

## **Lichens and bryophytes of Atlantic woodland in Scotland:** an introduction to their ecology and management

Back from the Brink Management Series







▲ **Lichen and bryophyte-rich oakwood** © John Douglass

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## Atlantic woodlands – our ‘Celtic’ rainforest

The influence of the Gulf Stream means that Scotland’s Atlantic coast has much milder winters than the east coast of Britain and other areas of Europe at the same latitude. These mild winters and our notoriously wet weather, with abundant rainfall throughout the year, provide ideal conditions for the development of a diverse flora. Within long established, semi-natural woodlands on the Atlantic coast, which are typically oakwoods, the ferns, lush carpets of bryophytes (mosses and liverworts), and colourful assemblages of lichens that develop can give these woodlands the character of a rainforest. This temperate or ‘Celtic’ rainforest supports many lichen and bryophyte species that are largely confined to this habitat. Many of these species are absent in other parts of Britain and Europe, and some are globally rare. Some species have their most significant strongholds in Britain, while others have irregular distribution patterns with a few sites widely scattered across the globe. Although the following guidelines have been primarily developed for Scotland’s Atlantic oakwoods much of the information, including the management recommendations, applies to other types of Atlantic woodlands throughout Scotland and the rest of the UK.



Exposed coastal oakwood at Glenluig, Moidart © Andy Acton

### Types of Atlantic woodlands

The characteristically rich bryophyte and lichen flora of Atlantic woodlands are best developed in long established semi-natural woodlands, where canopy cover, including oak, has been sustained over a long period of time. However, these species can also occur in planted oakwoods, particularly those adjacent to older Atlantic woodland. Management recommendations for these different types of Atlantic woodlands are the same.

#### ***Type 1: Gnarled, often exposed, upland oak and oak-birch woodland***

These comprise oak, oak-birch and birch woodlands in very exposed situations and/or on very thin soils (such as over acid rock outcrops, or on steep, often rocky terrain). These woods can be particularly important for oceanic bryophytes and lichens where they occur on slopes with a north or north-easterly aspect.

### **Type 2: *Relatively sheltered oak-birch woods with other tree and shrub species fairly frequent***

These are deciduous woodlands in relatively sheltered situations such as on sheltered slopes, in wooded valleys, along sheltered coastlines or associated with an undulating terrain of rocky outcrops, knolls or ridges alternating with small, damp valleys (e.g. the parallel ridges, 'cnavs', in Knapdale). Trees present can include oak and birch with some rowan, hazel and willow, holly and more locally alder and ash. Although the oak has generally been subject to management in the past, for example as pasture woodland, the woodland has not been managed as intensively as 'industrial' oak wood.

### **Type 3: *'Industrial' oakwoods***

These are woods dominated by even-aged oak. The understorey is sparse and other tree and shrub species are often local (e.g. on wet ground, associated with very steep ground, ravines or outcrops). Stands have been managed intensively in the past for charcoal, oak bark for tanning and timber. Many are of plantation origin. There is often clear evidence of past woodland management such as charcoal hearths, stone dykes or remnants of earth banks used to exclude browsing animals, and multi-stemmed oaks or evidence of multi-stemmed trees that have been singled or have self singled.

### ***Summary management recommendations to maintain and enhance lichen and bryophyte interest***

- Continue woodland expansion and the development of woodland habitat networks
- Eradicate *Rhododendron ponticum* from Atlantic woodland and adjacent habitats

- Manage woodlands to encourage a range of tree habitats, including dead and dying trees
- Ensure old and veteran trees are not felled to protect trees with high lichen and/or bryophyte interest
- Leave all deadwood on site
- Strictly limit coppicing, especially of hazel stands, to ensure that the associated lichens and bryophytes remain as part of the habitat
- Conduct sensitive woodland thinning
- Minimise the impact of the felling of commercial conifer plantations adjacent to valuable lichen and bryophyte habitats
- Avoid disturbance to areas of wet or riparian woodland
- Avoid long term exclusion of all grazing from woodland, using a varied level of grazing as a habitat management tool where appropriate
- Control growth of dense thickets of tree regeneration in areas with high lichen interest
- Use small, temporary exclosures to ensure variation in the size and age of stands of regeneration
- Consider tree planting if diversity of tree species is declining
- Site developments carefully to ensure minimal disturbance to mossy boulders, wayside trees, old or veteran trees, stands of wet and riparian woodland
- Adopt the precautionary principle: if in doubt, assume that the lichen and bryophyte interest in an Atlantic woodland with mature and old trees and hazel stools, particularly in ravines or rocky areas, is likely to be high so such sites should be managed sensitively.
- Seek specialist advice and surveys prior to any operations or developments in high conservation value Atlantic woods.





Even aged Atlantic Oakwood at Elleric, Glen Creran SSSI. © Andy Acton





#### **Tree lungwort (*Lobaria pulmonaria*)**

**Although a fairly common lichen in Atlantic woodland in western Scotland, this species can be an indicator of habitat that is potentially suitable for other, rarer, species. It is much more scarce in most other parts of Britain and it is a good indicator of ancient woodland.**

© Andy Acton.

### **Lichens of Atlantic woodlands**

There are about 1,850 lichens in Britain and over 500 of these have been recorded from Atlantic woodlands. Our Atlantic woodlands support an internationally important oceanic lichen flora with a significant proportion of the European and/or global populations of 86 lichen species for which the UK has international responsibility. Some of these species are endemic. Most of these species are associated with three important lichen communities: the *Lobarion pulmonariae* community (or *Lobarion*) on mildly acidic bark (hazel, ash, elm, rowan, willow and old oak), the *Parmelion laevigatae* (or *Parmelion*) on very acidic bark (oak, birch and alder), the *Graphidion scriptae* (or *Graphidion*), best developed on the smooth bark of hazel stems but also on rowan and old hollies. All three communities can be found in Atlantic woodlands. See Plantlife Lichens of Atlantic Woodlands guides to find out more.

#### ***The Lobarion - the 'lungs of the forest'***

This community includes some of our most conspicuous species of epiphytic lichens; (lichens that typically grow on trees and shrubs). See Plantlife's Lichens of Atlantic Woodlands guide 1. One of the most characteristic and distinctive species of this community is the Tree Lungwort (*Lobaria pulmonaria*) which, with its surface network of ridges, resembles green lungs hanging from the trees.

*Lobarion* communities can include good populations of a number of species that are rare elsewhere in Europe, and largely confined in Britain to ancient woodland or parkland. Well developed *Lobarion* communities will usually have a diverse range of species including several *Lobaria* species, 'stinky *Sticta*' species

(which smell fishy when wet), jelly lichens (*Collema* and *Leptogium* species), felt lichens (*Degelia* species), shingle lichens (*Pannaria* and *Fuscopannaria* species) and dog lichens (*Peltigera* species).

The *Lobarion* community on the even-aged oak trees of 'industrial' oakwoods can at first glance appear be inconspicuous compared to other woodland types. However, some trees may still support scarce and threatened *Lobarion* species and unusually good populations of some other specialist lichens such as Nationally Scarce species Smokey Joe (*Opegrapha fumosa*) and *Porina coralloidea* (a crustose lichen). Individual trees and woodland habitats pre-dating the even-aged 'industrial' oakwoods are very important, for example open-grown veteran pasture or boundary trees, other old trees and shrubs (e.g. hazel, rowan, birch, alder and holly) and areas that have not been planted with oak, such as riparian areas, very steep rocky terrain, outcrops and very wet ground. In general the more uneven the topography, and higher diversity of trees and woodland habitats present that predate the 'industrial' oaks, the greater the chance that the even-aged trees will have developed or will in time develop a rich lichen and bryophyte flora.

### **The *Parmelion* - grey lobes and whitish crusts on acid bark**

Trees with very acidic bark (birch, alder and oak) and sheltered rocks can support leafy lichens with small pale greyish leafy lobes, shrubby pale greyish 'coral' lichens and thick whitish crust-like 'cudbear' lichens of the *Parmelion* community. When well-developed, this *Parmelion* community can include a number of notable lichens including scarce



**A well-developed *Parmelion* community on oak. The presence of the community is indicated by thick whitish, porridge-like crusts (cudbear lichens) and pale grey leafy lobes.** © Andy Acton.

and endemic species and is often, but not always, indicated by an abundance of pale greyish lichens (see Plantlife's Lichens of Atlantic Woodland Guide 2).

### **The *Graphidion* - 'smoothies' on smooth hazel bark**

*Graphidion* species can be present as a patchwork of fawn, brownish, pale grey, whitish or orange patches with minute spots, pimples, warts and scribbles. Hazel in Atlantic woodlands is important because, as well as being one of the best hosts for *Lobarion* lichens, its smooth stems support a specialist hyperoceanic form of the *Graphidion* community that is globally very rare. Many Atlantic woodlands in western Scotland with significant stands of hazel support a well developed *Graphidion*. Hazel in Scotland is so good for lichens because it has not been as intensively managed as in other parts of Britain (e.g. in England where it was often coppiced on a rotational basis).



***Plagiochila punctata*** © Gordon Rothero



***Plagiochila spinulosa*** © Gordon Rothero

## Bryophytes of Atlantic woodland

Around 50% of Scotland's internationally important oceanic bryophyte flora (about 100 species) are essentially woodland plants, but the variety of habitat in rocky Atlantic oak woodlands also provides niches for a wealth of other mosses and liverworts. For example, the oak woodland at Tainish NNR supports 25% of the British bryophyte flora and many other woodlands are equally rich. These woodlands, particularly those with bouldery ravines, have as diverse a bryophyte flora as almost anywhere else on the planet, rivalling the tropical-montane cloud forests.

If an Atlantic woodland has a long-established cover of broadleaves, particularly oak trees, and a variety of rocky substrates, then it will certainly have a luxuriant cover of mosses and liverworts. Much of this carpet is of robust and common species with wefts of Little Shaggy-moss (*Rhytidiadelphus loreus*), and turfs of Greater Fork-moss (*Dicranum majus*) being particularly attractive. The best indicators of an important oceanic flora are rocks and trees with cushions of the liverworts Prickly Featherwort (*Plagiochila spinulosa*), Spotty Featherwort (*Plagiochila punctata*) and Western Earwort (*Scapania gracilis*), usually mixed with the common Slender Mouse-tail Moss (*Isoetes myosuroides* var *myosuroides*), and the small Wilson's Filmy Fern (*Hymenophyllum wilsonii*). Prickly Featherwort, *Plagiochila spinulosa*, is a European endemic species which is relatively common in the west of Britain and Ireland but it is rare elsewhere in Europe, making the large population in Scotland internationally important. Communities of these species can be large enough to completely cover big rocks and the





boles of substantial trees giving these woodlands their soft character and ‘elfin glade’ appeal.

Where these indicator species are present it is likely that other, less common species will also occur. The best Atlantic oakwoods are often identified by the presence of two species of featherwort, Western Featherwort (*Plagiochila heterophylla*) and Deceptive Featherwort (*Adelanthus decipiens*); both species are rare in Europe and have affinities with the Tropics. There are also a number of rather smaller oceanic species in these woodlands which are an important component of the diversity here. Rock Fingerwort (*Lepidozia cupressina*), is a small liverwort with finely divided leaves, rather like fingers, but it forms large cushions that are often

***Isoetecium myosuroides*** © Gordon Rothero

conspicuous. It seems to prefer acid rocks and trees near the coast and often occurs with Tunbridge Filmy Fern (*Hymenophyllum tunbrigense*), and the oceanic Scott's Fork-moss (*Dicranum scottianum*).

***Adelanthus decipiens*** © Gordon Rothero







▲ *Scapania gracilis* © Gordon Rothero



On acid-barked trees where *Plagiochila* species are frequent there may also be patches of the more cryptic Wedge Flapwort (*Leptoscyphus cuneifolius*), a nationally scarce species locally frequent in the west of Scotland and Ireland but rare elsewhere in Europe and only known from one site in Norway. Trees and shrubs with more neutral bark may have a number of tiny oceanic liverworts as epiphytes. The most common is probably Pearl Pouncewort (*Lejeunea patens*), but two other, even smaller species, Pointed Pouncewort (*Harpalejeunea mollerii*), and Toothed Pouncewort (*Drepanolejeunea hamatifolia*), can be frequent, particularly on hazel in very humid sites.

◀ *Lepidozia cupressina* © Gordon Rothero



## Identifying high conservation value Atlantic woodland using key indicator species

There are a number of lichen and bryophyte species that, if present, can be used to indicate high conservation value Atlantic woodland.

The presence of several of the species illustrated in Plantlife's Lichens of Atlantic Woodland Guides 1 and 2 may indicate that a woodland has good *Lobarion* and *Parmelion* communities. In western Scotland, particularly good indicators include Norwegian Speckle-belly (*Pseudocyphellaria norvegica*.) and the Brown Shingle-lichen

▼ **Brown Shingle Lichen (*Fuscopannaria sampaiana*)** This is another indicator of high quality lichen habitat. It is a European Red List species that is considered to be Near Threatened in Britain because of loss of suitable habitat. It is mainly found on hazel, oak and ash in Atlantic woodlands. It is reddish brown when dry, (paler creamy grey-brown to darker grey-brown when wet) with pale greyish to creamy powdery granules along the lobe margins and spreading onto the lobes. © Andy Acton.



▲ **The presence of *Graphidion* lichen communities that look like this can indicate the presence of high quality woodland.** © Andy Acton.



▲ Golden Specklebelly (*Pseudocyphellaria crocata*) This species is also a good indicator of high quality lichen habitat in western Scotland. It is a European Red List species. Mainly found on hazel, oak, rowan and willow in Atlantic woodlands. Lobes are pale grey brown to dark red-brown when dry (darker brown to grey brown when wet) with yellow powder along the margins and powdery dots on the surface. © Andy Acton.



◀ Tailed Loop lichen (*Hypotrachyna taylorensis*) – a good indicator of high quality lichen habitat. This species has pale grey leafy lobes and when well-developed the older lobes roll up to form distinctive tubes ('tails').

© Andy Acton



(*Fuscopannaria sampaiana*). The presence of bryophytes such as Prickly Featherwort (*Plagiochila spinulosa*), Western Earwort (*Scapania gracilis*) can indicate high conservation value Atlantic woodland, as does the presence of Wilson's Filmy Fern (*Hymenophyllum wilsonii*). See Plantlife's Bryophytes of Atlantic Woodlands Guide 1. Although these species are rare in Europe, the Atlantic woodlands of Scotland support

large, internationally important communities of these species.

The presence of any of these indicator species in an Atlantic woodland is a good indication that the woodland may support other important, but less conspicuous, lichens and bryophytes. Their absence, though, does not indicate the woodland is of low interest.

**Norwegian Specklebelly (*Pseudocyphellaria norvegica*)** This species is a good indicator of high quality lichen habitat in western Scotland. It is a European Red List species that is a Nationally Scarce species. It is mainly found on hazel, oak, ash and willow and occasionally rock outcrops in Atlantic woodlands. Lobes are reddish brown when dry (darker brown to grey brown when wet) with faintly grey-lilac powder along the margins and powdery dots on the surface. © Anna Griffith.



## **Important woodland features influencing the abundance and diversity of lichens and bryophytes in Atlantic woodlands**

### ***Diverse woodland structure:***

The best woodlands for lichens and bryophytes often have a diverse structure that includes areas with a closed canopy, dappled shade, glades, a patchy understorey including hazel, some denser stands of hazel, standing and fallen deadwood and veteran trees. These conditions provide a range of light/shade regimes and variation in humidity giving a variety of niches for both bryophytes and lichens.

### ***Diversity of tree and shrub species and ages:***

Different tree and shrub species have different bark characteristics, and these characteristics alter as a tree matures. Saplings and very young trees are generally of low importance for lichen and bryophyte epiphytes. While dense regeneration can pose a shade threat to notable lichens, some saplings and young trees are desirable to provide future habitat and add to overall biodiversity because they provide a niche for early-colonising species.

### ***Old and veteran trees:***

These act as an important refuge for a variety of species as they often provide a range of micro-habitats. Some may be relict trees from former pastoral systems, including old, open-grown ancient pasture trees. They can also provide standing and fallen deadwood habitat. Large, old stools of hazel can be particularly important for lichens and bryophytes. Large trees along margins of an otherwise shaded wood (boundary trees and

wayside trees) can be important for more light-demanding species of lichen, though the open habitat generally means that these boundary and wayside trees are less important for oceanic bryophytes.

### ***Less intensively managed woodland habitats:***

Wet woods, riparian woods, valley woodland and ravines, and woodland on steep, rocky terrain have often been less intensively managed in the past and can support a greater diversity of tree and shrub species. In long established plantation oakwood, such stands are particularly important as many tree and shrub species and their associated lichen and bryophyte flora may be confined to them. These stands can be an important source for re-colonisation as the oak woodland matures.

### ***Diverse topography including valleys, ravines and rock outcrops:***

Variation in topography results in a range of woodland habitats with a diversity of light and humidity regimes that will ensure the optimum conditions for a range of lower plants and thus give a diverse flora. Aspect can be important; for example well-lit, south-facing slopes will have a different flora from shadier, north-facing slopes. Particularly important topographical features in Atlantic woodlands include river valleys and ravines, rocky outcrops, flushed slopes, flat terraces, boulders, rocky slopes and boulder screes.

### ***Rock outcrops and boulders:***

These habitats are good for lichens that grow on rocks and are of overwhelming importance for oceanic bryophytes because of the lack of competition by other, more





A diverse range of tree species and steep slopes provides a range of habitats for epiphytes. D Long / Plantlife





*Plagiochila atlantica* bryophyte community in woodland in Beasdale. © Gordon Rothero

robust woodland floor species. The cycle of accumulation of plants on the rock-face and subsequent sloughing off provides a steady supply of new, open habitat for the smaller species.

### **Threats to lichens and bryophytes in Atlantic woodland**

#### ***Rhododendron ponticum*:**

Dense *Rhododendron ponticum* casts a very heavy shade that is disastrous for any existing lichen or bryophyte species, making it a major threat to Atlantic lichens and bryophytes in western Scotland.

#### ***Clearfelling and rotational cutting:***

Large scale felling and rotational cutting, including coppice, within Atlantic woodlands will seriously damage any lichen and bryophyte interest and should be avoided or minimised where possible. Any tree felling and canopy loss can reduce humidity levels and lead to direct loss of epiphytes, especially bryophytes, but also those lichens that require more humid conditions such as jelly lichens. Ground disturbance may also directly threaten bryophytes, including those on boulders, and may adversely affect hydrological regimes, thus affecting humidity. Small scale thinning or cutting are always



preferable to large-scale operations, although there is still the risk that stems or trees with high lichen or bryophyte interest could be inadvertently removed. If a crop is desired, for wood fuel for example, it would be far preferable to thin dense thickets of recently established trees (e.g. birch), rather than coppice hazel.

Hazel is one of the most important species in Atlantic woodlands for lichens. Hazel is naturally multi-stemmed so it should not be assumed that the presence of multi-stemmed stools indicates ex-hazel coppice. Although hazel was cut in the past, in the Atlantic woodlands of western Scotland this has generally not been done on an intensive, rotational basis, which is why hazel stands in Scottish Atlantic woodlands have such diverse bryophyte and lichen communities. It is a common misconception that hazel requires coppicing; any Atlantic hazel stand that is important for lichens and bryophytes and which has been subject to past cutting is important despite any cutting rather than because of it.

### **Scrub clearance:**

The clearance of 'scrubby' woods of birch, willow and hazel may be a threat to very important habitats for lichens and bryophytes. Wet woods of birch and willow may be important habitats for *Parmelion* lichens and epiphytic oceanic bryophytes. Hazel in western Scotland can be of international importance for *Lobarion* and *Graphidion* lichens.

### **Long term overgrazing of woodland:**

Very long-term overgrazing prevents woodland regeneration and ultimately leads to the loss



***Rhododendron ponticum* invasion of Atlantic woodland** © Gordon Rothero

or fragmentation of woodland cover, both of which are major threats to lichens and bryophytes. It can eventually lead to a decline in the diversity of tree species. For example old trees of palatable species with a relatively short life span, such as rowan, may disappear. It is important to note, however, that woodlands can survive relatively long periods of heavy grazing and old pasture woodlands are some of the best habitats for lichens. Provided the continued presence of old trees of the full range of tree species is assured in the long term, some canopy loss may not be a direct threat to lichens. However, any general opening up of the canopy, resulting in lower humidity levels, will be unfavourable for oceanic bryophytes unless the sites are very rocky or have a northerly aspect.

### **Undergrazing or stock exclusion:**

The decline in low-intensity livestock farming accompanied by the continued decline in stocking levels may lead to expansion and regeneration of our Atlantic woodlands. However, grazing levels in these woodlands need to be carefully managed to ensure that regeneration of native tree species is occurring but not developing into thickets. These can shade out important lichen communities in the short term.

Well-intentioned woodland regeneration schemes involving the erection of stock and/or deer fencing can be a potential threat to woodland plants, where they are left in place too long and allow the development of dense thickets of native and non-native species (including birch, holly, sycamore, beech and sitka spruce). The infilling of glades with thickets of natural tree regeneration can threaten a range of habitats such as species-rich grassland, flushes and mires and may reduce available habitat for some species, including, for example, some of the *Lobarion* species on old trees and hazel in glades, along woodland edges or waysides. In addition the spread of ivy, and even in extreme cases honeysuckle, when unhindered by browsing can smother trunks of trees, rocky outcrops and boulders thereby reducing available habitat for lichens and bryophytes. The main problem for bryophytes within exclosures is the growth of a dense herb and dwarf shrub layer which can completely cover important communities on rocks and tree bases. These plant communities can also produce a lot of litter which can accumulate, smothering low rocks and changing the character of flushes.

**Removing non native tree species from native woodlands is one way to improve woodland structure for lichens and bryophytes and a range of other species.** © D Long / Plantlife

### ***Developments such as hydropower schemes and road improvements:***

Infrastructure features such as roads and pipeline routes can lead to the direct loss of trees or damage to woodland habitats, resulting in lower humidity levels. In addition, developments such as hydropower schemes may pose other threats through their impact on river hydrology. There is a direct impact on those species growing on rock in the water channel but there may also be changes in the humidity regime in the surrounding woodland as flow rates are reduced over the length of river affected.

### **Managing woodlands for wildlife: avoiding species conflicts**

#### ***Changing woodland structure***

Managing woodlands for bryophytes and lichens is beneficial to both groups and is better than no management at all. However, the two groups do require slightly different conditions: oceanic bryophytes are more susceptible to desiccation than many lichens and lichens are more susceptible to shading. Hence, a policy of opening up glades for the lichen interest in a woodland may be beneficial for lichens if it avoids felling trees with high lichen interest but this practice has the potential to damage the bryophyte interest. Lichens are more threatened by heavy shading than bryophytes, so a policy of 'filling in' the canopy to increase humidity levels for bryophytes may pose a shade threat to valuable lichen communities. In either situation, it would be wise to assess the lichen and bryophyte floras in order to minimise potential negative impacts. One thing is clear, very heavy shade dramatically







**Gaps in the canopy provide a mosaic of habitats to support other woodland species.** © D Long / Plantlife

reduces the diversity of both lichens and bryophytes and should be avoided.

### ***Grazing and browsing***

Grazing and browsing by stock and deer can be fully compatible with management for lichens and bryophytes. Domestic stock or deer can be important conservation management tools. Grazing levels can be manipulated to, for example, expose a suitable seed bed for tree seedlings, permit and control levels of tree regeneration, determining future woodland structure, and to maintain woodland glades. Grazing can be used to maintain a species-rich sward and, especially in the case of cattle, can be used to control rank vegetation and maintain a variable sward height for invertebrates and woodland ground flora.

### ***Other woodland flora and fauna***

Management of woodland for lichens and bryophytes is compatible with management for fungi, butterflies, other invertebrates,

bats, birds and vascular plants. Management for bats involves retention of veteran trees and gladed areas, including open ground along woodland edges. These aims are fully compatible with the lichen and bryophyte interest. Butterflies associated with woodland habitats are, like many well-developed lichen communities, reliant on the presence of gladed conditions. Ensuring that new glades are opening up as trees die and regenerate will maintain maximum diversity of habitat niches for a wide range of wildlife at different life stages.

### **Management recommendations for lichens and bryophytes of Atlantic woodlands**

Expanding and connecting areas of broadleaf woodland is the best approach for ensuring a bright future for oceanic lichens and bryophytes. However, as many Atlantic lichens and bryophytes are inconspicuous,

they have frequently been neglected in the past when decisions have been made on site management. Today, the profile of lichens and bryophytes has been raised but it is still easy to overlook them when it comes to making decisions on site management. Even when their importance on a site is recognised, it is often assumed that if we ensure continuity of large scale habitat (ie the trees), the lichens and bryophytes will look after themselves. There are potentially serious implications of this approach: for example the encouragement of high levels of tree regeneration leading to dense shade will threaten lichen, bryophyte and flowering plant communities. It makes sense therefore for management to consider specifically the needs of lichens and bryophytes, enabling populations and communities to persist and thrive, whilst potential lichen and bryophyte habitat is expanded. Many of these recommendations will benefit other woodland species and encourage a diversity of woodland structure and tree composition. Some general guidelines are given below and further detail is available in Worrell et al (2010).

- ***Continue woodland expansion and the development of woodland habitat networks***

Woodland loss and fragmentation has historically been the major threat to lichens and bryophytes and in many areas, the fragmentation of suitable habitat is still a threat. Woodland expansion and the establishment of woodland habitat networks are important for the long term continuity and diversity of the lichen and bryophyte communities. Woodland expansion should be encouraged beyond

the boundaries of existing woodlands to link up existing fragments of old woodland. Extensive, dense tree regeneration within the boundary of existing woodland should be avoided in areas with high lichen and bryophyte interest. In some woods, only relatively low recruitment rates may be necessary for woodland continuity.

- ***Eradicate *Rhododendron ponticum****

Ideally all *Rhododendron ponticum* should be eradicated from Atlantic woodland and adjacent habitats. However, in practice, sites for *R. ponticum* management often need to be prioritised for practical and economic reasons. Long and Williams (2007) recommend:

- (a) Eradicating or at least controlling the spread of *R. ponticum* in high conservation value Atlantic woodland, where key bryophyte and lichen communities are present;
- (b) Identifying appropriate eradication/control techniques depending on site conditions and species present;
- (c) Ensuring that adjacent habitats are free from flowering *R. ponticum*, which will act as a continuous seed source for reinvasion.

- ***Manage woodlands to encourage a range of tree habitats***

A general principle would be to manage to ensure the continued presence of a range of tree and shrub species and ages, including dead and dying trees. This will provide a range of micro-habitats including rough and smooth bark, sheltered or exposed bark, very acidic bark (e.g. oak, birch and alder) and trees





*Rhododendron ponticum* © D Long / Planilife

and shrubs with less strongly acidic bark (e.g. ash, hazel, elm, willow and old oak).

- ***Retain and avoid damage to old and veteran trees***

Ensuring that old and veteran trees are not felled means that trees with high lichen and/or bryophyte interest are retained as important habitat.

- ***Leave all deadwood on site***

Deadwood, both fallen and standing, is an important habitat for both bryophytes and lichens as well as fungi and invertebrates.

- ***Strictly limit coppicing, especially of hazel stands***

As a general rule, coppicing of hazel in Atlantic woods should be extremely limited. Complete coppicing of the stool is to be avoided, as all lichens and bryophytes (specialist as well as common species) get taken away with the cut product. These specialist species are very poor colonisers and therefore unlikely ever to return. Very small-scale selective cutting of individual stems can be undertaken, for thatching spars, pea-sticks, walking sticks for example, as this allows the overall integrity of the stool to remain fairly intact, and ensures that the associated lichens and bryophytes remain as part of the habitat.

If a manager wants to coppice birch regularly employing larger scale operations, perhaps for wood fuel, then it is best to plant 'new' stands established purely for that purpose, rather than coppicing in established Atlantic woods. This is because the resulting regular

fluctuations of light and humidity around established lichen or bryophyte-rich habitats will lead to a rapid decline in these communities, which are unable to tolerate such rapid habitat changes.

- ***Conduct sensitive woodland thinning***

Lichen assemblages on trees can generally tolerate some thinning operations.

Thinning may be beneficial where dense thickets of regeneration are posing a threat to established epiphyte-rich habitats.

Small-scale thinning in even-aged woods, for example of Type 3 oakwoods for timber, can be used to diversify woodland structure, using patch thinning to create small glades, and thus diversify habitat.

The best areas of Atlantic oak woodland for oceanic bryophytes are those where there has been a continuity of canopy cover for a long period. The level of management does not seem to be critical as long as the solid substrates such as rocks and trees have had some buffering from changes in humidity as a result of thinning. Carrying out thinning on a rotational basis is likely to be damaging, as many of the more important species are slow colonisers with more specific habitat niche requirements.

- ***Minimise the impact of the felling of commercial conifer plantations adjacent to valuable lichen and bryophyte habitats***

Commercial conifer felling can lead to a dramatic reduction in humidity levels in adjacent broadleaf woodland leading to the desiccation, and potential loss, of some bryophytes and lichens. With





**Sympathetic plantation removal adjacent to lichen-rich native woodland, Tobermory, Mull © J Long**

larger stands of broadleaf woodland, this is only likely to affect the edge and is therefore unlikely to affect the lichen and bryophyte communities significantly. However, the lichens and bryophytes associated with smaller stands of trees within conifer plantations may be more vulnerable, especially in narrow strips of riparian woodland for example. If there are any particularly rare and important lichen and bryophyte species present, which is highly likely in ravines, restock with a wide band of native broadleaf trees, a minimum of 30 metres, along the ravine / feature of interest. Although some loss in bryophyte and lichen interest may occur, this provides future buffering for ongoing commercial conifer harvesting.

- ***Avoid disturbance to areas of wet or riparian woodland***

Wet woodland, including areas of scrubby birch and willow, should be left undisturbed. Such wet, scrubby areas are often dismissed as of low conservation interest but may be important habitats for lichens and bryophytes.

- ***Avoid long term exclusion of grazing from woodland***

Some level of grazing is generally desirable but prescribing a fixed grazing level is not always possible. The seasonality and the number and type of grazing animals, cattle, sheep or ponies, should be flexible and determined by the fluctuating condition of a site, for example in reaction to wet summers or

long dry summers. Grazing can be used to ensure the continuity of a wide range of habitat niches, based on a diverse tree age structure. High grazing levels can be sustained for long periods provided woodland continuity is assured in the long term. Conversely, sustained periods of very low grazing levels can be a serious threat to the diversity of woodland structure, affecting, for example, glades, flushes and species-rich grassland. Temporary low grazing levels (or temporary enclosure) can allow a flush of regeneration and ensure woodland continuity in the long term. However, woodland regeneration enclosures should be planned as temporary measures. If left in place for too long they may permit undesirable

thickets of dense regeneration to become widespread (see below).

- ***Control growth of dense thickets of tree regeneration in areas with high lichen interest***

Cattle or deer can control the formation of dense thickets if introduced early enough, otherwise hand cutting might be necessary before deer or other stock can have any significant impact. Some species of tree and shrub and/or growth stages may be avoided by certain animals. Different grazing animals can be used to target particular areas with problem excessive scrub regeneration. Where trees along well lit woodland edges support well developed lichen communities, extensive dense regeneration is not recommended.

**Some grazing can help to maintain grassy glades, retaining woodland structure diversity.**

© D Long / Plantlife

- ***Use smaller, temporary enclosures***

Patchiness is good where there is variety in the size and age of stands of regeneration, as well as variations in shade, light and humidity levels. Fencing to encourage tree regeneration should only be seen as a temporary measure, and enclosing the whole woodland area for a long period should be avoided. Smaller enclosures, enclosures with gates to allow grazing animals controlled entry or 'leaky' fences (where stock can periodically gain access for a limited time) may help to ensure a more varied woodland structure develops. This would need careful monitoring to ensure that the regeneration of more palatable species of tree and shrub is not affected, leading to a reduction in diversity of tree species.





- **Tree planting**

Planting should be considered if the diversity of tree species is declining. Suitable ground often has birch and rowan seedlings and young saplings suppressed by browsing. However, regeneration of desirable species such as hazel, ash and oak may be absent as these species can take a long time to establish naturally. If this is the case, then consideration could be given to planting, although planting should only be at low densities. Until they are established, trees could be protected with staked mesh. Care should be taken to avoid damage to mature trees by scraping as this could easily dislodge any lichen or bryophyte interest.

- **Careful siting and management of developments**

Any construction works, including access tracks should, where possible, be sited or routed to ensure minimal disturbance to mossy boulders, wayside trees, old or veteran trees, areas of wet woodland and riparian areas. If the felling of long established Atlantic woodland trees, including scrubby woodlands, cannot be avoided, specialist lichen and bryophyte advice can help to minimise impacts. Advice from specialists should also be sought on the impacts of changes in hydrology as a result of water extraction for hydro-electric power schemes.

- **Adopt the precautionary principle**

Atlantic woodlands are very special habitats and some are protected by conservation designations, but many woodlands that are important for lichens and bryophytes lie outside designated

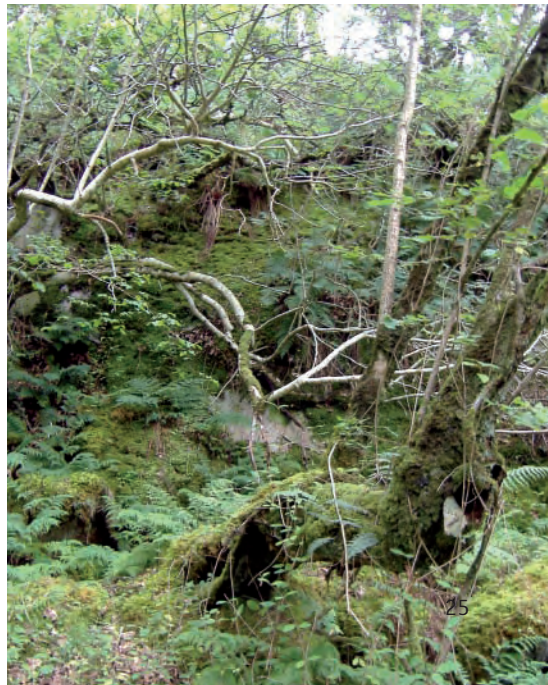
sites. If in doubt, it is a fairly safe to assume that the lichen and bryophyte interest in an Atlantic woodland with mature and old trees and hazel stools is likely to be high, and particularly so if the woodland is rocky or has a ravine. Such sites should be managed sensitively.

- **Specialist advice and survey**

Specialist lichen and bryophyte advice is strongly recommended prior to any operations such as thinning or infrastructure development in or near high conservation value Atlantic woods, to identify areas suitable or unsuitable for these operations, including marking up of individual trees or shrubs that should be retained. Contact details for support are given at the end of this leaflet.

**Rocky outcrops within woodland provide a mosaic of habitats for bryophytes and lichens.**

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## Further reading

Crawford, C. (2002) *A Field Guide to Common Mosses and Liverworts of Britain and Ireland's Woodlands 3<sup>rd</sup> Edition*. The Natural Resource Consultancy.

Rothero, G. (2010) *Bryophytes of Atlantic woodland Guides 1 and 2*. Plantlife Scotland.

Dobson, F. (2005) *Lichens: An Illustrated Guide to the British and Irish Species 5th Edition*. Richmond Publishing Co. Ltd.

Fletcher, A. (ed.) (2001) *Lichen Habitat Management*. British Lichen Society and Countryside Council for Wales.

Acton, A. & Griffith, A. (2008) *Lichens of Atlantic Woodlands Guides 1 and 2*. Plantlife Scotland.

Atherton, I., Bosanquet, S. & Lawley, M (2010) *Mosses and liverworts of Britain and Ireland, a field guide*. British Bryological Society.

Porley, R. & Hodgetts, N., (2005) *New Naturalist Mosses and Liverworts*. Harper Collins.

Long, D. & Williams, J. (2007) *Rhododendron ponticum: impact on lower plants and fungi communities on the west coast of Scotland*. Plantlife Scotland.

Worrell, R., Long, D., Rothero, G and Coppins, S. (2010) *Management of woodland plants in Atlantic broadleaved woodland: a conservation framework*. Plantlife Scotland.

## Other sources of information

**[www.bls.org.uk](http://www.bls.org.uk)**

The British Lichen Society (BLS).

**[www.britishbryologicalsociety.org.uk](http://www.britishbryologicalsociety.org.uk)**

The British Bryological Society (BBS).

**[www.nwdg.org.uk](http://www.nwdg.org.uk)**

The Native Woodland Discussion Group (NWDG) runs regular training courses on lichens and bryophytes of Atlantic woodlands.

**[www.britishlichens.co.uk](http://www.britishlichens.co.uk)**

The britishlichens website has useful photos of many British lichens.

## Who to contact for advice

### **Plantlife Scotland,**

Balallan House, Allan Park, Stirling FK8 2QG  
Tel: +44 (0)1786 478509

**[www.plantlife.org.uk](http://www.plantlife.org.uk),**  
**[scotland@plantlife.org.uk](mailto:scotland@plantlife.org.uk)**

### **Scottish Natural Heritage,**

Great Glen House, Leachkin Road, Inverness, IV3 8NW.  
Tel. 01463 72 5000

**[www.snh.org.uk](http://www.snh.org.uk)**

Dr David Genney, Policy & Advice Officer –  
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This leaflet has been written and illustrated by Plantlife Scotland with contributions from Andy Acton (lichenologist, [andy.acton.ESM@gmail.com](mailto:andy.acton.ESM@gmail.com)) and Gordon Rothero (bryologist, [gprothero@aol.com](mailto:gprothero@aol.com)). Oakwood types largely follow the guidelines developed by Sandy Coppins for monitoring the condition of oakwoods that have been designated Sites of Special Scientific Interest (SSSIs) for their lichen assemblage.



Oak woodland at Tynish National Nature Reserve. © D Long / Plantlife





*Dicranum scottianum* © Gordon Rothero



British Lichen Society



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**Plantlife**

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