UNITED UTILITIES

SUSTAINABLE CATCHMENT MANAGEMENT PROGRAMME

VOLUME 5

RESTORATION OF UPLAND OAK AND WET WOODLAND

FIVE YEAR REPORT 2010

United Utilities

Penny Anderson Associates Ltd
CONSULTANT ECOLOGISTS

UNITED UTILITIES
SUSTAINABLE CATCHMENT MANAGEMENT PROGRAMME

VOLUME 5
RESTORATION OF UPLAND OAK AND WET WOODLAND FIVE YEAR REPORT 2010

Penny Anderson Associates Limited
'Park Lea'
60 Park Road
Buxton
Derbyshire
SK17 6SN

Project Manager
Penny Anderson FIEEM, MSc, BSc, CEnv

Report Prepared by
Katharine Longden MIEEM, MSc, BSc, CEnv

September 2011

This project has been undertaken in accordance with PAA policies and procedures on quality assurance.

Signed:_____

VOLUME 5 WOODLAND REPORT

CONTENTS

TABLES (all within text)

FIGURES

A3 Figures

Figures within the text

PHOTOGRAPHS (all within text)

SUMMARY

Woodland management, succession and development are all long-term processes and a five-year monitoring programme can only report on the initial, albeit sometimes dramatic, changes which occur as a result of the management techniques.

Despite the short time-scale so far in woodland growth terms, it can be concluded that the structure and native species complement of the woods where management has been undertaken have improved, thus moving the woodland site as a whole towards reaching its Biodiversity Action Plan (BAP) target. The management measures have generally resulted in an enhanced structure to the woods, with less canopy dominance, opportunities for a new sub-canopy layer of shrubs, seedlings/saplings or brambles and re-establishment of a ground cover on bare ground previously shaded. Each woodland is individual and the nature of the changes tend to differ between each, but some generalisations can be made.

Where large beech have been removed, the physical characteristics of the sites and the initial vegetation in the area all influence the development of the ground flora and the species of seedlings and saplings which develop. In general, the reduction in beech has resulted in an enhanced woodland structure, with good regeneration in some locations. However, the release of non-native saplings can occur, requiring ongoing attention in the future.

Ring barking was undertaken on alder and sycamore. The results indicate that no clear effect of ring barking can be expected until a minimum of three years after the management has taken place, as the trees do not die immediately. The enhancements derived from the reduction in canopy are therefore generally longer than the timescale of the current monitoring.

The removal of conifers shows clearly that the speed of a wood's response to conifer felling varies greatly, depending on existing vegetation and sub-canopy, seed bank and whether or not the conifers, trunks and brash are left on the site or removed. In all cases the number of tree seedlings across the areas is increasing and so far there are few conifer seedlings amongst them.

Shrub and tree planting to supplement the sub-canopy layer and diversify or extend the wood has been undertaken at several sites, with two of the sites showing good sapling establishment and growth, whilst on other sites this is less apparent. Factors such as spring drought, deer browsing and competition under a canopy, or with a dense ground cover such as bracken, all affect how well new plants can establish. Establishment would be expected to vary in its speed and degree of success. Where some new plants do not thrive, this adds to the future woodland structural variation with differences in density and variable growth rates.

Rhododendron removal has been undertaken in four sites, although this clearance is not yet completed as re-growth has been witnessed.

Stock-proofing woodlands is expected to lead to enhanced tree/shrub seedling and sapling establishment, provided that there are suitable colonisation gaps. This has been recorded in Sykes Farm Wood, for example, in most of the quadrats.

1 INTRODUCTION

1.1 Background and Aims

Although the main habitat focus of SCaMP has been blanket bog, one of the key objectives has been to support United Utilities' (UU) Biodiversity Strategy (cascaded from the National BAP (HMSO 1995)), and, thus, areas of upland oak and wet woodlands (amongst other habitats, see Volume 6) have been included in the restoration plans. For areas outside Sites of Special Scientific Interest (SSSI) (which includes all the woodland sites except Holdron Castle) the broad aim has been to improve the ecological status of valuable wildlife habitats and species. This is being achieved through management that is designed to enhance the character of the woodlands in line with their development into better quality upland oak or wet woodlands, thus working towards meeting BAP targets for the habitats at a national and local level.

The management undertaken was expected to increase the potential for shrub and ground layers where the canopy was affected, increase regeneration where additional light was introduced or grazing removed and improve the range of native species as a result of removing non-native or locally unsuitable species. All these would, in turn, improve the structure and natural diversity of the woods.

This report presents the final findings of a five year monitoring study for a suite of nine upland oak woodlands and five wet woodlands located in UU's Southern Region and Bowland landholdings that have been subjected to various amounts of restoration management to move the habitats towards better quality upland oak or wet woodlands. The aim of the monitoring has been to follow progress in the development of the woodlands before and after proposed management works, which provides a measure of the degree of success in meeting the targets for these BAP habitats.

The study sites selected were considered to be the most representative examples of either upland oak or wet woodlands in the two regions, where management was possible and practical. The selection of individual sites for monitoring was based on consultation with the Woodland Project Officer in each area in 2006.

Several of the sites chosen are managed directly by UU ('in hand') whilst some are managed by tenant farmers, under guidance from UU. Seven of the woods are located within the Estate farms of Croasdale, Hareden, Sykes Farm and Lamb Hill (all in Bowland). One site, Croasdale House (Southern Section) is managed under a Higher Level Environmental Stewardship Scheme (HLS) prescription.

All the woodlands are listed in Table 1 (page 3) and the location of all of the woodlands are shown on Figure 1 (Southern Region) and Figure 2 (Bowland) (A3 figures).The site number indicates the region (S=Southern, B=Bowland), the area or farm (eg. G=Goyt, Cr=Croasdale) and the number of the wood within the area or farm (1-14).

Table 1 *The Woodland Sites*

Region	Location	Site Name	Site Number
Southern	Goyt Valley	Norman Wood West	SGW1
Southern	Longdendale	Landslow Green Wood	SLW2
Southern	Longdendale	Swallow Wood	SLW3
Southern	Longdendale	Didsbury Intake	SLW6
Southern	Macclesfield Forest	Bollin Brook Wood	SMFW1
Southern	Macclesfield Forest	Toot Hill Wood	SMFW2
Bowland	Stocks Reservoir	Bottoms Beck	BSRW2
Bowland	Stocks Reservoir	Board House Wood	BSRW7
Bowland	Croasdale	Croasdale House Plantation (Northern Section)	BCrW1
Bowland	Croasdale	Croasdale House (Southern Section)	BCrW2
Bowland	Sykes Farm	Crag Wood	BSW11
Bowland	Sykes Farm	Sykes Farm Wood	BSW12
Bowland	Sykes Farm	Holdron Castle	BSW13
Bowland	Hareden	Riggs Plantation	BSW14

As woodlands are very long lived habitats, natural succession is naturally a slow process in mature, established woodlands unless there is a specific event such as the uprooting of a mature tree. Some of the management tools used in this project mimic these major natural events (felling non-native species), whilst others are more subtle (eg. 'ring barking', ie. removing a ring of bark from the trunk to kill a tree slowly). The relatively short length of the project means that significant changes may not yet be apparent in the woods where restoration management has taken place.

N

LONGDENDALE

Land @ Ashway Gap

Quiet Shepherd

Pikenaze

Arnfield Moor

Arnfield Farm

Didsbury Intake
SLW6

Hollingworth Moor

Arnfield Farm

Swallow Wood
SLW3

Landslow Green Wood
SLW2

Peaknase Moor (see Blackshaw Farm)

Blackshaw Farm

Legend

Woodland Sites

UU Agricultural Tenancies

1:60,000

Aerial photography: United Utilites pre-2008

Legend

Woodland Sites

UU Agricultural Tenancies and Maccesfield Forest

GOYT

Norman Wood West
SGW1

Land @ Goyt Valley

MACCESFIELD FOREST

Land @ Goyt Valley

Toot Hill Wood
SMFW2

Bollin Brook Wood
SMFW1

1:50,000

OVERVIEW MAP

Huddersfield

Manchester

Sheffield

Norman Wood West
SGW1

Macclesfield

Buxton

Toot Hill Wood
SMFW2

Bollin Brook Wood
SMFW1

1:600,000

Penny Anderson Associates Ltd,
Parklea, 60 Park Road,
Buxton, Derbyshire, SK17 6SN.
Telephone 01298 27086

Penny Anderson Associates Ltd
Consultant Ecologists

United Utilities,
Bowland Estate Office,
Stocks Boardhouse, Catlow Rd.,
Slaidburn, Nr. Clitheroe,
Lancashire BB7 3AQ

Project: Restoration of upland oak and wet woodland: Five year report 2010

Discipline: Ecology

Title:

Location of Woodland Sites in the Southern Region

Scale	Drawing No.		
1:60,000	Figure 1		
Drawn By: JL	Originator: KL	Date: MAR 2011	
PAA Ref: G:\UNIT08_SCAMP\UNIT08_3_Woodland\Maps\2011		Revision: v1	

360000

370000

460000

450000

Aerial photography: United Utilites pre-2008

Lamb Hill

Halstead Farm

Higher Clough

Catlow

Bottoms Beck , BSRW2

Whitendale Fell

Croasdale

Croasdale House Plantation & Croasdale House , BCrW1&2

Land @ Hollins Farm - Stocks Res

Brennand

Whitendale In-bye

Board House Wood , BSRW7

Phynis Farm

Bill Crag Wood , BSW11

Land at Dunsop Valley

Sykes Farm Wood , BSW12

Sykes

Holdron Castle , BSW13

Riggs Plantation , BHW14

Hareden

Land @ Grindleton Mr Towler

Saddle End

Legend

- Woodland Sites
- UU SCaMP Agricultural Tenancies

N

British National Grid
Projection: Transverse Mercator
False Easting: 400000.000000
False Northing: -100000.000000
Central Meridian: -2.000000
Scale Factor: 0.999601
Latitude Of Origin: 49.000000

ISO A3

0 0.5 1 2 3 Km

United Utilities,
Bowland Estate Office,
Stocks Boardhouse, Catlow Rd.,
Slaidburn, Nr. Clitheroe,
Lancashire BB7 3AQ

Penny Anderson Associates Ltd,
Parklea, 60 Park Road,
Buxton, Derbyshire, SK17 6SN.
Telephone 01298 27086

Project Name: SCaMP Restoration of upland oak and wet woodland: Five year report 2010

Discipline: Ecology

Title:

Location of Woodland Sites in Bowland

Scale	Drawing No.	
1:70,000	Figure 2	
Drawn By: JL	Originator: KL	Date: MAR 2011
PAA Ref.: G:\UNIT08_SCAMP\Maps\UNIT_8-3_Woodland\2011		Revision: A

2 METHODS

2.1 Introduction

Table 2 (below) shows the management activities at each wood as part of this project. These measures are not applied evenly across each woodland but are, of necessity, patchy depending on the distribution of tree species and habitats across the wood. For example, the conifer removal referred to in Crag Wood is located at the very south-eastern corner of the wood and only impacts on a very small area of the monitored site, whilst in Croasdale House Plantation conifers were removed from two thirds of the site.

Table 2 *Management Undertaken in Areas of the Woodlands Monitored*

Site Number	Site Name	Remove non native tree species	Fell conifers	Ring bark	Under-plant with native shrub species	Plant appropriate oak woodland species	Control of rhododendron	Stock-proof fence
SGW1	Norman Wood West						✓	
SLW2	Landslow Green Wood					✓		
SLW3	Swallow Wood	✓				✓		
SLW6	Didsbury Intake		✓					
SMFW1	Bollin Brook Wood	✓						
SMFW2	Toot Hill Wood	✓			✓			
BSRW2	Bottoms Beck	✓	✓			✓		
BSRW7	Board House Wood		✓	✓				
BCrW1	Croasdale House Plantation (Northern Section)		✓					
BCrW2	Croasdale House (Southern Section		✓					
BSW11	Crag Wood		✓			✓	✓	
BSW12	Sykes Farm Wood					✓	✓	✓
BSW13	Holdron Castle (Sykes Fell)							✓
BHW14	Riggs Plantation		✓	✓		✓	✓	✓

2.2 Monitoring Approach

In each of the woodlands the recording methodology included a general description, three fixed canopy quadrats (CQ1[1]) per wood (approx 50m x 50m) and within each of these, three ground flora quadrats (GFQ[2]) (3m x 3m, ie. nine per wood). The detailed methodology is adapted from the Common Standards Monitoring guidance for Woodland Habitats produced by JNCC (2004a). Where possible, surveys were repeated at a similar time each year to minimise seasonal variation.

In addition to the fixed quadrat surveys, a walkover survey was undertaken for each wood in the spring of 2008 to identify any vernal species which may not otherwise have been recorded. In each of the woods, a botanical species list was produced and the abundance of each species estimated using the 'Dafor[3]' scale.

The aim was to survey all sites in 2006, prior to or immediately following management, and then in 2008 and 2010 to record the changes in canopy, sub-canopy and ground flora that occurred as a result of that management. Table 3 (page 6) summarises the surveys undertaken at each of the woodlands from 2006 to 2010, the frequency and timing of which have been dictated by the timing of the management in some sites. As all the management operations across the sites were not undertaken in the same year, not all the woods with the same treatment are directly comparable, as there will be a lag in response/development time to the management, which further complicates any analysis of the results.

In the Southern Region, all sites were surveyed in 2008 irrespective of whether management had taken place or not in order that successional changes (depending on the age of the woodland) or inter-year variation in species abundance could be identified.

1 The three canopy quadrats (CQ) are numbered 1, 2 and 3 in each wood.
2 The three ground flora quadrats (GFQ) are numbered a, b and c in each of the canopy quadrats.
3 Dafor: this is the relative abundance scale for assessing plant cover on a site: d = dominant; a = abundant; f = frequent; o = occasional; r = rare.

Table 3. *Woodlands Survey Summary, 2006-2010*

Site Name	Site Number	Date of Baseline Survey	2nd Survey	3rd Survey
Norman Wood West	SGW1	19.07.2006	08.07.2008	15.07.2010
Landslow Green Wood	SLW2	17.07.2006	13.07.2008	05.08.2010
Swallow Wood	SLW3	03.08.2006	06.08.2008	05.08.2010
Didsbury Intake	SLW6	01.08.2006	07.08.2008	03.08.2010
Bollin Brook Wood	SMFW1	19.09.2006	17.09.2008	15.09.2010
Toot Hill Wood	SMFW2	21.09.2006	18.09.2008	16.09.2010
Bottoms Beck	BSRW2	27.10.2006	19.06.2008	17.06.2010
Board House Wood	BSRW7	26.10.2006	18.06.2008	17.06.2010
Croasdale House Plantation (Northern Section)	BCrW1	19.06.2007	24.06.2009	16.06.2010
Croasdale House (Southern Section)	BCrW2	23.08.2006 & 21.06.2007	13.08.2008 Partial survey	16.06.2010
Crag Wood	BSW11	04.09.2006	13/14.08.2008	11.08.2010
Sykes Farm Wood	BSW12	25.08.2006	15.08.2008	10.08.2010
Holdron Castle (Sykes Fell)	BSW13	04.09.2006	14.08.2008 & 25.06.2009	11.08.2010
Riggs Plantation	BHW14	24.08.2006	11/13.08.2008	12.08.2010

Baseline surveys were repeated at Croasdale House Plantation (Northern Section) and Croasdale House (Southern Section) in 2007 as the quadrat markers had to be replaced.

The specific objectives of the fixed quadrat surveys were to:

- record tree species and ground flora vegetation so that any changes occurring as a result of management could be assessed;
- record other information about the woodland, such as management, presence of any invasive species and any non-woodland habitats of conservation interest; and,
- provide a record of the changes in the canopy and ground flora quadrats using fixed-point photographs.

The monitoring data are provided in an electronic format for UU.

2.3 Evaluation Methods

The main aim of the monitoring is to determine whether the condition of each woodland is improving in terms of its target woodland habitat. This has been undertaken by adapting the JNCC Common Standards Monitoring guidance (CSM) for woodland habitats (JNCC 2004a). Table 4 (below) shows the relevant CSM attributes and targets, which form the focus of evaluation for the woodlands in this project.

These three targets are all closely interwoven and are best addressed by examining the management methods used and their effect on these combined attributes. These targets aim to maintain or improve the balance between canopy and shrub layers, tree age structure, amount of standing and fallen deadwood and extent of open space within each wood. In addition, it is important that the species regenerating are the desirable ones or further management may be needed to weed them out.

Felling of conifers and locally non-native species such as beech (*Fagus sylvatica*) and sycamore (*Acer pseudoplatanus*) in the woodlands will alter the balance of the canopy and the sub-canopy percentage covers. The sub-canopy would be expected to thrive and expand once the canopy has been removed if, indeed, there was a sub-canopy present previously. The increase in light levels reaching the woodland floor would be expected to stimulate seed germination and increase the growth rate of already germinated seedlings, although this could be hampered by vigorous growth and shading effects of ground flora species once the canopy is opened out and enhanced light conditions pertain.

Table 4 *Selected Attributes and Targets for Woodland Monitoring*

Attributes	**Targets**
Structure and natural processes	Maintain or improve the balance between canopy and shrub layers; tree age structure, amount of standing and fallen deadwood and extent of open space.
Regeneration potential	Maintain or improve the level and distribution of saplings and young trees and/or the extent of re-growth from coppice or pollarding.
Composition (trees and shrubs)	Maintain or improve the cover of native and locally native trees and shrubs. Reduction in the extent of invasive species.

The recording of the sub-canopy has been regarded as having two components; shrubs and saplings, the measures of which are used to assess woodland structure. At the whole canopy level, a percentage cover has been given for the total sub-canopy and a separate value for the cover of saplings less than 1.5m high with a 'Dafor' list of the tree and shrub species included in each canopy quadrat. In addition, in the ground flora quadrats (3m x 3m), the number of tree seedlings, less than 1.5m tall but over two years old, and the number of seedlings less than two years old, were also recorded.

As described above, the complexity of the management at the different sites means that direct comparison of results is difficult and statistical data analysis is not appropriate. Descriptive comparison of the data is the most useful method available to express the results, in conjunction with photographs, at this stage in the monitoring process.

Descriptions of each site, the location details for each quadrat, the management undertaken and information on ongoing site specific management has been provided to UU in a separate document for their internal use. In addition all the monitoring data has been tabulated and has also been provided with the overall SCaMP database.

3 RESULTS

3.1 Introduction

Of the 14 woods monitored, where management had occurred, 26 canopy quadrats (out of 42) were directly affected by management. Of the ground flora quadrats (three per CQ), 67 or just over half (53% of the possible 126 GFQ) were directly affected by woodland management actions. Each management operation in Table 2 (page 4) is discussed below with a short explanation of the rationale for the management and examples of the results obtained across a range of sites.

3.2 Removal of Beech

The removal of beech will reduce the locally non-native canopy component of the wood. It is a species that casts a very heavy shade under which the ground flora is generally very species-poor. The dense shade also reduces the ability of tree seeds to germinate and seedlings to survive. By removing beech it would be expected, within the time frame of the monitoring, that there will be a flush in ground flora species and in seedling and sapling numbers.

Results

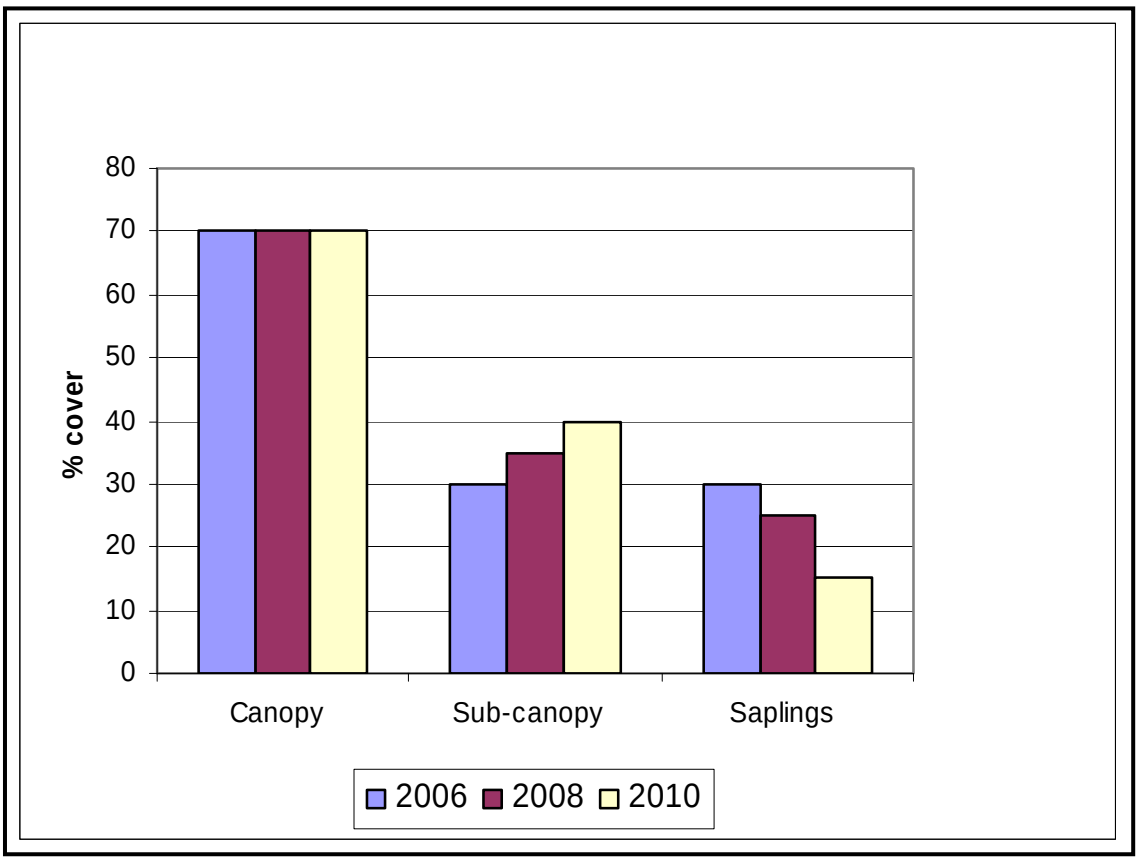
Three of the southern woodland sites, classed as oak woodland, had very mature beech trees felled before the monitoring commenced in 2006 and a further tree was felled in Bollin Brook Wood in 2010. The limbs have been removed and, where access was good (Landslow Green Wood), the large diameter timber has been removed. The trunks have been retained *in situ* to act as perches and to develop over time as standing dead wood for birds and invertebrates.

Photograph 1 (below) shows a large beech tree with felled limbs but the retained trunk, which will develop into standing dead wood. On this site the felled wood has been piled at the base of the very steep slope. Bare ground is very evident the summer after felling showing the lack of ground flora cover under the dense shade cast by the beech tree.

Photograph 1 *Canopy Quadrat 2 in Bollin Brook Wood 2010*

At Landslow Green Wood, a large beech tree was felled in 2006 prior to the first survey. The canopy cover for the whole quadrat remained at 70% throughout the monitoring period whilst the sub-canopy increased from 30% to 35% and then 40% in 2006, 2008 and 2010 respectively. The cover of saplings under 1.5m tall (but over two years old) decreased during the same period from 30% to 25% to 15%. The increase in sub-canopy and decline in saplings indicates that, overall, the small saplings are increasing in size and contributing to the sub-canopy layer but that the recruitment of seedlings into the sapling category does not match the rate at which the saplings are growing. The changes are shown in Figure 3 (below).

Figure 3 *Changes in the Canopy Quadrat – Landslow Green Wood*



The other sites where substantial beech trees have been removed are both in the Southern Region; Swallow Wood and Bollin Brook Wood. The data collected for these sites do not yet show such a clear pattern as that described above.

In two of the three woods where the beeches have been felled, the majority of the seedlings and saplings are beech. In one site this is also true of an adjacent canopy quadrat where there has been no beech felling, but where there are numerous mature beech trees. However, in the third site, the majority of the seedlings are rowan (*Sorbus aucuparia*), with some oak (*Quercus* spp) and ash (*Fraxinus excelsior*) saplings, all of which are a positive response in terms of moving the woodland towards a more natural character.

The ground flora composition of the canopy quadrats where beech has been felled is varied. The ground flora quadrat in Landslow Green Wood (GFQ1a – Figure 3 (page 10)) is, four and a half years after felling, completely dominated by bramble (*Rubus fruticosus*) (100% cover) which has formed a low canopy approximately 70cm above ground under which there remains bare ground. In Swallow Wood (CQ2) there are three very different results shown in Figure 4 (below). Plot Q2a has low levels of bare ground with moderate levels of bramble increasing steadily. Q2b has rapidly decreasing bare ground but little bramble colonisation; creeping soft grass (*Holcus mollis*) is the main species here, whilst in Q2c the bare ground remains high with little colonisation by any species. The situation in Bollin Brook Wood is similar to that in Landslow Green Wood across the three ground flora quadrats, with decreasing amounts of bare ground and increasing bramble (Figure 5 page 12).

Figure 4 *Cover of Bare Ground and Bramble in Landslow Green Wood (Q1a) and Swallow Wood (Q2)*

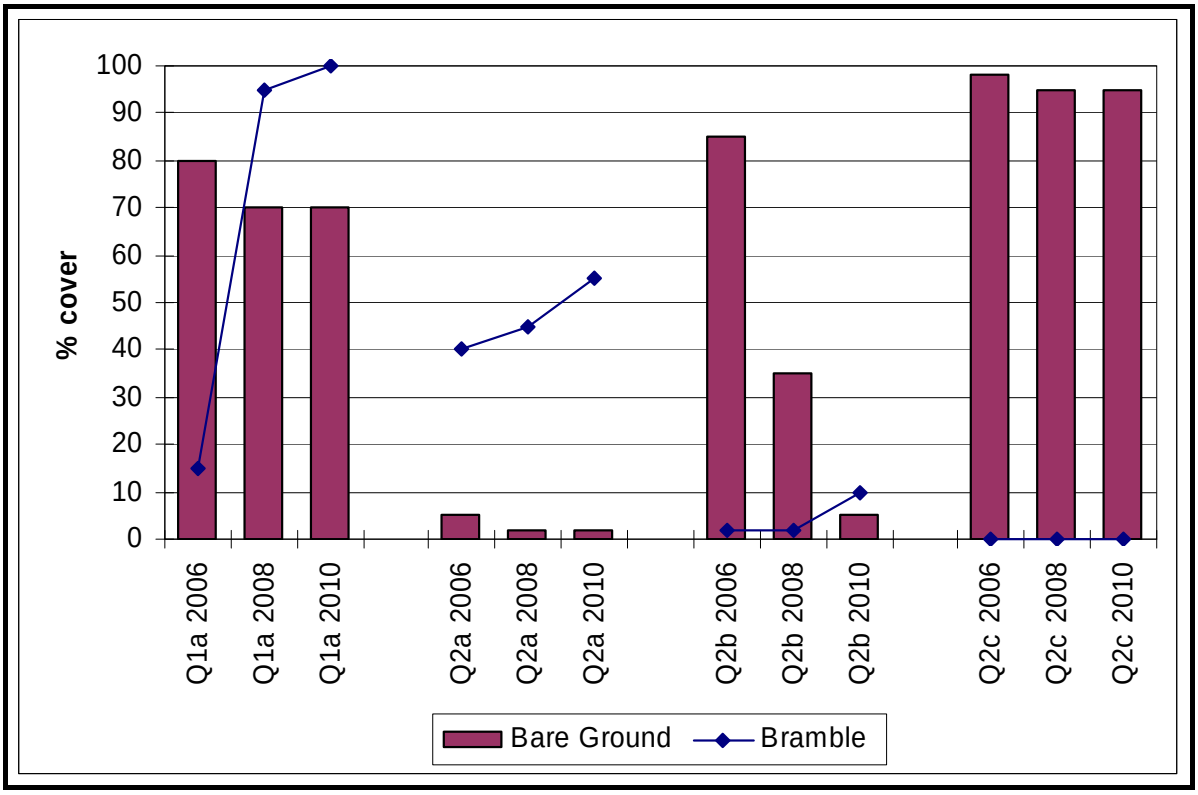
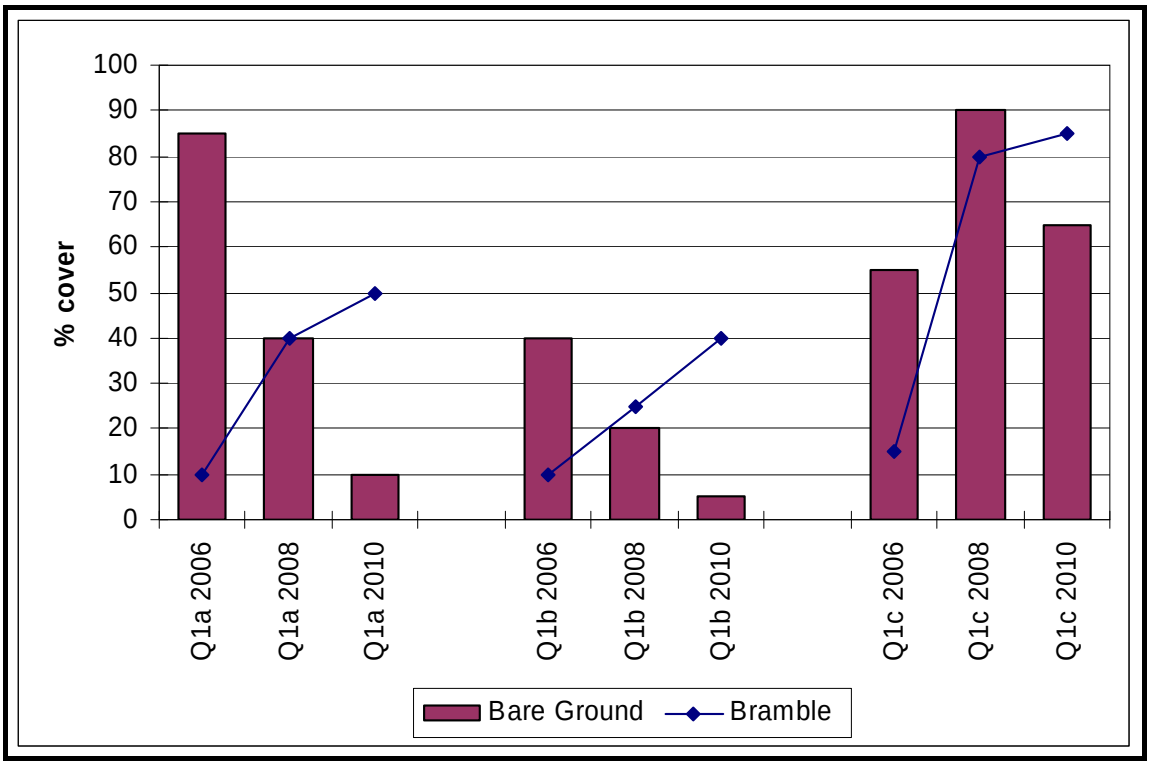


Figure 5 *Cover of Bare Ground and Bramble in Bollin Brook Wood (Q1)*



Conclusion

The physical characteristics of the sites and the initial vegetation in the area all influence the development of the ground flora and the species of seedlings and saplings which develop after the felling of beech trees. In general, the reduction in beech has resulted in an enhanced woodland structure, with good regeneration in some locations. However, on two of the sites it would appear that there will be a need in the wood to remove the non-native beech saplings to favour the native species over time. In some situations, if there is a lack of naturally regenerating desirable species, the additional planting of native trees and shrubs may be warranted in time.

3.3 Removal of Conifers

In most of the monitored woodlands, conifers have been planted with other species or into existing woodlands. The conifers used are non-native species and cast a dense shade when planted for forestry purposes, reducing light to the ground flora and shading out any existing vegetation. The fast growth rate of the conifers also means that they can shade out saplings, sub canopy species and sometimes mature trees too. The removal of conifers will allow native species to regenerate and ground flora vegetation and sub-canopy to establish, as well as allowing mature trees to thrive.

Conifer removal was undertaken across oak woodlands and wet woodland sites in both the Southern Region and in Bowland, with large scale felling of conifer plantations in some situations but also removal of scattered conifers amongst existing broadleaved woodland in others. It is expected that in those sites where the conifer plantation is particularly dense, recolonisation will occur more slowly than in those situations where more light is reaching the woodland floor and where other woodland tree species are already present.

Removal of Conifer Plantations

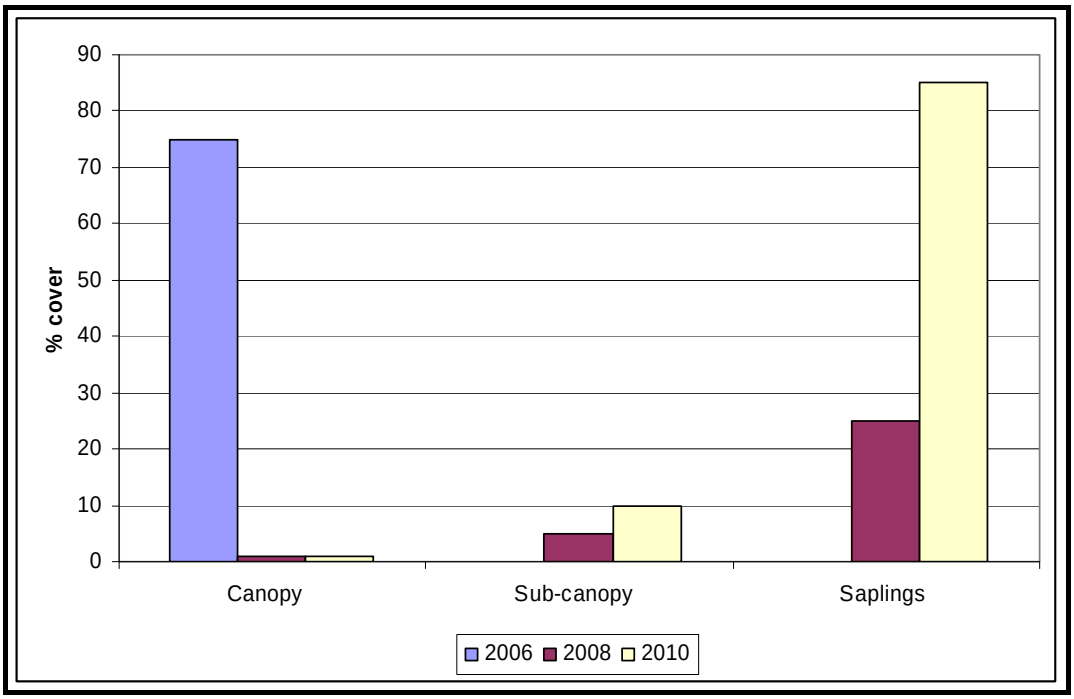
Results

There were three sites where dense conifer plantations were removed:

- in Didsbury Intake, which contained scattered oaks pre-dating the plantation; felling was prior to the 2006 monitoring;
- in Croasdale House Plantation (north) (CQ2 and CQ3), with scattered stunted alder (*Alnus glutinosa*); removal of the conifers took place in the 2008/2009 winter; and
- in Bottoms Beck (CQ3 and GFQ2c), scattered birch (*Betula* spp) and alders still existed within the plantation. Felling occurred here in spring 2007.

Results from the canopy quadrats show that in the period after felling, following the immediate decline as a direct response to the conifer removal, there was no change in the assessment of percentage cover for the canopy, sub-canopy or saplings in the first two of the woods. In the third wood, Bottoms Beck CQ3) there was a very sparse canopy (birch and willow (*Salix* spp) 1%) after conifer removal with an increase in the sub-canopy and cover of saplings the year after felling and a dramatic increase to 85% saplings three years on (Figure 6 below).

Figure 6 *Changes in the Canopy Quadrat – Bottoms Beck (CQ3)*



The saplings at this site were predominantly birch with some planted tree saplings. Photograph 2 (below) shows the dramatic change recorded in CQ3.

Photograph 2 *Changes Over Time at Bottoms Beck (CQ3*)

2006 2008 2010

Despite no change in canopy and sub-canopy cover in the Croasdale House Plantation (Northern section), there was an evident change in the growth form of the alder. When the conifers were standing the alders appeared to have little epicormic growth, but once the conifers were removed this growth increased dramatically (Photograph 3 below).

Photograph 3 *Changes in the Epicormic Growth of Alder at Croasdale House Plantation (Northern Section)*

2009 2010

The ground flora quadrats in Didsbury Intake show a substantial decline in bare ground in all quadrats, this being most marked in the first two years after felling. An expansion in wavy hair-grass (*Deschampsia flexuosa*) accounts for the change in two of the quadrats and bracken (*Pteridium aquilinum*) in the other. The numbers of seedlings in the GFQ are low, ie. three or under in any year, and only one sapling was recorded.

In Croasdale House Plantation (Northern section) the cut timber was not removed from the site but the trunks were cut into manageable lengths and stacked, whilst in other areas very dense piles of brash were created. Where this coincided with the GFQ there has been little change in cover and Figure 7 (page 16) shows the percentage cover of bare ground/timber/brash/needles against the cover of vascular plants and mosses in the different GFQs.

What this shows is that even in one wood, or within a certain area of a wood, the way the vegetation responds to substantial changes will vary. Species which have increased in cover on this site (to over 10%) include creeping bent (*Agrostis stolonifera*), common bent (*Agrostis capillaris*), tufted hair-grass (*Deschampsia cespitosa*), foxglove (*Digitalis purpurea*), creeping soft-grass, soft-rush (*Juncus effusus*), conglomerate rush (*Juncus conglomeratus*), yellow pimpernel (*Lysimachia nemorum*), wood sorrel (*Oxalis acetosella*), rough meadow-grass (*Poa trivialis*) and germander speedwell (*Veronica chamaedrys*). Seedlings only occurred in two of the GFQ, seven in total, and these appeared for the first time in 2010, two years after felling. Of the seven seedlings, six were alder and one hawthorn (*Crataegus monogyna*).

At Bottoms Beck some GFQs had very large numbers of seedlings and saplings (Figure 8 page 16). The figure shows that seedlings appeared in three of the four GFQs a year after the conifers were felled and that these developed into saplings by 2010. Seedling numbers dropped off with the increasing sapling numbers, probably as the shading caused by these would prevent further seed germination. In 2010 two seedlings and two saplings were conifers, the majority of the rest being birch. All four quadrats showed a dramatic fall in bare ground which, in a large part, was due to the cover of the birch seedlings and saplings. This predominance of birch after conifer felling has been noted on many sites (Harmer and Morgan 2009). A few vascular plants reached a cover of 10% or greater in at least one quadrat; these included creeping bent, rosebay willowherb (*Chamerion angustifolium*), cleavers (*Galium aparine*), Yorkshire fog (*Holcus lanatus*), soft-rush, bramble, raspberry (*Rubus idaeus*) and bilberry (*Vaccinium myrtillus*).

Conclusion

The results show clearly that the speed of a wood's response to conifer felling will vary greatly depending on existing vegetation and sub-canopy, seed bank, and whether or not the trunks and brash are left on the site or removed. In all cases, the number of tree seedlings across the areas is increasing and, so far, there are few conifer seedlings amongst them. It may be that seedling establishment at some sites, such as Didsbury Intake, is very slow. Mast years in oak are known to be erratic at altitude and Brockholes Wood, a UU owned but Derbyshire Wildlife Trust managed upland oak woodland nearby, has also exhibited little natural regeneration over the years. The option of planting the desired tree species may need to be considered in the future as at Brockholes after further site assessment.

Figure 7 *The Cover of Bare Ground, Vascular Plants and Mosses at Croasdale House Plantation (Northern Section)*

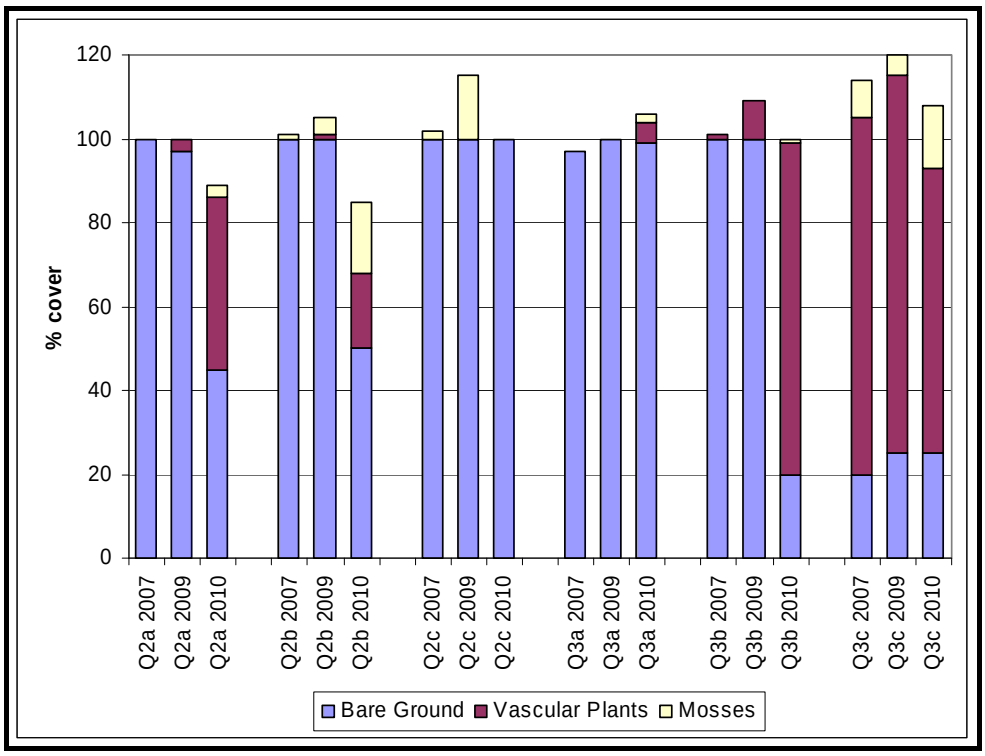
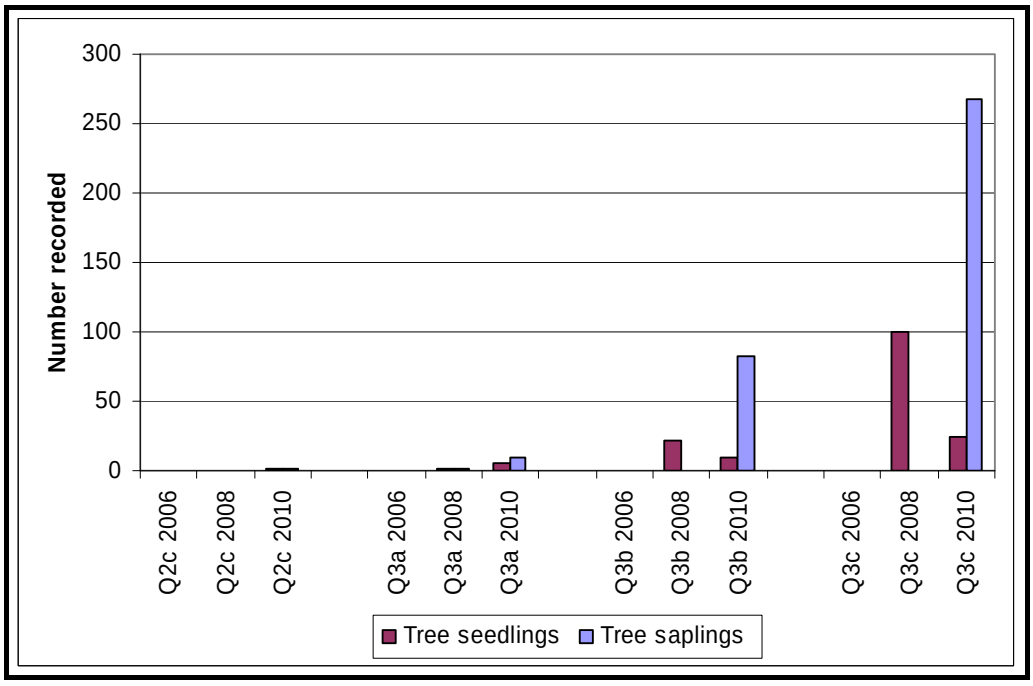


Figure 8 *The Changes in Seedling and Sapling Numbers at Bottoms Beck after Conifer Removal*



Removal of Scattered Conifers

Results

Scattered conifers have been felled in several of the monitored woodlands, with the timber generally left on site and existing broadleaved species retained. In such situations, the conifers have generally been planted further apart than in the large coniferous stands discussed above and more light has reached the ground, resulting in a better developed ground flora.

Removal of conifers will obviously have an impact on the canopy. However, it is expected that this will have less of an immediate impact on the ground flora associated with areas of scattered conifers compared to those in denser stands.

In two of the woodlands, (Board House Wood and Croasdale House (Southern section)) the scattered, felled, conifers were relatively young and located amongst other planted and semi-natural young trees with a grassland ground flora. There is no obvious directional change in the ground flora, seedling numbers or sapling numbers as a direct result of the conifer removal. This is partly due to the fast rate of change exhibited in woodlands of this age and partly due to the varying environmental conditions on the sites. However, both woodlands have been improved by the reduction in the number of alien tree species and by the fact that the existing ground flora has been retained rather than shaded out, as would have normally occurred as the trees matured. The felling has also increased the structural diversity of the woodland and resulted in brash piles which have temporarily created more niches for animal species to explore.

Another two woodlands (Riggs Plantation and Crag Wood) supported small conifer areas which had developed a relatively dense shade and needle layer; both sites have since been replanted with native species (see below). The relatively small patch size and the local occurrence of native tree species and adjacent ground flora have resulted in rapid colonisation of the sites. The results show that of the five GFQs, bare ground has fallen by at least 10% and in one case 60% in each. The results are complicated by the occurrence of large amounts of brash or timber in the quadrats, which prevents ground flora establishment in the short term. At Crag Wood, seedling numbers have increased in all three GFQ from zero prior to felling to 121, 10 and nine three years later; all the seedlings being birch. Far fewer seedlings were seen at the other site, but the felling had been much more recent (2009); the maximum number of recorded seedlings was two in any GFQ and all were sycamore.

Ground flora colonisation has been dramatic with acid grassland species, bracken and overall an increasing moss cover at Crag Wood (despite declines in some woodland mosses). Increases in common bent, tufted hair-grass and wood sorrel occurred in Riggs Plantation. The increase in wood sorrel is an encouraging result as this is a shade loving species which is generally a slow coloniser. Common species to increase after felling are generally ruderal[4] or competitive species which exploit the increased light levels to expand, woodland species if they expand in cover generally do so more slowly.

Ground flora quadrats in the other woods have responded very variably to the felling of the scattered conifers. Some have shown good increases in seedling and sapling numbers, whilst in others these numbers have remained low, grass cover has altered as brash and timber have appeared in the quadrat and some sites have responded with significant increase in bramble, whilst others have recorded little change.

[4] A ruderal plant is a ready coloniser of disturbed ground

Conclusion

Felling scatted conifers has reduced the canopy cover in the treated woods. It has, in many cases, stimulated seedling germination and sapling growth. Despite the cover of timber and brash, most areas have significantly increased ground flora vegetation cover, although much of this is an expansion of grass species and, in a few cases, bramble and bracken. The effects of selective conifer felling are unpredictable depending on factors unique to the wood, but the felling will increase the 'naturalness' of the woodland habitat and encourage an increase in the regeneration potential of the wood. In some cases the regenerating species may not be the desired species and further management may be required on a site by site basis.

3.4 Ring Barking

Ring barking trees is a widely used method of woodland management to reduce the numbers of a selected tree species in a woodland and increase the amount of standing deadwood without using chemicals. The selectivity of ring barking and the lack of disturbance in the woodland following management are both advantageous in semi-natural areas. In the woodlands monitored for this project, alder was ring barked in Board House Wood and sycamore in Riggs Plantation.

Results

The aim of ring barking the young alders in Board House Wood was to thin the very even-aged trees, thus increasing structural diversity and the amount of standing dead wood on the site. In Riggs Plantation, the treated sycamores were mature, but the management aims were the same: to remove the tree canopy and increase standing wood. The death of the trees will form gaps in the canopy which, in turn, allows seedlings to develop and diversify the age range of the woody species in the wood.

In Board House Wood, a proportion of the alder was ring barked in two canopy quadrats in 2006. In one CQ in 2010, a slight decline in the cover of alder was recorded (70% to 65%) with an almost equal increase in ash cover (7% to 10%). In tandem with the decline in alder cover there has been an increase in the standing dead wood units[5] from five in 2006 and 2008 to 10 in 2010. There would be an expectation that seedling numbers or sapling cover may increase with a decrease in alder cover, but there is no evidence of this in the areas where the alder was ring barked yet and, indeed, it may not occur here. The alder area as a whole has low seedling and sapling numbers and this is partly thought to be due to the lack of bare ground and dense cover of greater pond sedge (*Carex riparia*) and associated litter in much of this area.

The sycamore treatment in Riggs Plantation was undertaken in the winter of 2008/09 and only affected trees in one of the canopy quadrats. Although a decline in sycamore cover was recorded in 2010, this is due to selective sycamore felling rather than the death of the ring barked sycamores. There has been no increase in standing dead wood or change in seedling numbers in the ground flora quadrats associated with the ring barking. Notes taken in 2010 stated *'Sycamores which have been ring barked are still producing good leaf cover'*. It would appear that the effects of the ring barking are not yet apparent as was the case for the alder two years after treatment.

Forest Research (2003) suggests that a ring barked tree can take from one to three years to die, during which time it may increase its seed production which can lead to natural regeneration. Certainly this is a timescale compatible with the findings from the current monitoring.

[5] Standing or fallen dead wood units are trunks or branches with a diameter exceeding 0.25m within the canopy quadrat.

Conclusions

The results so far from this study indicate that no visual effect of ring barking can be expected until a minimum of three years after the management has taken place if the species treated are alder or sycamore. It is thought very likely that this delay in response will also be recorded with other tree species.

3.5 Planting of Native Shrub and Tree Species

During the 2004 survey of BAP woodlands in the Southern Region and Bowland undertaken by PAA to prepare restoration recommendations, it was noticeable that the shrub layer of many of the woodlands was poor and, with a lack of a nearby local seed source, the woodlands were unlikely to develop a shrub layer without additional planting of shrub species. One of the main reasons for poor shrub layer development can be a heavy grazing level, both current and historic.

Planting shrubs into an established woodland needs to be undertaken in areas where they will receive enough light to thrive and any planting should ideally be undertaken using mixtures of native species in uneven, irregular clumps, with gaps. Survival rates of trees and shrubs vary for many different reasons including the time in the season when they are planted; the weather conditions after planting (they are particularly susceptible to drought if planted in the spring); degree of shading and competition from other trees and ground flora.

Results

Only one site was planted with a mixture of shrubs and trees rather than just tree species. This site (Toot Hill Wood) is a mature woodland plantation of oak, sycamore, ash and occasional scattered conifers. The mixture planted included frequent oak and ash with occasional hawthorn, birch and rowan. The shrubs were planted between the monitoring in 2006 and 2008 and were all protected by standard tree or shrub guards. Many of the planted saplings have not developed above the height of the guard protection yet as shoots are regularly grazed by deer. Further planting in this area has been suspended until the deer damage can be reduced.

Trees (generally oak) have been planted in clearings and canopy gaps in several woodlands. Where planting has taken place under an existing canopy, the planting has generally been less successful than where large areas of cleared ground have been planted.

At Bottoms Beck, the tree planting was undertaken in spring 2007 directly after the clear felling of conifers and sycamores (Photograph 4 page 20). Alder and ash were planted and protected using rabbit guards and deer shelters respectively.

Tree planting in Crag Wood was limited in extent to a small area of conifer felling which was replanted in spring 2007 with ash and oak protected by tree shelters. Growth of some of the planted saplings has been good and several had emerged from the tubes by 2010 (Photograph 5 page 20). In both photographs, the tube in the foreground is the same one so the substantial growth of this specimen over the two-year timescale can clearly be seen. However, the bracken within this area has also benefited from increased light levels and is starting to shade some of the tubes which may become a problem if it out-competes the saplings.

Photograph 4 *New Tree Planting at Bottoms Beck (2008)*

Photograph 5 Growth *of Planted Trees in Crags Wood (2008-2010)*

2008

2010

Sykes Farm Wood (CQ1) is the only example within the monitoring study of tree planting into existing grassland to extend the woodland area. This site is shown in Photograph 6 (page 21). The aim is to extend the wet woodland up the slope from the stream and alder, oak, ash and hazel (*Corylus avellana*) were planted in 2007. By 2010 many of the saplings were overtopping the tree shelters, especially some of the oak and alder which had grown dramatically in the three and a half years since planting. However, as yet the saplings have not contributed to the data recorded in the monitoring programme, partly because of the small area of planting which falls within the canopy quadrat.

Photograph 6 *Planted Trees at Sykes Wood (2010)*

Conclusion

Two of the sites, Bottoms Beck and Sykes Farm have shown particularly good sapling establishment and growth, whilst on other sites growth has not been as effective. This uneven response could be expected as successful tree growth depends on local circumstances which will differ on all sites. It would appear that on the least shaded sites the saplings have been most successful. However, planting dates and weather conditions at the time of, and following planting, and browsing levels in each wood, as discussed above, could be equally important factors.

3.6 Control of Rhododendron

Rhododendron (*Rhododendron ponticum*) is an introduced species initially planted in woods as game cover. It spreads rapidly and regenerates from small fragments of material. It forms extensive dense thickets which cast a very deep shade, leading to loss of ground flora, bryophytes and lichens and preventing regeneration of trees. In addition to the effect of shade, it may produce biochemicals which can affect other plants, inhibiting the germination or seedling establishment of other species. In addition it is susceptible to *Phytophthora ramorum* which causes sudden Oak Death and has the potential to spread onto some native tree species (Brasier *et al*. 2004). There is the assumption that when it is recorded in a semi-natural woodland, rhododendron should be removed; frequently, removal is followed by herbicide application to kill the stump (Symes and Day 2003).

Results

Four sites have had some rhododendron treatment undertaken as part of the project but only on two sites, Norman Wood West and Riggs Plantation, did the treatment area correspond to the canopy and ground flora quadrats taken in the monitoring programme.

The treatment of rhododendron in Norman Wood West was undertaken prior to the 2006 survey and the stumps are not thought to have been treated with a herbicide as significant re-growth has occurred during

the monitoring period. Canopy quadrat 3 has a patchy and significant cover of rhododendron which is recorded as locally abundant and contributes to the sub-canopy in all years. The cover of rhododendron in the GFQ3a has increased from 20% cover in 2006 to 30% in 2010 (Photograph 7 below).

Photograph 7 *The Change in Rhododendron in Norman Wood West (GFQ3a)*

2008 2010

In Riggs Plantation, the rhododendron was removed from CQ2 in spring 2009 with none recorded in 2010. It is not known whether the stumps here were treated with herbicide or not. In CQ1 the rhododendron was not removed and the monitoring showed that it expanded here by approximately 5% every two years. The rhododendron present in one of the GFQ in this canopy area showed a very weak (2%) increase in cover during the monitoring.

Conclusion

The occurrence of rhododendron in the areas monitored is limited. However, in one situation where it has been removed it has not grown back whilst, in the other, despite removal, there is substantial re-growth which will require further treatment to protect the current woodland value. Such secondary treatment is normal and to be expected according to best practice guidance (Symes and Day 2003).

3.7 Stock-Proof Fencing

As discussed earlier, grazing levels are a key determinant in the ability of a woodland to regenerate itself. A history of high grazing levels by domestic stock, deer, hares, rabbits or smaller mammals leads to a very structurally poor woodland with even-aged woodland trees and a limited sub-canopy or shrub layer. Eventually such a woodland can die out.

Results

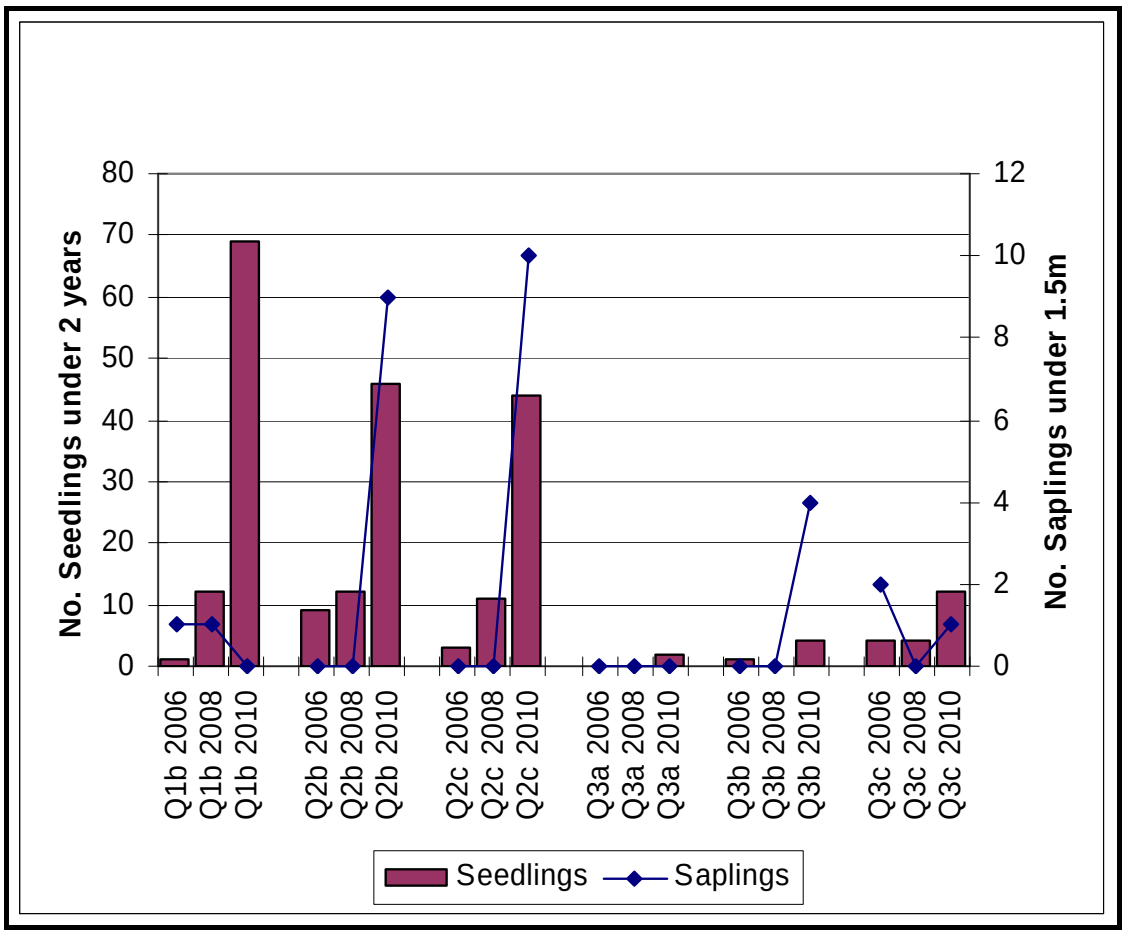
Grazing levels across the woodlands included in this project vary considerably with some sites (Toot Hill Wood) producing vast numbers of tree seedlings in the recorded GFQs (one GFQ had c.750 ash seedlings) but with few reaching the sapling stage (as might be expected owing to competition), and other woods (Bottoms Beck) supporting abundant seedlings (>100 in any GFQ) and translating this into 260 saplings two years on. Most sites are somewhere between the two extremes.

Three woodlands were newly stock-fenced as part of the woodland management programme for this project; these were Sykes Farm Wood - extension, Holdron Castle and Riggs Plantation. These woodlands are all very different.

The extension area to Sykes Farm Wood (CQ1) was stock-proof fenced in 2006 when the planting was undertaken. There was, and still is, very little bare ground in any of the ground flora quadrats as this area supports a dense grassland sward. At a canopy level there appears to have been no change in the percentage cover of the canopy, sub-canopy or cover of saplings between 2006 and 2010. At the GFQ level there has been a maximum of 10 saplings recorded in any quadrat; however, in one GFQ there has been a substantial increase in the number of ash seedlings during the monitoring period. In 2006 there were no seedlings, 11 in 2008 and 57 in 2010; in the same quadrat there has also been an increase in sycamore seedlings from zero in 2008 to 10 in 2010.

There has also been an increase in seedling numbers in many of the other GFQ within the wood, but at much lower levels (Figure 9 below). It is not clear whether the whole wood was re-fenced in 2006.

Figure 9 *Number of Seedlings and Saplings in the Ground Flora Quadrats at Sykes Farm Wood*



The seedling species recorded included sycamore, hazel, hawthorn and ash. As can be seen from the figure, there has been a continuation in growth of some of the seedlings into saplings by 2010. It is anticipated that if this trend continues, the woodland structure will become much more diverse and increase the value of the woodland.

The Holdron Castle quadrats are all part of an upland oak woodland surrounded by moorland, with abundant and locally dominant, heather (*Calluna vulgaris*), bilberry and bracken. The three CQ were included in a much larger fence erected during the winter of 2008. Throughout the monitoring there was no change in the canopy or sub-canopy cover. An increase in the percentage cover of saplings was recorded in 2009 from 2% in 2006 to 5% in 2009 and 2010. In the GFQ, numbers of seedlings and saplings were generally low, less than two in all but one quadrat. In this quadrat there was one seedling in 2006, zero in 2008 and 32 in 2010. Of the 32 seedlings, 19 were rowan and 13 birch. Saplings under 1.5m in the same GFQ totalled 19 rowan saplings in 2010, with none previously recorded. This site is dominated by wavy hair-grass and bilberry, with 30% litter providing possible colonisation gaps for the seedlings to establish. In other areas of the site, dense bracken and tall leggy heather and bilberry significantly reduce the likelihood of seedling germination since they cast a dense shade and produce an equally dense litter layer, which is not ideal for germination or survival of seeds which do germinate.

Riggs Plantation is predominantly a mature sycamore woodland with a grass-dominated ground flora which was fenced in the summer of 2008 prior to that year's monitoring. Other management has also occurred in the woodland in addition to the fencing, complicating the interpretation of any vegetation monitoring results. There were no saplings less than 1.5m tall recorded in any of the fixed quadrats during the monitoring. However, five of the GFQ had seedlings in very low numbers, a maximum of four in any quadrat with the highest numbers consistently in 2010. The seedlings were sycamore, birch, beech and rowan. This site has shown (in the CQ not affected by other management procedures) a reduction in bare ground from 20% to 1% or less in all three GFQs. It is noticeable too that these GFQs did not have any seedlings recorded. It would appear that, at the moment, the reduction in grazing has resulted in a more dominant grass sward and reduced opportunities for seedling germination and establishment in the areas where it has not been combined with other management.

Conclusion

Stock-proofing woodlands is expected to, and appears to have led to, enhanced tree or shrub seedling and sapling establishment in areas of two of the three woods monitored. This does, however, depend on whether there are suitable colonisation gaps remaining once grazing has ceased. Frequently, fencing is combined with other woodland management techniques and results in clearer increases in structural and age diversity within the woodland.

Although the regeneration and establishment of saplings in these woods shows a variable number and density, this is both expected and desirable. Trees and shrubs are long lived and only need one offspring to replace them in their life-time. Saplings also add to the structural diversity of a wood and many will not reach maturity owing to shading and competition with others of the same or different species. This is part of the natural processes of woodland ecosystems. Even the low numbers of saplings establishing is therefore positive, as many of the more dense clusters will not survive over the longer term, however they do add to structural variation in the shorter term. The woodland regeneration process can therefore be seen to have been kick-started in a positive fashion.

4 DISCUSSION

In the previous section the responses of the various woodlands to the different management actions were reported. This suite of management actions was devised to improve the structure and species composition of each individual woodland, with the aim of delivering the highest biodiversity value. The success of this against HLS and BAP targets is discussed below.

As woodland management is a continual process, inevitably there are additional management actions which, if acted upon, would continue to improve the woodland structure and composition. These actions are discussed in Section 4.2 and summarised in Table 5 (page27).

4.1 Assessment Against HLS and UU BAP Targets

HLS Targets

Most of the woodland management work has been carried out by contractors appointed by UU and funded through Biodiversity Capital Project and SCaMP. Only one woodland, Croasdale House (Southern Section), is within an HLS farm agreement under management option HC8 (Restoration of woodland). The aim of this agreement is to benefit broadleaved plantation, upland oak or upland mixed ash woodlands, both of which are BAP habitats. The agreement runs from 2007 to 2017.

The target for this management option is that management should be aimed to deliver the following outcomes:-

- tree species alder, oak, birch and larch (*Larix decidua*) should be present at irregular spacings, with overall canopy cover of between 50% and 100% of the area;

- cover of shrubs hazel, hawthorn and blackthorn (*Prunus spinosa*) should be between 10% and 100%.

From the monitoring results it is clear that the first target has already been met. The canopy cover from the fixed CQs gives and average cover of 78% and includes all four species listed in each quadrat.

However, the sub-canopy cover recorded in the CQs is negligible and averages at 1.3% across the 3CQs. The development of the scrub/understorey layer has yet to be realised. Natural regeneration is low with very few seedlings recorded in the GFQs and therefore planting additional shrub species, (hazel and hawthorn already occur in the woodland) into existing gaps and gaps created by the conifer felling would help this site meet its HLS target. The HLS schedule suggests that planting may be included in future capital work plans.

UU BAP Targets

All the management is aimed at moving the woodlands towards better examples of upland oak or wet woodland. However, this is a naturally slow process with an ongoing management input.

In respect to the oak woodlands (including wet woodland), targets are based upon the UK's BAP reporting system (BARS), targets for the UK BAP and local BAP targets for the Southern Region and Bowland (Peak District National Park 2001 and Lancashire's Biodiversity Action Plan 2006) and the achievements can be summarised below:

Southern Region

- In the PDNP BAP the target is to achieve favourable (or recovering) condition on 1,467ha (56.5%) of semi-natural oak/birchwoods outside SSSIs by 2010. There is also an initiative to create 400ha of new oak/birchwood including at least 100ha of clough woodland in relic sites adjacent to existing ancient woodland by 2010.

- Woodland management has been implemented on 3ha of woodland through SCaMP representing 2% of target area.

- In addition, 243ha of new upland oak woodland has been planted. 61% of the Peak District BAP targets for new native woodland planting have been met through this scale of planting.

Bowland

- The Lancashire BAP target is to identify and encourage the restoration of native species on 20% of the area (c.200ha) of former ancient semi-natural woodland by 2010 and 50% by 2015. Also whilst avoiding other areas of high conservation value, the target is to expand the area of native woodland by 20% (500ha) by 2005 and 50% by 2010.

- Woodland management has been implemented on 80ha of woodland which would lead them toward upland oak/wet woodland restoration, but not all is on former ancient semi-natural woodland sites.

- In addition, 273ha of new native broadleaved woodland has been planted - contributing 21% of the 2010 target.

It can be seen that the areas of woodland management and creation within the SCaMP project have helped to deliver the BAP targets in both regions. UU is undertaking woodland management works in many other woodland sites in addition to those monitored as part of this project.

4.2 Future Development of the Woodlands

The longevity of woodlands, where natural succession is usually a very slow process, means that the results after five years represent only the earliest of indications of change. The woodland management is also a continuous process over a period of time and other management procedures will be required in the woods in the short and longer term.

The management measures taken to date have, overall, resulted in an enhanced structure to the woods, with less canopy dominance, particularly of non-native species. Opportunities have been created for retained, existing trees to develop more rapidly and to increase their crown spread now that the competition has been reduced; the epicormic growth of alders particularly has responded very rapidly to increased light levels.

Reduction in competition and increased light levels will, over time, result in increased seedling germination and sapling growth. It may, however, be necessary to monitor whether re-growth is occurring or whether the grazing/browsing pressure is too high. The regenerating species need to be desirable ones, not a flush of non-native saplings as is developing at one site. Germination and growth of desired species may require further intervention including protecting desirable species from grazing. Alternatively, decisions will need to be taken on whether it may be more effective to plant the preferred species if natural regeneration is considered poor or too slow.

The presence of invasive species such as rhododendron and, in one wood, Japanese knotweed (*Fallopia japonica*), will need ongoing management with the aim of eradicating these species as early as possible

and, where necessary, through the use of approved herbicides to prevent re-establishment and ongoing management costs.

Future management measures for the individual woods that continue the progress to date are tabulated below. In the interests of the woodlands, not all measures can be undertaken at the same time, as woodland management is very much an ongoing process. Some options such as brush cutting saplings and planting additional trees/shrubs will depend on the results of regeneration after the further felling has occurred. In addition, the proposed management options vary greatly in extent in each wood.

Table 5 *Summary of Future Management Options for the Monitored Woodlands*

Site Number	Site Name	Remove non native tree species	Fell conifers	Ring bark	Under-plant with native shrub species	Plant appropriate oak woodland species depending on regeneration	Control of rhododendron	Stock-proof fence	Encourage Natural regeneration	Brush cut beech, sycamore or conifer saplings	Control of Japanese knotweed	Thin native tree saplings
SGW1	Norman Wood West	✓					✓		✓	✓		
SLW2	Landslow Green Wood	✓			✓	✓				✓	✓	✓
SLW3	Swallow Wood				✓	✓				✓		✓
SLW6	Didsbury Intake		✓			✓						
SMFW1	Bollin Brook Wood	✓		✓		✓						
SMFW2	Toot Hill Wood	✓			✓			✓	✓			
BSRW2	Bottoms Beck									✓		✓
BSRW7	Board House Wood		✓									✓
BCrW1	Croasdale House Plantation (Northern Section)		✓			✓						

Site Number	Site Name	Remove non native tree species	Fell conifers	Ring bark	Under-plant with native shrub species	Plant appropriate oak woodland species depending on regeneration	Control of rhododendron	Stock-proof fence	Encourage Natural regeneration	Brush cut beech, sycamore or conifer saplings	Control of Japanese knotweed	Thin native tree saplings
BCrW2	Croasdale House (Southern Section		✓		✓							
BSW11	Crag Wood				✓				✓			
BSW12	Sykes Farm Wood			✓								
BSW13	Holdron Castle (Sykes Fell)					✓			✓			
BHW14	Riggs Plantation		✓	✓	✓		✓					

5 CONCLUSIONS

Even given the short time scale of this monitoring project (in woodland terms) it can be concluded that the structure and native species complement of the woods where management has been undertaken have improved, thus moving the woodland sites towards reaching their BAP targets. The results show only the initial changes in what will be a long-term process. There is scope, with ongoing management, to help the woodlands develop still further towards better quality upland oak or wet woodlands.

In addition to the monitoring study, UU has established 516ha of new woodland, most of which would be classified as predominantly upland oak woodland, but many also support small areas of wet woodland. These have been designed where possible to match locally native woodland with appropriate tree and shrub communities varying where relevant to match the soils found. Small areas of willows and aspen with a few other species have been located in wet areas to develop into new wet woodland and open spaces have been incorporated in all woodlands to permit structural variation and the development of dwarf shrub heath banks or rocky outcrops as glades within the woods. Floristically richer flushes have been included in the woodland but planting avoided in these to maintain their interest.

In the woodland areas where no management has been undertaken, there are either no, or only very minor, changes in the canopy and ground flora vegetation. These changes can be attributed to annual fluctuations in response to the weather, grazing or natural succession at the site and are, by their nature, site specific.

The ongoing management measures tabulated in Table 5 (page 27) are those which would be relevant for the next five years, after which they would need to be re-assessed in response to how each site is developing.

What the monitoring has clearly shown is that, although there are relatively few management operations and the effects of a specific management operation can be predicted, the actual results of each can be very different at different sites depending on the individual site character and conditions.

REFERENCES

Brasier, C.M., Denman, S., Brown, A. and Webber, J.F., 2004. Sudden oak death (*Phytophthora ramorum*) discovered in trees in Europe. *Mycological Research* **108**; pp1108-110. Elsevier.

Forest Research, 2003. *Brash Management on Habitat Restoration Sites*. Report produced for FACT. Forestry Commission Technical Development Branch. http://www.forestry.gov.uk/website/oldsite.nsf/byunique/GGAE-5L3KEE.

Harmer, R. and Morgan, G., 2009. Storm damage and the conversion of conifer plantations to native broadleaved woodland. *Forest Ecology and Management* **258**; pp879-886. Elsevier.

HMSO, 1995. *Biodiversity: The UK Biodiversity Steering Group Report. Vol. 2. Action Plans.* HMSO.

JNCC, 2004a. *Common Standards Monitoring Guidance for Woodland Habitats.* Version February 2004. ISSN 1743-8160 (online).

JNCC, 2004b. *Common Standards Monitoring Guidance for Vascular Plant Species.* Version February 2004. ISSN 1743-8160 (online).

Lancashire's Biodiversity Action Plan, 2006. www.ukbap.org.uk

Peak District National Park Authority, 2001. *A Living Landscape - Biodiversity Action Plan for the Peak District 2001-2011*. Peak District National Park Authority. www.peakdistrict.gov.uk/index/looking-after/bap.htm

Symes, N. and Day, J., 2003. *A Practical Guide to the Restoration and Management of Lowland Heathland*. RSPB, Sandy, Beds.

Penny Anderson
Associates Ltd
CONSULTANT ECOLOGISTS

Park Lea, 60 Park Road, Buxton, Derbyshire SK17 6SN

Registered Office as Above | Registered in England & Wales | Company No. 4223109 | Directors: Mrs P Anderson Mr P Worrall Mr C Anglish