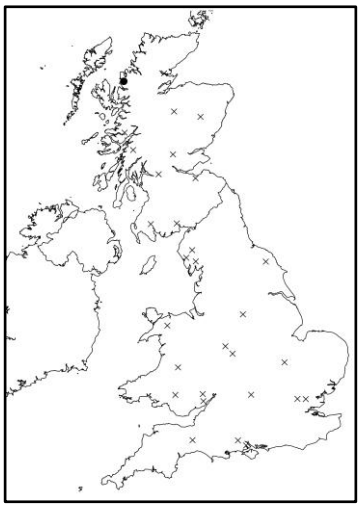
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Coille Dhubh



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

Oak and birch overstorey with developing understorey at Coille Dhubh

Case Study key facts

Location: Highlands, Scotland

Landscape context: On the relatively sheltered lowest south-westerly facing slopes of Loch Shieldaig made up of Torridonian breccia and sandstone. The woodland has a clearly defined periphery to the south-west where it runs right down to the loch and to the south-east where it is bounded by a minor road. To the north and north-east the wood has a less defined boundary and fades into rocky ground covered with wet heathland and bog on Lewisian gneiss. The wood is contiguous to other areas of oak woodland on the lower slopes surrounding Loch Shieldaig.

Case study area: c 40 ha of oak woodland in an SSSI of 61 ha.

Proportion of oak in stand canopy: 75%

Woodland type: High forest

NVC Woodland type: W11 (*Quercus petraea-Betula pubescens-Oxalis acetosella* woodland; sessile oak – downy birch – wood sorrel woodland) on the lower and more southerly slopes and W17 (*Quercus petraea-Betula pubescens-Dicranum majus* woodland; sessile oak – downy birch – moss woodland) on the upper and more northerly slopes.

Vulnerable oak-associated species: 4 obligate species, 6 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: The area has a wide association of semi-natural habitats including Atlantic oak woodland. The site includes extensive areas of acid oak woodland on the higher and more northern slopes, on rocky spurs (W17) and as well as slightly damper and base-richer oak-birch woodland on the lower and more southern slopes (W11), along with some wetter flushed areas of woodland with birch and willow and a variety of dry and wet heath and bog habitats on the upper slopes.

Soil type: The soils of the woodland are predominantly upland gleyed brown earths and mineral gleys although there are also significant areas of shallower soils on the upper slopes, on spurs and on some areas of steeper ground. Outwith the woodland, there are areas of very rocky ground as well as peaty gleys and peat.

Stand structure: The structure of the oak-dominated woodland is predominantly high forest of generally standard oak trees which have now attained a canopy height along with occasional multi-stemmed specimens. Some older birch trees also attain canopy height in places and c. 20% of the canopy is birch. The occasional patch of hazel is found on the richer soils on the lower slopes. There are some areas of mid-age birch which are old enough to have attained a lower canopy high forest structure in places as well as numerous patches of very young regenerating birch where the light levels are sufficiently high. The oak trees are predominantly standards although multi-stemmed trees also occur throughout the wood. On the lowest most sheltered ground on the deeper soils some specimens attain a DBH in excess of 100cm and a height of around 20m but typically are between 30-60 cm DBH and 15-20m high. Further upslope particularly where the soils shallower, the trees become somewhat shorter in stature, with a smaller DBH. Some areas have quite a dense canopy whilst other areas are much more open. The oaks support good populations of bryophytes and epiphytic lichens including much *Lobaria pulmonaria* on the lower ground. Oak seedlings are found throughout the wood especially in more open glades but rarely are they developing into saplings due to browsing pressure from deer. Seedlings of all tree species are absent where bracken is particularly dense.

Ground vegetation: In the damp acid oak-birch woodland (W11) the ground flora is dominated by abundant bracken, grasses, wood sorrel and mosses. Violets and primroses occur occasionally. In the drier, well-drained acid oak woodland the ground flora contains abundant grasses and mosses with frequent heather, bilberry and ferns.

Current management: A long history of management of the woodland is suggested. The oak trees are very even aged which may indicate that the woodland regenerated following a felling or has even been planted. More recently, the woodland was used for stock grazing and for firewood. Since 1998, the woodland has been fenced and stock excluded and the site planted with native trees. Bracken cover has been reduced. Deer fencing was erected in 2002 and the resident red and roe deer population controlled. The long-term objectives are

to maintain the extent and condition of the semi-natural woodland, primarily by preventing the colonization and spread of rhododendron and encouragement of natural regeneration through deer management and possibly by ground scarification using cattle and/or pigs.

Woodland Biodiversity

Designations: Notified as an upland oak woodland and is designated as part of Loch Maree Complex Special Area of Conservation (SAC). Coille Dhubh is one of the best examples of an oakwood on acidic soils in Wester Ross. The woodland has a characteristic woodland bird assemblage and is likely to support a rich community of mosses, liverworts and lichens, although it has yet to be fully surveyed. A number of locally important species of mammals, birds, invertebrates, vascular plants and mosses have been recorded including the pine marten (a protected species), four-spotted chaser dragonfly (*Libellula quadrimaculata*), slender false brome (*Brachypodium sylvaticum*) – both RDB/IUCN Least Concern.

Oak associated species: There are 369 oak-associated species that have been recorded in the area. Of these species 4 are obligate (only known to occur on oak trees), they are all invertebrate species. A further 6 highly associated species were identified (1 invertebrate and 5 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 45 partially associated oak species recorded in the area: 7 birds, 4 invertebrates 33 lichens and 1 mammal. Of the 369 oak-associated species 152 species use the dead wood associated with oak trees, this includes 1 bird species, 55 bryophytes (mosses and lichens), 2 invertebrates and 94 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 resilient oak woodland with a developed understorey, that will support a wide range of biodiversity in the long-term.

Management objectives: To provide support to the communities that thrive in the woodland, by increasing resilience of the oakwood to extreme climatic events and potential pests and diseases.

Target species composition and stand structure: Oak will remain the dominant overstorey species in the woodland, contributing at least 70% to the canopy. Other native broadleaved species such as birch, rowan, aspen, holly and hazel, which are already present in the woodland or wider environment will be encouraged to increase tree species diversity. On the lower slopes, where soils are a little deeper hazel is likely to be more suitable, while birch and rowan may be more dominant on the shallower soils higher up the slope.

Most tree species present are represented as seedlings, saplings, young trees and mature trees, and a sparse understorey is developing. However, although new oak seedlings are common, there are very few established seedlings, saplings or young trees. The target

stand structure will therefore include a higher proportion of oak regeneration to ensure long-term continuity of oak in the woodland.

Regeneration methods: Although some planting has taken place in the past two decades, natural regeneration of most species appears to be successful. Despite the deer fence a significant amount of deer browsing was noted on oak seedlings and this may be the reason that there are very few established oak seedlings and saplings in the woodland (see Operational factors below). Use of natural regeneration of all species, taking advantage of the existing site adaptation of parent trees, will result in trees that are best suited to the environmental conditions at the site. As c. 30% of the woodland is temporary open habitat and the canopy is not dense, the light levels should be sufficiently high for seedlings to establish successfully. If trees were to be planted then it is important to use material from a local source with similar climatic conditions.

Monitoring: A monitoring programme carried out within the woodland would help managers to determine whether previous interventions such as the erection of the deer fence and planting of trees in the past two decades had been successful. Any impacts of climate change or pests and diseases on the health of the trees would also be identified at an early stage allowing managers to consider actions.

Operational factors: Although the woodland is fenced against deer there appears to be sufficient deer browsing of oak seedlings to prevent almost all from developing into saplings and young trees. Exclusion of deer from the fenced area and repair of any damage is important to protect both the current developing understorey and future regeneration.

Tree seedlings were noted to be absent where bracken was denser. As bracken is frequent across the site carrying out control measures to prevent its spread and reduce the impact on seedling success would be beneficial. As stated in the current management plans, it is important to remain vigilant to colonisation by Rhododendron, and to act quickly and monitor efficacy if colonisation does occur.

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

The potential impacts of any non-native tree species that are found to be colonising the site should be considered carefully. Species that pose a threat to the oak associated biodiversity and ecosystem functioning should be monitored and removed if necessary.

There are a number of protected and rare or locally important species on the site and care must be taken to ensure that management interventions will not cause any damage or disturbance to these organisms.

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 369 oak-associated species at Collie Dubh, which include 6 highly associated and 45 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	11	64	2 (33%)	11 (24%)	64 (17%)
Rowan	1	8	58	3 (50%)	15 (33%)	98 (27%)
Sycamore	0	18	97	3 (50%)	21 (47%)	134 (36%)
Scots pine	0	11	62	3 (50%)	28 (62%)	172 (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 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.
Based on the analysis above Beech and Rowan (which would both grow at the site) would support 3 out of the 6 highly associated species and 15 out of 45 partially associated species known to occur at the site. No other tree species that would grow at the sight would support any of the highly associated species. If a more diverse woodland was established including sycamore and Scots pine then nearly half 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 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. If the establishment of non-native trees is considered (sycamore and beech) this would need to be cleared with the appropriate authorities as currently planting non-native tree species in semi-natural woodlands, particularly protected areas, is not considered appropriate; however sycamore is generally tolerated where it is already present. This study has focused on identification of other tree species that would support oak-associated biodiversity. However, some shrubs, e.g. hazel, that are not included in this study may also support oak-associated species.

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*	Shade**
Sycamore	Faster litter decomposition. Litter and soil have a higher nitrogen concentration and lower carbon 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, 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 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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