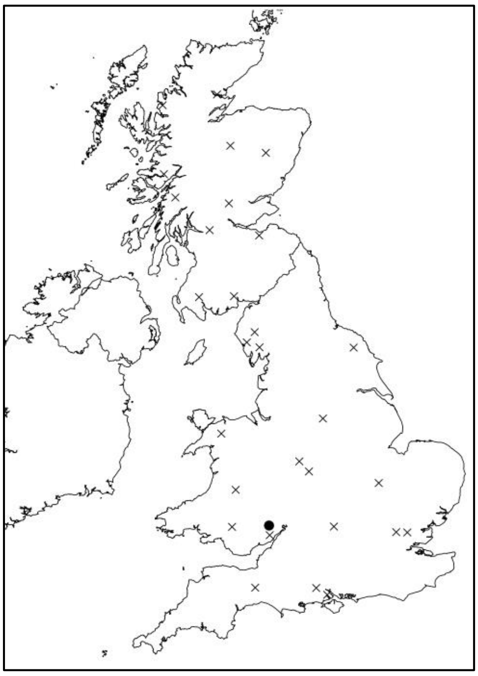
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity.

Case study: Hendre, Tintern (Whitehill Wood)



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

Canopy of mixed oak, ash and other broadleaved species at Hendre

Case Study key facts

Location: Monmouthshire, Wales

Landscape context: Within a large woodland (400 ha) which is surrounded by farmland. The area surveyed is on a gently sloping valley side with a south easterly aspect.

Case study area: 6.6 ha, set within a large woodland of 400 ha.

Proportion of oak in stand canopy: 50 %

Woodland type: High forest

NVC Woodland type: W10 (*Quercus robur – Pteridium aquilinum –Rubus fruticosus* woodland; pedunculated oak- bracken – bramble woodland)

Vulnerable oak-associated species: 3 obligate species, 12 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 growth and/or the health of oak as the site becomes less suitable under climate change. Oak woodlands on poorly draining soils in this area are predicted to show site stress between 2010 and 2050 (e.g. canopy loss, bleeding lesions, dieback).

Site Characteristics

Woodland type: High forest

Soil type: Basic brown earth

Stand structure: The overstorey comprises 50% oak, with mature ash (c. 20%), cherry and yew also present in the canopy. Hazel and holly are also patchily distributed but common as pole stage trees or saplings, with birch and ash occasionally present. Only holly is present as seedlings. There is no permanent open habitat in the stand and only 5% temporary open habitat (deer glades).

Ground vegetation: The ground vegetation is dominated by bracken (c. 50%), bramble (c. 25%), sedges and grasses. There is c. 10 % bare ground.

Historic management: The oak was planted in 1840 and is part of the estate woodland, which has been in multiple ownership (including the Rolls Estate), and was acquired by Forestry Commission Wales (now Natural Resources Wales) in the 1940s and 50s.

Current management: The aim in the medium term is to restore to ancient semi-natural woodland where it has been planted (PAWS) using low impact silviculture system operations. In the longer term the woodland will be managed under continuous cover forestry systems. A partnership project is exploring natural flood management measures in-wood to protect housing downstream on Watery Lane.

Long-term vision: Plans for the woodland are carefully aligned with both conservation and water catchment management plans. Future woodland will deliver amenity and biodiversity benefits, with timber production less significant.

Woodland Biodiversity

Designations: An ancient semi-natural woodland a listed on the 2011 Ancient Woodland Inventory, but not formally designated.

Oak associated species: There are 349 oak-associated species that have been recorded in the area. Of these species three are obligate (only known to occur on oak trees), all three species are invertebrates: two gall wasps and one beetle. A further 12 highly associated species were identified (1 fungus, 9 beetles, 1 moth and 1 ant), 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 36 partially associated oak species recorded in the area: 11 birds, 14 invertebrates, 5 lichens and 6 mammals. Of the 349 oak-associated species 43 species use the dead wood associated with oak trees, this includes 5 highly associated invertebrate species and 2 partially associated invertebrates. 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 mixed broadleaved woodland with oak remaining dominant in the stand, but a range of other native broadleaved species present. The stand will have a range of tree sizes and age classes, deriving from natural regeneration.

Management objectives: The key management objectives are to ensure continuation of oak habitat for the 3 obligate and 12 highly associated oak species on the site.

Target species composition and stand structure: The overstorey contribution of oak will increase to c. 60% in the long-term due to the likely future loss of ash from the site. Existing oak trees will be favoured as this is the best way to support the obligate oak and oak associated species on the site. The remaining 40% of the overstorey will comprise of cherry, yew and birch (which are already present on the site) and lime and hornbeam (which will be introduced to help support oak associated biodiversity, see Annex A).

Overstorey gaps occurring due to the gradual death of ash trees will be used to promote the development of an understorey of regenerating and introduced broadleaved tree species. The proportion of holly in the understorey will be monitored and may need to be reduced if it becomes dominant and prevents regeneration.

Regeneration methods: Following the development of canopy gaps due to dying ash trees natural regeneration will be promoted in patches in the understorey. Oak regeneration will be favoured as the site adapted seedlings will help to ensure presence of oak woodland on the site supporting the current biodiversity. Natural regeneration of other tree species on the site (ash, cherry, yew, hazel and birch) will also be encouraged.

Enrichment planting with lime and hornbeam may be considered, again taking advantage of canopy gaps due to dead and dying ash trees, and to fill gaps in the seedling and sapling distribution if required. Planted trees of these species should be sourced from the local area to ensure that they are well adapted to the climatic and site conditions.

Monitoring: Although there are no known problems with oak health at the site, a programme of monitoring should be implemented so that managers are able to act quickly if a problem does arise. Regular monitoring of the changes in species and stand structure within the woodland will also help mangers to adjust interventions if required and ensure that progress is being made towards the target structure. Success of natural regeneration and planted trees can also be monitored to ensure that light levels are adequate and deer browsing is under control.

Operational factors: Although there is some bare ground present in the woodland, the vegetation cover of bramble, bracken, sedges and grasses may present an obstacle to natural regeneration, both by preventing seeds from reaching mineral soil for germination, and by competing with young seedlings after germination. Vegetation competition is also likely to increase as canopy gaps develop under dead and dying ash trees. Carrying out some light ground preparation such as screefing in the canopy gaps may encourage germination of seeds and reduce vegetation competition during the early establishment. However, further weed control may be required for several years where bracken is dense, to prevent young trees being swamped, particularly during the autumn.

The amount of holly in the understorey will need to be monitored to ensure that it does not become dominant and competitive with developing seedlings and planted trees.

The woodland is not fenced against deer and browsing damage was observed on saplings and ground vegetation. Protection from deer browsing, either by fencing the woodland, or certain regenerating areas, or by providing individual tree protection will be necessary in order to ensure establishment of the next generation of trees on the site.

The woodland currently comprises native tree species only; if non-native species colonise the site managers will need to consider the potential positive and negative impacts of this on the woodland and associated biodiversity, and take appropriate action.

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

Badgers, kestrels and adders are all present on the site and any operations will need to take account of this, taking appropriate steps to minimize disturbance and ensure there is no damage to habitat.

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 349 oak-associated species at Hendre, which include 12 highly associated and 36 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	3	15	44	3 (25%)	15 (42%)	44 (13%)
Hornbeam	2	13	31	5 (42%)	21 (58%)	64 (18%)
Beech	2	21	106	5 (42%)	27 (75%)	130 (37%)
Turkey oak	1	3	14	6 (50%)	28 (78%)	133 (38%)
Aspen	1	7	32	7 (58%)	28 (78%)	143 (41%)
Sycamore	0	15	98	7 (58%)	29 (81%)	169 (48%)
Alder	0	13	74	7 (58%)	30 (83%)	185 (53%)
Crab apple	0	4	38	7 (58%)	31 (86%)	189 (54%)

Summary: Additional potentially beneficial tree species.

Of the tree species assessed small leaved lime supports the greatest number of highly associated species, three out of 12. Beech and hornbeam both support the same 2 highly

[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

associated species and both are suitable to grow under current conditions at the site. The ESC model suggests that hornbeam will be more suitable under a future climate suggesting the prioritization of that species, however beech is still categorized as suitable and supports more partially associated oak species than hornbeam, hence the inclusion of both species in the above table. Turkey oak and Aspen would each support one additional highly associated species if added to the mix of trees. None of the other five highly associated species were supported by any of the other beneficial tree species. This combination of six tree species would 35 of the 48 species most at risk (high and partially associated) and in total support just over 40% of the oak associated species present at the site. Sycamore, alder and crab apple would each support one more partially associated species. The remaining five partially associated species are not known to be supported by any of the alternative tree species assessed. However, it should be noted that 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.

The tree species suggested above 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. None of the beneficial tree species are already present at the site suggesting that planting would be the only way to establish these species. 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
Alder	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Lighter shade
Hornbeam	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Slightly 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
Crab Apple	Data lacking	Lighter shade
Aspen	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon concentration	Lighter shade

Turkey oak	Data lacking	Similar?
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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