

# How to collect, record and preserve fungi specimens

## A collector's guide

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### Introduction

Making a specimen collection can be both interesting and rewarding, particularly when the preservation technique used allows the specimens to survive long after the collection is made. The following guide outlines how to assemble a mushroom collection, what species information should be recorded, and when, how to preserve and present specimens so that they will survive for a long time, whilst being accessible to viewers. The suggestions and techniques outlined in this guide are drawn from the author's experience and, at the time of writing, the author's own collection, preserved in the way described, has survived almost 20 months with no degradation of specimens, in the absence of specialist storage conditions.

### Overview of fungi collecting

Unlike plants and animals, which are made up of many individual cells, fungi are composed from branching hyphae. These hyphae produce an expanding disc-like structure called a mycelium. This is most clearly seen in fungal moulds such as you might find on food. However, moulds are of little interest to many collectors, and most collections are likely to focus on the 'fleshy' fungi referred to as mushrooms and toadstools. Mushrooms, unlike plants, exist mainly underground, consisting of an extensive hyphae web, and send up 'fruit bodies' in order to disperse spores for reproduction. It is this 'fruit' that we see above ground, and think of as being the mushroom.

Whilst the underground mycelium may be substantially longer lived, the aboveground portion of the mushroom may exist for as little as a few days before releasing its spores and rotting away. As it is this aboveground 'fruit' that appeals to collectors, one of the most important aspects of assembling a collection is understanding the seasonality of the species you intend to collect. Of equal importance is the habitat in which the species can be found. Understanding the 'when and where' of mushrooms can help in the shaping of a collection. A collection could focus on garden mushrooms over the course of the year, or autumn mushrooms of a whole region. Alternatively it may comprise of the collectors favourites, and be gathered from a variety of locations over the course of the year. In this case it is particularly important to understand the when and where of the desired species. If focussing on a particular habitat or season, and not on particular species, things become simpler. There is such a large variety of mushrooms that there is almost always something available somewhere throughout the year. However, a little research before going out collecting would not be amiss as not all habitats will be fruitful all year round, and variety and abundance will vary enormously. Many field identification guides include season and habitat amongst their species notes, which can give a feel for when and where to look for abundance as well as particular species.

When making any sort of collection it is important to consider the conservation impacts of collecting. Enthusiastic collectors can seriously damage the survival chances of rare or sparsely dispersed species. In the case of mushrooms, as it is only the 'fruit' that is being collected, the most important factor to consider is spore dispersal. Allowing spores to disperse before collecting a specimen ensures that the 'fruit' fulfils its reproductive role. As mushroom spores are microscopic, and therefore cannot be seen prior to collection and analysis, it is important to understand the seasonality of the specimen prior to picking it. Without being a mushroom specialist it would be difficult to confidently assess whether or not spores have dropped. As a rough guide, the later it is in the season of that particular species, and the older and more degraded the specimen looks, the more likely it is to have dropped its spores. Obviously this is a very crude assessment, and it is better to avoid picking rare species altogether.

Accurately identifying mushrooms can be difficult. Many similar looking species exist, both edible and poisonous, and misidentification can be dangerous. It is a good idea not to ingest any mushrooms collected, even if they appear to be edible.

## Important features and what to record

When making a collection, important features include anything that helps identify a specimen, and anything that later distinguishes it from other specimens in the collection. Interesting features include habitat, size, colour and many more. Some of these features will be best recorded prior to collection, whilst others are better recorded after collection but prior to preservation.

### Pre collection

Many of the features recorded pre-collection are recorded at this stage simply because it is easier to get them right at the time. The following features are best recorded prior to collection:

- Geographical location → The nearest town and map co-ordinates are useful for remembering where the specimen was found, and recording the distribution of the species. This is particularly useful for collecting long term data on changes in species distribution, such as that brought about by climate change and habitat degradation.
- Season → The season, or preferably the complete date, should be recorded to aid with identification, and to help produce accurate species distribution data.
- Habitat → This can be very useful in identifying a specimen. Was it found in deciduous woodland or in open pasture? Was it growing amongst leaf litter or out of deadwood? As well as being useful for identification, this is an interesting detail for anyone viewing the collection.
- Single or colony? → This can be a useful feature in identification. It does not refer to whether or not there are several specimens growing close together, but whether the specimen has a single, or multiple, caps/‘fruit bodies’.
- *In situ* photograph → It can be both useful and interesting to record an image of the specimen in its natural surroundings. The picture should capture the key characteristics of the specimen, such as colour, shape and immediate surroundings. The picture should be of the specimen that is to be collected, and not of a similar, more photogenic example. This is because the picture is a record of the actual specimen *in situ*, and not a demonstration of an unobtained ideal.

Some species produce noticeable amounts of sap. If this is the case it can be worth recording the presence of large amounts of sap, as well as the sap colour, to aid with later identification.

The following two examples detail the essential information that should have been recorded thus far:

Specimen 3



*In situ*

Collected: Abbeystead (SD 590 534)  
On: 31/10/07  
Habitat: Amongst grass and leaf litter  
under sparse pine  
Single or colony: Individual caps  
Specimen #3

Specimen 13



*In situ*

Collected: Cabus (SD 488 476)  
On: 28/10/07  
Habitat: Unidentified deadwood in  
deciduous woodland  
Single or colony: Individual 'fruits'  
Specimen #13

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Note: At this stage no species name is given, and the specimen is simply referred to by a number. This number is also included in the specimen information (e.g. Specimen #3), in order that the information sheet can be linked to the numbered specimen after preservation.

#### Collection and transportation

Once all pre-collection information has been recorded the specimen can be collected. The 'fruit' should be collected complete with any accompanying stem. The stem should be plucked at ground level, to ensure that the entire exposed structure is collected. This is necessary as stem length and cap size are useful identification tools. Once collected specimens should be stored individually, along with a reference number linking them to the relevant pre-collection data. This is necessary to prevent confusion later on. Specimens should be protected from damage during transportation. Loose packing in cotton wool is one example of how this can be achieved. It should be noted that some stemless species would be difficult to present as a part of a collection without also collecting and preserving the item on which they are growing. The following image of a *Nectria cinnabarina* specimen is a good example of such a situation.



### Post collection

Accurate recording of specific features is often easier after collection. It is important to carry out *ex situ* measurements as soon after collection as possible, in order to avoid desiccation having an influence on readings. Having said this, it is still worth taking the time to move from the collection site to a more controlled environment, such as a lab, where greater time and care can be taken in the recording of features. The following features are best recorded after collection, but prior to preservation:

- Cap or 'fruit body' diameter → This is a very useful identification tool. It is important to record it now as desiccation will occur during preservation.
- Stem length and diameter → As with cap size, this is useful for identification, and needs to be recorded now as it will alter during preservation.
- *Ex situ* photograph → Now that the specimen has been collected, pictures can be obtained from any angle, allowing for the singling out of distinguishing features such as shape, colour and gill design. Whilst it is possible to take pictures of a whole variety of features, the ones of most interest will be those that display the defining features of the particular species. A good photograph may well be the best way of recording such features without producing large amounts of text, and as such, the taking of finalised *ex situ* pictures often comes after species identification.

Most mushrooms have visible gills on the underside, which carry the spores. The design of these gills can be very useful in identifying a specimen. A good quality photograph, whether or not accompanied by text, is probably the best way of accurately recording gill design for later reference, if desired.



This *ex situ* photo of a *Boletus badius* specimen clearly demonstrates its distinctive gill design.

If the collector has access to a microscope, knowledge of spore shape and colour can be very useful during identification. However, as mentioned earlier, collecting specimens, particularly rare ones, that have not had the opportunity to release the majority of their spores may threaten the future survival of the species. It is perfectly possible to make an accurate identification without spore information, and so collectors should not be afraid of compromising their collection by harvesting responsibly.

In order to collect spores for observation, leave the specimen, gill side down, over a sheet of white paper overnight. The longer the specimen is left, the more spores will drop. Having been left for a sufficient length of time, there should be a visible scattering of spores on the paper. These spores can then be placed under a microscope to aid in identification. Identification through spore shape requires specialist knowledge and it is likely that most collectors using spores will concentrate on spore colour alone. Whilst it results in the preserved specimen being incomplete, spore gathering will be a lot more satisfying if the stem is removed from the cap, allowing the cap to be placed flat on the paper. This will result in a patterned spore scattering, as spores drop straight down from the gills. Again, this can help in identification.

At this stage, all available information is used to identify the species of each specimen. It is worth looking through a variety of sources and identification guides, at least to begin with, in order to be confident that the necessary criteria are understood, and that the same conclusion is being reached each time. Not all identification guides are written in the same way, and it is important that the collector feels comfortable, and confident, with a particular guide, in order that they are satisfied with the identifications derived from it.

Once an identification has been made, and the collector is confident in its accuracy, features such as cap and stem size can, if wished, be altered from the actual measured readings, to reflect the range of sizes that the particular species can be found at. Other information associated with the species that may be added at this point includes season, edibility and, of course, scientific and common names.

An additional feature that may be added, particularly to more professional collections, is a reference to the original describer of that species. As such, *Russula caerulea* becomes *Russula caerulea* (Pers.) Fr., and *Auricularia auricula-judae* becomes *Auricularia auricula-judae* St. Amans. The rules of this referencing system should be described in any identification guide that includes the reference in the species name.

Below are the two sample specimens, updated to include the post-identification information. It should be noted that the sizes given in these examples are those common to the species, rather than those of the actual specimen. Such information is obtained from a species information guide once identification has been made. It is up to the individual collector to decide what information they wish to preserve; are they creating an identification guide to local species, or are they keeping a record of the individuals that they collect? The photographs remove the need for a lot of text by detailing the more defining characteristics of each specimen. Spore information is not included as the author wishes to demonstrate that it is not strictly necessary for accurate identification, and does not wish to promote irresponsible harvesting.

*Russula caerulea* (Pers.) Fr.



*In situ*



*Ex situ*

Common name: Humpback brittle gill  
Collected: Abbeystead (SD 590 534)  
On: 31/10/07  
Habitat: Amongst grass and leaf litter  
under sparse pine  
Single or colony: Individual caps  
Cap size: 30-80mm  
Stem size: 30-80mm x 10-25mm  
Edibility: Edible  
Specimen #3

*Auricularia auricula-judae* St. Amans



*In situ*



*Ex situ*

Common name: Jew's ear  
Collected: Cabus (SD 488 476)  
On: 28/10/07  
Habitat: Unidentified deadwood in  
deciduous woodland  
Single or colony: Individual 'fruits'  
Cap size: Fruit body 30-80mm  
Stem size: N/A  
Edibility: Edible  
Specimen #13

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Now that a complete set of data has been derived for each species, the information can be written up as a species information sheet (the examples are already in this format), listing all of the details for an individual species. These species information sheets should then be presented alongside the collection, in the form of an accompanying booklet. This is an essential part of preserving information about the collection.

## **Preservation and presentation**

Once specimens have been identified, preservation can begin. It is a good idea that identification take place beforehand as some information can be lost, or altered, during preservation.

### Preservation

The following preservation technique details the method used by the author for his own collection, and is both cheap and reliable. Whilst some specialist equipment is listed, there is nothing for which an everyday alternative is not available. Preservation took place in late October 2007, and specimens were still in good condition at the time of writing (June 2009), having had no special storage conditions, instead being placed in a clear top screw case and being left on a bedroom shelf. It should be noted that whilst preservation results in a long shelf life of specimens, desiccation and colour change does occur during the preservation process. This is why it is important to collect data and make an identification prior to preservation, and to record the original shape and colour through the use of good photographs.

The basic principle of this technique is to dry specimens out, to reduce the likelihood of consumption by moulds and fungivores.

- It is important to begin preservation as soon as possible, after collection. Preferable this should be done the same afternoon, but where this is not possible, specimens should be individually stored in plastic containers to protect them from desiccation, consumption and infestation. When it is necessary to store specimens overnight it would be best to begin preservation the next day.
- Specimens should be suspended in such a way that air is able to circulate around the entire specimen, allowing for even drying, thereby reducing the chances of splitting when desiccation occurs, as well as speeding up the preservation process. This can be achieved by creating a 'sling' in which to place specimens. Stretching a fabric mesh, such as an old pair of tights, over an empty, open topped box, such as a printer paper box, will create a hammock, or sling, in which specimens can be placed. Such an arrangement will allow ample air circulation. If preserving multiple specimens on the same sling, make a map of which specimens are positioned where, and leave sufficient space between them to be able to tell them apart. Remember, their appearance will change during preservation, so it is important to make a good map in order to be able to tell similar species apart after preservation. It is better to have a tight sling than a loose, saggy one, in order to prevent specimens from rolling into the middle, potentially becoming damaged, entangled and mixed up.

- Once specimens are appropriately slung, they should be placed into a warm, dry environment. It is essential that the environment is dry, as preservation relies on the removal of moisture to prevent the development of moulds and consumption by fungivores. For his own collection the author used a Snijder Microclima 1750 controlled environment cabinet, set to minimum humidity and 35°C. Such equipment is expensive and hard to come by, and unless the collector is affiliated with a major university it is unlikely that they will have access to one. Drying ovens, with low temperature setting, are common at schools and universities, and household ovens and airing cupboards are suitable substitutes. It is important to remember that the environment is supposed to be warm and dry. It may be necessary to add a dehumidifier to the airing cupboard. High temperatures should be avoided; the intention is to dry the specimen, not to cook it. If using a household oven the temperature should be set as low as possible. Through brief experimentation, the author found 35°C to be a good temperature; too much below and drying will take considerably longer, and too much above and specimens will be cooked rather than dried. The collector should experiment with the equipment that they have available, remembering that the objective is to use a warm and dry environment to dry specimens out.
- Experimentation by the author demonstrated that three days appeared to be sufficient a length of time to dry specimens in the described conditions. However, specimens were left in these conditions for almost two weeks, in order to ensure complete drying. The length of time available to each collector will vary, though it should be remembered that the longer the conditions are maintained, the more complete the preservation will be. It is also worth remembering that different equipment setups will require different preservation times. In particular, more humid environments, such as airing cupboards, may take longer to thoroughly dry specimens.

## Presentation

Once adequately preserved, specimens should be stored in such a way as to protect them from knocks, moulds, fungivores and contact with fluids. They also need to be clearly distinguishable from one another, relatable to the information sheet developed prior to preservation, and accessible to viewers.

- In order to achieve the above points, the author's collection was stored and displayed in a Black & Decker clear topped screw case, with individual species occupying their own compartment. With small and fragile species the collector may want to preserve several examples in the same compartment, though in this case it is particularly important to list whether they are multiple single cap specimens, or a single multi-capped 'colony'.
- Specimens should be protected from damage within their case. One way to achieve this is to line the compartments with cotton wool.



- It is important to number individual compartments, linking them to the species information sheets assembled before preservation. It can be useful to include additional information on these labels, such as the species name and the location at which it was found.



- A nice addition to the individual species information sheets is a table listing all of the species in a collection. Obviously this table can be arranged however the collector likes, though it is standard scientific practice to list species in taxonomic order. Below is a table of the species present in the author's collection. Note that the two example species given in this article, specimens #3 and #13, appear third and thirteenth on the list; in this way, specimen numbers correspond to their position on the list, and the order in which the species information sheets are presented in the booklet, which can be made to accompany the collection. The collector may wish to write a brief introduction to such a booklet, indicating whether the collection is of woodland or pasture species, or whether specimens were collected in summer or autumn. Note that such an introduction should not replace the information on the individual species cards, though it may be more generic as its purpose is to give an overview of the collection.

Species list

This is a complete list of all the species in the author's collection, detailing the major taxonomic levels for each species. This list tries to remain clear by avoiding repetition. For example the class Basidiomycetes is only mentioned once even though all of the species from *A. muscaria* to *I. geophylla* belong to this class. Where gaps are left it should be assumed that the higher level taxon for the species is the same as for the preceding species.

Kingdom	Division	Class	Order	Family	Genus	Species
Fungi	Ascomycota	Sordariomycetes	Hypocreales	Nectriaceae	<i>Nectria</i>	<i>N. cinnabarina</i>
	Basidiomycota	Agaricomycetes	Russulales	Russulaceae	<i>Lactarius</i> <i>Russula</i>	<i>L. turpis</i> <i>R. caerulea</i> <i>R. emetica</i>
		Basidiomycetes	Agaricales	Amanitaceae	<i>Amanita</i>	<i>A. muscaria</i>
				Bolbitiaceae	<i>Panaeolina</i>	<i>P. foenicicii</i>
				Hydnangiaceae	<i>Laccaria</i>	<i>L. bicolor</i> <i>L. laccata</i>
				Hygropharaceae	<i>Hygrocybe</i>	<i>H. strangulata</i>
				Strophariaceae	<i>Psilocybe</i>	<i>P. semilanceata</i>
				Tricholomataceae	<i>Clitocybe</i>	<i>C. nebularis</i>
					<i>Collybia</i>	<i>C. dryophila</i>
	Auriculariales			Auricularaceae	<i>Auricularia</i>	<i>A. auricular-judae</i>
	Boletales			Boletaceae	<i>Boletus</i>	<i>B. badius</i>
	Cortinariales			Cortinariaceae	<i>Inocybe</i>	<i>I. geophylla</i>

Comparison of original specimens with their desiccated counterparts

Below are the *in situ* and *ex situ* photographs of the two example species given in this article (species #3 and #13), along with pictures of their desiccated counterparts taken almost 20 months after preservation. It should be noted that this level of desiccation occurred during preservation, and that the specimens have remained unchanged since, clearly demonstrating the success of the preservation technique.

