



User Guide for the Standing Oak Tree Fungus Survey

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## Introduction

The oaks must be amongst the UK's most loved trees. Their tangled branches and grand stature have inspired countless folk tales and they are an iconic part of the British landscape. Oaks are the third most common tree in woodlands and the most common in openly grown settings, totalling more than 120 million individuals. They can live to over 1000 years and the UK supports more than 49,000 ancient, veteran, and notable oak trees, more than all other European countries combined.

As with all trees, fungi play many essential and formative roles in an oak's life. These range from mycorrhizal associations that provide critical nutrients throughout their lives, through to the heart-rot fungi that engineer the great hollows that support a rich multitude of biodiversity.

Despite a great history of research and observation, much like the empty mysterious darkness that an oak hollow emits, there are many gaps in our knowledge of the fungi that grow on and with oaks, their interactions, and their effects on the life of tree. Through this community science project, utilising a mobile app, we hope to encourage those of you that have a love and knowledge of oaks, and the fungi that inhabit them, to assist us by making and recording observations.

The project is launching in the autumn of 2020 and is intended to run until 2023, providing us with an up to date snapshot of the status of oak associated fungi and the trees themselves. The large amount of potential data that we hope will be kindly provided by the community would take an impossible amount of time for a small research team to acquire. So, your contribution can really make a difference to this research and our knowledge of these fantastic trees and their fungi.

This document is intended as a guide and reference for those contributing to this project, covering how to use the app, background information and pointers on identification of some of the key species of fungi found on oak. We hope that the app is reasonably accessible for arboriculturists and field mycologists alike, and therefore recommend using the guide to install and setup the app and then exploring it for yourself, coming back to this guide as a reference when you need it.

## Oak tree biodiversity

Oak trees support a phenomenal diversity of organisms, over 2,300 species not including all the fungi and other microbes. This includes birds, bats, bryophytes, lichens, mammals, and a huge number of invertebrates. Around 320 of these species are endemic to oak and a further 229 are rarely found on any other trees.

The larger currently known portion of these oak associates is made up of invertebrates, and a majority of these interact with the fungi in the tree in some way. Many make their homes and find their food where heart-rot decay fungi have been in action, leaving partially decayed material that is physically broken down by insects, creating mounds of composting wood mulch that creates further habitat for other invertebrates. Some ambrosia and bark beetles bring symbiotic fungi into the oak tree with them in specially adapted 'pockets' on their bodies, called mycangia. Once they have burrowed under the bark, these beetles deploy the fungus where it starts to grow and decompose wood, creating a food source that the beetle then harvests, leaving patterns of adjoining corridors.

The biodiversity that the fungal decay of oak supports goes beyond these saproxylic invertebrates. The hollows that are created by brown and white rot fungi become homes to many insects such as bees and ants, but also to a host of small mammals, bats and birds that make their roosts and nests in these dark crevices.

It is this amazing engineering partnership, between tree and fungus that creates this incredibly rich habitat, and we hope that this survey and your contributions will go some way towards a better understanding of this process and the fungi involved.

### Who can get involved?

This community science project is aimed at anyone with a knowledge of trees and the fungi that inhabit them. We openly encourage anyone who can tell a chicken-of-the-woods from a beefsteak to get involved. All we ask is that you are very careful in your identification before submitting a record. The only other requirements are to be able to access oak trees, which can be found everywhere in urban, rural, and woodland settings, and to have access to a mobile device or computer and camera.

The identification of fungi is a skill that requires time to develop and this may be a limiting factor for some who wish to be involved. In an attempt to encourage those less confident to use the app we have set two levels, a simple mode with photographs and a small selection of common or easily identifiable fungi, and an expert mode that is built around a list of all known oak associate species. We have included a guide to the field identification of key oak species later in this document. You can also get help with your identification from the British Mycological Society's Facebook group, for which you can find a link in the 'Useful Links' section.

There are plenty of technical terms for the features that can be observed on oak trees, many that may be new to field mycologists, less so to arboriculturists. For each section we have provided images in the app and a more detailed reference later in this guide. If at any stage you are unsure about a feature, please look it up or visit our Facebook group to get support from the community.

Learning to use the app with confidence and how to submit good records will take a few surveys submissions. We hope that we have made the app self-explanatory and for those parts that require additional assistance this guidebook will offer the answers.

We hope that being involved with this project will be rewarding and enlightening, bringing you closer to our majestic oaks and the weird and wonderful fungi that inhabit them.

### What does the survey hope to achieve?

The data that we will be gathering has the potential to give insights into many questions surrounding oaks and their fungi. By comparing with historical record data, we hope to be able to give an up to date picture of the distribution of different fungal species and how this may have changed over time. The data will also provide a baseline for future studies.

Along with this distribution data, we will also be aiming to answer some of the following questions:

- Which species of fungi are observed on oak trees surveyed between 2020 and 2023?
- Does the age of the tree (approximated from DBH) influence the likelihood of presence of different species?
- Where and when are decay fungi fruiting on oak?
- Are there any clear geographical variations or zones of species dominance or absence?
- Are any species changing their expected range?
- Does altitude effect species presence?
- Does the presence of one species reduce or increase the chance of the presence of other species within a locality?

- Are certain species more likely to be associated with a type of entry/exit point?
- What is the variation in height of fruiting in each species?
- Are trees which have undergone forms of human management (pollarding, coppicing etc) more likely to have observable fungal fruit bodies present?
- Are certain species associated with the human management of trees or with non-managed trees?

There are likely many more questions that we may be able to address with this data set. We will be monitoring and exploring the data throughout the 3-year period and will use our findings to shape new lines of enquiry and potentially make alterations to the app if needed.

Alongside the scientific output of this project we hope to bring people closer to these remarkable trees and their fungal allies, and to raise awareness of their importance. We hope that everyone involved will learn new things and that the outputs will go on to help with protecting these amazing organisms.

## Getting started

### What will you need?

We have aimed to keep the requirements for contributing data to this survey as simple as possible. The key items required are either a mobile device (iOS, Android or browser) with a camera, or a computer (Windows or Mac) with our app installed or through an internet browser, and a digital camera for taking photos in the field. Mobile data or Wi-Fi is required for uploading surveys.

To make accurate records a mobile device with GPS is preferable, as this allows the capture of location and images in the field directly into the app.

There are a few other bits of additional kit that are not essential but can improve the quality of your records:

- A 10m surveyors tape measure (flexible), for taking accurate girth measurements.
- A coin or small ruler for placing in photographs next to fungal fruit bodies to provide scale.
- A good field guide to fungi for clarifying your identifications (see 'Useful Links and Resources' at the end of this document).

### How long does it take to submit a record?

During our testing period we have found that submitting a record in the field takes between 5 and 15 minutes per tree, depending on the number of species of fungi present. The greater the number of fungi the longer it can take. There are now two versions of the app, the original longer survey, and a 'Lite' version for quicker records.

For those that have the skills to work with fungi that are more difficult to identify, which will often require microscopic examination, the time can be much greater.

We are as interested in the common and easily identifiable fungi as we are in the under recorded and unusual species. We are very grateful for any contribution you feel able to make.

## Where and when to look for oaks and fungi

Oak trees can be found in almost all parts of the UK, in urban and rural situations. Gathering information on oaks and their fungi in a diverse range of habitats and geographical locations will help us to build a better picture of how they are interacting in different scenarios.

Many hedgerows, parks, fields, and woodlands host oaks of all ages, from tender saplings to gnarled ancient giants. We are interested in any of them that have observable fungi on, in or around them.

This survey will focus on standing oaks only, both dead and alive. This is because we are particularly interested in the communities of fungi that affect the tree while it is standing and the additional micro-habitats that this creates. Many of these habitats are retained for some time after a tree dies if it remains standing, but things get a lot more complex and less clear in felled trees, which would require a whole other project in its own right.

Observations of fungi on oak trees can be made all year round. Most fungi have their own season, which means for us to capture a snapshot of current diversity we will require records throughout the year. Some fungi will produce rapidly growing fruit bodies that will disappear in a few days, others, like many of the bracket fungi that can rot heart-wood, have perennial fruitbodies that can be present for several years.

Whether on a wintery walk in the woods or coming home with the shopping through the park, there will be the opportunity to observe fungi in action on oaks. Once you start to notice oaks in the landscape it does not take long to find one that has some form of fungus present. We would be delighted to hear about it when you do.



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## Recording workflow



## Setting up the Standing Oak Tree Survey app

The Standing Oak Tree Fungus Survey has been designed using Survey123 to work on mobile devices and from an internet connected browser. The following sections will cover the installation and setup for the Survey123 app and the downloading of the Standing Oak Tree Fungus Survey.

There are now two versions of the survey available:

Our original survey allows for multiple fungus observations to be logged for each tree. It requires detailed observations of the trees condition and takes between 5 and 15 minutes per survey submission.

Our new 'Lite' version of the survey can be used for submitting single fungus observations with GPS position and tree measurements, with minimal additional information required. This version is quicker and simplified to use and still provides us with useful data!

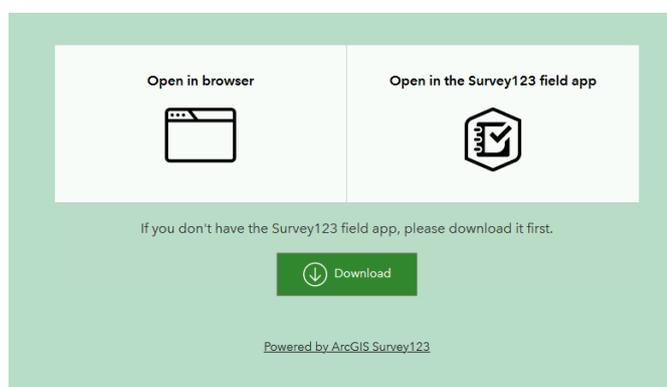
Both versions of the survey can be downloaded into the Survey123 app, so you can choose which to use based on your observations or the amount of time that you can spare.

### Mobile devices - downloading and installing the Standing Oak Tree Survey app

The mobile app is perhaps the most straight forward for users, due to its ability to access the mobile device's camera and GPS functionality, allowing these key data to be captured in the field and for additional information to be added or existing information to be edited later. The app operates on Android and iOS platforms.

1. The Survey123 field app is available from [Google Play](#) and the [App Store](#). You can install Survey123 directly onto your device from either of these stores. You can also follow the link below to download the app.
2. Once the app is installed, follow this link from your mobile device to download the original Standing Oak Tree Fungus Survey: <https://arcg.is/04aC9y> or, follow this link to install the new 'Lite' version of the app for quicker records: <https://arcg.is/1SiHKP>

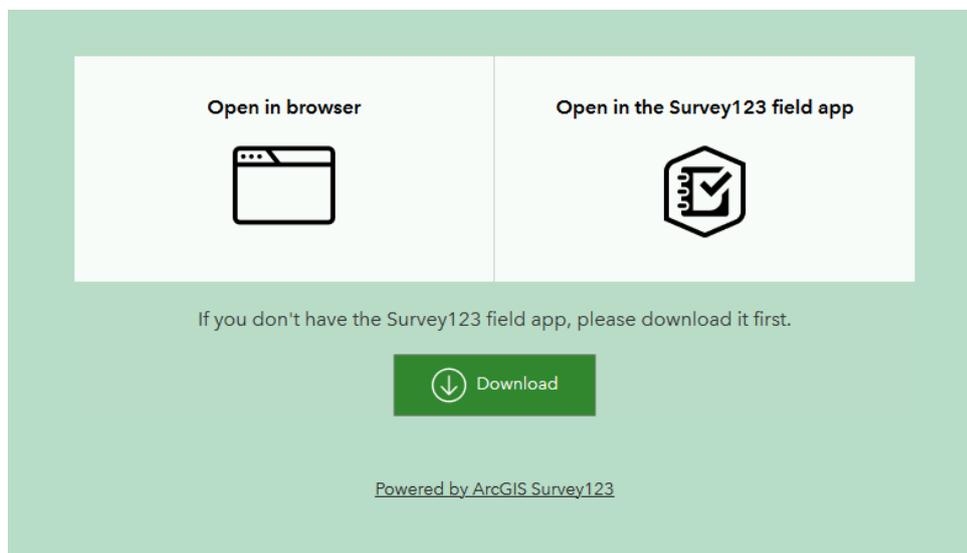
You do not need a username and password to use the app. If you open the link above, you will see a screen like this appear in your browser:



3. Select 'Open in the Survey123 field app' and the Standing Oak Tree Survey app will begin to download.

### Desktop or laptop computers - installing the app on PC, Mac or Linux

1. The Survey123 field app is also available for Windows, macOS, and Linux. To install Survey123 on a desktop, do the following:
2. Download the Survey123 field app installation file for your operating system from [the Survey123 Resources page](#). Alternatively, follow the link below and select 'download'.
3. Double-click the file to install. Once the installation is complete, a desktop shortcut named Survey123 for ArcGIS is created.
4. Once the app is installed, follow this link in your browser to download the original Standing Oak Tree Survey App: <https://arcg.is/04aC9y> or, follow this link to install the new 'Lite' version of the app for quicker records: <https://arcg.is/1SiHKP>
5. You do not need a username and password to use the app. If you open the link above, you will see a screen like this appear in your browser:



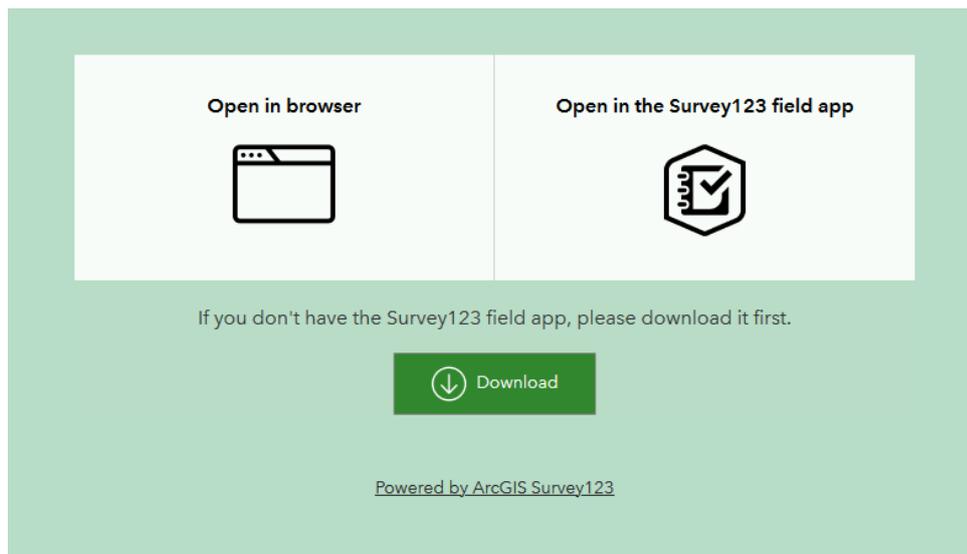
6. Select 'Open in the Survey123 field app' and the Standing Oak Tree Survey app will begin to download.

## Using the app in a browser

The Standing Oak Tree Survey app is also available for use directly from a browser, however this lacks some of the functionality, such as saving repeat answers and the ability to return to saved entries for further editing.

1. To open the FTOL collections portal in a browser follow this link: <https://arcg.is/04aC9y> or, follow this link for the new 'Lite' version of the app for quicker records: <https://arcg.is/1SiHKP>

You will see a screen like this appear in your browser:



2. Select 'Open in browser' and the Standing Oak Tree Survey will open in your default browser.

## Using the app



Once you have the Survey123 app installed and the Standing Oak Tree Survey downloaded, you can begin entering observation data. The questions and their format are identical on all platforms. Please take your time and good care when entering information. Please ensure spellings are correct, especially of scientific names when using expert mode. You can check these by making a Google search or looking in [Species Fungorum](#) if you are unsure.

When launching the Survey123 app, you will see a sign in screen. There is no need to sign in, so select 'Continue without signing in' to enter the 'My Surveys' page.

To begin, select the 'Standing Oak Tree Survey' from the 'My Surveys' page. This will open the survey and you can then press the blue 'collect' button to start adding data.

Each observation of a single tree from a unique location requires its own survey entry. If you have multiple trees from the same location, create separate survey submissions for each of these. Each tree can have up to 10 fungal observations attached to it.

You will notice that some questions or entries are marked with an asterisk, these are required questions and must be answered before the survey can be submitted.

Work through the survey from top to bottom, either in the app or a browser. Extra details for each of the entries is included in order below.

For additional guidance with using the apps features, see the 'Getting the Most Out of the App' section of this document.

## Your information

In this section we will collect information about you, the collector, and the collection you have made.

### **Collections number**

This is an automatically generated identifier for your observation, and you do not need to enter anything here. We use this to find records quickly.

### **Collector number**

If you intend to make an ongoing contribution, we recommend that you apply for a collector number so that we have your contact details and can trace your records. You can quickly get a collector number to your email account by following this link: [collector number form](#)

This is not a requirement and you are free to contribute records anonymously.

The form will ask for your name, email address and organisation if you have one. Once you've submitted you'll receive a code via email. Enter this into the collector number field each time you make a submission (it should be picked up by predictive text).

## Location details

The location at which the observation was made is of great value when it comes to conservation assessment, understanding distribution and many other uses. Our app can utilise the GPS location provided on mobile devices and allows the manual selection of a location on a range of different base maps.

### **GPS Location**

If you are using a mobile device in the field, please turn on your location service and your GPS location will update automatically. If you cannot use GPS location or you are entering the record away from the collection site, please select the location using the map tool.

By clicking or tapping on the GPS location widget you can enlarge the map view. From here you can select other types of base map, search by place name and right click or press and drag to drop a pin on the exact location of the collection. This can also be done to override an inaccurate GPS location.

There is a currently known bug with this GPS widget on older versions of Safari and Apple devices. If the widget does not display correctly or does not load, please provide us with a grid reference using the entry below.

### **Grid reference**

If you are having difficulty using the GPS location widget, which is known currently to have loading issues on some older devices, then please tell us the grid reference at which the collection was made. The grid reference should use the Ordnance Survey National Grid reference system. You can use [www.gridreferencefinder.com](http://www.gridreferencefinder.com) to assist you with obtaining an accurate grid reference. This web map service is searchable by location name, postcode, and other methods. A precise location can then be found using the aerial photography layer.

## Habitat

Providing information about the habitat in which the tree and fungus have been found is very valuable. This can help us understand the range of each species, where they prefer to grow and if this is changing, all things that can contribute to fungal conservation.

Select a habitat from the multiple-choice boxes. The list comprises of a simplified selection of broad habitats. You can select more than one answer to give a more accurate indication. E.g. "Improved + Grassland" or "Broadleaved woodland + River"

Woodland	Built-up area
Broadleaved woodland	Roadside
Coniferous woodland (mainly)	Montane
Mixed woodland	Rocky
Woodland and scrub	Sand dune
Scrub	Peat
Recently felled woodland	Marsh, bog or wetland
Recently planted woodland	River
Parkland/scattered trees	Brook or stream
Lone standing (field tree)	Coastal
Grassland	Farmland - crops
Hedgerow	Farmland - grazed
Urban	Farmland - ungrazed pasture
Garden	Improved

## Additional habitat information

If there is something more about the habitat that you would like to tell us, enter the detail here.

## Country, county, location name

Please give details in this order, separated by commas: country, county, and the closest location name. Location names can be found on Ordinance Survey maps.

e.g. Wales, Vale of Glamorgan, Merthyr Mawr.

## Information about the oak tree

In this section we would like you to provide us with as much information about the oak tree as possible.

### Which species of oak are you recording?

Our focus is on native oak trees, The pedunculate oak (*Quercus robur*) and the sessile oak (*Quercus petraea*). Select which species you are recording. If you are recording on a non-native oak or hybrid and you are sure of the identification, please select it from the drop-down box or type the scientific name into the 'Other species' box. You can find more information on how to identify the native species in the 'Identifying oaks' section of this guide.

If you are unsure of the oak species, please choose the 'I'm not sure!' option and take a photo of the leaves, and if possible, the acorns, while still attached to the tree. Upload it with the other tree images at the bottom of this section, to help us with identification.

Oak species options include:

*Quercus robur* (Pedunculate Oak)  
*Quercus petraea* (Sessile Oak)  
*Quercus x rosacea* (Hybrid Oak)  
*Quercus ilex* (Holm Oak)  
*Quercus rubra* (Red Oak)  
*Quercus cerris* (Turkey Oak)  
*Quercus coccinea* (Scarlet Oak)  
*Quercus macranthera* (Caucasian Oak)  
*Quercus ellipsoidalis* (Northern Pin Oak)  
*Quercus pyrenaica* (Pyrenean Oak)

### If you know when the tree was planted, please tell us how old it is

If you know from historical records or personal experience when the tree was planted, please tell us here. Estimates within a decade for older trees are acceptable, otherwise please leave this blank.

### Is the tree alive or dead standing?

Check the tree for any sign of green leaves still attached in Spring or Summer. During winter this can sometimes be difficult to judge. If there are very large areas of lost bark or complete ring barking of the trunk, please indicate as dead. If you are unsure, please leave this question blank.

### Has the tree been managed through coppicing, pollarding or monolithing, or does it have a particular growth style?

Trees can be pruned or managed in many ways, which will affect the overall form and development of the tree throughout its life. We are interested to know how this may affect the presence of different fungal species.

Being able to spot these management styles is a skill that takes a little understanding to develop. We have provided images to assist you with making a decision, but if in doubt answer, 'I'm not sure' and take some good photos from a distance.

## Measurements

Measuring trees can be a little tricky! To make things more difficult, there are lots of different ways that can be used to measure trees. Please check carefully that you are following our guidelines for measuring, in particular that we are measuring at **1.5 metres** (150 cm) above the ground level and all measurements are in **centimetres (cm)**.

There are two options when submitting measurement data, either accurately measuring with a tape and providing us with the tree's circumference or estimating the tree's diameter using your body as a guide. Please only supply one set of measurements, either measured or estimated.

Some trees may not offer a simple way to measure, multi-stemmed trees for example. In these cases, you can enter several measurements separated by commas.

For trees that are heavily burred or unusually shaped, please make an approximate subtraction to give a true sense of the tree's diameter, without burrs or cankers, at 1.5 m height from the ground.

For details on how to measure see the 'Measuring trees' section in this guide.

## Where are the signs of decay, wounds, or entry points on the tree?

Look at the tree from butt to lower branches and let us know in which areas of the tree there are any signs of decay, entry points or wounds. We divided a tree into 4 main areas: butt, trunk, lowest branches, and higher branches. Please select all that apply or no visible signs if there is nothing present. See the next question for a list of the types of entry point.

## Decay, wounds, entry points and features

Please select what types of decay, entry/exit points or wounds are present on this tree. Please select all that apply or select no visible signs if there is nothing observable. You can also select 'other' and provide us with further detail if your observation is not available on the list. The selections include:

- Cut branch(es)
- Reductions (pruned)
- Decayed or dead attached branch(es)
- Cracked branch(es)
- Woodpecker holes
- Insect galleries or bore holes
- Broken trunk
- Bark damage exposing cambium
- Large wounds exposing heartwood (not hollows)
- Healed over wound
- Small hollow (less than 20cm in any direction)
- Medium hollow (greater than 20 cm up to 40 cm in any direction)
- Large hollow (greater than 40 cm in any direction)
- Lightning scar(s)
- Fire scar(s)
- Burr(s) or canker(s)
- Damaged roots
- Exposed root cavities
- Water-filled hole(s) at base (Dendrotelm)
- Stem bleed (dark coloured weeping fissures)
- Buttress roots

## Other information about the tree

You can use this box to give us any additional information about the tree that you think may be relevant.

## Photos of the tree

Please provide one or more images of the tree, focusing on decay, wounds, and entry/exit points.

You can take a photo with your mobile device's camera or upload an image. To submit more than one photo press one of the '+' buttons that appears after adding a photo.

High-quality photographic documentation greatly improves the value of an observation and allows us to check for errors. Please take and select images that display the features as clearly as possible.

When adding images, you can do so either directly through the device's camera, which is very useful if you are in the field, or by uploading a previously taken image from your devices file storage.



This button will open your devices camera to take an image in the field or *ex situ*. This is not so useful on desktop devices as it will access your webcam.



This button allows you to upload a file and will open your file browser to enable selection.

By uploading images to this survey, you are giving permission for your images to be used by our project under a Creative Commons Share Alike 4.0 license (CC SA 4.0). If we use the photo in any form of publication, we will ensure that you are credited where it is used.

For further advice on taking good quality and informative photos, please see the 'taking photographs in the field' section further on in this document.

## Information about the fungi on the tree

In this section, please tell us about the fungi you have observed fruiting on the oak tree. You can add multiple fungus observations to a tree by moving the slider to the right. We can accept between 1 and 10 species of fungi per tree. If you have managed to find more than 10 species, you can list them in the 'Additional information' field at the end of the survey.

If you are unsure of the identity of the fungus please select 'I'm not sure!' and take 2 clear photos that include all of the features, especially the underside where there may be gills or pores.

For help with identification see the 'Key fungal species found on oak' section or alternatively the [TMA Fungi website](#) or app.

You can either choose a species from the selection of key oak species with images in 'simple' mode, which is great for most quick records, or you can enter species by scientific name in 'expert' mode. Select which one you would prefer and then move the slider to set how many species of fungi you will be recording; this will increase or decrease the number of 'Fungus observations'.

## Fungus observations

Open each fungus observation in order, complete the section and then close it before moving onto the next one. If you are working in 'simple' mode you will see a selection of species names, check boxes and images. As before, you can press an image to enlarge it, to help with identification. If you are working in 'expert' mode, start typing the current species name in the first field and a list of possible species will appear to select from. If the species you have found is not listed, please tell us the species name in the field below.

## Photos of the fungus

You can take a photo with your mobile device's camera or upload an image. Please try and capture an image that shows the top and underside of the fungus, including the pore or gill layers. If this is not possible in a single shot, please add another image. You can also upload microscopic images if relevant, but please ensure they include a scale bar.

If possible, place a coin or ruler in the photo for scale.

To submit more than one photo press one of the '+' buttons that appears after adding the first image.

When adding images, you can do so either directly through the device's camera, which is very useful if you are in the field, or by uploading a previously taken image from your devices file storage.



This button will open your device's camera to take an image in the field or ex situ. This is not so useful on desktop devices as it will access your webcam.



This button allows you to upload a file and will open your file browser to enable selection.

When moving on to add data to the next fungus observation section, we advise closing the previous section, as this will prevent the survey from jumping up the page when new images are added on the device. This is a known bug and one we hope will be resolved with updates by the platform developers soon.

By uploading images to this survey, you are giving permission for your images to be used by our project under a Creative Commons Share Alike 4.0 license (CC SA 4.0). If we use the photo in any form of publication, we will ensure that you are credited where it is used.

For further advice on taking good quality and informative photos, please see the 'taking photographs in the field' section further on in this document.

**From how many points on the tree is this species fruiting?**

For this question we would like you to count the number of separate clusters of fruitbodies that are growing from different points on the tree. This can help to give us an idea as to how colonised the wood is by this species.



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This *Armillaria* sp. (honey fungus) has lots of caps growing from a single point (fasciculate growth). As it is joined at the base, this would count as a single point of growth, therefore the entry would be “1”.



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This *Laetiporus sulphureus* (chicken-of-the-woods) has lots of dense shelf like lobes that are conjoined. The conjoined fruitings are arising from 4 separate places.

In this case, the entry for the number of points of fruiting would be “4”.



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Many fungi on trees are likely to produce a single fruitbody, but there are always exceptions. These Oak Brackets (*Pseudoinonotus dryadeus*) are fruiting extensively from 45 separate points around the tree, made up of a total of 75 brackets. The brackets that were joined to another bracket were counted as a single point.

The total number of points for this record is “45”.

### Where are the fruitbodies on the tree?

Look at the tree from butt to lower branches and let us know in which areas of the tree there are fruit bodies for this species of fungus. We have divided a tree into 4 main areas; butt, trunk, lowest branches, and higher branches and additionally mycorrhizal species, which are most likely to be found on the soil around the tree.

Please only select mycorrhizal species if you are confident that the species in question is mycorrhizal and that it is associated with the tree that you are recording.

Select all that apply for this fungus.

### Which part of the tree is the fungus growing on?

As well as which areas of the tree the fungus is found on, we would like to know more specific information. We have provided a selection of common options, if your observation does not fit any of these, select ‘other’ and tell us in the field below.

- |                          |                                      |
|--------------------------|--------------------------------------|
| On bark on trunk         | On rotten wood on butt               |
| On exposed wood on trunk | On exposed roots                     |
| On rotten wood on trunk  | On soil but attached to buried roots |
| In hollow on trunk       | On bark on branches                  |
| On moss on trunk         | On exposed wood on branches          |
| On dead trunk            | On dead branches                     |
| On bark on butt          | On soil around the tree              |
| On exposed wood on butt  |                                      |

### Additional fungus information

At the bottom of each ‘fungus observation’ section there is an area for any additional notes. You can tell us anything extra about the fungus here.

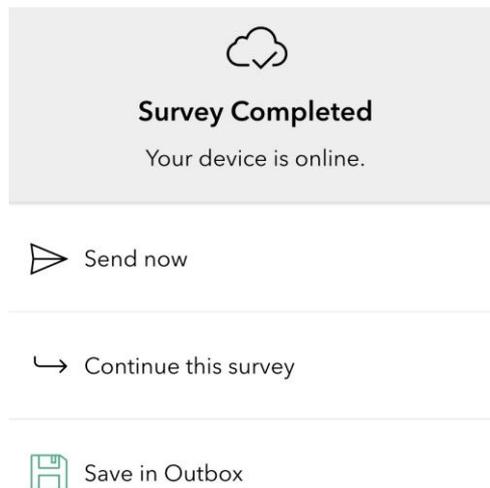
### Additional information

This is a final additional notes section where you could tell us anything you think has been left out, including more species of fungi if you observed more than 10 for this tree.

### All done!

Press the tick icon at the bottom right of the survey to submit your data. If you have not filled in some of the required information the survey will highlight your missing answers.

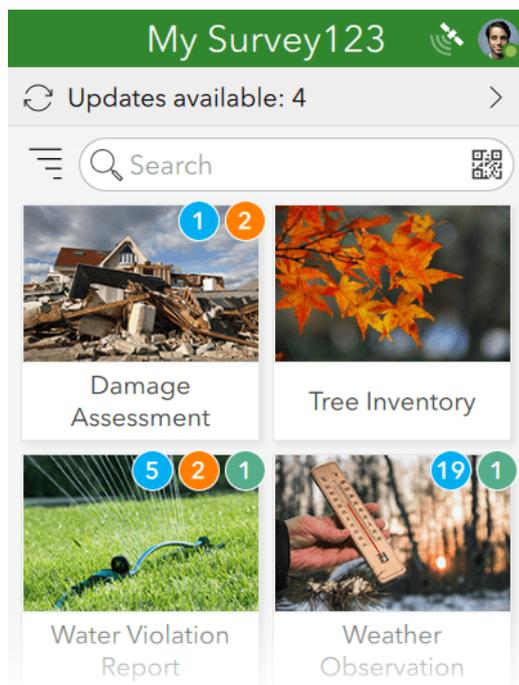
If everything is complete you will see the following options:



If you have a mobile data connection then choose 'Send now' to begin the upload, otherwise you can save in your outbox and send it when you have a data connection or access to Wi-Fi.

## Getting the Most Out of the App

When using the Survey123 field app there are additional features that can help to streamline your user experience. In this section we will look at some of the app's functionality.

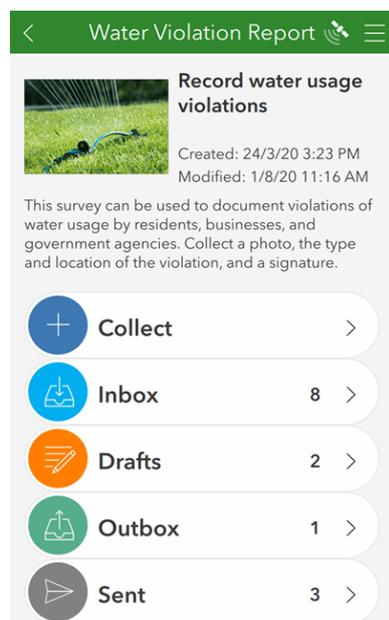


### My Surveys

This is the home page of the app. If you are only using the Standing Oak Tree Fungus Survey, then this will be the only survey with its icon displayed here.

Numbers in the corner of a survey's icon indicate unfinished or unsent results. If there are unfinished draft entries, the number of drafts will be listed in an orange circle, while the surveys queued to be sent later in the survey's outbox are numbered in a green circle.

A bar at the top of the page will show the number of updates available. Selecting this bar will open the Update Surveys page and will allow you to update to the latest version.



### Survey contents

The survey contents page can be accessed by selecting a survey from the My Survey123 page. Here, you can start collecting new data or access previously collected surveys.

The options on this page are as follows:

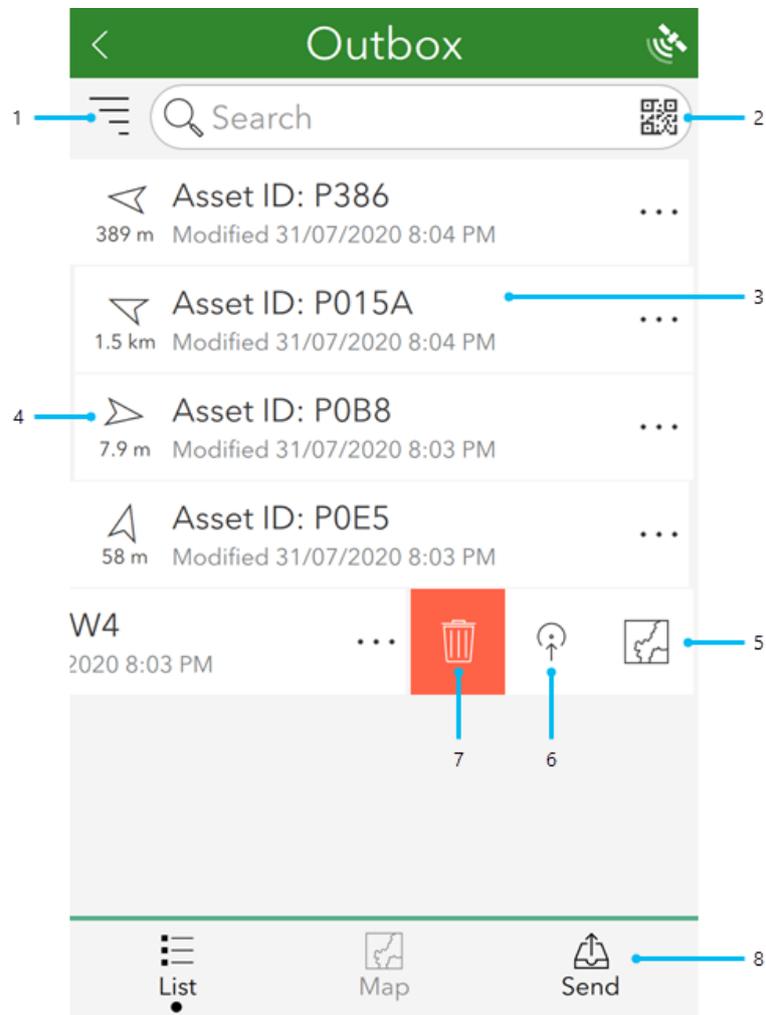
**Collect** - Opens a new, blank survey page for inputting data.

**Drafts** - Opens to a form currently left uncompleted by closing the survey before sending it.

**Outbox** - Opens to a listing of all forms finished but unsent, either by choice or because the device was offline when submitting.

**Sent** - Contains the records of all forms submitted to Kew.

The Drafts, Outbox, Sent, and Inbox pages have similar layouts, with standardized buttons and functions. The following image is of the Outbox page but be aware that all three pages look and behave similarly.



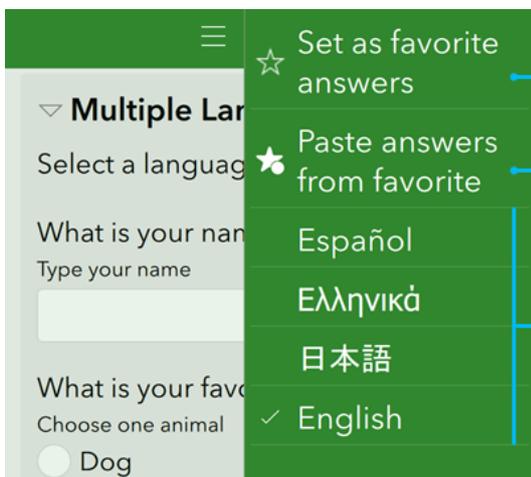
The options on these pages are as follows:

1. The sorting options allow you to list the responses by alphabetical order, submission date, or distance.
2. Search for values contained in existing records. If a single result is found, the app will load the survey with all existing answers from that record already filled in. Otherwise, the app will show a list of all results found.
3. Select a record to open it, either to edit the existing response, view, or create a copy. The available actions will vary depending on which folder you are in.
4. These indicators show the distance and direction from your device's location to the record and will update as you move.
5. The Map button opens a map of all records, centred on the selected record.
6. If the record has a valid location, this button will allow you to open another app to navigate to this point.

7. Delete deletes the record from your device.
8. The Send button on the Outbox page submits all records currently listed in it. This button does not exist on the Sent page; however, the Sent page instead has an Empty button, which clears the listing of all sent records. It does not delete the surveys from our data.

### Favourite answers

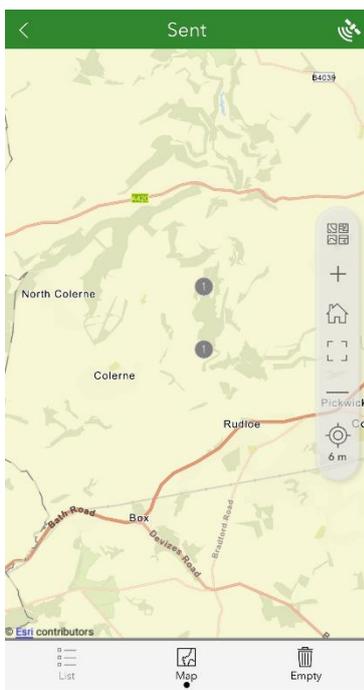
To create a set of favourite answers that you can reuse, first complete a survey with your preferred answers. Then use the Menu button to select Set as favourite answers (1a) before submitting it. This saved survey is now marked with a star icon in the Sent list, and the Paste answers from favourite option becomes visible on the menu bar in a new survey (1b). This menu option will apply your favourite answers to the current survey automatically.



Note:

1a Favourite answers are saved as a marker on the sent survey, signified by a gold star on their entry on the Sent page. If this survey is deleted from your device, the favourite answers will also be deleted.

2 Favourite answers do not include location values.



### Viewing your records

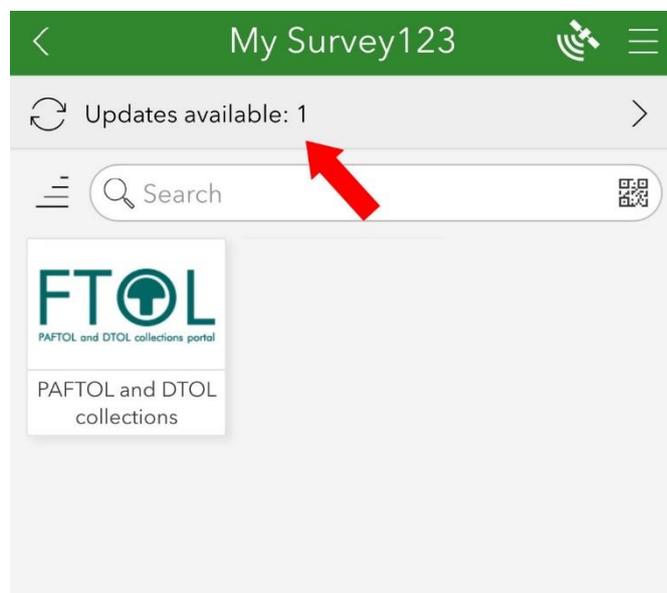
As mentioned above you can view your own records in your sent folder (or drafts). They will appear as a list and each can be opened and checked individually. You can also view all of the records on a map, which is helpful if you want to see how well you have covered a particular area or if you had recorded from a tree at a previous time.

You can update records from here with new information. This means that if you make a new fungal observation on a previously recorded tree, you can open the record and add the new observation and reupload the survey.

## Updating the Survey and Uninstalling the App

### Updating the survey

Every so often we will make alterations to the survey. These changes will be made in response to feedback and will also include new features or improvements. Updating is straightforward and you will receive automatic notifications of available updates at the top of the 'My Surveys' page.



Click on the update notification bar and then select 'Standing Oak Tree Fungus Survey' by clicking this button:



The survey will then automatically update.

### Uninstalling the App

The method of uninstalling the app will vary between devices but is easily managed through the native App Manager on all devices.

If you have unsent submissions which have not been sent in your drafts or outbox, please consider completing these before you uninstall the app, as all of your local data will be deleted during this process.

## Identifying native British oaks

In the UK we have 2 native species of oak: *Quercus robur* (pedunculate oak) and *Quercus petraea* (sessile oak). They have many similarities and to complicate matters there is also the hybrid between these 2 species, *Quercus x rosacea*. For this project we are content with identifications based on quick field characteristics, such as leaf shape and acorns. We will only focus on separating the 2 British species here. For suggested guides to identifying other oak trees see the 'References and useful links' section of this guide.

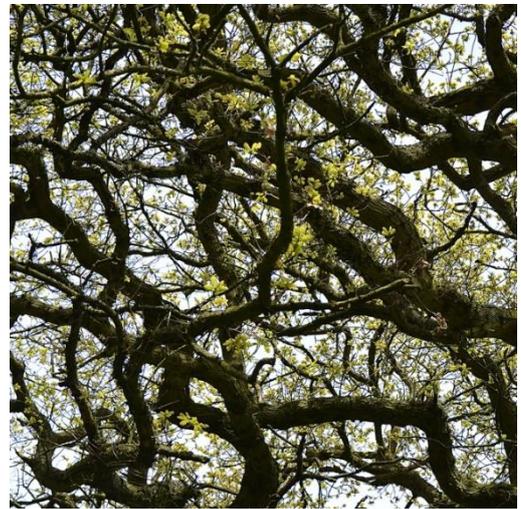
### ***Quercus robur* (pedunculate oak)**

This is the dominant oak tree in the UK and can be found most places, except for on marshy, chalky or light soils. It is the iconic oak of the British landscape.

**Overall shape:** Heavy, broad, and rounded, with twisting branches and foliage that forms in bunches.



© Peter O'Connor CC BY-SA 2.0



© Robin Stott CC BY-SA 2.0

**Bark:** Grey-brown with short running, deep, knobby ridges.



© Acabashi CC BY-SA 2.0

**Flowers:** Drooping strands of yellow male Catkins.



© Peter O'Connor CC BY-SA 2.0

**Leaves:** Margin is made up of irregular deep rounded lobes. 2 smaller lobes (auricles) curl around the short leaf stem.



© Trüffel Didi CC BY-SA 4.0



© Arnstein Rønning CC BY-SA 3.0

**Acorns:** Often form in pairs on a long (5-12cm) stalk (peduncle).

### **Quercus petraea (sessile oak)**

This species is generally absent from lowlands and avoids heavy alkaline soils. In some areas this is the dominant oak species, but it is less common than *Quercus robur*.

**Overall shape:** Cleaner, straighter, less twiggy, and often taller than *Quercus robur*.



© John Haynes CC BY-SA 2.0

**Bark:** Grey-brown with short running, fairly deep, knobby ridges.

**Flowers:** Drooping strands of yellow/green male catkins.

**Leaves:** Margin with regular, shallow lobes. Base broadly tapered down to a short (12-20mm) leaf stem.



**Acorns:** Form directly on the twigs, with only a very short stalk or none at all (sessile).



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## Key fungal species found on oaks

### *Laetiporus sulphureus* (chicken-of-the-woods)



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Perhaps one of the most recognisable of all British fungi, *Laetiporus sulphureus* is a distinctive bright yellow to orange coloured bracket that fades to off white with age. It is a fleshy, annual bracket with fruitbodies generally appearing from May until October, sometimes lasting a month or more. The pore layer, on the underside of each bracket, is often almost entirely smooth in appearance when young, with pores only appearing to the naked eye as the bracket matures.

There are no obvious lookalikes for this distinctive fungus, however, it is likely that there are several cryptic species present in the UK. We are conducting research into the current species diversity of *Laetiporus*, so if you notice a bracket with a pure white pore layer and bright orange cap, as opposed to the usual yellow pore layer, or if you notice other unusual characteristics, please tell us about them and take good photographs when submitting your records.

*Laetiporus* fruit bodies are important habitat for many insects, especially species of beetle like the hairy fungus beetle (*Pseudotriphyllus suturalis*).

This is one of the key heart-rot species on oak, causing a brown rot that eventually creates hollows that can be very rich in biodiversity.

*Fistulina hepatica* (beefsteak fungus)



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We currently believe *Fistulina hepatica* to be the most important of the heart-rot fungi on oak, causing a brown rot that creates hollows from the dead heartwood. This is another fleshy, annual bracket often with a moist surface. The top of each bracket ranges from pale foamy pink when young, through to rich reds and browns, reminiscent of internal organs like livers or hearts, as the bracket ages. A slice through this soft fruit body will reveal a veined flesh like context, which when squeezed will produce droplets of red exudate, making the common name 'beefsteak fungus' very fitting.

With these strong features it is an easy fungus to identify and is very common on older oaks.

*Ganoderma* spp. (bracket fungi)



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Species of *Ganoderma* are tough, woody, perennial brackets that can last for many years. They are white rotters of heartwood and in some cases, they are also parasitic on their host trees, attacking sap wood and roots.

They can have shiny, resinous caps, ranging from dark black through to fantastic orange and red sunbursts when young, often fading to a brown, brick like colour with age. Their pore surface is always white while alive and fresh and in some cases is easily bruised dark brown by applying pressure or marking with a stick. There are a few different species that occur on oak, which can be hard to tell apart in the field. Most of the common ones occur as brackets, others such as *Ganoderma lucidum*, can occur with a stem.

Their spores are the colour of coco powder and can often be seen attached to plants or wood below the fruiting bodies.

*Hymenochaete rubiginosa* (oak curtain crust)



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This is a common species of fallen oak wood but can also be found near wounds of living trees.

The curtain like brackets hang down over each other, often with many tiers in one location. Each has a dark base close to the substrate and a lighter, zonate margin made up of parallel bands in shades of brown. The pore layer is dark and smooth, often with a lighter margin.

It is similar to some *Stereum* species, but its dark colouring, overlapping tiers, and brackets that do not have a pore layer that runs down the woody substrate, help to separate it from these species.

*Gymnopus fusipes* (spindle toughshank)



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*Gymnopus (Collybia) fusipes* is a fungus that can be found at the base of oak trees, attached to roots that it is decaying beneath the soil.

It grows densely in clusters often arising from a small area. When a single fruitbody is gently pulled out of the soil it will reveal a long, tapered base to the tough and fibrous stem. These are pale gilled fungi with white spores that can sometimes be found on the caps of fruitbodies that are lower in the cluster. The stems fade from reddish browns in the base through to cream towards the gills.

The clustering (fasciculate) growth and tough, tapering stem are good field characters for this fungus.

*Gymnopus fusipes* is notorious for causing the early death of oak trees due to the rotting of roots that are essential to strengthening a large old tree against wind blow.

*Daedalea quercina* (oak mazegill)



© Norbert Nagel CC BY-SA 3.0

This tough, perennial bracket gets its common name from the large and labyrinth like pores on its under surface. It is a common white rot fungus on oak and occasionally other broadleaved trees.

It ranges in colour from creamy buff through to pale browns and can take on a deceptive array of forms. Sometimes it will occur as solitary semi-circular brackets, other times in a semi-conical form and also as patches of conjoined brackets with a shared pore surface (effused).

It is most often found on dead wood, but can also be seen on partly decayed living trees.

*Pseudoinonotus dryadeus* (oak bracket)



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Often a large and tough bracket, *Pseudoinonotus dryadeus* exudes amber droplets from the growing regions of the fungus. This occurs all over the surface when young and just around the advancing margin when older. This can be especially notable and beautiful in freshly emerging specimens.

This fungus is found at the base of trees, often where the butt reaches the soil surface.



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*Grifola frondosa* (Hen of the woods)



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*Grifola frondosa* is a short-lived firm, but fleshy polypore, that grows at the base of broadleaved trees such as oak and beech. This fungus attacks living trees often causing extensive white rot in the roots.

Its many wave like crests, brown upper surface and smooth white pore layer are distinctive. Another similar fungus, *Meripilus giganteus* (blackening polypore) can be separated from this species by its larger lobes, more yellowish colours and that it blackens when bruised or with age. Cauliflower fungi in the genus *Sparassis* are more evenly and finely lobed, over all dome shaped, and lack the darker brown colouring.

*Stereum* spp. (crust fungi)



© Henk Monster CC BY-SA 3.0

*Stereums* are fungi that grow as tiers of reflexed thin brackets extending from a smooth and often conjoined pore layer. They are somewhere between a resupinate crust and a small bracket. There are a few species that can be found on oak and they are not easy to separate for beginners. We are happy with an identification to genus level and some good photos.

However, a good field guide should be enough help to guide you to a clear identification in some cases.

The species pictured above is *Stereum gausapatum* (bleeding oak crust), which can often be found on oak branches and is also known to decay heartwood. When cut with a knife or dug into with a fingernail it bleeds a dark red latex, hence the common name, bleeding oak crust.

*Buglossoporus quercinus* (oak polypore)



© Vavrin CC BY-SA 3.0

This rare, annual bracket fungus is one of the few protected species of fungi in the UK. It is usually known from ancient or veteran oak trees, where it can be found decaying their heartwood, but it can also occasionally be found on younger trees where damage has exposed interior.

It produces fleshy, flattened, slightly convex brackets that can be fan shaped to rounded, that become tougher and lighter with age. They start off whitish with yellow tinges and then brown on the upper surface as they age. The pore surface is smooth and white, but bruises and ages to a dirty brown.

*Armillaria* spp. (honey fungi)



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Species of *Armillaria* are notorious amongst gardeners and foresters as they pose a serious threat to living trees. They often attack through white rot of the roots, eventually undermining the trees stability or reducing its ability to draw enough nutrients, either often resulting in death of the tree. The fungus then continues as a saprotroph breaking down the dead wood.

These fungi can occur in dense clusters or as scattered solitary fruitbodies, depending upon which species it is. Identification can be difficult, so we are happy with genus level for this group.

A distinctive feature of the *Armillaria* species that can be found on oak, is their black rhizomorphs which can be found working their way under bark and through the surrounding soil. These melanised conduits serve as an armour-plated corridor for the fungus to safely grow along, protected from insect damage, the elements and competitor fungi.

The fruit bodies all have light to mid golden-brown caps that have a finely scaly surface. Their gills are pale, and the spore print is white. They all have a ring on the stem, apart from *Armillaria tabescens*, the ringless honey fungus.

*Trametes* spp. (turkey tails)



© Jerzy Opiola CC BY-SA 3.0

Turkeytail fungi can be found throughout the year and occur in a diverse range of banded colours that can vary widely within species. The common species, *Trametes versicolor*, pictured above can be found on the wood of many broadleaved species throughout the temperate world.

There are several similar species in this genus, with similar zonation patterns, ranging from cream, through ochres to velvety greens and blues.

*Pleurotus dryinus* (veiled oyster)



© By Strobilomyces CC BY-SA 4.0

This uncommon and beautiful oyster fungus can be found on living or dead hardwood trees, often oak or beech. It often fruits in small numbers but can occasionally be found in larger groupings.

Unlike other species of *Pleurotus*, the veiled oyster has a partial veil, the remnants of which can be seen around the cap margin in the picture above. This oyster fungus also has a felty or scaly cap a feature not seen in other members of the genus present in the UK.

The pale cream fruitbody, decurrent gills and veil make this an uncommon fungus that is easy to identify.

*Pleurotus ostreatus* (grey oyster)



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One of the more common fungi to be found on dead wood and one well known amongst fungus enthusiasts, *Pleurotus ostreatus*, is a fleshy shelf like mushroom, with a brown to grey cap and strongly decurrent gills that often run all the way down their short stems.

It can be found on living and dead trees and fallen wood and often produces fruit bodies more than once a year.

*Peniophora quercina* (oak Crust)



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© Björn S... CC BY-SA 2.0

*Peniophora quercina* is a resupinate crust fungus that often occurs on dead wood of oaks but can also be found on living trees. It is a white rotter and is generally regarded as a pioneer species on dead wood.

This species changes appearance depending on whether it is wet or dry, ranging from adpressed pink patches that envelop the surface in damp conditions, through to broken grey or lilac islands with curled in edges when dry.

*Phellinus* or *Fuscoporia* spp. (pore crusts)



© Raeky CC BY-SA 3.0



© {{{2}}} CC BY-SA 3.0

*Phellinus* and *Fuscoporia* species are mainly white rotters that are found on wood and can take many different forms, from flat cushion like crusts, through to entire brackets. This makes them a difficult group for beginners to identify and hence we have grouped all of the pore crusts together in simple mode.

A useful character in this group is the pore layer, which may be all there is to see of a fruiting body that is adpressed to the surface of the wood or in other cases may be on the underside of a bracket. The pore layer is often a rich orange to cinnamon brown colour and the pores are visible to the naked eye with around 5 per millimetre.

*Podoscypha multizonata* (zoned rosette)



© Lukas Large CC BY-NC 3.0

*Podoscypha multizonata* is a rare and beautiful fungus that can be found at the base of oak trees. It appears to only be known from the southern UK, with a concentration of records in the south east.

This is a highly distinctive fungus, with pale pinkish lobes that form a dense rosette. The tips of each lobe end in a darker margin. Similar species include *Grifola frondosa* (mentioned above) which does not form a rosette like structure and lacks the pinkish tones.

## Measuring trees

The measurement of a tree's circumference or diameter is an important piece of data in our survey. From this data we will extrapolate a rough age for the tree.

There are two options when submitting measurement data, either accurately measuring with a tape and providing us with the tree's circumference or estimating the tree's diameter using your body or other methods as a guide. Please only supply one set of measurements, either measured or estimated.

All measurements need to be made at **1.5 meters** from ground level. If the tree is on a slope, measure from the 1.5m height on the upper side. If a tree is leaning, measure from the side that it is leaning towards.

If a tree forks below 1.5m then take the measurement below the fork and let us know what height this was taken from in the additional notes field at the end of the section.

Some trees may not offer a simple way to measure, split or multi-stemmed trees for example. In these cases, you can enter several measurements separated by commas. e.g. 75, 85, 60. Please add any notes about the number of stems or the overall form in the additional notes field.

For trees that are heavily burred, bulged, or unusually shaped, please make an approximate subtraction to give a true sense of the tree's diameter, without burrs or cankers, at 1.5m height from the ground. This can sometimes be achieved by measuring below the 1.5m height.

### By estimate

#### **For those who can make their collar bone level reach roughly 1.5m (either by tiptoes or crouching)**

This method works best if you are estimating with another person or in a group. Please remember to maintain physical distancing unless you are members of the same bubble.

To make a good estimate of the tree's diameter, you first need to know how long your arm span is. If you are able-bodied, this can be achieved with a tape measure or ruler by reaching straight out to one side with one arm, holding the end of the tape measure with the tips of your fingers and then measuring to a point at the centre of your collar bone, this measurement can then be doubled to give you the full span. The same can be achieved with a ruler if you have some help from someone else. If this measurement does not feel accurate, or does not work with your body, then choose a length that you will find easy to use in the field and measure that. Alternatively, see below for measuring by eye.

For estimated measurements we want to find the **DIAMETER**, which is the distance of a line that runs through the centre of the tree from one side to another.

Once you have the measurement of your arm span (mine is 165cm), to measure a tree, get right up close to the trunk and spread your arms out straight. This is where the other person comes in. Standing back, they can observe your position in front of the tree and ask you to move to the right until your fingertips or right extremity are aligned with the right-hand edge of the tree. They can then make an estimate as to how much of the tree's diameter is covered by your arm span. I find it easiest to think about this in divisions of 10, so how many tenths of the arm span cover the tree or how many extra tenths are required to reach all the way across?

For example, if I were measuring a tree that was 150cm diameter, the person observing would say that my arm span (165cm) covered roughly 9 tenths of the diameter. If the tree were 100cm diameter, they would likely come up with an estimate of roughly 6 tenths ( $6 \times 16.5 = 99$ ).

### Estimating by eye

There are also ways of estimating by eye, which also require a bit of calibration to improve accuracy. This method requires a pen or pencil to act as your measuring device.

To calibrate your pen or pencil, place a ruler or measuring tape on the edge of a table. Then with your back to the table take 2 (or 3 but remember how many and always stick to it) full length paces away from the table and then turn around to face it. Hold the pencil or pen out horizontally at arm's length, holding the centre, and line up the left tip with the start of the ruler or tape measure on the table. Now look carefully at how far along the ruler the right-hand tip reaches, keep a close eye on that point and then approach the table to record the measurement.

For me, at 2 full paces away from the table, my pen measures 55cm. My pen is now calibrated for use.

In the field you can now measure a tree by standing as close as possible with your back to it and then take two full paces away and turn around to face the tree. Take your pen in the same way that you did to calibrate it, at arm's length, and look to find a point on the tree that is roughly 1.5 meters from ground level. Now, measuring from left to right, approximate how many times your pen or pencil fits into the **DIAMETER** of the tree. If I was measuring a tree was 100cm in diameter, my pen would fit roughly 1.8 times.

### By tape

Measuring by tape is perhaps the easiest and most accurate method. Using a 10 metre surveyors' tape is best. Either by getting someone to assist or by using a drawing pin position the start of the tape at 1.5m height on the tree. Then bring the tape all the way around the **CIRCUMFERENCE** of the tree, back to the starting point and record the measurement. Remember to make subtractions if there are burrs or unusual growths that are affecting the measurement at this height.

## Taking Photographs in the Field

Wherever possible, it is of great use to have good images of the tree or fungus to support an observation. As the Standing Oak Tree Survey app is primarily designed to work on mobile devices, we here include a few simple tips to consider while photographing fungi on a smart phone. Many of these simple tips also work well for other cameras.

### 1. Avoid direct sunlight

This can be a little tricky when in an open field at midday, but in general the sun's rays can be blocked by your body or by a friend (observing social distancing). The whole field of view on the camera needs to be in shadow. This allows your camera to capture the most accurate colours and reduces problems of reflections and too much contrast.

### 2. Clean your lens

For mobile devices, rub the glass cover of the lens with a soft material like a T-shirt or lens cloth if you have one. Do this before taking any photos.

### 3. Capture all macroscopic details of the fungus

Fungi have many important identification features, and this is often challenging to capture. With a diverse array of forms there is no simple solution but using the example of an agaric will hopefully highlight the things to consider.

When photographing a fruit body, we may need to capture:

- Cap surface and colour
- Cap margin
- Gills, pores, tubes, spines etc.
- Stem shape and texture
- The ring or veil remnants
- The base of the stem
- Immature and mature examples
- Effects of bruising, colour changes or interior flesh

This can be achieved all in one photo if enough fruitbodies are present to assemble a photo that captures all of these details, like this example:



*Mucidula mucida* – © Rich Wright, 2018 CC BY-NC 3.0

If this cannot be achieved in a single image, then take 2 or 3 images that capture the necessary features.

#### **4. Capture position**

Where possible frame the shot to give a sense of the position of the fungus on the tree.

#### **5. Do not use filters**

Make sure your mobile camera is set to its default more, without any colour or effect filters that may alter the image or its colours.

#### **6. Consider a tripod**

Many photos, especially of smaller subjects, are greatly improved using a tripod, as this reduces camera shake. Tripods for mobile devices are reasonably priced and are easy to find online.

#### **7. Low angle**

When photographing, try to get down to a low angle with the subject. This may mean getting close to the ground. This will allow you to capture some of the top surface of the fungus and details like a stipe that may otherwise be obscured from the top. Remember to turn one fruit body over to capture the gills.

## 8. Object for scale

A ruler or a coin can be placed in photos, next to the fungus, to give a clear idea of scale.

## 9. Remove detritus

If the fungus has plant or soil material obscuring some of its details, gently try to remove this before taking a photo. Pulling back or parting plants in the fore and background can also help with getting a clearer photo of the fungus in situ.

## 10. Framing

Position yourself and the camera so that the fungus is the central focal point of the image. Get as close as you can to the subject so that it fills most of the frame.



*Terana caerulea* – © Rich Wright, 2018 CC BY-NC 3.0

## Permissions and agreement

### Personal data

When entering information into the survey we request that you provide us with your name and an email address. These will be used solely for communications regarding your record, should there be a problem or something of interest that we wish to follow up. When map data is published all names, and emails will be removed from the data, leaving only the information about the trees and the fungi. We intend to include all named contributors in an appendix of acknowledgements when publishing our data.

### Use of data and images

By submitting a survey response, you are giving us full permission to use the data (apart from names and email addresses) for our research and for us to be able to share it with third parties at our discretion.

By uploading images to this survey, you are giving permission for your images to be used by our project under a Creative Commons Share Alike 4.0 license (CC BY NC 4.0). If we use the photo in any form of publication, we will ensure that you are credited where it is used.

## References and useful links

### Free PDFs

Estimating the Age of Large and Veteran Trees in Britain, John White, Forestry Practice, 1998, [PDF](#)

How to estimate the age of an oak, Woodland Trust, 2007, [PDF](#)

Handbook for the measurement of macrofungal functional traits, Dawson et al, 2018, [PDF](#)

Catalogue of tree microhabitats, Kraus et al, 2016, [PDF](#)

Ancient and other veteran trees: further guidance on management, David Lonsdale, 2013, [PDF](#)

### Books on oaks

Ancient oaks: in the English landscape, Aljos Farjon, 2017

The British Oak, Morris and Perring, 1974

### Books on fungal interactions with trees

Biodiversity in Dead Wood, Stokland et al, 2012

Fungi and Trees: their Complex Relationships, Lynne Boddy, 2021

### Books on identifying oak trees

Collins Tree Guide, Owen Johnson, 2006

Collins Complete British Trees, Paul Sterry, 2008

### Websites on identifying oak trees

Woodland Trust - <https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/british-trees/>

English Heritage Buildings - [www.ehbp.com/the-definitive-list-of-british-oak-trees-their-history/](http://www.ehbp.com/the-definitive-list-of-british-oak-trees-their-history/)

### Books on identifying fungi

Collins Fungi Guide, Stefan Buczacki, 2012

Collins Complete British Mushrooms and Toadstools, Paul Sterry, 2009

Fungi of Temperate Europe, volumes 1 & 2, Thomas Laessoe, 2019

Mushrooms and Toadstools of Britain & Europe, volumes 1 & 2, 2018 – 2020

Fungi on Trees: An Arborists' Field Guide, Watson and Green, 2011

Fungi on Trees: A photographic reference, Humphries and Wright, 2021

Poroid Fungi of Europe, Ryvar den and Melo, 2017

### Websites on identifying fungi

[www.first-nature.com/fungi](http://www.first-nature.com/fungi)

British Mycological Society Facebook Group - [www.facebook.com/groups/18843741618](https://www.facebook.com/groups/18843741618)

## Acknowledgements

### Photo credits

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Front cover: Oak at the Cowdray Estate, Midhurst, © Rich Wright, 2020 CC BY NC 4.0

Many images in the app have been kindly provided by the wonderful online community through creative commons licensing. The attributions are noted with each image.

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