Practical guidance
Module 3

Ancient woodland restoration

Phase one: halting further decline

November 2018

WOODLAND TRUST

Contents

Figure 1 - Critical streamside hotspot in western red cedar PAWS in Mid Wales. Ancient woodland flora include tutsan, sanicle, scaly male fern, wild garlic, with marsh hawk's-beard and some ash, wych elm and rowan.

Introduction

This guide is the third in a series on the restoration of ancient woodland sites. The first module 'Ancient woodland restoration: an introductory guide to the principles of restoration management' sets out the rationale for ancient woodland restoration and presents an overview of the Woodland Trust's approach. The second module 'Survey and assessment of ancient woodland sites' looks in detail at the assessment process and how to recognise and record remnant features, identify threats, and prioritise actions.

This guide is concerned with the first phase of restoration management, which is about halting further decline in the most critical areas. It sets out the remnant features that are most at risk of further decline; the indications that suggest urgent intervention is required; an overview of the 'first aid' management techniques that could be employed to halt further decline; and the issues and limitations that may need to be overcome to enable active management to take place. This approach is underpinned by the UK Forestry Standard (UKFS), which states that 'The minimum required by the UKFS is to ensure that these remnant features are retained'.

The series of guides is aimed at everyone involved with restoration management of ancient woodland. Whilst they are intended to support decision-making, every wood is different, and the advice of a Woodland Trust adviser or woodland management consultant may help to shape this guidance into more site-specific recommendations.

2. About ancient woodland restoration

Ancient woodland is woodland that has existed since 1600AD in England and Wales and 1750AD in Scotland. We use these dates to determine the ancient status of a woodland, as maps from this period can be relied upon to confirm the presence of woodland with reasonable accuracy. The concept and classification of ancient woodland is important in identifying woods of high biodiversity value. This continuity, stretching back to at least medieval times, has allowed the development of rich interdependent communities of plants, fungi and animal life, and often the conservation of features of cultural heritage and landscape significance.

Around half of all ancient woodland remains in a semi-natural state, but the rest has been cleared and replanted, or under-planted, with introduced tree species or invasive woody shrubs. The introduction of these exotic and sometimes invasive trees, often as even-aged single-species plantations, has diminished native woodland biodiversity and reduced the resilience of our ancient woodlands. Other ancient woodlands may be impacted by issues such as invasive non-native plants or severe overgrazing. But evidence shows that features of the ancient woodland can survive and that these are able to act as building blocks for restoration. These are known as 'ancient woodland remnants'.

2.1 Remnant features

The remnant features still present within degraded ancient woodland habitats provide an unbroken link back to the past and are vital for helping to guide future management. Remnants can include ancient woodland specialist plants, deadwood and stumps, pre-plantation and relic native trees, and archaeological and cultural remains. These features are regarded as proxies, with potential to support a far wider assemblage of remnant ancient woodland life. Woodland soils are also an important remnant feature where they contain woodland specialist fungi, soil invertebrates and microorganisms, and plant seedbanks. They are a vital aspect of the ecological functioning of woodland systems. Even in plantation woodlands that, at first glance, do not appear to contain these remnant features, it is still possible to secure and build upon those remnants found within the soils.

A comprehensive overview of remnant features and how to identify and assess them is included in Module 2.

2.2 Threats

Assessing the nature and severity of threats to remnant features is a key part of the management planning process for ancient woodland restoration. The UK Forestry Standard (UKFS) states 'on plantations on ancient woodland sites, ensure that features of ancient woodland remnants are protected and consider progressive restoration to native woodland'. Prioritising remedial actions will depend on the vulnerability of the remnant

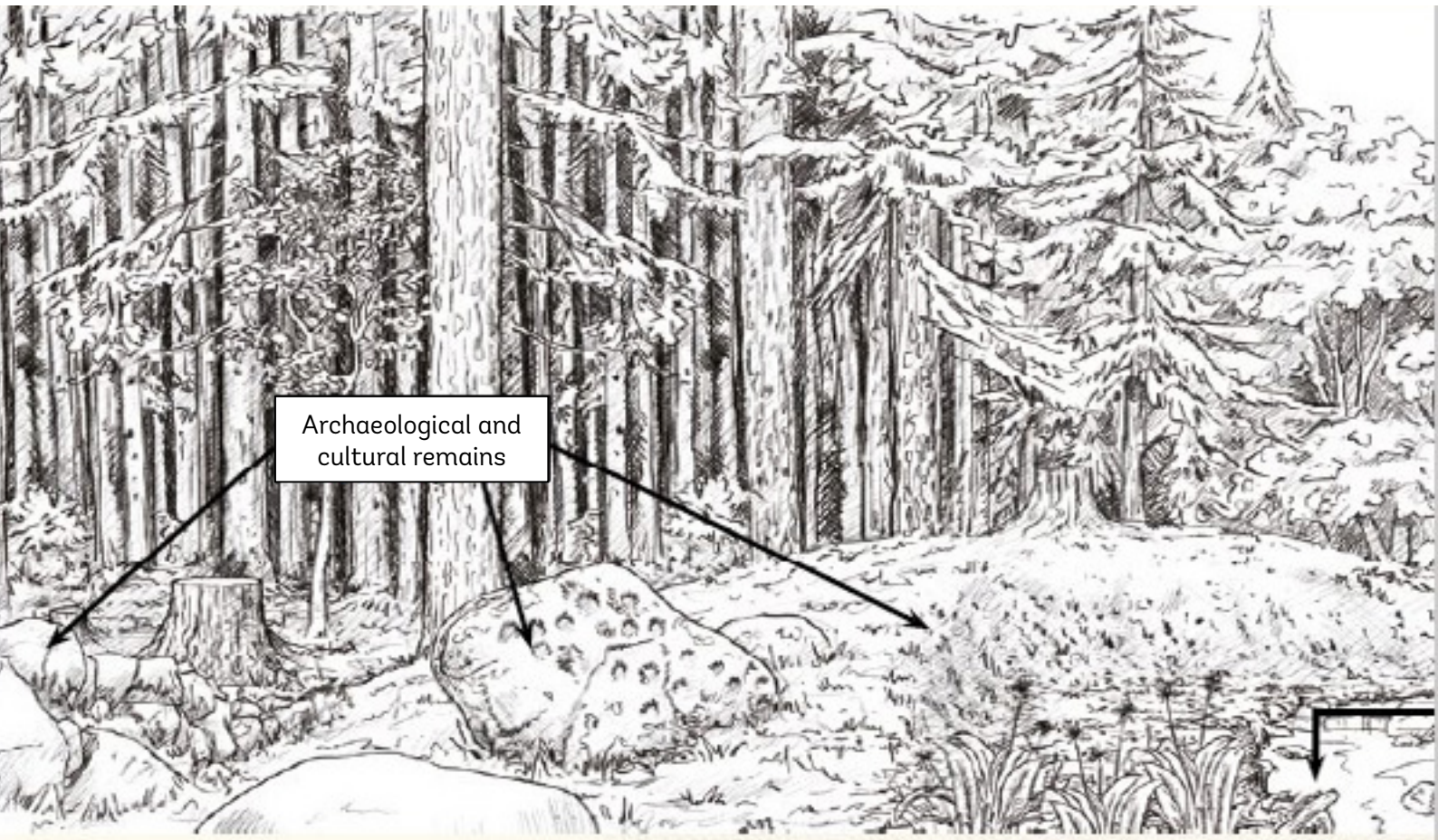
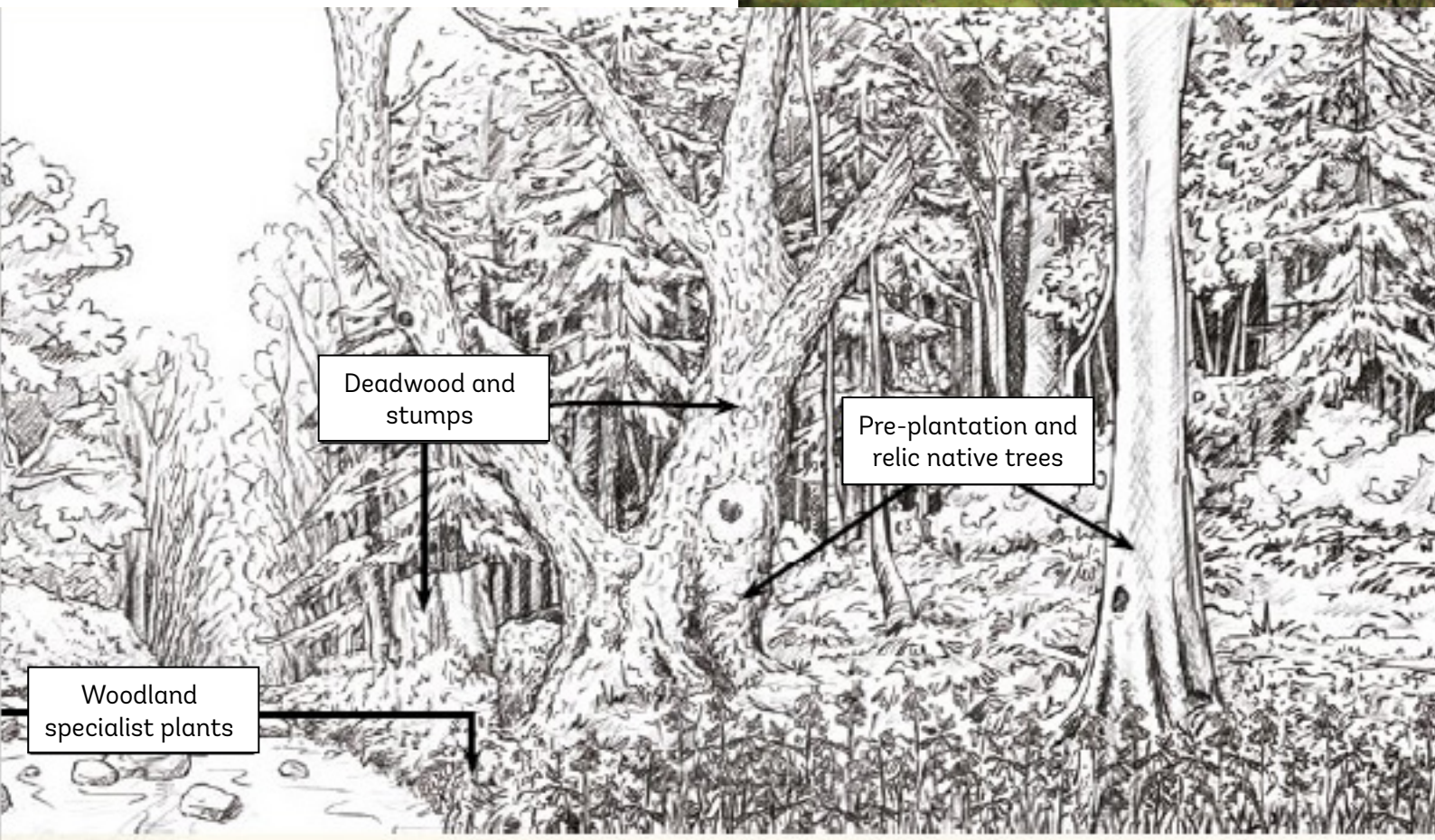


Figure 2 - (left) Remnant ancient woodland ground vegetation with herb Paris, wild garlic, opposite-leaved golden-saxifrage and dog's mercury; and (right) remnant 'granny' pine within dense sitka spruce plantation on ancient Caledonian Scots pine forest. Photo: Alastair Hotchkiss/WTML.

features being affected, and the agent of threat causing the problem. Threats can typically include both low and high light levels, inappropriate land use and forestry operations, invasive non-native species, grazing and browsing, and dominance of coarse vegetation.

Table 1 in Module 2 includes a summary of the remnant and vulnerable features, and the main threats that they face.



3. Halting further decline

Once the initial ancient woodland assessment has identified both the remnant features present within the woodland and the nature of threats, the assessor will determine whether any of these are likely to result in the short term significant decline, damage or total loss of features. If identified as such, the woodland zone will be assigned the threat level critical.

The phase one restoration process is concerned with these critical areas, aiming to halt any further degradation through a series of targeted operations. In most cases these processes will be localised, concentrating on specific remnant features that require a certain type of direct action. Critical sites should be dealt with as a priority to ensure that irreplaceable remnant features are not lost or irreparably damaged.

The aim of this urgent 'first-aid' intervention will be to ensure critical remnant features are maintained in the short-term, and to ensure they are resilient enough to withstand further management interventions around them.

The following table includes examples of some of the more common indicators of critical condition, where some form of urgent intervention is required in order to maintain remnant features. The severity of the indicator is important, and often what determines an area as critical. This is influenced by a number of factors including the plantation species involved, the age of the stand and thinning history.

Remnant features	Indicators of critical condition – examples of where urgent intervention is often required
Relic and pre-plantation native trees and shrubs (including veteran and ancient trees)	• Remnant native trees being overtopped, excessively shaded and suppressed by plantation conifers or broadleaves. • Significant damage to stem and branches from previous or current harvesting operations; compaction from forestry machinery. • Rapid exposure resulting in significant windthrow risk or detrimental impacts on epiphytes occurring on remnant trees. • Lack of management putting veteran and ancient trees at significant risk of failure.
Woodland specialist plants	• Woodland specialist flora hotspots clearly struggling in increasingly shaded conditions, eg. straggly bluebells *(Hyacinthoides non-scripta)* not flowering, or following exposure resulting from felling operations, eg. hard fern *(Blechnum spicant)* scorched in exposed clearfell. • Identified populations of specialist flora in close proximity to invasive non-native species, eg. dense rhododendron, threats due to competition and/or changing conditions. • Strong evidence of excessive grazing and/or ground disturbance by livestock and/or deer. • Competition from coarse vegetation, eg. as a result of canopy removal or disturbance, or nutrient deposition (or a lack of grazing and browsing by large herbivores). • Inappropriate ground preparation activity in restocking sites and herbicide damage as a result of restocking establishment. • Excessive ground disturbance, eg. from forestry machinery use during wet periods, off-roading, or game management activities such as inappropriately located rearing pens.

Remnant features	Indicators of critical condition – examples of where urgent intervention is often required
Deadwood and stumps	• Recent felling operation exposing large standing and fallen deadwood and associated risk of desiccation or scorching. • Deadwood which had previously been in more open conditions becoming increasingly shaded, impacting on specialist interests (eg. dead standing oak or pine snag becoming too shaded to support lichens associated with exposed lignum). • Regrowth from old cut stools (often cut at time of plantation establishment) being shaded and suppressed by plantation conifers or broadleaves. • Current or planned operations or activities not taking account of important deadwood features. • Evidence of fires as a result of misuse and anti-social behaviour.
Soils	• Current forestry operations or other land uses, eg. off-roading access, causing significant rutting, erosion and/or compaction, or taking place in inappropriate weather that has the potential to result in irreparable damage. • Seedbank longevity being impacted by continued suboptimal conditions for germination, eg. inappropriate shade, temperature or leaf/needle litter. Germination potential varies significantly with species. • Inadequate supply of seed from native trees and vegetation, or excessive seed and freely regenerating non-native trees. • Clear signs of a damaging pollution event as a result of on- or off-site activities, eg. run-off from a fuelling station or wash facility. • Drainage or drying-out of wet woodland soils and peat as a result of plantation and historical management. • Presence of damaging invasive non-native species, such as rhododendron which can have an allelopathic impact on soils.
Archaeological and cultural remains	• Recent or ongoing operations at risk of causing irreversible physical damage to remnant historical features, for example through felling or extraction routes. • Presence of damaging invasive non-native species, such as Japanese knotweed.

Figure 3 - Lying oak deadwood from sanitation felling during plantation establishment. Photo: Alastair Hotchkiss/WTML.

Figure 4 - Hotspot of ancient woodland specialist flora associated with the light reaching ground around broadleaved trees, including bluebell, yellow archangel and red campion. Note the darkness and lack of ground vegetation beyond. Photo: Laura Shewring.

Figure 5 - Veteran remnant beech in South East England being shaded by conifer plantation. Photo: Jim Smith-Wright.

Figure 6 – Critical patch of ramsons (wild garlic) being heavily impacted and deteriorating from heavy shade cast by western red cedar plantation. These are surviving as a small streamside pocket. Photo: Alastair Hotchkiss/WTML.

4. Phase one: 'first aid' restoration management

Once these critical areas have been identified and recorded, the assessor will select an appropriate method of intervention to ensure that the critical remnant features are maintained and achieve a more robust condition. The urgency of these interventions often means that they need to be localised and targeted actions, which will be independent of any wider stand management. However, it is often also possible to incorporate these targeted phase one operations around critical features as part of wider thinning interventions within stands or compartments. This often makes most sense practically and economically when the extraction of timber is involved. Other critical interventions such as control of dense invasive rhododendron are often standalone operations, and their control may be required in advance of any planned felling and harvesting operations.

4.1 Setting clear objectives

It is important that ancient woodland restoration is achieved within the context of clear aspirations and objectives. Halting further decline by securing and maintaining critical features is a fundamental part of the restoration process, underpinned by the UK Forestry Standard, and will always be required as the first phase in any longer-term restoration strategy. The Woodland Trust works with landowners to understand their objectives and to set the restoration process in the context of what they want their woods to deliver.

The subsequent phases of restoration (covered in Modules 4 and 5) consider in more detail how objectives can be achieved through longer-term planning and adaptive management.

Figure 7 - Critical remnant oaks where targeted halo thinning has been prioritised at Coed Felinrhyd, a Woodland Trust wood in Snowdonia. Photo: Alastair Hotchkiss/WTML.

Figure 8 - Noble fir ringbarked in an intimate mixture with sessile oak, in a stand that is difficult to access and where felling and extraction are likely to cause damage to remnant features. Photo: Alastair Hotchkiss/WTML.

Figure 9 - Ringbarked larch now forming standing deadwood. Ringbarking has been used to remove the threat from larch scattered among an important stand of ancient hazel which was supporting notable species such as hazel gloves fungus. Felling or extracting the larch here would have been too difficult without damaging this important feature. Photo: Alastair Hotchkiss/WTML.

4.2 Targeted felling

Targeted felling of non-native plantation trees is often the most urgent 'first-aid' restoration intervention. 'Halo thinning' is often a suitable option to immediately reduce shading and encroachment of critical pre-plantation trees or hotspots of woodland specialist flora. Halo thinning means cutting down plantation trees in a ring, to gradually increase the light available to the critical features, ensuring their survival.

Often, given the urgency, a standalone operation is essential. Removing just a small number of non-native trees in this targeted way can achieve important results in maintaining remnant features. However, at times it is also possible to arrange for this targeted felling work to occur during wider thinning and harvesting operations. Therefore, the selection criteria and marking-up of trees to be felled is crucial to ensure that there is preferential thinning around critical features, such as overtopped native trees or streamside patches of ancient woodland flora.

Where the direction of felling is likely to be difficult due to immediate proximity of mature native trees, or where the plantation trees are caught up within the canopy of remnant native trees, it may be advisable to use techniques such as ringbarking or chemical thinning to create standing deadwood. This will reduce the risk of damaging the very features the operation is trying to protect, and the standing deadwood will gradually break down. It will also provide valuable decaying wood biomass for associated invertebrates and their predators. This technique may also be useful where timing is critical or where extraction is particularly difficult on steep rocky sites with poor track infrastructure. It can also be used where felling to create lying deadwood would cause too many obstructions for future access and operations, although there are other circumstances where felling to create lying deadwood is best – for example, in the proximity of public access routes, watercourses, power lines or other potential risks. The non-native species involved will also make a difference. Some species are more resistant to this sort of management, such as western hemlock and western red cedar, which have particularly fluted stems, or certain broadleaved species such as North American red oak or sweet chestnut, which readily grow back from the base.

Case study

Barling's Barn – Coed Caeau-Gleision, Llanbrynmair, Mid Wales

In the mid-20th century, the semi-natural native trees at Coed Caeau-Gleision were removed, and in 1962, the site was planted with stands of western hemlock, noble fir, Japanese larch and Norway spruce. Most native oak and ash were felled and extracted, but many remain as lying deadwood where they were simply felled and left. Some mature sessile oak and ash were left standing but have been suppressed by the fast growing conifers, so much so that a number of these have now died.

More recently, the site was acquired by the owners of the neighbouring smallholding, who also run a holiday-let business. Initially intending to halt the proposed clearfell of the plantation, they soon realised that they could achieve their aims for woodland restoration and provide a regular source of firewood to heat their house and fuel their accommodation business at the same time. Guided by the Woodland Trust's advisers, the owners have embarked on a programme of ancient woodland restoration which is opening up the most critical areas to the light, just in time to save the remaining remnant broadleaves.

Halo thinning has been carried out to release critical sessile oak and ash trees from suppression. Directional felling by experienced chainsaw operators has created space around the crowns of these broadleaf specimens, this space is letting light in around these remnant trees, building crown strength, increasing root structure and wind firmness and also allowing light to reach the ground around the trees. The regeneration of ancient woodland ground flora around the base of these haloed trees has also been striking, having been completely bare ground just a couple of years before. Extraction of timber has been carried out sensitively with horses which have been able to access the dense conifer stands and skid out logs with minimal impact on forest soils and ground flora hotspots. Extracted material is processed on site into logs to fire a biomass batch boiler, and the work is financed by the Renewable Heat Incentive. The halo thinning will precede a site-wide thinning operation, intended to transform the site to an irregular structure managed under the principles of continuous cover forestry. This preliminary critical halo thinning work will strengthen the remnant broadleaves prior to further release and opening up of stands in the future.

Figure 10 - Woodland Trust adviser and woodland owner looking at the halo-thinned ash at Barlings Barn. Photo: Alastair Hotchkiss/WTML.

Figure 11 - Flushed woodland ground vegetation hotspots beneath western hemlock at Barlings Barn with ancient woodland specialists such as hard fern, wood sorrel, yellow pimpernel, beech fern (top right) and mosses such as shining Hookeria (top left). Photo: Alastair Hotchkiss/WTML.

Figure 12 - Hemlock logs extracted to trackside by horse-logging and processed into wood fuel for biomass batch boiler. Photo: Alastair Hotchkiss/WTML.

Figure 13 - Opened canopy of previously overtopped native broadleaves, and good ground vegetation recovery around halo-thinned trees (right) with ancient woodland specialists such as yellow pimpernel and wood sorrel amongst more generalist species like buckler ferns and foxglove, which responds well from the seed bank. Photo: Alastair Hotchkiss/WTML.

4.3 More extensive felling

Where an entire stand of plantation trees is resulting in a critical threat, for example because of its widespread impact on scattered and struggling ancient woodland ground vegetation, more extensive thinning/selective felling is likely to be required to maintain these features. The approach to this will vary depending on the age of the stand, thinning history, stability, and importantly, the frequency and distribution of mature native trees and/or regeneration. Line-thinning will support extraction and future interventions but this systematic thinning and the spacing of the racks may need to be determined by the occurrence of native trees in the stand. Graduated density thinning can offer opportunities to selectively favour native broadleaved components either side of the racks as part of this intervention. In other circumstances an extensive selective thinning may be required. Where there are options for low-impact extraction systems like horse-logging or small-scale forwarding equipment, this approach may be appropriate.

This can also be achieved with the use of standard forestry harvesters and forwarders, but it is always important to ensure that remnant features are clearly marked up on maps or on-site to ensure they are safeguarded during harvesting operations, such as on extraction routes and stacking areas.

4.4 Invasive Non-Native Species (INNS)

A number of commonly found INNS are listed under Schedule 9 Part II of the Wildlife & Countryside Act (1981), including rhododendron, cotoneaster and Himalayan balsam. Inclusion on this legislation means that it is illegal to cause any of these species to grow in the wild. The list does not include laurel or snowberry, although in the context of ancient woodlands these are often considered to be equally damaging. Commencing treatment or control of INNS will in most cases be a phase one operation, with the specification for works determined by the type of INNS found, and its location and extent within the woodland. However, they are often unlikely to be one-off operations, and usually always require a degree of follow-up in order to be successful. Rhododendron, for example, should be managed through an initial treatment and a five-year plan of follow-up control and monitoring. Eradication can rarely be achieved through a single intervention, and a combination of methods is often necessary. The initial intervention can either be cutting back (ensuring cut material is kept away from moist ground, as it can regrow) or controlled stem injection with an appropriate herbicide. In year three it is advised to revisit and foliar spray any regrowth, and again in year five with hand-pulling of any missed plants or regrowth. Other shrubby species such as cotoneaster, laurel and snowberry can usually be managed by cutting back and removing arisings, and treating stumps. Stump removal is not recommended in particularly sensitive areas, for example where plants are growing from archaeological features such as woodbanks. Management of Japanese knotweed and giant hogweed should be carried out by a specialist company with appropriate licences and experience. Treatment generally involves spraying or stem injection with an appropriate herbicide and can continue for up to three years with follow-up monitoring visits to confirm that there is no further regrowth.

Figure 14 - Bluebell and wood anemone struggling in the shade within a 20-year-old Douglas fir plantation on second rotation PAWS where larch was the previous plantation. Here, graduated density line thinning will open up the stand by favouring regrowth of oak and birch, along with best quality Douglas fir. Photos: Alastair Hotchkiss/WTML.

Figure 15 - *Rhododendron ponticum* dominating understorey and ground vegetation in Southern England. Photo: Jim Smith-Wright.

4.5 Regeneration of non-native tree species

In many Plantations on Ancient Woodland Sites (PAWS), excessive regeneration of the non-native plantation trees can be a greater threat than either INNS or coarse vegetation. It can hamper efforts to halo thin if these areas subsequently fill up with regeneration from western hemlock, for example. In stands of shade-tolerant plantation species, light thinning can sometimes just result in perpetuating regeneration of the plantation species (eg. western red cedar or beech). Adaptive management, informed by regular ongoing monitoring, is important to respond to this threat. At an early stage, regular respacing by cutting-out excessive non-native regeneration is likely to be required to favour any native broadleaved regeneration. But, if managed carefully, a degree of non-native regeneration may be tolerated to form a useful component to increasing structural diversity through the gradual transformation of the stand.

4.6 Livestock, deer and squirrel management

In woods that receive severe levels of excessive grazing or damage by deer, livestock, boar, and/or grey squirrel, addressing this problem will often be an essential first priority before progressing towards any other restoration objectives such as thinning or restocking. While it may not be practical or cost-effective to deer-fence an entire woodland, small fenced coops could be established to secure particularly vulnerable areas, and a programme of deer stalking can be implemented. Further information on this crucial element of restoration can be sought from working with local deer management groups or the Deer Initiative. For woods that are unfenced to adjacent pasture, it will be essential to control the level of livestock grazing occurring, usually through fencing to exclude livestock. However, in some ancient woodlands a degree of grazing is important in maintaining specialist interests (eg. some important lower plant assemblages), and it is important to consider this at the site level. Management of grey squirrel is more effective when carried out at a landscape level, so communication with neighbouring landowners to establish a concerted effort will be the most appropriate phase one restoration action.

4.7 Coarse vegetation

Coarse vegetation - the excessive growth of brambles, bracken, rushes and some grasses - is a normal part of many native woodland vegetation communities and plays a key role in woodland ecosystems. Sometimes however, as a result of historical land-use and/or with a sudden change in conditions (usually the amount of light or nutrients), this type of vegetation can spread rapidly to dominate the ground cover and shade out more delicate woodland plants. There are some instances when this could result in ancient woodland being in a critical condition. For example, clearfelled stands where regeneration is clearly being inhibited (and is likely to be over a long period) and impacts on remnant ground vegetation are clearly significant. Where this is the case, management of this coarse vegetation should focus on reducing the impact on regeneration and not complete control or eradication. Intervention may simply involve strimming back or mulching bramble or bracken to prevent further encroachment into areas containing populations of specialist woodland flora or regenerating broadleaves. Mechanical control can be either using pedestrian operated equipment such as brush-cutters, or for larger-scale sites where access is possible, tractor-mounted cutters/flails may be appropriate if this can be achieved without excessive ground disturbance. Grazing animals offer a sustainable option, but must be managed and monitored carefully to avoid detrimental impacts. Infrastructure (fencing, water, holding facilities) is also required. After some felling operations there can be a narrow window of opportunity for natural regeneration to establish, before coarse vegetation closes over. Where deer pressure (or other herbivore presence) is particularly high, it is essential that this is addressed first to avoid missing this narrow window of time. The phase two restoration strategy will include the long-term management of coarse vegetation, including the careful manipulation of light levels when specifying felling operations.

4.8 Other external influences

The integrity of remnant features may be threatened by the influence of external factors such as illegal off-roading activity, pollution incidents, and spread of invasive species. In these instances, the phase one intervention may involve identifying and dealing with the agent of threat in order to maintain remnant features. The details of this intervention will vary greatly between woodland and the issue, but at its core will be effective communication.

Figure 16 - Excessive regeneration of western hemlock is dominating ground vegetation and engulfing replanted oak in a small restocked PAWS in North East Wales. Photo: Alastair Hotchkiss/WTML.

Case study

Robingate and Greggs Wood, Tunbridge Wells, High Weald

The majority of this site is owned by a property developer. Much of both woods was overrun by invasive *Rhododendron ponticum* and *Gaultheria shallon*. In the most affected zones, identified through the survey and assessment process, this formed a fairly dense understorey, with enough gaps so that some remnant ancient woodland flora still persisted, in a critical condition.

It was practical to cut these areas by hand, with follow-up treatment with glyphosate to kill off subsequent regrowth from the rhododendron stumps and/or gaultheria roots. This allowed a detailed, careful approach, with minimal damage to the soil. The cutting created limited amounts of arisings, so these could be left in small piles on site to rot down. The work was carried out in February to minimise disturbance to wildlife.

Zone 9 (Figures 17 and 18) was dominated by an impenetrable thicket of large rhododendron bushes, with virtually no ground flora, and very little else surviving apart from scattered canopy trees, including an impressive and important range of veteran trees. In this case the rhododendron was mechanically removed, in order to allow complete removal of the plant, and thus minimise the amount of follow-up intervention required. The ground flora and soil had been so impoverished, for so long, that the potential damage was considered to be far outweighed by the benefits of completely removing the rhododendron. Arisings were chipped and windrowed in order to minimise surface area coverage, and expedite the decomposition process. The clearance has opened up a previously invisible landscape, revealing the full extent of the amazing resource of mature trees hiding within the rhododendron. Many of these display open grown, veteran characteristics, and thus are potentially home, now or in the future, to specialist species associated with veteran trees in more open wood-pasture.

A small section in the south-east corner of Robingate Wood is privately owned. Here the entire ancient woodland area was overrun by a rhododendron thicket, in a similar condition to that of Zone 9 in the neighbouring ownership, with some very large veteran beech among other notable trees. Access was limited by the steep slope, and isolation within surrounding woodland blocks, meaning that a relatively high level of government grant funding was available. In this case the entire plants were again removed mechanically, but in this case they have been left entire in windrows for the landowner to remove off-site when possible.

Figure 17 - Invasive rhododendron and gautheria completely dominating ground vegetation and understorey. Photo: Rick Vallis / Silva Woodland Management.

Figure 18 - Rhododendron before (left) and after (right). Photos: Rick Vallis / Silva Woodland Management.

Figure 19 - Rhododendron before (left) and after (right) initial phase one treatment at Robinsgate and Greggs Wood. Photos: Jim Smith-Wright.

5. Considerations and permissions

While the nature of phase one restoration is to carry out urgent intervention to maintain remnant features, it is important to note that any required works will still need to adhere to all standard considerations and permissions associated with woodland management. The list below is not exhaustive but provides an overview of some of the key considerations that may determine aspects such as the timing of phase one operations.

5.1 Protected and priority species

All forestry operations are subject to protected species legislation. If phase one operations are required in areas known to contain protected species or habitats, ie. otters, bats, dormouse, badger setts, ponds containing great crested newts etc., advice should be sought from the relevant statutory nature conservation organisation, for example Natural England, Natural Resources Wales, Scottish Natural Heritage and Northern Ireland Environment Agency, and/or a licensed ecologist. Felling trees and scrub management is advised against during bird nesting season, which generally runs from March to August inclusive but is seasonal and can be earlier for some species, such as raven, crossbill and long-tailed tit. If thorough checks can be made by an ecologist experienced in bird surveying to ensure that no nesting activity is taking place, then it may be possible to carry out some operations without committing a possible offense. This may be required on particularly wet or poor-draining sites to avoid excessive ground disturbance from machinery in wet winters.

Other important woodland specialist species could be present within the woodland. Some of these could be regarded as remnants in themselves, such as toothed fungi assemblages, oceanic mosses and liverworts of humid wooded ravines, or rare insects associated with dead or decaying wood. Others may be more mobile species, for example bats and birds, that are nevertheless important conservation features. Some of these may be more difficult to identify by the non-specialist, but their presence may place greater urgency on restoration, or a need to carry out restoration sympathetic to their requirements. Completing a search with a local record centre, national recording scheme (eg. NBN Atlas) or the Woodland Wildlife Toolkit, can help inform you of the presence of other key species, although lists may need to be interpreted by an ecologist. The Woodland Wildlife Toolkit can, for any given site, give an instant list of priority woodland species which could be found there, along with a report of what management would support them.

5.2 Statutory designations

Operations in the vicinity of statutory protected sites such as Sites of Special Scientific Interest (SSSI) may require the consent of the statutory nature conservation organisation, eg. Natural England, Natural Resources Wales, Scottish Natural Heritage, Northern Ireland Environment Agency etc. and they should be contacted before any works take place. Similarly, Scheduled Monuments will require consultation with the relevant body, ie. Historic England/Cadw/Historic Scotland/NI Government Historic Environment. Any works to trees or woodland covered by Tree Preservation Orders or within Conservation Areas will require permission from the local planning authority.

5.3 Felling licence

All phase one 'first aid' operations generating more than $5m^3$ of timber in a calendar quarter will require a felling licence, or in some parts of the UK, an agreed management plan. Ringbarking and felling to create deadwood requires a felling licence. There are exemptions to this, and trees of small diameter can be thinned or coppiced without the need for a licence. However, you should always seek the advice of the relevant forestry organisation in each country when considering a felling operation.

5.4 Public rights of way and access

Any works that will require the temporary closure or diversion of a public right of way will need permission from the relevant local authority.

Figure 20 - Ancient woodland specialist flora in critical condition, restricted to a narrow band between the edge of a dense western hemlock stand and agriculturally improved sheep pasture. Nettles also indicating elevated levels of nitrates and phosphates in the soil, and fence no longer in a stock-proof condition. Photo: Alastair Hotchkiss/WTML.

Case study

Cadora Woods, Lower Wye Valley, Gloucestershire

Cadora is set in the richly wooded Lower Wye Valley. Acquired by the Woodland Trust in 1999, urgent restoration work was required to attend to critical remnant features within the plantation ancient woodland stands of mostly Douglas fir. The site was rich in notable pre-plantation trees, including ancient small-leaved lime pollards, ash pollards and large maiden oaks, yew and beech, all retaining important old-growth characteristics. Shading and overtopping from the planted conifers was the main critical threat to these features, and they were at risk of being lost. One of the ancient lime pollards in a critical condition was featured as the front cover to the Woodland Trust's original guidance on ancient woodland restoration, published in 2005 (see Figure 21). A programme of progressive thinning and selective felling commenced in 2004, prioritising the most critical features in the first phase – to halt further decline.

Constraints on the removal of planted conifers include steep slopes, poor access and presence of large boulders and loose scattered rocks on slopes above a main A-road. The more fragile critical remnant trees and pre-plantation deadwood were also at risk of being damaged during thinning operations, so careful planning, contract preparation and management were required to avoid this. The ancient woodland flora, limited to rides and ride margins, were also at risk of damage during the extraction of conifers, especially in the north of the site where tracks are generally less well drained. Extraction was therefore timed and managed to minimise damage to acceptable levels. Other considerations included badger setts, goshawk nests and archaeological features such as Offa's Dyke and Caley's Grove Cairn, and so were marked up on site to avoid any damage during operations. Charcoal hearths were considered less likely to suffer significant damage through timber extraction from rides, but were also marked on site in the unlikely event of heavy machinery working within stands.

Over 15 years on from the initial 'first-aid' interventions in critical areas, the remnant ancient and veteran trees are now robust and while the stands are not yet considered secure, the wider stand transformation is well underway and subsequent thinning interventions are progressing the site into the second phase of restoration. The high local deer population is also being addressed to reduce impacts on regeneration of both trees and other woodland flora.

The long-term objective (50+ years) for the wood is that all plantation ancient woodland is restored to native semi-natural woodland dominated by site-native species. All remnant ancient woodland components will be in a secure condition. The site also supports other notable features, including two rare woodland plants which both require a degree of disturbance and sunlight to flourish: upright spurge (*Euphorbia serratula*) and spreading bellflower (*Campanula patula*). Mammals such as dormouse and a number of bat species are known. Important invertebrates associated with dead and decaying wood (saproxylic invertebrates) still persist on the site, despite these old-growth habitats being severely degraded and limited during the plantation history of the site. These include Welsh oak longhorn beetle (*Pyrrhidium sanguineum*) which is associated with oaks, and Cosnard's net-winged beetle (*Erotides cosnardi*) which is associated with ancient beech forests with old-growth characteristics, where the larvae feed within white-rotten heartwood of trunk cavities. Through active management and longer-term planning, these important features can be further enhanced through the subsequent phases of restoration.

Figure 21 - Small-leaved lime pollard in the Lower Wye Valley, Gloucestershire which has been gradually opened up over several years. Photo: Alastair Hotchkiss/WTML.

6. The next phase of restoration and monitoring progress

Phase one operations to address areas of ancient woodland in a critical condition should continue until the remnant features are deemed to be in a robust enough condition to cope with the next phase of restoration. Although no longer critical, these features or stands will remain threatened until wider interventions are carried out as part of the longer-term restoration process. It is crucial to understand that these phase one operations often only buy some time, and if interventions are not continued or followed up there is often a chance that these features will regress to becoming critical again, with a risk of being lost. This is particularly true of halo thinning operations, which can soon close over again.

Evidence of reaching this position will in most cases be through confirming the removal or control of the identified agent/s of threat. Before and after photographs are often very useful to make comparisons on sites; fixed points such as key remnant pre-plantation trees can be useful anchors for direct comparisons. Fixed point plots may also be a useful tool in recording the recovery of ancient woodland ground vegetation.

Using the process set out in Module 2, reassessing the areas of woodland subject to phase one intervention will help to show whether or not they are still in critical condition. At that stage, woodland management can become more proactive in terms of progressing stands into a secure condition and enhancing the wider woodland ecosystem over the longer term.

The subsequent two modules will cover the final two phases of restoration. The second phase (covered in Module 4) looks at the recovery of the wider ecosystem by transforming the woodland as a whole, to progress from threatened to a secure condition over an appropriate timescale. The final phase (covered in Module 5) looks at guiding the future trajectory of ancient woodlands, by long-term planning, adaptive management, and natural processes, in order to further enhance the ecological functioning and integrity of a site, as well as increasing its resilience in tomorrow's landscapes.

All ancient woodland sites, and different areas within them, will have varying 'starting points' with restoration, and the three phases do not need to run sequentially. In practice, the phases may overlap operationally as work is planned and carried out.

Photo: Alastair Hotchkiss./WTML


Photo: Paul Glendell/WTML.

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