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Sustainable forestry and nature conservation

Slow steps in the right direction?

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Preface

English Nature is concerned to develop ideas on sustainable forestry as they apply in an English context. In particular we wish to ensure that the nature conservation values of our woods and of open ground habitats such as moorland are included in the definition of what is sustainable. There needs to be a consensus of what types of woodland we want, and where they should be; what sort of monitoring and research is needed to ensure that forestry really is becoming more sustainable?

This paper was produced as the basis for a presentation to a seminar on sustainable forestry in Japan. It concentrates on the question of how much of different types of woodland we might want. Further papers may be produced on other aspects, for example on monitoring requirements and methods over the next year.

In the meantime any comments on the ideas in this report would be welcome.

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Summary

The UK government is committed to producing a report on sustainable forestry practice. This must ensure that maintenance of the biodiversity of British woodland is one of the criteria used to measure sustainability. There is broad agreement that the area of forests in Britain should be doubled during the next century, but this will only be acceptable in nature conservation terms if mechanisms are developed to encourage new forests in the right places, where they will not degrade existing valuable wildlife habitat but will help to reduce the isolation and fragmentation of existing woods. Other targets that should be incorporated in a sustainable forestry programme include acceptance of the need to clear some forests to restore open habitats; to reduce the losses of ancient semi-natural woodland; and to increase the diversity of modern commercially orientated plantations. Areas should also be set aside in which natural forest processes can be allowed to operate and be studied. The setting of targets for different aspects of the sustainable forestry programme must be matched by the implementation of a monitoring programme to tell whether or not they are being met, with adjustments to policy, incentives or regulations if they are not. Forestry in Britain is in a state of flux: the opportunity exists to ensure that conservationists and foresters are able to work together more constructively in the future. A properly devised sustainable forestry programme would set the scene for this.

Introduction

In January 1994 the British Government published *Sustainable forestry - the UK programme* as part of its response to the UNCED conference in Rio de Janeiro in 1992 and to subsequent discussions in Helsinki (HMSO 1994a). This report pulled together various strands of existing policies and programmes relating to forestry and the conservation of woodland biodiversity, but contained few new commitments or targets. In 1995 forests will be a key theme of country reports to the United Nations Commission on Sustainable Development and the Forestry Commission has been charged with producing the UK's report to UNCSD during the second half of 1994. English Nature believes that this report should reflect the Helsinki principles on the conservation of biodiversity in European forests and help to link the government's policies for future forestry with EN's objectives for woodland conservation.

In this paper we explore some of the areas where targets for English woods will need to be developed if these principles are to be met, but these must first be set in the context of the way that British forestry and nature conservation have developed.

Table 1

a.	**Extract from the Helsinki principles on the conservation of biodiversity in European forests.** The conservation and appropriate enhancement of biodiversity should be an essential operational element in sustainable forest management and should be adequately addressed, together with other objectives set for forests, in forestry policies and legislation. The conservation and appropriate enhancement of biodiversity should be based both on specific, practical, cost-effective and efficient biodiversity appraisal systems, and on methods for evaluating the impact on biodiversity of chosen forest development and management techniques. Where possible the size and degree of utilisation of forest compartments and other basic management units should take account of the scale of variation of the site, in order to better conserve and manage the diversity of habitats. Management should aim at increasing the diversity of forest habitats. Where possible, the establishment of taxa which are naturally associated with those that occur most frequently in the forest should be encouraged, and a variety of structure within stands should be favoured where the natural dynamics of such associations permit.
b.	**Government forestry objectives** The sustainable management of our existing woods and forests. A steady expansion of tree cover to increase the many, diverse, benefits that forests provide.
c.	**Woodland conservation objectives (Kirby 1993a)** Maintain and expand the area of ancient semi-natural woodland and reduce loss of ancient semi-natural woodland with its distinctive plant and animal communities. Maintain and, if possible, enhance populations of rare woodland species. Maintain and enhance the populations of all native woodland species. Maintain the traditional range of native species and communities.

British forests and forestry

About 7,000 years ago, about 80% of Britain was covered by forests that were predominantly broadleaved, except in the Highlands of Scotland where there were extensive tracts of Scot's pine *Pinus sylvestris*. By about 1000 years B.P. forest cover in much of England (and probably elsewhere) had shrunk to less than 20%, and this decline continued, so that by 100 years B.P. only about 5% of the country was tree-covered (Rackham 1980). In 1919 a state forest service was created (Ryle 1969), and since then forest cover has expanded, through both state and private planting, to about 10% cover for Britain (or 2.2 million hectares).

Most of the expansion of forests this century has been for commercial timber production and has relied heavily on the use of introduced coniferous species: Norway and sitka spruce *Picea abies, P. sitchensis*, Corsican and lodgepole pine *Pinus nigra, P. contorta*, Douglas fir *Pseudotsuga menzsii* and the larches *Larix decidua, L. kaempferi*. Indeed sitka spruce is now our most abundant tree, occupying 28% of the total forest area.

The predominance of conifers in afforestation and in the replanting of existing broadleaved woods during the last 50 years reflects the market demands, which are mainly for softwood and softwood products (85%). However home production meets only about 10% of consumption (Williams 1992). As the new forests planted in the last 30 years come to maturity the proportion of consumption that is home produced should rise, but it is not expected to exceed about 20-25% by the year 2020 or thereafter, unless either the productive forest area expands substantially or there is a large drop in demand.

Nature conservation and forestry in Britain

There are few, if any, areas in Britain below the potential tree line (mainly between 2000 and 3000 m according to latitude) whose habitats could be regarded as completely natural: all have been affected, and in many cases created and maintained by human activity. In particular farming practices have shaped the landscape for hundreds if not thousands of years.

This applies even to our woodland. Much has only been planted in the last century. About 2-3% of the land surface (25% of the woodland), however, appears to have borne some sort of tree cover continuously for the last few hundred years at least and probably in some cases back to the time of the original natural forests, formed after the last glaciation. These cannot be considered as virgin forests because they have been cut-over, burnt or overgrazed many times in their history, but they are our closest link to the original forest. Instead they are referred to as ancient woods (Marren 1992; Peterken 1981; Rackham 1976,1980; Roberts *et al* 1992; Spencer & Kirby 1992).

Where they have not been replanted in recent years, woods are described as semi-natural and their composition is believed to reflect many of the variations that would have existed in the original forests in terms of responses of the woodland ecosystem to regional patterns of climate and soil. These woods tend to have the richest assemblages of woodland plants and animals, including a high proportion of the rarest species (Marren 1990). They are thus of the highest priority in woodland conservation terms (Table 2). This resource is, however, highly fragmented, with few woods over 20 ha (Spencer & Kirby 1992; Roberts *et al.* 1992). Until recently under modern forestry regimes they were largely neglected or, even worse, were replanted usually with introduced coniferous species, which increased their productive capacity in timber terms but at the expense of much of their nature conservation value (Mitchell & Kirby 1989).

Table 2. Reasons why ancient woods are important (based on Peterken 1983).

They include all primary woods. Their tree and shrub communities preserve the natural composition of Atlantic forests. Once destroyed they cannot be recreated.
Being relatively unaffected by man, they provide baselines against which to measure the effects of man on, say, soils, productivity of woodland communities, food webs etc.
Their wildlife communities are generally, but not invariably, richer than those of recent woods.
They contain a very high proportion of the rare and vulnerable wildlife species, in other words those most in need of protection if all existing species are to survive in Britain. Many of these species cannot colonize newly created woodland, or do so only slowly.
Where large old trees have been present for several centuries, they provide refuges for the characteristic inhabitants of primeval woodland, such as lichens.
They contain other natural features which rarely survive in an agricultural setting, such as streams in their natural watercourses.
They are reservoirs from which the wildlife of the countryside has been maintained and could be restored.
They have been managed by traditional methods for centuries and can be living demonstrations of conservation in the broader sense of a stable, enduring relationship between man and nature.

Nature conservation objectives in Britain are also concerned with the habitats and species associated with the open cultural landscapes that have been created over the last 4000 years, some of which support species and assemblages now rare on a European scale (NCC 1984, 1989). Modern forestry has at times led to the destruction of these habitats (NCC 1986; Maitland *et al* 1990).

Nature conservation issues in sustainable forestry

Britain's high dependence on imported wood and wood products may be leading to environmental degradation of forests elsewhere. As a nation we should therefore be prepared to support and help countries that are trying to improve the sustainability of their forestry regimes. We should also look at whether we can reduce our demands on the world's resources, either through more efficient use of wood and wood products or through increasing home production. Many bodies concerned with land use, including conservation bodies, support an increase in forest cover, with a doubling of the woodland area by the middle to end of the next century being commonly quoted as an aim.

Any such increase in home wood production must avoid the damaging effects on the environment and in particular to nature conservation that led to major conflicts between these sectors in the late 1970s and early 1980s. New forests must be put in areas where their impact on the nature conservation of the land in its open state will be small. Opportunities should also be sought to undo some of the damage done through past planting schemes, for example by removing plantations established recently on open heath, a habitat that is rare and declining in Europe .

In other large modern plantations there is scope for improving their value for nature conservation as they come to the end of their first rotation, by clearing back from streamsides (to reduce acidification of streams), by retaining some stands to over-maturity, by encouraging broadleaved species in conifer plantations and otherwise diversify the structure and composition of these forests (eg Good *et al* 1991; Peterken *et al* 1992).

Any further decline in the area of ancient semi-natural woods must be resisted and we must look at where and how they may be managed for wood production without losing their special character and

richness. Some woods should, however, be left to develop as old growth, with the other characteristics that might be expected of natural woodland. In ancient woods that were replanted during the last 50 years there may be scope for restoring the native tree cover and with it perhaps some of the other elements of the former semi-natural system.

Finally the fragmented state of most of ancient semi-natural woodland needs to be addressed, particularly in the context of possible climate change. Where is it most appropriate to develop new native woodland to provide corridors or stepping stones to foster movement of woodland species? And where should it be developed to expand the area of native woodland, either to increase the populations of species in their current location, to reduce the likelihood of extinction, or to create new sites in which these species could thrive.

Mechanisms available to promote nature conservation in forestry

Nature conservation in Britain is actively promoted by separate government agencies in England, Scotland and Wales and by a wide range of voluntary and private conservation organisations. The influence that the country agencies can have on forestry directly through reserve management or through control of management within Sites of Special Scientific Interest (SSSIs) is limited: in England, for example, only 43 National Nature Reserves contain ancient woodland and only 20% of the ancient semi-natural woodland is within SSSIs. Similarly the SSSI mechanism can only influence the location of new forests locally, ie, where an SSSI is directly affected.

To achieve the full integration of nature conservation in a sustainable forestry programme means incorporating EN's advice and recommendations in general land use policies and programmes. This integration should include the development of targets for the extent and condition of different forest types and for particular species and communities found in them, as well as ways in which the achievement (or not) of these targets can be monitored. The principle of setting such targets appears to have been accepted, in that a number relating to forestry and woodland were included in the UK Biodiversity Action Plan (Table 3) (HMSO 1994b). Other more detailed proposals were made by a consortium of voluntary conservation bodies (Table 4) (RSPB 1993).

Table 3. Forestry and woodland related targets from the Biodiversity Action Plan (HMSO 1994b).

Objective no	
23.	Continue to support measures for hedgerow management and restoration in England and Wales.
24.	Implement the biodiversity aspects of the UK Sustainable Forestry Programme.
25.	Continue to protect ancient semi-natural woodlands and encourage forms of management which conserve their special characteristics.
26.	Continue to encourage the regeneration of woodland.
27.	Encourage the restructuring of even-aged plantations to create more varied forests with a mixture of types and ages of trees, including the implementation of forest design plans in State forests.
28.	Continue to encourage a steady expansion of woodland and forest cover.
29.	Encourage the extension and creation of native woodlands, including extending the area of Forestry Commission Caledonian Forest (native pine and broadleaves).
30.	Support the creation of community woodlands near population centres.
31.	Support the creation of a new national forest in the English midlands, and the creation of multi-purpose woodlands in Scotland's central belt through the Central Scotland Woodlands initiative.

Table 4. Example of targets proposed by the non-governmental organisations.

a.	**Caledonian pinewoods** Maintain, and manage where necessary, all existing Caledonian pinewoods (12,500 ha) and produce the correct conditions during the next five years to begin the process of regeneration of a further 10,000 ha.
b.	**Ancient broadleaved woodland** Maintain existing extent of ancient broadleaved woodland (approximately 300,000 ha), including ancient coppice woodlands and ancient woods in undisturbed sites. Suspected ancient broadleaved woodland to be systematically sampled over the next five years and protected and managed as appropriate.
c.	**Other broadleaved and coniferous plantations** New plantations, coniferous or non-coniferous, should not impinge upon threatened semi-natural habitats such as blanket bog or ancient woodlands, but should be designed to supplement existing habitats by utilising land of otherwise low quality. In general the expansion of the forest estate should occur in lowland areas, particularly where new forests can buffer ancient semi-natural, especially broadleaved, woodlands and link isolated woods or enhance ecologically impoverished areas.

Targets for a sustainable forestry programme

Extent of new forests

Within England there is a growing consensus that an increase in forest cover from the current c7% land surface area (940,000 ha) is desirable and that an approximate doubling by the middle of the next century is both a practicable and reasonable aim. Most of this new woodland creation is likely to come about through planting.

Currently, new planting is about 75% broadleaved species, and English Nature would like to see this predominance maintained, with particular emphasis on the species native to a particular soil type and region. In practice some increase in the proportion of conifers used seems likely, since to get the increased rate of planting needed to meet the target the woods created will have to have a commercial as well as an amenity value. (Much recent planting has been of small woods, less than 5 ha, primarily for amenity or sporting purposes.)

At present there are about 150,000 ha of woodland and scrub that has grown up naturally in the last 100 - 300 years on abandoned farmland or derelict industrial land. This can be a valuable conservation resource and English Nature would like to see a 10% increase in the area of this sort of woodland over the next decade, as part of the broader target for forest expansion.

Forest expansion will only benefit nature conservation, however, if it takes place in appropriate places. Hence a sustainable forestry programme must include mechanisms for indicating where such places are.

Location of new forests

Proposals for the creation of new forests are submitted to the Forestry Authority, who provide the main funding for woodland planting in Britain. Depending on the nature of the scheme and which part of the country it is in, the Forest Authority may consult with local government bodies or conservation agencies as to the appropriateness of the proposal. This system provides a way of discouraging new planting in the 'wrong' places but does not encourage planting where it would be beneficial.

To supplement the above, therefore, criteria have been published (Watkins 1991) to help landowners decide where new forests are likely to meet the least objections, from a nature conservation point of view. These can be summarised as follows.

a. The aim is to ensure that the nature conservation value of the area after planting, while inevitably different, is not less than it was before planting.

b. Areas of open semi-natural habitat should not, as a rule, be converted to woodland or allowed to be adversely affected by the establishment of new woodland next to them. There are exceptions; for example, some semi-natural vegetation types (eg dense bracken stands) are of relatively low nature conservation value in many situations and would benefit from the increased habitat diversity provided by new native woodland. Particularly in the uplands, any expansion of the native woodland resource will involve establishing some woods on existing semi-natural habitat.

c. In other areas, particularly on arable land and agriculturally-improved grassland, there is less likelihood that new forests will damage existing nature conservation interests, and even forestry designed primarily for timber production purposes may improve the wildlife potential of the area. However, there is still a need to consider whether there are existing features that should be avoided, for example plant populations of local interest, such as rare arable weed communities or old parkland trees; farmland areas used by important populations of breeding or wintering birds; and features of geological and geomorphological interest that may be damaged or hidden by new planting.

Many of the areas where new planting would be undesirable, (b) above, have already been mapped or can be determined from aerial photographs. Local government authorities have therefore been encouraged to produce, in conjunction with the Forest Authority, Indicative Forestry Strategies which zone land according to how likely it is that new forestry would be acceptable within a zone. Landowners could use these to see in broad terms what scope there was for forest expansion, particularly for large schemes aimed at timber production in an area.

At a local scale English Nature staff are looking at the characteristics of different 'natural areas' to see whether or not new forestry would be beneficial to nature conservation in them (English Nature 1993). This may include consideration of the opportunities for creating forest types that have been lost more-or-less completely in England, for example those at the tree line or floodplain forests.

Locating new woods to reduce fragmentation

Fragmentation of all wildlife habitats is a problem, particularly in lowland England. New woodland can help to reduce the adverse effects of this by extending existing sites and by linking them up with others. New woodland formed next to existing woods or other features such as hedges and streams will also be richer than that created in isolated situations. However the new woodland must not lead to increased isolation and fragmentation of other habitats such as grassland. The following principles may help to judge the priority that should be attached to linking up existing woodland blocks.

a. In areas that are rich in woodland and other semi-natural habitats, often with concentrations of SSSIs or other conservation areas, creating direct links between the woods is less critical than simply expanding the area of woodland and improving the management of what is there already. New woods, wherever they are put, are likely to be close enough to other semi-natural features for colonization to be rapid; also this is where linking up the woodland is most likely to increase the fragmentation of other habitats.

b. Where there are isolated patches of woodland, new woods should be added on to what exists. Existing woods and hedges should be encouraged to spread by natural regeneration on to suitable adjacent ground.

c. In the long term there are parts of the country where widely separated blocks of woodland need to be linked to allow easier movement for of species through the landscape. Initially we believe that this may be achieved more efficiently by creating a series of small stepping-stone woods through the gap rather than a single long thin corridor of woodland.

d. Some large new woods are likely to be created as part of future forest expansion, but if they are in isolated locations they are unlikely to attract many of the specialist species that in theory would require large areas, because these also tend to be poor colonists. Thus there may be a need to consider introduction or translocation of species in such circumstances.

Various measures of woodland fragmentation need to be developed and then converted into targets for different landscape zones. These could be in terms of percentage woodland cover, size distributions of woods and minimum inter-wood distances (Kirby & Thomas 1994).

Restoring some recently formed woodland back to other habitats

While the overall aim is to see the forest cover of England increase, there are areas where, in nature conservation terms, forests should be cleared. A sustainable forestry programme must allow for this, since otherwise there will be a conflict with other programmes dealing with maintaining the biodiversity of the whole countryside, not just of forests. Such clearance may help to expand the area of rare habitats such as lowland heathland or upland bogs or to restore links between sites. Regions and sites where such restoration is desirable are being identified, but as yet no overall target has been set. However, even if this figure were set at 30,000 ha of clearance it would be only about 3% of the proposed expansion of forests over the next 60 years - a small sacrifice if it helps to secure wide acceptance of the expansion programme elsewhere.

Minimizing the loss of ancient semi-natural woodland

Ancient semi-natural woodland has declined in area by about 45% since c1930, through clearance to other land uses and through conversion to plantations (Spencer & Kirby 1992). The scale of these losses of the most important type of woodland for nature conservation, which is for all practical purposes irreplaceable, led to pressure to change the national forestry policy-change that occurred in 1985. Since then both clearance and unsympathetic forestry practices in ancient woods have declined. Ideally, losses due to these causes should be stopped completely, but this is probably not realistic.

For England we have suggested the following as a guide to whether or not forestry is becoming more sustainable over the next decade (objective 25 of the Biodiversity Action Plan, Table 3).

a. Any loss to ancient semi-natural woodland should be no more than the unavoidable minimum.

b. Total losses due to clearance should be no more than 0.2% of the existing area (400 ha).

c. Total losses due to conversion to plantation should be not more than 1% of the current resource (2,000 ha).

d. Where some loss has occurred, some mitigation measures must be instigated, such as the safeguarding of ancient semi-natural woodland elsewhere, improvements in its management, or the creation of new native woodland in appropriate locations.

Restoration of ancient woods that have been replanted

Replacing the native tree and shrub layer of an ancient wood with a plantation of introduced conifers greatly alters the nature conservation value of the site, through the changes to the woody layers and to the associated assemblages of plants and animals (Mitchell & Kirby 1989). However, on some such sites sufficient interest may remain to make it very worthwhile trying to restore the original species mix, or at least to restore a broadleaf cover of some sort (objective 27, Table 3). In particular the species associated with the open stages of the woodland cycle and with woodland glades, such as butterflies, have sometimes survived well even in woods where most of the wood is now coniferous plantation (Greatorex-Davis *et al* 1992; Warren 1993).

Restoration could be undertaken when the current crop comes to be felled, or there may be circumstances where sufficient broadleaves have regrown amongst the young conifers to try to move the crop towards a native cover by premature thinning and removal of the conifers. Such work is in its infancy and there are few studies as to how quickly the ground flora and other elements of the system can be restored. However initial indications (Kirby & May 1989) are that it is worth trying, and English Nature have proposed that at least 4,000 ha of plantations on ancient sites should be restored over the next decade.

Efforts should be concentrated on those woods that are most likely to show a strong response, for example those on base-rich rather than acid soils; those that have only recently been replanted (last 30 years); those where some of the former broadleaved cover and/or the ground flora survives within the crop; those with a species-rich ride system; or those in the east of England (because the influence of site history appears to be strongest in the east).

Management of ancient semi-natural woods - principles

The majority of ancient semi-natural woods have been managed in the past, often by coppicing, and frequently there are benefits both from a nature conservation and a wood production point of view in trying to continue with some sort of active management. Not least of these benefits is that most ancient woods are privately owned and if the owner does not see some personal economic return from their wood then they may be less inclined to retain it.

Woodland management for conservation is described elsewhere (eg Kirby 1984; Peterken 1977, 1981; Watkins 1990). In terms of targets for a sustainable forestry programme it will probably be sufficient to specify our aims at a broad level similar to that of Steele & Peterken (1982), but taking account of the changes in the forestry scene since then. Three categories of targets are proposed:

a. for the extent of woodland that should be assigned to minimum intervention to allow natural processes to take place;

b. for the amount of woodland where the former (or 'traditional') management should be restored, to maintain the conditions for particular suites of species and perhaps also certain types of cultural landscape;

c. in other ancient semi-natural woodland, for types of management that will still retain the special characteristics of ancient woods but may better fit today's economic and social conditions (objectives 24,25 Table 3).

The relative merits of these different options for nature conservation vary according to the type of woodland (Kirby & Patterson 1992), so eventually any targets will need to be set in terms of woodland types rather than for all ancient semi-natural woods in England.

Minimum-intervention areas in ancient semi-natural woods

At present many ancient semi-natural woods have not been managed for at least 50 years. There is therefore no shortage of minimum intervention stand created by default. However, if the moves towards encouraging woodland management are successful then that number could rapidly decline, particularly in the larger site size categories, which are the ones where minimum intervention is likely to bring the most benefits for nature conservation (Table 5, 6). Hence within the sustainable forestry programme a series of sites across the country and across the range of woodland types should be identified in the next decade, so that they are not then put into active management at some future date.

Table 5. Main nature conservation benefits from minimum intervention woods.

Allows expression and study of natural woodland processes.
Potential to develop old growth forest structures and associated species.
Potential accumulation of dead wood habitats.
Undisturbed soil profiles.
Controls against which to measure change in managed woods.

These sites form bench marks against which to assess the effects of natural change and the impact of our management. Many will probably be nature reserves or in some other form of institutional ownership, because while there may be costs in their upkeep, by definition there can be no timber return to the owners. Our initial estimate is that about 20-40,000 ha should be identified for this category.

Table 6. Desirable characteristics for woods that are to be put into minimum intervention.

Large area.
Compact shape.
Little recent treatment or unnatural disturbance.
Few introduced species and no highly invasive ones.
No major external deleterious factors operating, eg spray drift from neighbouring agricultural land.
Not noted for rare or unusual species that depend on management for their survival on site.
Stable ownership.
Diversity of age structure.

Restoration of former management regimes in ancient semi-natural woods

There would be considerable nature conservation benefits from restoring coppice or coppice with standards to many ancient semi-natural woods where this was the former treatment (objective 25, Table 3) (Kirby 1993b; Fuller & Warren 1990). The precise woods in which it is restored will be determined by the owner's preference, availability or not of good markets and whether there are historical or cultural reasons for coppice restoration on a particular site. However the nature conservation criteria for deciding where it would be most desirable are given in Table 7.

Table 7. Criteria for or against restoration of coppicing as a priority in ancient woods.

For coppice restoration:	
a.	Woods with a history of coppicing and which have been cut over this century, preferably during the last 10 years.
b.	Woods in regions where coppice management has been common until recently.
c.	Woods likely to produce a diverse ground flora and/or food plants for-open stage invertebrates. Woods on base-rich or poorly drained soils are more likely to produce a rich response to coppicing than species-poor woods on acid soils.
d.	Woods with a wide variety of trees and shrubs or distinct patterns in their distribution and abundance. In many cases this diversity is likely to be best maintained by restoring coppice, rather than by allowing high forest to develop.
e	Woods with large old coppice stools - a feature of interest in their own right.
f.	Woods with elements of open grassland, scrub or heath communities that have been largely lost from the surrounding landscapes.
Against coppice restoration:	
g.	Woods with communities of epiphytic lichens and bryophytes that may not tolerate the sudden changes in light and humidity associated with coppicing.
h.	Long-neglected woods that have developed a mature high forest structure with much dead wood and many veteran trees.

Preliminary estimates are that a two- to three-fold increase in the area of ancient semi-natural woodland that is being worked as coppice, ie to about 60-70,000 ha, should be the target for the next decade.

The nature conservation value of another formerly common management system - wood-pasture - is also increasingly being recognized (Kirby *et al* in press). Some of these sites may now be best treated as minimum intervention but there are others where continuation or restoration of a grazing regime would be desirable. Targets for such restoration are likely to emerge as part of a new English Nature initiative on old parklands.

Developing new regimes for ancient semi-natural woods

A sustainable forestry programme cannot specify what alternative regimes will maintain the special character of ancient semi-natural woods in all cases, but certain criteria can be used as a guide to the likely impact of different systems.

a. The system should maintain the native tree and shrub cover.

b. It should promote structural diversity at both the stand and whole wood levels.

c. Methods of working, for example, extraction procedures and other activities that may be encouraged or allowed in the wood (game management, grazing etc) should not lead to excessive disturbance to the characteristic plant and animal assemblages.

d. Rare or locally uncommon species must be maintained.

Another way of approaching this issue is through defining either habitats or species that a sustainable forestry system should maintain at a site, for example some open space, both in the form of permanent glades or rides, and a steady occurrence of temporary clearings following fellings. Similarly, some trees (say four or five per hectare) or an equivalent block of woodland should be left unharvested to provide some habitat for the species of old growth conditions and dead wood or dying trees. Key natural processes could be defined that should be incorporated within the management regime for particular sites: for example in wet woodland a key process would be maintaining the water regime; on another site the particular concern might be keeping the natural regeneration process going to maintain the local genetic variation in the tree layer.

In some instances it should be possible to define a small series of species that could be used as indicators of the success or otherwise of the treatments to maintain a particular process or habitat within the woodland. Further work on defining such indicators is required.

Targets for the diversification of recent woods, particularly large conifer plantations

The large coniferous plantations created this century have no semi-natural equivalent in England. Some of the communities that develop or survive within them may be similar in some respects to the open habitats they replace or semi-natural woodland on equivalent soils, but others will not be (Good *et al* 1990), and the overall mosaic of habitats and species assemblages produced is a completely new element in the English landscape. Some uncommon species, particularly birds such as the woodlark, nightjar and goshawk, now have their strongholds in these plantations. As the forests are felled and restocked, opportunities exist to increase their structural diversity and to reduce their impact on, for example, the acidification of streams (Forestry Commission 1993; Maitland 1990) . Methods of assessing biodiversity within these new forests and setting targets for what should be achieved are being developed by the Forest Authority, and further work will needed on this.

Monitoring

Defining targets and standards for different woodland types will only further nature conservation if there are incentives and regulations to assist those who wish to implement them and if the achievement of standards and targets is monitored. Monitoring of woodland in England is fragmented. Some aspects are the responsibility of the Forest Authority, others of English Nature (Kirby 1994), while some aspects are not adequately covered at present at all. The sustainable forestry programme must address this issue and provide a framework within which the different schemes can be fitted.

From discussion of the targets above,it is clear that this monitoring needs to be carried out at a variety of levels.

a. Information is needed on changes in the extent of woodland types: broadleaf versus coniferous; ancient semi-natural, ancient replanted, recent natural regeneration and recent plantations.

b. Within the ancient semi-natural woods the balance between the main management options needs to be kept under review.

These data should be available from a combination of the results from the Forestry Commission's Census of woodland and trees and English Nature's ancient woodland inventory, including sample field surveys, and analysis of the proposals that are made to the Forest Authority under their woodland grant schemes.

For some of the management options being proposed there is not sufficient previous experience to be certain that their application will produce the expected conservation benefits in all cases. Selective monitoring/research on their use will be needed in the next 5-10 years, looking at the changes in the flora and fauna of particular stands. Similarly, while some proposals have been made for indicator species or habitat types as measures of site diversity, these need to be monitored in their initial application phase.

All these elements then need to be put together to determine whether the aims of the sustainable forestry programme are being achieved and if not what changes in incentives or regulations are required.

Research needs

We are not yet in a position to define precisely what is required to implement a forestry programme that we can be sure will maintain the biodiversity of British and, in particular, of English woods. However we are reasonably clear of the direction in which such a programme must go. There is also a series of issues where further research or development is required to support current proposals. Some of these are indicated below.

a. Improved understanding of the need for expansion of and links between native woodlands.

b. Identification of the scale and location of areas where forest clearance for open habitat restoration is desirable.

c. Description and accounts of likely success of restoration of replanted ancient woodland sites.

d. Better definition of the criteria for allocating sites to different management regimes.

e. Research into the consequences of minimum intervention.

f. Implications (including problems) and desirability of coppice restoration on particular sites.

g. Where and how we should be restoring wood-pasture treatments.

h. Research into ways of reducing habitat fragmentation in a cost-effective manner.

i. Definition of acceptable levels (from a nature conservation point of view) of disturbance in forests where wood production is also important.

j. Better understanding of the effects of alternative forestry systems in ancient woods.

k. Research into indicator species.

l. Biodiversity measures for large coniferous plantations.

It is important that these ideas are developed jointly by forestry and nature conservation organisations and not by either in isolation, if progress is to be made.

Implementation

Nothing has been said about the mixture of regulation, incentives and advice that will be needed to implement a sustainable forestry programme. In practice many of the ideas discussed above could fit reasonable well with the types of government grants and controls that have operated within British forestry for the last 40 years and particularly the systems introduced in the last 5 years, provided the political will is there.

Conclusion

British forestry is in a state of flux and the next few years will be important for determining the types of forests that will be developed in the 21st century. Much of the last 50 years has been characterised by antagonism and conflict between nature conservationists and commercial foresters. Development of a national sustainable forestry programme provides the opportunity to try to ensure that the more constructive relationship of the past few years is continued.

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