Forestry Commission England

Project Report

Open habitats and open habitat potential on the Forestry Commission Public Forest Estate in England

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Contents.

Open habitats on the Forestry Commission Public Forest Estate in England and the potential for their further extension.

1. Executive summary

This report assesses the extent and character of the open habitat on the Forestry Commission (FC) Public Forest Estate in England and considers the remaining potential for further restoration. The report is part of the process to develop Government policy on restoring and expanding open habitats from woods and forests in England (see www.forestry.gov.uk/england-openhabitats). The key driver of this policy is biodiversity but the process takes account of all elements of the Government's strategy for England's trees, woods and forests: a sustainable resource, climate change, natural environment, quality of life and business and markets. The policy will develop a way of deciding when it is right to remove woods and forest to restore or expand open habitats and when it is right to retain the woods and forests.

The report provides evidence about the possible implications for one of the delivery mechanisms for policy, the Public Forest Estate. This and other strands of evidence will be taken into account as the Forestry Commission develops options for Ministers to consider.

A strategy for restoring open habitats on the Public Forest Estate will be produced to follow policy once a policy is in place. This report is not an initial version of this strategy although it does provide information that could be useful. How much open habitat restoration and where it is done on the Public Forest Estate depends on policy and the eventual response of the Public Forest Estate.

The costs of restoration, the costs of ongoing management and the impact on future timber yield are considered alongside the implications for Carbon management.

The Public Forest Estate and areas of open habitat. The Public Forest Estate in England is some **258,972ha** in extent. Of this **36,045ha** is existing open, unwooded, habitat. Forest Design plans identify a further **12,415ha** to be restored over the next 20 years.

Study of the remaining forest area indicates a further **54,674ha** of plantation and woodland that could be restored to open habitat. This covers **36,958ha** of freehold land and **17,516ha** of leasehold land. Subsequent analysis is focussed on the freehold land because of the constraints on most leasehold land.

Social acceptance of change from forest to open habitat. This section of the survey was tentative given the difficulty of pre-judging likely local reaction to proposals.

Nevertheless, we believe that our judgements are sufficiently robust to draw some tentative conclusions at this national scale. Of the potential habitat on the freehold areas of the estate, some **10%** (c. 3,800) could probably be restored with little risk of adverse reaction from current public users of the Public Forest Estate. About **32%** (some 11,800ha) would probably generate adverse reaction from users of the Public Forest Estate. Across the remaining **57%** (c. 21,700ha in total) extensive restoration would probably not generate such significant adverse reaction. However, it may be necessary across this area to manage local reaction through detailed local participation. Additionally, the extent of open habitat restoration emerging, following plan preparation and consultation, would probably be less than the full potential identified.

The restoration and management costs associated with the existing, planned and potential open habitats were explored, as was the impact on future timber yield.

Impact on Timber. Across the total area that has potential for restoration, an area of conifer plantation of YC 10 and below of **5,032ha** was identified. Conversely an area of **6,890ha** of high yielding plantations with a yield class greater than 16 was also identified.

A large area of the conifer plantation in YC lower than 10 was Scots pine (some **1,962ha**); a large area of Corsican pine currently ascribed to YC 12 –14 was also identified (some **9,367ha**).

The production forecast for the total freehold area with potential for restoration as open habitat is evenly spread across the **period 2010 to 2060**, with some **5,000ha a year** destined for felling and replanting in each decade.

When the **12,415ha** of planned open habitat restoration in current Forest Design Plans is concluded it will reduce forecast timber production by an estimated **114,000m3** per annum.

For illustration, a hypothetical programme of restoration of the entire **36,958ha** of the remaining potential open habitat would lead to a long-term reduction in timber production of **388,000m3** or **33%** of the current overall annual production from the Public Forest Estate in England.

Red Band Needle Blight (*Dolistroma septosporum*) is recognised as having considerable impact on the future of Corsican pine in forestry in England. In considering the future yield of established and restocked Corsican pine stands the Yield Class has been viewed as being at least one class lower than that currently recorded.

Regional Variation. The variation in potential open habitat between English Regions is considerable; the majority by far, over 14,000ha, lies in the East of England. Elsewhere the potential ranges from just over a thousand hectares in the South East to over 7,000ha in the North West. The variation lies not only in the area; the contribution to biodiversity outcomes, the costs of restoration and subsequent management and the impact on future

timber production all vary considerably, and in ways not strictly linked to potential area alone.

Restoration Costs. Estimates of the costs of undertaking the planned restoration of **12,415ha** to open habitat is calculated as a one off cost of **£16.8m** (**c. £1,350 per hectare).**

For illustration, using the average restoration cost of **£1,350 per hectare** above, a hypothetical comprehensive restoration programme of the remaining freehold with potential for open habitat would cost **£49.86m.**

Again, for illustration a restoration programme aiming at delivering **1,000ha per annum** of open habitat restored would require **c. £1.35m** in additional funding per annum.

Ongoing Management Costs. Ongoing costs have also been explored in detail. The current cost of managing open habitat across the Public Forest Estate in England is approximately **£2.09m per annum**.

The cost of managing the additional restored area of planned open habitat will be in the order of **£3.1m per annum**, leading, over time to a total annual cost of managing open habitat on the England Public Forest Estate of some **£5.19m**

By way of illustration, if all the remaining potential open habitat across the freehold of the Public Forest Estate were restored then the annual management costs would be in the order of **£11.7 million** (an average cost of **c. £317** per hectare per year).

The capital outlay of fencing those areas best managed for biodiversity through appropriate grazing regimes is more difficult to ascertain but would not be more than an additional **£3.7m**. For illustration, if all the area best managed through grazing were placed under grant support to tenants via Higher Level Stewardship payments the call on public funding would be **£1.3m** per annum..

Carbon Management and Open habitat restoration. The Carbon account of the Public Forest estate would be significantly changed under any significant programme of open habitat restoration through:

- A reduction in the standing crop of stored carbon per hectare.
- A reduction in the capacity of the Public Forest Estate to contribute to the provision of alternatives to high embedded carbon building materials and fossil fuels (product displacement).

Assuming all the potential open habitat was restored, the stored carbon lost to atmospheric carbon dioxide would be in the order of **7million tonnes of CO2**.

The combined impact on carbon storage and product displacement would amount to **20.5 million tonnes of CO2**. This would be sufficient to result in the Land Use Change and

Forestry element of Greenhouse Gas Inventory of the UK shifting from sink to source over the period of the implementation (assuming felling at economic maturity).

The impact of open habitat restoration on existing wildlife interest is discussed (along with some specific examples where change might be detrimental to important populations of birds).

2. Introduction

Creating more open habitat on any meaningful scale would have a considerable impact on wildlife interests, timber production, production forecasting and the carbon budget across the Public Forest Estate. There would be a significant impact on management costs as the balance shifts between assets that generate income to liabilities that require regular management expenditure for their maintenance.

Government policy on the restoration and expansion of open habitats from woods and forests will determine how the above factors are taken into account. The public consultation for this will run between March 2009 to June 2009 (see www.forestry.gov.uk/england-openhabitats-consultation). A restoration strategy for the Public Forest Estate will be produced to follow policy once a policy is in place. The output of the Study of the Long-term role of the Public Forest Estate due to be completed in early 2010 (see www.forestry.gov.uk/england-estatestudy) will also guide the response of the Public Forest Estate. Ultimately individual Forest Design Plans and consultation on these plans will determine the details of what happens on a site by site basis.

This report provides general quantitative information on the extent of existing, planned and potential open habitat and explores some of the implications of extending the area of open habitat restoration further. Evidence presented in this report will inform policy formulation and help to guide future delivery.

The management of public land is just one of the delivery mechanisms for which the emerging open habitat policy will have implications. Others include public funding, guidance and standards, and further research. Whatever we do will need to take account of all the aims in the Government's Strategy for England's Trees, Woods and Forests (ETWF) and wider Government policy, particularly with respect to climate change and greenhouse gas management. The ambitions of the ETWF are set out in the Delivery Plan for ETWF under its 5 aims; ensuring England's forests are managed as a sustainable resource; address climate change; enhance the natural environment, support a desirable quality of life and secure and support business and markets.

All of the information collected and collated has been systematically entered into the FC Geographic Information System (GIS) database. This has allowed analysis of the information at a wide range of scales and across a range of important interacting variables. Only by ascertaining and mapping the potential for restoration of priority open habitats has it been possible to cross reference this data with information on yield class, harvesting dates and tenure. Potential open habitat was determined as those areas which, should they be restored from their current forest stands, would create open habitat of a type and quality that would contribute to the current UK Biodiversity Action Plan (BAP) targets for restoration and expansion of open habitats in Habitat Action Plans.

The whole FC landholding was examined and considered, with exception of the Statutory Inclosures of the New Forest and the Forest of Dean. These were excluded from the outset. Recent studies and public consultation have already confirmed the future configuration of open habitats and woodland in these ancient forests, and their historic importance and peculiar statutory status set them apart from the remaining land holding managed by the Forestry Commission. However the areas of existing open habitat across the Forest Inclosures and planned habitat restoration within them have been included in the overall figures for the Public Forest Estate.

This Report thus attempts to explore the extent of existing, planned and potential open habitat and the constraints and implications for further habitat restoration and expansion.

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Part I.

3. The composition of the Public Forest Estate in England

3.1 The existing forest

Table 1 sets the context against which the extent of open habitat on the Public Forest Estate and the restoration of remaining potential must be considered.

Table 1. Overview of forest and open habitat across the Public Forest Estate in England

Area of Public Forest Estate	Plantation and other woodland	Ancient Woodland (ASNW and PAWS)*	Existing open habitat (*Priority & Broad Biodiversity Action Plan habitats*)	Planned open habitat
258,972ha	**155,486ha**	**55,041ha**	**36,045ha**	**12,415ha**
100%	**60%**	**21%**	**14%**	**5%**

Source: Forestry Commission Sub Compartment Database (*as of March 2009*)

* ASNW: ancient semi-natural woodland; PAWS: plantations on ancient woodland sites (FC 2002).

The Public Forest Estate in England covers **258,972ha.** It includes **55,041ha** of ancient woodland, of which some **28,630ha** are currently plantations on ancient woodland sites (PAWS) under restoration from plantation to semi-natural woodland. There are **36,045ha** of existing open habitat, with an additional **12,415ha** planned for restoration in current Forest Design plans. Some **c.3,000ha** of the area of open habitat has been created since 2000 as contributions to the UK Biodiversity Action Plan.

The remainder, some **155,486ha**, is comprised of forest stands of plantation and woodland on former open land that might retain potential as worthwhile open habitat for

wildlife, plus ancillary rides, roads, landings etc. It is this area of forested land that is the subject of Part II of this report.

3.2 Existing open habitat

Of the 36,045 hectares which is already open habitat, most has remained open since the land was acquired in the first half of the 20th century. The largest open areas by far are the "Open Forest" of the New Forest (some 13,600ha when the ancient pasture woodlands are excluded) and the unplanted areas of upland bog, mire and rock of Northumberland, Cumbria and the Lake District. The remaining 10,000ha, while significant, is widely spread across the landscape, with many important areas of lowland heath, common, fen, upland heath and limestone pavement.

Since 2000 the area of open habitat has expanded as restoration programmes for lowland heath, mire, upland heath and limestone pavement have progressed adding some 3,000ha of open habitat to the original open land legacy acquired in the 20th century.

Table 2 provides a breakdown of the existing open habitat to be found on the Public Forest Estate.

3.3 Planned open habitat restoration

All woods and forests across the estate are subject to detailed Forest Design Plans. These determine the felling and planting of forest stands and the distribution of open space and unforested habitat. Forest Design Plans are agreed for a management period of 10 years, though are subject to revision every 5 years.

From the current suite of Forest Design Plans it is possible to assess the extent and character of open habitat that is currently planned for restoration from existing forest stands. An informed judgement on the habitat type to emerge after felling and restoration work has been made. This has been based on soils, and past and present vegetation cover, allowing such areas to be nominally allocated to open habitat types prior to its expression.

The area of woodland planned for conversion to open habitat in current Forest Design Plans is shown in Table 2 below. The total area of open habitat planned for restoration or expansion in current Forest Design Plans is some **12,415ha,** representing a **c.34%** increase over the present area of open habitat over the next 10 to 20 years.

The distribution of this area across the various Biodiversity Action Plan habitats is shown in Table 2.

Table 2. The nature of existing and planned open habitats across the FC Estate

Habitat type	Existing area on the Public Forest Estate (ha)	Planned restoration across Public Forest Estate (ha)	Total (ha)
Heathland habitats			
Lowland Heath	2,751	1,933	4,684
ACID GRASSLAND* *Lowland forest districts*	217	204	421
Lowland dry acidic grassland	156	48	204
BRACKEN*	77	33	110
Purple Moor Grass and rush pasture	36	44	80
Existing New Forest – heath/mire. ****	13,619	1,443	15,062
Existing Forest of Dean – heath. ****	458	126	584
	Total area heathland habitat		**21,145ha**
Upland habitats			
Blanket Bog	6,204	346	6,550
Upland Heath	6,734	709	7,443
ACID GRASSLAND* *Upland forest districts*	3,457	6,562	10,019
Limestone pavement	163	11	174
Upland calcareous grassland	244	109	353
Upland hay meadow	37	1	38
	Total area upland habitat		**24,577ha**
Lowland habitats			
Lowland calcareous grassland	203	123	326
CALCAREOUS GRASSLAND*	73	188	261
NEUTRAL GRASSLAND*	491	188	679
Lowland meadows	105	10	115
Maritime Cliffs and slopes**	35	0	35
Coastal saltmarsh	1	0	1
Cereal field margins	4	0	4
	Total area lowland habitat		**1,421ha**

Water bodies and wetlands			
Aquifer fed naturally fluctuating waterbody	0	2	2
Eutrophic standing Waters***	83	15	98
Lowland raised bog	0	42	42
Fens	133	17	150
Reedbeds	2	0	2
Mesotrophic lakes	3	0	3
FEN,MARSH AND SWAMP*	23	18	41
RIVERS AND STREAMS*	47	65	112
STANDING OPEN WATER & CANALS*	142	11	153
BOGS*	545	167	712
Chalk rivers	2	0	2
	Total area wetland habitat		**1,317ha**
Total area	**36,045ha**	**12,415ha**	**48,460ha**

- *identifies Biodiversity Action Plan broad habitat types; the remainder are Biodiversity Action Plan priority habitats, both as recorded on the FC Sub Compartment Database.
- ** the slumping cliffs on the Isle of Wight that form part of FC woods.
- ***the shoals of pingos on the edge of the Brecks in East Anglia within the FC forest.
- ****The open heathland habitats of the New Forest and the Forest of Dean are insufficiently differentiated in the sub-compartment database to record under the BAP habitat headings used here.

The distribution of current existing and planned habitat across the 12 English Forestry Commission Forest Districts is shown in Table 3.

Table 3. Existing and planned open habitats across the English FC Forest Districts

Forest District	Total Area of FD (ha)	Existing Open Habitat (ha)	Planned Open habitat (ha)
Kielder	72,466	11,129	5,502
New Forest – Statutory Forest	34,779	13,619	1,443
New Forest - Dorset	*Included above*	1,252	621
East Anglia	25,204	1,149	578
South East England	22,087	491	610
North York Moors	21,290	1,833	517
North West England	17,183	3,918	1,812
Forest of Dean - Statutory Forest	15,900	458	126
Forest of Dean - FD	*Included above*	113	106
Peninsula	15,630	495	564
Sherwood & Linc's	14,178	1,216	340
West Midlands	12,491	238	123
Northants	7,522	119	73
Westonbirt Arboretum	242	15	0
Total	**258,972**	**36,045**	**12,415**

3.4 Summary

The Public Forest Estate in England, at nearly 259,000 is a very large landholding of considerable complexity. It includes several very large forests, from Kielder, Grizedale and the North York Moors in the north of England, through to Thetford Forest in East Anglia, Cannock Chase and the Wyre in the Midlands, to the New Forest in the south and the Forest of Dean in west. Alongside these major forests are a great many large woods and many smaller ones. A substantial area is ancient woodland, mostly under active restoration to native woodland bringing the Public Forest Estate into line with the 2005 “Keepers of Time” policy on the conservation of ancient woodland.

Taken as a whole some 21% of the area is ancient woodland, 14% is existing open habitat, consisting mostly of heathland and upland peatland, with a further c.5% of the estate planned to be restored to open habitat in the near future. Of the remaining area c. <1% is

comprised of the roads, rides, loading bays and buildings that support the running of the forests and woods. The remaining 60% is comprised of managed forest of plantations and other woodland.

It is this area of **155,486ha** of plantation and high forest (**60%** of the total area) that is currently the main resource for timber production, carbon management, and recreation provided by the Public Forest Estate. It is this area of forested land that is the subject of Part II of this report; how much of this area retains potential for effective restoration to wildlife rich open habitat and what are the implications of doing so?

Part II

4. Mapping the remaining potential

4.1 Project aim

The primary aim of the project was to map and describe the potential to restore open habitat across the remaining **155,486ha** of recently established plantation and other woodland on the Public Forest Estate in England. Important subsidiary aims were to quantify the impact of legal and social constraints on restoration potential, and to estimate both the restoration and management costs of any significant restoration programme.

Ancient woodland, old established woodland, existing and planned open habitat, and the Statutory Inclosures of the New Forest and Forest of Dean, along with areas to be restored to new native woodland, were excluded from the project remit.

All the remaining area was considered and assessed with the aim of identifying those areas where the potential for restoration was clearly higher than from comparable areas of agricultural land of similar geology and soils.

It was these areas retaining their capacity for conversion back to their former land use prior to afforestation that were regarded as retaining significant potential for contributing to the UK BAP and mapped in this project.

4.2 Project methodology and approach

The project team consisted of Jonathan Spencer (Senior Ecologist, FC Policy and Programmes Group), Rachael Edwards (FC Bristol) and John Tewson (Head of Planning and Environment, FE Bristol).

Survey and mapping was undertaken on contract by recently retired FC planning and environment staff:

- Paul Barwick - (Sherwood and Linc's; South East England; Northants; Peninsular Forest Districts)
- Bill Burlton - (Kielder, North York Moors, North West, West Midlands and Forest of Dean Forest Districts),
- Oliver Lucas - (New Forest District - Dorset)
- Nick Gibbons - (East Anglia Forest District)

The project assembled information on existing and potential open habitat across each Forest District, using information from soil maps and historical maps, earlier studies

undertaken across all or parts of each District, and the knowledge of staff and of other individuals actively involved with each Forest area.

Each Forest District was surveyed in turn by one of the contract surveyors starting in each case with the Forest District most familiar to them during their former FC employment. This allowed for both swift initial progress and the development of consistency across Districts.

All of the FC landholding was considered at the outset of each Forest District exercise.

Excluded from further consideration were:

- Ancient woodland (both semi-natural woodland and plantations on ancient woodland sites).
- Long established woodland of over 100 years age.
- Former improved agricultural fields (apart from within Thetford Forest in the Breckland).
- Areas within Forest Design Plans already planned as future new native woodland.
- Land within the Statutory Inclosures of the Forest of Dean and the New Forest.

The remaining landholding was then considered in close consultation with FC District staff and with expert individuals associated with particular forest areas. Surveyors compiled extensive notes on forest areas, and collected wherever available information on existing wildlife interest.

Across each Forest District landholding the surveyor:

- Listed existing projects and sources of information concerning the potential open habitat.
- Recorded on paper maps (provided by the FC) the areas of potentially restorable open habitat.

On these maps, the surveyors clearly identified:

- The type of habitat.
- Graded each area according to anticipated ease of restoration.
- Graded each area according to expected cost of subsequent management.
- Mapped areas that may be unacceptable or difficult on social acceptability grounds for open habitat restoration
- Mapped areas of potential open habitat that could be grazed with livestock.
- Noted leasehold areas and whether the ownership was institutional or private, the land uses permitted by the lease and any constraints the lease may represent to open habitat restoration.

All potential areas of priority Open Habitat were systematically mapped, recorded and graded using staff knowledge, experience, and other readily available existing sources. Ground survey was not undertaken except in situations where additional clarity of understanding was required. The grading of sites is explained more fully below.

4.3 Identifying areas of potential habitat

Identifying areas of plantation and woodland where the land has retained capability to justify consideration for restoration to open habitat on conservation grounds was difficult. These difficulties varied from habitat to habitat. The approach adopted in resolving these challenges is described below.

Peatland soils

Extensive peat soils derived from former blanket bogs are found in the Public Forest Estate in Northumbria and East Cumbria. The following protocol for identifying potentially restorable habitat was developed in consultation with Forest District staff and the Border Mires Group and is consistent with similar protocols adopted by FC Scotland.

Forests on afforested deep peat soils with an average depth of 1 metre or greater were regarded as having potential for restoration (Patterson, G and Anderson, R (2000) Forests and peatlands habitats guidelines note, Forestry Commission, www. Forestry.gov.uk/pdf/fcgn1.pdf/$FILE/fcgn.pdf). The British Geological Survey publish drift maps in GIS form which identify peat areas over a metre deep and these were used as an initial sift to identify areas with potential for restoration. These areas were then considered and the following assessed;

- The impact of road building and associated infrastructure breaking up areas of blanket bog and irreversibly changing the underlying hydrology.
- The impact of second and third rotation crops and associated drainage that had changed the hydrology beyond effective reversion.
- The scale of restoration and the creation of large contiguous areas of open habitat (either as a result of restoration or as extensions to existing or planned areas), or conversely of small isolated areas of restored peatland habitat. The large areas were termed “areas of significant peat” and included in this study, while smaller isolated areas (less than 50ha in extent) were discounted from consideration.

Mires (mainly in the south of Kielder Forest) occur on the numerous deep peat lenses on peat up to 10 metres deep. These mires, many of which are designated as SSSI, have been the subject of a major mire restoration programme for nearly a decade. Consequently only a small area of afforested mire (as opposed to afforested blanket bog) remains in the potential area for restoration, with all this area planned for restoration in the future.

Heathland and acid grassland soils

Extensive areas of Public Forest Estate pine forest were planted on former upland and lowland heaths, on podsols and gleys, across the north east of England, and more locally in the south and south east of England. Large areas of spruce were also planted on former upland heath. The majority of such stands are readily identifiable from soil maps and from the heathland vegetation that persists throughout the forest cycle. Occasionally interspersed with these areas are stands on former improved farmland, on similar soils but with a more recent history of marling and ploughing. Such soils are much more challenging to restore to heath or acid grassland.

In the Breckland of East Anglia the soils consist of sand over underlying chalk at very variable depth. Breckland soils are thus naturally calcareous over large areas and their associated vegetation less influenced by past marling and ploughing. The rare plants and animals of the Brecks are associated with broken sandy soils, including those created by past agricultural usage. Other areas of the Brecks are clearly heathland podsols while yet others much more fertile acidic brown earths. There is much less critical difference in the value of open habitat restored from former breck heathland and that restored from former breck farmland. Areas derived from inherently more fertile soils (identifiable as brown earths) or heavily marled and modified soils (usually readily identified from the abundant bramble understorey) were regarded as having limited potential for restoration in Thetford Forest, while stands planted on former farmland were not dismissed. In the Breckland, potential was based almost entirely on field observation and soil characteristics.

Heathland soils (both in the uplands and lowlands) present fewer limitations to successful restoration of open habitat than most soils and are consequently heavily represented in this study. Rotation length and frequency do not compromise potential to the same extent as on more fragile peat soils. Drainage can shift wet heath on gleys to drier heathland types, but drainage rarely destroys potential and the hydrology can be demonstrably (if expensively) restored. Areas of potentially restorable heathland were identified using a combination of National Soil Research Institute soil maps, aerial photographs (past and present) and local field knowledge interpreting vegetation.

This approach has reliably identified former heathland in both the uplands and the lowlands, while identifying and excluding those areas on agriculturally improved soils and more natural brown earths or clays where heathland restoration is challenging and uncertain.

Grasslands on base rich soils

Experience has shown that species rich grasslands are far less readily restored once having passed through a cycle of forest planting or prolonged woodland cover. Their potential for recovery from forest conditions is not significantly different from agricultural soils, though the treatments may be very different depending on the degree to which the soils have been agriculturally improved. Consequently there is comparatively little scope identified in this project for the restoration of species rich grassland across the estate. Where this has been identified it is invariably in locations where the survival of relict patches of rich grasslands surviving as rides, glades wayleaves or relict meadows can be extended and their future management made more viable in the long term.

The area of potential chalk grassland is probably rather exaggerated. Much is now under mature ash and beech woodland, though there is scope for restoration from neglected scrub thorn on relict areas rather within the beech plantations that were extensively established by the FC in the early part of the 20th Century.

Areas of potential limestone pavement habitat in the north of England were readily identifiable (as were all areas of rocky outcrop with ready potential for restoration to open

habitat). The limited area of potential reflects the successful conservation programmes undertaken to date by FC in restoring this rare and unusual habitat type.

Wetlands

Former wetland sites, including the priority BAP habitats of fens and reedbeds, were readily identifiable from a combination of old maps, local topography, drainage patterns and persistent wetland or carr vegetation. A large proportion of the potential wetland consists of poplar plantation along river valleys notably in Thetford Forest.

Local knowledge provided both information on the location and extent of wetland potential but also clearly tied any potential into local wetland conservation objectives; the wildlife gains were invariably clear and projects often already under discussion. A restorable hydrology and control over future water management were important criteria in identifying potential.

Existing wet woodlands were not considered as potential areas for creating more open wetland habitat. Wet woodland is itself a priority habitat under the woodland Habitat Action Plan. Elsewhere we are in partnership with others to ensure that decisions about removing or retaining wet woodland on sites where there is potential for wetland restoration do not result in a conflict of objectives.

Exceptionally, areas of woodland *surrounding* water bodies were included in the area of potential habitat restoration. This was most notable in the forest stands enclosing the shoals of *Pingos* (ponds created by freezing springs at the height of the last ice age) in Thetford Forest. These form an extraordinary feature of the forest estate and already restoration action is taking place to restore these natural ponds to a more open landscape of native woodland more in keeping with their origin, ecology and unique character. Similar measures are in place for the rare post glacial tufa springs in the North York Moors.

Potential areas of wetland restoration are limited in extent compared to other habitats but could contribute disproportionately to wildlife conservation across the Public Forest Estate.

4.4 Site grading – Ease of restoration

Each area of potential open habitat was graded according to the technical ease and readiness of restoration using a three tier system:

- **Easy**: No or only limited remedial action required following felling *e.g. some light brash or vegetation removal or similar.*
- **Moderate**: limited remedial action following felling *e.g. scattered rhododendron removal, some restitution of drains or similar.*
- **Difficult:** extensive remedial action required after felling *e.g. Thick rhododendron cover, extensive reinstatement of watercourses or similar.*

Collection of this information allows an estimate of overall cost of restoration to be made.

4.5 Site Grading – Cost of subsequent management

The potential open habitat was graded according to the likely annual cost of subsequent management, again using a three tier system.

- **Low**: limited ongoing cost of management *e.g. upland mires once fully restored; blown sand heaths in Lincolnshire.*
- **Moderate**: moderate ongoing cost of management *e.g. dry heathland areas subject to a grazing or cut and burn programme*
- **High**: high ongoing management costs *e.g. small isolated areas; rich and/or moist sites requiring frequent interventions; other inherently fertile soils; places with continued need for rhododendron control or similar.*

Collection of this information allows an estimate of overall annual management costs to be made.

4.6 Grazing potential

Areas that could potentially be readily grazed and where added conservation value might be secured were recorded. Grazing will be a particularly important tool in securing the quality of restored open habitats, notably in heathland and grassland ecosystems.

Areas that could be readily grazed by livestock were identified as such by consultation with FC planning staff and discussions with Natural England staff (as part of the SSSI restoration programme) and other interested parties. These areas tended to be the larger, less urban areas, mostly of former heathland.

Collection of this information allows an estimate of the overall capital costs of fencing the potential open habitat that would benefit from grazing to be made.

5. Freehold and leasehold issues

Large areas of the Forestry Commission estate are leased on long (e.g. 999 year) leases. Some areas are leased from organisations such as the National Trust, which have an environmental and landscape conservation agenda, but the majority is leased from private estates and individuals.

The leases vary but most are forestry only leases, restricting FC activity to forestry and timber production only. The leases can be held to allow modern forestry practice. It can therefore be argued that they allow FC to pursue the restoration of native woodland on ancient woodland sites or elsewhere and extension of open space to the extent regarded as appropriate within modern multi-purpose forests as defined by the UK Woodland Assurance Standard (UKWAS). But leasehold status nevertheless often seriously curtails any extensive restoration of established forest to open habitats across most leases. Leasehold situations vary widely across the area managed by the FC, but the potential for restoration on leasehold land remains limited by the leasehold arrangements.

Consequently, the difficulties in making a realistic assessment of the realisable potential across the leasehold area precluded in depth investigation in this report.

The area of both leasehold and freehold land with potential for restoration back to open habitat of various types is shown on Table 4 below.

Table 4. The extent of potential open habitat on freehold and leasehold property on the Public Forest Estate.

Habitat type	Potential habitat on FC Freehold (ha)	Potential habitat on FC leaseholds (ha)	Total (ha)
Heathland habitats			
Lowland Heath	19,076	10,357	29,433
ACID GRASSLAND* *Lowland forest districts*	2,096	236	2,332
Lowland dry acidic grassland	185	85	270
Purple Moor Grass and rush pasture	15	0	15
Upland habitats			
Blanket Bog	1,436	358	1,794
Upland Heath	12,695	5,044	17,739
Limestone pavement	0	6	6
Upland hay meadow	45	0	45
Lowland habitats			
Lowland calcareous grassland	4	11	15
CALCAREOUS GRASSLAND*	540	974	1,514
NEUTRAL GRASSLAND*	386	277	663
Lowland meadows	16	0	16
Maritime Cliffs and slopes**	1	0	1
Water bodies and wetlands			
Aquifer fed naturally fluctuating waterbody	0	1	1
Eutrophic standing Waters***	42	26	68
Fens	382	51	433
Reedbeds	2	0	2
FEN,MARSH AND SWAMP*	37	90	127
Total area	**36,958**	**17,516**	**54,474**

6. Social constraints

Proposals to remove forest and woodlands and replace them with open habitats are not universally popular, no matter how rich or how interesting the resulting wildlife. The removal of woodland can be resisted in many places, particularly where there is intensive usage of the site by local people for informal recreation, walking, cycling and exercising dogs.

While the resistance to change can be very variable, and influenced by careful consultation and planning, a strong local response usually influences the emerging Forest Design Plan. In practice experience shows that it leads to the retention of a higher % of woodland or plantation than envisaged in proposals driven by biodiversity outcomes alone, and usually a slower rate of change.

All areas of forest with potential for restoration to open habitat were considered in the light of the 'social acceptability' of extensive change from forest stands to a landscape with a more extensive open character. While acknowledging that the impact of such predictable opposition can be mitigated by careful design, skilled consultation and engagement with the public, it was considered important to have some form of *quantitative* estimate of the impact of the social acceptance of forest change. Judging the social acceptability of change and mapping it was the most difficult task tackled in this project.

Areas of clear amenity importance as forested land, given its location surrounding a visitor centre for example or as a result of its heavy public usage, were readily mapped, as were areas where no strong opposition to change was anticipated (remote mire systems deep in extensive forest for example). Experience in previous consultations over Design Plans has also provided a clear understanding of where change is opposed and where change is widely accepted. Mapping the *boundaries* however was very challenging. All surveyors reported difficulties, recognising that so much also depended on the scale of change across a site, the extent of change in any one area, and the rate at which any proposed change might take place.

Nevertheless, the forest was scored according to an adopted three point scale, based primarily on information collated from FC staff engaged in the preparation of Forest Design plans and their associated consultation programmes.

In the event, the results given here are best viewed as a guide to both the resources required to maintain local engagement in landscape planning, and the extent to which this might influence the gross area ultimately changing from forest to open habitat. They are not a working guide to where change may or not take place.

6.1 Impact of acceptability on the scale of forest restoration

Each area of potential open habitat was graded according to perceived social acceptance to extensive change using a three tier system:

- **Difficult:** areas where any significant restoration to open habitat is known to be unacceptable to users of the forest.
- **Possible:** where extensive change of up to 50% change from forest to open habitat would probably be accepted within Forest Design Plans but where significant additional work engaging with local stakeholders may be required.
- **Acceptable:** areas where little or no opposition to open habitat restoration is anticipated.

The area of potential habitat influenced by the social acceptability of forest change to open habitat is shown on Table 5 below, distributed across the various potential habitats.

Table 5. Social acceptability of change from forest to open habitat (FC freehold land only)

Habitat type	Social Acceptability of Forest Change					
	Acceptable		Possible		Difficult	
	Area(ha)	%	Area(ha)	%	Area(ha)	%
Heathland habitats						
Lowland Heath	833	4.4%	14,492	76%	3,751	19.6%
ACID GRASSLAND* *Lowland forest districts*	316	15%	1,253	59.8%	527	25.2%
Lowland dry acidic grassland	42	23%	143	77%	0	
Purple Moor Grass and rush pasture	0		15		0	
Upland habitats						
Blanket Bog	1,371	95%	65	5%	0	
Upland Heath	835	6.5%	4,511	35.5%	7,349	58%
Upland hay meadow	45		0		0	
Lowland habitats						
Lowland calcareous grassland	4		0		0	
CALCAREOUS GRASSLAND*	6	1%	344	64%	190	35%
NEUTRAL GRASSLAND*	135	35%	215	56%	36	9%
Lowland meadow	16		0		0	
Maritime Cliffs and slopes**	1		0		0	
Water bodies and wetlands						
Eutrophic standing Waters***	25		17		0	
Fens	187	49%	193	50%	2	<1%
Reedbeds	2		0		0	
FEN,MARSH AND SWAMP*	8		29		0	
Total area	**3,826**	**10.3%**	**21,277**	**57.5%**	**11,855**	**32.2%**

7. The impact of change on timber production.

The survey shows that the area of the Public Forest Estate currently under plantation or woodland with potential for effective restoration to open habitat that would contribute both quantitatively and qualitatively to the UK BAP, amounts to some **54,474Ha**.

This represents the maximum area that the Public Forest Estate in England could contribute towards targets in the UK BAP aimed at increasing the area of priority open habitat.

The area is made up of a range of potential habitat types across a range of forest situations, each of which is influenced by a range of issues that might determine the extent to which its restoration may be fully realisable. These are explored more fully below.

This area is split between the freehold landholding of **36,958ha** and the leasehold area of **17,516ha** (32% of the potential for open habitat) where the land management options are more constrained. Given these constraints only the freehold area is considered further here.

7.1 Impact on forest production

The impact of removing land from the productive forest area over the next forest rotation will affect both the amount of timber and woodfuel generated by the estate into the future *and* the yearly profile of harvested volume in coming years. Both have important implications for the FC budget and our ability to fulfil the Government's objectives for supporting business and markets as set out in ETWF, along with commitments to produce timber for the timber processing industries.

7.2 Impact on timber yield

The overall yield generated by the area identified depends largely on rates of tree growth and the productivity of the land upon which the trees are planted. These interact according to which tree species are planted and the inherent character of the site. This is expressed in forestry terms as the Yield Class (YC); the volume of accrued timber expressed in cubic metres per year per hectare, averaged over the economic life of the crop. For example, a stand of YC 12 Scots Pine accrues 12 cubic metres of timber per hectare each year, when growing at optimal spacing across the site. A cubic metre of timber weighs approximately 1 metric tonne when harvested (i.e. before drying) and it is reasonable to equate a stand of YC 12 Scots pine as accruing 12 tonnes of harvestable timber per hectare each year.

Yield Class varies with the combination of site and species choice; a site yielding YC 18 Douglas Fir might support at best YC 8 or 9 Ash for example. The YC of each stand of planted trees across the Public Forest Estate is recorded on the Sub Compartment Database. In this exercise it is reasonable to assume that across the majority of the area under consideration foresters have chosen the most appropriate combination of species

and site for conventional timber yield. Consequently the YC as presently recorded on the FC sub compartment database is a close approximation to the lost production from any site should it be restored to open habitat.

Table 6 below provides a breakdown by area of the impact of restoration on forest productivity as expressed in current Yield Class across the forest. Note that broadleaves rarely have a yield class greater than 10. Yield Class data is unavailable for **2,873ha** of land identified as having open habitat potential.

Table 6. Yield class of crops across land with open habitat potential on the Public Forest Estate(freehold land only)

Habitat Potential	Yield Class				
	YC<10		YC 10-14		YC 16+
	Conifer (ha)	Broad-leaves (ha)	Conifer (ha)	Broad-leaves (ha)	Conifer (ha)
Heathland habitats					
Lowland Heath	914	1,514	11,948	39	3,453
ACID GRASSLAND* *lowland forest districts*	32	71	488	4	1397
Lowland dry acidic grassland	5	25	129	0	11
Purple Moor Grass and rush pasture	0	0	15	0	0
Upland habitats					
Blanket Bog	562	4	749	0	48
Upland Heath	3,487	237	5,874	9	1,806
Upland hay meadow	6	2	21	0	16
Lowland habitats					
Lowland calcareous grassland	0	2	2	0	0
CALCAREOUS GRASSLAND*	3	394	44	0	32
NEUTRAL GRASSLAND*	17	85	189	2	75
Lowland meadows	0	5	10	0	1
Maritime Cliffs and slopes**	0	1	0	0	0
Water bodies and wetlands					
Eutrophic standing Waters***	2	15	22	0	0
Fens	4	103	121	20	50
Reedbeds	0	2	0	0	0
FEN,MARSH AND SWAMP*	0	9	8	0	1
Total area	**5,032**	**2,469**	**19,620**	**74**	**6,890**

Table 7 below shows the distribution of the total area of potential open habitat (across the freehold land of the Public Forest Estate) with respect to the area of the current tree crops of different yield class. Again note that yield class and/or species data is unavailable for 2,876ha of land identified as having potential as open habitat.

Table 7. The distribution of all potential open habitat by crop species and yield class on the Public Forest Estate (freehold land only)

Species	YC <10	YC 10 -14	YC 16+	YC unknown
Douglas Fir	13	374	157	0
Sitka Spruce	757	5,123	3,214	18
Norway Spruce	31	143	47	4
Larch spp	754	833	7	11
Corsican pine	192	9,367	3,294	9
Scots pine	1,962	3,275	11	19
Other conifer spp	1,321	508	160	72
Ash	21	2	0	4
Beech	936	11	0	11
Birch	334	8	0	134
Oak	538	3	0	19
Sycamore	46	5	0	5
Other broadleaf spp	591	42	2	187
Unknown				2,383
Total	**7,496ha**	**19,694ha**	**6,892ha**	**2,876ha**

Though a gross simplification of a complex situation, the data above do provide a clear insight into the impact that extensive open habitat restoration would have on the timber productivity of the forest estate.

It is reasonable to assume that the lower yield class stands are those most readily restored to valuable wildlife habitat. The poor growth and often open nature of these stands usually supports more remnant vegetation, and the nutrient poor status of the soils is usually less fundamentally changed by periods under tree cover. They are also those areas that would have the least impact on future timber yield. More productive stands are generally the least readily restored to species rich native vegetation, and have the greatest impact on yield.

Some areas are of a yield class barely worth replanting if economic timber production were the primary objective. Others are of considerable importance for timber production, in terms of both volume and quality from the estate, notably the higher yield classes of Douglas fir and Sitka spruce in the south west. A few areas, for example some lodgepole pine or Sitka spruce stands on the deeper peat soils of Northumberland and Cumbria, may be of comparatively high yield class, as measured by tree growth, but are very difficult to work profitably.

While the tables provide a clear appreciation of the impact of open habitat restoration on forest productivity, yield alone is clearly not always directly linked to revenue, nor the only material consideration when planning forest change.

Regional Variation. There is considerable variation in the potential for open habitat restoration on the Public Forest Estate between English Regions. This variation lies not only in the area that could be returned to open habitat, but also in qualities associated with any change. The outcomes for nature conservation may be of a very different quality in different Regions. For example in Dorset, heathland is both readily restored and subsequently occupied by rare wildlife of restricted range. In other parts of the country such as the Brecks, a very different suite of rare species are associated with heathland, and usually with very broken sandy soils, but the forest itself is rich in woodland and heathland birds. On former Midland heaths the response of wildlife may be much more limited to widespread species more readily accommodated in well-managed forest and woodland mosaics. The costs of restoration and subsequent management will also vary with habitat, the location and the scale of emerging habitat. The impact on future timber production will also vary considerably depending on the timber species in place, their comparative yield and value, and the prevalence of Corsican pine at risk from Red Band Needle Blight. This qualitative variation is considerable and not strictly linked to potential area alone.

As reflection of this variation, Table 8 below presents the distribution of potential habitats on the Public Forest Estate distributed across the English Regions.

Table 8. The distribution of potential open habitat on the Public Forest Estate by English Region (freehold land only)

Potential Open Habitat by Region (*excluding Statutory Forests*) (ha)									
Habitat Type	**Potential** ***FC Freehold***	North East	North West	Yorks. & Humber	West Mid's	East Mid's	East of England	South East	South West
HEATHLAND									
Lowland heath	19,076	109		207	1,258	2,315	13,678	749	760
ACID GRASSLAND (all lowland)	2,096								2,096
Lowland dry acid grassland	185					5	99	20	61
Purple moor grass/rush pastures	15					15			
UPLANDS									
Blanket bog	1,436	1,360	56	20					
Upland heath	12,695	2,987	338	7,375	122	113			1,760
Upland hay meadow	45					1			44
LOWLANDS									
Lowland calcareous grassland	4								4
NEUTRAL GRASSLAND	386					18	232	56	80
Maritime cliff/slopes	1							1	
Lowland meadows	16						16		
WATER BODIES AND WETLANDS									
Eutrophic standing waters	42						42		
Fens	382					167	215		
Reedbeds	2						2		
FEN, MARSH/SWAMP	37					8	29		
OTHER									
CALCAREOUS GRASSLAND	540						4	530	6
TOTAL	**36,958**	**4,456**	**394**	**7,602**	**1,380**	**2,642**	**14,317**	**1,356**	**4,811**

7.3 Impact on future production and the production forecast

The impact on the volume of timber and woodfuel to be harvested in coming decades can be estimated with some precision from the projected harvesting dates of stands, in combination with the yield class data. The planned harvest of timber volume over coming years is referred to as the *production forecast*.

It is assumed that current stands of trees will not be felled before they are at economic maturity, and at present not before they are currently planned to be felled.

Figure 1. shows the current projected harvesting profile, as determined by the current projected felling dates, of the freehold stands identified as having potential as valuable open habitat. This is expressed as hectares to be felled in decade intervals. The area identified as 2061+ will also include a large area currently managed as continuous cover forest.

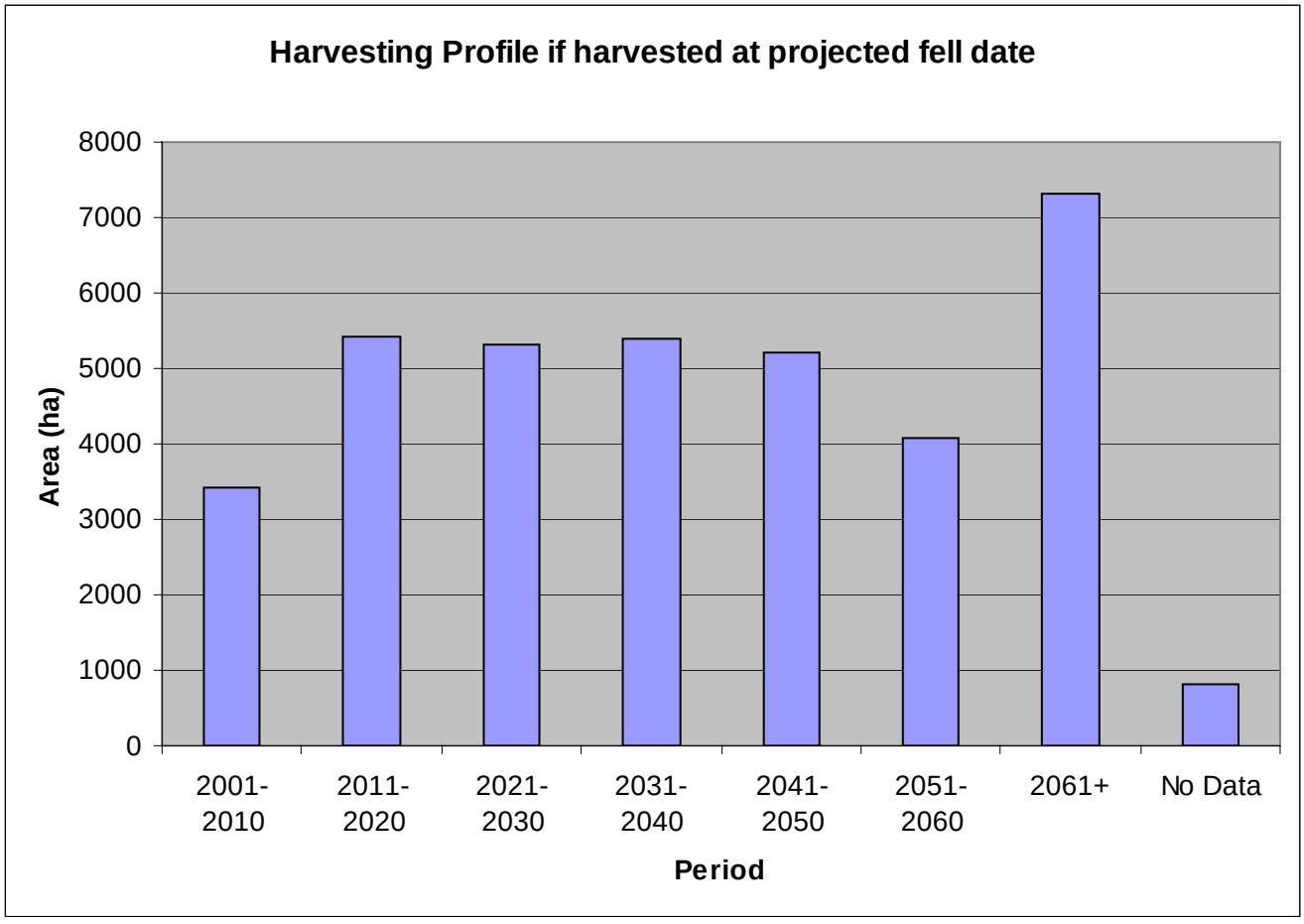

Figure 1 Harvesting profile of open habitat potential (freehold only)

The impact of not replanting the areas in Figure 1 on future timber production will only be realised when harvesting of the replanted crops begins. For thinned areas this will be approximately 20 years after planting (and at intervals thereafter), while for unthinned stands (largely upland crops with a high risk of windthrow), some 40 to 50 years after planting.

The **12,415ha** of open habitat already planned for restoration represents a 7% reduction of the woodland area (some 10% of the conifer area) of the Public Forest Estate in England. The volume of timber this represents will depend on the exact areas selected, given the variation in species and yield class. Based on the current average yield from the estate it is likely to result in a long-term reduction in timber yield in the order of **114,000m3** per annum. Restoration of the entire area of woodland with potential for open habitat restoration on freehold land (the **36,958ha** discussed in detail above) would, on a similar average volume per hectare basis, reduce the long term average annual timber production by a further **274,000 m3**. In combination this would be in the order of some **388,000m3** or a **33%** reduction in overall timber production by the Public Forest Estate.

If all the areas growing less than yield class 10 crops were cleared and not replanted (a total of c. 7,500ha) the resulting reduction in timber production per annum would be a maximum of 47,000m3.

In combination with information on the costs of restoration and ongoing management, the felling forecast for any agreed restoration programme can also be converted into a projected funding profile identifying both the restoration funding required for any period of time and the accruing costs of ongoing management.

Red Band Needle Blight (*Dolistroma septosporum, RBNB*) is a widespread fungal pathogen of pines to which Corsican pine is particularly susceptible. It has spread across England and is now found in virtually all extensive stands of Corsican pine and in the nurseries that provide planting stock. RBNB is now recognised as a very serious threat to the future of Corsican pine in forestry in England. The growth of Corsican pine is greatly curtailed in affected areas and its use in restocking felled stands has come to a halt. In this report, Yield class estimates for Corsican pine are those currently recorded on the Sub Compartment Database. In practice it is currently more realistic to consider the future yield of Corsican pine to be equivalent to that of Scots pine stands, a species far less susceptible to RBNB. This is effectively reached by assuming each Corsican pine stand to be at least one Yield Class lower than that currently shown on the database.

RBNB will thus be an important factor influencing decisions over the future management of pine forests where Corsican pine, a more productive tree than Scots pine, is a major component. The influence of RBNB will be particularly acute on the dry chalky soils of the Brecklands where alternative choices are effectively limited to Scots pine, birch or possible novel fuelwood crops such as Eucalyptus or sweet chestnut.

Table 9 below shows the distribution of Corsican pine by Yield Class on land with potential to become open habitat, almost all being on former heathland with the large majority of the higher yield classes being located in Thetford Forest in East Anglia.

Table 9. The distribution of Corsican pine stands across yield Class on the Public Forest Estate (freehold land only)

	Corsican Pine (Yield Class by area ha)										
District	2-4	6	8	10	12	14	16	18	20	Unknown	TOTAL
Sherwood			6	59	341	637	328	49		3	1423
East Anglia	10		1	79	862	6066	2357	123	39		9537
Northants				4	3						7
Kielder			15	5	4						24
Lakes	0	0	0	0	0	0	0	0	0		0
NY Moors	0	1	60	28	27	1	32	1			150
South East				8	89	116	59	68	7		347
New Forest (excl. Stat. Forest)	1	5	44	55	174	152	86			1	518
West Mid's		4	6	71	358	207	123	9		4	782
Peninsula	2	2	33	3	10	10	11				71
Dean (excl. Stat. Forest)						1	1	1			3
Total	3	12	165	312	1868	7190	2997	251	46	8	**12,862**

Soils supporting the lower yield classes of Corsican and Scots pine are largely unsuitable for replacement conifer crops. Those in the higher yield classes can frequently support stands of higher yielding conifers such as larch or Douglas fir.

8. Restoration and management costs

8.1 Restoration costs

All areas of potential habitat were graded by experienced FC staff into three broad categories with respect to the costs of restoration.

- **Easy**: No or only limited remedial action required following felling.
- **Moderate**: limited remedial action following felling.
- **Difficult:** extensive remedial action required after felling.

The costs of habitat restoration vary greatly between habitat types and across the country. However recent experience and current costs suggest the following range of average costs are appropriate in estimating the overall cost of habitat restoration undertaken by the FC.

Habitat type	Cost of Restoration £/ha		
	Easy	Moderate	Difficult
Heathland	£300	£650	£2000
Upland	£160	£500	£1600
Bog and Mire	£1000	£1500	£3000
Grassland	£250	£750	£1000
Water bodies and wetlands	£1000	£1500	£3000

8.2 Cost of planned habitat restoration in existing Forest Design plans

Habitat restoration currently planned across the Public Forest Estate amounts to **12,415ha**. This area however was not divided into the easy to difficult categories described above in this survey. Using the average cost per hectare derived below it is nevertheless possible to estimate the overall cost. At an average cost of **c. £1,350 per hectare** the estimated cost of the planned programme is **c. £16.8 million**. However, given that the planned area is likely to include a higher proportion of the more readily restored sites this figure is likely to be exaggerated to a degree.

8.3 Cost of restoration of potential habitat on the Public Forest Estate (freehold only)

Assuming for illustration only that all the available potential on the freehold landholding of the Public Forest Estate is restored to open habitat, the total cost of such a comprehensive hypothetical programme would be distributed as shown in Table 10 below:

Table 10. Cost of restoration of potential habitat on the Public Forest Estate (freehold land only)

Habitat Type	Costs of Restoration					
	Easy		Moderate		Difficult	
	Area (ha)	Total cost £K	Area (ha)	Total cost £K	Area (ha)	Total cost £K
Heathland habitats	**4,320**	**£1,296K**	**10,097**	**£6,563K**	**6,955**	**£13,910K**
Upland habitats	**573**	**£917K**	**965**	**£4,825K**	**12,638**	**£20,221K**
Lowland habitats	**1**	**£1K**	**519**	**£389.6K**	**427**	**£427K**
Water bodies and wetlands	**4**	**£4K**	**44**	**£66K**	**415**	**£1,245K**
Total area (ha)	**4,898**		**11,625**		**20,435**	
Total cost (£million)		**£2.218m**		**£11.843m**		**£35.803m**
	Overall Area (ha)					**36,958**
	Overall cost (£m)					**£49.86m**
	Average cost per hectare (£)					**c.£1,350**

This table represents the approximate cost at current prices of a hypothetical comprehensive restoration programme across the entire freehold area of the Public Forest Estate.

Restoration at a hypothetical rate of **300ha** per year would cost **c. £546,000** per year on this basis (but take up to 120 years to complete if all restored). A programme of, say, **1,000ha** per annum programme would cost **c. £1.35 million** per year and take up 60 years to complete, in keeping with a programme of felling stands at economic maturity.

The real costs of implementing a major programme such as these illustrative examples would require adjustment based on the agreed combination of habitat type, ease of restoration, scale of operations and the prevailing costs at the time. Harvesting existing stands at economic maturity, a key carbon management action proposed in the

consultation on Government policy on restoring and expanding open habitats from existing woods and forests, would determine the spread of restoration activity over time.

8.4 Ongoing management costs

As with the cost of initial restoration all areas of potential habitat were graded by experienced FC staff into three broad categories:

- **Low**: limited ongoing cost of management.
- **Moderate**: moderate ongoing cost of management.
- **High**: high ongoing management costs.

The cost of management and maintenance varies considerably between habitats. Recent experience suggest the following range of average costs per hectare per year for the ongoing management of open habitat:

Habitat type	Cost of ongoing management £/ha per year		
	Low	Moderate	High
Heathland	£30	£250	£750
Upland	£160	£250	£750
Bog and Mire	£50	£150	£300
Grassland	£50	£500	£750
Water bodies and wetlands	£50	£100	£500

The costs of ongoing management of open habitat can be separated into three categories:

- The cost of managing the existing area of open habitat.
- The future cost of managing the open habitat planned for restoration in current Forest design plans.
- The future cost of managing the potential open habitat should it be restored to open habitat.

8.5 The cost of managing the existing area

These figures can be used to estimate the current cost of managing the existing open habitat responsibilities across the Public Forest Estate and are shown in Table 11 below. An average management cost of £50 per ha per annum for established open habitat has been adopted in this table for heathland, mires and upland habitats. This is designed to reflect the low cost per hectare of the large established areas such as the New Forest and the very low costs of existing areas of upland mire and blanket bog. An average cost of £200 per hectare per year has been applied elsewhere.

Table 11. The cost of managing the existing open habitat on the Public Forest Estate.

Existing open habitat management costs		
Habitat	**Area (ha)**	**Total cost (£K per annum)**
Heathland	17,314	£865.7K
Upland	16,839	£842K
Lowland habitats	912	£182.4K
Water bodies and wetlands	980	£196K
Total	**36,045**	**£2,086.1K**

8.6 The cost of managing the area of planned open habitat

Similar figures can also be used to calculate the current cost of managing the open habitat planned for restoration in current Forest Design Plans. These are shown in Table 12 below. An average management cost of £250 per ha per annum has been adopted in this table, reflecting the experience of staff across the country and the greater challenge of managing newly established habitat. £250 per hectare per annum is widely accepted amongst other organisations as a realistic figure for the management of open both upland and heathland habitat, which dominates the planned habitat portfolio.

Table 12. The cost of managing the planned open habitat on the Public Forest estate.

Planned open habitat management costs		
Habitat	**Area (ha)**	**Total cost (£K per annum)**
Heathland	3,831	£957.8K
Upland	7,738	£1,934.5K
Lowland habitats	509	£127K
Water bodies and wetlands	337	£84K
Total	**12,415ha**	**£3,103.3K**

8.7 The additional cost of managing the restored potential open habitat

The amount and nature of additional open habitat restoration on the Public Forest Estate depends on emergent policy and wider strategic planning. However for illustration, if we assume all available potential habitat across the freehold land of the estate in England is restored, the additional costs of ongoing management are significant. A breakdown is shown in Table 13 below.

Table 13. Cost of ongoing management if all potential open habitat restored on the Public Forest Estate (freehold land only)

Habitat Type	Cost of ongoing management					
	low		Moderate		High	
	Area (ha)	Total cost £K per annum	Area (ha)	Total cost £K per annum	Area (ha)	Total cost £K per annum
Heathland habitats	**3,872**	**£116.6K**	**11,491**	**£2,872.8K**	**6,009**	**£4,596.8K**
Upland habitats	**148**	**£21.5K**	**13,656**	**£3,261K**	**372**	**£279k**
Lowland habitats	**347**	**£17.4K**	**346**	**£143K**	**254**	**£187.5K**
Water bodies and wetlands	**4**	**£0.2K**	**39**	**£3.9K**	**420**	**£210K**
Total area (ha)	**4,371**		**25,532**		**7,055**	
Total cost (£million)		**£0.16m**		**£6.28m**		**£5.27m**
	Overall Area (ha)					**36,958**
	Overall cost (£m per annum)					**£11.7m**
	Average cost per hectare per annum (£)					**c.£317**

This table represents the additional cost at current prices of the ongoing management of a hypothetical comprehensive open habitat restoration programme. Real costs would require adjustment to reflect the combination of habitat types of varying management challenge, the scale of restoration and the intensity of management regimes adopted. Any change in scale could of course be adjusted *pro rata* to accommodate the area involved.

8.8 Grazing potential

If it were restored, some **6,714ha** of the potential open habitat identified would be best managed using grazing livestock alongside vegetation management to improve the wildlife quality of the resulting habitat.

This area is made up of **414** identified separate units, ostensibly with an average size of c.16 hectares (though this is almost certainly an underestimate of average area as many units would be extending existing open areas, many of which are already grazed). Together they have a combined perimeter of 735 Kilometres.

Experience has shown that given the incentives currently available within Natural England's Higher Level Stewardship (HLS) scheme, in most areas graziers can be found to manage livestock for conservation grazing. HLS payments amount to £c.200/ha/per annum. This implies that a hypothetical comprehensive restoration programme coupled with an assumption of grazing where possible would require an overall additional sum of **£1.3m** in annual payments from HLS to secure grazing across all the additional area.

Using the perimeter length of the GIS polygons identifying areas that could realistically be grazed if restored it is possible to calculate the capital cost of fencing involved.

With 6,714ha of potentially grazed open habitat across the estate (mostly lowland heathland) with a combined perimeter of 735Km, and at a cost of c. £5 per metre the total capital outlay of fencing following a hypothetical comprehensive restoration programme with grazing would be in the order of **£3.68m**. Note however that these figures are indicative only as they assume a) all units are separate grazing enclosures b) that all grazing would attract HLS payments, and that c) all boundaries would need to be fenced (as opposed to extensions to existing fenced areas).

9. Carbon budget

Significant land use change from existing stands of plantation or woodland to open habitat of various kinds will have a considerable effect on the present carbon account of the Public Forest Estate across England.

The Carbon account is changed in two significant ways:

- A reduction in the standing crop of stored carbon per hectare.
- A reduction in the capacity of the Forestry Commission Public Forest estate to contribute to the provision of alternatives to high embedded carbon building materials and fossil fuels (product displacement).

The greenhouse gas issues associated with implementation of any policy aimed at restoring open habitat from forested land is explored in more detail in the Open Habitat policy summary of evidence, which can be found at www.forestry.gov.uk/england-openhabitats, page 20.

Assuming all the available potential open habitat across FC freehold land is restored to open habitat, the amount of stored carbon released can be calculated by comparing the average carbon held in a hectare of open habitat against the carbon held by the land area of forest. On average across the forest this is approximately 50 tonnes of carbon per hectare.

9.1 Stored carbon

If all the available **36,958ha** of potential habitat on the FC freehold land were to be restored to open habitat then the amount of currently stored carbon released (i.e. the difference between carbon storage in forest and carbon storage on an equivalent area of other habitat) would be in the order of **7.0 million tonnes of CO_2e**. This level of change would result in the Greenhouse Gas inventory for forestry in the UK, as reported under the Kyoto Protocol, changing from a carbon sink to a source of carbon over the period of implementation of the adopted programme.

9.2 Product displacement

Restoration also results in a loss of potential for harvested wood products to substitute for higher carbon materials such as oil for fuel or concrete, aluminium and steel for construction. The hypothetical reduction in carbon emissions due to substitution over a complete forestry cycle in productive woodland is significantly higher than the long-term average carbon store. A conservative product displacement estimate (as outlined in the policy evidence paper cited above) uses woodfuel used in co-firing as a proxy, and a figure of 100 tonnes of CO_2e equivalent per hectare as a workable guide to carbon emission abatement with respect to forest and product displacement.

While authoritative figures for the potential of product substitution to reduce emissions are as yet unavailable, fuel substitution is proposed as a reasonable interim proxy (see Open

Habitat policy summary of evidence at www.forestry.gov.uk/england-openhabitats, page 20).

9.3 Combined impact on sequestration and product displacement

In keeping with the approach used in the open habitats policy public consultation a combined total average negative impact on carbon balance of **151tonnes C0$_2$e per ha** has been used. This equates to 550 tonnes of CO_2e per hectare of forest replaced by open habitat. Should all the potential area of 36,958ha be restored to open habitat, the increase in atmospheric carbon that would result would be in the order of **20.5 million tonnes of CO_2e**.

*Note that the existing plans for open habitat restoration represent an existing as yet unrealised negative impact on carbon balance of **c.1.9m tonnes of CO_2e** not included in the figures above.*

9.4 *A note on carbon and peatland soils*

Some of the priority open habitats are on peatland soils. Peatlands store more carbon in their soils than in their vegetation, including the trees where they have been afforested.

However, peatland soils also emit methane and, in some cases, nitrous oxide, both of Which are more powerful greenhouse gases than CO_2. As a consequence, it is unlikely that any active peatland soil acts as a net sink for greenhouse gases.

The potential loss of carbon from these stores is significant. But this is more than balanced by sequestration in vegetation due to the growing trees. However, the woodland or forest reaches equilibrium and stops sequestering carbon after about 100 years. The soil emissions though can carry on for a long-time because peatland soils under closed canopy degrade due to drying. It is anticipated that following restoration, peatland soils will eventually return to sequestering carbon.

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 the changes in soil carbon due to restoration on peatland soils is set at 0. It is accepted that this pollution swapping (i.e. CO_2 for CH_4) does not account for the long-term loss of soil carbon stocks, but it is believed to be the correct approach to take in this restricted assessment of green house gas balance. The details of this issue are presented in full in www.forestry.gov.uk/england-openhabitats.

9.5 Summary of impact on carbon management

In keeping with the approach used in the open habitats policy public consultation a total average negative impact on carbon balance of **151tonnes CO_2e per ha** has been used.

A hypothetical programme of restoration of all potential open habitat represents a carbon equivalent of approximately **20.5 million tonnes** of CO_2e over a hundred years or 0.21 millions tonnes of CO_2e per year. This represents a 5% reduction in the total rate of removal of greenhouse gases from the atmosphere by England's woods and forests of 4 millions tonnes CO_2e per year.

A smaller programme would represent a *pro rata* smaller impact on the carbon budget, and variation in the Yield Class of stands would contribute a little differentially to a more exact carbon account prepared for any real proposals for habitat restoration in the future.

Further work will improve the accuracy of these figures and is being undertaken to that end. At present the simple calculations presented here act only as a guide to the likely scale of impact open habitat restoration might have on the carbon balance of the estate.

10. Existing wildlife interest

10.1 Wider existing wildlife interests

A comprehensive study undertaken by Forest research into the biodiversity of plantation stands in Britain clearly 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. Considerable invertebrate and fungal diversity can be found (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.

Such studies are studies of forest stands and not forests *per se*. Consequently much of the biodiversity associated with actively managed forests or forest heath mosaics is often missed. Species associated with rides, disturbed ground, clearfells, forest edge etc. are important aspects of biodiversity associated with forests rather than forest stands. This can be clearly seen in large pine forests where nightjar and woodlark densities, for example, can be greater across extensive network of recent clearfells, than in equivalent areas of heathland/birch woodland mosaics.

10.2 Example locations

Many areas of plantation and secondary woodland have wildlife values that have accrued since planting. In some instances it is very clear that the existing interest may be compromised by the potential interest that would arise should the area be restored to open habitat. Some good examples emerged during the collection of information for this study:

Mendips, Stock Hill Plantation

The plantations at Stock Hill are locally renowned for the numbers of long eared owls that nest within them. They nest in the mature plantations and feed over the areas of recent clearfells as well as the surrounding landscape. Much of this area is also of considerable archaeological interest being the site of past lead mines and associated tailings.

Slaley Plantation, Northumberland

Slaley plantation hosts most of the breeding pairs of nightjars in County Durham and is one of the most northerly concentrations of nightjars in Britain. The birds nest in the clearfells and hawk over the clearfells and rides. The plantation provides the sheltered habitat that can support them and the moth species they feed on, which is absent from the surrounding open moor.

Thetford Forest, Norfolk

Thetford Forest now consists of a complex mosaic of plantation, open heath and grassland, clearfells and wide rides. The area supports large populations of nightjars and woodlarks in such numbers that the whole forest has been designated a SPA (Special Protection Area) as a result. The forest is also of regional importance for its bird communities as a whole which thrive on the complex mosaic, with many woodland edges and successional stages. The forest has been described by the BTO (British Trust for Ornithology) as being the most important area in East Anglia for woodland birds, heathland birds *and* farmland birds. Changes to the prevailing mosaic would need to be very carefully considered if this diversity and abundance is to be maintained. Any change in management would need to be agreed with Natural England as the condition of the current Special Protection Area (SPA) is determined by numbers of woodlark and nightjar, whose abundance is largely determined by the area managed as rotational clearfell of pine. It is worth noting here that Thetford Forest contains nearly half the potential for heathland and grassland restoration identified in this study.

Kielder Forest, Northumberland

As a result of its extent, the preponderance of small seeded conifers and the virtual absence of large seeded broadleaves such as oak Kielder Forest remains the last stronghold for red squirrels on mainland England. Changes to the connectivity of stands resulting from the restoration of mire and upland blanket bog may need to be planned in such a way as to ensure that the requirements of the squirrels are accommodated.

11. Conclusion

The aims of the survey in providing reliable quantitative information on the extent and character of the existing, planned and potential open habitat across the Forestry Commission Public Forest Estate in England were met. The methodology adopted is regarded as reliable given the experience of the staff involved, the scale of the task attempted and the time available. The data collected should not however be used in any detailed assessment of any particularly area's biodiversity value, precise habitat character or the actual anticipated costs and benefits of any proposed operation at a local level. The level of detail adopted here, in considering the implications of potential extensive land use change across thousands of hectares, mitigate against such usage.

The report does nevertheless give reliable indicative figures for the area of potential habitat that resides across the Public Forest Estate and very reliable indicative figures for the costs of restoration and ongoing management, the impact on timber yield, and the implications for managing for carbon budgets.

The report does not fully explore the potential for open habitat across the land *leased* by the Forestry Commission in England, nor does it discuss in any depth the options for realising open habitat potential on leasehold land. In many instances open habitat restoration may well be possible, but in exploring indicative costs of an extensive programme of open habitat restoration it was thought more appropriate to consider the freehold potential to illustrate the costs and implications of extensive change.

The areas and figures are reported as available from the Forestry Commission Sub Compartment Database in March 2009 and are subject to continual change as the database is used, amended and updated.

JWS and RE May 2009

12. Key references

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