

GUIDELINE NOTE

BY GORDON PATTERSON & RUSSELL ANDERSON

JULY 2000

INTRODUCTION

This Guideline Note sets out forestry policy and practice in relation to peatland habitats, with particular focus on blanket bogs and lowland raised bogs. These two types of internationally important peatland habitat are the most extensive, have been most affected by forestry in the past, and are now the subject of UK-wide Habitat Action Plans to conserve and enhance their biodiversity.

The guidance should be useful to foresters, environmental interest groups and planners as well as to landowners. It indicates how the Forestry Commission will evaluate proposals for woodland expansion on to peatland or for restoration of peatland habitats from woodland.

This Note updates the *Forest nature conservation guidelines* (Forestry Commission, 1990) in respect of peatlands. It follows consultation with a wide range of interested parties.

BACKGROUND

Today there are nearly 1.7 million hectares of deep peat soils in Britain, the great majority of which are bogs, where the main nutrient source is rain water (Table 1). Fen peats, which receive water flowing from surrounding land, form less than 10% of the total area.



FOREST LIFE Picture Library

Figure 1

An area of peatland set aside as an SSSI in Dolgellau, Wales.

Key definitions of peatland types used in this Note can be found on page 6.

The area of bog has declined throughout historic times and the rate of loss has increased in recent decades. Good quality lowland raised bogs are now especially rare. The area of blanket peat is still large (nearly 1.5 million hectares) but at least 10% of it no longer supports bog vegetation (UK Biodiversity Group, 1999).

Table 1

Estimated areas of peat soils in Great Britain greater than 1 m in depth (000 ha) (Adapted from Lindsay and Immerzi, 1996)

Country	Fen*	Raised bog	Blanket bog	Intermediate bog	Total area
England	132.5	37.7	214.1	1.0	385.2
Scotland	1.2	27.9	1056.2	10.6	1096.0
Wales	2.9	4.1	158.8	0.1	165.8
Total recorded peat	136.6	69.7	1429.1	11.7	1647.0
Total bog peat					1510.0

*Fen peat soils poorly recorded by the BGS Drift Maps, particularly in Scotland; total area will exceed this. Totals include some peat which is 0.3-0.5 m deep.

Between the 1940s and 1980s agricultural and forestry development on peatland became widespread, as well as peat extraction for horticulture. Drainage and ploughing technology together with use of fertilisers made it possible to afforest deep peat areas, and forestry use on such areas was encouraged because they were of low agricultural value. Many successful plantations were established on deep peat sites during this period and they now contribute to the rural economy.

However, increasing realisation of the conservation value of peatlands led to a change of emphasis in the late 1980s. Since then there has been a steep decline in new planting on peatland sites, and most of the planting which now occurs is new native woodland planted for environmental benefits.

Many lowland raised bogs and large tracts of blanket bog have now been designated as SSSIs because of their biological interest. The 1992 Habitats and Species Directive recognised both active raised bog and active blanket bog as habitats of European Union interest requiring priority in application of conservation measures. Bog woodland is also recognised as a priority type but it is very rare in Britain. For each of these habitat types, designation of a number of Special Areas of Conservation has been proposed by the UK Government to comply with the Directive.

The UK Biodiversity Action Plan defines lowland raised bogs, blanket bogs and fens, as well as several other related habitats which can include peat, as priority habitats requiring Habitat Action Plans (Anon., 1995). The two bog Habitat Action Plans (UK Biodiversity Group, 1999) have targets for conserving and improving the quality of remaining bogs and restoring some areas which have been altered through agriculture, peat extraction or forestry (Table 2).

PEAT AS AN ARCHIVE

As well as its importance for nature conservation and landscape quality, peat is very important for its value as an archaeological and scientific resource; it contains a record of climatic and ecological changes and of human history over millennia. Peat preserves pollen and plant remains, tree stumps and many human artefacts which have disappeared elsewhere. Peat can also conceal archaeological evidence on underlying strata from times pre-dating peat formation. Drainage

and the growth of tree roots can damage these attributes, so careful location and design of new woodlands is required to avoid important sites, especially scheduled ancient monuments.

PEAT AND CLIMATE CHANGE

The contribution of rising atmospheric carbon dioxide concentrations to global climatic change has emphasised the importance of carbon storage in deep peats which form a major part of Britain's terrestrial carbon sink. In general, woodlands are net sinks, removing carbon from the atmosphere, although further research is necessary to determine the carbon budgets of different woodland types and the level of carbon exchange between woodlands and the atmosphere.

However, there is some evidence that afforestation can change deep peat from a carbon sink to a carbon source, thus contributing to global warming. The Forestry Commission will continue to encourage and contribute to relevant research but meantime a cautious approach to planting on deep peat sites is appropriate.

FORESTRY POLICY AND PEATLAND CONSERVATION

Forestry policy in Britain is aimed at the sustainable management of existing woods and steady expansion of tree cover to achieve the diverse economic, social and environmental benefits which forests can provide (HMSO, 1994a). Forestry is expected to contribute to the UK Government's programmes for sustainable development, biodiversity conservation and ameliorating climate change (HMSO, 1994b, 1994c, 1994d). The Forestry Commission will co-operate with others to help implement the Habitat Action Plans for lowland raised bogs, blanket bogs and fens, and other parts of the Biodiversity Action Plan which are relevant to peatland.

The Forestry Commission has consulted relevant interests and reviewed the application of these principles to peatlands. Sections 1–3 on pages 4 and 5 set out the broad approach we intend to take. As forestry and environment are now devolved matters, it is a matter for England, Scotland and Wales to develop distinctive policies in future within the context of the international commitments of the UK. This guidance will be reviewed as policies and best practice evolve.

Table 2

Peatland habitats relevant to forestry: Biodiversity Action Plan priorities and targets, and habitats of European Union importance

Category	UKBAP priority habitats with Habitat Action Plans	EU Habitats Directive: main habitats of EU interest	Summary of key BAP targets
Bogs	Lowland raised bog (UK Biodiversity Group, 1999) [Transitions to blanket bog, upland and lowland heath, fens and wet woodland]	Active raised bogs ⁺ . Degraded raised bog still capable of natural regeneration [Bog woodland ⁺] [Transition mires and quaking bogs]	<ul style="list-style-type: none"> • Maintain or enhance primary near-natural bog in/to favourable condition. (P1*) • Improve readily restorable damaged areas towards favourable status by 2015. (P2, P3*) • Restore some significantly altered areas used for agriculture, peat workings and woodlands: identify areas by 2002; start restoration by 2005. (S1, S2, P4, P5*)
	Blanket bog (UK Biodiversity Group, 1999) [Includes intermediate bogs, transitions to and complexes with raised bogs, fens, upland heath, wet woods]	Blanket bog (*active only) [Bog woodland ⁺] [Transition mires and quaking bogs]	<ul style="list-style-type: none"> • Maintain current extent and overall distribution of blanket bog currently in favourable condition • Restore/improve other areas so that by 2015 over half the total area (845 000 ha) should be in, or approaching, favourable condition
Fens	Fens (Anon., 1995) [Transitions to blanket and raised bogs, reedbeds, wet woods, upland and lowland heath, purple moor grass rush pasture]	[Transition mires and quaking bogs] [*Calcareous fens with <i>Cladium mariscus</i> and <i>Carex davalliana</i>] [*Petrifying springs with tufa formation], alkaline fens, <i>Molinia</i> meadows on chalk and clay	<ul style="list-style-type: none"> • Start rehabilitation of priority fens by 2005 • Rich fens and rare types to be prioritised
Other habitats including peatland [Mostly shallow peat <0.5 m, or very local deeper peat habitats]	Upland heathland (UK Biodiversity Group, 1999) - wet heath areas	Northern Atlantic wet heaths with <i>Erica tetralix</i>	<ul style="list-style-type: none"> • Maintain current extent, distribution and condition of areas in favourable condition • Improve condition of most of the rest by 2010 (includes encouraging a native woodland component in some circumstances) • Restoration of up to 105 000 ha including some reseeded and afforested areas to reverse fragmentation (5000 ha)
	Lowland heathland (Anon., 1995) - wet heath areas	[Depressions on peat substrates (<i>Rhynchosporion</i>)] *Southern Atlantic wet heaths with <i>Erica ciliaris</i> and <i>E. tetralix</i>	<ul style="list-style-type: none"> • Maintain/improve all existing areas and restore some
	Wet woodlands (UK Biodiversity Group, 1998) on fen and bog sites	[Bog woodland ⁺]	<ul style="list-style-type: none"> • Maintain/improve current areas; restore some from plantations and expand on to unwooded land

⁺ = priority habitats in EU.

* = refers mainly to the categories explained in Table 3 and Figure 3.

NB: EU habitat types in square brackets [] are relatively rare and/or occupy very small areas. They have been placed with the main UKBAP habitat type in which they occur.

FORESTRY POLICY AND PEATLAND CONSERVATION

1. New woodlands on bogs

The Forestry Commission has concluded that for conservation and wider environmental reasons there should be a strong presumption against further forestry expansion on the following peatland types:

- Active raised bog and degraded raised bog capable of restoration to active status.
- Extensive areas (exceeding 25 ha) of active blanket bog averaging 1 m or more in depth or any associated peatland where afforestation could alter the hydrology of such areas.

In future, the Forestry Commission will not approve grant applications containing proposals for new planting or new natural regeneration in these situations. Forest Enterprise planting proposals will also exclude such sites. Recent revisions of the Regulations concerning Environmental Impact Assessment of forestry projects allow the Forestry Commission to prevent forestry developments which could damage these habitats, even if no grant aid is requested by the developer. The Forestry Commission is also empowered to require restoration where unauthorised forestry developments have occurred.

The Forestry Commission will continue to consider sensitive proposals for the creation of new woodland on other peatland sites, including shallow (<1 m depth) peat and peaty mineral soils and degraded blanket bogs on deep peats. The expansion of native woodlands on to shallow peat and degraded blanket bog soils within their natural range will be encouraged on suitable locations to help achieve Government targets under the Biodiversity Action Plan. There may also be some areas, mostly in Scotland, where isolated, smaller pockets of active blanket bog are interspersed with mineral soils, on which woodland expansion proposals will be suitable, especially where they have been fragmented by past land management.

However, many such peatland sites have a high value as open ground for biodiversity, including internationally and nationally important habitats

(see Table 2), or for landscape, cultural or other reasons. The Forestry Commission will therefore consult relevant interests upon proposals for woodland creation or expansion for these categories, following the procedures set out in *The UK forestry standard* (FC 1998) to ensure that any planting is appropriate. We may require owners to carry out an Environmental Impact Assessment where significant impacts from planting are possible.

By ruling out the best of the bog habitats from woodland expansion, the Forestry Commission expects that owners, agents, consultees and foresters will be able to concentrate attention upon those peatland areas where planting may be acceptable. The definition and identification of these categories is often not easy in such variable ecosystems, however, and it may be necessary to develop regional variations and local plans to implement this general framework. The Forestry Commission will work with nature conservation agencies and other partners to do this.

2. Conserving and restoring bogs in existing forests

The Forestry Commission will encourage the conservation of peatland habitats within forests as part of the design and management of open ground, which is normally expected to form 10–20% of the total area of woodland. Restoration of former bog habitats may be possible within some of the larger openings in extensive forests. The creation of transition zones at planted forest edges adjacent to open blanket bog will also be encouraged. The possibility of developing new forms of wooded bog will be researched, especially those which may contribute to the wet woodland Habitat Action Plan and expansion of the European Union priority habitat type Bog Woodland. The Forestry Commission may offer grant-aid towards the cost of bog restoration operations such as drain blocking or the removal of unwanted natural regeneration in areas forming part of the open-ground component of woodlands. Forest Enterprise will carry out similar work in Forestry Commission forests where it is considered appropriate to do so.

There is a lack of firm evidence on the prospects of successfully restoring raised or blanket bog ecosystems after woodland removal. Further research is required to establish the costs and benefits of bog restoration on a variety of scales and conditions. The Forestry Commission is carrying out research of this type, and will continue to do so in partnership with others.

In the meantime (because the Government's policy is to maintain and expand woodland cover), bog restoration projects on a scale which exceeds the normal open ground provision within woodlands will only be approved by the Forestry Commission where there are high net environmental benefits to be obtained from permanent tree removal. An Environmental Impact Assessment may be required by the Forestry Commission to help reach a decision.

In such cases the Forestry Commission may give felling approval without a replanting condition and may also decide not to pay grants for restocking an area either by planting or by natural regeneration. Similarly, Forest Enterprise may decide not to replant. Such special cases in both private and public forests are likely to be found on deep peat sites (average depth 1 m or more), which are judged to have a high probability of successful restoration to active raised bog or active blanket bog; and are either hydrologically linked to significant remnant areas of active bog or are adjacent to them and important to their ecological integrity. Important archaeological or landscape benefits may sometimes justify felling without subsequent replanting in some peatland areas, especially when combined with ecological benefits. Further guidance is given on page 13 and in Figure 8.

A key requirement for Forestry Commission support for bog restoration projects will be an agreed management plan which sets out how restoration is to be achieved and who will carry out the work over an adequate timescale. The Forestry Commission will seek to work with partner organisations to develop management plans.

3. Fens and fen peatland

The Forestry Commission will apply a similar approach to fens (and fen peatland) as for bogs. However, fens vary even more widely in their character and importance for conservation or restoration, so each case will need to be considered on its merits. The guiding principles are outlined here.

- Sites which are important for conservation as open wetland will not be approved for grant-aid for new woodland, and Forest Enterprise will not plant such sites on its estate (an Environmental Statement may be required by Forestry Commission where significant impacts on important sites are possible from planting proposals);
- However, native wet woodland expansion may be encouraged on fen peatland sites to meet HAP targets where this provides more biodiversity benefits than open fen habitat;
- The Forestry Commission will encourage suitable restoration of fen wetland habitats within existing woodlands as part of normal open space provision; it will also encourage suitable expansion of native wet woodland into former fen peatland sites;
- In cases where restoration of larger areas of fen peatland from woodland would yield high net environmental benefits, the Forestry Commission may withhold replanting grants or give unconditional felling licences, and Forest Enterprise will consider not replanting.
- Fen peatlands can be dynamic habitats. Natural transitions and fluctuations between open wetland and woodland are common. The Forestry Commission will take account of this in considering proposals for expanding or removing woodlands.

Fen peatlands vary widely in size, ecological character and conservation importance and advice will need to be obtained from nature conservation agencies on the importance of individual sites. Generally, sites with designations or containing European Union priority habitat types or species are likely to be seen as more important. Research into the costs and benefits of restoring fen peatland habitats will be considered by the Forestry Commission in partnership with others.

PEATLAND TYPE AND CONDITION - TERMINOLOGY

Peatland

Peatland is any wetland with peaty soils whether or not the natural vegetation remains and peat is still being formed.

Mire

A mire is a wetland which supports at least some vegetation which is normally peat forming (Lindsay and Immirzi, 1996). Mires in their natural state support very distinctive wildlife communities including many specialist species. They can be divided on the basis of their source of water and nutrients into fens and bogs.

Fen

Fens receive rainwater and also water flowing from surrounding land as surface run-off or flow through soil or rocks. They are typically found at the edges of lakes, on river floodplains and by springs and seepages and are often small. Fens vary widely in base and nutrient status according to their position and the local geology. They therefore support a wide range of ecosystems with distinctive conservation needs.

Bog

Bogs are peat-forming mires which are supplied with water and nutrients only from rain, snow, mist and dust. The term ombrotrophic is used to describe this. They are therefore naturally acidic and nutrient-poor systems. Bogs include blanket bogs, lowland raised bogs and intermediate bogs.

Active bog

This term is used in the European Union Habitats and Species Directive to describe bogs which are actively forming peat, i.e. still functioning as bog ecosystems. Active status is hard to define and assess precisely but is generally taken to mean that the site 'still supports significant areas of vegetation which is normally peat forming' (Manual for the Interpretation of Annex 1 Priority Habitat Types of the Directive 92/43/EEC.) See page 10 for further guidance.

Degraded bogs

Degraded bogs are those where widespread, and usually man-made, disruption has occurred to the hydrology of the bog over the greater part of the site. Causes include drainage, drying through tree growth or natural climatic fluctuation, peat removal and agricultural management (muirburn or conversion to pasture). Vegetation composition reflects these changes.

Degraded bogs capable of natural regeneration

This is a European Union Habitats Directive category for lowland raised bogs. However, the concept can be applied also to blanket bogs, bogs where the hydrological conditions for peat formation can be restored and where, with suitable management, there is a reasonable expectation of establishing widespread peat-forming vegetation within 30 years (JNCC, 1997).

Further description and explanation of the ecology of bogs and other peatland types is found in the raised bog inventory (Lindsay and Immirzi, 1996), the Habitat Action Plans, and in JNCC, 1995.

GUIDELINES FOR FORESTRY AND BOGS

The sections which follow give guidance on how to apply the policy principles to lowland raised bogs and blanket bogs, the two major categories of peatland affected by forestry.

Lowland raised bogs

Lowland raised bogs have a characteristic, gently sloping, raised mound of waterlogged peat, and today they are typically surrounded by farmland or woodland (Figure 2), although they originally developed within a wetland environment. The peat is usually 3–10 m deep in the centre but shallower near the edge. Vegetation is largely composed of heather, *Sphagnum* (bog) mosses, cross-leaved heath, common and hare's-tail cottongrass, deer grass, bog myrtle and downy birch (Figure 5). The vegetation of the grassy (lagg) zone around the edge is usually taller, not heathery and consists mainly of purple moor grass, wavy hair-grass, tufted hair-grass, sedges, or rushes. Often the transition is abrupt through drainage at the margins.

Raised bogs are also found in the uplands but usually within blanket mires and so are not distinguished in classification or management prescriptions from the surrounding blanket bog. Intermediate bogs are raised bogs with some tendency to expand on to sloping ground.

An inventory of lowland raised bogs in Great Britain (Lindsay and Immirzi, 1996) classified lowland raised bogs in terms of their condition (Figure 3). Classes P1, 2, 3 and 4 and S1 are generally considered to be either active or degraded but capable of natural regeneration.

In primary bogs (P) the peat surface may have been affected by drains or drying and burning but the peat archive is largely intact and, at least for categories P1–4, peat-forming vegetation and hydrological conditions are either still present or should be readily restorable given sympathetic management.

In a few cases Class P4 (open canopied scrub or woodland) will include the European Union priority habitat Bog Woodland which should not be treated as degraded bog.

Figure 2 Examples of raised bogs



Lorne Gill, SNH

a. Offerance Moss (classic shape)



Lorne Gill, SNH

b. North Waukenwae Moss (V irregular shape, multiple domes)



Lorne Gill, SNH

c. Blacklaw Moss (partly afforested, partly cut-over)



Lorne Gill, SNH

d. Bog damaged by mineral extraction

Class P5 sites are now occupied by closed-canopied woodland. They will have lost most of the bog vegetation and in most cases the peat has irreversibly dried and shrunk in response to tree growth and drainage under plantations of lodgepole pine and spruce. The potential for restoration is very uncertain on such sites: the best that can presently be said is that some might eventually be restored to something approaching their original state if trees were removed and drains blocked up.

Secondary bogs are those subject to partial peat removal by cutting or industrial processing. Where the cutting has ceased, been minor and has revegetated (S1) the bog may be capable of repair to active status provided drainage can be stopped. Bogs where commercial scale peat stripping has occurred (or permission has been given) on most of the site (S2), are more difficult and longer term sites for restoration.

Archaic bogs where the peat has been removed or oxidised down to the groundwater table, or where the peat is buried under buildings or industrial development, are not capable of restoration. These will include some woodlands planted on peat soils which were formerly farmed.

The inventory has shown that many bogs are a mixture of several classes and management decisions should take account of the proportions and distribution of the dominant and the best classes on the site.

Table 3 summarises the general approach the Forestry Commission will take to new planting and restocking for each of the lowland raised bog classes in applying the policy principles on pages 4 and 5.

Table 3 should be used only to indicate the broad approach; each site must be considered on its merits. For example, a number of sites containing substantial areas of class S2 are SSSIs, where planting would not be acceptable.

Figure 3 Raised bog condition classes

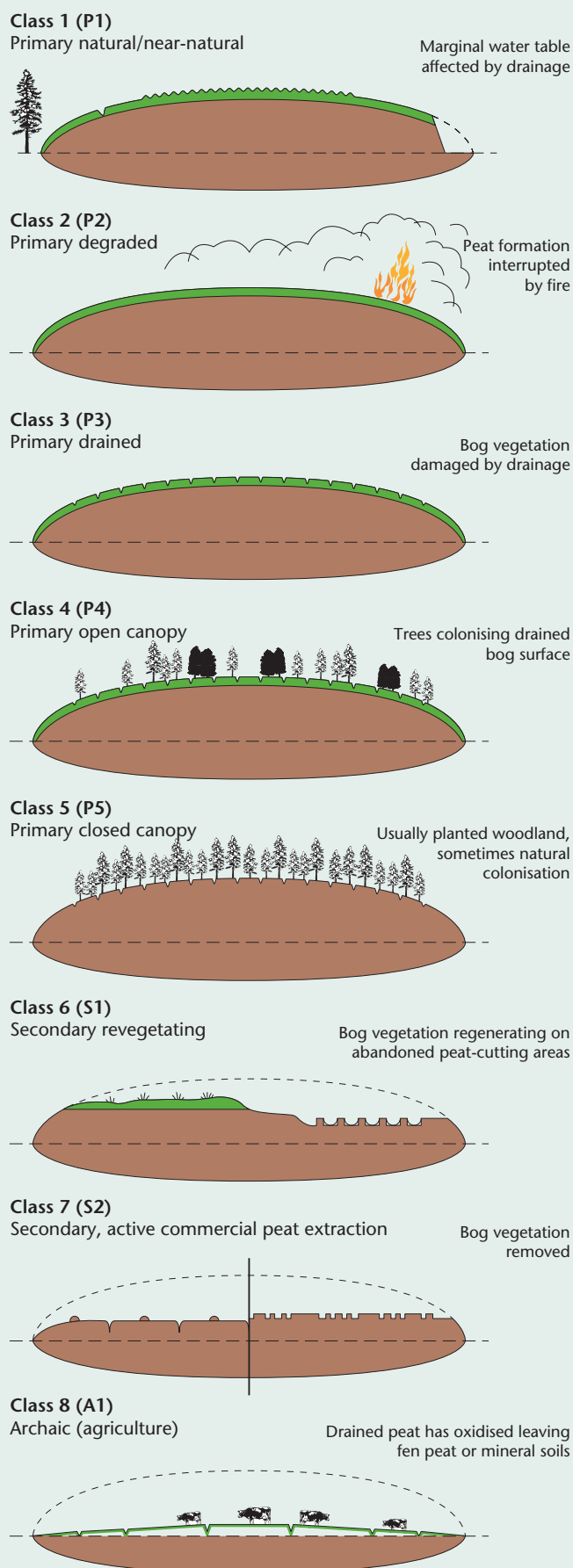


Diagram reproduced with permission, from *Peatland Issues - Report of the Working Group on Peat Extraction and Related Matters* (DETR, 1999).

Table 3

Forest policy in relation to the condition-classification of lowland raised bogs (adapted from *An inventory of lowland raised bogs in Great Britain*, by Lindsay and Immirzi, 1996)

Condition class	Total area in GB ^{*1} (000 ha)	Status			Consider for	
		Active ^{*2}	Degraded but restorable	Degraded not restorable	New planting	Replanting
P1 Natural or near natural	5.4	✓			NO	N/A
P2 Degraded vegetation	5.0	✓ ^{*3}			NO	N/A
P3 Drained	1.9	✓ ^{*3}			NO	N/A
S1 Revegetated or regenerating	4.7	✓ ^{*4}	(✓)		NO	N/A
P4 Open scrub/ woodland	0.6		✓ ^{*5}		Sometimes ^{*5}	Sometimes ^{*5}
P5 Closed canopy woodland	11.0		✓	✓ ^{*6}	N/A	Normally YES
S2 Active peat workings	12.8		(✓)	✓	Normally YES	N/A
A1 Agricultural	2.1			✓	YES	N/A
A2 Built	2.0			✓	YES	N/A
Unknown	1.8					
TOTAL	69.7					

*1 Area of whole sites where the specified class is the major proportion.

*2 Active defined as 'supporting a significant area of vegetation which is normally peat-forming' in the EU Manual for the Interpretation of Annex 1 Priority Habitat Types of the Habitats and Species Directive.

*3 Classed as 'active' by Lindsay and Immirzi because the vegetation is only temporarily affected by burning, drainage or dry periods.

*4 Classed as 'active' by Lindsay and Immirzi but where the surface is severely affected by past cutting the period of restoration to P1 could be quite long. So 'Degraded and restorable' may apply to such sites.

*5 Includes recent scrub invading artificially drained bog surfaces but also 'natural' Bog Woodland which is an EU Priority Habitat type. Careful evaluation of the conservation merits of restoration to bog or continuing under woodland is required in each case.

*6 Knowledge of restorability of raised bog after canopy closure is very limited (see page 13). Most sites will experience shrinkage and irreversible cracking of the peat from 15–20 years after planting.

Blanket bogs

Blanket bogs (Figure 4) are only found in the wetter uplands (defined by climate, not by altitude), usually above about 400 m in England and Wales but down to sea level in northern and western areas of Scotland and Ireland. A single continuous area of blanket mire will include sites ranging in wetness and in nutrient availability from very wet, very poor ombrotrophic bog areas similar to raised bogs to drier, more steeply sloping sites, and localised fen sites flushed by mineral-rich water. Peat depth is typically in the range 0–6 m with a typical average of 2–3 metres. The species listed for raised bogs are all found on blanket bogs, with cotton-grasses, deer grass, heather or *Sphagnum* mosses, usually dominant and joined by others with a higher nutrient demand, such as purple moor grass, or more tolerant of the colder climate, such as cloudberry and bearberry. The total area of blanket peat in Scotland, England and Wales is around 1.4 million hectares (Table 1). However there is no complete inventory similar to the one for raised bogs. Around 90% of blanket peat supports mire vegetation, but the proportion of active bog is unknown.

Deciding the condition and conservation importance of bogs in relation to forestry proposals

Deciding whether a bog is ‘active’

The term is used as an abbreviation of 'actively peat-forming', so active peatlands are ones which continue to lay down new peat. However, peat accumulates too slowly (typically at a rate of 1–2 mm per year) for this to be used as a practical means of deciding whether a peatland site is active. The definition of ‘active’ in the Habitats Directive manual (see section on ‘bog type and condition’) is that the site still supports significant areas of vegetation which is normally peat-forming.

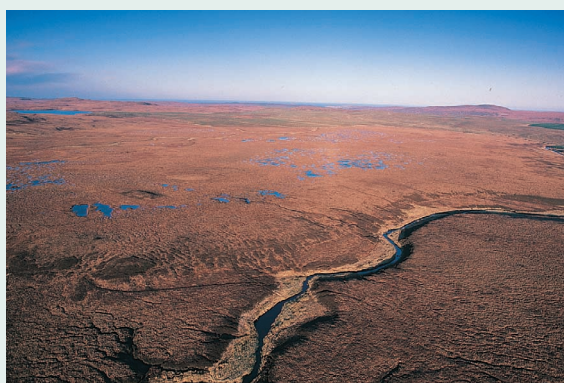
However, the range of species found in active bogs varies regionally with the climate. For example, in the oceanic west the National Vegetation Classification (NVC) Community M17, *Scirpus cespitosus*–*Eriophorum vaginatum* (deer grass–hare's tail cotton-grass) (Rodwell, 1991), dominates on blanket bogs. Purple moor grass (*Molinia caerulea*) and bog myrtle (*Myrica gale*) are widespread constituents. In the more continental eastern blanket bogs, hare's tail cotton-grass (*Eriophorum vaginatum*) and blaeberry (*Vaccinium*

Figure 4 Examples of blanket bogs



Lorne Gill, SNH

a. Typically bleak, watery landscape.



Lorne Gill, SNH

b. Sutherland bog with pool system



Lorne Gill, SNH

c. Howdrake Moss, Pennines



Lorne Gill, SNH

d. Blanket bog sometimes adjoins improved farmland.

myrtillus) form more of the vegetation and the main NVC type is M19, *Calluna vulgaris*–*Eriophorum vaginatum* (ling heather–hare's tail cotton-grass).

Some bogs in eastern England have been so altered by drying and by atmospheric pollution affecting the vegetation that the vegetation may not be a reliable guide and active status may need to be detected by measurements of the fluctuations in water table at the surface.

Regional or local guidance on the types and amounts of plant communities which indicate active status is therefore advisable for accurate diagnosis and advice should be sought from Scottish Natural Heritage, English Nature or Countryside Council for Wales. However the Box below lists species which tend to suggest active or degraded status throughout Britain. It can be used for guidance when following the decision diagram in Figure 7 on page 14.

In practice a gradation is often found between active and degraded at any one site as the raised bog inventory shows and designation of the whole site can be difficult.

Active bogs can include some areas where temporary disruption has occurred where the recovery is expected to be rapid, e.g. the site of a recent fire or period of heavy grazing. Expert advice may need to be sought on whether the signs of recovery are sufficient for such an area to be treated as active.

Typical dominant ground vegetation on active bog and degraded bog which is no longer active

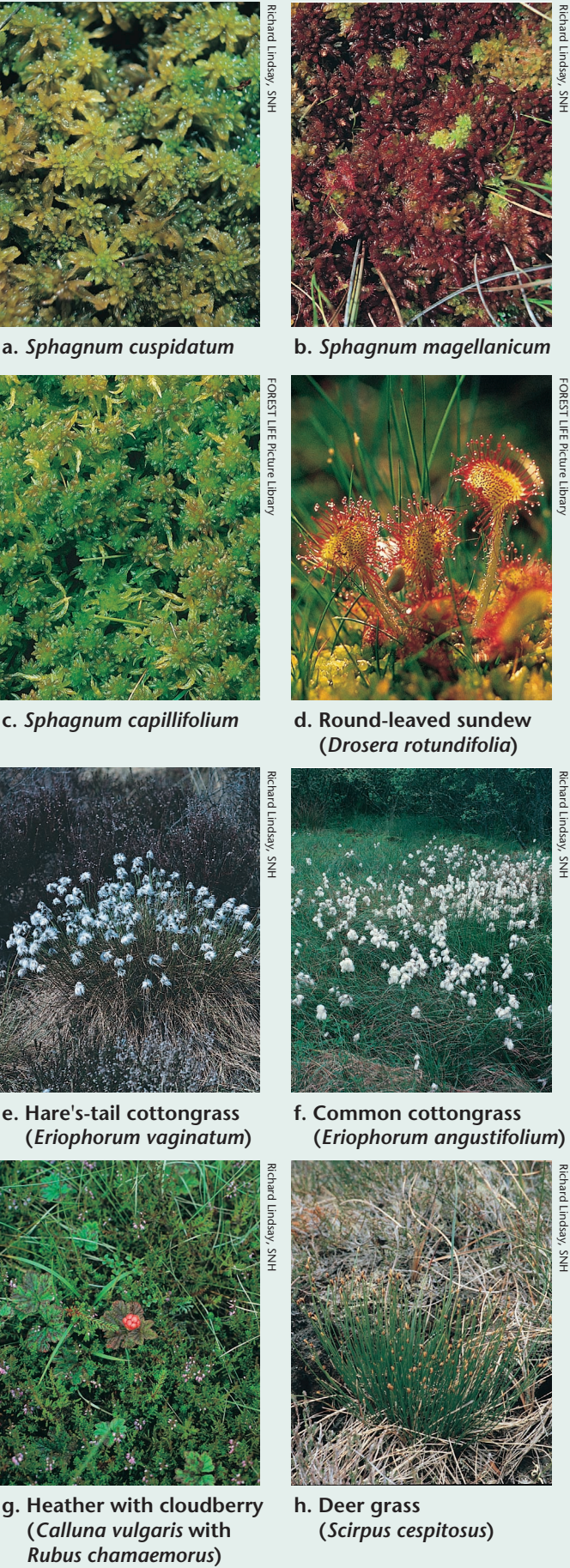
Active bogs

- Abundant *Sphagnum* mosses
- Heather (with *Sphagnum* understorey)
- Cross-leaved heath
- Cottongrasses
- Deer grass
- Purple moor grass (with *Sphagnum*)
- Bog asphodel

Degraded bogs : no longer actively forming peat

- Exposed peat with low cover of vegetation
- Artificially sown grass or agricultural crop
- Broadleaved grasses other than purple moor grass
- Dense heather with no *Sphagnum*
- Dense bracken
- Dense woodland or scrub with no *Sphagnum*

Figure 5 Some component species of actively peat forming bog vegetation.



Peat depth

Average peat depth is a useful practical guide to the importance of bogs for conservation and to their potential for woodland. Although blanket bogs and the edges of raised bogs do include some areas with average depth below 1 metre the great majority of active and restorable bogs have deeper peat. Likewise although commercial forest can be successfully established by cultivation and drainage of deeper peat, (and trees can successfully colonise degraded bogs deeper than 1 metre) new native woodlands planted mainly for biodiversity conservation would not normally be planted on peat deeper than 1 metre.

Average peat depth is more readily assessed than active status. A series of measurements, using rods, or even just a marked stick, should be made across the site or associated peatland areas.

Approximate boundaries of peat >1 metre deep can also be obtained from drift maps at 1:50 000 scale produced by the British Geological Survey. Where there are gaps in upland Scotland, Soil Survey of Scotland 1:50 000 maps can help.

Conservation importance of bogs

As well as active status and peat depth there are other factors which need to be considered in relation to forestry proposals. These include: conservation and other designations, and importance for European Union habitats or species of conservation importance and for UK Biodiversity Action Plan priority species and habitats. The effects of current or proposed woodlands on the hydrological, ecological, scenic, scientific and cultural integrity of areas adjacent to them must also be considered.

The decision chart in Figure 7 concentrates on hydrological integrity because it is peculiar to peatland. But the other factors must also be evaluated in each case as they are for forestry proposals on any other site type under the procedures summarised in *The UK forestry standard* (FC, 1998).

The Forestry Commission, as a competent authority under the legislation enacting the Habitats and Species Directive and Birds Directive, must pay particular attention to the implications of proposals for raised and blanket bogs, and for designated species which use

them and wider moorland areas. Examples are golden eagle, merlin, hen harrier and golden plover.

Conserving the cultural heritage

Because of the importance of many peatlands for preserving evidence of past environments and human activities, forestry planning should take account of information about these aspects.

Information on known sites of value can be obtained from local authority archaeologists and from databases such as the Scottish Palaeoenvironmental Archive Database (SPAD, available on the internet at [www. geo.ed.ac.uk/spad](http://www.geo.ed.ac.uk/spad)) and the Scottish Wetlands Archaeological Database (SWAD) which are both available from Historic Scotland.

Drying by forests of adjacent areas of peatland

Forests on blanket peat dry the surrounding peatland although this effect only extends about 40 m in first rotation forests (Pyatt *et al.*, 1992; Shotbolt *et al.*, 1998). A buffer zone should be used to protect areas of active bog over 1 m deep from any peatland planting sites which are hydrologically linked to it.

Forests at the margins of raised bogs, especially the smaller ones with more pronounced ground water mounds, can cause increased drainage rates by increasing the slope of the water table.

There can sometimes also be undesirable ecological effects associated with woodland planting on the adjacent bog or moorland areas, for example, reduced breeding success of ground nesting birds has been reported, which could be connected to increases in some predator species or changes in the vegetation structure near the woodland edge (Anderson, in preparation). In general the principle should be to minimise possible drying or nutrient enrichment effects and any other impacts on the ecological integrity of bogs within the same hydrological unit as the proposed planting site.

A minimum buffer distance of 100 m between the planting site and important areas of bog is proposed as a standard measure (see Figure 7) but this will need to be varied according to the circumstances of individual sites including the potential for natural colonisation by trees in future. For lowland raised bogs it may be necessary to avoid any planting at all within the same hydrological unit.

Deciding whether to consider proposals for new woodlands on bog

Figure 7 and Table 3 summarise how the Forestry Commission will apply the principles and criteria described in this section and on page 4 to evaluate proposals for new woodland on peatland areas. They can also be used by landowners, managers and environmental interest groups for guidance on where new woodland might be acceptable.

Bog restoration

The potential to restore active bog habitats is mentioned in parts 1 and 2 of the policy described on pages 4 and 5. Degraded raised bogs not capable of restoration to active status (already defined in section on peatland types) are regarded as having lost much of their value as habitats and forestry is seen as one possible use for these sites. Permission to fell large areas of existing woodland on deep peat without replanting may be given in exceptional circumstances, one requirement being a high probability of successfully restoring active bog. Potential methods of restoring bogs which have been afforested are described in a forthcoming Forestry Commission Technical Paper (Anderson, in preparation).

In several years' time, research results should give a firm indication of whether bog ecosystems can be successfully restored following forest removal. The chances of success are thought to be higher if restoration is undertaken before the first rotation forest has closed canopy. After this the peat can become severely cracked, making it difficult to rewet the ground sufficiently. An opportunity for bog restoration arises when the mature forest is harvested but the feasibility of rewetting the ground sufficiently at this stage is not known.

The few examples of bog restoration already undertaken have shown that costs can be high, varying from hundreds to thousands of pounds per hectare, depending on how close the trees are to their normal harvesting age and on site factors such as slope and ease of access.

Figure 8 shows how the potential feasibility and environmental benefits of bog restoration from woodland can be assessed. It also shows how the Forestry Commission will treat proposals to replant or restore bog to such sites after felling, following the principles on pages 4 and 5.

Figure 6 Bog restoration work in progress

Trees have been removed from a deep bog within a blanket mire in Kielder Forest and the main drain is being dammed to help retain water on the site.



FOREST LIFE Picture Library

SOURCES OF FURTHER ADVICE

The guidance given in this Note should in many cases be sufficient to clarify how Forestry Commission policy applies to particular peatland sites. Where there are still uncertainties they should be discussed with Forestry Commission staff at Conservancy offices, who will be pleased to have an early opportunity to discuss proposals likely to result in applications for woodland planting, management grants or felling licences.

Habitat Action Plans for lowland raised bog, blanket bog and fens include background information on the current status of the habitats and the factors affecting them.

The nature conservation agencies (Scottish Natural Heritage, Countryside Council for Wales and English Nature), have a network of area offices where staff can advise on natural heritage values of local sites and management for nature conservation. They can also refer enquirers to contractors offering specialist services such as habitat survey.

Wildlife Trusts and County Naturalists' Trusts may have inventories of local wildlife sites and some have experience of peatland conservation or restoration.

Archaeological advice

Contact the relevant national heritage agencies, CADW, English Heritage and Historic Scotland. Local authority archaeological services in Scotland and England together with the Welsh Archaeological Trusts maintain Sites and Monuments records and can provide helpful advice.

Figure 7 Evaluating proposals for new woodland on peat

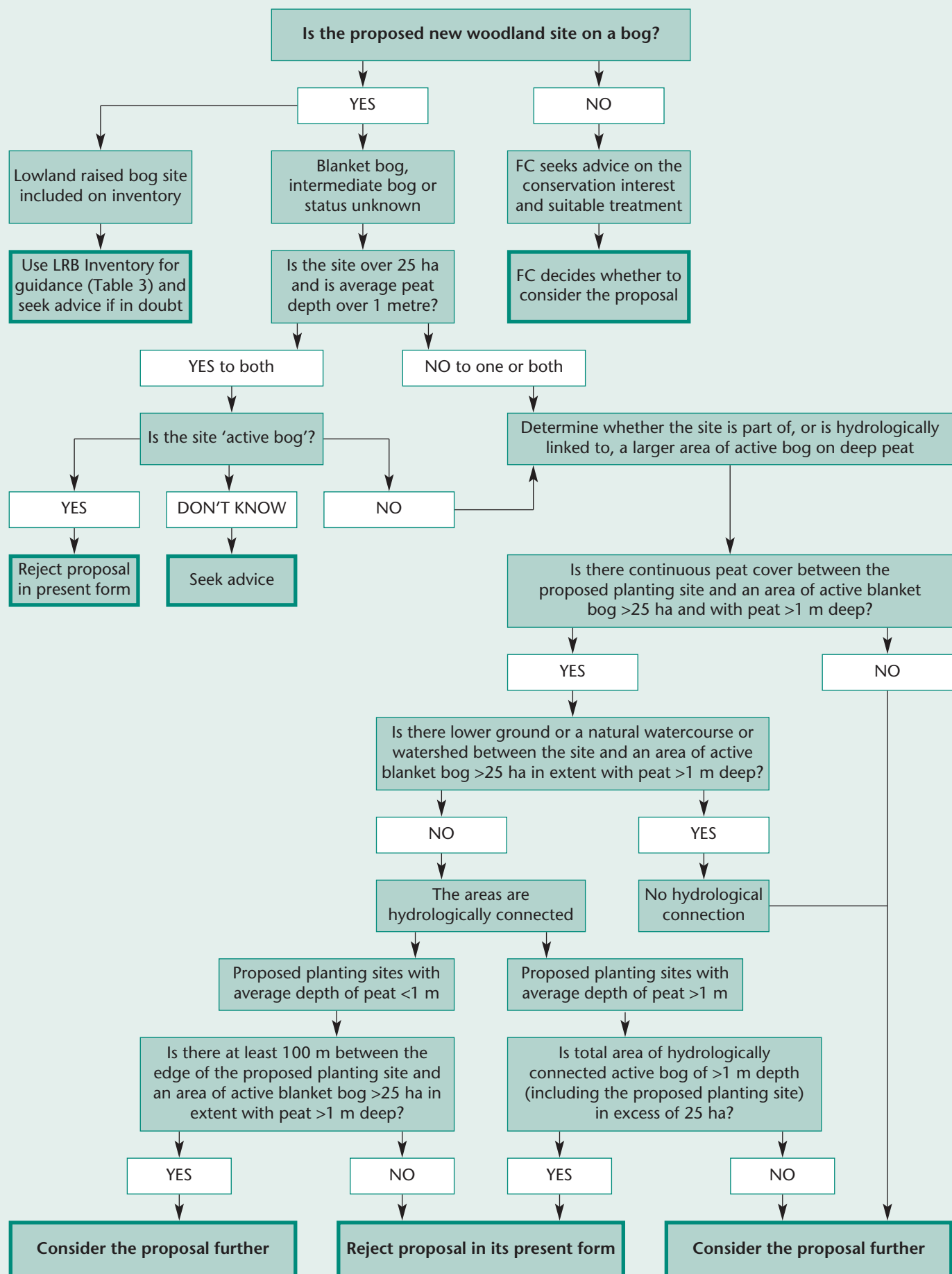
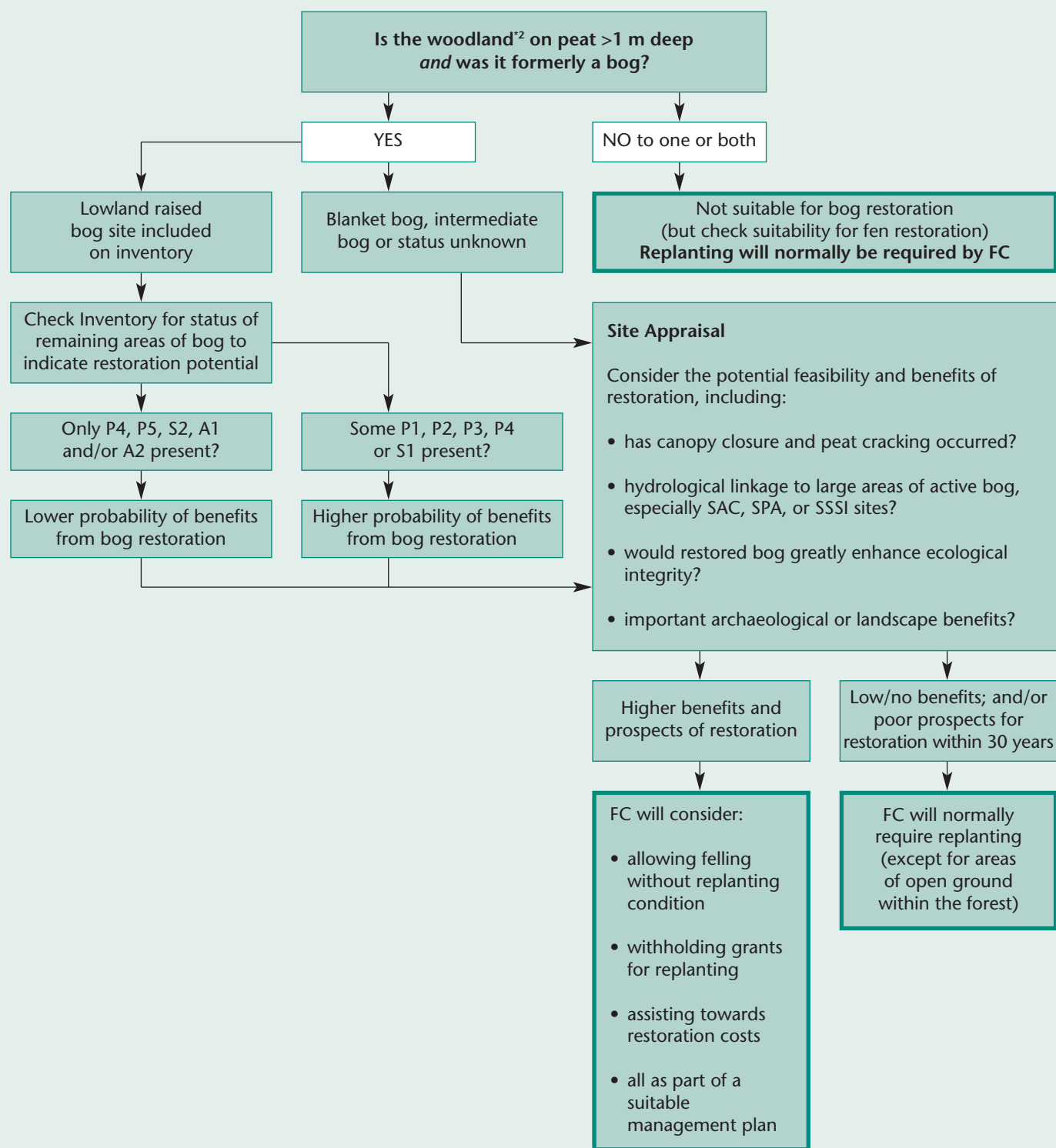


Figure 8 Identifying the potential of sites for restoration from woodland to bog¹



¹ This refers to restoration on a scale exceeding the normal open ground provision inside forests.

² Any area of Bog Woodland (EU priority habitat type) must be excluded from this appraisal.

REFERENCES

ANDERSON, R. A. (in preparation).
Bog restoration. Forestry Commission Technical Paper.

ANON. (1995).
Biodiversity: the UK Steering Group Report (2 volumes). HMSO, London.

CM 2429 (1994a).
Sustainable forestry. The UK programme. HMSO, London.

CM 2426 (1994b).
Sustainable development. The UK strategy. HMSO, London.

CM 2428 (1994c).
Biodiversity. The UK action plan. HMSO, London.

CM 2427 (1994d).
Climate change. The UK programme. HMSO, London.

COUNCIL OF THE EUROPEAN COMMUNITIES (1979). *Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds*. Official Journal of the European Communities No. L 103/1.

COUNCIL OF THE EUROPEAN COMMUNITIES (1992). *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*. Official Journal of the European Communities No. L 206/7.

FORESTRY AUTHORITY (1995).
Forests and archaeology guidelines. Forestry Commission, Edinburgh.

FORESTRY COMMISSION (1990).
Forest nature conservation guidelines. HMSO, London.

FORESTRY COMMISSION (1998).
The UK forestry standard. Forestry Commission, Edinburgh.

JNCC (1995).
General descriptions of the Habitats Directive Annex I habitat and Annex II species interests. Joint Nature Conservation Committee, Peterborough.

JNCC (1997).
The Habitat Directive: selection of Special Areas of Conservation in the UK. JNCC Report 270. Joint Nature Conservation Committee, Peterborough.

LINDSAY, R.A. (1995).
Bogs: the ecology, classification and conservation of ombrotrophic mires. Scottish Natural Heritage, Battleby.

LINDSAY, R. A. AND IMMIRZI, C. P. (1996).
An inventory of lowland raised bogs in Great Britain. Scottish Natural Heritage, Battleby.

PAAVILAINEN, E. AND PÄIVÄNEN, J. (1995).
Peatland forestry: ecology and principles. Springer Verlag, Berlin.

PYATT, D. G., JOHN, A. L., ANDERSON, A. R. AND WHITE, I. M. S. (1992).
The drying of blanket peatland by 20-year-old conifer plantations at Rumster Forest, Caithness. In *Peatland ecosystems and man: an impact assessment*, edited by O. M. Bragg, P. D. Hulme, H. A. P. Ingram and R. A. Robertson. Department of Biological Sciences, University of Dundee.

RODWELL, J. S. S. (ed.) (1991).
British plant communities, Vol. 2 *Mires and heaths*, Cambridge University Press, Cambridge.

SHOTBOLT, L., ANDERSON, A. R. AND TOWNEND, J. (1998).
Changes to blanket bog adjoining forest plots at Bad a' Cheo, Rumster Forest, Caithness. *Forestry* 71, 311–324.

UK BIODIVERSITY GROUP (1998).
Tranche 2 Action Plans, Volume II - *terrestrial and freshwater habitats* (includes the wet woodlands Habitat Action Plan). English Nature, Peterborough.

UK BIODIVERSITY GROUP (1999).
Tranche 2 Action Plans, Volume VI - *Terrestrial and freshwater species and habitats* (includes lowland raised bog, blanket bog and upland heathland Habitat Action Plans). English Nature, Peterborough.

Enquiries relating to this publication should be addressed to:

Russell Anderson
Forest Research
Northern Research Station
Roslin
Midlothian
EH25 9SY

Tel: 0131 445 2176
Fax: 0131 445 5124

E-mail: r.anderson@forestry.gsi.gov.uk