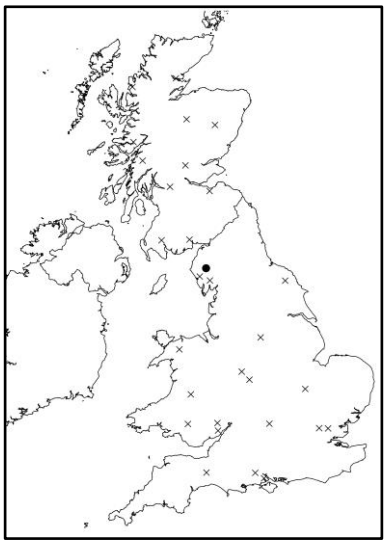
Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. (Updated February 2020)

Case study: Seatoller (Borrowdale)



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

Oak and ash woodland at Seatoller Woods, Borrowdale, with bracken dominated ground vegetation.

Case Study key facts

Location: Cumbria, England

Landscape context: Seatoller Wood lies towards the head of the Borrowdale Valley. The ancient upland Atlantic oak woodland forms a major feature of the lower to mid slopes of the northern side of the Derwent River. The woodland is surrounded by rich pastures bordered by dry stone walls that spread across the flat valley floor and up towards the steep and rocky fells characteristic of this part of the Lake District. The woodland is contiguous with an area of scattered trees and shrubs which also forms part of the SSSI.

Case study area: c 95 ha out of 137 ha

Proportion of oak in stand canopy: 80%

Woodland type: High forest with some coppice with standards

NVC Woodland type: The closed canopy is W11 (Quercus petraea-Betula pubescens-Oxalis acetosella woodland; sessile oak – downy birch – wood sorrel woodland) surround by open areas of U4 (Festuca ovina-Agrostis capillaris-Galium saxatile grasslandand) and U20 (Pteridium aquilinum-Galium saxatile community).

Vulnerable oak-associated species: 0 obligate species, 8 highly associated species.

Likely scenario: Parts of the woodland on gleyed soils will become less suitable for oak in the coming decades and productivity may be lower. This will be caused by increased winter waterlogging followed by drier warmer and droughtier summers. The changes in climate will result in increased stress (loss of canopy density, die-back, bleeding lesions).

Site Characteristics

Woodland type: The greater area of the SSSI supports upland woodland and open hillside with scattered trees and shrubs. The oak woodland itself is generally more mixed with ash and hazel on the lower slopes along with a few more flushed areas (W11) and more exclusively oak and more acidic on the higher slopes where there are some crags and scree (W11-W17). There are also a few areas of poorer drained ground with a little more birch and a ground flora with *Molinia* and *Sphagnum palustre* as the major components in the northern part of the site on shallower slopes (W4).

Soil type: Predominantly upland gleyed brown earths and mineral gleys although there are also significant areas of shallower soils/scree on the mid and upper slopes and some peaty gleys on shallower ground.

Stand structure: The oak trees comprise c. 80% of the canopy and are predominantly standards although multi-stemmed trees also occur occasionally throughout the wood. On the lowest most sheltered ground on the deeper soils there are some ancient and veteran oaks attaining a dbh in excess of 100 cm and a height of around 20 m but typically the oak trees are between 60-90 cm dbh and 15-20 m high. Further upslope particularly where the soils are 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. Ash occurs throughout the wood, and some older ash trees have also attained canopy height in places, contributing c. 15% to the canopy cover. Some have a pollarded structure and have been re-cut in the last five years or so. Hazel coppice is found on the richer soils on the lower and mid slopes, but its density varies, and it rarely forms a particularly dense understorey. There are also some pockets of well grown holly trees in places. In addition to the tree species mentioned above there are a few ancient yew trees and occasional birch and rowan with hawthorn and bird cherry occasionally occurring as scrub. The canopy is generally quite closed but even in more open areas there are no young or regenerating trees, and very few seedlings, probably due to the current and historic levels of browsing from livestock which were seen in the wood.

Ground vegetation: Under the closed woodland canopy the ground vegetation is dominated by abundant bracken, grasses and mosses and frequent wood sorrel and tormentil. Ferns and primroses also occur occasionally.

Current management: Although individual trees have been pollarded in the past, there has been a lack of intensive woodland management over many years. Management is by minimum intervention with the aim of retaining all ancient semi-natural woodland and recent native stands and veteran trees. Losses occurring by natural processes are acceptable. There is an active programme of repollarding the important trees.

Woodland Biodiversity

Designations: Along with other parts of the Borrowdale SAC complex, Seatoller Wood is recognised as a Habitats Directive Annex 1 habitat: H91A0 Old sessile oak woods with Ilex and Blechnum in the UK. Seatoller lichen flora is known to be the finest of all woodland sites in northern England and the bryophyte species recorded are also outstanding. Depending on the woodland type, different lichen communities are present *Lobarion pulmonariae* community occurs in the ash-oak-hazel woodland and *Lobarion pulmonariae* community on trees in the acid oak birch-woodland. *Lobaria pulmonaria* is a protected species. A total of 182 lichen species recorded includes many rarities such as *Bacidia isidiacea* and *B. affinis,* which are restricted in Britain; *Arthothelium orbilliferum*, *Leptogium burgessii*, and the protected *Sticta canariensis*, for which this is the only English record; *Lopadium pezizoideum* for which there is no other English record. The bryophyte flora contains numerous rare oceanic species including the protected *Radula voluta* and *Adelanthus decipiens*, which have only two other English localities; and *Jamesoniella autumnalis*, *Hylocomium umbratum* and *Leucobryum juniperoideum*.

The ground flora, although heavily grazed contains two species of interest the alpine enchanter's-nightshade *Circaea alpina*, and the rare Wilson's filmy fern *Hymenophyllum wilsonii* (RDB/IUCN Near Threatened) which is present on damp shaded rocks.

Red squirrels are known to occur in the wood.

Oak associated species: There are 151 oak-associated species that have been recorded in the area. Of these species none are obligate (only known to occur on oak trees). There are 8 highly associated species (2 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 24 partially associated oak species recorded in the area: 8 birds, 4 invertebrates and 12 lichen species. Of the 151 oak-associated species 51 species use the dead wood associated with oak trees, this includes 1 bird species, 16 bryophytes (mosses and liverworts), 7 invertebrates and 27 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 native species woodland that provides a wide range of habitats, particularly for the nationally important rare bryophyte communities.

Management objectives: To maintain presence of a range of tree species that provide long-term habitat continuity for the important biodiversity present in the woodland.

Target species composition and stand structure: Climate change predictions suggest that the conditions at the site may become less suitable for oak in the long-term. Growth rates may be slower and oak may be more seriously affected by extreme climatic events than in the past. In addition, ash, which currently contributes c. 15% to the canopy is likely to

decline in the coming years. It is important to maintain the presence of oak on the site to support the bryophyte diversity, and the contribution of oak to the overstorey should not fall below 60%. The remainder of the overstorey should comprise of other native species, many of which are already present on the site, such as birch, rowan, yew, holly, hazel, hawthorn and bird cherry. The soils and microtopography are variable, and the proportion of hazel may therefore be higher on the lower slopes, with birch and rowan being more dominant on the shallower soils and screes of the mid and upper slopes. Introduction of Alder would also help to support some of the partially oak associated species in the woodland and would be suitable in the wetter parts of the woodland. To secure the long-term future of oak in the woodland successful regeneration must be developed, with ongoing recruitment of new trees of oak and other native species to the overstorey to fill the canopy gaps.

Regeneration methods: Crown thinning of some mature oak trees in the denser areas may help to reduce water stress among overstorey trees in the future and may also increase the success of natural regeneration in these areas as light levels will be higher. Many of the species that could contribute to the future canopy are already present in the woodland and may be recruited through natural regeneration, taking advantage of site adaptation of the mature trees. However, in areas which are oak dominated other species may need to be introduced by targeted planting in canopy gaps, using trees that are suitable for the local conditions.

Monitoring: The overstorey of the woodland is likely to change over the coming decades due to the probable loss of ash and possible impacts of extreme climatic events on some of the oak trees. Monitoring is important to ensure that managers are aware of the extent and timing of these changes and can take appropriate action, such as introduction of new species if required. The success of natural regeneration is currently limited, probably due to browsing by sheep and deer. This must be monitored and controlled to enable establishment of new saplings and trees on the site. In addition, if Seatoller is to remain a native species woodland managers must be prepared for colonisation by non-native species and ready to act to remove this should it occur.

Operational factors: The natural regeneration in the woodland is currently failing due to the presence of sheep and deer. To establish the next generation of trees managers will need to prevent browsing ideally by fencing the woodland against both sheep and deer. Alternatively fencing to exclude sheep may be successful if a deer control programme is carried out, or if establishing seedlings and saplings are protected in shelters.

There is no road access and parts of the woodland are steeply sloping, which may restrict operations and require the use of alternative approaches such as horse logging. Any colonisation by undesirable non-native tree species should be carried out early to prevent these becoming difficult to tackle with limited access.

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

The vegetation is dominated by bracken and grasses. The bracken in particular may compete with young tree seedlings, and smother them when it dies back in the autumn. Control or cutting of the bracken in some areas, particularly where natural regeneration is desired may be beneficial.

There are several protected lichen species in the woodland (Habitats Directive Annex 1 species, listed above) and a range of other uncommon species and it is important that any operations undertaken do not cause any damage to the habitats of these species.

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 151 oak-associated species at Seatoller, which include 8 highly associated and 24 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	1	11	35	1 (13%)	11 (46%)	35 (23%)
Sycamore	0	11	41	1 (13%)	15 (63%)	56 (37%)
Alder	0	7	22	1 (13%)	17 (71%)	67 (44%)

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 beneficial tree species.
From the list of tree species studied no tree species, other than ash, is known to support more than 1 of the highly associated species present. Sweet chestnut, beech, Scots pine and small-leaved lime each support one highly associated species. Ash is not recommended due to ash dieback and ideally beneficial tree species should be selected because they support more than one highly associated oak species. However, if a particular highly-associated oak species was identified as being of very high conservation value this course of action could be taken. The selection of beneficial tree species was therefore based on the number of partially associated species supported.

Beech and sycamore each supported 11 partially associated species but beech was prioritized as it also supported one highly associated species. Beech and sycamore together (both of which would grow at the site) would support 1 out of the 8 highly associated species and 15 out of 24 partially associated species known to occur at the site. If alder was also included this would support an additional two highly associated species. Further additional beneficial tree species would only increase the number of partially associated species by one. As with the highly associated species this would involve very target management for a specific species and would depend on the conservation importance of that species. Beech, sycamore and alder will 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 by natural regeneration, 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.
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 (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

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

*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 on line early 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.

Acknowledgements: The work was funded by Defra through the BBSRC grant Protecting Oak Ecosystems (PuRpOsE): BB/N022831/1. With additional support from the Forestry Commission England and the Scottish Government's Rural and Environment Research and Analysis Directorate 2016-2021 strategic research programme. We thank Duncan Ray and Andrew Rattey for help with the predictions of changes in oak condition over time and the Forest Research Technical Support team for their help with the fieldwork. Finally we thank the site owners for access to their land.

Citation: Mitchell R.J., Broome A, Hewison RL, Stokes V. (2019) Protecting Oak Ecosystems: Managing oak woodlands to maximize support for oak associated biodiversity. Case study: Seatoller. Available at https://www.hutton.ac.uk/oak-decline