	d	m	dm	
Scleroderma aurantia	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	dm	m
Sparassis crispa																dm	
Stropharia aeruginosa					d		m				m					m	
Suillus aeruginascens																m	
Suillus grevillei	l						m		l		m					m	
Suillus luteus					m		m				m					m	
Tricholoma gambosum					d				l							m	
Tricholomopsis rutilans	m						m				m					dm	
Vascellum pratense							m										

Mixed conifer woodland with a moss ground cover.

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