Summary: Intervention & Options

Department /Agency:	Title:	
Forestry Commission	**Impact Assessment of "Restoration and expansion of open habitats from woods and forests: Government policy**	
Stage: Consultation	**Version:** 4	**Date:** 28 November 2008

Related Publications: Restoration of open habitats from woods and forests: process for developing policy. Restoration of open habitats from woods and forrests: evidence.

Available to view or download at:

http://www.forestry.gov.uk/england-openhabitats

Contact for enquiries: Dominic Driver **Telephone:** 0117 906 6003

What is the problem under consideration? Why is government intervention necessary?

Restoration and expansion of open habitats is an element of delivering the England Biodiversity Strategy. Woods and forests provide a potential resource for such restoration and expansion. However, the woods and forests already deliver a range of public goods. In addition, removal of woods and forests can be perceived negatively by many people. We need a policy to enable effective decision making about removal or retention of woods and forests on potential open habitat. This is to ensure that we end up with a landscape that delivers the greatest possible public benefit.

What are the policy objectives and the intended effects?

To develop a clear rationale to guide decisions about the removal or retention of plantations and woodland where Biodiversity Action Plan (BAP) open habitats can be restored.
Desired outcomes: Ecological communities able to cope with threats (key driver) , financially viable land management, no net deforestation in England, positive engagement by local and other users, biodiversity benefits and climate mitigation costs balanced, timber sector confidence not reduced, woodland biodiversity retained or enhanced.

What policy options have been considered? Please justify any preferred option.

At this consultation stage there are still several dependencies. Therefore, this analysis focusses on the reasomable range of scales of intervention over 10 - 15 years. Three scenarios are analysed:
High: based on Habitat Action Plan (HAP) targets: 30,000ha, 3,000 ha per year.
Middle: based on avoiding net deforestation: 16,500ha, 1,100ha per year
Low: based on remedies to bring SSSI into target condition: 5,600 ha, 370 ha per year.
A "do nothing" option is not analysed because this would not meet the policy objective.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

2012 - in line with Delivery Plan for England's Trees Woods and Forests (ETWF).

Ministerial Sign-off For **Impact Assessments:**

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:

..... Date:

Summary: Analysis & Evidence

Policy Option: Low intervention	**Description: 5,600 ha over 10 - 15 years, 370 ha per year**

COSTS

ANNUAL COSTS	
One-off (Transition)	**Yrs**
£ 0.17M	3
Average Annual Cost (excluding one-off)	
£ 0.75	

Description and scale of **key monetised costs** by 'main affected groups' Net cost of conversion woods to open habitat: £0.43M yr-1. Net additional cost of management of open habitat: £0.046M yr-1 cumulative, £0.28M yr-1 average. Amin. 20% conversion costs: £0.086M yr-1. Carbon emissions (drop in long-term average carbon store and potential for abatement by subsitution) :£0.045M

Total Cost (PV) **£ 10.5M**

Other **key non-monetised costs** by 'main affected groups' 1% reduction in timber availability, possible negative impact on timber sector business acvtivity.

BENEFITS

ANNUAL BENEFITS	
One-off	**Yrs**
£	
Average Annual Benefit (excluding one-off)	
£	

Description and scale of **key monetised benefits** by 'main affected groups'

Total Benefit (PV) **£**

Other **key non-monetised benefits** by 'main affected groups' Net change in the value of non-use benefits of biodiversity through conversion of woodland into open habitat.

Key Assumptions/Sensitivities/Risks Assumed a linear rate of conversion of open habitat. Assumed the amount of each habitat converted is proportional to total potential habitat under woodland.

Price Base Year 2008	Time Period Years 15	**Net Benefit Range** (NPV) **£ ?**	**NET BENEFIT** (NPV Best estimate) **£ ?**

What is the geographic coverage of the policy/option?	England
On what date will the policy be implemented?	June 2009
Which organisation(s) will enforce the policy?	FC and NE
What is the total annual cost of enforcement for these organisations?	£ 0.086
Does enforcement comply with Hampton principles?	Yes
Will implementation go beyond minimum EU requirements?	No

What is the value of the proposed offsetting measure per year?			£ N/A	
What is the value of changes in greenhouse gas emissions?			£ 0.65M	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	No	No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase £ ? Decrease £ ? **Net** £ ?

Key: **Annual costs and benefits: Constant Prices** **(Net) Present Value**

Summary: Analysis & Evidence

Policy Option: Middle	**Description: 16,500 ha, 1,100 per year**

COSTS

ANNUAL COSTS	
One-off (Transition)	**Yrs**
£ 0.17M	3
Average Annual Cost (excluding one-off)	
£ 2.2	

Description and scale of **key monetised costs** by 'main affected groups' Net cost conversion woods to open habitat: £1.3Myr-1. Net additional cost management of open habitat: £0.14Myr-1 cumulative, average £0.82M. Admin. costs 20% conversion costs: £0.26M. Carbon emissions (reduction in long-term average carbon store and potential for abatement through subsitution) :£0.13M

Total Cost (PV) **£ 31M**

Other **key non-monetised costs** by 'main affected groups' 3% reduction in timber availability possible negative mpact on timber sector economic activity.

BENEFITS

ANNUAL BENEFITS	
One-off	**Yrs**
£	
Average Annual Benefit (excluding one-off)	
£	

Description and scale of **key monetised benefits** by 'main affected groups'

Total Benefit (PV) **£**

Other **key non-monetised benefits** by 'main affected groups' Net change in the value of non-use benefits of biodiversity through conversion of woodland into open habitat.

Key Assumptions/Sensitivities/Risks Assumed a linear rate of conversion of open habitat. Assumed the amount of each habitat converted is proportional to total potential habitat under woodland.

Price Base Year 2008	Time Period Years 15	**Net Benefit Range** (NPV) **£ ?**	**NET BENEFIT** (NPV Best estimate) **£ ?**

What is the geographic coverage of the policy/option?	England
On what date will the policy be implemented?	June 2009
Which organisation(s) will enforce the policy?	FC and NE
What is the total annual cost of enforcement for these organisations?	£ 0.26M
Does enforcement comply with Hampton principles?	Yes
Will implementation go beyond minimum EU requirements?	No

What is the value of the proposed offsetting measure per year?			£ N/A	
What is the value of changes in greenhouse gas emissions?			£ 1.9M	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	Yes/No	Yes/No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase £ ? Decrease £ ? **Net** £ ?

Key: **Annual costs and benefits: Constant Prices** **(Net) Present Value**

Summary: Analysis & Evidence

Policy Option: Higher	**Description: 30,000ha, 3,000ha per year**

COSTS

ANNUAL COSTS	Description and scale of **key monetised costs** by 'main affected groups' Net cost of conversion woods to open habitat: £3.5Myr-1. Net additional cost of management of open habitat: £0.37Myr-1 cumulative, average £2.2Myr-1. Admin costs 20% conversion costs: £0.70M. Carbon emissions (reduction in long-term average carbon store and potential for abatement through subsitution) :£0.36M
One-off (Transition) **Yrs**	
£ 0.17M	
Average Annual Cost (excluding one-off)	
£ 6.1M	**Total Cost** (PV) **£ 66M**

Other **key non-monetised costs** by 'main affected groups' 6% reduction in timber availability possible negatve impact on timber sector economic activity.

BENEFITS

ANNUAL BENEFITS	Description and scale of **key monetised benefits** by 'main affected groups'
One-off **Yrs**	
£	
Average Annual Benefit (excluding one-off)	
£	**Total Benefit** (PV) **£**

Other **key non-monetised benefits** by 'main affected groups' Net change in the value of non-use benefits of biodiversity through conversion of woodland into open habitat.

Key Assumptions/Sensitivities/Risks Assumed a linear rate of conversion of open habitat. Assumed the amount of each habitat converted is proportional to total potential habitat under woodland.

Price Base Year 2008	Time Period Years 15	**Net Benefit Range** (NPV) **£ ?**	**NET BENEFIT** (NPV Best estimate) **£ ?**

What is the geographic coverage of the policy/option?	England
On what date will the policy be implemented?	June 2009
Which organisation(s) will enforce the policy?	FC and NE
What is the total annual cost of enforcement for these organisations?	£ 0.70M
Does enforcement comply with Hampton principles?	Yes

Will implementation go beyond minimum EU requirements?			No	
What is the value of the proposed offsetting measure per year?			£ N/A	
What is the value of changes in greenhouse gas emissions?			£ 5.3M	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	Yes/No	Yes/No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices)				(Increase - Decrease)
Increase	£ ?	Decrease	£ ?	**Net** £ ?

Key: **Annual costs and benefits: Constant Prices** **(Net) Present Value**

Evidence Base (for summary sheets)

[Use this space (with a recommended maximum of 30 pages) to set out the evidence, analysis and detailed narrative from which you have generated your policy options or proposal. Ensure that the information is organised in such a way as to explain clearly the summary information on the preceding pages of this form.]

1. Introduction.

The England Biodiversity Strategy includes restoration and expansion of open habitats to combat their decline over the last few hundred years and contribute to targets to halt loss of biodiversity. During the 20th Century large areas of heathland, moorland, wetland and unimproved grassland – what are now considered to be priority open habitats - were planted with conifers for timber production. On other sites these open habitats were colonised by birch and pine due to lack of grazing or other management (Table 1). These woods and forests now have many public values, but there is increasing interest in removing the trees and restoring them to open habitats. The England Biodiversity Strategy includes targets for restoration and expansion of open habitats as part of delivering biodiversity objectives. Woods and forests provide a potential resource for this. However, woods and forests already provide a range of public goods. England's Trees Woods and Forests (ETWF) includes a task to "produce a clear rationale to guide removal of inappropriate plantations and woodland where other key open habitats can be restored and where the benefits of doing so outweigh the environmental and social costs".

We are developing a policy to provide this rationale. At this stage there are dependencies and undetermined balances between potentially competing priorities. This means that there are numerous policy options available. For simplicity, we focus in this assessment on a range of scales and rates of interventions. Following the consultation we will be presenting coherent policy options, the impact of which will be assessed.

The policy is assumed to operate over 15 years, to fit in with the timescale of ETWF.

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

Habitat Action Plan	Potential habitat under plantation.		Potential habitat under native woodland		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.[2]	
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.[3]
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, 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.

[1] 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.

[2] 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.

[3] We estimate that 66% of the grassland resource is in southern England.

Habitat Action Plan	Potential habitat under plantation.		Potential habitat under native woodland		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.	
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.[4].	c.20,000	Mixed regeneration mainly birch with some Scots pine.	Mainly southern or central.[5]
TOTAL	86,700		45,200		

We analysed the impact of removing this woodland and forest to restore open habitat for 16 factors derived from ETWF (Table 2). A detailed discussion can be found at www.forestry.gov.uk/england-openhabitats. This analysis showed that the key impacts that need to be monetised are on:

Biodiversity.

Carbon emissions

Timber sector economic activity.

Conversion, long-term management, and administrative costs.

Table 2: Likely impact of removing woods and forests to restore and expand open habitats from woods and forests.

ETWF theme	Factor	Likely impact	Comments
A sustainable resource.	Financial viability of land management.	Negative.	Woods and forests on average cost less to manage than open habitats. The net cost of managing open habitats ranges from £60 to £800 per hectare with a typical cost of about £200ha per year. Preventing tree growth and managing access is the main cost. The average cost of woodland management is £61per ha per year, timber income ranges from £180 per ha per year to £40 per ha per year.
	Avoiding net deforestation in England.	Negative or little impact.	The area of woodland or forest in England has been expanding for about 100 years. If the rate of woodland or forest removal goes above a threshold the area could start to decrease. Our current calculation of this threshold is 1,100ha per year.

[4] 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.

[5] We estimate that 75% of the lowland heathland resource is in southern England.

ETWF theme	Factor	Likely impact	Comments
Climate change.	Ecological communities able to cope with threats, particularly climate change, so that biodiversity is maintained or enhanced.	Positive.	Likely to help the development of ecological communities that can cope with threats, climate change being the main threat. This should help reduce loss of biodiversity. Having a lot of variation in the landscape appears to be helpful as does developing large areas of semi-natural habitat. Therefore, mosaics of woodland and open habitat appear useful.
	Carbon balance.	Negative.	There is a reduction in long-term (100 years) average carbon store of 168 tonnes of carbon dioxide equivalent per hectare of woodland removed (tCO_2eha-1). There is a reduction in the long-term potential for reducing carbon emissions through substituting wood for higher carbon products of $289tCO_2eha-1$.[6] The total negative impact on carbon balance is therefore $457tCO_2ha-1$. Under the possible range of woodland removal the contribution of England's woods and forests to reducing carbon emissions could be reduced by between 1% and 3%. This is a maximum negative impact on England's total carbon emissions of 0.1%. The cost of the impact is £0.5 million to £5 million.

[6] Based on an assumption that all the wood is mixed with coal for power generation ("co-firing"). The calculations are discussed in more detail below.

ETWF theme	Factor	Likely impact	Comments
Natural environment.	Positive trends in populations of open habitat species.	Positive.	See 'Ecological communities" factor above.
	Quality of life and landscape.	Little impact.	There could be significant changes in the landscape. However, these changes are unlikely to take the landscape across thresholds whereby there are significant impacts on quality of life. However, if the process is handled badly or if the resulting landscapes are poorly designed there could be significant negative impacts. Conversely, there could be opportunities to make improvements in the landscape. Therefore, it is important that landscape guidelines are followed.
	Learning about landscape history.	Little impact.	A historic landscape will be restored. However, historic environment policy does not demand recreation of a particular type of landscape. Provided appropriate interpretation is used people will be able to learn how history has shaped the landscape whether or not woodland is removed.
	Preservation of historic environment.	Positive or negative.	Potential to improve the setting and access to the historic environment. Potential to damage heritage features through inappropriate operations or subsequent management. It is important that guidelines are followed.
	Commitments on native and, or, ancient woodland.	Little impact.	There is a clear policy framework protecting ancient and native woodland. Restoration of open habitats from well-established native woodland is difficult so they are unlikely to be targeted anyway.
	Desired trends in woodland biodiversity not compromised.	Little impact.	The woodlands most likely to be targeted tend to be the less biodiverse. However, policy will need to be flexible to respond to local conditions. There is a particular issue with wet woodlands being targeted for removal to restore fen or reedbed. We can resolve this through guidance. There will be a presumption against removal of ancient woodland or recent but mature native woodland.
	Water quality and yield maintained.	Little national impact or local impacts vary.	On a national or regional scale there is little impact. Local impacts vary, but should be low if good practice followed.
	Soil condition maintained.	Little impact.	If good practice is followed.
	Air, light and noise pollution abated.	Little impact.	Trees have significant local role as visual screens, but whole woodland blocks are not required. Such screens can be easily accommodated in open habitat projects.

ETWF theme	Factor	Likely impact	Comments
Quality of life.	Positive engagement by local and other users.	Negative or little impact.	Without high quality local engagement local users can feel that they have no say in changes to their local landscape. This can result in reduced benefits to those people. It can also result in opposition from the local community to projects to remove woodland. Therefore, high quality local engagement in decisions about the initial proposals is important. If you have this type of process there can be a positive impact if the proposals can meet local aspirations.
	Access and recreation.	Little impact.	While the landscape may change significantly it is unlikely to change across thresholds where access patterns are significantly changed. There could be an exception where heathland restoration results in more conflict between the needs of recreational users and the needs of ground nesting birds.
Business and markets.	Timber sector confidence.	Negative.	There will be little impact on hardwood timber production. Softwood timber production could be reduced on a regional scale by between 8 and 1%. We do not fully understand the relationship between the reduction in timber production and timber sector business activity. We are working to fill this gap.

2. Monetising the impact.

2.1 Biodiversity benefits.

There is evidence that removing woods and forests to restore or expand open habitat will have significant biodiversity benefits in certain circumstances. There is strong evidence that failing to achieve biodiversity benefits will be costly, e.g.: Braat, L and ten Brink, P (ed's) (**2008***) The Cost of Policy Inaction: The case of not meeting the 2010 biodiversity target.* However, there is also evidence that the woods or forests that might be removed under this policy have biodiversity value.

Any valuation must take account of the net impact of marginal change – the impact of losing some woodland must be assesed against the impact of gaining some open habitat. Table 3 shows that the changes directed by the policy, including biodiversity benefits, will have little impact on direct and indirect use values. Therefore, the impact will be on non-use values.

There are several examples of potentially relevant studies cited in Economics and Funding SIG (**2007**) *Valuing the benefits of biodiversity*, Defra:

Studies of residents in Cambridgeshire gave direct use and non-use value of action to halt biodiversity loss in the county at £16.6M per year.

A study of the non-use value of Natura sites in Scotland gave a value of £211M per year across the UK.

Studies in Cambridgeshire and Northumberland gave direct use and non-use values for conserving rare unfamiliar species or rare and common familiar species of between £189 and £94 per year per household.

Studies of the direct use and non-use value of restoration of existing habitats in Cambridgeshire and Northumberland found values of £34 - £71 per year per household.

A study of the non-use value of biodiversity in woodlands in Britain found a value of £386M per year.

A study of the non-use value attributed to increases in the area of different types of woodland gave figures ranging from £0.35 per household per year for a 12,000ha increase in the area of upland conifers to £1.13 per household per year for a 12,000 ha increase in lowland ancient woodland.

These studies indicate that the non-use vallue of the bioiversity benefits of both woodland and open habitat are high. Howver, they are not comparable nor can they be scaled up to a national picture. We know of no studies that provide direct evidence of the net change in value as a result of restoring or expanding open habitat from woodland.

2.2: Carbon costs.

To calculate the impact on greenhouse gas balance we have taken three elements into account:

The process of restoring or expanding open habitats can result in carbon emissions – policy is likely to require adoption of good practice to minimise emissions so the impact is considered to be minor.

Removal of woods and forests to restore open habitats results in a reduction in the long-term average carbon store on the site.

Removal of woods and forests reduces the opportunity for timber to be used as a substitute for higher carbon materials or fuel.

Long-term average carbon store: We calculate the reduction in long-term average carbon store as 168tons of carbon dioxide equivalent per hectare of woodland removed (tCO_2e per ha)[7] taking into account only above ground biomass (Table 3).

Substitution: Restoration results in a loss of potential for harvested wood products to substitute for higher carbon materials such as oil for fuel, or concrete and steel for construction. We believe that we should take account of changes in long-term average carbon storage and loss of potential to reduce emissions due to substitution. The evidence on the size of this impact is uncertain. Forest Research has a project to develop accurate figures, the Forest Carbon Review[8]. We will use the most accurate figures available at each stage of the policy process. In the meantime, for illustration, if we assume that all the wood is mixed with coal for power generation ("co-firing") the loss of potential to reduce carbon emissions is 289tCO_2e per ha over and above the reduction in long-term average carbon store.

[7] Average weighted for area of woodland or forest on potential open habitats, This includes an assumption of little impact for carbon in peatland soils, see evidence paper for detailed discussion..

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

Table 3: : Changes in carbon balance due to removal of woodland or forest for restoration and expansion of open habitats (tCO_2e per ha).

Land use change	Wood or forest pre-restoration		Restored open habitat		Change on restoration	
	Long-term carbon store	Theoretical abatement over 100 years due to product substitution.	Long-term carbon store	Theoretical abatement over 100 years due to product substitution.	Long-term carbon store	Theoretical abatement over 100 years due to product 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
Pine or poplar yield class 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

We can therefore conclude that the total negative impact on carbon balance is $457tCO_2e$ per ha on average over 100 years. Under the range of interventions the contribution of England's woods and forests to reducing carbon emissions could be reduced by between $0.026MtCO_2$ per year and $0.14MtCO_2$ per year. This is between 1% and 3% of the total rate of sequestration by woods and forests in England of $4MtCO_2e$ per year. The maximum reduction is therefore 0.1% of total carbon emissions for England.

We calculated the carbon impacts using the following assumptions (Table 4):

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 thinning (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).

Table 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

The cost of this impact over 15 years is between £5.3M and £0.65M (Net Present Value) (calculated using See shadow price of carbon according to Defra guidance, see http://www.defra.gov.uk/Environment/climatechange/research/carboncost/index.htm)

2.3: Reduction in timber sector economic activity due to reduction in timber availability.

Woodland removal for restoration or expansion of open habitat could eventually have an impact on the timber producing and primary processing sector, because the amount of timber and other harvested wood will be reduced.

Hardwood: There are about 43,200ha of native woodland on potential open habitat. 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.

Softwood: There are about 86,700ha of conifer plantations on potential open habitats in England. Due to high transport costs the timber 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 analysed the impact on softwood production according to these zones.

We estimate the reduction in softwood production under the scenarios could range from 1% to 7% in the Southern zone, 1% to 8% in the Central zone, and 1% to 4% in the Northern zone. This equates to a reduction England-wide of between 6 and 1% (Table 5).

Table 5: 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)[9]	Total area of conifers (ha)[10]	Total potential loss of production under scenarios.		
			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%

Impact on businesses: The contribution to England's Gross Domestic Product (GDP) of production, primary and secondary processing of English grown timber is estimated at £2.1 billion or 0.1% of England's GDP employing 64,000 Full Time Equivalents (FTE) [11] 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 £3.3M and £18M (Net Present Value) (Table 6). These are hypothetical maximum figures only because the relationship between product supply, competition, business confidence, investment and ultimately on jobs is complex. We have asked for further evidence as part of the consultation. In the meantime, we do not consider these figures to be robust enough to be presented in the impact summaries.

[9] Figures from Table 1.

[10] Figures from the NIWT 1998.

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

Table 6: Theoretical maximum impact of reduction in timber supply on timber sector business activity.

	Higher	Intermediate	Lower
Impact on GDP (£ Net Present Value)	17,877,549	9,754,937	3,310,767

Assuming no impact for 20 years, discount factor 0.5026.

2.4: Net cost of converting woodland to open habitat and additional net cost of managing open habitat converted from woodland.

The average cost of converting woodland into open habitat is £1,164 per ha (Table 7)

Table 7: Cost of converting woodland into open habitat.

Land use change	Area (ha)	Net cost of conversion (including net profit from timber)
Scots pine GYC 12 to lowland heathland	60,000	1,245
Sitka spruce GYC 8 (thinned) to upland heathland.	20,000	150
Sitka / Norway spruce (some Lodgepole pine) yield class 8 (unthinned) to lowland raised bog	500	4,975
Sitka / Norway spruce (some Lodgepole pine) yield class 8 (unthinned) to blanket bog.	5000	500
Scots pine GYC 8 to lowland dry acid grassland	300	517
Douglas fir and Sitka spruce GYC 18 to purple moor grass and rush pasture	300	575
Poplar GYC 14 to fen	600	517
Native woodland GYC 4 to lowland calcareous grassland	20,000	2,063
Native woodland GYC 4 to lowland dry acid grassland	3,000	830
Native woodland GYC 4 to purple moor grass and rush pasture	200	517
Native woodland GYC 4 to fens	1,000	575
Native woodland GYC 4 to reedbed	1,000	817
Native woodland GYC 4 to lowland heathland	20,000	1,245
Average		1,117
Average weighted by area		1,164

Costs from 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. Lowland heathland costs from Forest Enterprise England and Tomorrow's Heathland Heritage.

The average net additional cost of managing open habitat once restoration is complete is £124 per ha per year, assuming the absolute cost is £100 per ha per year (Table 8).

Table 8: Net cost of managing open habitat (£ per ha per year)

Land use change	Average annual timber income foregone	Cost of managing woodland	Cost of managing open habitat	Net cost of management
Scots pine GYC 12 to lowland heathland	120	61	100	159
Sitka spruce GYC 8 (thinned) to upland heathland.	80	61	100	119
Sitka / Norway spruce (some Lodgepole pine) yield class 8 (unthinned) to lowland raised bog	80	61	100	119
Sitka / Norway spruce (some Lodgepole pine) yield class 8 (unthinned) to blanket bog.	80	61	100	119
Scots pine GYC 8 to lowland dry acid grassland	80	61	100	119
Douglas fir and Sitka spruce GYC 18 to purple moor grass and rush pasture	180	61	100	219
Poplar GYC 14 to fen	140	61	100	179
Native woodland GYC 4 to lowland calcareous grassland	40	61	100	79
Native woodland GYC 4 to lowland dry acid grassland	40	61	100	79
Native woodland GYC 4 to purple moor grass and rush pasture	40	61	100	79
Native woodland GYC 4 to fens	40	61	100	79
Native woodland GYC 4 to reedbed	40	61	100	79
Native woodland GYC 4 to lowland heathland	40	61	100	79
Average				116
Average weighted by area				124

These figures equate to a total cost of conversion over the period of the policy of £3.5M, £1.3M and £0.43M per year depending on the policy scenario. This gives the total cost of conversion over the lifetime of the policy as £30M, £15M or £5M (NPV).

Evidence from recent projects on open habitat restoration (e.g.: Tomorrow's Heathland Heritage) show that about 50% of this cost is to the Government with the rest being contributed mainly by non-public grants such as the lottery.

The cost of management is cumulative. Assuming the rate of restoration or expansion is linear the total cost is £24M, £10M, or £3.5M (NPV) over the lifetime of the policy . The dominant source of funding for open habitat mangement is Environmental Stewardship. The standard grants cover about 70% of the cost of management so we can assume that 70% of the management cost will be to Government.

The greater the proportion of restoration on the FC estate the higher the % cost to Government for both conversion and management. The above are operational costs. Administrative costs (e.g.: cost of administering Environmental Impact Assessment) can be assumed to be 20% on

top of the conversion costs (GHK Consulting (2006)). Therefore, the total cost of delivering the policy scenarios is £61M, £27M, or £9M (NPV) over 15 years..

Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Type of testing undertaken	*Results in Evidence Base?*	*Results annexed?*
Competition Assessment	No	No
Small Firms Impact Test	No	No
Legal Aid	No	No
Sustainable Development	No	No
Carbon Assessment	Yes	No
Other Environment	Yes	No
Health Impact Assessment	No	No
Race Equality	Yes	Yes
Disability Equality	Yes	Yes
Gender Equality	Yes	Yes
Human Rights	No	No
Rural Proofing	No	No

Annexes

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