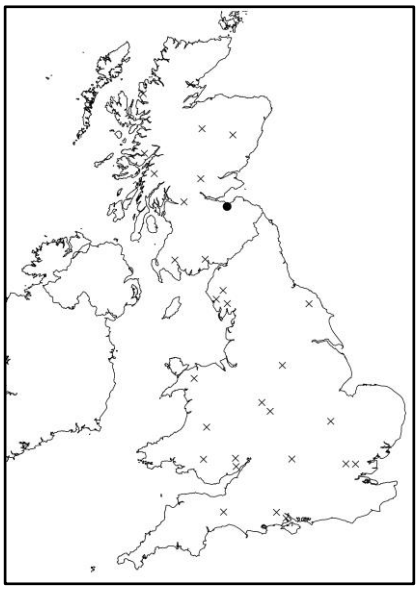
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Dalkeith



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

Oak dominated park woodland and grassy glades at Dalkeith

Case Study key facts

Location: Midlothian, Scotland

Landscape context: The woodland is on a plateau surrounded by rivers on three sides, with steep valley sides. The central part of the SSSI is fenced pasture with park woodland surrounding it.

Case study area: 2.0 ha, set within a woodland area of 26.5 ha

Proportion of oak in stand canopy: 100%

Woodland type: Park woodland; open woodland with grassy glades.

NVC Woodland type: W16 (W16 *Quercus* spp. – *Betula* spp. – *Deschampsia flexuosa* woodland; oak - birch - wavy hair-grass)

Vulnerable oak-associated species: 0 obligate species, 7 highly associated species.

Likely scenario: No changes in oak suitability are expected on this site, but extreme events are likely to become more frequent, resulting in increased stress in the coming decades and perhaps a reduction in productivity of oak.

Site Characteristics

Woodland type: Park woodland

Soil type: Stony brown earth

Stand structure: The woodland overstorey is 90% oak, with c. 25% permanent open habitat. A large proportion of the oak trees are veteran trees that have previously been coppiced, with diameters frequently >75cm. Holly is common in the understorey, covering c. 40% of the ground, and occasionally reaching the overstorey. There are no other tree species in the overstorey, although patchy and occasional saplings and young trees of hawthorn and oak are present, with beech saplings also present. Hazel, sycamore and ash seedlings are also present in low abundance (<1% each) but have not developed into saplings.

Ground vegetation: The ground vegetation is dominated by grasses (creeping soft-grass, sweet vernal grass and false oat grass) with bracken and nettle (c. 30% and 20% respectively) and tormentil and wood sorrel also present.

Current management: Dalkeith oakwood is a remnant of the post-glacial forest which has been grazed as a park woodland since the 12th century. The oldest oaks were coppiced in approximately the 15th or 16th century; younger 'maiden' trees have not been coppiced. Recent management has been by changeable grazing regime (which has included supplementary feeding and pasture improvement), fencing small areas to encourage natural regeneration and planting of oak trees (100 seedlings were planted in 2008).

The long-term goal for the site is to maintain and, if possible, enhance the age diversity and open structure of the parkland oakwood together with its associated assemblages of rare beetle and lichen species This will be attempted through encouragement of natural regeneration and planting of new trees, expanding woodland in to the pasture areas, enhancing habitats for lichens and for beetle fauna including maintaining old trees, deadwood and nectar-producing flora. In the pasture, maintaining characteristic ground flora composition and suitable sward height through suitable grazing levels is the main objective.

Woodland Biodiversity

Designations: Notified for wood pasture and parkland habitat, lichen assemblage and beetle species. Dalkeith Oakwood is one of only two remaining ancient park woodlands in Scotland. The Oakwood supports a species-rich beetle fauna, the majority of which is dependent upon deadwood habitats, and includes several nationally scarce species. It is an important site for lichen flora with over 126 lichen species recorded including 16 nationally scarce and one nationally rare species, *Lecania suavis*.

Oak associated species: Only 48 oak-associated species have been recorded in the area. Of these species none are obligate (only known to occur on oak trees). There are 7 highly associated oak species recorded in the area, all of which were 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 13 partially associated oak species recorded in the area, all of which are lichens except for 1 mammal. Of the 48 oak-associated species most of them, 41 species, use the dead wood associated with oak trees, this includes 1 invertebrate and 40 lichens. 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: Maintain as an open park woodland with a range of mature and veteran trees while establishing and securing the next generation of trees to ensure the long-term presence of oak on the woodland site.

Management objectives: The key aim is to maintain the open parkland character of the woodland and maintain the specific habitats required by the biodiversity present.

Target species composition and stand structure: The aim is to ensure that oak remains the dominant overstorey species with a minimum of 80% contribution to the canopy, but to retain the open wood pasture feel and habitat of the woodland which are vital for the species present. There is currently a large amount of holly in some parts of the woodland, creating a very dense understorey and in places contributing to the overstorey. The proportion of holly on the site should be reduced to a maximum of 10% cover in the understorey to allow young oak trees to establish and develop. Other native broadleaved species which are already on the site will also be encouraged to provide diversity and increase stand resilience; sycamore in particular has the ability to support some of the oak associated species on the site (see Annex A). The developing understorey will be encouraged in and confined to certain patches, while ensuring that other parts of the woodland remain open to provide continuity of habitats.

Although it would not be suitable in the main parts of the open pasture woodland, alder could be encouraged in the wetter areas along the riverbanks which surround three sides of the woodland, as this would help to support several of the highly and partially oak associated species (Annex A).

Regeneration methods: Within the woodland areas natural regeneration will be the favoured method of establishing new oak trees on the site, as this takes advantage of the site adaptation that has already occurred in the overstorey trees and will help to ensure that the next generation is well suited to the site and climate. Natural regeneration of the other species that are present within the woodland (hawthorn, beech, hazel, sycamore) will also be welcomed to increase diversity and resilience.

In the areas where the aim is to expand light woodland cover into areas that are currently pasture, oak trees will need to be planted as the distance to the seed source is too great. Trees should either be from local site-adapted sources, or could perhaps include an element from a slightly more southerly region in England.

Monitoring: Although there are currently no signs of oak tree health problems, a programme of regular monitoring is important so that managers are aware of any changes in health or productivity and are able to act quickly if needed. Monitoring should also include the changes in the woodland species composition and structure, to ensure that the interventions are having the desired effect and that regeneration and any planted trees are establishing successfully.

Operational factors: As the ground vegetation in much of the woodland is dominated by dense grasses this may compete with regenerating seedlings. One option may be for managers to try to promote new regeneration in areas where dense holly has recently been cleared and there is no vegetation, as this may provide a less competitive seed bed, while leaving the current grassy glades as undisturbed open habitats. Weed control may be required to protect developing seedlings as ground vegetation reinvades.

Heavy deer browsing impacts were observed in the woodland and this is likely to have limited past regeneration success. Areas of the woodland where regeneration is being encouraged and pasture area where trees are planted must be protected from deer damage by fencing or by individual tree protection.

Deadwood should be left in the woodland to support the large number of oak associated and other species that use it.

The non-native tree species beech and sycamore are both currently accepted in the woodland; any changes in their frequency or distribution should be monitored and reviewed.

All interventions should be carefully considered and planned to ensure that there are no negative impacts on any of the nationally scarce or rare species.

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 48 oak-associated species at Dalkeith, which include 7 highly associated and 13 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
Scots pine	3	8	27	3 (43%)	8 (62%)	27 (56%)
Sycamore	2	4	12	5 (71%)	11 (85%)	38 (79%)

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 potentially beneficial tree species.
Based on the analysis above Scots pine and sycamore (both of which will all grow at the site) would support 5 out of the 7 highly associated species and 11 out of 13 partially associated species known to occur at the site. One of the remaining two highly associated species and one of the remaining two partially associated species would be supported by alder but this tree is predicted not to grow within the main woodland area at the site, although (as noted above) it would grow in the wetter areas just outside the woodland. the other remaining one highly associated species and one partially associated species are not known to be supported by any of the 30 tree species studied. Scots pine and sycamore 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 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; and at Dalkeith, where the site is a designed landscape, non-native sycamore and beech are accepted. Some shrub species e.g. hazel, that were not considered in this study, which concentrated on tree species, may also support some of the oak-associated biodiversity.

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
Scots Pine	Slower litter decomposition. Litter and soil have a high carbon concentration and lower nitrogen concentration.	Darker shade in winter as evergreen, but may be lighter in summer?

*Functioning information based on extensive literature reviews of comparative data and analysed in Mitchell et al (submitted) Collapsing foundations: the ecology of the British oak, implications of its decline and mitigation options. Biological Conservation.

**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.

Acknowledgements: The work was funded by Defra through the BBSRC grant Protecting Oak Ecosystems (PuRpOsE): BB/N022831/1. With additional support from the Forestry Commission England and the Scottish Government's Rural and Environment Research and Analysis Directorate 2016-2021 strategic research programme. We thank Duncan Ray and Andrew Rattey for help with the predictions of changes in oak condition over time and the Forest Research Technical Support team for their help with the fieldwork. Finally we thank the site owners for access to their land.

Citation: Mitchell R.J., Broome A, Hewison RL, Stokes V. (2019) Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. Case study: Dalkeith. Available at https://www.hutton.ac.uk/oak-decline