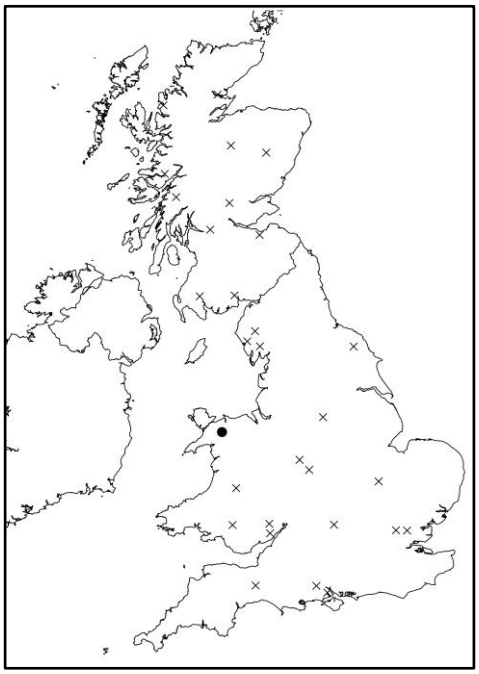
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Bryn Engan



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

High forest woodland structure with Deschampsia flexuosa and bracken vegetation

Case Study key facts

Location: Gwynedd**,** Wales

Landscape context: The woodland occupies the northerly and easterly facing sides of a river valley. To the west is a large mixed conifer/broadleaved woodland and to the north and south east is agricultural land.

Case study area: 0.6 ha, set within a woodland area of 2.3 ha.

Proportion of oak in stand canopy: 80%

Woodland type: High forest

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

Vulnerable oak-associated species: 30 obligate species, 23 highly associated species.

Likely scenario: No changes in oak suitability are expected on this site. But a greater frequency of extreme events in the form of a shift to wetter winters and warmer drier summers is likely to cause stress to oak trees in this region situated on surface-water gley soils (shoot die-back, crown loss, bleeding lesions).

Stand Characteristics

Woodland type: High forest

Soil type: Podzolic brown earth

Stand structure: A managed woodland with a high forest structure. The woodland is generally healthy but there are some standing dead trees and others in decline. The mature oak overstorey trees are over 20 m tall and over 30 cm diameter. About 10% of the site is permanently open habitat in the form of rock outcrops, and c. 20% is temporary open habitat. The canopy is 80% oak, with younger birch and rowan trees also present. Occasional young hazel and sycamore trees are also present, but the understorey is generally quite sparse. Birch, rowan, hazel and holly saplings have regenerated (hazel and holly being only occasional and patchy through the woodland). Birch and rowan seedlings are also common, but seedlings of oak and hazel are occasional, and no oak seedlings have developed into saplings.

Ground vegetation: The ground vegetation is dense and is dominated by wavy hair-grass (c. 50%), bracken (c. 30%), bilberry (c. 20%), ferns (c. 10%) and mosses (c. 80%).

Current management: Removal of invasive western hemlock is the main silvicultural intervention applied recently.

Woodland Biodiversity

Designations: The site is an ancient semi-natural woodland but is not formally designated. However, it is likely to have a rich lichen and bryophyte flora, and support a diverse woodland bird community as it is similar in character to the Coedydd Aber SSSI oak woodland, 14km to the north.

Oak associated species: There are 634 oak-associated species that have been recorded in the area. Of these species 30 are obligate (only known to occur on oak trees), this includes 2 fungi, 1 lichen and 27 invertebrates. A further 23 highly associated species were identified (8 fungi, 3 invertebrates and 12 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 118 partially associated oak species recorded in the area: 11 birds, 55 invertebrates, 48 lichens and 4 mammals. Of the 634 oak-associated species 229 species use the dead wood associated with oak trees, this includes 1 bird species, 3 fungi, 68 bryophytes, 25 invertebrates and 132 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: An oak dominated stand with a range of tree sizes and developing regeneration. A range of other species will be present in small proportions helping to support the oak associated biodiversity on the site and to increase resilience.

Management objectives: The key management objectives are to provide continuation of oak habitat for the 30 obligate oak species and the 23 highly oak associated species on the site (5km area).

Target species composition and stand structure: The best way to support the oak dependent and oak associated species on the site is to manage the woodland to favour the oak trees, maintain them in a healthy condition and ensure their regeneration. The target stand composition is oak dominated (>70%) with a small proportion of other species, such as birch, rowan and sycamore, which are already present. A small increase in the amount of sycamore present in the stand would help to support some of the highly and partially oak associated species (see analysis of additional beneficial tree species, Annex A). There may be opportunities to introduce alder to wetter areas of the woodland, such as along stream sides, in damp hollows and close to the river bank, and this would also help to support a large number of highly and partially oak associated species (Annex A).

The target structure will retain the mature oak overstorey but will strongly encourage regeneration and recruitment of younger oak seedlings, saplings and trees to develop a mixed-age stand and ensure long-term presence of oak on the site.

Regeneration methods: Use of natural regeneration will help to increase resilience of oak on the site, as it will be site-adapted and better suited to the climatic and environmental conditions in the woodland. If natural regeneration fails then oak trees from other local sources should be planted to retain adaptation to local conditions.

For the other tree species that are present on the site (birch, rowan, sycamore and hazel) existing natural regeneration will be favoured and promoted, and new regeneration encouraged. Alder is not currently present on the site, and if it is to be introduced into suitable wetter areas it will require planting, ideally with trees from nearby local sources. Thinning of the overstorey will reduce competition for nutrients and soil moisture between overstorey trees and improve the stand condition, while increasing the light availability for naturally regenerated and planted seedlings and saplings.

Monitoring: Although there are currently no known tree health related problems reported at the woodland, a programme of monitoring is required to ensure that any developing problems are identified at an early stage. The changing species composition and structure of the woodland, and success of natural regeneration and planted trees should also be monitored to ensure that the actions being taken are resulting in the desired outcomes.

Operational factors: Dense ground vegetation of wavy hair-grass, bracken and fern in the woodland is likely to inhibit natural regeneration and compete with any planted trees. Securing successful natural regeneration of oak and other species may therefore require

some disturbance of the ground vegetation (e.g. screefing) to reduce vegetation competition in the areas where natural regeneration is desired. Ongoing vegetation control is also likely to be required until the trees are safely established.

The woodland is not currently fenced against deer. Although there is currently no evidence of deer browsing in the woodland, this would need to be monitored to ensure that no damage was done to naturally regenerated or planted trees. Deer control by shooting or by fencing of the woodland, groups of regenerating trees, or individual trees would be required if deer browsing did start to occur.

There is no road access within the woodland which may limit management operations.

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

The presence of sycamore, a non-native species is currently accepted in the woodland. Sycamore may help to support some of the oak associated biodiversity in the woodland (see Annex A) and may be beneficial provided that the amount of sycamore does not pose a threat to any of the protected species of conservation importance in the woodland.

All management interventions must be carefully planned and managed to ensure that there are no adverse impacts on the oak associated species, or other flora and fauna present in the woodland.

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 634 oak-associated species at Bryn Engan, which include 23 highly associated and 118 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	2	39	127	2 (9%)	39 (33%)	127 (20%)
Sycamore	1	37	144	3 (13%)	57 (48%)	205 (32%)
Scots pine	0	19	87	3 (13%)	66 (56%)	259 (40%)
Hornbeam	0	27	39	3 (13%)	74 (63%)	267 (42%)
Downy birch	0	13	48	3 (13%)	78 (66%)	288 (45%
Aspen	0	13	58	3 (13%)	81 (69%)	291 (46%)
Rowan	0	13	74	3 (13%)	83 (70%)	310 (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

[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

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.

Summary: Additional potentially beneficial tree species.
Based on the analysis above Beech, Sycamore and Scots Pine (which would all grow at the site) would support 3 out of the 23 highly associated species and 66 out of 118 partially associated species known to occur at the site. Thus, these three tree species would support just over half the partially associated oak species but very few of the highly associated species. 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. If a more diverse woodland was established including Hornbeam, Downy birch, Aspen and Rowan then 70% of the partially associated species would be supported but this would not increase the number of 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. 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. 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*	Shading of ground flora**
Beech	Slightly slower litter decomposition. Litter and soil have a slightly higher carbon concentration and slightly lower nitrogen concentration	Darker 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?
Hornbeam	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Slightly lighter shade

Downy birch	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Lighter shade
Aspen	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Lighter shade
Rowan	Data lacking	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 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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