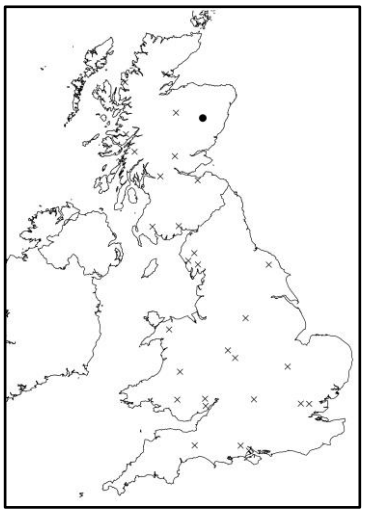
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Dinnet Woods



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

Oak dominated overstorey with ground vegetation of bracken and grasses at Dinnet Woods

Case Study key facts

Location: Aberdeenshire, Scotland

Landscape context: On the gently sloping, lower till-covered, slopes of the Middle Dee valley mostly above the level of the floodplain. The wood is contiguous with other areas of both deciduous and coniferous woodland and open ground on either side of the River Dee. Most of the site is a non-adjoined part of the much larger Muir of Dinnet NNR which includes woodland, moorland and freshwater lochs on the north side of the river.

Case study area: 19.7 ha

Proportion of oak in stand canopy: >90%

Woodland type: Predominantly high forest, some areas are coppice with standards and there is evidence of old coppicing.

NVC Woodland type: A mixture of W11 (*Quercus petraea-Betula pubescens-Oxalis acetosella* woodland; sessile oak – downy birch – wood sorrel woodland) and W17 (*Quercus petraea-Betula pubescens-Dicranum majus* woodland; sessile oak – downy birch – moss woodland)

Vulnerable oak-associated species: 14 obligate species, 18 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: Mostly high forest.

Soil type: Lower and mid-slopes are brown and brown-podzolic soils, with the upper slopes being shallower brown-podzolic soils and rankers.

Stand structure: Predominantly an unmanaged high forest comprising of >90% oak (*Quercus petraea*), although both species of oak are present and possibly hybrids too. The oaks are mature, well grown specimens the result of previous plantings. There is a reasonable cover and diversity of bryophytes and lichens on the oaks. In places the canopy has plenty of birch of young and mid-age forming a sub-canopy. Some of the areas of birch are young dense patches probably developed from seed after felling episodes in the past. Much of the birch is also multi-stemmed so was probably browsed by deer as it was regenerating. On the lower slopes, adjacent to the floodplain, there is some ash and hazel and the wood also contains small clumps of aspen and bird cherry. Alder and willow are also present in very low numbers. Although new seedlings of oak are common throughout the woodland there are no established seedlings or saplings. Rowan seedlings and saplings are common.

Ground vegetation: The ground flora on the lower and mid slopes is quite diverse (W11) but dominated by bracken and grasses with scattered wood anemone, wood sorrel and violets. The upper slopes support a more acidic and heathy plant community (W17) dominated by wavy hair grass and bilberry, but these areas are rather limited in extent.

Current management: Likely to have a long history as an oakwood, individual trees date back to 1790 and the woodland appears on the First Edition Ordnance Survey (1882). The current woodland is mainly the product of plantings in the early nineteenth century. After 1905 the wood was used mainly for game cover. There has been intermittent extraction of timber (e.g. 300 m^3 removed from 2.4 ha). Timber quality is however poor (wood develops 'shake'). Sheep grazing severely limited natural regeneration until the 1960s. Since fencing in 1988, there has been some regrowth of coppice stools. The primary objective of management is nature conservation, specifically to prevent the deterioration of natural habitats and the habitats of species, as well as disturbance of the species. Intervention may be required to encourage oak regeneration, but this is not seen as an urgent issue.

Woodland Biodiversity

Designations: Dinnet Oakwood SSSI is designated as Dinnet Oakwood Special Area of Conservation (SAC) for the European habitat Western acidic oak woodland. Characteristic northern species present in the ground flora include intermediate wintergreen *Pyrola media*, chickweed wintergreen *Trientalis europaea* and stag's-horn club-moss *Lycopodium clavatum*. The fungal flora of the wood is of local interest, a number of uncommon species having been recorded. The fauna of the wood is of local interest. A good range of breeding warblers are found including wood warbler (*Phylloscopus sibilatrix*). A number of

uncommon invertebrate species have been recorded such as the beetle *Enicmus rugosus* (Nationally Notable occurs in maximum of 100, 10km squares) species), the gnat *Boletina digitate* (Data deficient but of conservation concern) and the moth *Eupithecia trisignaria*.

Oak associated species: There are 423 oak-associated species that have been recorded in the area. Of these species 14 are obligate (only known to occur on oak trees): 2 fungi, 2 lichen and 10 invertebrates. A further 18 highly associated species were identified (6 fungi, 2 invertebrates and 10 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 73 partially associated oak species recorded in the area: 8 birds, 37 invertebrates, 25 lichens and 3 mammals. Of the 423 oak-associated species 177 species use the dead wood associated with oak trees, this includes 1 bird species, 40 bryophytes (mosses and liverworts), 3 fungi, 6 invertebrates and 127 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 and resilient woodland dominated by oak but with a mixture of other broadleaved species, hosting a wide range of oak associated communities.

Management objectives: To improve the diversity, structure and resilience of the woodland providing long-term habitat security for rare species.

Target species composition and stand structure: Oak will continue to be the dominant species in the woodland, occupying at least 70% of the overstorey. However the contribution of other native broadleaved species present on the site, birch, rowan, aspen, alder, willow, bird cherry and hazel will be increased to improve diversity. Ash would also increase the biodiversity present but this species may decline in abundance due to ash dieback. Species composition will vary depending on location and soil type within this relatively large woodland; on the lower slopes and deeper soils hazel will be more common, while birch and rowan will be present in higher density on the shallow soils of the upper slopes, and alder and willow largely in the wetter areas. Increasing the proportion of alder in particular will assist many of the highly and partially oak associated species on the site (see Annex A). The woodland already has a reasonably well developed understorey, with young trees and saplings of a range of species present. Oak is only present in the overstorey and the target stand structure will include young oak saplings and young trees that will eventually develop to become the future overstorey trees.

Regeneration methods: Natural regeneration appears to be successful, with seedlings of several species present throughout the woodland. However, few seedlings have reached sapling stage, particularly for oak. This may be due to low light levels and the dense overstorey; crown thinning may create areas where seedlings can grow and establish more successfully, provided weed competition is not too high. Deer browsing has been recorded in the woodland and is also likely to be limiting regeneration success of oak and other species. If natural regeneration can be protected it offers the best resilience for the future

stand as it will already be well adapted to the site conditions. Alternatively planting seedlings from a suitable locally adapted source would also be appropriate. Planting should be carried out in the centre of canopy gaps to ensure that seedlings have an appropriate light environment and establish quickly. Planting will also be required for some of the species that are currently in very low abundance; material should be from a suitable local source, or ideally with trees grown from seeds collected on site.

Monitoring: A programme of regular monitoring of the changes in the woodland is required, firstly to identify any changes in oak tree health that may occur, and secondly to record the changes in woodland species composition and structure, and ensure that operations are resulting in the desired outcomes.

Operational factors: The ground vegetation, which is dominated by bracken and grasses, is potentially competitive with young tree seedlings and saplings. In addition, bracken may collapse onto young seedlings at the end of the season and damage or smother them. Where bracken is particularly dense, and in areas where natural regeneration has developed or is hoped for, it should be controlled so that it does not compete with the young trees. Planted trees will also require protection from highly competitive ground vegetation to establish successfully.

There is some track access within the woodland, although access to other areas away from these tracks may be more difficult.

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

Although the woodland is fenced against deer and livestock there were signs of deer browsing of vegetation and seedlings on site. This is likely to be a key factor in the failure of the numerous oak seedlings and the reason that there are no oak saplings present. Repair of the fence and exclusion of deer is crucial if natural regeneration and planted trees are to establish successfully.

The woodland currently does not contain any non-native tree species. If non-native tree species do colonise the woodland careful consideration of their potential positive and negative impacts on the existing woodland and biodiversity within it will be needed before making a decision on whether to remove the non-native species.

All planned interventions must be carefully considered before proceeding to ensure that there will not be any negative impacts or disturbance to the uncommon species of conservation interest that are 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 423 oak-associated species at Dinnet, which include 18 highly associated and 73 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	3	23	89	3 (17%)	23 (32%)	89 (21%)
Sweet chestnut	2	12	30	5 (28%)	31 (42%)	110 (26%)
Scots pine	2	18	99	7 (39%)	41 (56%)	179 (42%)
Beech	1	18	74	8 (44%)	50 (68%)	203 (48%)
Sycamore	0	23	102	8 (44%)	58 (79%)	247 (58%)

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

[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

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 alder, sweet chestnut and Scots Pine (which would all grow at the site) would support 7 out of the 18 highly associated species and 41 out of 73 partially associated species known to occur at the site. Thus, these three tree species would support just under half the partially associated oak species and a third of the highly associated species. If a more diverse woodland was established including beech and sycamore then 79% of the partially associated species would be supported and one additional highly associated species would be 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. Alder is already present at the site (see above) and its 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, beech and sweet chestnut are non-native tree species and currently planting non-native tree species in existing native woodland is not recommended and this would need to be cleared with the appropriate authorities, 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
Sweet Chestnut	Similar to oak but with slightly slower litter decomposition. Litter and soil have a slightly higher carbon concentration and slightly lower nitrogen 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?

*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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