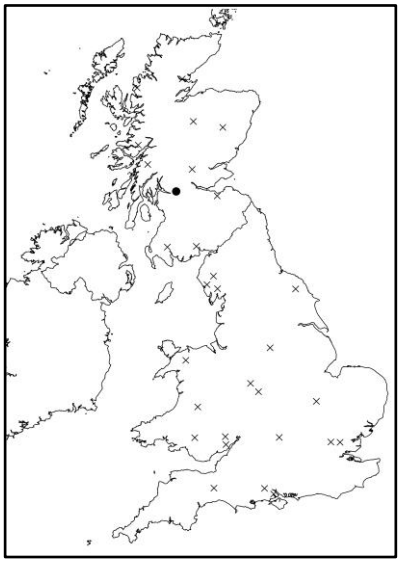
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Mugdock



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

Oak, birch and sycamore at Mugdock

Case Study key facts

Location: Stirlingshire, Scotland

Landscape context: On the generally southerly facing slopes on the undulating terrain of the lower western extension of the predominantly extrusive volcanic rocks of the Campsie Fells. It lies close to the north western outskirts of the Greater Glasgow conurbation. The wood is contiguous with other areas of both deciduous and coniferous woodland, pasture, lochs/reservoirs and amenity land between Milngavie to the south and the Strathblane Valley to the north. It is part of the Mugdock Country park which is an SSSI.

Case study area: c. 120 ha within an SSSI of 169 ha.

Proportion of oak in stand canopy: 60%

Woodland type: High forest

NVC Woodland type: W11 (*Quercus petraea-Betula pubescens-Oxalis acetosella* woodland; sessile oak – downy birch – wood sorrel woodland) with smaller areas of W17 (*Quercus petraea – Betula pubescens – Dicranum majus* woodland; sessile oak – downy birch – moss woodland)

Vulnerable oak-associated species: 1 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

Site Characteristics

Woodland type: The area has an unusual association of diverse semi-natural habitats of wooded and non-wooded features. The site includes extensive areas of ancient upland oak woodland, damp ash-elm woodland, wet species-rich alder-dominated woodland, smaller areas of dry and wet heathland with associated patches of scrub and some open water. This case study focuses on the better drained woodland communities (W11, drier W9 and W17) comprising the upland oak woodland.

Soil type: The soils are predominantly brown earths and mineral and peaty gleys although there are a few shallower soils in places too on the upper slopes of some areas of steeper ground.

Stand structure: The structure of the woodland regardless of whether it is oak, ash or alder woodland is predominantly high forest of formerly coppiced trees along with some larger standards. There are also some areas of dense birch which has similarly been coppiced but is rather younger. Sycamore is also common (both as standards and coppice structure) throughout the area and there is a variety of age classes present. Sycamore is found in both the areas dominated by oak and those where the community is on richer substrates (where there is more ash). Where oak is dominant it comprises c. 60% of the overstorey and is predominantly old multi-stemmed coppiced oak with occasional standards of much larger girth. The coppiced specimens typically have dbh of around 45-60cm. There are also some veteran specimens (both of coppice and pollard structure) particularly on old wood banks. The largest specimens have dbh more than 100cm. There appears to be both Q. *petraea* and *Q. robur* present and probably hybrids too. There are seedlings, saplings and young trees present of a wide range of species (oak, sycamore, rowan, ash, birch, beech, hazel, bird cherry, hawthorn) but few established oak seedlings, and the oak saplings have been planted rather than regenerating naturally.

Ground vegetation: The ground flora within the oak dominated woodland area contains abundant wood sorrel and bluebells and frequent bracken, grasses and ferns.

Current management: The woodlands have been managed since the early 18th century, with coppice management continuing until the end of the 19th Century. Drumclog Moor was cleared of woodland before 1800 and used as rough grazing, and grazing rights in the rest of the woodland have been in place during recent history. The woodland has been subject to little management in the last 50 years. Since 2000 however, deer management, bracken control and selective removal of sycamore regeneration and mature trees has taken place. The long term objectives for the woodland are to maintain the extent of the woodland by continued deer management and encouragement of natural regeneration, and also to maintain and increase the population of beetles by providing habitat through leaving both standing and fallen deadwood.

Woodland Biodiversity

Designations: Notified for ancient upland oak woodland containing both pedunculate (*Quercus* robur) and sessile oak (*Q. petraea*), and nearby wet woodland, heathland, mesotrophic lochs. The high levels of deadwood support an important beetle assemblage, including the rare *Acritus nigricornis* (RDB/IUCN Least Concern), *Cerylon histeroides* which are restricted to ancient deciduous woodland and one which occurs nowhere else in Scotland, *Geostiba armata*.

Oak associated species: There are 97 oak-associated species that have been recorded in the area. Of these species none are obligate (only known to occur on oak trees). One highly associated species was identified, a butterfly – purple hairstreak, highly associated species are ones 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 11 partially associated oak species recorded in the area: 9 birds, 1 invertebrate, and 1 mammal. Of the 97 oak-associated species 27 species use the dead wood associated with oak trees, this includes 23 bryophytes (mosses and liverworts), and 1 invertebrate 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: The long-term vision is for an oak dominated woodland but with a large contribution from a wide range of other native broadleaved species. The woodland will regenerate naturally and there will be a developing cohort of young oak trees that will eventually replace ageing overstorey trees.

Management objectives: To maintain the diverse species and structure that supports the oak associated biodiversity and important beetle assemblages in the woodland.

Target species composition and stand structure: Although oak will remain dominant in the overstorey at c 60%, the remainder will comprise a large number of other native broadleaved species which are already present on the site. The species composition will vary depending on the soil type and depth; hazel will be more common on the deeper soils of the lower slopes, while on the shallower soils of the upper slopes birch and rowan will be more common. There is already a developed understorey in the woodland but oak is under-represented and will need to be increased to ensure long-term dominance of oak.

Regeneration methods: This is a highly variable woodland and decisions on overstorey management and regeneration priorities should be carefully considered for each different area. In the areas that are dominated by mature dense oak, and where there is little temporary open habitat, crown thinning will increase the opportunities for successful natural regeneration of oak, and other species. In some areas re-coppicing of some oak coppice stools may achieve the same result. There has been little successful oak regeneration previously, perhaps due to deer browsing, or competition from ground

vegetation or other regenerating tree species. Oak will need to be favoured to ensure that it has a long-term presence on the site. One option may be to collect seed from the site, grow the trees on and plant them in recently created canopy gaps where light levels are higher. Reduction in the amount of sycamore, as is being carried out under the current management programme, may also improve establishment success of oak by reducing the shading in areas where oak may regenerate. Use of natural regeneration should be preferable to planting material from a different source as it will already be well adapted to the environmental conditions and climate at the site.

Monitoring: This is a complex woodland with a range of species and different management histories. A programme of monitoring should be introduced to record the changes in species composition and distribution. This will allow managers to check that interventions are having the desired effect and that regeneration of oak is increasing.

Operational factors: Deer are present in the woodland and although a control programme is underway, there is evidence of browsing damage to regeneration. Increasing the level of deer control, or providing an alternative method of protection for regenerating seedlings and saplings may be required to ensure that sufficient oak is established.

The vegetation within the woodland is highly variable, depending on the dominant canopy species and density. In areas where bracken is present it may represent a threat to seedling growth, or cause damage when it dies back at the end of the growing season, and some form of bracken reduction may be advantageous.

The amount of sycamore accepted within this otherwise native species woodland should be kept under review. At present sycamore is abundant in some areas, and while it is likely to be providing support to some oak associated biodiversity, and other species, the density may need to be reduced to prevent it becoming dominant and to improve establishment success of oak.

Deadwood should be left in the woodland to support the large number of oak associated and other species that use it. However, Mugdock Country Park is in the SSSI and has high visitor numbers, so standing deadwood should only be left where health and safety considerations allow.

Management interventions must be carefully considered and planned to ensure that there are no negative impacts on the upland oakwood community or neighbouring habitats.

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 97 oak-associated species at Mugdock, which include 1 highly associated and 11 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
Sycamore	0	9	33	0 (0%)	9 (82%)	33 (34%)
Beech	0	9	36	0 (0%)	11 (100%)	48 (49%)

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.
The one highly associated species will use sweet chestnut and Turkey oak but neither of these tree species are predicted to grow at this site. In addition, the highly associated species will use ash but ash is not recommended due to concerns over ash dieback. The analysis therefore concentrated on supporting partially associated species. Based on the analysis above sycamore and beech (which both grow at the site) would support all of the partially associated species. 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. Both these species are already present at the site (see above), and thus could be established using natural regeneration; 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. However, sycamore and beech are both non-native tree species and currently planting non-native tree species in existing native woodland is not recommended and permission from the appropriated authorities would be required, although sycamore is generally tolerated where it is already present. 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 other 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
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

*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.

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