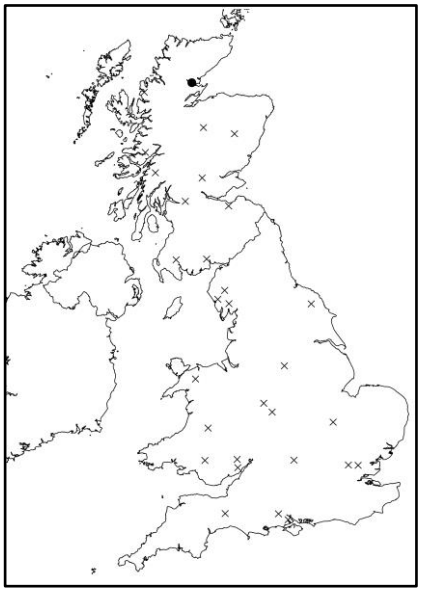
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity.

Case study: Ledmore Wood (also known as Spinningdale oakwood)



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

Pure oak overstorey and bilberry dominated ground vegetation at Ledmore Woods

Case Study key facts

Location: Highland, Scotland

Landscape context: To the north of the Dornoch Firth, on the gentle slopes rising up from the Firth with a southerly aspect. Pine woodland to the east and north-east and mixed rough grazing in surrounding area.

Case study area: 93 ha

Proportion of oak in stand canopy: 100%

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: 38 obligate species, 9 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 upland brown earth

Stand structure: The overstorey is composed entirely of mature oak, generally 10-20 m tall in the majority of the woodland, however in the southern part of the wood, on the lower slopes, a higher proportion of the trees are taller than 20 m. There is no permanent open habitat and c. 1% of temporary open habitat. There are patchy and occasional holly saplings which are heavily browsed by deer, and occasional but less frequent birch, oak and rowan seedlings. Occasional hazel are also present along the road edge, but not within the stand.

Ground vegetation: There is an unusual heather dominated ground flora at the eastern end of the site. At the western end the vegetation is the more typical bilberry, bracken and grass community. There is plentiful deadwood on the site, largely from oak.

Current management: Records suggest that oak wood on the site was felled in the mid 18th century. Most of the present oak trees range between 100 and 200 years old and some may have been coppiced in the past. The site is currently managed for conservation purposes (maximising biodiversity) and for public access under an agreement between Woodland Trust and SNH. The aims for management are to maintain the condition, distribution and extent of upland oak wood habitats by appropriate minimum intervention; to continue deer control measures to encourage natural regeneration of native species; to create structural, species and age diversity; to control invasive or non-native species (e.g. gorse and *Gaultheria*) and to maintain the distribution and extent of suitable otter habitat e.g. by leaving suitable structures for shelters and adjusting fencing for otter access.

Woodland Biodiversity

Designations: Notified for the Upland oak woodland, one of the largest and northerly oak woods in Britain. The site is also designated as a Special Area of Conservation (SAC) for Western acidic oak woodland. The woodland has high levels of nativeness. The canopy is dominated by oak (mostly sessile but some pedunculate oak is also present) and an untypical ground flora dominated by heather and bilberry. Juniper (a protected species) and nationally scarce rock whitebeam (*Sorbus rupicola*) are also present. The woodland also provides habitat for rare lichen species e.g. *Schismatomma graphidioides* and *Buellia violaceofusca* (both protected species). A good range of woodland bird species occur at Ledmore Wood including redstart, wood warbler, tree pipit and woodcock (all are protected species in Scotland). The site also hosts a number of notable invertebrates, and is known to support optimum otter habitat on the lower slopes adjacent to the Dornoch Firth. The woodland also provides habitat for wildcat and pine marten. All three mammals being protected species.

Oak associated species: There are 207 oak-associated species that have been recorded in the area. Of these species 38 are obligate (only known to occur on oak trees): all of which are invertebrates except for one lichen. A further 9 highly associated species were

identified (3 invertebrates and 6 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 39 partially associated oak species recorded in the area: 12 invertebrates, 26 lichens and 1 mammal. Of the 207 oak-associated species 82 species use the dead wood associated with oak trees, this includes 4 invertebrates and 78 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 upland oakwood, with a diverse tree species and age structure, which supports the large number of native species in this rare habitat type.

Management objectives: The key management objective is to maximise biodiversity in this special area of conservation; this requires promotion of natural regeneration of oak to ensure the presence of oak in the long-term.

Target species composition and stand structure: As the oak wood is a Special Area of Conservation, oak will remain the dominant tree species on the site, contributing at least 90% to the overstorey. However, other native broad leaved species that are appropriate to the site, particularly birch and rowan, will also be encouraged to increase the diversity of the woodland. These species will also help to support some of the partially oak associated biodiversity present (see Annex A). There are currently no young trees in the woodland, and although there are occasional oak seedlings there are no oak saplings present. In future the number of seedlings that develop into saplings and into young trees will need to increase so that in the long-term there will be replacement of ageing canopy trees.

Regeneration methods: There has already been a small amount of successful seedling germination of oak in the woodland, and these seedlings will already be well adapted to the environmental and climatic conditions at the site. Securing a higher rate of seedling germination, and successful development into saplings and young trees will be the best way to regenerate the stand while retaining the existing genetic advantage. Seedlings may be more likely to survive in areas where light levels are higher; one option could be to collect seed from the woodland, grow the young trees off site and plant them in appropriate open areas of the woodland when they are large enough. Natural regeneration of smaller-seeded birch and rowan is likely to spread within the woodland provided deer browsing is controlled, see below.

Monitoring: Although no changes in oak health are predicted on this site, a programme of regular monitoring should be established to ensure that the woodland is in good condition. This will allow managers to check that any interventions planned are having the desired effect on tree species composition and stand structure, and that regeneration success is improving. The extent of deer browsing appears to be limiting natural regeneration and monitoring of control measures will be needed.

Operational factors: The woodland is not fenced against deer and browsing damage to holly saplings and to young tree seedlings was heavy. There are also well-used deer paths in the woodland. Successful natural regeneration of sufficient oak seedlings and saplings will not be possible unless deer are excluded from the woodland or another form of browsing protection (such as shelters or exclosures) is provided.

The ground vegetation does not currently appear to be preventing seedling germination, but may be competing with them. Once deer browsing pressure has been reduced ongoing monitoring will confirm whether vegetation competition is a factor in poor seedling survival. It will also be necessary to carry out vegetation control if colonisation of invasive plants, such as *Gaultheria* and gorse becomes a threat.

The woodland currently comprises only native broadleaved species. The potential positive and negative impacts of other tree species that may colonise the woodland in the future should be carefully considered and a decision taken to remove them if necessary.

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

There are a number of Scottish and European Protected Species present in the woodland (see above) and it is important that any operations take account of these to ensure that habitats are suitably protected and no disturbance of protected organisms occurs. Ledmore Wood also contains a number of features of archaeological interest including prehistoric chambered cairns which must be considered before any interventions are carried out.

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 207 oak-associated species at Ledmore, which include 9 highly associated and 39 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
Scots pine	0	11	38	0 (0%)	11 (28%)	38 (18%)
Rowan	0	3	26	0 (0%)	14 (36%)	62 (30%)
Silver Birch	0	3	4	0 (0%)	17 (44%)	65 (31%)

Summary: Additional potentially beneficial tree species.
Few of the tree species studied are predicted to be suitable to grow at Ledmore and of those tree species that are suitable, none of them will support any of the highly associated species. The analysis was therefore based on the suitability of tree species to support partially associated oak species.

Based on the analysis above Scots Pine, rowan and silver birch (which would all grow at the site) would support 17 out of the 39 partially associated species known to occur at the site but none of the highly associated species. These tree species may need to be grown in

[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

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. 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**
Birch (Silver and downy)	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?
Rowan	Data lacking	Lighter 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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