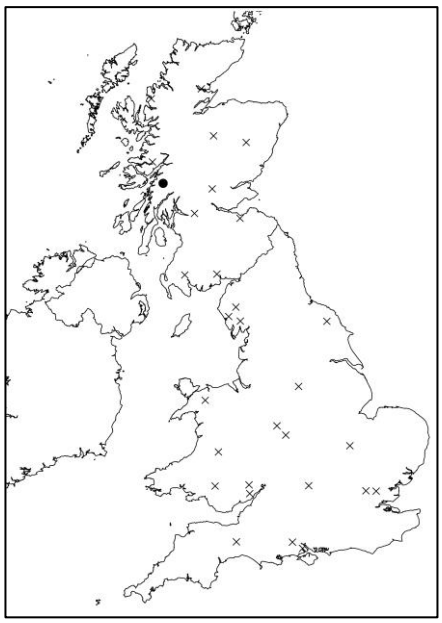
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Glen Nant



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

Mixed native broadleaved woodland at Glen Nant

Case Study key facts

Location: Argyll, Scotland

Landscape context: The site is in a valley with an easterly aspect overall, but there is a lot of microtopography, small humps and hollows and rocky outcrops. It is surrounded by upland habitats of moorland, native woodland and commercial conifers.

Case study area: 2.0 ha within a wider SSSI of 502 ha. Less than half of the SSSI is woodland, and only a relatively small area is oak woodland

Proportion of oak in stand canopy: 30%

Woodland type: High forest

NVC Woodland type: W11 (*Quercus petraea-Betula pubescens-Oxalis acetosella* woodland; sessile oak – downy birch – wood sorrel woodland)

Vulnerable oak-associated species: 1 obligate species, 6 highly associated species.

Likely scenario: The site is expected to become less suitable for oak in the coming decades and productivity may be lower. Extreme events are likely to become more frequent, resulting in increased stress

Site Characteristics

Woodland type: High forest

Soil type: Brown earth

Stand structure: The overstorey in the case study area is c. 30% oak, comprising mature and veteran trees, some of which are large and have been coppiced in the past. The canopy is dominated by birch (c. 60%) with hazel, ash, rowan and alder also present in small amounts. There are also rare young holly trees. About 1% of the woodland is permanent open habitat and c. 5% is temporary open habitat. All trees are covered in epiphytic lichens and bryophytes. Willow saplings and occasional alder saplings are present, with occasional patchily distributed seedlings of oak, hazel and rowan.

Ground vegetation: The ground vegetation is dominated by bracken (c. 50%) and grasses, bilberry is also present at c. 10% cover.

Current management: The woodland, besides that in the river gorge, was coppiced during the 18th and 19th centuries resulting in uniform and close-grown woodland with an oak-dominated canopy. In the 1880s, silvicultural practices ceased. Glen Nant was divided between smaller holdings and was managed for the grazing of both cattle and sheep and woodland regeneration was held in check. Since the 1970s there have been varying forms of silviculture and conservation management practiced. Although stock has been removed from much of the woodland, deer are present in sufficient numbers to suppress natural regeneration. Some inter-planting with Sitka spruce occurred in the 1970s and 80s but by 2010 these conifers, on ground within and adjacent to the SSSI, were removed. The main objectives for the woodland are now to: a) maintain and enhance the extent and distribution of upland oak woodland habitat through promoting natural regeneration of native species through control of browsing pressure, removing non-native trees and shrubs, maintaining glades and promoting veteran trees in areas of even age, closed canopy stands and b) maintain and enhance the diversity and distribution of the bryophyte assemblage by maintaining deadwood habitat and removing non-native trees and shrubs from the site.

Woodland Biodiversity

Designations: An important Upland oak woodland, Glen Nant also supports rich communities of lower plants (lichen and bryophyte assemblages). The woodland's bryophyte assemblage provides a suitable habitat for a nationally-rare species of cranefly (*Tipula luridorostris*) which is known from only two other sites in Britain. The woodland supports outstanding and varied assemblages of internationally important Atlantic bryophytes and lichens. The majority of lichens are from three notable communities; *Lobarion pulmonariae*, *Graphidion scriptae* and *Parmelietum laevigatae* and contain two vulnerable species, ten near-threatened species, nine nationally-rare species and 53

nationally-scarce species. The site has recently been estimated to support at least 240 species of bryophyte (155 mosses, 85 liverworts), more than 25% of the Scottish bryophyte flora. Of this total 11 are nationally-scarce species and 35 are oceanic species. The site supports rich and diverse communities of woodland invertebrates. The larvae of the rare cranefly *Tipula luridorostris* lives in moss found on trees in western oak woods where rainfall is relatively high. Additionally, the site provides suitable conditions to support a wide range of fly species including 2 nationally-scarce species, *Tetanocera phyllophora* and *Botanophila maculipes*, the site also supports the rare wood ant *Formica aquilonia* (RDB/IUCN Near Threatened). Otter, a protected species, is also likely to use the woodland.

Oak associated species: There are 267 oak-associated species that have been recorded in the area. Of these species one is obligate (only known to occur on oak trees) which is a lichen. A further 6 highly associated species were identified, which were all 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 33 partially associated oak species recorded in the area: 5 birds, 1 invertebrates and 27 lichens. Of the 267 oak-associated species 110 species use the dead wood associated with oak trees, this includes 55 bryophytes (mosses and liverworts), 1 invertebrate and 54 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: A thriving oak dominated woodland, with a range of other native broadleaved species present, supporting many oak associated species and communities.

Management objectives: The key management objective is to maintain and improve the long-term habitat for the wide range of rare and protected species.

Target species composition and stand structure: As the proportion of oak in the overstorey is currently only 30%, this will be increased to help support the oak associated biodiversity in the oakwood; the target should be at least 50% oak, with the remainder being other native broadleaves. The proportion of birch in the overstorey will be reduced slightly by careful thinning, to create opportunities for oak, and for other native broadleaved species (hazel, ash, rowan, alder, willow) in the woodland. The complex microtopography and varying soils will influence which species are present in each area; hazel will be more common on the deeper and richer areas, rowan and birch on the poorer and shallower soils, and alder and willow will be more frequent on the wetter sites. The understorey is currently patchy with occasional saplings and small trees. The target structure will have a developing cohort of future canopy trees as seedlings, saplings and young trees.

Regeneration methods: Natural regeneration should be favoured over planting as the trees will be well adapted to the site and environmental conditions. There has been some success with natural regeneration already, and some saplings and small trees are present. However, creation of canopy gaps by removal of a small number of overstorey birch trees will increase light levels and improve success of natural regeneration. For species that are present in the

woodland in very lower numbers, or with patchy distribution it may be necessary to plant seedlings grown from seeds collected on site, or from another local source. Both naturally regenerated and planted seedlings will require control of deer browsing and competitive vegetation to be successful, see below.

Monitoring: A programme of regular monitoring will be important to record the changes in species composition and stand structure, the success or failure of regeneration, deer impacts and colonisation and control of any unwanted species. This information will assist managers and confirm whether the interventions are resulting in the desired changes in the woodland.

Operational factors: Although the site is fenced against deer they are clearly present and a lot of browsing damage was observed on the site. This is likely to be having a significant impact on regeneration success. Removal of deer from within the fenced enclosure, and securing the fence against further deer entry should be a priority.

Bracken dominates the ground vegetation and in some areas may be reducing the success of natural regeneration. As the canopy is opened the bracken may need to be controlled to prevent it from spreading further and outcompeting young seedlings. Non-native tree species have been removed from the woodland and any regeneration of these species, or colonisation by other non-native tree species may also need to be controlled.

Access within the woodland is restricted, with few roads, uneven ground and rocky outcrops which may limit operations that can be carried out.

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

It is important that any management interventions are carefully considered and managed to ensure that there are no unwanted impacts on habitat provision for the wide range of scarce and rare species and communities within the woodland. In addition to the important species present in the woodland, otter, a European Protected Species is also likely to use the woodland and this must be considered when planning interventions.

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 267 oak-associated species at Glen Nant, which include 6 highly associated and 33 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
Alder	2	18	77	2 (33%)	18 (54%)	77 (29%)
Sycamore	0	8	66	2 (33%)	23 (70%)	117 (44%)
Scots pine	1	11	39	3 (50%)	26 (79%)	134 (50%)

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.
Only 3 of the highly associated species are known to use any of the 30 tree species studied and alder is the only tree species that will support more than one of these highly-associated species, other than ash which is not recommended due to ash dieback. After including alder in the selection the analysis therefore concentrated on maximizing the number of partially associated species supported. Based on the analysis above alder, sycamore and Scots Pine (which would all grow at the site) would support 3 out of the 6 highly associated species and 26 out of 33 partially associated species known to occur at the site. Thus, these three tree species would support half of the highly associated species and over three-quarters of the partially associated oak species. The other highly and partially associated species were not known to be supported by any of the other tree species studied, accept ash, which is not recommended due to ash dieback. Alder, sycamore and Scots Pine 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. Some shrubs such as hazel, which were not included in this study that focussed on other tree species, may also be beneficial to 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
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.

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