Monitoring the effects of ash dieback: instructions for the survey of epiphytic lichens

The spread of ash dieback disease has been widely publicised but, despite alarming reports from some European countries, its likely impact on the structure, function and biodiversity of UK woodlands remains unclear. As with Dutch Elm disease in the 1970s, high tree mortality is likely to reduce the habitat available to some species, especially epiphytic lichens and bryophytes that grow primarily on ash (Edwards 2012; Ellis et al. 2012), whilst creating open niches into which other plant species might spread, and altering the structure, composition and ecological functioning of many woodland sites. In addition, the widespread loss of ash away from woodlands is likely to have a significant impact on the character of many landscapes and to reduce the availability of hosts for epiphytes in more open conditions.

The UK has a number of volunteer-based monitoring and surveillance schemes designed to monitor change in the abundance of a wide range of taxa. However, no single survey has the capacity to track the impacts of the disease on woodland plants and epiphytes. The voluntary sector[1] therefore has a rare opportunity to monitor the impact of ash dieback, either by altering existing schemes, or, ideally, by developing a more targeted scheme focusing on the habitats that are most likely to be affected. As yet no other European country has attempted to do this although there have been national surveys to map the extent of the disease.

Rather fortuitously a consortium of volunteer societies are working with the Centre for Ecology and Hydrology (CEH) on a Defra-funded project to pilot a range of surveillance methods designed to improve our capacity to monitor changes within semi-natural habitats in response to environmental drivers (Walker et al. 2010). Field testing is currently underway and so it seemed appropriate to adapt some of these methods specifically to monitor the biodiversity impacts of ash dieback. In 2013-14 the project partners are therefore proposing to use this new approach to establish a baseline from which future changes can be monitored. The methodology, described in detail below, is intended to be very straightforward to carry out and is aimed at recorders with some basic experience of habitat survey. It requires no specialized equipment or training and should be undertaken by recorders who are confident at recording woodland plants, bryophytes or lichens. It is not necessary to be able to identify ash dieback to participate.

[1] Botanical Society of the British Isles (BSBI), British Bryological Society (BBS), British Lichen Society (BLS)

Overall aims of the scheme

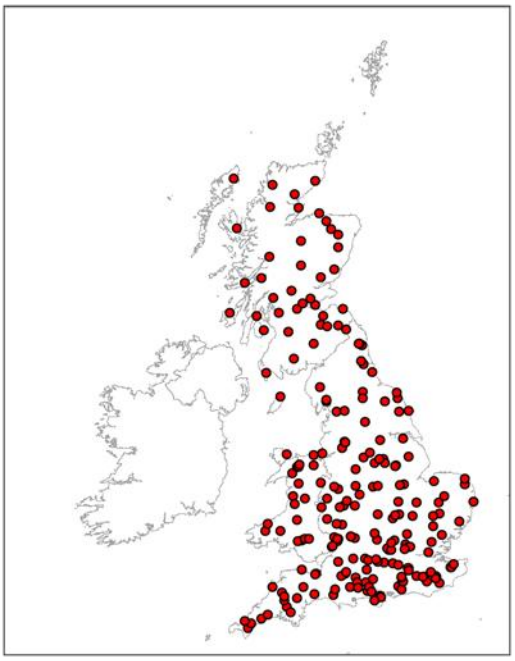
To set up a national network of sites to monitor the impact of ash dieback disease on the vascular plants, bryophytes and lichens associated with ash in woodlands and other semi-natural habitats for which ash is an important component (e.g. hedgerows, wood pasture). The specific aims of the scheme are:

- To record the ground flora of small permanent plots located under a canopy of ash.
- To record a comparison plot under a different tree canopy to help identify changes occurring due to other factors (e.g. climate, management, etc.).
- To record epiphytes growing on at least 5 ash trees and, for comparison, at least 5 trees of other species 1) in similar woodland plots and 2) in more open habitats (e.g. hedgerows, wood pasture).
- To resurvey these sites at least once every 5 years in order to track any changes caused by the disease.

We have discussed the possibility of recording vascular plants, bryophytes and lichens in the same sites but have decided that the problems of co-ordination would be too great. However, we hope that recorders may be able to visit the same sites, and a list of sites surveyed for each group will therefore be maintained on the project website (http://www.brc.ac.uk/splash).

Survey squares

A random sample of 1 × 1 km squares (monads) located across Great Britain has been selected in which to record these plots (opposite). This selection was based on the distribution of woodlands known to contain ash trees taken from the Forestry Commission National Forest Inventory (Forestry Commission 2012). Monads containing ash woods were then stratified into the 112 Watsonian vice-counties that make up Great Britain. Within each vice-county a random sample of monads was then selected with the number being proportional to the amount of ash estimated for each vice-county, whilst ensuring that each received a minimum of 1 square and a maximum of 5. This random sample of 218 monads includes 157 in England, 21 in Wales, 39 in Scotland, and 1 in the Isle of Man. The Orkneys and Shetlands were excluded due to low woodland cover.



These are termed the **core squares**: we hope that these will be prioritised to ensure sufficient replication and geographic coverage across the range of ash in Britain. In addition, volunteers have the option to record plots in additional monads of their own choosing. These are termed

additional squares. An interactive map of the core squares can be viewed on the project website (www.brc.ac.uk/splash).

Survey method: lichens

The aim of the lichen surveys is to monitor the epiphytes of mature ash trees in woodland (survey L2), as well as the epiphytes growing on ash in more open habitats (survey L3), and in each case to compare them with the epiphytes of other species of broad-leaved trees in the vicinity. Definitions of the habitats to be included are given below. **If possible, please survey at least one woodland and one open-habitat site in the core squares in your area first.** If these prove unsuitable (e.g. if the land is intensely private, or there are too few ash trees), **please select a suitable monad as close as possible to the core square**.

Survey L2: epiphytes growing on ash in woodlands

Selecting a woodland site – an overview

Ash is the third most common tree in Great Britain, occurring in most semi-natural woodland types on circum-neutral to basic soil types up to c. 500 m altitude (Rodwell 1991; Forestry Commission 2012). It tends to be the dominant tree species in woodlands on calcareous soils in both lowland and submontane areas (W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland; W9 *Fraxinus excelsior-Sorbus aucuparia-Mercurialis perennis* woodland) but also occurs intermixed with other tree species in all but the wettest and most acid woodland types. Ash may also form a closed canopy woodland in more ruderal habitats such as waste ground, old industrial sites, disused quarries, etc. For the woodland survey, only stands with mature trees or mature coppice stools should be recorded. Surveyors should therefore avoid young plantations or areas where trees are regenerating following recent coppicing (i.e. within the previous 10 years) or clear-felling. Ideally you should choose woodland with a continuous ash canopy but you may need to record in mixed woodland if the ash does not grow in pure stands. We recognise that in some areas of Britain the distinction between closed-canopy woodland and wood-pasture or wooded parkland may not be clear cut. As a rule of thumb if the canopy closure is less than 60%, and the understory is grassy, please treat the habitat as open.

It is not necessary to choose plots in ancient woodland, although we hope that such sites will be well represented in the survey. When choosing the locations of plots within wooded stands you should choose areas that are relatively homogeneous and representative of the surrounding wooded habitat, avoiding edges and areas disturbed by unusual management (e.g. pheasant pens). Please do not select an area just because it has a rare species – it is unlikely to be representative. In general it is probably best to avoid areas with restricted access as these may be less practical for other recorders to visit at a later date. If you need to record on private land then please seek permission from landowners before your visit and explain that the plot will be monitored in the future. An introduction letter explaining this with contact details for further information is available on the project website. The website will also list sites recorded for each group with any notes provided by the recorded on access etc. This will enable recorders for one group to see which sites have already been recorded in or around the core squares by others.

Selecting and recording the position of a plot within a wood

The aim of survey L2 is to list the epiphytic lichens of between 5-10 ash trees of a minimum size (30 cm circumference at 1.4m height for maidens and pollards; 30 cm basal circumference for coppice stools) in woodland. **Plots should be 20 x 20 metres**. This size should be large enough to include enough suitable trees; however, in mixed woodlands, where ash is not a large component of the canopy, it may be necessary to include trees outside of the plot in order to reach the 5 trees required. Plots can be positioned near to obvious landmarks, such as rides, ditches, ponds, gates, etc., to aid relocation.

Once an area for the plot has been chosen, take a GPS reading for the south-west corner. The sides of the plot (20 x 20 m) can then be measured out using a tape measure and compass, or using GPS if your unit is accurate enough (estimates using paces should be avoided). Please orientate the sides of the plot along a north-south axis if possible. Record the details of the plot on the recording form. A rough sketch map is requested, showing approximate distances and bearings to landmarks or permanent features. For recording purposes it may be helpful to temporarily mark the corners of the plots with wooden canes or other visible markers. We do not recommend permanently marking the plots (e.g. by using plastic tape, wooden posts, tree tags, etc.) without the prior knowledge/consent of the landholder. If this is granted then please minimise disturbance to the plots and use markers that do not draw attention to the plots. Photographs may also be helpful for locating plots in subsequent years. When taking photographs it is important to note the position and orientation of the photograph on the sketch map. A facility for uploading photos and maps will ultimately be a part of the data submission page on the project website.

If there are more than 5 ash trees of minimum size in your plot, record 5 (or more up to 10) chosen randomly, rather than selecting trees with a particular rich (or poor) flora. A random sample can be accomplished by numbering all the trees of minimum size in the plot, and then reading off the first 5-10 numbers corresponding to numbered trees from a random number table (Annex 2); if manoeuvrability in the plot is limited, and/or this strategy is too time-consuming, then a ‘haphazard’ (i.e. subjectively random) selection of accessible trees can be performed. If trees have no epiphytes, because they are covered in ivy, or for other reasons, they should nevertheless be recorded as part of the sample. For each tree in turn, use the recording form provided to note:

1) The grid reference (as accurately as your GPS unit allows).
2) The form of the tree (maiden, pollard or coppice stool).
3) For maiden and pollard trees, measure the circumference of the trunk 1.4 m above ground level (the traditional ‘girth at breast height’ measurement; see Annex 1 for guidance); for coppice stools with numerous poles/stems please record the basal circumference.
4) The lichens present on the trunk and any branches up to 2 m.

Non-ash comparison plots

We also need comparable data on 5-10 trees of other species. Comparison plots should be **within the same wood or, if this is not possible because the woodland is pure ash, then in the**

nearest woodland possible. Please choose plots in broad-leaved woodland and try to make sure that the conditions are as similar as possible to the ash plot in all other respects (e.g. soil type, soil moisture, geology, slope, aspect, degree of vegetative cover, etc.). The species of the comparison trees are not important, they should merely be a random sample of the broad-leaved non-ash species present, and may be a mix of species. If the ash trees were recorded in mixed woodland, it might be possible to select 5-10 trees of other species in the same plot as that in which you recorded the ash. In either case, record 5-10 broad-leaved trees of other species in the same way as you did for ash, but on a separate form, noting the species (or at least the genus) of the trees surveyed (see Annex 3 for an *aide memoire* of tree names). If you have set up a separate comparison plot, do not record ash trees amongst the sample even if they are represented in this plot.

The non-ash comparison is an essential feature of the survey as it will act as a control to assess the relative importance of the ash woodland and the impact of other factors that might be affecting epiphytes over the longer term. It will also allow the quantification of the relative importance of ash as a host for any particular lichen species (Jönsson & Thor, 2012).

Survey L3: epiphytes growing on ash in open habitats

In addition to its occurrence in woodland, ash is also an important species of more open habitats in both the lowlands and uplands, including hedges or stone walls, lightly wooded pastures, moorland fringes, rock outcrops, limestone pavement, screes and more ruderal habitats such as waste ground, disused quarries/railways, infrastructure corridors, etc. In the majority of these habitats ash often grows as scattered trees although densities can vary quite dramatically ranging from isolated trees to almost continuous cover (e.g. wood pasture). In many of these situations ash frequently supports a conspicuous growth of epiphytic bryophytes and lichens, especially in the north and west, but there is little systematic information on the diversity of these epiphytes or the relative importance of the species supported by ash.

The methods here are essentially similar to those in survey L2, but there is no need to define a plot of any type. Select an area of relatively homogeneous open habitat (e.g. hedgerow, riverside, parkland, disused quarry) where it is possible to record the epiphytes on 5-10 ash trees and (if possible) 5-10 trees of other broad-leaved species. Trees growing along the edges of woodland can also be recorded by this method. Record the location with a sketch map, as in survey L2, and the grid reference of each tree. Again, please make sure that you do not select 5-10 particularly promising trees. If the trees are in a line in a hedgerow or along a field margin, it is better to record the first 5-10 from the starting point than to pick and choose. **It is possible that open habitats in some of the core squares will contain little ash; if this seems to be the case, please record in the nearest suitable open habitat closest to the core square that you can locate.**

How many plots should be recorded in each square?

Ideally record the epiphytes in at least one woodland site (L2) and one open habitat site (L3) in the core survey squares. You can record as many more plots in these squares and plots in as

many additional squares as you like! A list of plots already recorded in each square will be available on the project website.

Number and timing of visits

Only a single visit should be needed to each site.

Other things to record

Time spent surveying

It is important to record the total time spent searching for species in the plot (excluding time taken to reach or layout the plot) as well as the number of recorders involved.

Nature of the woodland surveyed

If you know something of the history of the woodland sites (whether it is an ancient woodland, plantation etc.) please add this to the form.

Management

Please note any obvious woodland management apparent at the time of survey by ticking the appropriate field on the survey form. If the management is not included please note the type in the box labelled 'Other management'.

Evidence of ash dieback

Any signs of the disease should be noted on the survey form including the number of trees affected. Please add additional comments on the extent of dieback in the free-text box. If you are not confident identifying the presence of ash dieback, please simply describe any potential symptoms; photos can also be uploaded to the project website.

Other information

Any other information relevant to the survey should be include in the 'Other comments' box on the recording form. This might include information on the management of the site, changes since the last visit, notes to aid relocation of the plot, etc.

Completed forms & feedback

Survey forms for each survey can be requested from the contact address below or downloaded from project website: www.brc.ac.uk/splash. Completed survey forms should be entered online on the website or sent to the same contact at the address below. We would welcome feedback on any aspect of this survey either via the website or the email address given below.

Health and safety

Please do not take unnecessary risks and if possible always work with a 'buddy' or at the very least let someone know where you are planning to go and when you are likely to be back. If possible always carry a mobile phone, although note that these are unlikely to work in remote regions. Do not take unnecessary risks when locating plots or with the weather; always check

the forecast the day beforehand and be prepared to abandon fieldwork in the event of bad weather. Always carry a first-aid kit and wear appropriate clothing.

Acknowledgements

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Contact us

Please contact Oliver Pescott (CEH, ash-survey@ceh.ac.uk) or Janet Simkin (BLS, janetsimkin@btinternet.com) if you have any queries about this survey, if you would like copies of the survey forms or if you would like to submit completed forms. We thank Andy Amphlett, Theresa Greenaway and Mark Powell for valuable feedback on the protocol in the design stage.

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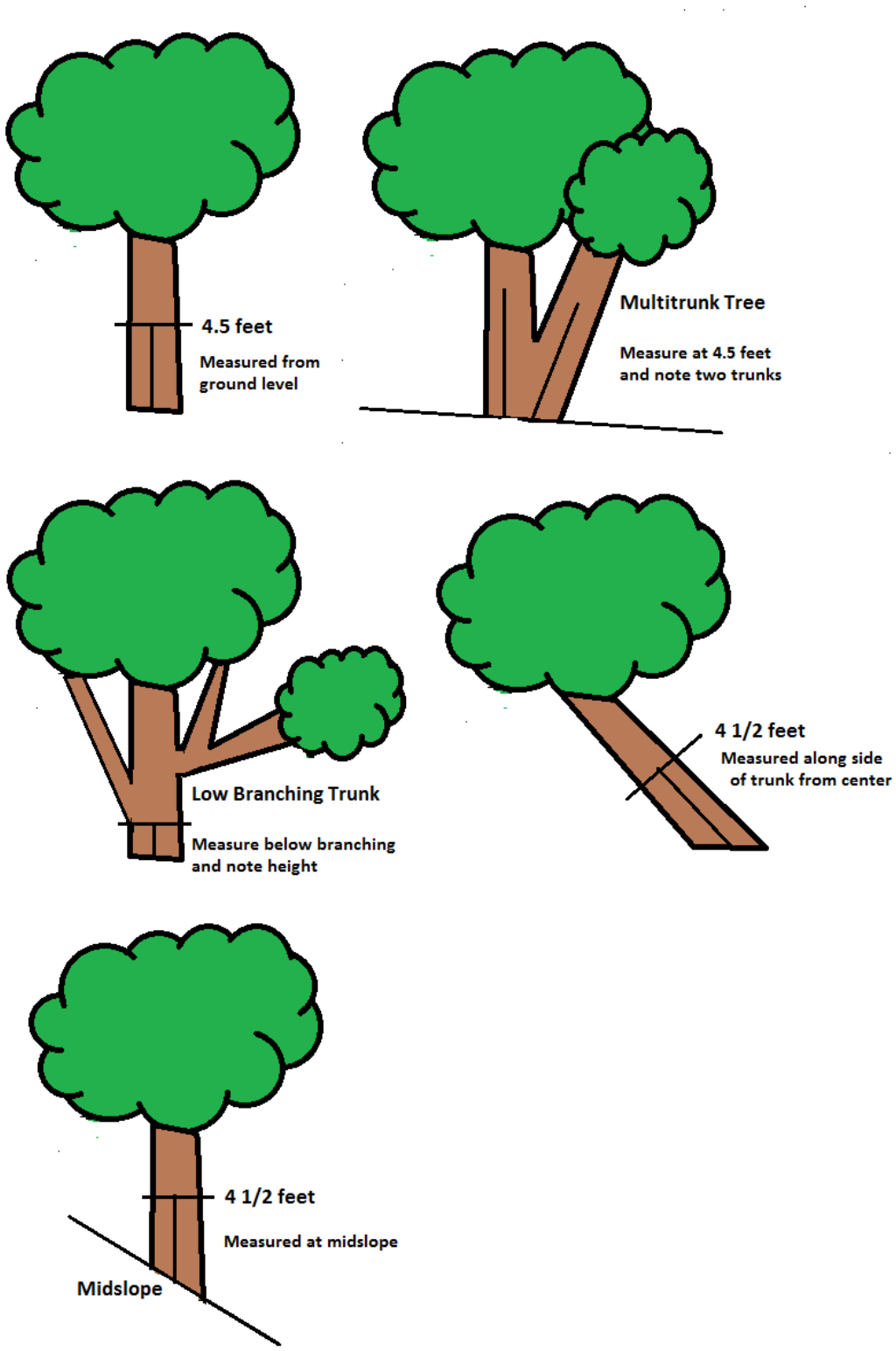
Annex 1. How to record Girth (circumference) at Breast Height[2]



[2] Please record the girth of coppice stools at ground level.

Annex 2. Random number table

27	23	41	49	23	20	11	1	20	23	32	19
22	19	8	44	22	7	20	5	2	46	37	18
36	11	15	44	42	5	21	13	6	18	49	16
11	48	12	22	49	25	40	5	34	1	26	32
43	13	33	17	7	13	46	6	44	25	2	6
12	28	43	28	44	19	41	44	45	21	24	16
48	11	37	39	46	6	10	46	30	44	26	30
39	24	25	28	29	8	45	41	5	16	8	20
21	24	40	21	20	36	14	26	18	39	8	44
8	8	10	16	11	44	38	47	49	32	15	5
4	20	15	39	9	1	22	23	13	21	3	45
10	33	34	36	17	49	38	30	5	14	25	23
2	35	18	12	9	49	21	36	39	28	30	44
38	47	9	14	40	41	7	14	6	8	11	31
14	19	4	4	4	6	3	30	34	32	26	10
33	22	8	13	33	11	38	12	3	16	41	40
32	43	21	14	16	17	47	5	33	21	13	47
44	50	34	13	37	10	1	27	8	41	16	28
34	40	48	1	45	50	29	36	7	13	35	34
22	21	12	12	41	6	33	14	5	46	13	5
34	18	49	49	48	11	1	49	23	3	36	13

Annex 3. Tree species abbreviations *aide memoire*

Acer campestre	Acer camp		Prunus avium	Prun aviu
Acer platanoides	Acer plat		Prunus cerasifera	Prun cera
Acer pseudoplatanus	Acer pseu		Prunus cerasus	Prun cera
Aesculus hippocastanum	Aesc hipp		Prunus domestica	Prun dome
Alnus glutinosa	Alnu glut		Prunus laurocerasus	Prun laur
Alnus incana	Alnu inca		Prunus lusitanica	Prun lusi
Betula pendula	Betu pend		Prunus padus	Prun padu
Betula pubescens	Betu pube		Prunus spinosa	Prun spin
Carpinus betulus	Carp betu		Pseudotsuga menziesii	Pseu menz
Castanea sativa	Cast sati		Pyrus communis	Pyru comm
Chamaecyparis lawsoniana	Cham laws		Quercus cerris	Quer cerr
Cornus sanguinea	Corn sang		Quercus ilex	Quer ilex
Corylus avellana	Cory avel		Quercus petraea	Quer petr
Cotoneaster bullatus	Coto bull		Quercus robur	Quer robu
Crataegus laevigata	Crat laev		Rhamnus cathartica	Rham cath
Crataegus monogyna	Crat mono		Rhododendron ponticum	Rhod pont
Euonymus europaeus	Euon euro		Robinia pseudoacacia	Robi pseu
Fagus sylvatica	Fagu sylv		Salix alba	Sali alba
Frangula alnus	Fran alnu		Salix fragilis	Sali frag
Fraxinus excelsior	Frax exce		Salix caprea	Sali capr
Ilex aquifolium	Ilex aqui		Salix cinerea	Sali cine
Juglans regia	Jugl regi		Salix pentandra	Sali pent
Laburnum anagyroides	Labu anag		Salix phylicifolia	Sali phyl
Larix decidua	Lari deci		Salix triandra	Sali tria
Larix kaempferi	Lari kaem		Salix viminalis	Sali vimi
Laurus nobilis	Laur nobi		Sambucus nigra	Samb nigr
Ligustrum ovalifolium	Ligu oval		Sorbus aria	Sorb aria
Malus domestica	Malu dome		Sorbus torminalis	Sorb torm
Malus sylvestris	Malu sylv		Sorbus aucuparia	Sorb aucu
Mespilus germanica	Mesp germ		Taxus baccata	Taxu bacc
Picea abies	Pice abie		Thuja plicata	Thuj plic
Picea sitchensis	Pice sitc		Tilia cordata	Tili cord
Pinus contorta	Pinu cont		Tilia xeuropaea	Tili xeur
Pinus nigra	Pinu nigr		Tilia platyphyllos	Tili plat
Pinus sylvestris	Pinu sylv		Tsuga heterophylla	Tsug hete
Populus alba	Popu alba		Ulmus glabra	Ulmu glab
Populus xcanescens	Popu xcan		Ulmus minor	Ulmu mino
Populus nigra	Popu nigr		Ulmus procera	Ulmu proc
Populus tremula	Popu trem			