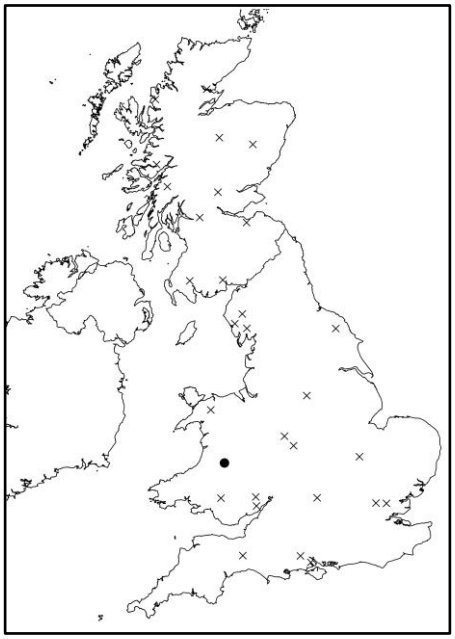
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study : Rhayader



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

Oak overstorey and underplanted noble fir at Rhayader

Case Study key facts

Location: Powys, Wales

Landscape context: A small wood situated at the top of a NE facing slope leading down to the River Wye. The woodland is at c. 300 m above sea level, with open grazed hillside above it and agricultural fields in the valley bottom below.

Case study area: 3.0 ha, set within a wider woodland of 25 ha.

Proportion of oak in stand canopy: 70%

Woodland type: High forest

NVC Woodland type: W17 (*Quercus petraea – Betula pubescens – Dicranum majus* woodland; sessile oak – downy birch – moss woodland)

Vulnerable oak-associated species: 36 obligate species, 52 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: High forest

Soil type: Podzolic brown earth

Stand structure: The overstorey comprises c. 70% mature oak trees, which are > 20 m tall and have an average diameter >30 cm. Some of the oak trees have signs of crown die-back. The remainder of the canopy cover is noble fir, which was underplanted; this is causing some competition to some oak canopies in the overstorey. There is 5% temporary and 5% permanent open habitat in the woodland. In some areas there are dense patches of noble fir in the understorey, present as young trees, saplings and seedlings, with an uneven distribution through the stand. No other tree species were recorded on the site.

Ground vegetation: The ground vegetation is dominated by mosses at c. 50% cover, with bracken contributing c. 30% cover. There is c. 30% bare ground and 10% red fescue.

Current management: A sessile oak stand planted in 1880. Besides the underplanting in pure patches with noble fir and grand fir there has been little or no previous management at this site. The site will continue to be managed under non-intervention with the objective of maintaining biodiversity.

Woodland Biodiversity

Designations: Identified as an ancient semi-natural woodland in the Ancient Woodland Inventory of 2011. The site is of local wildlife conservation value and was identified as a conservation area by a Forestry Commission survey of 1972, however it is not formally designated.

Oak associated species: There are 778 oak-associated species that have been recorded in the area. Of these species 36 are obligate (only known to occur on oak trees), this includes 5 fungi, 1 lichen and 30 invertebrates. A further 52 highly associated species were identified (3 fungi, 16 invertebrates and 33 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 142 partially associated oak species recorded in the area: 11 birds, 66 invertebrates, 60 lichens and 5 mammals. Of the 778 oak-associated species 328 species use the dead wood associated with oak trees, this includes 1 bird species, 63 bryophytes, 85 invertebrates and 181 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: Restoration of this ancient semi-natural woodland site to a native broadleaved species woodland which is resilient and ensures long-term presence of oak on the site.

Management objectives: To promote the long-term presence and health of the oak woodland and maximise the oak associated biodiversity.

Target species composition and stand structure: The non-native noble fir will all be removed from the site. The future overstorey will be c. 80% oak, with the remainder comprising birch and rowan. The woodland will regenerate naturally with an understorey of young birch, rowan and oak.

Regeneration methods: The noble fir will be gradually removed from the woodland, initially removing the largest trees which are currently interfering with the oak crowns, and later by removing the more recent noble fir regeneration from the site. Ideally the ground disturbance caused during the felling operations will result in opportunities for oak natural regeneration to take advantage of the higher light environment. This would be preferable to planting as natural regeneration would be well adapted to the site conditions. However, if natural regeneration does not occur then planting of oak, birch and rowan seedlings from a suitable local provenance should be carried out. Seedlings should be planted at close spacing in the centre of canopy gaps created by removal of the noble fir. On the lower slopes where soils are deeper, pure oak could be planted, with increasingly more birch and rowan on the shallower soils on the higher parts of the site.

Monitoring: The planned interventions will result in a dramatic change in species composition and structure in the woodland. A programme of regular monitoring should be implemented to ensure that managers are aware of the impacts of the operations and to check that the desired species composition is being achieved. The success of any natural regeneration or planted trees should be tracked and any evidence of deer browsing recorded.

Operational factors: Felling of the larger noble fir will require care to make sure that the oak crowns are not damaged.

The ground cover is currently predominantly mosses and bare ground, which will provide a good seed bed for germination and is not competitive. However, following removal of the noble fir and increase in light levels the vegetation is likely to change and managers may need to consider management in future years if competitive vegetation becomes dominant.

Any future natural regeneration of noble fir, or other non-native or coniferous species that are not desired on the site, should be removed.

The woodland is fenced against livestock but not deer; although no evidence of deer browsing was observed this will need to be monitored in the future and action taken if naturally regenerated or planted trees are becoming damaged.

There is road access in the woodland, but in places the slope of the site is steep and this may restrict access.

The woodland is not currently designated and there are no protected species listed for the site, although it is of local wildlife conservation value. However, operations must be carefully planned and managed to ensure that there are no negative impacts of the interventions on the oak associated biodiversity present.

A large number of oak associated species in the woodland use deadwood and this should be left in the woodland to support these 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 778 oak-associated species at Rhayader (Coed Sarnau), which include 52 highly associated and 142 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
Beech	4	42	147	4 (8%)	42 (30%)	147 (18%)
Scots pine	4	27	113	8 (15%)	60 (42%)	234 (30%)
Sweet chestnut	2	23	45	10 (19%)	72 (51%)	251 (32%)
Rowan	2	15	79	12 (23%)	78 (55%)	286 (37%)
Small-leaved lime	2	17	40	14 (27%)	81 (57%)	295 (38%)
Sycamore	1	39	166	15 (29%)	98 (69%)	367 (47%)

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

[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

risks to oak woodland. These wider issues should be considered in developing comprehensive resilience approaches to woodland management.

Summary: Additional potentially beneficial tree species.
Only a few highly associated oak species are supported by each tree species so a large diversity of tree species is required. Based on the analysis above Beech, Scots Pine, sweat chestnut, rowan and small leaved lime (which would all grow at the site) would support 14 out of the 52 highly associated species and 81 out of 142 partially associated species known to occur at the site. Thus, these five tree species would support just over half the partially associated oak species but very few of the highly associated species. If a more diverse woodland was established including sycamore then 69% of the partially associated species would be supported but this would only increase the number of highly associated species supported by one. Sycamore is a non-native species, and generally the planting of non-native species in semi-natural woodlands is not advised, however sycamore is generally tolerated where it is already present. 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. 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
Sweet Chestnut	Similar to oak but with slightly slower litter decomposition. Litter and soil have a slightly higher carbon concentration and slightly lower nitrogen 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
Scots Pine	Slower litter decomposition. Litter and soil have a high carbon concentration and lower nitrogen concentration.	Darker shade in winter as evergreen.

Rowan	Data lacking	Lighter shade
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 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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