Forestry Commission England

Policy

Restoration of open habitats from woods and forests in England: developing Government policy: evidence.

November 2008

Contents

This document was developed in consultation with colleagues in Natural England and Defra. A previous iteration was reviewed at a stakeholder workshop in September 2008.[1] This final version takes account of advice from that workshop.

Anyone with comments[2] on this document is invited to contact:

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[1] See http://www.forestry.gov.uk/website/oldsite.nsf/byunique/INFD-7K9CPA for a report of the workshop.

Restoration of open habitats from woods and forests in England: developing Government policy: evidence.

"It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so." Mark Twain 1835-1910

What is this about?

This document sets out step two in a nine step process (Annex 1) that Forestry Commission England (FC, "we, us, our") is following to develop Government policy on restoration of open habitats from woods and forests in England. In this document we set out our assessment of the evidence about how restoring open habitats from woods or forests could impact on a set of factors that need to be taken into account in the policy.

During the process we are involving key stakeholders and communicating each step openly through a web-site[3] and participation in internal and external forums. We will also be running a public consultation on the proposed options.

Background.

Through the England Biodiversity Strategy[4] and A Strategy for England's Trees Woods and Forests (ETWF) [5] the Government has committed to developing a policy on restoration of open habitats from woods and forests and a restoration strategy for the FC estate.

So far, we have established principles for the process, defined the policy problem, identified desired outcomes and other issues and set down policy options (Annex 2).

In the Step 1 paper[6] we identified five desired outcomes that might lead Government to support restoration of open habitat from woods or forests. These relate to biodiversity, people's enjoyment of landscape, and cultural heritage. We also identified ten issues that need to be taken into account. These arose from other objectives in ETWF.

In this paper we have changed the issues statements into outcomes statements. We have done this to enable easier weighting for policy appraisal. Annex 2 shows the relationship between the Step 1 outcomes and issues and the outcomes in this paper.

We have also made some other changes to the proposals in the Step 1 paper that appear to make sense following analysis of the evidence. These are noted where relevant.

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[2] Please note that this is not a public consultation but you are welcome to provide feedback. We are planning to launch a public consultation on the policy options in autumn 2008.
[3] www.forestry.gov.uk/england-openhabitats.
[4] DEFRA (2006) Working with the grain of nature – taking it forward: Volume I. Full report on progress under the England Biodiversity Strategy 2006, http://www.defra.gov.uk/wildlife-countryside/biodiversity/biostrat/index.htm
[5] Department for Environment Food and Rural Affairs (Defra) (2007) A Strategy for England's Trees, Woods and Forests, http://www.defra.gov.uk/wildlife-countryside/rddteam/forestry.htm .
[6] Forestry Commission (2008) Restoration of open habitats from woods and forests: Policy development step 1 of 9: fit progress to date into a policy cycle, www.forestry.gov.uk/england-openhabitats.

Table 1: Woodland or forest on potential UK Habitat Action Plan open habitats in England.[7]

Habitat Action Plan	Potential habitat under plantation.		Potential habitat under native woodland		Spatial distribution within England Northern – North of Humber & Mersey. Central – East and West Midlands. Southern – rest.
	Area (ha)	Typically managed for timber.	Area (ha)	Typically natural regeneration, little management, general yield class (GYC) 4.[8]	
Lowland meadows	0	n/a	0		n/a
Upland hay meadows	0	n/a	0		n/a
Lowland calcareous grassland	0	n/a	c.20,000	Scrub.	Mainly southern or central.[9]
Lowland dry acid grassland	c.300	Scots pine GYC 8	c.3,000	Mixed regeneration mainly birch with some Scots pine.	Mainly southern or central.
Purple moor grass and rush pasture	c. 300	Douglas fir and Sitka spruce, GYC 18.	c. 200	Scrub / secondary native woodland	Plantation mainly south west, native woodland in all parts.
Upland heathland (moor)	c.20,000	Sitka spruce GYC 10	0	n/a	Mainly northern.
Lowland raised bogs	c.500	Sitka / Norway spruce, Lodgepole pine GYC 8	0	n/a	Mainly northern.
Blanket bog	c.5,000	Sitka / Norway spruce, Lodgepole pine GYC 8	0	n/a	Mainly northern.
Fens	c 600	Scots pine GYC 6 and poplar, GYC 14.	1,000	Wet woodland	Wet woodland in East England, plantation in northern England.
Reedbed	0	n/a	1,000	Wet woodland	East.
Lowland heathland	c.60,000	Scots pine GYC 12.[10].	c.20,000	Mixed regeneration mainly birch with some Scots pine.	Mainly southern or central.[11]
TOTAL	86,700		45,200		

[7] Figures from national and regional staff in Natural England and Forestry Commission and various studies such as the RSPB's HEAP project, see http://www.rspb.org.uk/ourwork/conservation/advice/heap.asp.
[8] General Yield Class (GYC) is a measure of timber productivity. It is the number of m3 of timber by which a stand grows per ha per year. Some conifers can reach YC22, many hardwoods can achieve just YC4 or 6.
[9] We estimate that 66% of the grassland resource is in southern England.
[10] Much is currently Corsican pine at yield class 14 but guidelines for responding to red band needle blight (see below) make an assumption of Scots pine at yield class 12 more realistic.
[11] We estimate that 75% of the lowland heathland resource is in southern England.

The key question when assessing the evidence is:

"What is the net impact of changing the current landscape of woodland and forest and open habitats into a landscape with some less woodland and forest and some more open habitat?"

The reason for attempting to answer this question is to:

"Develop a clear rationale to guide removal of inappropriate plantations and woodland where other key [Biodiversity Action Plan] habitats …. can be restored and where the benefits of doing so outweigh the environmental and social costs."[12]

We need to understand the nature of the change when we assess the evidence of the likely impact.

The nature of the change.

We need to understand:

- **The kind of woodland and forest that might be removed:** the woodland and forest that might be removed is mainly lowland pine plantation, upland Sitka spruce plantation, birch dominated regeneration and some wet woodland (Table 1). Nearly all these woods are currently providing a range of public benefits. The plantations tend to be managed for multiple-objectives including timber production. The birch and wet woodlands tend to have little active management. Most of the woods or forests that might be removed are either in the northern uplands or southern and central lowlands.

- **The amount of woodland and forest that might be removed and the rate of removal:** The amount of woodland or forest removed and the rate at which it is removed depends on policy. At this stage the best we can do is supply a reasonable range and identify some useful points in this range against which to assess the evidence on impact (Table 2). To assess likely rate we have assumed that policy will be deliverable over 10-15 years, the timescale of ETWF. There are about 130,000ha of woodland or forest on potential open habitat (Table 1). However, this level of woodland removal over the timescale of the policy is unlikely.

- **Higher:** The total woodland or forest that could be removed to achieve relevant HAP targets is 30,239ha from 2005 to 2015 (Table 3). 30,000 ha over 10 years or 3,000ha per year therefore forms the higher point of reference for this analysis.

  For all but fens, reedbeds and lowland heathland the HAP targets have modest implications for woodland removal. This is because some HAPs do not set expansion or restoration targets or focus on expansion from improved grassland or arable rather than woodland. However, we have used the HAP targets to set an upper scale of woodland removal across all habitat types. See Annex 3 for more detailed discussion.

- **Intermediate:** Below we calculate the threshold rate of woodland removal above which there is a risk that England could be in net deforestation as 1,100 ha per year. 1,100 ha per year or 16,500 ha is therefore the intermediate level.

- **Current:** the current rate is 500 ha per year or 7,500 ha over the policy period.[13]

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[12] From ETWF

- **Lower:** There are 11,351ha of open habitat SSSI currently not in target condition that could be remedied by woodland removal (Table 4). Under current practice open habitat restoration projects result in retention of about 49% of the woodland on site (Table 5). A minimum scale of woodland loss is therefore 5,600ha or 370ha per year.

Note that these figures do not necessarily reflect the outputs of a set of policy options.

Table 2: Scale and rate of woodland removal to illustrate analysis of evidence for a policy on restoration of open habitats from woods and forests in England.

	Scale (ha)	Rate (ha per year) over 10 - 15 years	Comments
Higher	30,000	3,000	Based on HAP targets
Intermediate	16,500	1,100	Based on avoiding net deforestation.
Current practice	7,500	500	No national policy.
Lower	5,600	370	Based on SSSI condition and 49% woodland retention per project

Table 3: Maximum potential direct contribution to open habitat Habitat Action Plan targets through removal of woodland and forest.

Habitat Action Plan (HAP)	**Maximum potential contribution to 2015 HAP targets by removal of woodland (ha). Removal would occur over 10 years: 2005 – 2015.**			
	Restoration target		**Expansion target**	
	Plantation	**Native wood**	**Plantation**	**Native wood**
Lowland meadows	0	0	0	0
Upland hay meadows	0	0	0	0
Lowland calcareous grassland	0	726	0	0
Lowland dry acid grassland	0	285	0	0
Purple moor grass and rush pasture	0	128	0	0
Upland heathland (moor)	0	0	0	0
Lowland raised bogs	500	0	0	0
Blanket bog	HAP target not set	HAP target not set	0	0
Fens	600	1,000	0	0
Reedbed	0	0	0	1,000
Lowland heathland	0	20,000	6,100	0 (assuming no mature native woodland is removed)
TOTAL	30,239			

[13] Based on felling licence returns.

Table 4: Open habitat SSSI in unfavourable condition that might be remedied by woodland removal.[14]

Habitat	Area SSSI (ha)	Area of SSSI in unfavourable no change, or unfavourable declining	Area SSSI in unfavourable no change or unfavourable declining condition due to reasons that might be rectifiable by woodland removal ("inappropriate scrub control" or "inappropriate woodland management")
Blanket Bog	176,140	51,081	2,373
Fen	19,515	7,904	367
Lowland Raised Bogs	8,949	3,624	168
Reedbed	5,388	1,972	92
Lowland heathland	48,290	8,451	4,551
Upland heathland	179,912	52,174	1,000
Lowland calcareous grassland	42,701	4,315	1,322
Lowland dry acid grassland	7,209	1,929	591
Lowland meadows	10,927	2,395	734
Upland hay meadows	1,470	117	36
Purple moor grass and rush pasture	3,974	385	118
	504,475.00	134,346.76	11,351.00

Table 5: % woodland removal by projects for restoring or expanding open habitats from woods or forests.[15]

Proposal	**Total initial area (ha)**		**Area of woodland for permanent removal (ha).**		**% of woodland for permanent removal**	
	Site	**Woods**	**Initially proposed**	**Eventually approved.**	**Initially proposed**	**Eventually approved**
Bradfield Woodlands	200	200	153	69	77	35
Broadwater Warren	180	177	116	n/a	66	n/a
Cam Fell	200	200	200	n/a	100	n/a
Dunwich Forest	514	514	37	37	7	7
Esher Common	358	316	85	23	27	7
Farnham Heath	164	164	135	105	82	64
Foxbury Plantation	150	150	125	105	83	70
Grimstone Warren	60	60	60	60	100	100
Sandy Warren	60	60	?	36	?	60
Three Stone Burn	300	300	300	n/a	100	
				Average	71	49

- **The kind of landscapes that might result:** under current practice these will tend to be open habitats with a scattering of trees at 5 – 15% cover in line with definitions of

[14] Figures from Natural England Site Information System (ENSIS) database supplied by Natural England staff.
[15] Figures from returns by Regional Directors on various open habitat projects referred for Environmental Impact Assessment or screening in the past 5-years. All plantation woodland.

favourable condition for SSSIs (Table 6). Favourable condition, while it sets a benchmark, may be applied differently outside SSSIs, e.g.: higher levels of canopy cover may still be considered good conservation management. Depending on policy they will be associated with smaller or larger areas of retained woodland. Current practice results in about 49% of the predominately closed canopy woodland being retained, initial proposals prioritising HAP targets tend to be for 30% retention (Table 5).

The new landscapes will be managed predominately for biodiversity conservation although there may be some upland heathland restoration projects on private land where the primary management aim is for sporting.

Table 6: Tree cover on open habitats in definition of favourable condition on SSSIs.-

Open habitat.	**Maximum cover for favourable condition[16] - the trees should be scattered around the site.**
Lowland meadows	5%
Upland hay meadows	5% (1% if non-native)
Lowland calcareous grassland	5%
Purple moor grass and rush pasture	5%
Lowland dry acid grassland	5%
Upland heathland (moor)	10% (1% if non-native)
Lowland raised bogs	5% (margins 10%)
Blanket bog	Lowland: 5% (margins 10%) Upland: 10% (1% if non-native)
Fens	10% (1.5m high)
Reedbeds	?
Lowland heathland	10% wet heath, 15% dry heath (25% where species indicate).

- **The financial cost of change:** the average cost (weighted for area of potential habitat) of restoration of open habitats is £622 per ha using estimates from a costing exercise for the UK Biodiversity Action Plan. [17] (Table 7). The costs for lowland heathland appear low in comparison with those given by Forest Enterprise England (FEE) and Tomorrow's Heathland Heritage. Using these figures increases the average cost to £1,164 per ha. We consider this to be a more realistic estimate and use this figure below.

[16] From Joint Nature Conservation Committee Common Standards Monitoring guidance, http://www.jncc.gov.uk/page-2217

[17] GHK Consulting Ltd (2006) UK Biodiversity Action Plan: Preparing Costings for Species and Habitat Action Plans: Costings Summary Report, https://statistics.defra.gov.uk/esg/reports/bioactionplan/default.asp.

Table 7: Restoration costs of open habitats relevant to policy on restoration from woods and forests.

Open habitat.	Restoration cost (£ per ha)[18] Figures in brackets = revised estimate.	Area restorable from woods or forests (ha)
Lowland meadows	453	0
Upland hay meadows	1,245	0
Lowland calcareous grassland	2,063	20,000
Lowland dry acid grassland	830	3,300
Purple moor grass and rush pasture	517	500
Upland heathland (moor)	150	20,000
Lowland raised bogs	4,975	500
Blanket bog	500	5,000
Fens	575	1,600
Reedbed	817	1,000
Lowland heathland	350 (1,245)[19]	80,000
Average (weighted by area):	622 (1,164)	

The % of the restoration cost that tends to be covered by public funding has not yet been calculated. It seems likely that much of the initial cost for many projects is provided by non-public sources, e.g.: Heritage Lottery Fund, land-fill tax. Despite this, the cost is relevant to Government policy because the non-public funds allocated may be diverted from other activity that accords with Government priorities.

There is also a cost of administering the process of change, e.g.: Environmental Impact Assessments (EIA) are estimated to cost Government about £25,000 each with a similar cost to the applicant[20]. A review of terrestrial HAP costing found that adding a 20% mark-up to area based land management costs was a reasonable way of calculating total cost[21].

Applying this methodology to the ranges in Table 2 gives costs of £4.2M, £1.5M, and £0.52M per year. For comparison, in 2006 the annual cost of achieving the relevant open HAPs in England was estimated to be £135M per year, funding levels were at about 84% of this.

Open habitats cost about £200ha-1 more to manage than the equivalent area of woodland or forest including timber income foregone.[22].

In summary, restoration and expansion of open habitats from woods and forests could involve 30,000 to 5,600 ha of pine or spruce plantation, wet woodland or birch regeneration. It will not result in tree-less landscapes and may result in mosaics of woodland and open space dependent on policy. These will be managed mainly for biodiversity with some private sporting in the uplands. The rate of change may be from

[18] GHK Consulting Ltd (2006) UK Biodiversity Action Plan: Preparing Costings for Species and Habitat Action Plans: Costings Summary Report, https://statistics.defra.gov.uk/esg/reports/bioactionplan/default.asp
[19] Appears low compared to cost reported by FEE of £1,350ha-1 and Tomorrows Heathland Heritage in Dorset of £1,140ha-1.
[20] Figures from returns by FC regional staff.
[21] GHK Consulting Ltd (2006)
[22] See further discussion under "financial viability" below.

hundreds to thousands of hectares a year. It could cost between £0.52M and £4.2M per year, the landscapes that result will be more costly to manage.

The evidence on the likely effect of this kind of change on the outcomes is summarised below. The order in which the outcomes are presented reflects the order in which aims are presented in ETWF, not any assessment of relative weight for appraisal.

Likely impact on outcomes.

We have assessed the evidence of impact against 16 factors organised according to ETWF theme. Our thinking is set out below and summarised in Table 8.

A sustainable resource.

Financial viability.

Outcome: Management of the landscapes that result from restoration of open habitats is financially viable in the long-term.

Likely impact of restoration of open habitats from woods and forests: A negative impact. The open habitats are more costly to manage than the woods or forests from which they arise.

Evidence: Most open habitats require periodic intervention to remove natural regeneration of woodland or regular grazing. Open habitat management costs are in the order of £70 - £800ha-1 per year with an average of about £188ha-1per year.[23] Permanent removal of woodland and trees will also remove a source of income on those sites where management includes production of harvested wood products. Income foregone due to loss of timber ranges from -£13 to +£147 per ha per year. Taking into account before and after costs of management, income foregone from harvested wood products, and forest management costs saved (e.g.: restocking costs) net open habitat management costs are likely to be in the order of £175-£336 per ha per year. A figure of £200 per ha per year net cost appears to be widely accepted.

Sources of funding for open habitat restoration projects are rarely long-term and usually focussed on one-off costs. Sources of funding for long-term maintenance are limited.

The dominant source of funding for long-term maintenance is Higher Level Stewardship (HLS) administered through the Rural Development Programme for England (RDPE). HLS agreements are made for a ten-year period and funding of £200 per ha per year is typically available for open habitat maintenance. The maximum HLS budget is likely to be £200M per year but the English portion of the UK Biodiversity Action Plan will cost £430M per year of which about £324M per year is deliverable via Environmental Stewardship. The current budget is therefore not sufficient to fully address all the scheme objectives.[24] A map-based approach to targeting is in production to resolve this challenge.

[23] Figures from FEE study of Sherwood and Lincs Forest district.
[24] Defra – Natural England (2008) Environmental Stewardship Review of Progress.

Table 8: Impact of restoring open habitats from woods.

ETWF theme	Outcome	Likely impact	Comments
A sustainable resource.	Financial viability.	Negative	Net cost of management £200ha per year.
	Keeping to Government commitments on woodland cover	Negative / little impact	Negative if net deforestation – threshold rate of restoration 1,100ha yr-1?
Climate change.	Resilient ecological communities.	Positive	Mosaics of woodland and heath may be useful.
	Carbon balance.	Negative	Reduction in long-term average carbon store and loss of potential for abatement of carbon emissions due to substitution amounts to 457tCO_2 per ha of woodland removed over 100 years.
Natural environment.	Positive trends in populations of open habitat species.	Positive	Mosaics of woodland and heath may have beneficial impact for many species.
	Quality of life and landscape.	Little impact	Provided landscape design guidelines followed.
	Learning about landscape history.	Little impact	Interpretation will do the job.
	Preservation of historic features.	Positive / negative	Positive if guidelines followed, negative if not.
	Commitments on native and/or ancient woodland.	Little impact	Because of policy framework and retention of some woodland in most projects.
	Desired trends in woodland biodiversity not compromised.	Little impact	Provided we can be respond to local conditions. Need to resolve wet woodland.
	Water quality and yield maintained.	Little national or catchment scale impact / local impact vary	Provided guidelines followed.
	Soils	Little national impact / local impact vary	Provided guidelines followed.
	Air, light and noise pollution abated.	Little impact	Trees play significant role via screens rather than woodland blocks
Quality of life.	Positive engagement by local and other users.	Negative / positive	Negative if projects do not use high quality local engagement.
	Access and recreation.	Little impact.	Except temporary local conflict with ground nesting birds.
Business and markets.	Timber sector confidence.	Negative	Regionally negative.
	Rationalisation of low public and private benefit forestry.	N/A	A possible feature of the process.

There may be savings on expenditure on the English Woodland Grant (EWGS) scheme due to removal of woodland. Policy may include using this saving to offset the increased call on HLS by moving funds into the measures relevant to maintenance of open habitat. However, this would require European Union and State Aids approval. It is more likely that any savings in EWGS would be diverted to fund more woodland management, a current policy priority.[25]

Many open habitats, whatever their recent history, are defined as being in unfavourable condition due to lack of appropriate management. We have no systematic national scale evidence for the state of open habitats recently restored from woods or forests. However, feedback from FC regional staff and some studies indicate that there are several examples that are reverting back to woodland due to management difficulties. For example, five years after restoration of seven heathland sites in Breckland none fitted target National Vegetation Classification communities and many stands were dominated by birch, bracken and wood small-reed.[26] In addition, site managers commonly report challenges associated with finding resources for maintenance.

Grazing is a desirable management tool for several open habitats. Grazing tenancies can offset some costs and there is an effective network of graziers in some areas although site managers report difficulties in finding graziers in other areas. However, in practice grazing is not a cheap mechanism for maintenance usually costing more than mechanical methods. Grazing is desirable mainly for its conservation benefit as opposed to it being a cheap way of preventing tree regeneration. Above a certain scale, reported by some site managers as 100 head of livestock for cattle grazing, it can become cost effective. In these examples, the grazing unit can provide enough income for the activity to be economically viable with no more input than the standard agri-environment grants. At lower scales it appears that site managers tend to pay directly for the services of the grazier.

Assuming that the stocking rate is 1 head of livestock per hectare the higher scenario in Table 2 would require 3,000 new livestock per year if all restored open habitat were to be grazed. The most suitable livestock appear to be the hardier rare breeds, e.g.: longhorn cattle. While these assumptions show the hypothetical maximum (e.g.: herds can be moved from one site to another) they demonstrate that it may not be possible to find enough new livestock to apply the preferred management regime of grazing. For example, FEE staff had to source Longhorn cattle from several areas of the UK to generate a 100 strong herd for grazing on the Neroche project at a cost of £1,200 per cow and calf.

There is an interaction between access and management regimes such as grazing and fire. There is evidence that managing access in order to facilitate such management regimes adds significantly to the costs, particularly on lowland heathland, e.g.: additional fencing costs, regular inspection of livestock, regular retrieval of escaped livestock, complex fire management procedures.

Counter evidence / uncertainties: Many open habitats are being successfully managed, e.g.: 83% of SSSI lowland heathland is in favourable or recovering condition (Table 4).

[25] From discussion with our Grants and Regulations staff.
[26] Eycott, AE, Dolman, PM, Davy, AJ (2005) The vegetation of heathland re-creation sites in Breckland five years after felling' report to Natural England, University of East Anglia.

However, this appears to be a function of the additional funding currently available to bring SSSIs into target condition. Thus it is possible to manage open habitat to favourable condition given the resources. However, that areas outside SSSIs are more likely to be in unfavourable condition (Table 9) is evidence that where these resources are not available appropriate management tends not to be in place.

Economies of scale and reduced edge effects can reduce costs. For example, RSPB estimate that the costs of managing heathland is £207 per ha per year for a 20ha heath and £72 per ha per year for a 500ha heath. FEE calculates that the net cost of open habitat can be reduced to £57 per ha per year by focussing on low yield class sites, those where restoration is easiest, and through economies of scale.

Under these cost variations and the scale range identified in Table 2 the additional cost of managing open habitats ranges from £6.2M to £320K per year.

Table 9: Proportion of SSSI and non-SSSI open habitat not in target condition.[27]

Habitat	Total resource (ha)	Area outside SSSI (ha)	Area inside SSSI (ha)	% of SSSI not in target condition	% of non-SSSI not in target condition (estimate)
Blanket Bog	255,308.00	79,168.00	176,140	30	?
Fen	21,927.00	2,412.00	19,515	19	66
Lowland Raised Bogs	10,227.00	1,278.00	8,949	40	?
Reedbed	6,378.00	990.00	5,388	36	?
Lowland heathland	72,331.00	24,041.00	48,290	17	95
Upland heathland	243,929.00	64,017.00	179,912	19	?
Lowland calcareous grassland	53,943.00	11,242.00	42,701	10	72
Lowland dry acid grassland	12,202.00	4,993.00	7,209	27	79
Lowland meadows	20,378.00	9,451.00	10,927	22	84
Upland hay meadows	2,024.00	554.00	1,470	8	93
Purple moor grass and rush pasture	8,734.00	4,760.00	3,974	10	71
	707,381.00	202,906.00	504,475.00	33	80

Continued wetting can also reduce tree regeneration in many peatland habitats. In practice all will experience encroachment by trees except in some habitats such as reedbed if water levels are kept high.[28]

[27] From Natural England (2008) State of the natural environment: resource documents, http://www.naturalengland.org.uk/sone/resourcedocs.htm, figures updated to October 2008.
[28] Anderson, R (in preparation) Restoring afforested peat bogs - results of experiments and implications for practice, Forest Research.

There are some projects that have found outlets for open habitat produce, e.g.: heather bales, small round wood for wood fuel, conservation grade meat. These are a possible way of offsetting some of the costs and practitioners are working on new products and outlets.

Much of the cost of managing open habitats appears to be associated with maintaining the land to static definitions of favourable condition. Evidence elsewhere in this paper suggests that desired outcomes associated with restoration of open habitats may be delivered effectively by a more dynamic attitude to land management. It may be that managing land more dynamically (e.g.: allowing birch regeneration on some parts of a site for 20 – 30 years) may allow desired outcomes to be delivered for less resource.

We do not know how much woodland removal would have to take place before the viability of management of associated woodland or woodland remaining elsewhere would be compromised. Small areas of woodland tend to be less viable than large blocks. A figure of 10ha has been quoted as a minimum viable size for woodland from a biodiversity perspective[29], a minimum of 2ha for plant biodiversity has been quoted[30]. A range of FC staff contacted suggested 5ha as the minimum for cost effective management.

Monetising costs and benefits: It is feasible to calculate the change in net cost of land management for most situations.

Possible indicators for policy evaluation:

- % of open habitat SSSIs in favourable or unfavourable recovering condition.
- Net cost of managing land following restoration.
- % of open habitats restored from woodland and forestry with Higher Level Stewardship or other equivalent resourced management plan in place.

Implications for policy: Should more open habitat be restored when it is already a challenge to manage what there is already? Could restoring more in the right place make it easier to manage what there already is? Do the potential benefits outweigh the increased cost of management? Should we be worried if some open habitat restoration projects regenerate back to woodland?

Changes since Step 1[31]: the SSSI indicator is suggested to shed light on long-term viability in practice.

Commitments on woodland cover.

Outcome: The UK Government is able to demonstrate fulfilment of international commitments to sustainable forest management, especially maintaining net woodland cover.

Likely impact of restoration of open habitats from woods and forests: A potential negative impact if rates of permanent woodland loss due to restoration go above a threshold, currently thought to be 1,100ha per year

[29] Woodland Trust (2000) Expanding our horizons. In discussion of minimum area for biodiversity, 10ha is suggested figure for some species in lowland England, figures up to 500ha are quoted for other species and situations.

[30] Peterken, G *(*1981*)* Woodland Conservation and Management

[31] See Forestry Commission (**2008**) *Restoration of open habitats from woods and forests: Policy development step 1 of 9: fit progress to date into a policy cycle*, www.forestry.gov.uk/england-openhabitat .

Evidence: The UK Government has international commitments to avoid deforestation associated mainly with supporting efforts to combat climate change. Examples of such commitments include:

- The United Nations Climate Change Conference in Bali (2007) a 'Decision on Deforestation' acknowledged that deforestation contributes to greenhouse gas emissions and that there was an urgent need to reduce emissions from this source. Although aimed at developing countries the decision also signalled a clear need for developed countries to lead by example.
- United Nations non-legally binding instrument on all types of forests that sets out strengthened commitment to implementation of sustainable forest management including reversing the loss of forest cover. It refers to all types of forest and reaffirms the special needs of countries with fragile forest ecosystems, including those of low forest cover countries.[32]

High standards of woodland management[33] and pattern of net increase in woodland area for the past 80 years in the UK appears to help the UK Government's credibility in international negotiation on climate change and forestry The area of woodland is included in one of the contextual indicators of sustainable development for the UK Government Sustainable Development Strategy 2005.[34]

Woodland cover in England has risen from an all time low of 5% (680,000 ha) early in the 20th Century to the current figure of a little under 9% (1.1 million ha), but is still one of the lowest in Europe. Changes in woodland cover are measured through the National Inventory of Woodland and Trees (NIWT)[35]. The definition of woodland or forest in the UK agreed under the Kyoto protocol is:

- a minimum area of 0.1 hectares;
- a minimum width of 20 metres;
- tree crown cover of at least 20 per cent, or the potential to achieve it; and
- a minimum height of 2 metres, or the potential to achieve it.

Permanent removal of woods or forests to create open habitat could be measured as deforestation under UK definitions, even though open habitat restoration projects so far have rarely removed 100% of woodland. Open habitat restoration that results in changes in tree cover that go below these thresholds over an area or more than 0.1ha and 20 metres minimum width will register as deforestation.[36]

The rate of expansion between 1998 to 2007 was about 3,000ha per year but in 2007/08 it was just 2,388 ha.[37]

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[32] United National General Assembly (2007) Non-legally binding instrument on all types of forest, resolution 2007/40.
[33] e.g.: in 2001 the UK was the first country in the world to have all its state forests certified, see http://www.panda.org/about_wwf/how_we_work/gifts_to_the_earth/browse_by/index.cfm?gift_id=363&ignorehidden=1.
[34] http://www.defra.gov.uk/sustainable/government/progress/national/index.htm
[35] http://www.frcc.forestry.gov.uk/forestry/hcou-54pg9u.
[36] NIWT maps down to 0.5ha. The estimate to 0.1ha will be achieved statistically.
[37] Expansion figures from Forestry Facts and Statistics http://www.forestry.gov.uk/forestry/infd-7aqdgc.

The rate is uncertain due to difficulties in measuring expansion by means not controlled by Government. Indeed, the figures for expansion since the last NIWT reported in 1995-1998 take no account of conversion from or to other land-uses.

The Countryside Survey 2007 suggests that woodland cover in England increased by 51,000 ha between 1998 and 2007, a rate of expansion of 5,700ha per year.[38] Note the survey is based on a limited sample.

The impact on the outcome becomes negative if the rate of deforestation caused by restoration of open habitats approaches the rate of expansion, i.e.: if we switch to a net deforestation situation.

Absolute deforestation rates in Great Britain (GB) have been estimated at about 1375ha per year. About 75% or 1030ha per year is thought to come from England.[39] The Green house Gas Inventory (see below) reports deforestation in England in 2006 of 1,040ha per year, projected from data for 1991 to 1999. There is considerable uncertainty (e.g.: over woodland lost to development) with reasonable estimates for GB ranging from 500 to 3000ha per year, i.e.: the real rate could be more than twice the estimated rate.

The system for measuring changes in woodland area in the UK is being upgraded to the "National Forest Inventory" (NFI) and better figures will be available in late 2009 after which any threshold could be revisited. For now, a figure for the threshold could be calculated as:

- The 2007/08 estimate of woodland creation of 2,300ha per year less 1.2 times the estimate of deforestation (1.2 * 1,040 = 1,248).
- Equals: 1,100 ha per year maximum rate of deforestation through open habitat restoration.

The assumptions in Table 2 show that the rate of deforestation could range from 3,000 – 370ha per year. This shows that open habitat restoration could conceivably result in net deforestation and therefore that this outcome is a live issue for the policy.

We welcome discussion of whether this is a reasonable threshold, the principle of setting maximum rates based on this outcome and the mechanism by which such a threshold could be applied to policy.[40]

The higher range rate of 3,000ha per year is based on an assumption that removal of woods and forests contributes a high proportion of HAP targets for restoration and expansion of open habitat from woods and forests. If the threshold rate of 1,100ha per year were applied removal of woods and forests would contribute about 37% of the targets. Interestingly, estimates of the total area of lowland heathland that could be brought into favourable condition by woodland removal show that 36% of the lowland heathland HAP target for restoration could be contributed by this means (Table 10).

Counter evidence / uncertainties: Rates of deforestation and afforestation by mechanisms not controlled by Government are uncertain. Whether the reduction in rate of planting in 2007/08 is long-term or a blip is open to debate. We believe that it is long-

[38] Carey, PD *et al* (2008) Countryside Survey, UK Results from 2007, Centre for Ecology and Hydrology, http://www.countrysidesurvey.org.uk/reports2007.html.
[39] Estimates of deforestation in England derived from Levy, P and Milne, R (2004) Forestry, Vol. 77, No. 1, Estimation of deforestation rates in Great Britain.
[40] For example, we could amend the threshold rate in accordance with the trend shown in the latest NFI report. The NFI is likely to report at a two or three year interval.

term due to declining funds for woodland creation and increasing costs, greater targeting of woodland creation grants, general budgetary constraints in the RDPE, and wider economic factors. It could, however, be reversed if carbon finance makes a significant impact on woodland planting. There is also uncertainty in the level of woodland encroachment on abandoned agricultural land.

Table 10: Area of open habitats that could be brought into favourable condition by woodland removal (ha).

Habitat	SSSI not in target condition due to reasons that might be rectifiable by woodland removal ("inappropriate scrub control" or "inappropriate woodland management")	Non-SSSI in unfavourable condition that might be rectifiable by woodland removal (where no estimate exists for non-SSSI assume same % as within SSSI).	Area of total resource not in favourable/target condition that might be remedied by woodland removal	HAP targets for achieve condition + restoration by 2015	% HAP target potentially delivered by woodland removal
Blanket Bog	2,550	1,146	3,696	0	n/a
Fen	179	77	257	8,966	3%
Lowland Raised Bogs	175	25	201	8,466	2%
Reedbed	95	18	113	4,680	2%
Lowland heathland	4,551	12,420	16,971	47,000	36%
Upland heathland	1,000	356	1,356	0	n/a
Lowland calcareous grassland	1,309	2,481	3,790	32,762	12%
Lowland dry acid grassland	597	1,209	1,806	17,580	10%
Lowland meadows	737	2,433	3,170	6,559	48%
Upland hay meadows	36	158	194	878	22%
Purple moor grass and rush pasture	122	1,036	1,158	19,323	6%
	11,351.00	21,358.41	32,709.41	146,214	22%

Monetising costs and benefits: It is not possible to monetise this aspect.

Possible indicators for policy evaluation:

- Net change in woodland cover (as defined the NIWT and its eventual successor, the NFI).
- Government funded woodland creation less Government approved permanent woodland loss.

Policy implications: Should we use this outcome as a basis for setting maximum rates of loss of woodland for restoration of open habitats? If so, how do we calculate the threshold? If we do set such a rate, what is the best mechanism to ensure we do not cross it? What is the role, if any, of compensatory planting in delivering this outcome?

Changes since Step 1: Some changes to the two indicators to make them more accurately reflect forest mensuration in the UK and current available data.

Climate change

Resilient ecological communities.

Outcome: Communities of key open habitat species that can cope with threats, particularly climate change, such that biodiversity is not lost.

Likely impact of restoration of open habitats from woods and forests: A positive impact provided guidelines on managing biodiversity to adapt to climate change are followed. The key factor is the development of heterogeneous habitat well connected to other habitat and with some patches of sufficient size to support populations that are viable in the long-term even if relatively isolated. Retaining some woods and forests to develop mosaics of woodland and open habitat is likely to have a positive impact.

Too great a focus on retaining at stasis open habitats that conform to definitions of favourable condition may have a negative impact.

Evidence: Biodiversity faces a number of threats such as development, pollution, and invasive non-native species. Climate change is the most significant of these threats. The response of habitat management to climate change is primarily a response to uncertainty. The top priority actions are to conserve existing biodiversity, reduce sources of harm not linked to climate change, develop ecologically resilient and varied landscapes and establish habitat networks through protection, restoration and expansion.[41] Bigger areas of habitat with larger populations are likely to be more robust. Several open habitat HAPs have identified minimum viable areas (Table 11) and for all habitats increased patch size is regarded as important. However, the evidence on the species outcome shows that for many key open habitat species these large areas of suitable habitat can be supplied by mosaics of open space and woodland (see below).

We should also take into account evidence on the changes that open habitats will face due to climate change. Most of the relevant open habitats are still in decline, although this decline is slowing and some are increasing including lowland heathland (Table 12). Several open habitats appear to be under severe threat due to climate change (Table 13) and for some, such as lowland raised bog and upland heathland it may be necessary to assess long-term survival as part of deciding whether to restore them from woods or forests.

[41] Defra (2007) Conserving biodiversity in a changing climate. Guidance on building capacity to adapt.

Table 11: Target patch sizes for open habitats.

Open habitat.	**Threshold patch size (ha) target in HAP**
Lowland meadows	2
Upland hay meadows	2
Lowland calcareous grassland	2
Lowland dry acid grassland	6
Purple moor grass and rush pasture	2
Upland heathland (moor)	Target not set
Lowland raised bogs	Target not set.
Blanket bog	Target not set
Fens	Target for 2 new landscape scale wetland complexes in England.
Reedbeds	
Lowland heathland	30

Table 12: Trends in open habitats.[42]

Plan name	**Trend**
Blanket bog	Declining (slowing)
Fens	Declining (slowing)
Lowland calcareous grassland	Declining (slowing)
Lowland dry acid grassland	Declining (slowing)
Lowland heathland	Increasing
Lowland meadows	Declining (slowing)
Lowland raised bog	Increasing
Purple moor grass and rush pastures	Declining (slowing)
Reedbeds	Increasing
Upland hay meadows	Declining (slowing)
Upland heathland	Stable

Table 13: Threats to open habitat due to climate change.[43]

Open habitat.	**Threat from climate change**
Lowland meadows	Changes to the timing of the seasons, species composition, and flooding patterns,
Upland hay meadows	Change towards lowland meadow flora.
Lowland calcareous grassland	Shift to more annual plants.
Lowland dry acid grassland	Resilient, changes to more stress tolerant species.
Purple moor grass and rush pasture	Little evidence.
Upland heathland (moor)	Very vulnerable.
Lowland raised bogs	Vulnerable to drying, especially away from west.
Blanket bog	Vulnerable to drying, especially away from west.
Fens	Vulnerable to drying.
Reedbeds	Depends on rainfall patterns.
Lowland heathland	Sensitive, change to acid grassland, loss of wet heath. Increased fire damage. Change in species due to pollution.

[42] Information from UK Biodiversity Action Plan Website, http://www.ukbap.org.uk/ as at 13th Sept 2008.
[43] Derived from Mitchell *et al* (2007).

Counter evidence / uncertainties: While there is strong evidence that patch size is important there is little direct experimental evidence on dimensions required for optimum response and the exact nature of the patch required. The effect of both future changes in climate and the response of ecosystems is uncertain.

Monetising costs and benefits: Little evidence to enable us to monetise the costs and benefits of the impact of habitat characteristics on the resilience of ecological communities.

Possible indicators for policy evaluation:

- Total hectares of open habitats restored from woods and forests since 1994.[44]
- Number of open habitats above a threshold patch size.
- Mean patch size of open habitats.
- Rate of restoration of open habitats from woods and forests.
- Reported trends in open habitats potentially restorable from woods and forests.
- If feasible, we will develop an indicator that combines patch size and connectivity: the extent to which open habitats are connected to each other or by land through which priority species can move.

Policy implications: Restoration of open habitats should concur with Defra guidance on managing biodiversity in response to climate change. What account should we take of the guidance to favour heterogeneity when defining habitat patch size? What is the balance between mosaics of woodland and open habitat and contiguous areas of open habitat conforming to definitions of favourable condition?

Linkages: How would an option enabling mosaic habitats effect the ability to achieve HAP targets? An option that made it harder to demonstrate favourable condition on SSSIs might result in undesirable perverse consequences for the SSSI programme. But is the situation different outside SSSIs?

Changes since Step 1: The initial proposal was: **"Outcome 1, habitats:** Ecologically robust open habitats with secure long-term management regimes in place.

Since Step 1 the evidence we have collated has led us to change the habitat outcome to refer to the resilience of ecological communities. This is to better reflect the importance of climate change adaptation. It is also because of the evidence we have collated for the species outcome (see below) that shows that management to deliver niche requirements may be more important that maintenance of defined habitats. However, the extent, connectivity and management of habitats are still useful indicators of likely success.

Step 1 had indicators on SSSI condition and open habitats with long-term management plans. We now think these are better suited to the long-term viability outcome.

Carbon balance.

Outcome: Woods and forests continue to make an appropriate contribution to the UK Government's international and domestic commitments for reducing carbon emissions.

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[44] Date of publication of the UK Biodiversity Strategy.

Likely impact of restoration of open habitats from woods and forests: A negative impact. This should be set in the context of efforts by the Committee on Climate Change to unlock additional green house gas abatement.. These are part of setting five-yearly carbon budgets for meeting the emissions reduction targets required in the Climate Change Bill.

Evidence: We have analysed three strands of evidence: impact on the UK Green House Gas Inventory under the Kyoto protocol, direct impact on carbon abatement, and emissions caused by management operations during restoration.

Green House Gas Inventory: This includes emissions and sequestration from land use, land use change and forestry activities. The carbon uptake by forests planted since 1922 is calculated by a carbon accounting model, (C-Flow[45]). Forests accumulate carbon (sequestering it from the atmosphere) in their biomass and soils as they grow. When timber is harvested it stores carbon during the lifetime of the timber product.

The amount of carbon contained in woody biomass is calculated from the standing volume of usable timber expanded by a factor to take into account branches and roots. The standing volume of usable timber is estimated from the recorded year of planting and Forestry Commission Yield Tables assuming conventional forest management.

The UK Green House Gas Inventory reports that in 2006 a total of 409,780 ha had been converted to forest from other land uses in England since 1922. This was sequestering a total of 3.32 million tons of CO_2 equivalent ($MtCO_2e$).

If the higher scenario in Table 2 was implemented (25,000 ha more deforestation over a ten-year period) this would represent a 7% reduction in the area afforested in England since 1922. This would correspond to a reported reduction of 0.23 $MtCO_2e$ in the sink strength of woodland and forest over ten years, a 1.5% reduction at UK level.

In addition to the reduction in sink strength, open habitat creation will also be reflected in the emissions related to deforestation. These are reported separately. The reported rate of deforestation for England is a projected 1040 ha per year for 2006 based on records covering the period 1990-1999. This results in emissions attributable to biomass loss of 0.21 $MtCO_2e$. About 500ha of this deforestation is due to open habitat restoration under current practice. Therefore, implementation of the higher scenario in Table 2 would represent an increase in reported emissions of about 0.53 $MtCO_2e$ per year. This is nearly 70% of the carbon uptake in 2006 associated with all woodland planted in England between 1990 and 2006 (0.78 $MtCO_2e$).

Under Article 3.3 of the Kyoto protocol emissions or removals due to afforestation, reforestation and deforestation since 1990 have to be reported. As outlined above, implementation of the higher scenario over and above the current (projected) rate of deforestation would lead to additional emissions of between 0.56 and 0.76 $MtCO_2e$ per year reported under Article 3.3. This is highly significant when placed in the context of UK total submissions under Article 3.3, which amounted to 1.7 $MtCO_2e$ sequestered in 2006.

In conclusion, there could be a significant decrease in sequestration reported due to afforestation, reforestation and deforestation under Article 3.3 of the Kyoto protocol and a relatively insignificant decrease in the reported sink strength of woods and forests in the UK. It should be noted that apart from the small reduction in the sink strength, the main impact under Article 3.3 will be restricted to the period of implementation.

[45] Cannell et al, 1992

Direct impact on abatement: Removal of woods and forests to restore open habitats results in a one-off reduction in the long-term average carbon store on the site of 168tCO_2e per ha[46] of woodland removed taking into account only above ground biomass (Table 14).

In addition, open habitat restoration would also remove the potential for abatement of green house gas emissions through harvested wood products substituting for high carbon products or fuel. If we assume that the harvested wood product is being used as woodfuel (see below for discussion on whether this is valid) we estimate that potential abatement of 289tCO_2e per ha would be lost over 100 years.

The total negative impact on carbon balance of woodland removal can therefore be estimated as 457tCO_2e per ha of woodland removed on average.

The figures for woodfuel substitution above are for illustrative purposes. They assume that all woody biomass is used as woodfuel in co-firing coal-fired electricity generation. This is not the most efficient use of woodfuel in carbon terms nor is it the focus of our Woodfuel Strategy. The assumption has been made for simplicity, because it is a conservative approach and there is an existing market. However, if wood were used as a fuel source for combined heat and power generation the abatement potential would rise by a factor of over three. The reduction in abatement potential could be even greater if the avoided emissions associated with timber substituting for high energy products such as concrete and steel in construction is also considered. However, robust figures for abatement potential due to product substitution are not available. We therefore do not use product substitution to estimate impact in this policy process.

Some of the priority open habitats are on peatland soils. Peatlands store more carbon in their soils than in their vegetation, including trees where they have been afforested. The potential loss of carbon from these stores is significant. This is because of their extent and vulnerability. In the years immediately following planting on peatland the soils emit 7-15t CO_2e per ha per year. Peatland soils under mature woodland or forest emit less than 4tCO_2e per ha per year.[47] with a rate of 1.5t CO_2e per ha per year assumed in the UK Green House Gas inventory[48]. This is more than balanced by sequestration in vegetation due to growing trees. However, the woodland or forest reaches equilibrium and stops sequestering carbon after about 100 years. The soil emissions can carry on for a long-time because peatland soils under closed canopy degrade due to drying.[49] It is anticipated that following restoration, peatland soils will return to sequestering carbon at the rate of 0.7-1.8tCO_2e per ha per year typical of pristine peats. They should continue to do so for many hundreds of years unless environmental conditions become unfavourable, e.g.: too dry. However, peatland soils also emit methane and, in some cases, nitrous oxide. Both of these are more powerful greenhouse gases than CO_2. As a consequence, it is unlikely that any active peatland soil is a net sink for greenhouse gases.[50] The level of methane emissions is lower or zero following afforestation due to the lower water table and resultant aerobic conditions in the top 15-20 cm of soil. The impact of restoration of peatland habitats on this outcome therefore depends on the timescale and site details. Over a timescale of about 100 years we have set the changes in soil carbon sue to restoration on peatland soils at 0. We accept that this pollution swapping (i.e. CO_2 for CH_4), does not account for the long-term loss of soil carbon stocks, but believe that it is the correct approach to take in this restricted assessment of green house gas balance.

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46 Average weighted for area of woodland or forest on potential open habitats, see (Table 1).
47 Haregreaves et al (2003)
48 Milne (2002).
49 Thompson (2008). Carbon Management by Land & Marine Managers, Natural England Research Report 026
50 Byrne et al (2004) EU Peatlands: Current carbon stocks and trace gas fluxes.

Table 14: Changes in long-term average carbon store and potential abatement during restoration of woodland and forest to open habitat (tons of CO2e per ha).[1]

Land use change	Changes in carbon balance on removal of woodland or forest for restoration of open habitats					
	Wood or forest pre-restoration		Restored open habitat		Change on restoration	
	Long-term carbon store	Theoretical abatement due to substitution.[2]	Long-term carbon store	Theoretical abatement due to substitution.	Long-term carbon store	Theoretical abatement due to substitution.
Scots pine general yield class (GYC) 12 to lowland heathland	158	554	18	92	-139	-462
Sitka spruce GYC 8 (thinned) to upland heathland.	106	308	18	92	-88	-217
Sitka / Norway spruce (some Lodgepole pine) GYC 8 (unthinned) to lowland raised bog or blanket bog.	169	264	18	0	-150	-264
Scots pine GYC 8 to lowland dry acid grassland	136	374	18	0	-117	-374
Douglas fir and Sitka spruce GYC 18 to purple moor grass and rush pasture	213	899	18	0	-195	-899
Poplar GYC 16 to fen	393	1,505	18	0	-374	-1,505
Native woodland GYC 4 to lowland calcareous grassland, lowland dry acid grassland or purple moor grass and rush pasture.	261	176	18	92	-242	-84
Native woodland GYC 4 to lowland heathland	261	176	18	92	-242	-84
Native woodland GYC 4 to fens or wet reedbeds.	261	176	37	330	-224	154
	Average weighted by area of land-use change				-168	-289

[1] Woodland figures from Morison, J *et al* (in preparation) Integrated UK Forest Carbon Review: Phase 1 report, Forest Research, figures are provisional. See Annex 4 for a technical summary of how we calculated carbon impacts.

[2] Over 100 years, we have used theoretical abatement due to co-firing of coal with wood as a proxy measure of the impact of product substitution.

Table 15: Changes in carbon balance associated with scenarios for policy on restoration of open habitats from woods and forests in England ($MtCO_2e$ over 100 years)

	High –30,000 ha of woodland removal		Medium – 16,500 ha of woodland removal		Low – 5,600 ha of woodland removal	
	Long-term carbon store	Theoretical abatement due to substitution.[1]	Long-term carbon store	Theoretical abatement due to substitution.	Long-term carbon store	Theoretical abatement due to substitution.
Totals	-5.1	-8.7	-2.8	-4.8	-0.94	-1.6
Grand total	-14		-7.5		-2.6	

Combining the figures in Table 14 and the range of interventions in Table 2 gives a reduction in the long-term average carbon store and abatement potential of between $14MtCO_2$ and $2.6MtCO_2$ over 100 years (Table 15) or between 140 and $26KtCO_2$ per year. This is between 3% and 1% of the total rate of sequestration by woods and forests in England of $4MtCO_2$ per year. The maximum reduction is therefore 0.1% of total carbon emissions for England. This illustrates that the potential magnitude of impact is relatively small on a national scale although comparable with a number of mitigation measures introduced across Government.

Emissions caused by management operations for restoration: The difference in carbon emissions during management operations in woodland or forests compared to open habitats after restoration is considered negligible. However, the way in which restoration is performed could have an impact on carbon emissions. These could be minimised by:

- felling at economic maturity to maximise product substitution,
- not disposing of arisings by burning,
- minimising soil disturbance, and
- not removing stumps from the ground.

Counter evidence / uncertainties: There is uncertainty over average carbon storage for different habitats, woods and management regimes and over carbon characteristics in potential open habitats. Evidence is that yield class and soil type have low sensitivity in terms of changes in long term carbon stocks, and that management regime is more important. However, abatement potential through renewable energy production is far more sensitive, and directly proportional to cumulative production. Forest Research are engaged in a project to capture accurate figures, the Forest Carbon Review[2]. There is little comparable research on carbon stocks in open habitat vegetation and soils. There is uncertainty over how to convert theoretical potential product substitution into realistic product substitution.

[1] Over 100 years, we have used theoretical abatement due to co-firing of coal with wood as a proxy measure of the impact of product substitution.

[2] http://www.forestresearch.gov.uk/website/forestresearch.nsf/ByUnique/INFD-62XH5R

Monetising costs and benefits: There are well established protocols for monetising carbon emissions.

Possible indicators for policy evaluation:

- % of projects that adopt low emissions techniques during restoration operations.
- Change in long-term average carbon store.
- Change in fossil fuel substitution benefits through woodfuel production (as a proxy for product substitution in general)

Policy implications: The impact on carbon balance is not a dominant driver for this policy, either for or against restoration. However, the impact of forestry is comparable to the potential contribution of other sectors so we believe that carbon balance must be taken into account in the policy process and when making decisions about individual projects. The outcome refers to the UK Government's commitments for reducing carbon emissions, currently made under the Kyoto agreement. However, the draft Climate Change Bill requires that all abatement opportunities are explored. Therefore, we should take account of changes in long-term average carbon storage *and* loss of potential abatement due to the use of timber to substitute for other high carbon materials or fuel. In this paper we have used abatement due to use of woodfuel as a reasonable proxy for potential abatement due to substitution of fossil fuels. We do not yet have authoritative figures for potential abatement due to product substitution, e.g.: using timber instead of concrete or steel. These figures are being worked up and we will use them if they become available in time. The question is, therefore: "How can we build in mechanisms to enable us to take account of the impact on carbon balance when making decisions about restoration projects?"

Any option should also support the adoption of practices that will minimise emissions during operations for restoration. How can we best achieve this?

Linkages: The interaction between the carbon and woodland cover outcomes is critical because net deforestation in England might have a significant negative impact on the UK Government's ability to press for reduction in deforestation internationally.

There is another significant role for trees to play in addressing climate change and that is to help in communication on climate change. Any activity that involves permanent woodland removal is likely to have a negative impact on such communication. 62% of respondents to the Public Opinion of Forestry Survey[3] identified "To help tackle climate change" as a reason for the Government to support forestry, the second commonest reason after "To provide places for wildlife to live". 80% of respondents agreed with the statement, "'Trees are good because they remove carbon dioxide from the atmosphere and store it in wood'. 50% agreed with the statement "Cutting down forests and woodland makes climate change worse, even if they are replanted'.[4]

Changes since Step 1: Change to indicator on emissions during restoration operations to remove need to attempt to measure actual emissions. Rationalisation of indicators to long-term average carbon store.

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[3] Public Option of Forestry survey 2007, http://www.forestry.gov.uk/forestry/INFD-5ZYL9W .
[4] Note this last statement is incorrect for most situations and illustrates common misunderstanding.

Natural environment.

Positive trends in populations of species.

Outcome: The declining trend in populations of key open habitat species is halted and if possible reversed.

Likely impact of restoration of open habitats from woods and forests: A positive impact. The magnitude of benefits depends on the starting woodland or forest, the open habitat being restored, subsequent management and other changes such as patterns of recreation. The evidence appears to show that for most key species woodland and forest has a positive role to play and that a mosaic of permanent woodland, temporary open space, and permanent open space will deliver the desired outcome. Much depends on the management regime generating ecological processes that will deliver the niche requirements of priority species.

Evidence: The declining trend for populations of several Biodiversity Action Plan (BAP) species associated with open habitat has reversed with 47% of species stable or increasing and 25% declining (Table 16). These trends are likely to be reflected in non-BAP species.

However, threats remain with most of the habitats in slow decline (Table 12). Note, though that the most biodiverse open habitat with most significance to this policy, lowland heathland, is increasing albeit more slowly than the HAP targets. The general picture is one of recovery in many groups of species but continuing worrying decline in some specialists and continuing vulnerability across the board.[5]

Table 16: Trends in species in England with Species Action Plans identified as linked to open habitat Habitat Action Plans.[6]

Trend	**Count**	**% of species**
Declining (continuing/accelerating)	5	7
Declining (slowing)	8	11
Fluctuating - probably declining	5	7
Fluctuating - probably increasing	1	1
Fluctuating - probably stable	11	15
Increasing	12	17
No clear trend	9	13
Not relevant	3	4
Stable	10	14
Unknown	8	11
	% stable / increasing	**47**
	% declining	**25**

[5] Natural England (2008) State of the Natural Environment.

[6] Information from UK Biodiversity Action Plan Website, http://www.ukbap.org.uk/ as at 13th Sept 2008. Will be updated following closure of the 2008 BAP reporting round.

We have examined evidence from a variety of taxa.

Birds.
For several bird species much of the increasing population occurs in pine plantations managed on a clear-fell rotation, e.g.: woodlark, nightjar, grasshopper warbler, linnet, and yellow hammer[7]. Studies in Thetford Forest by the British Trust for Ornithology show that some bird species traditionally associated with lowland heathland such as woodlark and nightjar appear to have higher populations in recently clearfelled areas of pine plantation than in associated heathland. Indeed, several pine plantations form important components of Special Protection Areas designated for their bird populations, e.g.: Thetford Forest, Thames Basin Heaths. The evidence is that plantations, if they are sympathetically managed, can support populations of birds of high conservation interest, some at higher densities than alternative open habitats. There are, however, some species such as stone curlew and skylark that do not occur in plantations and require large areas of open land, albeit not always semi-natural, e.g.: stone curlew occur on arable fields in East Anglia[8].

Plants.
In contrast to birds, many priority open habitat plants are far less capable of colonising restored open habitat sites. Therefore for plants it is critical that the open habitat being restored still retains much of its soil, hydrology and vegetation (the "critical natural capital") that existed prior to conversion or regeneration to woodland or forest. Many but not all priority plant species can persist in seed banks. Significant populations can survive within forest and woodland areas such as rides and open space in wetter areas.

Lowland heathland plants provide a good illustration. There are about 100 rare or threatened species of vascular plant associated with lowland heathland of which 32 are UK BAP species.[9] Only about 26 of the 100 can be expected to colonise open habitats being restored from land-use where much of the critical natural capital has been lost (e.g.: improved agricultural land) on a human timescale. Most of the priority plant species require permanent heathland habitat, only about 5 can survive in temporary open space. However, only 3 of the priority species are dependent on permanent dry heath, the rest occur in micro-habitats that tend to be present in actively managed heath such as mires, pools, scrapes and lawns. This demonstrates that the management regime is vital for the long-term survival of plant species. The regime must create the disturbance patterns that generate the niches that plants require. There is also evidence that disturbance facilitates dispersal. The optimum form of disturbance appears to be grazing.

Invertebrates.
Invertebrates form the largest group of priority species associated with open habitat. Many are site restricted with limited ability to colonise relying on small scale features such as bare ground and pools rather than the presence of particular vegetation. By contrast, several species of wasp and bee require complex landscapes with a mosaic of habitats.

Amphibians and reptiles.

[7] Fuller, R, British Trust for Ornithology (unpublished) Birds, forest and open habitat – presentation at open habitats policy seminar in Lambourne, June 2007, quoting various published studies.
[8] Species Action Plan Stone Curlew (*Burhinus oedicnemus*), http://www.ukbap.org.uk/UKPlans.aspx?ID=175
[9] Byfield, A, Plantlife (2008) pers. comm.

There are six UK BAP amphibian and reptile species associated with open habitat, particularly lowland heathland. The rarer reptiles are exacting as to site conditions, requiring south facing slopes, tight mosaics of varying vegetation cover, and in the case of the sand lizard, open sandy sites for egg laying. Restoration to open habitats would almost invariably be positive for reptiles, although there will often be a need to retain some scrub and tree cover, and the methods of clearance would need careful consideration. Restoration to open habitats would be neutral to most English amphibian species, but has the potential for negative impacts if substantial areas are removed close to important breeding sites of some species. This is likely in some cases because some kinds of woodland and forest – typically old growth broadleaved woodland - are known to constitute high value terrestrial habitat. Restoration to open habitats would be most beneficial when there is small scale tree removal on the southern side of breeding ponds. Conversion to open habitats would be of major benefit in virtually all cases to the natterjack toad. Fragmentation of habitat into small islands is clearly an issue for rare reptiles and amphibians, since they have limited dispersal.

The general point is that the niche requirements of many priority species can be provided by a variety of land-uses not just the habitat with which they are traditionally associated, provided the management regime is appropriate. It is the management processes that produce the required niches rather than the definition of the habitat that is the key factor in determining population trends[10]. See Annex 5 for more detailed discussion. Patch size and connectivity are still important but it becomes harder to define the boundaries and absolute nature of the patch.

There is also considerable geographical specificity amongst many open habitat priority species, e.g.: assemblages unique to the Brecks heathland. This emphasises a need to address national conservation objectives in a regionally specific way. In other words, we could probably not deliver desired biodiversity related outcomes by developing a single area of open habitat in one place in England.

Counter evidence / uncertainties: Little evidence that integrates woodland and open habitat management from a biodiversity perspective, e.g.: that evaluates the change when moving from one land-use to the other. Exceptions such as stone curlew that need large areas of open undisturbed landscape (although not necessarily semi-natural habitat). Little evidence to enable us to quantify the magnitude of impacts, although there appear to be several relevant local studies that might be comparable. Some species have little data.

Monetising costs and benefits: There is a growing body of evidence and methodologies to enable us to monetise biodiversity benefits. However, there has been little direct work on monetisation of the biodiversity benefits of changing woodland or forest into open habitat. Monetisation would probably require primary research.

Indicators for policy evaluation:

- Trends in populations of UKBAP birds associated with open habitats in England.
- Trends in populations of other UKBAP species associated with open habitats.

Policy implications: Decisions about removal of woodland to restore open habitat should take account of the ability of the woodland to support populations of key “open habitat” species through appropriate management rather than removal. The ability of retained

[10] After Webb, J, BAP Integration Project, Natural England (unpublished) Integrating species into habitats, presentation May 2008.

woodland to complement management of associated open habitat for niche provision should also be taken into account, i.e.: mosaics of woodland, permanent open space, and temporary open space are likely to be beneficial for many species.

Linkages: The evidence presented here led us to develop the Step 1 "habitats" outcome into the "resilient ecological communities" option above. Note, though, that we still believe that patch size and extent of open habitat are important indicators of success.

Quality of life and landscape.

Outcome: Changes in landscape due to restoration of open habitats from woods or forests improve the quality of life of people who experience that landscape.

Likely impact of restoration of open habitats from woods and forests: Landscape character might change significantly through the restoration of open habitats from woods or forests. However, there will be little long term impact on landscape quality, or how it is valued by people, provided that it is carefully designed and implemented.

Evidence: The European Landscape Convention[11] provides a robust and comprehensive policy context. The term "landscape" is defined as "part of the land, as perceived by local people or visitors, which evolves through time as a result of being acted upon by natural forces and human beings." Defra's 'Framework for Implementation' of the Convention[12] stresses the need for landscapes to develop, rather than be preserved, and for local communities to have an influence over the future of their local landscape. Natural England is currently working on a policy document, 'All Landscapes Matter'

Woodland and forests have a significant visual impact on landscapes; many are highly valued in landscape terms[13], but some are considered inappropriate due to their shape, scale, location, composition or management. Larch and pine appear to have positive values as does broadleaved woodland, whereas large even-aged stands of conifers such as Sitka spruce can have a negative value. Large mature trees, diverse species composition, open space within woodland and views of water tend to have higher preference ratings[14]. Above 20% woodland cover incremental change in the amount of woodland appears to have little impact on the social value of woodland in the landscape. There is some evidence that above 60% cover the value is static or possibly decreasing. Shape, structure and design of woodland or forest appear to matter in landscape values.

The magnitude of landscape impact related to woodland will depend on the topography and surrounding land use, as well as the number of viewers, their vantage point and distance from the view. Lowland heathland restoration is likely to be viewed by large numbers of people because the habitat tends to be in densely populated areas, but their vantage point is unlikely to be from an elevated position, so edges, belts and strips of retained woodland will have greater visual impact. Some upland heathland in well visited landscapes such as

[11] http://www.coe.int/t/dg4/cultureheritage/conventions/Landscape/florence_en.asp#TopOfPage
[12] *www.**defra**.gov.uk/wildlife-countryside/issues/landscap/pdf/elc11.pdf*
[13] CJC Consulting (2005) Review of evidence for the formulation of forestry policy in England, http://www.defra.gov.uk/wildlife-countryside/rddteam/ffinfo.htm.
[14] Lee, T (2001) Technical Paper 14, Perceptions Attitudes and Preferences for Forests and Woodlands, Forestry Commission.

national parks will have similar numbers of viewers, but retained belts might have higher negative visual impacts.

There is evidence that humans have an innate preference for certain landscape attributes to do with scale, composition and complexity.[15] For example, people seem to have a preference for the junction between woodland and open ground.[16] This has been borne out recently in GPS tracking studies in the New Forest. Such evidence suggests that restoration of open habitats, with a retained woodland component, could result in higher landscape character preference values.

Restoration of open habitats, by definition, involves reducing tree density. The potential for negative public responses, except possibly when removing large blocks of dense conifers, is therefore high. There is no known research evidence on the impact of deforestation on landscape values, e.g.: before and after studies of perception of value. There are some local experiences that changes in the landscape can result in short term negative responses from those that use it. These responses could be attributed to change in the landscape or a response to some of the negative visual impacts of the process itself, e.g. harvesting debris, rutted rides, or machinery.

Based on evidence that people favour afforestation for landscape benefits, it would be reasonable to assume that deforestation at a landscape scale would result in a significant negative response [17]. Restoration of open habitats, by definition, involves some deforestation with a reduction in tree density to between 5 and 15% for most. In practice open habitat restoration projects where 70-50% of the woodland is permanently removed could leave flexibility to mitigate for potential negative impacts on landscape due to woodland loss, or take opportunities to improve landscape through careful design. Most open habitat projects under current practice involve woodland removal at this kind of scale.

Local tensions created by landscape changes during restoration of open habitats appear to arise mainly from the loss of amelioration provided by woodland on surrounding development. This amelioration invariably comes from relatively small areas of woodland, such as screens beside roads. In addition local tensions occur through inadequate local participation during the decision making process. Much of this can be avoided by high quality participation.

Rate and scale of change are often cited as the most important factors related to open habitat restoration. The scale of change and final landscape pattern must reflect the surrounding landscape scale and underlying topography to be visually acceptable, but pace of change is less critical than ensuring that at any given stage in the process restored areas are well designed and implemented. Well designed retentions of trees and areas of woodland and attention to other mitigation measures during each stage of the process can reduce the negative impact.

Natural England's Joint Character Areas (JCA) system[18] for characterising landscape has as its key indicator the number of JCAs where landscape character is being maintained or

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[15] S. Kaplan. (1995) Review of The Biophilia Hypothesis (S. R. Kellert & E. O. Wilson, Eds.). Environment and Behavior, 27, 801-804.

[16] Kahn, HP and Kellert, SR (2002) Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations

[17] CJC Consulting (2005).

[18] http://www.countryside.gov.uk/LAR/Landscape/CC/jca.asp

enhanced. The scale and nature of landscape change that occurs during open habitat restoration projects should contribute to the maintenance and enhancement of JCAs.

Counter evidence / uncertainties: There have bee no direct studies of changes in social value of landscape caused by removal of woodland or forest to restore open habitat.

Monetising costs and benefits: Not applicable because little/no evidence of impact.

Possible indicators for policy evaluation:

- % of projects to restore open habitats from woodland or forest that result in patterns of landscape change that either maintain or enhance the landscape character as defined by Joint Character Assessment.

Changes since Step 1: A suite of indicators to test reaction to open habitat restoration projects mediated by landscape were proposed. These are no longer considered relevant for evaluation of a national policy because of the evidence of little net impact on social value of landscape. However, landscape is an important issue and the uncertainties outlined above imply that research into changes in perception of landscape value caused by open habitat restoration might be worthwhile. Much of the potential for local concern is caused by inappropriate or poorly managed landscape change. Therefore, the indicators in the “local and other user concerns” outcome are linked to this aspect.

Policy implications: Impact on landscape is unlikely to be a major issue in making decisions about restoration proposals. However, the policy should encourage restoration projects to follow good practice in landscape design and management of change, including public participation. Failing to get these right could have significant negative impacts. Conversely, getting them right could result in local enhancement of landscape’s contribution to quality of life. Part of this good practice will be to plan carefully landscape scale deforestation in areas viewed or used by large numbers of people.

Linkages: Clear links to the local and other user concerns outcome.

Learning about landscape history.

Outcome: People now and in the future can learn through direct enjoyment of the outdoors how history has shaped the landscape.

Likely impact of restoration of open habitats from woods and forests: Little effect on the ability of people to learn how history has shaped the landscape.

Evidence: Some of the landscapes associated with open habitats are important cultural heritage features. However, beyond ensuring that some “type” landscapes are retained (see below) policy on landscape and cultural heritage does not lead us to attempt to restore an imagined landscape that may have existed at a particular point in time. Realising education potential and including involving people are two of the themes of the Government’s policy statement on the historic environment: “A Force for our Future”[19]. Instead, delivery of this outcome can be achieved through interpretation and sensitive landscape design (see above).

Counter evidence / uncertainties: Some stakeholders attach greater importance to reversion to a historically defined landscape.

[19] DCMS (2001) The Historic Environment: A Force for our Future, http://www.culture.gov.uk/reference_library/publications/4667.aspx .

Monetising costs and benefits: Government encourages economic valuation of the historic environment. However, there appears to be little evidence available to enable monetisation of this aspect without primary research.[20]

Possible indicators for policy evaluation:

- Number of interpretation projects for open habitats restored from woods or forests that include landscape history.
- Proportion and number of scheduled monuments in open habitats recently restored from woodland or forest that have some on-site interpretation.

Policy implications: This aspect has little relevance to decisions on whether to restore open habitats. The evidence implies that any policy should encourage good interpretation of landscape history.

Preservation of historic environment.

Outcome: The condition of historic environment features in open habitats restored from woods and forests improves and key cultural and designed landscapes are retained.

Likely impact of restoration of open habitats from woods and forests: Potential for negative impact if guidelines for dealing with the historic environment are not followed . Conversely, the potential impact could be positive if guidelines are followed.

Evidence: Many open habitats, particularly lowland heathland, contain heritage assets .[21] Removal of trees is sometimes the recommended measure to conserve features and archaeological deposits. At other times it is not recommended due to the potential for damage during harvesting and erosion from increased exposure. There is good guidance on how to avoid damage and increasingly good databases of the location and nature of the historic environment in woodland or forest.[22] Following this guidance should avoid damage during restoration projects and could increase access to appreciation of the historic environment

There is a wide range of open habitat landscapes in existence. Those which contribute to historic landscape character should be conserved to maintain the range of examples of historic environments.

Counter evidence / uncertainties: Although survey coverage of the location and nature of historic features is improving there are still gaps. There is high quality systematic evidence on the condition of scheduled monuments and other designated heritage assets but little national level evidence on undesignated features.

Monetising costs and benefits: See above.

Possible indicators for policy evaluation:

- Proportion and number of scheduled monuments not at risk in open habitats restored from woods and forests compared to the number and proportion in woodland as a whole.
- Proportion and number of scheduled monuments that are fully accessible to the public before and after restoration.

[20] Eftec (2005) Valuation of the historic environment, http://www.english-heritage.org.uk/server/show/nav.9091 .
[21] Hawley, G et al (2008) Impact of heathland restoration and re-creation techniques on soil characteristics and the historical environment, Natural England.
[22] See Forest Research on historic environment at http://www.forestresearch.gov.uk/fr/INFD-5W2D8Y.

Changes since Step 1: We have made some minor amendments to the indicators to align the language with English Heritage's "Heritage at Risk" survey[23]. We have dropped the indicator "Number of open habitat projects that are aligned with landscape strategies for cultural and designed landscapes" because this element is captured in the proposed landscape indicator.

Policy implications: Conceivably, a project could include such high risk of damaging historic features that it is not supported. Alternatively, opportunities to improve the condition of historic features may be an added benefit. However, in general this aspect is not a driver for or against restoration. The evidence implies that any policy should support application of good practice for preserving historic features.

Commitments on native and/or ancient woodland fulfilled.

Outcome: The Government is able to keep to commitments in Keepers of Time[24] on area of native and/or ancient woodland.

Likely impact of restoration of open habitats from woods and forests: Little impact if policy is followed.

Evidence: Keepers of Time states, "The existing area of ancient woodland should be maintained and there should be a net increase in the area of native woodland" and "Sustain the total extent of native woodland (ensuring that gain exceed any losses)". Keepers of Time does not set any expansion targets but the HAPs for native woodland have a shared target of expanding the area of native woodland by 2,700ha per year. The current rate is about 3,000ha per year and trends for most UKBAP woodland habitats are positive (Table 17).

Table 17: Trends in UK Habitat Action Plan woodland in England.[25]

Plan name	Trend
Upland oakwood	Increasing
Lowland beech and yew woodland	Increasing
Upland mixed ashwoods	Increasing
Wet woodland	Increasing
Lowland wood-pasture and parkland	Declining (slowing)

The open habitat HAP targets for restoration or expansion could conceivably involve 23,000ha of native woodland at rate of loss of 2,300ha per year. However, this assumes that restoration from woods or forests contributes either 100% of the target or that all the potential open habitat under the woodland is restored. Neither of these is likely. In addition, the bulk of the targets that could come from native woodland are for restoration where the target woodland is likely to be relatively recent birch regeneration. Mature native woodland, which tends to be the most valuable under Keepers of Time is also

[23] http://www.english-heritage.org.uk/server/show/nav.19188
[24] Keepers of Time is the Government's statement of policy on ancient and native woodland, see http://www.forestry.gov.uk/forestry/infd-6h3fvs.
[25] Information from UK Biodiversity Action Plan Website, http://www.ukbap.org.uk/ as at 13th Sept 2008.

unlikely to be a target for open habitat restoration due to the difficulty of successful restoration. The current rate of native woodland expansion is unlikely to be overtaken by native woodland loss due to open habitat restoration.

The policy framework for protecting ancient woodland is clear with an effective mapping system in place. There are some areas where ancient woodland is closely associated with potential open habitat (e.g.: birch dominated ancient woodland on sandy soils in High Weald) but these can be managed as ancient woodland and still deliver many of the desired outcomes for open habitats.

Native woodland on potential fens and reedbeds is an exception. Such wet woodland is a priority habitat but 178ha has been removed for open habitat restoration over the past eight years in the Norfolk Broads National Park alone[26]. There is thus conflict between wet woodland and reedbed and fen habitat action plans which needs to be resolved. Mechanisms exist for promoting such a resolution, e.g.: the Wetland Vision project.[27]

Counter evidence / uncertainties: An exception to the relative ease of resolving potential policy tension is where a relatively young native woodland has the potential to deliver significant biodiversity benefits, e.g.: if it is buffering ancient woodland from intensive land-use or where it could contribute to local BAP targets for woodland such as wood pasture. The decision making process for removal of native woodland should include consideration of these factors at a local level.

Rarely, open habitat restoration proposals include clear-felling of ancient woodland (e.g.: a lowland heathland restoration proposal in High Weald) but we believe we can accommodate both ancient woodland and open habitat objectives by woodland restructuring in these cases. It is unlikely that we would support open habitat restoration that involved permanent removal of ancient woodland.

There is uncertainty over when birch regeneration and scrub becomes potentially valuable native woodland. It may be desirable to develop a consensus broad definition, e.g.: based on the international definition of forest as being over 20% canopy cover and 2m tall or on age since establishment. An age of 75 years has been suggested for birch dominated woodland on lowland heathland. However, the time it takes birch woodland to develop what could be considered a functioning woodland ecosystem could be much shorter. This is because the birch/pine growth and decay cycle is 30-50 years and that for *Calluna* is 25 years. Therefore, fauna associated with woodland should be established within a 25 year period. It may be that there should be different definitions for different potential open habitats. For example, a Wealden clear fell site near Chiddingfold has established common lizard and adders within a 5 year period, Similarly, ash woodland on chalky soils would be well established within 25 years.

Monetising costs and benefits: There is a growing body of evidence to enable monetisation of native woodland. However, there appears to be little evidence enabling monetisation of a change from native woodland to open habitat and primary research may be needed. Evidence on local user concerns, landscape and quality of life, and access and recreation imply there would be little difference in value for immature woodland but mature woodland would be more highly valued.

Possible indicators for policy evaluation:

- Gains and losses of native woodland associated with open habitat restoration projects.

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[26] Information from FC regional staff.
[27] http://www.wetlandvision.org.uk/.

Policy implications: Restoration projects that involve removal of woodland shown as ancient on indicative maps or mature native woodland are unlikely to be supported. A definition of "mature" may need to be agreed. Proposals for removal of all native woodland should consider local opportunities for the woodland to contribute to local BAP targets or conservation of existing woodland of high nature conservation value. We need to initiate work to resolve conflict between the wet woodland and fen and reedbeds HAPs.

Linkages: This evidence has strong implications for the woodland biodiversity outcome.

Desired trends in woodland biodiversity are not compromised.

Outcome: Any improvement in trends in populations of key species[28] associated with native and non-native woodland habitats is not compromised.

Likely impact of restoration of open habitats from woods and forests: Little impact.

Evidence: Several important species that rely on woodland are declining (Table 18). More common woodland species with less exacting requirements are increasing or stable. Woodland bird populations decreased by around 20 percent between 1990 and 2000 but they have generally remained at these levels since then. However, birds that are woodland specialists have shown the greatest declines and many continue to decline (Figure 1). Woodland butterflies and moths are in marked decline.

Table 18: Trends in species in England with Species Action Plans identified as linked to woodland Habitat Action Plans.[29]

Trend	Count	% of species
Declining (continuing/accelerating)	2	9
Declining (slowing)	3	13
Fluctuating - probably declining	1	4
Fluctuating - probably increasing	2	9
Fluctuating - probably stable	0	0
Increasing	1	4
No clear trend	2	9
Not relevant	1	4
Stable	6	26
Unknown	5	22
Total number	23	
% stable / increasing		**39**
% declining		**26**

[28] By "key" we mean "species of conservation concern". Under section 41 of the Natural Environment and Rural Communities Act, the Secretary of State must, as respects England, publish a list of the living organisms and types of habitat which in the Secretary of State's opinion are of principal importance for the purpose of conserving biodiversity.

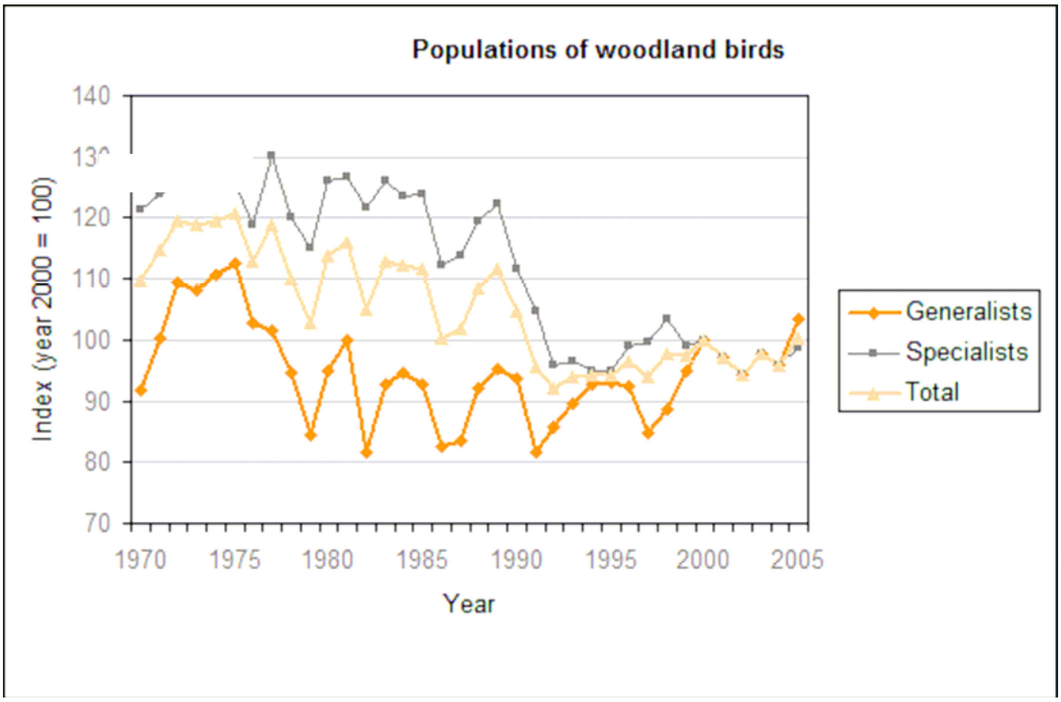
[29] Information from UK Biodiversity Action Plan Website, http://www.ukbap.org.uk/ as at 13th Sept 2008. Uses information from BAP reporting round 2005, updated information in 2009.

Most open habitat restoration projects that have an impact on native woodland will involve the removal of relatively recent secondary woodland regenerating on former open habitat. Native woodland developing on semi-natural habitat is of higher nature conservation value than woodland on former farmland[30].

Nevertheless recent successional native woodland is widely acknowledged to have inherently lower conservation importance than old or ancient woodland even when it is on semi-natural habitat.

Native secondary woodland is occupied by more widespread and mobile species, notably woodland and farmland birds. These assemblages can be recreated or catered for within project design or within native woodland established elsewhere in the region. In any evaluation of an open habitat restoration project, the more exacting, specialist species requiring open habitats are likely to be far more discerning as to soil conditions, vegetation type or locality. Therefore, in an assessment of biodiversity loss or gain they will probably carry more weight. Assessments undertaken for specific projects will readily identify the more important woodland species and their locations and account for them in any particular project proposal. In practice, woodland biodiversity *per se* is therefore unlikely to be a major consideration in decisions about restoration to open habitat in most cases. Any rare and local species of significance can be catered for in design, mitigation and/or subsequent management of the site. Many of the more generalist woodland species will benefit from the greater amount of edge habitat resulting from restoration of open habitat. The total area of semi-natural habitat will not decline so there will be little impact on woodland connectivity for many species.

Figure 1:



Wet woodland may be an exception. Carr and bog woodlands, collectively termed wet woodlands, arise on unmanaged and drying mires, fens and reedbeds. They may be of

[30] Peterken *(*1981*)* Woodland Conservation and Management

particular ecological interest even if they have arisen over the last century and are not strictly speaking ancient. See above for discussion of the implications of this.

Restoration of several open habitats targets removal of non-native plantation. A comprehensive study undertaken by Forest Research into the biodiversity of plantation stands in Britain[31] established that such stands make a significant contribution to biodiversity conservation. While not as diverse as native woodlands and often lacking the plants characteristic of old or ancient native woodland, they nevertheless support diverse associations of fungi, invertebrate and lower plants and are significant habitats for woodland birds. The sampling approach adopted revealed considerable invertebrate and fungal diversity (including 29 red data book species of fungi) comparable to native woodland ecosystems. The study revealed the importance of stand age, the presence of abundant deadwood and stand proximity to old established or ancient woodland as key determinants of species diversity. While not explicitly addressing self sown native woodland, these indicators are likely to hold good for native birch and other woodland arising on former open habitat and could be used as surrogate measures of biodiversity value in native woodland in the absence of empirical survey.

The study surveyed forest stands and not forests as a whole. Consequently much of the biodiversity associated with actively managed forests is missed. Species associated with rides, disturbed ground, clearfells, forest edge etc. are important aspects of biodiversity associated with forests rather than forest stands. A comprehensive study of forest wide biodiversity was undertaken for Thetford Forest which supports this view.

There may be an interaction with some designated species such as red squirrels and dormice but these are well protected by regulation.

Counter evidence / uncertainties: We are uncertain about the magnitude of the impact of woodland creation and management, and therefore woodland loss, on species of principle importance that tend to rely on woodland.

Monetising costs and benefits: There is a growing body of evidence to enable economic analysis of biodiversity. However, it seems likely that primary research would be needed to establish the value of changes to woodland biodiversity.

Possible indicators for policy evaluation:

- Population and population trends of woodland birds and other priority species[32].

Implications for policy: As above for ancient / native woodland outcome.

Linkages: Much of the value of plantations rests in the rides, disturbed ground, clearfells, forest edge etc. These are features of a worked landscape. The linkage of this with the evidence of dynamic mosaics being good for resilient ecological communities and appropriate disturbance regimes being good for species should be noted.

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[31] Humphrey,J.W., Ferris, R. and Quine,C.P. eds (**2003**) *Biodiversity in Britain's Planted Forests. Results from the Forestry Commission's Biodiversity Assessment Project.*, Forestry Commission, Edinburgh

[32] Such as some bat species and red squirrels in some areas.

Water quality and yield maintained.

Outcome: There is no significant negative impact on diffuse pollution, river flows, groundwater resources, flood risk or river morphology.

Likely impact of restoration of open habitats from woods and forests: Little impact on a national or river basin scale. Potential positive or negative impacts at a local scale, e.g.: positive impact on river flows and groundwater resources following conifer deforestation, negative impact on flood risk and river morphology, and positive impact on surface water acidification.

Evidence: The Water Framework Directive 2000/060/EC establishes a framework for protecting and improving inland surface waters, transitional waters, and coastal waters through a requirement to achieve 'good surface water status', a term that refers both to their chemical and ecological quality. The Directive also aims to protect the quality of groundwater (both quantitatively and chemically) and to ensure that the water needs of adjacent wetlands are adequately met. The new Floods Directive 2007/60/EC will establish a system for reducing and managing the risks that floods pose to human health, the environment and infrastructure. Therefore, impact on water quality, yield and flooding must be considered in this policy process.

The Forests and Water Guidelines[33] were updated in 2003 and are widely regarded as remaining effective at addressing all forest-water issues through good practice.[34] Much of the information in this discussion is taken from these guidelines.

Research shows woods and forests generally have a small impact on peak flows at a large catchment scale and therefore acute flooding. There is evidence that woods and forests on the floodplain attenuate flood flows and so their removal above settlements may be undesirable. Removal of woods and forests, especially conifer, could conceivably increase river flows and groundwater resources but only at a local scale; it is difficult to detect any impact when <20% of the area of a water body is cleared. Consequently, water utilities tend not to report this as an important issue.[35] Well managed woodland and forests are widely regarded as protecting water quality and maintaining good ecological status. The removal of conifer plantations in acid sensitive areas and from dry regions could locally improve water quality due to a reduction in pollutant scavenging and higher water yields. The risk of negative impact mainly concerns site disturbance during restoration work, including increased erosion and nutrient enrichment, especially of phosphate on peatlands. The clearance of riparian woodland, except conifer plantation, is generally negative for river morphology and buffering water temperature.

Responses by water regulators and utilities to deforestation EIA consultations are in line with this analysis.

Counter evidence / uncertainties: Research is in progress to generate better understanding of the effects of woodland and forests on flooding. There is emerging evidence that they may play a greater role in flood risk management, as well as controlling

[33] Forestry Commission (2003) Forests and Water Guidelines, 4th Edition.
[34] Advice from Environment Agency contact.
[35] CJC Consulting (2005) Review of evidence for the formulation of forestry policy in England, http://www.defra.gov.uk/wildlife-countryside/rddteam/ffinfo.htm.

diffuse pollution from more intensive land uses.[36] We have not undertaken any analysis to test the extent to which woods or forests on potential open habitats are in situations where their removal could generate local risk.

Monetising costs and benefits: Not appropriate because of low impact. If the impact is shown to be significant it should be possible to monetise the costs, e.g.: costs of treating drinking water.

Indicators for policy evaluation:

- Number of EIAs where impact on water is identified as an issue at scoping stage.

Changes since Step 1: A small change in the indicator to make it more feasible to collate.

Policy implications: The Forests & Water Guidelines provide an effective framework for addressing water issues. Policy needs to promote their continued development and application to ensure they remain fit for purpose.

Changes since Step 1: A small change in the indicator to make it more feasible to collate.

Air, noise and light pollution abated.

Outcome: There is no significant negative effect on the role woods and forests play in ameliorating air, noise and light pollution.

Likely impact of restoration of open habitats from woods and forests: Little impact provided flexibility is given to allow belts and other small areas of trees to be retained as screens and provided these are well managed.

Evidence: Trees can scavenge particulate and other pollutants from the air via deposition on their aerial parts. This can have health benefits to users of the area around these trees. Non-deciduous conifer trees have a higher pollution capturing effect than deciduous broadleaves because broadleaves have no leaves in the winter. The pollution-capturing effect of broadleaved trees is some five times greater than that of grassland.[37]

On a national scale the amount of air pollution removed by trees is thought to be substantial.[38] However, because of the improvement in air quality in the last century the value of any health benefits appears relatively low except in some urban situations[39]. It seems likely that for most open habitat restoration projects relatively small areas of trees close to sources of pollution will have the same degree of beneficial impact as larger areas of trees.

A number of priority open habitats are, by definition, nutrient limited. Surrounding woodland will scavenge nutrients, particularly nitrogen, and reduce pollutant deposition. Woodland may therefore play a protective role when they occur between sources of nitrogen pollution and the open habitat. In most cases, this role is likely to be minimal where diffuse pollution is the source. However, where point sources have been identified,

[36] Calder, IR et al (2008) Woodland actions for biodiversity and their role in water management, Woodland Trust. http://www.woodlandtrust.org.uk/water/

[37] CJC Consulting (2006) Market and non-market benefits of Forestry for People in Scotland, final report for Forest Research.

[38] Beckett, K.P., Freer-Smith, P.H., & Taylor, G. (1998) Urban woodlands: their role in reducing the effects of particulate pollution *Environmental Pollution*, **99**, 347-360.

[39] CJC Consulting (2006).

poultry or pig units, for example, removal of trees may exacerbate the effects of pollution on nearby open habitat sites. Indeed, woodland has been promoted as a mitigation measure for point source pollution in the rural environment.[40] On certain sites, this may be a material consideration, but is more likely to affect design rather than represent a serious argument against restoration.

Trees can also act as a screen for noise. There is evidence that noise has a detrimental effect on populations of breeding birds.[41] Increased road noise due to tree loss has also been a significant concern raised by users when responding to proposed lowland heathland restoration projects[42].

Trees are generally better at attenuating noise than grassy vegetation.[43] To be effective at attenuating noise the area of trees must have a good understorey. In winter, deciduous trees may become ineffective. Relatively narrow (e.g.: 10 – 100m depending on noise levels and exact conditions) belts of mixed trees with a good understorey are effective at reducing road traffic noise levels.[44]

The role of trees in reducing light pollution is likely to be similar to noise pollution. It is questionable how significant an issue this aspect is because most open habitat restoration will take place in rural areas where light pollution is less of an issue.

The screens of trees that the evidence indicates will do the job can easily be accommodated in most open habitat restoration proposals.

Counter evidence / uncertainties: Unless the trees are well managed, particularly with a good understorey their role in noise pollution abatement becomes minimal. There is evidence that retained woodland can be neglected following open habitat restoration. There is evidence that the greatest effect on noise by trees is the perception of reduction due to visual screening.

Monetising costs and benefits: There is relatively sound science behind noise and air pollution abatement and methodologies for calculating the value of health benefits. It should therefore be possible to derive figures to monetise costs. However, this is not considered necessary at the moment because the evidence shows low potential impact.

Indicators for policy evaluation:

- Number of open habitat restoration projects adjacent to category B or above roads.

Changes since Step 1: This is an additional outcome added since Step 1.

Implications for policy: Need to find a way of building in guidance on good practice for screening roads in particular.

Linkages: There are strong links to the local and other user concerns outcome.

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[40] AMBER:http://www.defra.gov.uk/science/Project_Data/DocumentLibrary/WA0719/WA0719_1734_FRA.doc.
[41] Reijnen, R. & Foppen, R. (1995) The effects of car traffic on breeding bird populations in woodland IV. Influence of population size on the reduction of density close to a highway. *Journal of Appled Ecology*, **32**, 481-91.
[42] Returns from FC regional staff.
[43] Huisman, W.H.T. & Attenborough, K. (1991) Reverberation and attenuation in a pine forest. *Journal of the Acoustical Society of America*, **90**, 2664-77.
[44] Huddart, L. (1990). The use of vegetation for traffic noise screening. In. Transport and Road Research Laboratory Research Report 238., Wokingham.

Soil quality maintained.

Outcome: There is no significant negative impact on soil carbon and nutrient capital, soil acidification, soil biodiversity, soil structure, functions or morphology.

Likely impact of restoration of open habitats from woods and forests: Little impact on a national scale, potential positive or negative impacts at a local scale. For example:

- Positive impact on soil water, base cation status and soil biodiversity in conifer plantations.
- **N**o impact or positive impact on soil acidification in conifer plantations.
- **N**egative impact on soil carbon stores, soil erosion and slope stability.

Evidence: The European Commission Thematic Strategy for Soil Protection was launched in 2006 and its overall objective is the protection and sustainable use of soil. A Framework Soil Directive was proposed in 2007 with a focus on reducing erosion, organic matter decline, salinisation, compaction, landslides, contamination and sealing, and is currently under discussion for adoption. The FC Forests and Soil Conservation Guidelines[45] address all soils issues through good forest management practices.

Soils supporting forests and woodlands are generally well protected. Forests tend to reduce soil erosion, improve slope stability, accumulate soil organic matter and conserve nutrients. Forest soils tend to be naturally acidic unless situated over calcareous geological material and can be relatively drier than comparable soils under open habitats due to the potentially greater water use of forests. Most conifers and some broadleaves acidify the soil due to the acidic nature of litter accumulated and its slow decomposition. This can be accentuated by the ability of forest canopies, especially conifer, to scavenging S and N acid pollutants from the atmosphere. Forest operations can disturb or damage the soil but these can be controlled by good forest management

Research shows that growing woods and forests tends to increase the soil carbon stock compared to that under most open habitats. Conversion therefore will often lead to a reduction in carbon storage, which can be accentuated by the soil disturbance caused during restoration work.

Soil microbial diversity is important for the maintenance of soil functions and quality. The effect of removing woods and forests on soil biodiversity remains unclear due to the mixed effects on soil carbon, acidity, nutrition and water.

Counter evidence / uncertainties: Research is in progress to generate better understanding of the effects of forest management practices on soil chemical, physical and biological properties, including soil carbon and interactions with pollution and climate change.

Monetising costs and benefits: Generally not appropriate because of low impact. There are well established protocols for monetising changes in soil carbon stocks.

Indicators for policy evaluation:

- Long-term trends in soil chemical, physical and biological quality

[45] Forestry Commission (1998) Forests and Soils Conservation Guidelines.

Changes since Step 1: This outcome has been added since step 1.

Policy implications: The Soil Guidelines provide an effective framework for addressing all soil issues and ensuring appropriate forest management. Policy needs to promote their continued development and application to ensure they remain fit for purpose.

Quality of life.

Positive engagement by local and other users.

Outcome: People's positive engagement in the landscape they use, particularly their local landscape is maintained or enhanced (including engagement of woodland owners and those working in forestry).

Likely impact of restoration of open habitats from woods and forests: A risk of significant negative impact.

Evidence: Generally, there appears to be little difference in the value, use and non-use benefits attributed to open habitats compared to the woodland or forest currently growing on those open habitats. There is evidence that people value woodland for the same kinds of reasons as they value all green open space with semi-natural characteristics. For example:

- In the Public Opinion of Forestry Survey 2007 93% of respondents selected at least one public benefit as a good reason to support forestry with public money. The top three reasons were "to provide places for wildlife to live", "to help tackle climate change" and to "provide places to walk in".
- A survey of public attitudes to Dorset Heathlands showed a similar set of high values for wildlife and accessibility.
- A landscape preference study found that large mature trees, diverse species composition, open space within woodland and views of water tend to have higher preference ratings.[46]

However, experience of local conflict over open habitat restoration projects shows that negative engagement can easily arise if the process is wrong or the proposals ill-advised from a local perspective. Four out of eleven recent EIAs for deforestation associated with open habitat restoration included local community reaction as a significant issue[47]. Several projects have generated significant adverse local engagement, e.g.: Esher Common, Town Common.

If negative local engagement arises it can reduce the feasibility of the project. More deeply, it reduces the use and non-use value of the site for local users and has a negative impact on community – agency relations.

The range of concerns raised by local users encompass, in approximate order of frequency:

- Objection to loss of woodland.
- Reduction in screening of road noise.

[46] Lee, T (2001) Technical Paper 14, Perceptions Attitudes and Preferences for Forests and Woodlands, Forestry Commission.
[47] Returns from FC regional staff.

- Inappropriate landscape change.
- Reduction in screening of neighbouring houses.
- Reduction in carbon sequestration due to loss of woodland.
- Negative impact on recreation during felling.
- Lack of trust in agencies to do the work and maintain the habitat to an adequate standard.
- Increased risk of localised flooding.
- Fears about housing development.
- Reduction in absorption of atmospheric pollutants.
- Temporary increases in road traffic during harvesting.

The modifications resulting from local input were:

- Reduction in area of deforestation.
- Changes to landscape design to avoid negative visual impact within or close to the site.
- Changes to the phasing of felling to reduce visual impact.
- Conditions on continued local information sharing.
- Conditions on the nature of operations, e.g.: treatment of brash.

The quality of the process by which the proposals are communicated is as important as the proposed change. It appears that to minimise the risk of negative engagement projects should:

- Undertake stakeholder analysis before forming proposals.
- Run high quality local consultation where potential local interest is identified.
- Phase felling over long-timescales.
- Ensure that each phase of clearance is well implemented to a quality that minimises short-term negative impact on people's experience of the landscape.
- Design the landscape carefully, particularly internal and adjacent landscape.
- Determine what scale of deforestation is appropriate for the landscape and context.
- Take into account road noise and intrusion from other development and leave well managed woodland screens.
- Undertake individual householder consultation where deforestation is close to homes.
- Avoid felling of locally iconic trees, particularly old trees, e.g.: over 100 years old.
- Undertake consultation before firm plans are drawn up and demonstrate change in response to user input.
- Include clear commitments to long-term management, high quality operations, and continued local engagement.

- Be prepared to drop or radically alter proposals if there is strong local opposition.

The delivery of this outcome relies on more than just getting the local participatory process right. A change imposed by an external agency, however well consulted and however well co-ordinated with national priorities, has the potential to be disempowering if local people are not able to participate in the decision making process. There is evidence that local empowerment has personal and social benefits[48]. The Government white paper, "Communities in control, real people, real power "states "We want to shift power, influence and responsibility away from existing centres of power into the hands of communities and individual citizens. This is because we believe that they can take difficult decisions and solve complex problems for themselves. The state's role should be to set national priorities and minimum standards, while providing support and a fair distribution of resources."[49]

Woodland owners and those working in forestry: The motivation, skills and rate of recruitment of the forestry sector workforce and woodland owners are important for the health of the sector. Some organisations representing forestry workers or landowners have expressed concerns over open habitats policy. Examples of concerns raised include uncertainty over the total extent of woodland that could be lost, reduction in timber supply, demotivation of the forestry profession and policy dislocation particularly on mitigating climate change. If properly motivated, forestry workers could supply many of the skills and expertise needed for successful restoration and management of open habitats.

Counter evidence / uncertainties: No studies are known that directly measure changes in use and non-use values as woodland or forest is changed to open habitat. No systematic surveys of forestry workers or landowners on this issue are available.

Monetising costs and benefits: Methodologies exist for valuing the change but measurement would probably require primary research.

Indicators for policy evaluation:

- The number of EIAs for deforestation associated with restoration of open habitats where local community concerns are identified as an issue during the scoping process.
- The number of EIAs where the initial proposals are significantly modified following local community input.
- Indicator to be developed of the attitude of forestry workers and woodland owners to the policy on restoration of open habitats.

Changes since Step 1: We have dropped the indicator on cost to Government of dealing with controversial proposals because of difficulty in measurement and defining "controversial". We have added in an indicator trying to get at the attitude of the sector to the policy.

Policy implications: For many potential restoration projects high quality local engagement and probably some pre-engagement modification of plans will be necessary if significant harm is to be avoided. Local engagement should follow good practice and find out the aspirations of people for their local area in terms of quality of life or habitat , or access, recreation and educational opportunities. Decisions making needs to be

[48] Communities and local Government (2008) Communities in control, real people, real power – evidence annex.
[49] http://www.communities.gov.uk/communities/communityempowerment/communitiesincontrol/

transparent and demonstrate local opinion has been properly taken into account. How do we build this into policy?

Access and recreation.

Outcome: The rates of use and benefits received by recreation users are maintained or enhanced.

Likely impact of restoration of open habitats from woods and forests: Little impact except for some open habitats where there may be a conflict between recreational users and ground nesting birds.

Evidence: People appear to value woodland and open habitats for similar reasons (see above). There is no reported significant change in rate of use following restoration.

There is evidence that there are values that users place on green open space for recreation that could conceivably be altered by conversion of woods and forests to open space:

- **Feeling of isolation:** because lines of sight are broken up by the trees, woods and forests can absorb more visitors than open space and still retain a feeling of isolation for the visitor. Deforestation may result in a decrease in the number of people that can be absorbed by the landscape before a feeling of isolation is lost, which may reduce the rate of use and benefits received by users. Apart from some returns on consultation on proposed open habitat projects when respondents have indicated a preference for woodland over tree-less landscapes there is little evidence to indicate whether this is a factor in determining rates of use in reality. In practice, open habitat restoration projects rarely result in large areas of tree-less landscape.

- **Feeling of safety:** many people report a feeling of insecurity as a barrier to access in woodland. There are design guidelines based on experience on how to generate a feeling of safety in woods and forests directed at creating good lines of sight, particularly at entry points. While we know of no experimental evidence, it seems likely that the threshold tree density at which safety fears are minimised is well above the threshold tree density at which woods are converted to open habitats, i.e.: this barrier to access can by minimised by good woodland design rather than deforestation.

- **People like edges:** studies in the New Forest[50] have shown that recreational users tend to adopt highly stereotypical routes that often follow the transition between woodland and open habitat . Projects that reduce the amount of edge might have an adverse impact on recreational use. As discussed above in practice open habitat restoration projects tend to result in mosaics of woodland and open habitat with plenty of edge.

Restoration of upland heathland from Sitka spruce might have a significant positive impact on the attractiveness of the site for recreation. Local walking groups have provided supportive comments on EIA consultations on at least two such proposals. However, the number of potential and actual users of such sites is low. They also tend to occur in landscapes that already have large amounts of accessible open space. The net marginal impact is therefore likely to be insignificant on a national scale.

There are reports of increased conflict between users and needs of ground nesting birds following open habitat restoration. There is evidence that several priority bird species

[50] The Progress Project, http://www.forestry.gov.uk/forestry/INFD-6AQEUA .

associated with open habitat are negatively effected by disturbance due to users.[51] There are examples of open habitats being closed under the Countryside and Rights of Way Act or voluntary restrictions being applied to ameliorate this conflict. While these can be locally controversial most users seem to accept the restrictions.

There are also reports of conflict between access and management regimes such as grazing and fire. For example, grazing requires fencing and there have been reports of users complaining about restrictions on their ability to roam. However, there are also reports that users enjoy seeing grazing animals and that by designing access points fencing has little impact on users, most of whom stick to paths.

It seems likely that the restrictions to avoid conflict with ground nesting birds and potentially conflicting management regimes have a negative impact on only a small number of users or displaces recreational activity rather than reducing it overall.

Counter evidence / uncertainties: No evidence known to directly test changes in rates of use or benefits received before and after restoration or whether conflict with ground nesting birds reduces recreation levels overall.

There is some evidence that the pattern of use differs for woodland and lowland heathland with more dogwalkers in heathland.[52]

Monetising costs and benefits: There is good information on the value of woodland recreation. No comparable figures for the value of restored open habitats are known.

Possible indicators for policy evaluation:

- Changes in area of land where direct management practices are employed to reduce or control visitors (e.g.: closure under the Countryside and Rights of Way Act (CROW), parking restrictions, codes of conduct, education programmes) due to concern about conflict between recreational users and the needs of wildlife.

Policy implications: Given the uncertainties and low potential impact this issue is not particularly helpful in distinguishing between policy options. It is more likely that it will lead to some generally applicable principles for all options. For example, it would be possible to reduce the potential negative impact of conflict between users and ground nesting birds by avoiding open habitat restoration on sites close to high density residential areas, sites that are currently well-used, and by designing sites to lead users away from sensitive areas, e.g.: by careful placing of car-parks and woodland areas.

Changes since Step 1: The indicator has been changed to make measurement more feasible.

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[51] Liley, D et al (2006) The effect of urban development and recreational access on the distribution and abundance of nightjars on the Thames Basin and Dorset Heaths, http://www.footprint-ecology.co.uk/publications_and_downloads/reports.html .
[52] Underhill-Day, JC and Liley, D (2007) Visitor patterns on southern heaths: a review of visitor access patterns to heathlands in the UK and the relevance to Annex I bird species

Business and markets.

Timber sector confidence.

Outcome: Any reduction in timber supply has little impact on the confidence in the harvested wood products producing and processing sectors meaning that economic activity in the sector is not significantly reduced.

Likely impact of restoration of open habitats from woods and forests: Potentially negative impacts at a regional scale.

Evidence: The long-term impact on timber availability will be different and have different implications for hardwood as opposed to softwood production. Woodfuel is also a developing market that is treated separately below.

Hardwood

There are about 45,200ha of native woodland on potential open habitat (Table 1). However, the nature of this woodland means that little of it is likely to be delivering timber to the market so the likely impact on the timber sector of its removal is insignificant. The impact on woodfuel of native woodland removal may be more significant (see below).

Softwood.

There are about 86,700ha of conifer plantations on potential open habitats. Due to high transport costs the market is regionalised. Forest Enterprise England divides its timber production into three marketing zones: Northern (North of the Humber/Mersey), Central (West and East Midlands) and Southern (the rest). We analyse impact on softwood according to these regions.

We estimate the reduction in softwood production under the scenarios in Table 2 could be range from 7% to 1% in the Southern zone, 8% to 1% in the Central zone, and 6% to 1% in the Northern zone. This equates to a reduction on an England wide basis of between 6 and 1% (Table 19).

Table 19: Potential loss (ha) of softwood timber availability due to removal of conifer plantations for restoration and expansion of open habitats.

Marketing zone	**Conifer plantation on potential open habitat (ha)**[53]	**Total area of conifers (ha)**[54]	**Total potential loss of production under scenarios in Table 2**[55]		
			Higher	Intermediate	Lower
Southern	45,500	151,430	7%	4%	1%
Central	15,100	43,972	8%	4%	1%
Northern	26,100	142,929	4%	2%	1%
England	86,700	338,331	6%	3%	1%

53 Figures from Table 1.
54 Figures from the NIWT 1998.
55 Calculated as (woodland loss in scenario / total area of woodland on potential open habitat) * (conifer plantation on open habitat / total area of conifers).

Woodfuel.
Our Woodfuel Strategy for England[56] aims to bring an additional 2M tons of wood into the market annually by 2020. We are focusing our efforts on the potential resource in undermanaged English woodlands, generally native woodland. These currently deliver about 25% of their net annual increment to the market. Using the assumptions on scale and rate in Table 2 gives potential reduction on wood products of most relevance to the Woodfuel Strategy of between 1.4% and 0.3%. Locally the impact might be more significant. The economics of woodfuel supply is dependent on transport distances.

Table 20: Potential reduction in wood products of relevant to the Woodfuel Strategy for England due to restoration and expansion of open habitats from woods and forests.

Native woodland on potential open habitat (ha)	**Total area of native woodland (ha)**	**Total potential loss of production under scenarios in** Table 2		
		Higher	Intermediate	Lower
45,200	706,000	1.4%	0.8%	0.3%

The figures for potential impact on timber production are hypothetical only, e.g.: the actual impact on softwood production may be larger if most of the woods removed are from the 60% of plantations that are currently delivering timber to market. The impact on business is further complicated by:

- Timber currently growing will still reach the market, it is the next rotation of potential timber that will not. This may therefore have little impact for 20+ years (when thinning of the next crop starts). Significant reduction in timber supply will not happen until beyond the investment horizon for sawmills of 10 to 15 years. However, there is evidence that sawmill owners are concerned at future reduction in supply and that this may be influencing investment decisions.[57] Without re-investment in both the processing and harvesting sectors of the market other areas, particularly our ability to deliver the Woodfuel Strategy for England, could be adversely affected.

- The potential reduction should be viewed in the context of the “timber production forecast”. Softwood timber availability in England is set to rise by 10% between 2007 and 2021 after which it is set to fall (Table 21). The rise is due to maturation of the crop planted in the 20th Century. The forecast of availability is accurate to about 10% per year per 5 year period. Forecasts of hardwood availability are not published. Availability is different to production because market forces may change the rate at which available timber is brought to market. A total of 8.5 million green tonnes of softwood was produced in the UK in 2006. This was almost unchanged from the previous year. Over the same period, hardwood removals fell by more than one quarter, to 0.4M green tonnes. Provisional figures for 2007 show a 6% increase in softwood production to 9.1M tons and a 1% increase in hardwood, still estimated at 0.4M tons.

[56] http://www.forestry.gov.uk/england-woodfuel
[57] Reports by FC staff of conversations with owners.

Table 21: Softwood availability forecasts in England.

Period	Annual average availability in the five years (1,000 green tons)
2007 - 2011	2,639
2012 – 2016	2,807
2017 - 2021	2,910
2022 - 2026	2,781

- The timber processing sector has a large number of small to medium sized companies. There are 226 sawmills in the UK, over 2/3 of them produce less than 5K m3 of sawnwood per year, the smallest 91 produce less than 1K m3 sawnwood each , the largest 19 produce more than 50K m3 each. 2/3 of sawmills processed softwood only in 2006, 9% processed both softwood and hardwood and 23% processed only hardwood. Bigger mills with more than 10K m3 per year capacity processed 91% of the softwood. The smaller sawmills may rely on local sources of timber. Large scale clearance in a particular location may have a disproportional impact in the local area.

The contribution to England's Gross Domestic Product (GDP) of production and primary and secondary processing of English grown timber is estimated at £2.1Bn or 0.1% of England's GDP employing 64,000 Full Time Equivalents (FTE). [58] Of this, 40% is contributed by businesses significantly exposed to changes in English timber production. These are defined as businesses where more than 50% of their wood material is grown in England. We can therefore calculate that the potential reduction in timber supply across England could reduce forestry's contribution to GDP of between £18M and £3.3M (Net Present Value) (Table 22). The reduction could result in the loss of 1,500 to 300 FTEs. While the impact is small in national terms it should be noted that many of the businesses are in rural areas where their contribution to local employment may be disproportionate.

Table 22: Potential impact on timber businesses of woodland removal due to restoration and expansion of woods and forests in England.

	Higher	Intermediate	Lower
Impact of scenarios in Table 2 measured in terms of GDP (£M Net Present Value)[59]	18	9.8	3.3

However, these are hypothetical figures only because the relationship between product supply, competition, business confidence, investment and ultimately on jobs is complex.

- The impact on jobs will vary depending on activity. For example, people in maintenance will probably have work opportunities on open habitat, harvesting contractors may have an increase of work while restoration is taking place
- Other economic forces may swamp any impact due to restoration of open habitats, e.g.: the impact of Red Band Needle Blight (see below) on pine production, the international economic downturn. Timber prices in the UK rose by 31% between October 2006 and 2007

[58] Jaakko Pöyry Consulting (2006) Woodland and forest sector in England, England Forest Industries Partnership, www.efip.org.uk/

[59] Calculated as % reduction in timber * GDP of timber businesses significantly exposed to domestic timber market * discount rate of 0.5026 (assumes no impact until 2028).

but they are still not as high as levels in the late 1980s.[60] Timber prices experienced a downturn in 2008 and there is concern about the impact of the downturn in the wider economy. While in August timber prices were forecast to recover by 5% per year to 2010 in September and October there was evidence of an acute downturn in the domestic timber market.

We are working to upgrade our understanding of the potential impact of timber production changes on the sector's business confidence. The England Forest Industries Partnership (EFIP) and other stakeholders are helping us with this. We will present the results as the policy process progresses and take any new information into account.

Red Band Needle Blight.
Red band needle blight (RBNB) is the most significant disease of coniferous trees presently facing Britain.[61] Since the late 1990s there has been a dramatic increase in the occurrence of the disease. It has been identified in all forest districts in England and a number in Scotland and Wales. The disease causes premature defoliation, leading to reduced growth, increment loss and in the worst cases, mortality. If trees are infected, they may remain so throughout their life, which may be shortened considerably.

The impact of the disease has been most marked on Corsican pine. Corsican pine is particularly important in England, where over 20% of the FC coniferous area is planted with this species. It has also been identified as the species with greatest potential to fit the changing climate in many parts of England. Due to the extent and severity of the disease on Corsican pine, there is presently a five-year moratorium on its planting on the FC estate, due to end in 2012. However, in the last 12 months RBNB has also been found to be causing significant damage to Lodgepole pine in several areas in Scotland. It has also been identified on a further 13 species in Great Britain. Recent work has shown that Scots pine and young Douglas fir, Sitka spruce and Norway spruce can all become naturally infected under field conditions in areas with high levels of inoculum. However, it has not been found to have a significant impact on the growth and health of these trees.

In England we do not expect planting of Corsican pine to resume on any scale. The disease is too widespread and the impacts too severe. RBNB in Lodgepole pine is not a big issue for England. In this review of evidence we have assumed that areas currently under Corsican pine at yield class 14 are actually under Scots pine at yield class 12. This is because this is the likely predominant species in current Corsican pine areas, assuming these areas are retained as commercial plantations.

There is a programme of work to monitor the impact of RBNB and test options for a response, e.g.: alternative productive species, alternative models of forestry.

Possible indicators for policy evaluation.

- Reduction in timber production due to loss of woodland compared to production forecast at a regional (timber marketing zone) scale.
- Indicator to be developed from survey of confidence of timber producing and processing businesses.

[60] UPM Tilhill (2008) Trends and influences on the UK standing conifer timber sales market, UPM Tilhill Timber Bulletin Ed 7, http://www.upm-tilhill.com/documents/1/ZZ_1211372519_Timber%20Bulletin%2008.pdf
[61] See http://www.forestresearch.gov.uk/fr/infd-6zckae.

Monetising costs and benefits: We have monetised the costs using the calculations in Table 22. However, these are unlikely to be a true reflection of costs and benefits due to uncertainties about the actual impact on business activity of changes in timber availability. At best, they are proxy indicators of maximum impact.

Indicators for policy evaluation:

- Maximum potential change in annual increment of timber.
- Maximum potential change in annual increment of wood products.
- If feasible we will develop an indicator from the survey of confidence of timber producing and processing businesses to be developed as part of the FCE Corporate Plan indicators.

Policy implications: we may need to undertake further analysis to work out a more realistic figure for potential impact. The policy may need to build in mechanisms to consider current local markets for timber and potential local impact on woodfuel.

Changes since Step 1: Minor changes to the annual increment indicators for clarification.

Rationalisation of low public and private benefit forestry.

Outcome: Opportunities are provided for woodland owners to remove forests that they no longer want that have low public benefit. These opportunities do not result in perverse incentives for removal of low private but moderate public benefit woodlands.

Discussion.
This is a different category of change to the outcomes above. This is because it describes a desirable process that may or may not be a function of the eventual policy rather than a change in the real world that can or cannot be delivered by changing woods and forests to open habitat. The equivalent outcome statement would be "The public benefit of land-uses resulting from open habitat restoration is not reduced". This is a catch-all that is covered by the outcomes above so it is not discussed further here.

In the past five years there have been 3 felling proposals relevant to this process covering 569ha. All were projects to convert plantations in upland heathland for grouse moor. Only one application of 69ha has gone ahead so far. Grouse moor has considerable potential private benefits and questionable public benefits given that there is a lot of upland heathland already. There is considerable potential for proposals of this nature, particularly in north east England where c1,000ha of proposals may come forward in the next year.

Indicators for policy evaluation:
Number and area of proposals for conversion to upland heathland for grouse moor.

Changes since Step 1: Clarification that it occupies a different category of change to the other outcomes. Focussing of the indicator.

Conclusions.

The key question we have been attempting to answer is "What is the net impact of changing the current landscape of woodland and forest and open habitats into a landscape with some less woodland and forest and some more open habitat?" We need to answer this question is in order to "Develop a clear rationale to guide removal of inappropriate plantations and woodland where other key [Biodiversity Action Plan] habitats …. can be restored and where the benefits of doing so outweigh the environmental and social costs."

We can also draw together some implications for policy:

- For positive trends in populations of open habitat species and resilient ecological communities the impact is positive. For commitment on native and/or ancient woodland and desired trends in woodland biodiversity the impact is insignificant provided there is sufficient flexibility to respond to local conditions. Mosaics of permanent open habitat, temporary woodland / open habitat, and permanent woodland may be preferable in many cases. We need to decide where the balance lies between mosaic habitats and open habitat with less than 5-15% trees.
- For timber sector confidence, carbon balance, and keeping to Government commitments on woodland cover the rate and total magnitude of deforestation alters whether the impact is insignificant or negative. We need to decide whether this means we should attempt to set maximum rates and amounts and if so, how.
- For Government commitments on woodland cover there is a threshold rate of deforestation which, if crossed, will have a significant negative impact. We need to decide how to respond to this threshold in policy.
- Woodland and forest is currently a valuable land-use delivering public benefit. Retentions of woodland in open habitat restoration projects can mitigate a number of potential negative impacts, enhance some positive impacts such as habitat heterogeneity, and act as a source of income to off-set costs. How do we encourage those proposing open habitat restoration to view the woodland or forest as an asset not a liability?
- For financial viability and carbon balance the impact is negative. We need to decide how significant this negative impact is and what it means for policy.
- For positive engagement by local and other users, good quality local engagement is important. We need to decide on the relative importance of this outcome and how to amend policy accordingly.
- For quality of life and landscapes and preservation of historic features, the impact is insignificant if guidelines are followed. For preservation of historic features impact is positive if guidelines are followed, negative if not followed. We need to decide how to build mechanisms into policy that ensure projects follow guidelines.
- For learning about landscape history, interpretation is required. We need to decide whether to build mechanisms into policy to encourage interpretation of landscape history.
- For water quality and yield and soils there is little national scale impact but potential negative and positive impacts locally. We need to decide how to build into policy mechanisms to allow local impacts to be taken into account.

Next steps.

The next step is to use this evidence, if we have enough, to develop outcomes and a set of criteria by which we can appraise the policy options. See www.forestry.gov.uk/england-openhabitats for details.

Annex 1: Summary of policy development process.

Note the timing of the process may change. See www.forestry.gov.uk/england-openhabitats for up to date timings.

Step	**Mechanism**	**Output**	**Timescale**
1. Fit progress to date into a policy cycle.	Forestry Commission (FC) to define the problem, desired outcomes including indicators of outcomes and other issues for consideration, and set out policy options.	Paper	June 2008.
2. Work out implications for delivery mechanisms and collate evidence.	FC to set out summary of evidence.	Papers	August – September 2008
3. Plan evaluation.	Includes stakeholder workshop.	Workshop report.	September 2008
4. Appraise options.			
5. Consult	Formal public consultation.	Consultation report.	November 2008 – February 2009.
6. Make a decision.	Options paper to be submitted to Ministers by FC.	Submission to Ministers.	June 2009
7. Produce policy document	FC to draft.	Published document	June 2009
8. Set up delivery mechanisms.	Depends on policy decision.[62]	Depends on policy decision	Depends on policy decision.
9. Launch policy	Launch at an outdoor event.	Launch event.	Depends on policy decision.

[62] A strategy for the FC estate will follow in 2009/10.

Annex 2: Principles, policy problem, outcomes, issues and options.

For a policy on restoration of open habitats from woods and forests in England.

Overarching principles.

- Government objectives for biodiversity and habitats are the principal drivers of the policy along with landscape and cultural heritage as secondary drivers.
- Desired outcomes will relate to biodiversity, landscape, and cultural heritage.
- All of the Government's aims for England's woods and forests need to be taken into account.
- Long-term viability of woodland and open habitats is important.
- Lowland heath is the most testing issue but we must ensure that the policy works for all relevant types of open habitats.

The problem.

Open habitats are valuable for their biodiversity, contribution to the landscape and cultural heritage. Many are also vulnerable and have declined over the past few hundred years. However, the land-use from which open habitats would be restored under this policy, woods and forests, contributes to several Government objectives. We therefore need to get the policy right or we could end up ineffective decision making about removal of woods and forests and a landscape that delivers less public benefit overall.

Desired outcomes and issues from Step 1 and their relationship to outcomes in Step 2.

Outcome / issue in Step 1	Outcome in Step 2.
1. Habitats: Ecologically robust open habitats with secure long-term management regimes in place.	**Resilient ecological communities:** Communities of key open habitat species that can cope with threats, particularly climate change.
2. Species: The declining trend in populations of key open habitat species is reversed.	**Positive trends in populations of species:** The declining trend in populations of key open habitat species is halted or if possible reversed.
3, quality of life and landscape: Changes in landscape due to restoration of open habitats from woods or forests improve the quality of life of people who experience that landscape.	**Quality of life and landscape:** Changes in landscape due to restoration of open habitats from woods or forests improve the quality of life of people who experience that landscape.
4, heritage: People now and in the future can learn through direct enjoyment of the outdoors how history has shaped the landscape.	**Learning about landscape history:** People now and in the future can learn through direct enjoyment of the outdoors how history has shaped the landscape.

Outcome / issue in Step 1	Outcome in Step 2.
5, preservation of historic features: The condition of historic features in open habitats restored from woods and forests improves and key cultural and designed landscapes are retained.	**Preservation of historic features:** The condition of historic environment features in open habitats restored from woods and forests improves and key cultural and designed landscapes are retained.
1, financial viability: Would management of the landscapes that result from restoration of open habitats be financially viable in the long-term, including open habitats, associated woodland, and remaining woodland elsewhere?	**Financial viability:** Management of the landscapes that result from restoration of open habitats is financially viable in the long-term.
2, woodland cover: What are the implications for our international commitments to sustainable forest management including maintaining net woodland cover?	**Commitments on woodland cover:** The UK Government is able to demonstrate fulfilment of our international commitments to sustainable forest management, especially maintaining net woodland cover.
3, carbon: What would be the effect on Government targets for reducing carbon emissions as part of combating climate change?	**Carbon balance:** Woods and forests continue to make an appropriate contribution to the UK Government's commitments for reducing carbon emissions.
4, native and/or ancient woodland: What would be the effect on our ability to keep to commitments in Keepers of Time[63] on area of native and/or ancient woodland?	**Commitments on native and/or ancient woodland:** The Government is able to keep to commitments in Keepers of Time[64] on area of native and/or ancient woodland.
5, woodland biodiversity: What would be the effect on priority species associated with native and non-native woodland habitats?	**Commitments on woodland biodiversity:** Any improvement in trends in populations of key priority species associated with native and non-native woodland habitats is not compromised.
6, water quality and yield: Is there any potential significant effect on nitrate run-off, scavenging of airborne pollution, water yields, flooding, or other water quality factors?	**Water quality and yield:** There is no significant negative effect on diffuse pollution, river flows, groundwater resources, flood risk or river morphology
7, local community and other user concerns: What would be the effect on the level of people's positive engagement in woods and forests (including the effect on woodland owners and those working in forestry)?	**Positive engagement by local and other users:** People's positive engagement in the landscape they use, particularly their local landscape is maintained or enhanced (including engagement of woodland owners and those working in forestry).
8, access and recreation: What would be the effect on rates of use and benefits received by users?	**Access and recreation:** The rates of use and benefits received by recreation users are maintained or enhance.

[63] Keepers of Time is the Government's statement of policy on ancient and native woodland, see http://www.forestry.gov.uk/forestry/infd-6h3fvs.
[64] Keepers of Time is the Government's statement of policy on ancient and native woodland, see http://www.forestry.gov.uk/forestry/infd-6h3fvs.

Outcome / issue in Step 1	Outcome in Step 2.
9, timber: What would be the effect of changes in timber production on stability of timber supply, confidence in the timber producing and processing sectors, and ultimately on economic activity in the timber producing and processing sectors?	**Timber sector confidence:** Any reduction in timber supply has little impact on the confidence in the harvested woods products producing and processing sectors meaning that economic activity in the sector is not significantly reduced.
10, rationalisation of low public and private benefit forestry: Are there opportunities to help woodland owners remove forests that they no longer want to have on their land that have low public benefit and replace them with higher public benefit land-uses of equal or greater use to the landowner?	**Rationalisation of low public and private benefit forestry:** Opportunities are provided for woodland owners to remove forests that they no longer want that have low public benefit. These opportunities do not result in perverse incentives for removal of low private but moderate public benefit woodlands.[65]
Not considered.	**Air, noise and light pollution abated:** There is no significant negative impact on the role woods and forests play in ameliorating air, noise and light pollution.
Not considered.	**Soils:** There is no significant negative impact on soil carbon, nutrient capital, acidification, biodiversity, structure, function or morphology.

Policy options

In no particular order.

Option 1: Driven by national targets for open habitats.

Option 2: Open habitats are important but woods and forests come first.

Option 3: Compensatory planting.

Option 4: Open woods and forests fit for the future.

Option 5: Local level decision making.

Option 6: Open habitat critical natural capital.

[65] Now considered to be a feature of the process adopted in the policy rather than an outcome of the policy.

Annex 3: England Biodiversity Strategy.

Context for a policy on restoration of open habitats from woods or forests in England.

We have established that we need to take into account all of the Government's objectives for forestry. Nevertheless, the main reason for the policy is biodiversity. The England Biodiversity Strategy[1] sets much of the context for this policy process, it states:

- Woodlands and forestry: "A significant contribution to the restoration and [expansion] targets for open ground priority habitats through removal of trees from appropriate sites"

The Habitat Action Plan (HAP) targets of relevance to this process cover about 60,000ha in total (Table 1) or about 50% of the potential under woodland or forest. There is uncertainty about how much of the "achieve condition" and "restoration" targets might be delivered by removal of woodland and some HAPs do not yet have all targets set. We have assumed that only the restoration and expansion targets have significant implications for this policy but we may reassess this as further evidence is gathered.

Combining the HAP targets and the total woodland or forest on potential open habitat (see figures in main paper) shows that the maximum opportunity to directly deliver HAP targets by removing woodland or forest ranges from 100% of the potential to just 4%. For all but fens, reedbeds and lowland heathland the HAP targets have modest or insignificant implications for woodland removal. This is because some HAPs do not set expansion or restoration targets or focus on expansion from improved grassland or arable.

It is interesting to compare the open HAP targets and the maximum contribution from woodland with the woodland HAP (Table 2). Trends in all woodland types apart from wood pasture and parkland are positive.

However, this does not necessarily mean that the policy should constrain removal of woodland to only that which will directly deliver HAP targets. HAP targets are one element of the England Biodiversity Strategy. Restoration and expansion of open habitats that does not directly deliver the targets would still be in line with the Strategy, e.g.: for several relevant Species Action Plans, to buffer designated sites. Nor does it necessarily mean that restoration from woods or forests should be maximised in line with HAP targets. The appropriate contribution to HAP targets of woods and forests should be calculated during the open habitats policy process.

A note on wording.

The policy documents that provide the context for this process use the word "restoration of open habitats from woods and forests". It is clear that this phrase is referring to both "restoration" and "expansion" in the HAP targets. It may be helpful to call this is a policy for restoration or expansion of open habitats from woods and forests

[1] Department for Environment, Food and Rural Affairs (DEFRA) (2006) Working with the grain of nature – taking it forward: Volume I. Full report on progress under the England Biodiversity Strategy 2006, http://www.defra.gov.uk/wildlife-countryside/biodiversity/biostrat/index.htm

Table 1: Open habitat Habitat Action Plan targets (Ha) for England.[2]

Open habitat.	Maintenance, i.e.: total area of habitat to be maintained.	Achieve condition by 2015, i.e.: habitat in unfavourable condition to be brought into favourable condition (as defined).	Restoration by 2015, i.e.: where it has been partly lost, recovering vegetation pertaining to that habitat (as defined).	Expansion by 2015, i.e.: habitat to be created from established land-uses other than that habitat.
Lowland meadows	7,282	6,078	481[3]	256 from improved grassland or arable.
Upland hay meadows	870	830	48[4]	72 from improved grassland or arable.
Lowland calcareous grassland	38,687	32,036	726[5]	8,426 from improved grassland or arable.
Lowland dry acid grassland	20,142	17, 295	285	276 from improved grassland or arable.
Purple moor grass and rush pasture	21,554	19,195	128	151 from improved grassland or arable.
Upland heathland (moor)	220,000	To be confirmed	No target	No target
Lowland raised bogs	11,200	7,466	1,000[6]	No target
Blanket bog	240,000	To be confirmed	No target	No target
Fens	11,200	7,466	1,500[7]	No target
Reedbed	5,200	4,680	No target	1,900[8]
Lowland heathland	58,000	47,000[9]		6,100

Table 2: England HAP targets to 2015 for woodland and forestry (ha)

Open habitat.	Maintenance, i.e.: total area of habitat to be maintained.	Achieve condition by 2015, i.e.: habitat in unfavourable condition to be brought into favourable condition (as defined).	Restoration by 2015, i.e.: where it has been partly lost, recovering vegetation pertaining to that habitat (as defined).	Expansion by 2015, i.e.: habitat to be created from established land-uses other than that habitat.
Native woodland (all)	535,000	375,000	N/A	53,000
Planted ancient woodland sites (PAWS) restoration	88,000	N/A	36,000	N/A.
Wood pasture and parkland	6,000	4,200	400	120

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[2] HAP target figures from Biodiversity Action Reporting System (BARS), http://www.ukbap-reporting.org.uk/ as at 11th Sept 2008.
[3] May include some scrub clearance but unlikely to be seen as woodland loss.
[4] May include some scrub clearance but unlikely to be seen as woodland removal.
[5] May include some scrub clearance, advice from staff is that some of this may be seen as woodland removal.
[6] Areas for restoration identified and prioritised, see Headly and Dargie and Capita Symonds Reports.
[7] Target is to initiate the restoration.
[8] Targets land of low nature conservation interest. Some of this may be wet woodland.
[9] For lowland heathland, the HAP targets combine "achieving condition" and "restoration" under the "achieve condition" target because there is little distinction between operations for condition and restoration. Many of these operations will involve clearance of regenerating woodland.

Annex 4: Calculation of carbon impacts.

Woodland to be removed.	Rotation length	Specific density	Spacing	Sequestration		Substitution	
				Standing volume (>7cm) at end of rotation	Average long-term carbon stock	Harvested biomass (>7cm)	Theoretical abatement over 100 years
Scots pine Yield Class (GYC) 12	65 35	0.41	2.0	367 152	43	740 126	151
Sitka spruce GYC 8 (int. thinning)	65 35	0.35	2.0	299 133	29	505 56	84
Sitka spruce GYC 8 (unthinned)	65 35	0.35	2.0	479 169	46	479 0	72
Scots pine GYC 8 (int. thinning)	76 24	0.41	2.0	310 67	37	584 0	102
Douglas fir GYC 18 (line thinning)	54 36	0.43	1.7	486 300	58	964 372	245
Poplar GYC 14 (unthinned)	27 27 27 19	0.40	2.7	802 802 802 500	107	802 802 802 0	410
Native woodland GYC 4 (continuous cover)	NA	0.55	1.5	176	71	854	48
Native woodland GYC 4 (continuous cover)	NA	0.55	1.5	176	71	854	48
Native woodland GYC 4 (continuous cover)	NA	0.55	1.5	176	71	854	48

For all woodland types, apart from native woodland GYC4, it is assumed that the option for open habitat restoration is made at the economic time of felling. The 100 year period over which the carbon benefits/disbenefits of retaining woodland cover is calculated starts follows felling, assuming immediate re-planting. The carbon associated with the previous crop is not considered.

Standing volumes and production from Edwards and Christie (1981), assuming harvest of first rotation at maximum mean annual increment. Estimates of long-term carbon stocks in standing biomass include root and branch components, calculated according to the approach adopted in the UK GHG inventory (expansion factors of 1.18 and 1.2, respectively) and time-averaged across the two (or more) rotations.

Estimates of substitution savings include cumulative production from the first rotation (and second and third in the case of poplar) together with thinnings (from Edwards and Christie, 1981) from the second/final rotation. Branch biomass is included, assuming an expansion factor of 1.2.

Native woodland (GYC4) is assumed to be mature (age 100 years, extrapolated SAB model from Edwards and Christie, 1981) and retained at the time that the decision over open habitat restoration is made. The woodland is then assumed to be managed on a continuous cover basis with 10 cubic metres per hectare harvested at 5 year intervals, typical for late rotation according to Edwards and Christie.

Specific densities taken from Hamilton and Christie (1974), apart from poplar, for which expert judgement was used from a range of sources. Carbon substitution benefits calculated assuming substitution for coal through co-firing of electricity generation, adopting a conversion factor of 0.71 tonnes carbon saved per tonne carbon in biomass (after El Sayed *et al*., 2003).

Annex 5: Integrating Habitat Action Plans and Species Action Plans.

Can we tell species of conservation concern where they should or shouldn't be?

There are a great many priority species associated with open habitats. The number of rare and declining species associated with such habitats is clearly linked with their decline in area in the face of agricultural reclamation and intensification, afforestation and development over the past century. But it is also the result of their reduced patch size, increased isolation and the decline in active exploitation and management in the modern economy.

Given the above, an increase in area, patch size, connectivity and management is seen as an obvious and necessary step in securing robust, resilient ecological communities capable of coping with change.

Jon Webb of Natural England has undertaken an assessment of the relationship between habitat action plan actions and BAP priority species for heathland.[1] Comparable assessments for other open habitats do not appear to be available, but the conclusions drawn would appear to be applicable to most other extensive open habitats targeted in the UK BAP.

Integrating Species into Habitats: Heathlands as an Example

Webb approached various specialists for data on "heathland" species, examining niche and resource requirements.

Some 90 species were identified as being closely associated with heathland. The vast majority were invertebrates, with a large number of plants but only a handful of vertebrates (Table 1).

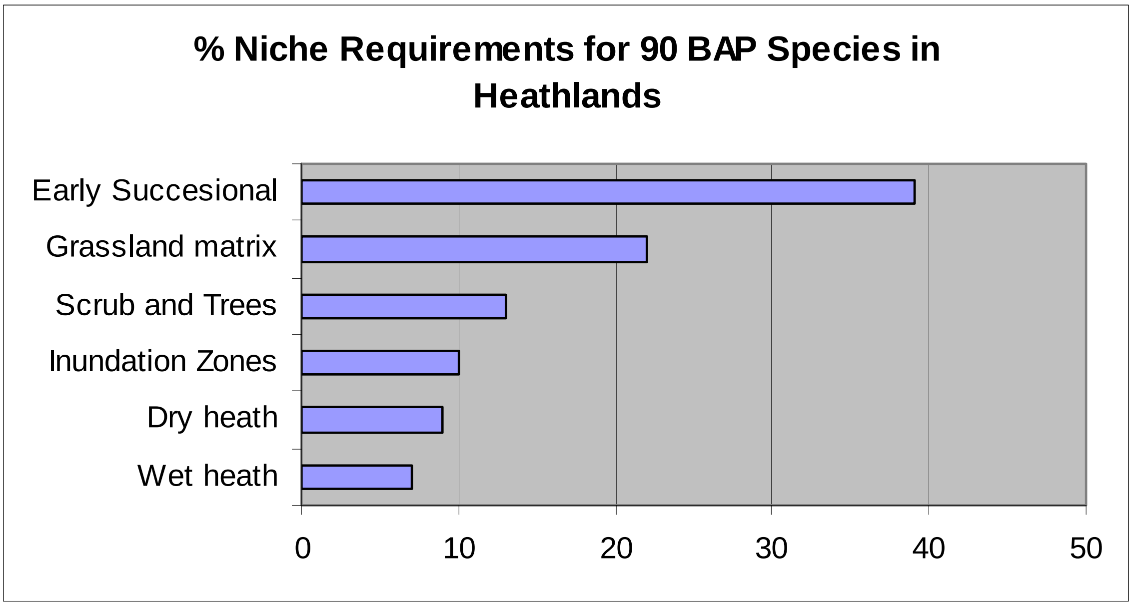
Table 1: Species associated with heathland.

Mammals	0
Birds	4
Amphibians and reptiles	6
Invertebrates	55
Vascular Plants	16
Lower Plants (mosses and liverworts only)	9

[1] Web, J (2008) per's comm.

The niche requirements identified emphasised the need for "openness" amongst these species, with most requiring early successional stages, wet or dry heathland or grassland habitat. Only some 12% were associated with scrub and trees.

Table 2:



There was also considerable geographical specificity amongst many heathland priority species, emphasising a need to address national conservation objectives in a tightly specified regionally specific way (Table 3).

Table 3: Geographical Ranges of 'heathland' species

Brecks	6
Northern Heathlands	2
Southern Heathlands	30
Heathlands Throughout	19
Restricted to 1-5 sites	33

Of the invertebrates, lower plants and vascular plants, most were site restricted species, of limited ability to colonise new or restored habitat in well tightly defined niches.

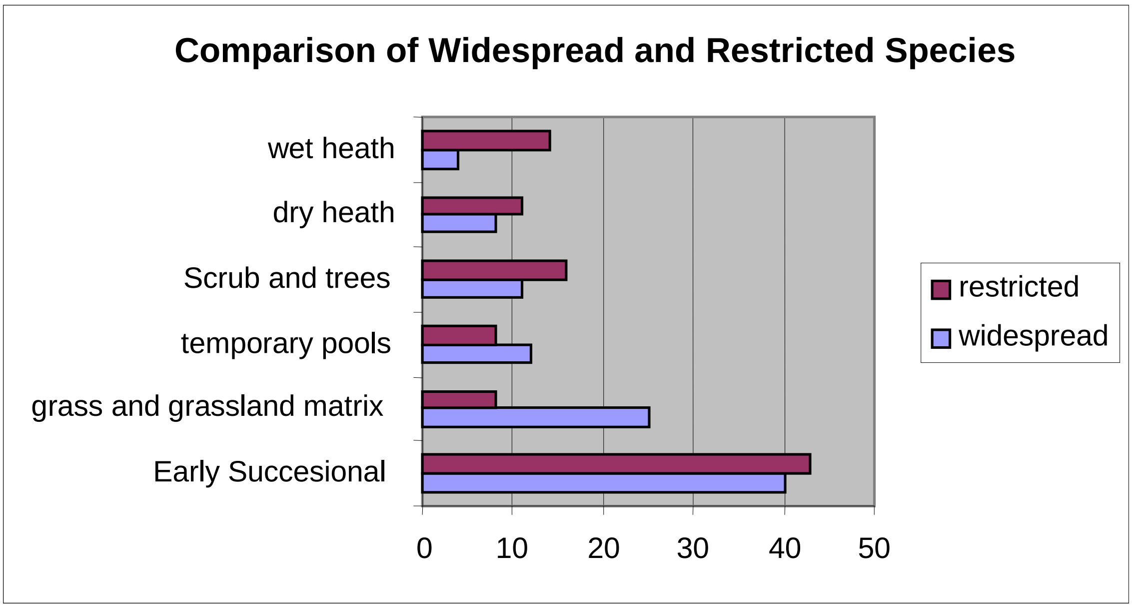
The rarer reptiles were exacting as to site conditions, requiring south facing slopes, tight mosaics of varying vegetation cover, and in the case of the sand lizard, open sandy sites for egg laying. Fragmentation of habitat into small islands was clearly an issue for rare reptiles and amphibians.

None of the rarer mammals were strictly associated with heathland.

There were clear taxonomic differences, with many insects, especially beetles, requiring very local conditions that could be provided at a very small scale, and with other groups, notably the hymenoptera amongst the insects, requiring more complex landscapes. These taxonomic differences can also be strongly represented in regional assemblages of rarities (rare beetles a speciality of the Brecks for example, and rare bees and flies in Dorset and the New Forest).

A comparison of widespread and restricted species was revealing, emphasising the importance of maintaining the whole range of heathland habitats and vegetation structures in any successful species conservation strategy (Table 4). Only 9% of heathland species were dependent on ericaceous heath being present; many more were dependent on bare ground, temporary pools, heavy grazing or other features of heath rather than the presence of heather.

Table 4:



Webb concludes that HAPs should focus on the range of niches that a habitat provides, via appropriate management regimes. In doing so the heathland ‘ecosystem’ Action Plan could communicate general heathland management principles, support the use of restricted species as the basis of site-based management within HAPs, and use the more geographically limited species as the basis of devolved regional accountability for species conservation.

A more general conclusion was that there was no reason why this approach should not work in other open habitat ecosystems.

Based on a presentation by Jon Webb, Project Manager: England Biodiversity Strategy Integration Project in May 2008.