



- ▶ A survey conducted in 2007 recorded 29 edible fungi from 53 woodland sites representing the major natural and afforested woodland types in Ireland.
- ▶ 33% of the woodland sites produced edible fungi, and broadleaved woodlands were generally more productive than conifer woodlands.
- ▶ Hedgehog fungus, honey fungus, wood blewit and cep were the most frequent fungi found.
- ▶ Production of edible mycorrhizal species was greater overall on broadleaved sites than on Sitka spruce, pine and other conifer sites. Interestingly, cep (*Boletus edulis*) was recorded from two Sitka spruce sites.
- ▶ Production rates were low, rarely exceeding 0.3 kg per hectare fresh weight from most sites. However, anecdotal evidence suggests that relative to previous years, 2007 was a poor year for fungal fruitbody production in Irish woods.
- ▶ The survey will be repeated in 2008 and 2009, giving a better evaluation of the potential of Irish woodland sites for edible fungal production.

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## Assessment of wild edible fungal production in Irish woodlands

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At least 1,154 species of wild fungi are collected around the world for culinary or medicinal use (Boa 2004). China, Japan, Mexico, Turkey, several European countries, and major areas of central and southern Africa have long traditions of collecting wild edible fungi and in some of these countries collection for consumption provides significant economic return. Picking edible mushrooms is also an important, if seasonal, recreational activity. Fungi supplement and add variety to the diet. Conservation issues and logging bans in several countries have renewed interest in wild edible fungi as a non-wood forest product and an alternative source of income for people previously employed in forestry. Wild edible fungi have played an important role in providing new sources of income in the Pacific north west of the United States of America, and in China.

In Europe, the most highly valued commercially collected wild edible fungi are truffles (*Tuber* species), cepts (*Boletus edulis* and related species) and girolle or chanterelle (*Cantharellus cibarius*), but many more species may be collected for consumption depending on regional preferences. France and Italy are the



A collection of cepts, hedgehog fungus and chanterelle from mixed broadleaved woodland, Curraghchase, Co Limerick.

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foremost mycophilic countries in Europe, and most Slavic countries have equally strong mycophilic traditions and possibly consume a greater range of edible species. Even in traditionally ‘mycophobic’ countries such as the Celtic countries, interest in consumption of wild edible fungi is steadily increasing.

Spain, which was traditionally mycophobic except for two provincial regions, is the foremost example of this change. At least 61 species are now collected for consumption (de Román and Boa 2004). While most are collected for personal consumption, there is also a growing market for chanterelles, ceps and the saffron milk cap (*Lactarius deliciosus*); for example, a wholesale mushroom market has been established in Andalucia under a regional development initiative (Plan for the Conservation and Sustainable Use of Wild Mushrooms and Truffles in Andalusia). The saffron milk cap is mycorrhizal on various species of pine, and has become a significant commercially collected species in parts of Spain with extensive *Pinus nigra* plantations. A further development in Spain is the development of black truffle (*Tuber melanosporum*) plantations using holm oak (*Quercus ilex*) as a host tree.

## Edible woodland fungi in Ireland

Harvesting of edible fungi in Irish woodlands was traditionally insignificant, but interest in collecting edible fungi for culinary use has increased greatly in recent years. Approximately €600,000 worth of fresh or chilled wild mushrooms (excluding truffles and *Agaricus*) and €800,000 worth of frozen wild mushrooms were imported into Ireland



Ceps (*Boletus edulis*).

in 2005 (Smith 2006). Most of these were destined for the hotel and restaurant trade, but a substantial and increasing proportion is now making its way to private consumers. The market for wild mushrooms and the volume of imports are likely to increase significantly in the future. Foraging for wild edible mushrooms is becoming popular in Ireland and is linked with the increase in demand for organic and fresh local produce, a demand that is strongly backed by groups such as the Slow Food Movement. This indicates that there is room for import substitution with native wild edible forest mushrooms. There is a demand from restaurants and hotels for organic native wild forest mushrooms that cannot be supplied at present. There is some indication that native produce could satisfy this demand, but the extent of this has yet to be quantified.

## Ecology of edible woodland fungi

Most of the highly valued edible woodland mushrooms found in north western Europe are also found in Irish woods (Table 1). These can be classified into three types:

- (ecto)mycorrhizal types that form symbiotic relationships with tree roots,
- pathogenic types that attack living trees, and
- saprobic types that decompose organic materials, such as dead wood and fallen leaves.

The mycorrhizal types (denoted by (m) in Table 1) include truffles, ceps chanterelles and hedgehog fungus and are the most highly esteemed and commercially valuable. They cannot be grown in the same manner as the cultivated mushroom (*Agaricus bisporus*) and the commercial trade is based on harvesting from the wild (or increasingly in the case of truffles, from plantations). Edible mycorrhizal fungi have fairly broad host ranges and can occur on the roots of native trees such as aspen, birch, hazel and oak, and on introduced species such as beech, Douglas fir, larch, Norway spruce, Scot's pine (and other pines), silver fir, and Sitka spruce. Other native and introduced trees such as alder, ash, holly, sycamore and yew do not support mycorrhizal fungi (or at least any valuable edible species). Pure stands of these trees are therefore unlikely to yield any of the most prized edible fungal types, but they may produce some valuable non-mycorrhizal edible types such as wood blewits (*Lepista nuda*), morels (*Morchella* spp.) or lawyer's wig (*Coprinus comatus*).

Table 1: List of edible forest fungi. Those marked with (m) are mycorrhizal types.

Hedgehog fungus ( <i>Hydnum repandum</i> )	(m)
Chanterelle or girolle ( <i>Cantharellus cibarius</i> )	(m)
Winter chanterelle ( <i>Cantharellus tubaeformis</i> and <i>C. aurora</i> )	(m)
Horn of plenty ( <i>Craterellus cornucopioides</i> )	(m)
Cep ( <i>Boletus edulis</i> , <i>B. reticulatus</i> )	(m)
Bay bolete ( <i>Boletus badius</i> )	(m)
Saffron milk cap ( <i>Lactarius deliciosus</i> )	(m)
Wood blewit ( <i>Lepista nuda</i> )	
Cauliflower fungus ( <i>Sparassis crispa</i> )	
Lawyer s wig ( <i>Coprinus comatus</i> )	
Parasol mushroom ( <i>Macrolepiota procera</i> )	
Honey fungus ( <i>Armillaria mellea</i> )	
Giant puffball ( <i>Calvatia gigantea</i> )	
Velvet shank ( <i>Flammulina velutipes</i> )	
Chicken of the woods ( <i>Laetiporus sulphureus</i> )	
St George s mushroom ( <i>Calocybe gambosa</i> )	
Morel ( <i>Morchella esculenta</i> )	
Oyster mushroom ( <i>Pleurotus ostreatus</i> )	
Summer truffle ( <i>Tuber aestivum</i> )	(m)
Beefsteak fungus ( <i>Fistulina hepatica</i> )	
Slippery jack ( <i>Suillus luteus</i> )	(m)
Larch bolete ( <i>Suillus grevillei</i> )	(m)
Birch bolete ( <i>Leccinum scabrum</i> )	(m)
The prince ( <i>Agaricus augustus</i> )	
Wood mushroom ( <i>Agaricus silvicola</i> )	
Deceiver ( <i>Laccaria laccata</i> )	(m)
Charcoal burner ( <i>Russula cyanoxantha</i> )	(m)

*Nomenclature follows Legon, N.W. and Henrici, A. (2005).*

From anecdotal evidence, production of fruitbodies of mycorrhizal and non-mycorrhizal fungal species appear to be very variable from year to year and these fluctuations are largely determined by weather variables. In Ireland, the principal variable that is positively correlated with productivity appears to be average daily temperature in the period 2-4 months before fruiting (Eveling et al. 1990), but other factors may also be involved, particularly soil moisture levels in September and October. It has also been frequently observed that productive years may be followed

by one or more fallow years. Because of this variability, surveys of edible fungal production need to span at least 3-4 years.

## Study objectives

Information on the potential of edible fungi as a secondary forest product in Irish woodlands is sparse, anecdotal and unpublished, in contrast to the situation in many other European countries where collecting wild edible mushrooms is popular and well documented. The primary aim of the study is to answer some basic questions about the productivity of edible fungi in Irish woodlands such as:

- What are the most productive edible fungal species to be found in Irish woodlands?
- What sort of woodland sites are the most productive?
- What volumes are produced in a typical year?
- What is the extent in year-to-year variation in yield?
- What factors have a significant positive influence on yield?

Answers to these questions will provide an objective basis for assessing the commercial and recreational potential of edible fungal harvesting in Irish woodlands, and for managing the resource.

The specific objectives of the project are:

- To identify woodland study sites that are representative of larger areas of forest in Ireland, for long term monitoring of wild edible fungal production and to establish a framework for long term monitoring.
- To obtain quantitative information on wild edible fungi production of fruitbodies of edible fungi in these study sites over a three year period.
- To extrapolate wild edible fungi production from the study sites to larger areas of similar forests in Ireland.
- To assess year to year variation in fungal production.
- To correlate wild edible fungi production with environmental and habitat variables.
- To analyse the community structure of mycorrhizal wild edible fungi on the sample sites, and to relate wild edible fungi production to mycorrhizal abundance.

## Preliminary results

Fifty-three forest sites were selected for surveying in Counties Limerick, Clare, Cork, Kerry, Waterford, Tipperary, Wexford, Wicklow, Dublin, Westmeath, Mayo, Galway, Roscommon, Sligo, Leitrim, Cavan, Offaly, Laois and Donegal during the main period of production between September and November 2007. Each site was visited and surveyed 3 to 4 times using a combination of permanent plot and plotless methods. Total fresh weight and dry weight production of fungal fruitbodies (kg per hectare per year), and fruitbody density (numbers per hectare per year) were estimated for each site. The sites comprised replicate stands of the following range of tree types, generally in single-species, mature stands: beech, birch, Douglas fir, hazel, lodgepole pine, noble fir, Norway spruce, oak (sessile and pedunculate) and Sitka spruce.

Only 33% of the woodland sites produced edible fungi in the 2007 fruiting season. Nonetheless, of 40 species regarded as edible and known to occur in Ireland, 29 were recorded from these sites over the 3-month sampling period.

Hedgehog fungus (*Hydnum repandum*) was the most abundant mycorrhizal species followed by chanterelle (or girolle) (*Cantharellus* species) and ceps (*Boletus* species). Of these, only hedgehog fungi were produced in appreciable quantities, i.e. with average densities across productive sites of less than 10 fruitbodies per hectare and average fresh weights of 0.3 kg per hectare. There was a great deal of variation between sites, however, with a small number of sites producing twice to three times the average. The rest of the mycorrhizal species had average densities of less than one fruitbody per hectare and fresh weights of less than 20 g per hectare. Production of edible mycorrhizal species was greater overall on broadleaved sites than on Sitka spruce, pine and other coniferous sites. Interestingly, cep (*Boletus edulis*) was recorded from two Sitka spruce sites.

The most abundantly fruiting species overall was honey fungus (*Armillaria mellea*). Fruitbody densities and fresh weights of 19,400 per hectare 232 kg per hectare respectively, were estimated for this species from an old Sitka spruce stand in Co Clare, but in general, productivity was much lower than this. Wood blewit was also common on some broadleaved sites later in the season.



St. George's mushroom (*Tricholoma gambosum*).

## Conclusions

The results of the 2007 survey broadly confirm the anecdotal evidence (Harrington unpublished data) that hedgehog fungus (*Hydnum repandum*) is the most common edible species to be found in Irish broadleaved woods. It also supports the widely held belief that broadleaved woodlands are more productive edible fungi sites than conifer forests. Production of wild edible fungi in the 2007 season was poor by the standards of recent years. These conclusions are preliminary and a clearer pattern will emerge by the conclusion of the project in 2010.

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