

# The conservation and restoration of plantations on ancient woodland sites

A guide for woodland owners and managers



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## INTRODUCTION

Ancient woodland is the UK's richest habitat for wildlife, the result of centuries of continuous woodland conditions and management. This continuity means that it has had time to develop complex ecological communities characterised by species of plants, fungi and insects that are rarely found in younger woods. Ancient woods are also historical treasure troves full of archaeological and cultural features that give a picture of past land use. Ancient woodland is a scarce and irreplaceable resource.

Plantations on ancient woodland sites (PAWS) are ancient woods that have been planted with non-native species, mostly during the 20th century with the intention of providing a strategic timber reserve. Non-native conifer plantations can have a particularly negative impact on the ecology of ancient woods, firstly through the process of establishing them and subsequently from the effects of the shade and leaf litter that they cast. However, research has shown that in most PAWS remnant historic and ecological features still survive in amongst the plantation crop. These remnants provide vital links back to the original ancient woodland. By acting now, owners and managers can make a major contribution towards securing and maintaining some of the UK's most valuable and threatened habitats. The Woodland Trust regards the restoration of PAWS as a top priority.

This guide is intended to give woodland owners and managers an idea of how best to conserve and restore ancient woods planted with non-native conifers. The Forestry Commission is committed to restoration and offers grants to assist landowners; details vary across GB so contact your local office. Similarly agri-environment schemes may offer assistance, so talk to your relevant agency if you farm. For those interested in certification to the UK Woodland Assurance Standard (UKWAS 2006), the process outlined here should help provide compliance with the PAWS section. A number of useful publications and websites can be found listed on page 17.





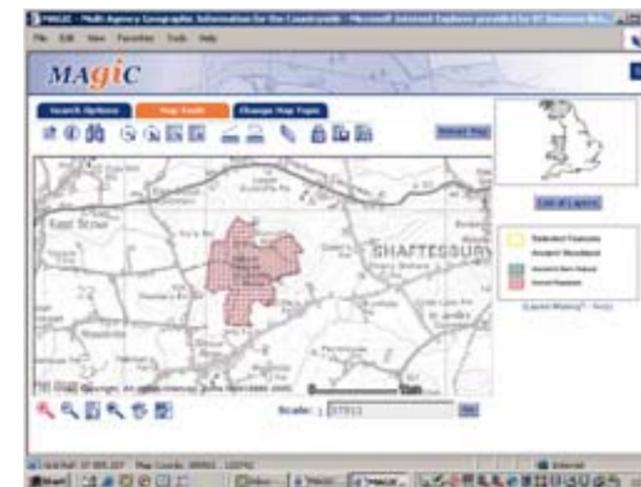
## SUMMARY

- The approach starts from the premise that all PAWS are likely to retain some of the ecological and archaeological value from their ancient woodland origin.
- We advocate two distinct operational phases. First to maintain and enhance remnant ancient woodland features by reducing immediate threats to their survival. This process may take some years. Second to make long term improvement to the general ecological value of the site, by gradually shifting the canopy towards a more semi-natural species composition and structure.
- Planning and operations are based on site surveys that identify the type, distribution and condition of remnant ancient woodland features.
- Action to conserve and enhance remnant ancient woodland features is prioritised based on the level of threat, with urgent and careful attention being directed to those most at risk.
- The approach is in essence about gradual change, in particular the management of light levels, as most threats to remnant ancient woodland features may come from either excessive shade or light.
- The emphasis is not simply on replacing the plantation crop with native trees and should seldom require rapid or complete removal of non-native conifers.
- The suggested techniques may also help deliver other management objectives. These may include timber production and game management, public benefits such as recreation and landscape enhancement, and straightforward improvements to the aesthetics and private amenity value of a property, which may in turn result in an increase in its capital value.

## WHERE TO START

### Establishing whether the wood is a PAWS

To find out whether your wood is a PAWS, the first points of reference are the Ancient Woodland Inventories. These inventories are available for all of the UK except Northern Ireland, where the Woodland Trust is producing one. By their nature the inventories will always be provisional, so treat the presence or absence of a wood with a little caution. Furthermore they only consider woods over two hectares.

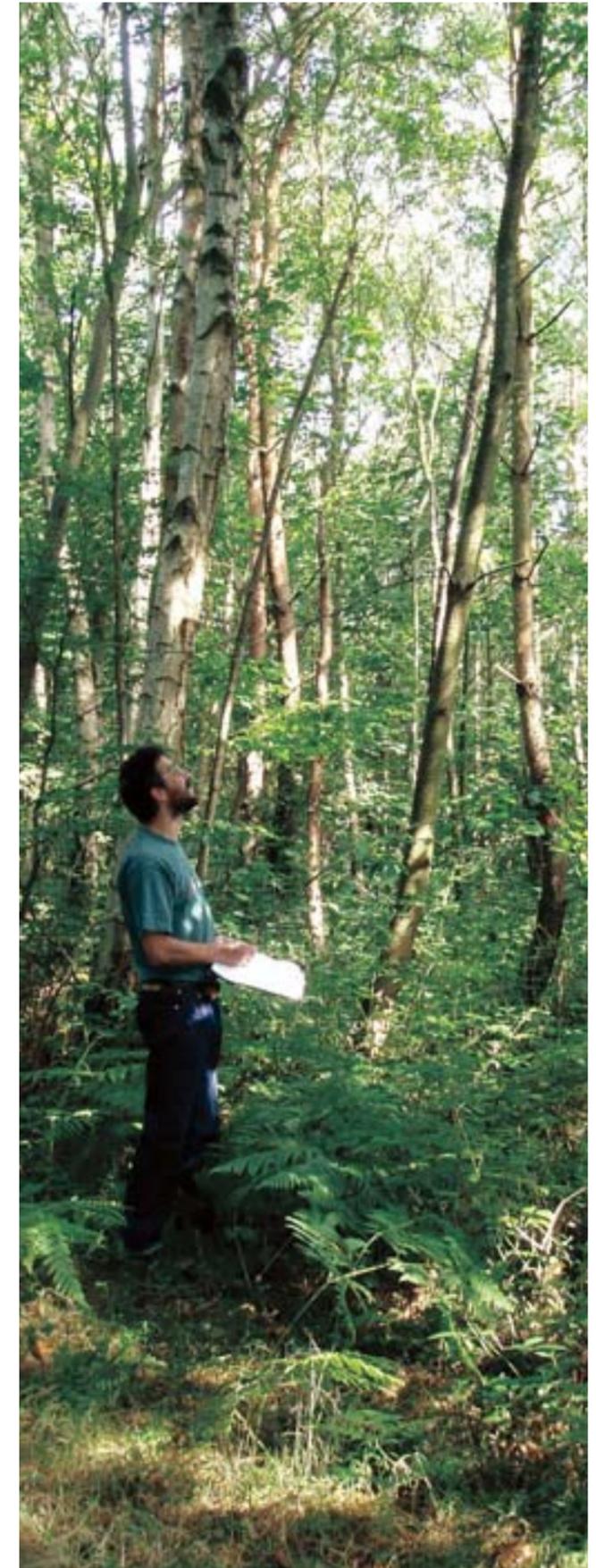


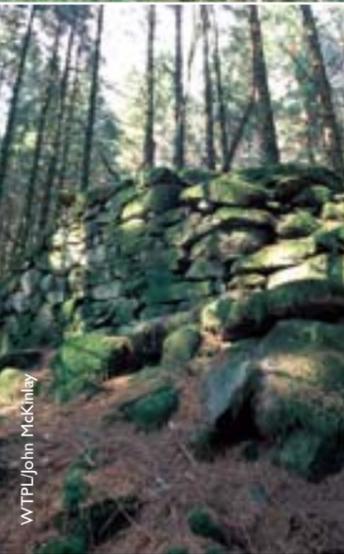
▲ Online ancient woodland inventory for England via Magic web site (see page 17)

Other evidence, such as estate maps, archaeological features, local knowledge or species thought to be characteristic of ancient woodland, can be very helpful in confirming an area's value. This should be considered in conjunction with the inventories.

### Surviving ancient woodland features

The most obvious ancient woodland remnants commonly surviving in PAWS are deadwood, trees and understory shrubs, archaeological features and woodland plants. These form the focus of our approach and are likely to be associated with less obvious remnants of the ancient woodland ecosystem (e.g. soils, lower plants, fungi and invertebrates). Table 1 gives further details about these features.



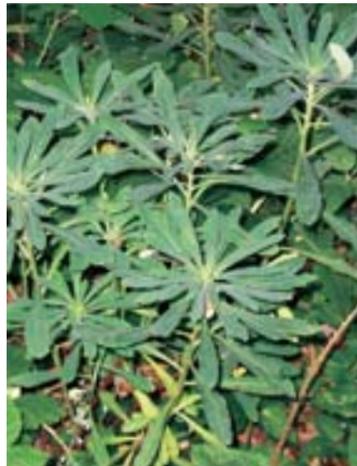


**Table I: Characteristics and identification of remnant ancient woodland features**

Deadwood
<p>Coarse woody debris from the original woodland cover, including old felled tree trunks, snags, stumps and rotting coppice stools, is a significant part of the ancient woodland inheritance in many PAWS.</p> <p>Large pieces of deadwood kept biologically active by relatively moist, shady conditions are likely to be of the greatest importance. Many of the species associated with deadwood in ancient woods (e.g. fungi and invertebrates) rely on long term continuity in the supply of deadwood habitat.</p>
Trees and understorey shrubs
<p>Of particular interest are trees that clearly pre-date the plantation crop, such as standards, coppice stools or pollards. They may include veteran or ancient trees, and all provide important habitats for lichens, mosses, fungi, invertebrates, mammals and birds.</p> <p>The surviving understorey and shrub element of stands are similarly important but often overlooked. Woodland managers have a natural tendency to focus on canopy trees, but they are only part of the system.</p>
Archaeological features
<p>There is wide variation in the scale and significance of ancient woodland archaeological features, from Offa's Dyke to charcoal hearths, boundary banks, trackways, mine workings or 19th century sawpits. All are of intrinsic value, being representative of the unique accumulation of historical and cultural artefacts found in ancient woods. These features are often also associated with 'hotspots' of survival for flora, old trees and deadwood. They are prone to irreversible physical damage.</p> <p>They are most easily identified in winter.</p>

**Table I continued : Characteristics and identification of remnant ancient woodland features**

Woodland plants		
<p>Plants that have a particular affinity for ancient woods tend to rely on moderate shade and low levels of disturbance. In PAWS their populations are often depleted and fragmented, making them especially vulnerable. Many have poor powers of dispersal and do not appear to survive in the seed bank, so once lost from a wood they will at best be very slow to return. Their presence can also indicate where other less obvious remnant species of ancient woodland may occur.</p> <p>The density and composition of ancient woodland flora vary considerably, even between intact ancient woods. Managers should therefore be less concerned with a fixed list of what 'should' be of value in their PAWS and focus more on locating and making the most of what actually remains. Concentrations or 'hotspots' often occur where conditions associated with the pre-plantation ancient woodland are more likely to have persisted, such as along watercourses, old rides and under native trees. Another common distribution pattern is where low level survival is scattered throughout a stand.</p> <p>The best time to assess woodland plants is in spring or early summer.</p> <p>Differentiating specialist woodland plants from others need not require expert botanical skills. A manager may find it useful to simply relate light levels to basic vegetation composition in the following manner:</p>		
Light	Intermediate	Dark
<p>High light levels (often with an associated increase in the local water table) provide ideal conditions for coarse or generalist vegetation, such as bracken, bramble, coarse grasses, nettles and rosebay willowherb. Where these dominate they may have potential to exclude vulnerable woodland species, and so their identification can help indicate that light levels are too high. The restoration process should try to avoid such high light levels.</p>	<p>Moderate shade approximates to favourable conditions for remnant woodland species (mimicking those found in the pre-plantation ancient woodland). With these light levels it is simplest to assume that much of the ground flora will comprise remnant woodland plants. Where possible this should be confirmed by identifying familiar species, for instance wood spurge and yellow archangel in the lowlands, or wood sorrel and cow wheat on more acidic upland sites. However, an absence of these 'charismatic' species does not infer that there is an absence of valuable woodland flora. Many other species, particularly lower plants are hard to spot or identify; if you cannot recognise plants, assume that they may be important.</p>	<p>Prolonged heavy shade can eventually be beyond the tolerance of even the most resilient woodland species. In these conditions it may be appropriate to simply differentiate live, 'green' patches from dead 'brown' patches of ground, especially where the remnants are hard to identify, e.g. mosses.</p> <p>The most urgent action is often associated with these conditions.</p>



# SURVEYING AND ASSESSMENT

There are two objectives to this stage, identifying where remnant features survive and assessing what threats they may be under.

Whilst this is central to the restoration process, it need not involve a specialist or unduly detailed ecological survey. The aim is to gather enough information about the surviving remnants to be able to make management decisions and to describe their distribution accurately enough for them to be located again in the future: for example, in advance of forest operations.

## Identifying where remnants survive

The remnant ancient woodland features will vary between and even within each stand. It is therefore practical to make separate assessments for each stand within the PAWS.

## Illustrations of patterns of remnant survival

Rideside hotspot



Streamside hotspot



Scattered throughout



One of the most effective methods of recording this information is to draw an annotated sketch or compartment map (see page 8).

Avoid focusing only on the main body of the crop; it is likely that remnants will be unevenly distributed and 'hotspots' often occur along stand boundaries, ride sides, water courses and woodland edges. A good way of capturing these variations is to split the compartment into zones.

Also give consideration to the context of the stand in the wood, and of the wood in the landscape. Are there factors or sensitivities in surrounding stands, down connecting rides, or in areas outside the wood that may affect the stand and the way it can be treated? If you have access to aerial photographs these may be very helpful in establishing broad patterns, particularly for large sites.

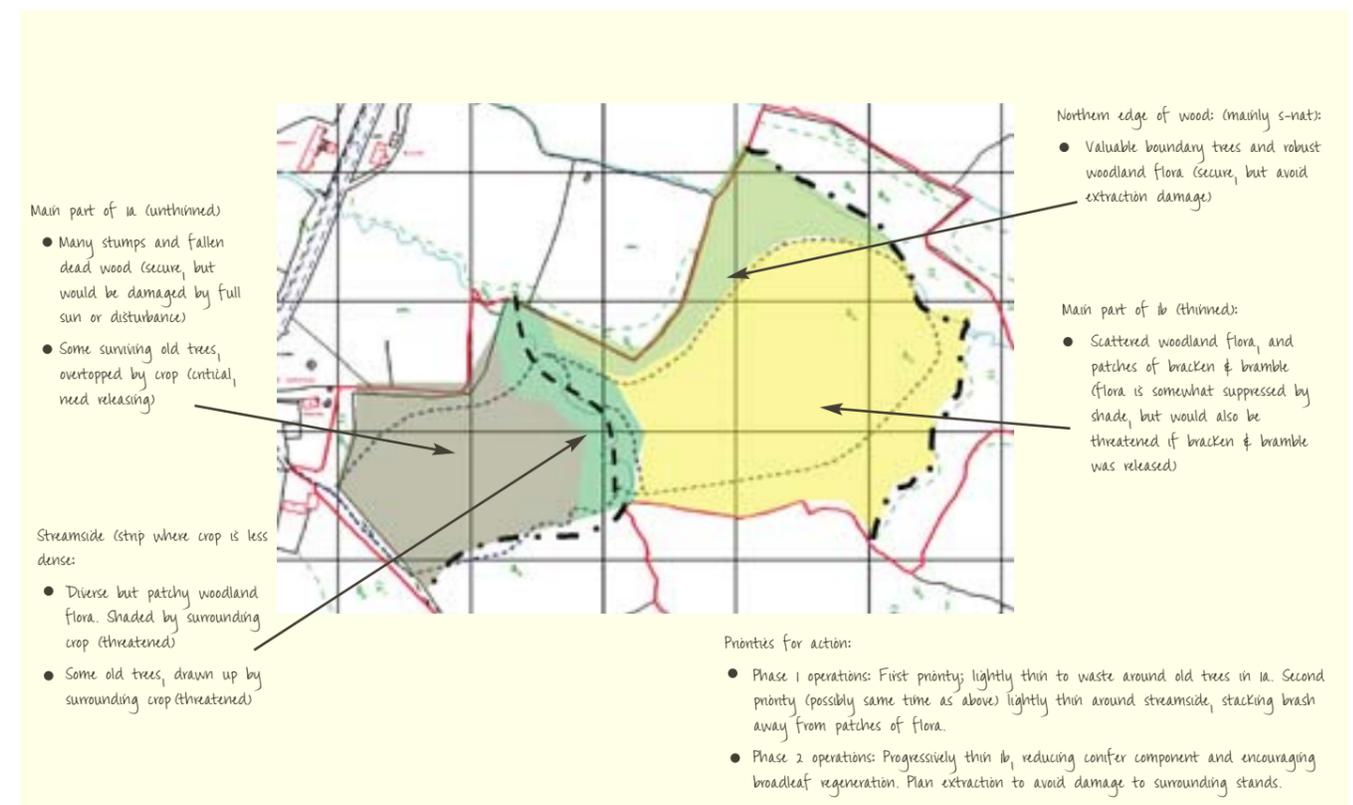
## Assessing the threats

Most remnant features are in a damaged or weakened condition and the plantation crop and its management may continue to make them vulnerable. Action needs to address the nature of the threats involved, and should be prioritised according to their severity.

### Sources of threats

Attention should be paid both to the current threats, such as shading of old trees, and potential threats, such as windthrow resulting from heavy thinning. Note that different remnant features are susceptible to different threats. Specific practical guidance which links threats to potential solutions is provided in Table 2.

## An example of an annotated compartment map



## What if no remnant features appear to have survived?

At first glance, some PAWS appear to have no remnant features. However, experience shows this is rarely the case. Once you become attuned, you are soon likely to identify heavily suppressed features. Be aware that weakened woodland plants may not produce flowers.

## Level of threat

It is important to make a comparative assessment, so that the most threatened remnants are addressed first and with greatest care. Remnants can be categorised as:

- **Secure:** likely to remain the same or improve given current conditions
- **Threatened:** unlikely to be lost in the short term, given current conditions, but long term survival is doubtful without intervention
- **Critical:** need urgent action to avoid irreversible, loss or serious deterioration.

Annotated maps may suffice to record this information, such as the one below, but an example of a form used by the Woodland Trust to introduce managers to the process is available at [www.woodland-trust.org.uk](http://www.woodland-trust.org.uk). This provides extra guidance on identifying remnant components and a framework for assessing the threats.



**Table 2: Linking threats to management solutions**

Deadwood	
Main threats	Solutions and recommendations
<p>Physical damage from machinery or fire.</p> <p>Scorching and drying out, resulting from loss of shade.</p> <p>Loss of habitat continuity, resulting from a lack of future sources of deadwood.</p> <p>Removal for firewood.</p>	<ul style="list-style-type: none"> <li>• Avoid mechanical extraction over old stumps and coarse woody debris</li> <li>• Maintain shaded woodland micro-climate</li> <li>• Retain any semi-mature trees (a scattering of non-native conifers if necessary) existing in the stand in order to provide a future deadwood habitat</li> <li>• Consider ring barking as a means of thinning a proportion of non-native conifers</li> <li>• Consider stacking the boles of some felled non-native conifers and retaining them in situ</li> </ul>
Trees and understorey shrubs	
Main threats	Solutions and recommendations
<p>Shading out by the plantation crop.</p> <p>Soil compaction and mechanical damage to root systems and to stem and branches during harvesting operations.</p> <p>Wind throw, tree death and loss of associated species, resulting from rapid exposure to sun and wind.</p> <p>Loss of habitat continuity, resulting from a lack of future old trees.</p>	<ul style="list-style-type: none"> <li>• Reduce competition/shade gradually in the immediate vicinity of individual trees ('halo thinning') but maintain some of the surrounding canopy, at least until trees are more robust. Thinning around old trees need not immediately create a complete 'halo'</li> <li>• Retain veteran and ancient trees</li> <li>• Secure an upcoming generation of 'new veteran trees'</li> <li>• Keep some non-native conifers to over maturity, if there is no alternative option</li> <li>• Avoid driving machinery over root systems of old trees, as a rule of thumb keeping out of an area around the base with a radius of at least 15 times the diameter of the tree's trunk</li> <li>• Be tuned into the existence of understorey and shrubs during assessments</li> </ul>

**Table 2 continued: Linking threats to management solutions**

Archaeological features	
Main threats	Solutions and recommendations
<p>Physical damage from harvesting operations.</p> <p>Trees being blown over together with their root plates allowing soil erosion and upturning structures.</p>	<ul style="list-style-type: none"> <li>• Locate and record archaeological features through observation, records and advice</li> <li>• Mark off features to avoid during forest operations</li> <li>• Avoid heavy and protracted extraction leading to ground disturbance and carry out operations in dry conditions</li> <li>• Avoid leaving trees vulnerable to wind blow on or close to archaeological features</li> </ul>
Woodland plants	
Main threats	Solutions and recommendations
<p>Dense, continuous shade from the conifer canopy.</p> <p>Competition from coarse vegetation, especially following disturbance or canopy removal.</p> <p>Harvesting operations.</p> <p>Brash.</p>	<ul style="list-style-type: none"> <li>• Gradually reduce shade but avoid removing canopy cover entirely</li> <li>• If coarse vegetation, including bracken and bramble, starts to spread across the site, the simplest response is to delay or reduce the intensity of subsequent thinnings</li> <li>• If the problem is the result of the site having been clearfelled consider whether it is better to plant trees into the area as soon as possible, rather than waiting for natural regeneration. This may re-establish shade conditions more quickly</li> <li>• Don't be tempted to use herbicide</li> <li>• Avoid severe disturbance, especially to 'hotspots' of survival: e.g. rides and ride edges</li> <li>• Enable surviving plants to multiply before carrying out more disruptive harvesting work</li> <li>• Phase operations over time</li> <li>• Time operations to minimise ground damage</li> <li>• Density can be more of a problem than depth</li> <li>• Avoid obvious hotspots</li> <li>• Remember ride and ride edges are often important so be careful with build up here</li> <li>• Avoid burning as it permanently changes soil and encourages invasion by coarse vegetation</li> <li>• Consider leaving time for brash to rot in between operations</li> <li>• Consider ring barking or chemical thinning</li> </ul>





**Table 2 continued: Linking threats to management solutions**

Woodland plants continued	
Main threats	Solutions and recommendations
Herbicide damage associated with restocking	<p>Try to avoid herbicide use by:</p> <ul style="list-style-type: none"> <li>• Maintaining canopy to avoid excessive weed growth (using herbicides as a method of control is likely to harm the survival of remnant woodland plants)</li> <li>• Where possible using natural regeneration, which often does not require weed control.</li> <li>• Using alternative means of weed control for planted trees</li> </ul>
Rhododendron	<ul style="list-style-type: none"> <li>• This should be treated in a similar manner to other threats to ancient woodland remnants</li> <li>• Rhododendron can be suppressed by the shade cast by conifers so it may be sensible to control it first before carrying out operations that will let light in and stimulate its growth</li> </ul>
Dense conifer regeneration is expected	<p>Depending on conditions, maintaining continuous cover by retaining conifer canopy runs the risk of producing vigorous conifer regeneration and, in effect, 'continuous cover conifers', particularly with species such as western hemlock and more generally in upland situations. The straightforward solution is to clearfell the parent crop. However, this needs to be weighed against the risk to surviving remnant features. In addition, the following factors should be considered:</p> <ul style="list-style-type: none"> <li>• Some non-native conifer regeneration in the stand is acceptable, even in the long term and it may not always come up uniformly across a site. Taking the risk to thin before clearfelling such stands may give surprising results and it may be possible to keep regeneration to manageable levels</li> <li>• In mixed species stands where non-native conifers of one species are regenerating most, these should be thinned first</li> <li>• Thinning prior to felling gives the opportunity for suppressed flora to be revealed and for more obvious features such as old trees to be strengthened</li> </ul>

**Table 2 continued: Linking threats to management solutions**

Ride and ride-edge habitat	
Main threats	Solutions and recommendations
Roading and extraction.	<p>Established rides can be some of the most important refuges for woodland plants and native trees.</p> <ul style="list-style-type: none"> <li>• If you cannot redirect your extraction routes to within the stands, try to use rides only during dry conditions and preferably only after taking action to strengthen any remnant features. Such action may take the form of targeted thinnings along the ride edges in the years running up to operations involving extraction</li> <li>• If you need to create a new track or road try to avoid remnants</li> <li>• It is worth weighing up carefully construction costs and timber income against potential damage, and then considering whether there is another way of conserving the remnant features</li> </ul>
Wind blow	
Main threats	Solutions and recommendations
The effect of wind can be a major constraint on the sort of continuous cover silviculture that PAWS restoration preferably involves. The default solution in a conventional plantation would be to clearfell and restock, but in the case of PAWS the risk that this presents to remnant features needs to be weighed against those associated with wind throw.	<ul style="list-style-type: none"> <li>• Maintaining and enhancing operations (see page 13), which are often some of the most vital and urgent, may only apply to a limited proportion of the stand, restricting the area over which wind risk is increased. So focused light thinnings carried out over a number of years before addressing the main part of the stand, may bolster the remnant ancient woodland features ahead of more disturbing operations or unavoidable clear felling</li> <li>• Novel approaches such as ring barking and high pruning wind firm edges next to hot spots may help to reduce the wind throw risk that light thinning may bring</li> <li>• In some situations it may be decided that the best solution is not to harvest the crop but leave it to grow old and diversify naturally. In such cases the maintaining and enhancing operations outlined above should still be considered</li> <li>• How extensive wind blow becomes will depend on local circumstances</li> <li>• There is the potential for dense conifer regeneration and this may be difficult to manage amongst wind blow. Dense stands of species such as spruce or hemlock are likely to be particularly challenging</li> </ul>



# PLANNING AND PRIORITISING ACTION

## Maintain and enhance critical and threatened ancient woodland remnant features (phase one).

In areas where the remnant features are judged to be either threatened or critical, targeted action should be taken to reverse decline.

Drastic measures will rarely be needed. One of the problems of rapid restoration is that high impact operations and sudden changes are often implemented when the remnants are at their most vulnerable. The aim is to reduce excessive shade, whilst at the same time maintaining canopy cover. Operations are likely to include:

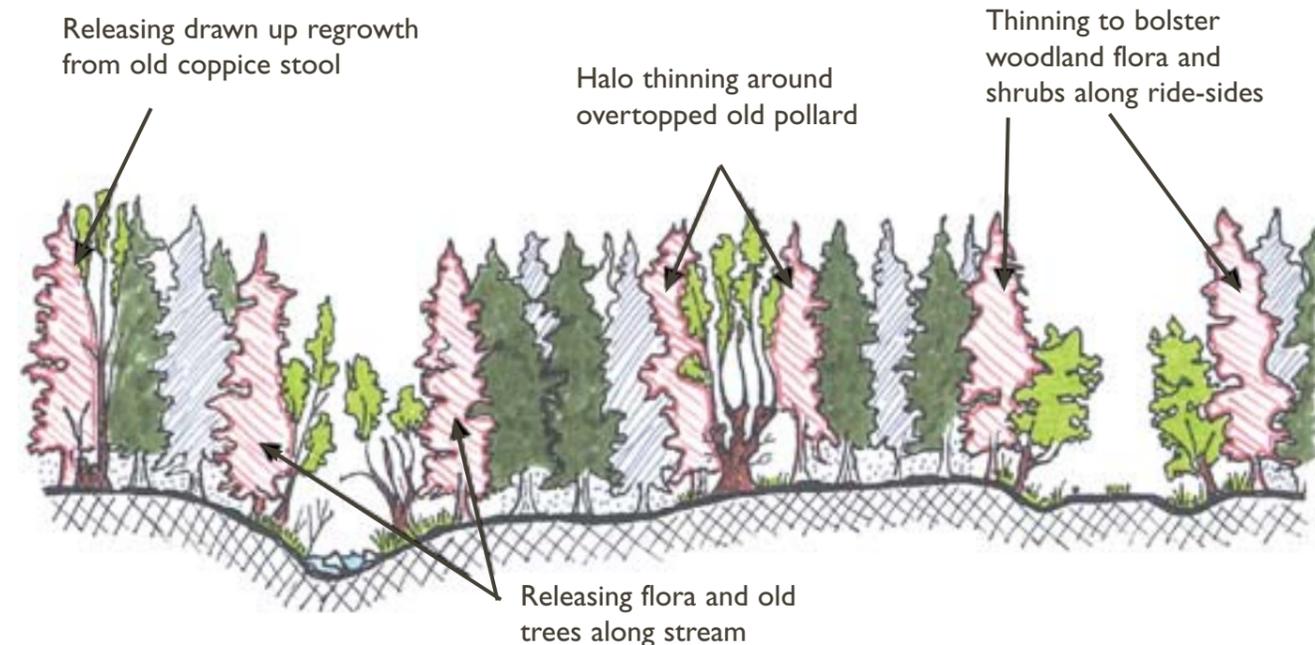
- Opening up patches of flora along shaded rides or stream sides.
- Releasing veteran trees from densely shading conifers.
- Thinning around surviving coppice poles.

This first phase may take many years of gradual work, with periodic monitoring and successive management interventions. It should continue until the remnant features are judged to be secure and robust enough to benefit from the next phase of operations.

All PAWS sites should be brought to this stage as a priority.



### Examples of maintaining and enhancing operations



## Moving towards a semi-natural composition (phase two).

The objective here is to make long term improvements to the woodland habitat by shifting the canopy gradually towards a species composition that is predominantly native. These operations should be carried out only in areas where the remnant features are secure, either because of the nature of the existing plantation, or because of the results of successful earlier works. Depending on the nature of the site, a wood may have both phase one and phase two operations underway at the same time.

It is important that this phase does not take precedence over maintaining and enhancing remnant features. A component of non-native conifer species may provide essential woodland habitat structure and canopy cover for an extended period. The scale and intensity of operations in this phase are likely to be more in line with standard woodland management practices. However, particular care will still need to be taken to ensure that safeguards are in place to protect secured ancient woodland features. Operations may include:

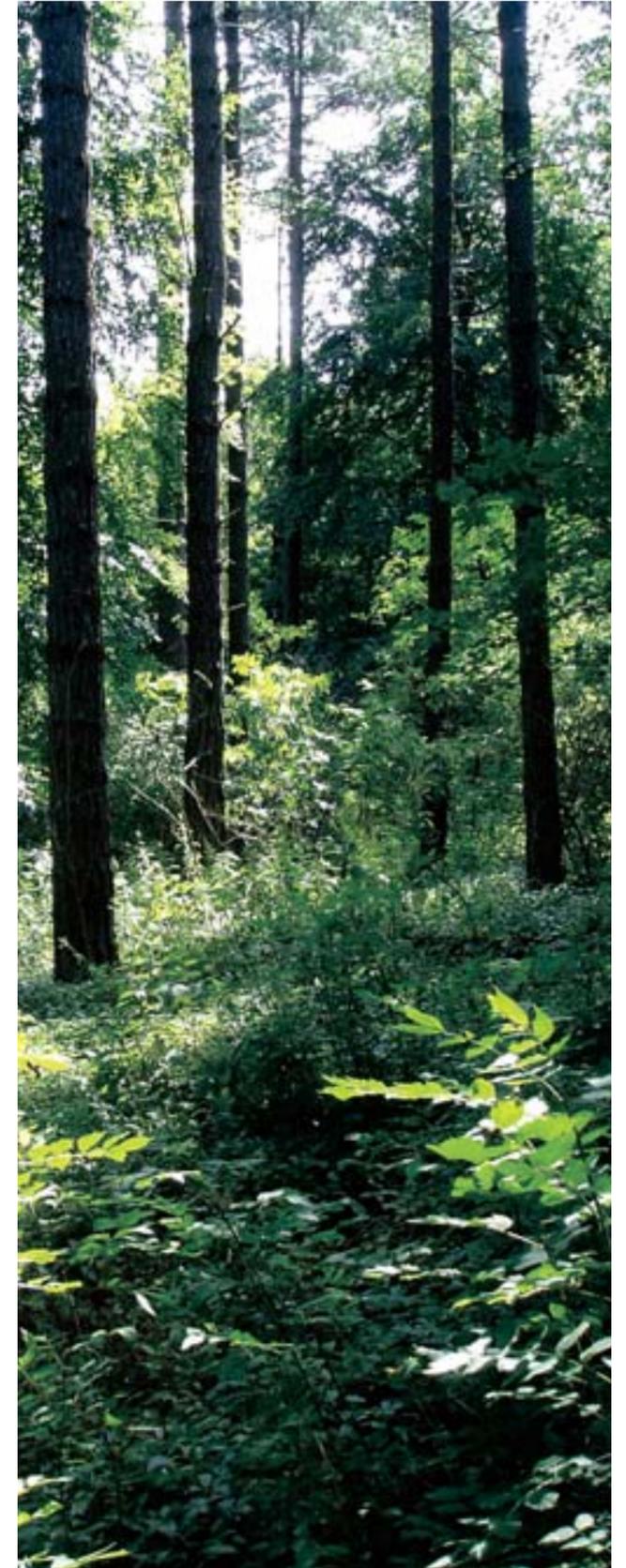
- Conventional thinning and continued opening up of ancient woodland features.
- Small scale selective felling to change stand composition and structure and create conditions for natural regeneration or enrichment planting.
- Releasing advanced native regeneration.

In some secured stands, where light conditions are improving naturally, the only action necessary may be periodic monitoring to make sure threats don't re-emerge.

It is important to remember the potential impacts of grazing and browsing by deer and in some cases rabbits, on plans to regenerate stands or the coppicing of understorey shrubs.

Priorities for this phase are sites which present the greatest potential habitat value. For example those that:

- Are close or adjacent to ancient or other semi-natural habitat.
- Are very large.
- Contain or form part of areas recognised for their conservation importance.



## RECORD WHAT YOU DECIDE AND OBSERVE PROGRESS

Once you have made your decision on what you intend to do, and when and how you intend to carry out the operations, it is sensible to record it for future reference. Copies of the annotated maps made in the assessments may suffice, although ideally everything should be written into a management plan.

It is important to watch how the remnant features respond to your management choices and tailor future actions accordingly. PAWS are highly variable and it is not possible to accurately predict precise responses to procedures. It is particularly vital to take a note of the condition of stands ahead of incremental management decisions or interventions. Bear in mind that thinned stands will respond by closing canopy again and threats from shading may therefore return with time.

### Some questions to ask are:

- Are the remnants that were originally found still there?
- Have the threats originally identified been removed or reduced as planned?
- Have previously unrecorded features now been revealed?
- Are the desired trees, shrubs and flora spreading?
- Has coarse vegetation been kept in check?
- What further actions are required to counter any further threats?

When answering these questions consider how or if you need to modify your management.

We hope you see this approach to PAWS management as a stimulating challenge that can significantly benefit biodiversity and help deliver your own particular set of objectives. We feel sure that within the broad principles outlined there is scope for novel approaches to be developed.



## FURTHER READING AND USEFUL WEBSITES

### For identification and general reading on ancient woodland:

Oliver Rackham (1990) *Trees and woodland in the British Landscape*. Revised edition Dent London.

English Nature (2000) *Guidelines for identifying ancient woodland*. IN5.0/1(F6.35) ISBN 1857162536.

### For ancient woodland inventories contact:

English Nature ([www.english-nature.org.uk](http://www.english-nature.org.uk))

Scottish Natural Heritage ([www.snh.org.uk](http://www.snh.org.uk))

Countryside Council for Wales ([www.ccw.gov.uk](http://www.ccw.gov.uk))

For online inventories the Forestry Commission website has a land search facility for each country at [www.forestry.gov.uk](http://www.forestry.gov.uk) follow the links to grants and licences.

For England only, also try [www.magic.gov.uk](http://www.magic.gov.uk)

### For further information on PAWS and their management:

SN Pryor, TA Curtis & GF Peterken (2002) *Restoring plantations on ancient woodland sites* Woodland Trust. [www.woodland-trust.org.uk](http://www.woodland-trust.org.uk)

RN Thompson, JW Humphrey, R Harmer & R Ferris (2003) *Restoration of native woodland on ancient woodland sites*. Forestry Commission Practice Guide.

### For guidance on how to take account of archaeology refer to:

Forestry Commission. (1995) *Forests and archaeology guidelines*.

### For alternatives to herbicides and a summary of the control of rhododendron:

I. Willoughby (2004) *Reducing pesticide use in forestry*. Forestry Commission Practice Guide.

### For those interested in native pinewoods in Scotland (outside the scope of this publication):

Eds W L.Mason, A. Hampson & C.Edwards (2005) *Managing the pinewoods of Scotland*. Forestry Commission

### Where to find out more

#### If you would like to discuss the methods outlined in this guide please contact:

The Woodland Trust, Autumn Park, Grantham, Lincolnshire, NG31 6LL.

**Email:** [enquiries@woodland-trust.org.uk](mailto:enquiries@woodland-trust.org.uk)

**Telephone:** 01476 581135

We intend to add further information on PAWS to our website at [www.woodland-trust.org.uk](http://www.woodland-trust.org.uk)

The principles and methods outlined in this guide are supported by:



The management suggested in this guide is compatible with the woodland options of Defra's Environmental Stewardship Scheme and the principles and methods are supported by the Rural Development Service.



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The Woodland Trust was founded in 1972 and is the UK's leading woodland conservation organisation. The Trust achieves its aims through a combination of acquiring woodland and sites for planting and through advocacy of the importance of protecting ancient woodland, enhancing its biodiversity, expanding native woodland cover and increasing public enjoyment of woodland.

The Trust relies on the generosity of the public, industry, commerce and agencies to carry out its work. To find out how you can help, and about membership details, please contact one of the addresses below.

**The Woodland Trust (Registered Office)**

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Facsimile: 01476 590808

**The Woodland Trust Wales/Coed Cadw**

Uned B, Yr Hen Orsaf  
Llanidloes  
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Telephone: 01686 412508  
Facsimile: 01686 413284

**The Woodland Trust Scotland**

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Telephone: 01764 662554  
Facsimile: 01764 662553

**The Woodland Trust in Northern Ireland**

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County Down BT20 3BX

Telephone: 028 9127 5787  
Facsimile: 028 9127 5942

**Website:** [www.woodland-trust.org.uk](http://www.woodland-trust.org.uk)



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