**Waxcaps**

*Hygrophoraceae*

Introduction

Waxcaps are brightly coloured fungi of the genus *Hygrocybe.*  Often referred to as ‘grassland gems’, they are indicators of ancient grassland, thriving in areas that have not been ploughed or treated with high amounts of fertiliser.

Scotland has waxcap grasslands of international importance[[1]](#footnote-1),[[2]](#footnote-2), possibly due to large areas of unimproved upland sheep pastures. Conservation of waxcap grasslands is a priority for SNH. Biodiversity Action Plans have been developed for two red data book waxcap species; *Hygrocybe spadicea* (date-coloured waxcap) and *Hygrocybe* *calyptriformis* (pink meadow waxcap or ballerina).

Distribution

Waxcaps are distributed worldwide, from the tropics to the sub-polar regions. Some 60 species occur in Europe, most commonly in wetter Western and Northern regions[[3]](#footnote-3). In Europe, they are generally found in unimproved pasture, old lawns and grassy churchyards though some species notably *Hygrocybe* *viola* and *H*. *quieta* frequently occur in woodlands. Elsewhere, for example in North America, waxcaps are mainly associated with woodland habitats. Usually several species occur together, and a good site may contain a ten to twenty species. Conversely, sites with a history of treatment with artificial fertiliser are unlikely to have more than one or two species.

Recent interest in waxcap fungi has led to the discovery of many more UK sites for some of the rarer species and most distribution maps are not up to date.

Description

The visible parts of waxcap fungi, the fruiting bodies, occur in a range of striking colours from pink and red, to yellow and green. They frequently have a shiny appearance due to the presence of a glutinous layer covering the cap. Under the cap are thick and often waxy gills. Species identification can be tricky, and may require microscopic analysis. Two species that occur in Scotland are described below.

**Splendid waxcap**(*Hygrocybe splendidissima*)**:** This is a stunning little red waxcap that is found throughout Scotland but especially in the Scottish Borders, Caithness & Sutherland. It appears in autumn on hill pasture, meadows, maritime grassland, ancient lawns and graveyards.

**Date coloured waxcap** (*Hygrocybe spadiceae*): This fungus has a dark brown cap with a waxy feel. Underneath it has yellow gills and a yellow stalk. It appears to be very rare throughout the UK occurring on old, short grassland, often pastures, lawns or churchyards, usually but not exclusively on chalky soils. It is also found on coastal dunes.

Ecology

Waxcap fungi exist for the most of the year as a vast network of minute tubes or 'mycelium' beneath the ground. The familiar fungal fruiting bodies emerge above ground for a relatively short time. Waxcaps don’t necessarily fruit each year. In dry years fewer species appear to fruit. Similarly, a temporary lack of grazing causing more vigourous growth of surrounding plants may inhibit fruiting. Because of this unpredictability of the appearance of fruiting bodies several recording visits over three or more years and at different times of the year thought necessary to properly assess a site9.

In 1995, Rald[[4]](#footnote-4) proposed a simple count of the number of *Hygrocybe* species present at a given site in order to assess its value as a waxcap grassland. He suggested that the presence of 17 or more species meant the site was of national importance, 9-16 species of regional importance, 4-8 species of local importance, and 3 or fewer of no importance. This system has since been modified to include other characteristic grassland macrofungi in addition to waxcaps[[5]](#footnote-5) and is known as the "CHEG" system. The acronym "CHEG" stands for the main groups of relevant fungi: C - the clavarioid species; H - *Hygrocybe* species; E - *Entoloma* species; and G - the Geoglossaceae (earthtongues).

Genetic analysis of mycelia from the soil can now allow species to be indentified without presence of fruiting bodies. This has revealed that some species are present at a site but have never been seen to fruit. This could mean that species that are perceived to be very rare, may just fruit very infrequently[[6]](#footnote-6).

Waxcaps thrive in nutritionally impoverished soils and it is proving very difficult to establish how these fungi obtain their nutrients. They may acquire nutrients through enzymatic breakdown of organic matter in the soil and/or they might associate in some way with living plant roots[[7]](#footnote-7), possibly forming mycorrhizal relationships which could benefit both partners by facilitating an exchange of nutrients. Another consistent feature of habitats in which waxcaps occur (in the UK at least) is the presence of moss cover and it has been suggested that there might be some kind of mutual relationship between waxcaps and mosses[[8]](#footnote-8).

Threats

* Mycologically important grasslands have usually been under traditional non-intensive management for long periods: at least 20-30 years but often for centuries[[9]](#footnote-9). Once damaged they are very difficult, if not impossible to restore[[10]](#footnote-10).
* Grasslands rich in waxcap fungi are a declining habitat throughout Europe due to a combination of factors.
* Waxcaps are vulnerable agricultural improvements such as fertilizers, ploughing and reseeding and also threatened by housing or other developments.
* Waxcaps need short turf and therefore will only persist on grasslands that are regularly mown or grazed. A change of management from regularly grazed pasture to hay meadow, often to favour the flowering plants may also be damaging. Poaching by larger livestock can also be a threat.
* Rabbit grazing has probably provided ideal conditions on some sites and the recent reduction of rabbits due to disease may also constitute a threat if substitute gazing stock cannot be arranged.
* Many grasslands that are good for waxcaps are not particularly rich in higher plants and thus were sometimes missed in conservation assessments in the past. This is beginning to be addressed and in recent years their scientific interest and importance for biodiversity have become increasingly recognised at the national and international level.

Management

Sites with diverse waxcap populations need to be managed appropriately.

* Keep the sward well grazed or mown, remove grass clippings if possible
* Use no fertilisers
* Do not reseed
* Keep well-drained
* Avoid deep shade

Other work

* **Grassland Fungi Project**

DEFRA and Scottish Natural Heritage (SNH) are funding research into the classification and ecology of fungi from unimproved grassland habitats. The research is being carried out by a partnership between CABI, the Royal Botanic Gardens, Kew and the University of Aberystwyth with support from a large number of local fungal recording groups and expert individuals.

This project will (a) define species using more objective criteria, using a combination of morphological and molecular methods; (b) recognize cryptic species that may need to be considered for conservation management; (c) gain a better understanding of the ecology of waxcap fungi, (d) designate barcode sequences to allow development of novel monitoring tools for non-fruiting populations, and (e) further improve the partnership between the scientific and lay communities to study these beautiful species.

Wider Context

The loss of biodiversity among some of the more prominent plant and animal species of our unimproved grasslands (e.g. wildflowers and insect pollinators) is reasonably well known, but it is only in recent years that the distinctive mycota of these habitats have been recognised as also being under threat.

Surveys indicate that, compared to other European countries, the UK is of exceptional importance for waxcap fungi. For example, the number of nationally important grassland fungus sites, according to the system devised by Rald5, is at least 150 in the U.K. This compares, for example, with 14 in the Netherlands, 20 in Denmark. Furthermore, on a world scale these types of grasslands are rare as elsewhere (e.g. in North America) waxcapspecies are more often associated with woodlands.

Quick Facts

* In other parts of the world, e.g. North America the species that occur in European grasslands are found in woodlands.
* The name of the waxcap genus, Hygrocybe, means "moist head".
* Most *Hygrocybe* species appear on a Red Data List somewhere in Europe[[11]](#footnote-11).
* Recent research detected waxcap DNA material and waxcap hyphae in forb roots, suggesting that for at least some of the time these fungus are biotrophic, forming attachments inside the roots of other plants[[12]](#footnote-12).

Selected references

**Plantlife (2003) Grassland gems: Managing lawns and pastures for fungi.**

http://www.plantlife.org.uk/uploads/documents/management-guide-Grassland-gems-managing-lawns-pastures-for-fungi.pdf

Short guide on good practice for encouraging fungi on pastures and lawns. Produced by Plantlife for the Fungus Conservation Forum (4 pages).

[**https://sites.google.com/site/scottishfungi/**](https://sites.google.com/site/scottishfungi/) Accessed 13/11/13

Scottish Fungi is an information hub for both beginner and established mycologists.

[**http://www.aber.ac.uk/waxcap/index.shtml**](http://www.aber.ac.uk/waxcap/index.shtml) Accessed 13/11/13

Website on waxcap fungi covering biology, ecology, current research, references.

[**http://www.plantlife.org.uk/uploads/documents/Hygrocybe\_calyptriformis\_species\_dossier.pdf**](http://www.plantlife.org.uk/uploads/documents/Hygrocybe_calyptriformis_species_dossier.pdf)

This is a dossier on the ballerina waxcap, but contains lots of information relevant to all waxcap species in the UK. As well as information on distribution, ecology and management there is an overview of current research. Also a long reference list.

**Boertmann, D. (1995). The genus Hygrocybe. Fungi of Northern Europe, Vol. 1. 287. Danish Mycological Society.**

**Griffith, G.W., Bratton, J.H. and Easton, G. (2004). Charismatic megafungi. The conservation of waxcap grasslands. British Wildlife 15(3): 31-43.**

Easy to read and comprehensive discussion of ecology of waxcaps and other associated grassland fungi.

**Griffith, G.W., Easton, G.L., Jones, A.W. (2002). Ecology and Diversity of Waxcap (Hygrocybe spp.) Fungi. *Botanical Journal of Scotland* 54(1): 7-22.**

This review describes long term field experiments at Sourhope in the Borders and what is known about biology and ecology (no longer up to date). Useful for background information and references, but molecular techniques have advanced understanding of waxcap ecology considerably since.

**Griffith, G.W., Holden, L., Mitchel, D., Evans, D.E., Aron, C., Evans, S. & Graham, A. (2006).** *Mycological survey of selected semi-natural grasslands in Wales.* Countryside Council for Wales Science Report 743.

**Genney, D.R., A.D. Hale, R.G.Woods & M. Wright (2009). Guidelines for** **selection of biological SSSIs Rationale Operational approach and criteria: Detailed guidelines for habitats and species groups. Chapter 20 Grassland fungi. Nature Conservancy Council/JNCC.**

Suggests the following threshold values for numbers of *Hygrocybe* to indicate whether a site should be considered for SSSI status: Single visit - 12 species, Multiple visits - 18 species. However, this is only guidance and other fungal groups e.g. earth tongues and fairy clubs could also be considered.

**McHugh, R., Mitchel, D., Wright, M. & Anderson, R. (2001). The fungi of Irish grasslands and their value for nature conservation. *Biology and Environment*: *Proceedings of the Royal Irish Academy*, 101B (3):225-242.**

**Newton, A.C., Davy, L.M., Holden, E., Silverside, A., Watling, R., Ward, S.D. (2003*).* Status, distribution and definition of mycologically important grasslands in Scotland. *Biological Conservation* 111:11-23.**

**Newton, A. C., Holden, L., Davy, L., Silverside, A. & Watling, R. (2000). Survey of waxcap 'Hygrocybe' grassland and compilation of species dossiers on three grassland fungi. First Annual Report to Scottish Natural Heritage, Jan 2000 (contract code BAT/AC318/99/00/78).**

**Rotheroe, M. (2001). A preliminary survey of waxcap grassland indicator species in South Wales. In Fungal Conservation: Issues and Solutions, (ed. D. Moore, M. M. Nauta, S. E. Evans & M. Rotheroe), pp. 120-135. Cambridge, U.K.: Cambridge University Press.**

**Rotheroe, M., Newton, A., Evans, S. & Feehan, J. (1996). Waxcap-grassland survey. *The Mycologist.* 10, 23-25.**

1. [www.rhs.org.uk/Plants/News/Waxcap-fungi-discovery](http://www.rhs.org.uk/Plants/News/Waxcap-fungi-discovery) accessed 13/11/13 [↑](#footnote-ref-1)
2. [www.nts.org.uk/Wildlife/Fungi/Waxcaps/](http://www.nts.org.uk/Wildlife/Fungi/Waxcaps/) accessed 13/11/13 [↑](#footnote-ref-2)
3. Boertmann, D. (1995). The genus Hygrocybe. Fungi of Northern Europe, Vol. 1. 287. Danish Mycological Society. [↑](#footnote-ref-3)
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6. Griffith, G.W., Bratton, J.H. and Easton, G. (2004) Charismatic megafungi. The conservation of waxcap grasslands. *British Wildlife* **15(3):** 31-43. [↑](#footnote-ref-6)
7. Halbwachs, H., Dentinger, B.T.M., Detheridge, A.P., Karasch, P. and Griffiths, G. W. (2013). Hyphae of waxcap fungi colonise plant roots. *Fungal Ecology* **6(6):** 487-492. [↑](#footnote-ref-7)
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