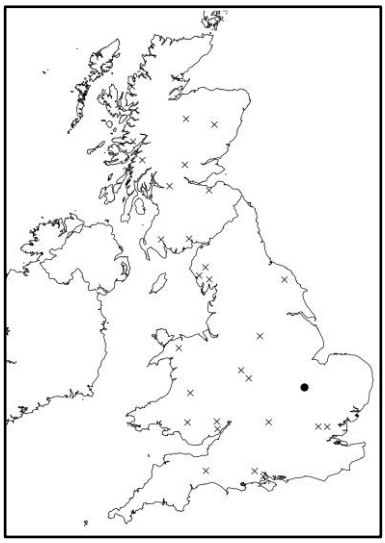
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Monks Wood



• = current case study site
X = other case study site

Oak dominated area of Monks Wood with bluebell ground flora

Case Study key facts

Location: Cambridgeshire, England

Landscape context: Monks Wood is an ancient woodland site protected in 1949 as a National Nature Reserve. The woodland is a remnant of the forest area that surrounded the fens to the north and east. The parent material is the Oxford clay and surrounded by chalky boulder clay, on which loamy and clayey textures surface-water gley soils have formed.

Case study area: 20 surveyed sites of 0.01 ha within a wider woodland of 170 ha

Proportion of oak in stand canopy: Variable, in surveyed areas oak is dominant forming 60% or more of the canopy.

Woodland type: High forest

NVC Woodland type: W10a oak woodland

Vulnerable oak-associated species: 14 obligate species, 22 highly associated species.

Likely scenario: A reduction in oak suitability and health is likely to occur on this site. Extreme events will become more frequent, and the surface water gley soils will exacerbate the effects of drought, causing increased seasonal soil moisture fluctuations from water-

logging in winter to drought in summer. Oak trees are very likely to become increasingly stressed in the coming decades (e.g. loss of crown, dieback, bleeding lesions).

Site Characteristics

Woodland type: The woodland is primarily a high forest of the wet ash-maple type with acidic pockets holding stands of pedunculate oak-hazel and pedunculate oak-hazel-ash woodland types. Small-leaved elm *Ulmus minor* is dominant in a few areas. The tree canopy is predominantly of ash *Fraxinus excelsior* with some pedunculate oak *Quercus robur*. The shrub layer is rich and was formerly coppiced and includes species such as hazel *Corylus avellana*, Midland hawthorn *Crataegus laevigata* and field maple *Acer campestre*. Blackthorn *Prunus spinosa* occurs in dense thickets. Of particular interest is the presence of wild service tree *Sorbus torminalis*.

Soil type: loamy and clayey textured surface-water gleys, respectively Wicken series and Denchworth series

Stand structure: The woodland stand in which oak study species occurred were on both the loamy and clayey textured soils. In each of the areas oak was dominant forming 60% or more of the canopy, with ash, and field maple. Understorey species included ash, hawthorn, field maple, wild service tree, and goat willow. Rides form the main open spaces of the woodland. The surveyed mean basal area of stands surrounding study trees was 25 m^2 ha^{-1}

Ground vegetation: Field layer species were indicative of Rich-Very Rich Fertility and Moist-Very Moist site conditions. Species included bluebell, dog's mercury, nettle, wood avens, cleavers, herb Robert, dog violet, honeysuckle, ivy, enchanters nightshade.

Current management: Traditionally coppice with standards but much of the site was clearfelled during the 1920's. Subsequently there has been little management of the regenerated stand, but small areas of coppice have been cut since it became an NNR. The current management is high forest management with the minimum of interventions to allow natural stand development. Also to maintain the small area of coppice using a 25-year rotation and manage rides to create structurally diverse habitats. In the long-term the aim is for a mixed broadleaved woodland comprising the same mixture of species and range of habitats as currently present.

Woodland Biodiversity

Designations: The ground flora is characteristic of ancient woodlands in this area with species such as primrose *Primula vulgaris*, wood anemone *Anemone nemorosa* and early-purple orchid *Orchis mascula*. Monks Wood is also highly important for its invertebrate fauna and for its birds which include good breeding populations of woodcock *Scolopax rusticola* and nightingale *Luscinia megarhynchos*.

Additional habitats include ponds, streams, herb-rich neutral grassland and woodland rides, and these are also of high wildlife value. The grassland holds three species of orchid including two marsh orchids *Dactylorhiza spp*. and adder's-tongue fern *Ophioglossum*

vulgatum.

Oak associated species: There are 390 oak-associated species that have been recorded in the area. Of these species 14 are obligate (only known to occur on oak trees), all invertebrate species. A further 22 highly associated species were identified (20 invertebrates and 2 lichens), these are species that are predominately found only on oak trees but will occasionally occur on other tree species. Species that use oak more frequently than its availability in the landscape but use a wider range of trees than the highly associated species are termed partially associated species. There are 49 partially associated oak species recorded in the area: 7 birds, 26 invertebrates, 14 lichens and 2 mammals. Of the 390 oak-associated species, the majority of them, 235 species, use the dead wood associated with oak trees, this includes 34 bryophytes (mosses and liverworts), 137 invertebrates and 64 lichen species. These species may increase in abundance if there is an increase in dead wood associated with oak.

Management Plan for maximising oak associated biodiversity

Long-term vision: A resilient mixed broadleaved native woodland containing all-aged trees of a range of species to support the important woodland communities present.

Management objectives: To ensure long-term presence of oak and other tree species on the site and thereby provide habitat for important oak associated species, particularly invertebrate fauna and birds.

Target species composition and stand structure: Monks Wood contains a diverse mixture of tree species, but their distribution and the stand structure is highly variable across the large woodland. In the oak dominated areas the target should be to maintain oak at a minimum of 70% contribution, with a mixture of other native broadleaved species contributing the remainder of the canopy. Where ash is common this is likely to become less frequent in the coming years, creating canopy gaps which will eventually be occupied by other species. The reduction in overstorey density may help to reduce the water stress in the oak trees in the event of extreme drought, which could be exacerbated by the surface water gley soils. Introduction of small leaved lime in some of the canopy gaps, and alder in wetter parts of the site near ponds and streams may be beneficial to some of the oak associated biodiversity (see Annex A) and increase the diversity of the woodland. The well-developed understorey of field maple, wild service tree, hawthorn and hazel provides rich habitat for biodiversity; in some areas coppicing this, as in the current management regime, will further widen the diversity of habitat provided.

Regeneration methods: Despite the well-developed understorey, there are very few oak saplings or young trees present in the woodland. This is likely to be due to relatively low light levels and potentially browsing by deer (although this was not assessed during the site visit). Regeneration of oak on the site could be assisted by collecting seed from the woodland, growing the seedlings on and transplanting them into canopy gaps caused by loss of ash when they are large enough. Protection from deer browsing such as small fenced exclosures or shelters may be required. Use of on-site seed sources would take advantage of the site adaptation of the parent trees and ensure that the next generation were well

adapted to the environmental conditions; however, planting oak from other local sources would also be appropriate. Introduction of alder or small leaved lime to the woodland would require planting material from locally appropriate sources to ensure the trees were well adapted.

Monitoring: A programme of regular monitoring of the woodland health and response to climate changes should be implemented to ensure that managers are aware of any changes in tree health and are able to act accordingly. The tree species composition and stand structure is likely to change over the coming years due to the loss of ash, the response of oak and the development of other understorey species; this should be monitored to ensure that the changes are within the agreed targets for the woodland and are supporting the biodiversity present as intended. Deer browsing was not recorded at the woodland and should be part of the monitoring programme to ensure that browsing pressure is not limiting regeneration or establishment of young a trees.

Operational factors: Monks Wood is a very rich site where competitive ground vegetation may limit the success of oak seedlings and saplings, particularly in areas where there has been loss of ash from the overstorey, or coppicing of the understorey, resulting in higher light levels. Low impact control of ground vegetation may be necessary for a short period in certain areas, such as where regeneration appears to be developing, or where trees have been planted.

Deer control or other forms of browsing prevention may be required if this is found to be preventing natural regeneration or survival of planted oak trees.

The woodland currently comprises almost entirely native tree species. If non-native tree species, such as beech or sycamore start to colonisation the woodland managers will need to consider both the potential benefits, such as additional support of oak associated biodiversity (see Annex A) and negative impacts of this, before making a decision on whether to accept the presence of these species.

The majority of the oak associated species at Monks Wood use dead wood, and this should be left in the woodland where it is safe to do so, helping to support these species.

Nightingale and woodcock, two protected species, are present in the Monks Wood and any management interventions must fully consider impacts on the habitat available for these species, as well as the wide range of other biodiversity in the woodland and the other habitats that are present.

The management recommendations set out in this case study scenario do not constitute consent for any operations, which would be required from the relevant body.

Annex A: Identification of additional tree species which are beneficial to oak-associated biodiversity

In the event of a significant loss of oak (not currently predicted for any of oak diseases present in the UK) it may be desirable to encourage a greater diversity of other beneficial tree species to support oak-associated biodiversity. If oak abundance were to significantly decline due to either climate change or disease it would be those species that are most reliant on oak, (obligate, highly associated and partially associated species) that would be at risk of declining in abundance. No other tree species will support obligate oak-associated species, therefore the analysis concentrated on identifying the tree species that would support the greatest number of highly and partially associated species present at the site using OakEcol[1]. Those tree species assessed as supporting a high percentage of the oak-associated biodiversity present at the site and that are able to establish and grow at the site based on soil and climatic factors[2] were selected. The mixture of tree species identified were selected by prioritizing the tree species supporting the greatest number of highly-associated oak-species and partially associated oak-species[3].

Table 1. Number and cumulative number of oak associated species known to be supported by the most suitable beneficial tree species and mixtures of tree species. Number of species are based on records showing a total of 390 oak-associated species at Monks Wood, which include 22 highly associated and 49 partially associated species.

	Number of oak-associated species supported at the site.			Cumulative number (and percentage) of species supported by the addition of each new tree species (from the top of the list downwards).		
	Highly associated	Partially associated	All	Highly associated	Partially associated	All
Small-leaved lime	4	12	49	4 (18%)	12 (24%)	49 (13%)
Beech	2	19	100	6 (27%)	25 (51%)	126 (32%)
Sycamore	0	18	107	6 (27%)	33 (67%)	184 (47%)
Alder	1	12	63	7 (32%)	37 (76%)	204 (52%)
Scots pine	1	10	42	8 (36%)	39 (80%)	215 (55%)

It is stressed that the suggestions above for alternative trees are designed to demonstrate how OakEcol can be used to consider management for species that would be affected by a decline in oak. We have not provided a detailed assessment of the impact of these suggestions on the wider ecology of the woodland (but see Table 2 below), or on other species present, nor have we considered how this fits into the wider balance of threats and risks to oak woodland. These wider issues should be considered in developing comprehensive resilience approaches to woodland management.

[1] The OakEcol database is available at: https://www.hutton.ac.uk/oak-decline

[2] Site suitability (climate and soils) for different tree species was based on: Pyatt DG, Ray D, Fletcher J. 2001. An ecological site classification for forestry in Great Britain: bulletin 124. Edinburgh: Forestry Commission

[3] See accompanying methodological documentation: Mitchell et al Managing oak woodlands to maximize support for oak associated biodiversity: 30 cases studies. https://www.hutton.ac.uk/oak-decline

Summary: Additional beneficial tree species.
Based on the analysis above small-leaved lime and beech (which would both grow at the site) would support 6 out of the 22 highly associated species and 25 out of 49 partially associated species known to occur at the site. The addition of other tree species: field maple, alder, hornbeam, Scots pine, aspen, Turkey oak, Western hemlock, would only add one highly associated oak species per tree species added. If a more diverse woodland was established including sycamore, alder and Scots pine then 80% of the partially associated species would be supported and an additional 2 highly associated species supported. These tree species may need to be grown in different areas or within compatible mixtures within the wood to match site micro-climate conditions and species light requirements. Some of these beneficial tree species are already present at the site (see above) and their abundance could be increased by natural regeneration but others are not. If planting is considered it is important that the trees are sourced from stock grown in the UK to reduce the risk of spreading other pests/pathogens. Sycamore is a non-native tree species and currently planting non-native tree species in existing native woodland is not recommended, although sycamore is generally tolerated where it is already present.

This study has concentrated on identification of other tree species that would support oak-associated biodiversity. However, some shrubs, e.g. hazel, that are not included in this study may also support oak-associated species.

While we have concentrated on identifying trees to support oak-associated biodiversity it should be noted that a change in tree canopy composition due to loss of oak and increased abundance of these beneficial tree species, will drive changes in ground flora composition (due to changes in shading) and in ecosystem functioning such as litter decomposition, soil chemistry and carbon storage (Table 2). When deciding which beneficial tree species to encourage a trade-off may have to be made between supporting oak-associated species and changes in these other woodland functions.

Table 2. Likely impact on selected ecosystem functions and shading of ground flora of selected beneficial tree species compared to oak.

	Functioning*	Shade**
Sycamore	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Similar
Alder	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Lighter shade
Beech	Similar to oak but with slightly slower litter decomposition. Litter and soil have a slightly higher carbon concentration and slightly lower nitrogen concentration	Darker shade
Scots Pine	Slower litter decomposition. Litter and soil have a high carbon concentration and lower nitrogen concentration.	Darker shade in winter as evergreen.
Small leaved lime	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Lighter shade

*Functioning information based on extensive literature reviews of comparative data and analysed in Mitchell et al (2019) Collapsing foundations: the ecology of the British oak, implications of its decline and mitigation options. Biological Conservation on line early DOI 10.1016/j.biocon.2019.03.040.

**Shading information based on expert judgement. The above provides a broad comparison of individual tree species compared to oak; the overall shade cast will depend on the mix of species in the canopy, the age of the trees and the density of trees. If the shade cast by the tree species is lighter than oak then light demanding ground flora species may increase in abundance. If the shade cast by the tree is darker than oak then light demanding ground flora species may decrease in abundance.

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