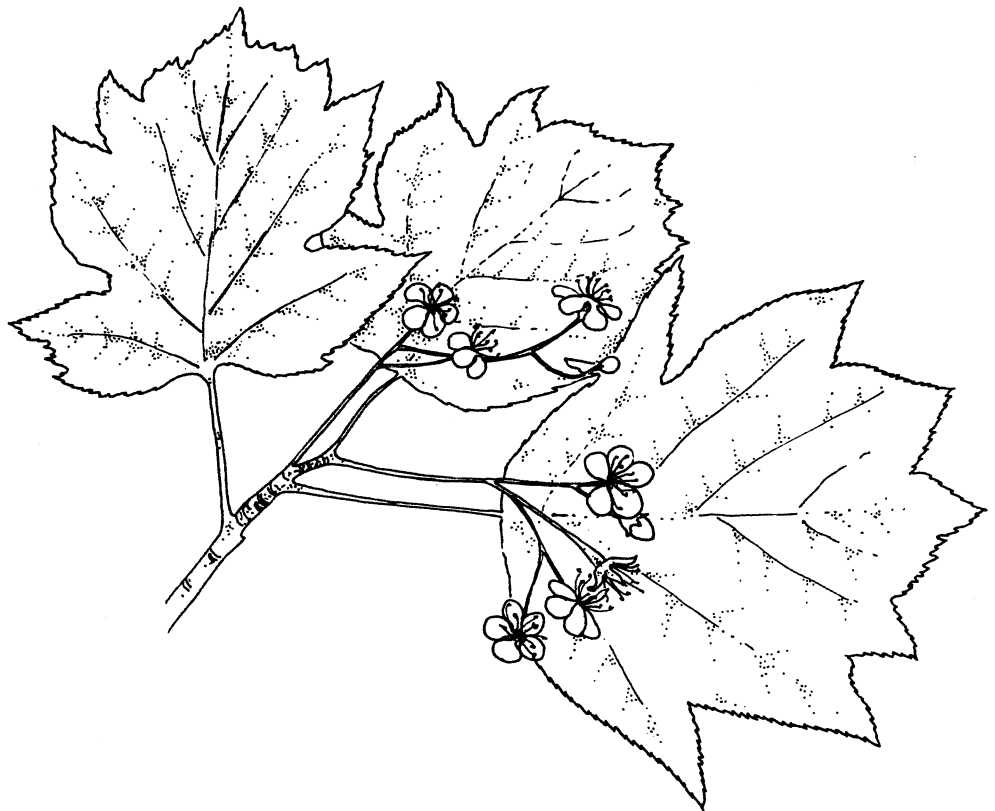




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English Nature Research Reports

**A provisional minimum intervention woodland reserve
series for England with proposals for baseline
recording and long-term monitoring therein**



No. 385

working today
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English Nature Research Reports

Number 385

**A provisional minimum intervention woodland reserve series
for England with proposals for baseline recording
and long-term monitoring therein**

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Summary

The Habitat Action Plans for different woodland types suggest that a series of minimum intervention sites should be established across the country. This report identifies a provisional list of sites that might form the basis for such a series.

Some of the suggestions may on further consideration prove unsuitable/unavailable, while others may be brought forward. The aim has simply been to develop a list that can be used as a basis for discussions.

A key use of minimum intervention areas is for research and monitoring. Therefore proposals are made for the basic records that might be carried out on each site.

A companion *English Nature Research Report* (No. 384) by George Peterken covers the concepts and rationale behind minimum intervention as a treatment for woodland reserves.

Acknowledgements

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The views expressed in this contract are those of the author and do not necessarily reflect those of English Nature staff.

Contents

Part 1: Provisional List of Representative Minimum Intervention Woodland Reserves	9
Introduction	9
What representative site types should be covered by the Minimum Intervention Reserves?	9
What sort of sites should be considered for Minimum Intervention Reserves?	13
Gathering information on candidate sites	14
What Minimum Intervention Reserves are available?	15
Part 2: Proposals for Baseline Recording and Long-term Monitoring	19
Introduction	19
Approaches to monitoring in minimum intervention reserves	19
Proposals for monitoring in minimum intervention reserves in England	21
Next steps	21
References	25
Appendix 1. Common and scientific names of trees and shrubs used in text	29
Appendix 2. Provisional list of thirty-four characteristic woodland types to cover the range of original- and inherited-natural woodland types in England	30
Appendix 3. Details of candidate minimum intervention woodland reserves	31
Appendix 4: Model accounts of selected sites	54
1. Monks Wood	54
2. Langley Wood	57
3. Lady Park Wood	60
4. The Mens	64
5. Wistman's Wood	67

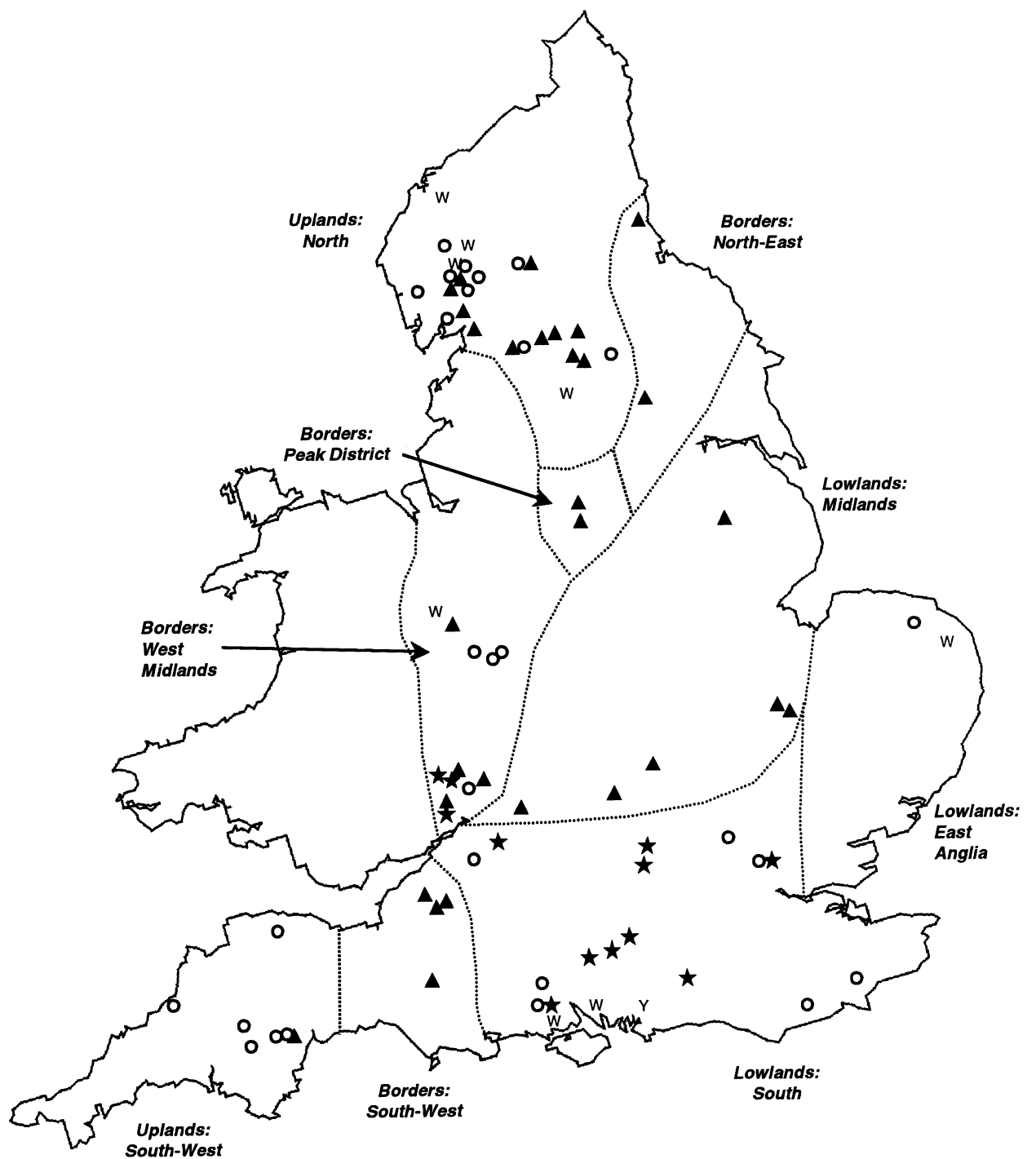


Figure 1: Location of candidate minimum intervention woodland reserves in England within nine broad regional areas. The main woodland type represented at each location is shown by a symbol: beech (★), oak (○), ash (▲), yew (Y), and wet (W). For a few locations the symbol represents several near-by sites.

Part 1: Provisional List of Representative Minimum Intervention Woodland Reserves

Introduction

This report is part of an English Nature project concerned with the 'Establishment of a series of minimum intervention reserves across the range of woodland types in England'. Such a series is seen as important in the UK woodland Habitat Action Plans and fits with the recently completed activities of the European Commission COST Action E4 (Forest Reserves Research Network) (Parviainen *et al* 2000). The series would be complemented by smaller 'minimum intervention stands' in actively managed woods, as encouraged by, for example, the UK Forestry Standard and Woodland Assurance Scheme. The initial phase of this English Nature project has been divided into two parts, with a review of the concept of minimum intervention being prepared by George Peterken (Peterken 2000a).

Most European Countries have established minimum intervention woodland reserves, although they usually referred to these as Strict Forest Reserves, and several (eg Austria, Belgium, Germany, Netherlands, Slovenia) have developed a representative series of sites that attempts to encompass the full range of naturalness in the particular country (Parviainen *et al* 1999). In England also has existing minimum intervention woods and the record of research in these is discussed by Peterken & Backmeroff (1988) and Hall, Kirby & Morecroft (1999). However, there has so far been no attempt to produce a draft list of sites based on readily available data and see how well this represents the range of semi-natural woodland types found in England. This is the aim of this part of English Nature's project.

What representative site types should be covered by the Minimum Intervention Reserves?

Site selection needs to be based on representation, ie the minimum intervention reserve series should include the full range of variation within British woodland, in so far as this is possible. For this initial suite of sites the emphasis was on the commonest original-natural and inherited-natural stands in ancient woods, largely excluding recently established types with sycamore and beech beyond its 'native' range, but including wood-pasture (Peterken 2000a).

The condition and range of variation in original- and inherited-natural forest has been the attention of much research (eg Godwin 1975; Birks 1989; Rackham 1976, 1980; Peterken 1981, 1996; Bell & Limbrey 1982; Bennett 1989). The extent of grazing in the original natural-forests is debated: although the woodland model appears to be generally applicable, the wood-pasture model applies in at least some areas. Based on the likely composition of the last original-natural forests of England, an emphasis in site selection is placed on the following (see Appendix 1 for scientific names):

- lime-dominated sites on non-calcareous fertile forests across much of England;
- ash-dominated sites on calcareous soils across England;
- alder-dominated sites in floodplain and low-lying wetland areas (mainly The Broads, Fens, Somerset, and other coastal areas);

- oak-dominated forests on acid infertile soils in south-west and north England;
- birch-dominated sites at extreme high altitude.

The variation in inherited-natural stands is revealed in Peterken's (1981) classification of ancient semi-natural woodland. This places emphasises in site selection on:

- sites originally dominated by lime but now dominated by either oak, beech, or hornbeam;
- sites originally dominated by ash but now dominated by beech.

The main types and distribution of semi-natural woodland in England can be determined by reference to the ecological classifications devised by Peterken (1981) and Rodwell (1991), which formed the basis for the groupings adopted by the Biodiversity/Habitat Action Plans (Hall & Kirby 1998). Based on this, Peterken (2000a) proposes about 30 representative minimum intervention reserves for ancient semi-natural woodland in England. These would also cover the groupings used by the Forestry Authority (1994). A parallel set of minimum intervention wood-pasture reserves would be additional to these. The basic approach was to look for a minimum representation of 5 sites, then supplement this in rough proportion to each type's internal variety, total area, geographical range, and intrinsic importance. In practice, each type is likely to form a major component of some sites, and a minor component of several others. Thus, fewer sites may be needed as long as overall representation is achieved.

This approach proposed by Peterken (2000a) was developed in this part of the project as follows. Thirty-four characteristic woodland types were identified (Table 1, Appendix 2). These were based on three geographical regions (lowlands, borders, uplands), five dominant trees or tree groups (beech, yew, ash, oak, and wet species alder/willow/ash), three main soil types (acid-mesotrophic, calcareous-mesotrophic, or wet soils), and treatment as low- (woodland) or high-grazing (wood pasture). For each, the NVC/Peterken/Forestry Authority classification groups were fitted. The major forest zones identified by Hall, Kirby & Morecroft (1999) provided a basis to delimit the three geographical regions. The main concentrations within each region were identified using maps which showed the proportional representation of NVC communities in English SSSIs and similar information (Peterken 1981; Rodwell 1991; Hall 1997).

To accommodate features derived from the original- and inherited-natural forest composition, special consideration was given to include examples of:

- mixed beech-lime sites as found in borderland beech woodland;
- ash-dominated sites on calcareous/mesotrophic soils in the native range of beech;
- ash-lime sites on calcareous/mesotrophic soils within the native range of lime;
- oak-lime sites on acidic/mesotrophic soils within the native range of lime;
- oak-hornbeam sites in lowland acidic/mesotrophic oak woodland.

Table 1 Provisional list of thirty-four characteristic woodland types that intend to cover the range of original- and inherited-natural woodland types in England

(a) Relationship between the woodland types and the National Vegetation communities (Rodwell 1991), Peterken stand types (Peterken 1981) and special considerations to ensure the full range of woodland types is included.

Region	Woodland type	Main NVC communities	Main Peterken stand types	Special considerations
Lowlands	Beech	W14/15	8A/8B	
	Beech	W12/14	8C/8D	
	Yew	W13	No equivalent	
	Oak	W10a-d/16a	3A/4A/5A/9Aa/9Ba/6C/6D/12	Include examples with lime and with hornbeam
	Ash	W8a-d	1Aa/1B/2/3B/4B/7C/9Ab/9Bb/10	Include examples with lime
	Wet	W2/4/5	No equivalent	
	Wet	W6/7	7A/7B/7E	
Borders	Beech	W12/14/15	8C/8D/8E	Include examples with lime
	Oak	W10a-e/11/16b/17	5B/6A/6B/6C/6D/12	Include examples with lime
	Ash	W8e-g/9	1Ab/1C/1D/3C/3D/4Bb/4C/7D	
	Wet	W2/4/5	No equivalent	
Uplands	Oak	W10e/11/16b/17	3A/4A/5A/5B/6A/6B	Include examples with lime
	Ash	W8e-g/9	1Ab/1C/1D/3C/3D/4Bb/4C/7D	Include examples with lime and dominated by yew
	Wet	W2/3/ 4/5	No equivalent	
	Wet	W6/7	7A/7B/7E	

(b) Breakdown of thirty-four characteristic woodland types by region, main associated soils, treatment/ locality, and main geographical concentrations.

Region	Woodland type	Main associated soils	Treatment/locality	Main concentrations
Lowlands	Beech	Acid-mesotrophic	Woodland	South Chilterns New Forest
			Wood pasture	
	Beech	Calcareous-mesotrophic	Woodland	South Chilterns Cotswolds
	Yew	Calcareous-mesotrophic	Woodland	South
	Oak	Acid-mesotrophic	Woodland	South Midlands
			Wood pasture	New Forest
	Ash	Calcareous-mesotrophic	Woodland	Midlands South
	Wet	Peats	Woodland	East Anglia
	Wet	Alluvium, gleys	Flood plain Salt-marsh Streams, flushes, depressions	Very localised Very localised Widespread
	Borders	Beech	Calcareous-mesotrophic-acid	Woodland
Oak		Acid-mesotrophic	Woodland	West Midlands
Ash		Calcareous-mesotrophic	Woodland	West Midlands South-west Peak District North-east
Wet		Peats	Woodland	West Midlands
Uplands	Oak	Acid-mesotrophic	Woodland	North South-west
			Wood pasture	North South-west
	Ash	Calcareous-mesotrophic	Woodland	North South-west
			Wood pasture	North
	Wet	Peats	Woodland	North
	Wet	Alluvium, gleys	Floodplain Streams, flushes, depressions	Very localised North South-west

What sort of sites should be considered for Minimum Intervention Reserves?

Not all sites would make acceptable minimum intervention reserves (Peterken 2000a). Ideally they should be ancient woodland sites, with a compact shape, covering a minimum area of about 20ha and with a buffer of at least 50m of forest, all set in a well-forested landscape.

The minimum area can be related to the specific woodland type based on the Minimum Structural Area, as developed by Koop (1989) and used by Al (1995) in the Netherlands and Vanderkerkhove (1998) in Belgium in the selection of their minimum intervention reserves. They used 10 ha for ash-dominated woodland; 10-20 ha for alder-dominated woodland; 15 ha for hornbeam-dominated woodland; 20-25 ha for willow-dominated woodland; 20-30 ha for birch-dominated woodland; 20-40 ha for beech-dominated woodland; and 40-50 ha for oak-dominated woodland. Smaller areas could be accepted if the minimum area were made up on adjacent ground by allowing semi-natural woodland to develop into a similar condition, but in general larger areas would be desirable.

The buffer could be varied according to the potentially-damaging factor, eg 200 m for clear-felling of surrounding forest, 100 m for invasive species, or 50 m for spray- or fertiliser-drift. This should surround the reserve on all margins, or alternatively, if no buffer zone is possible, a larger minimum area of such woodland should be reserved.

Minimum intervention reserve stands should ideally be mature and comprise a mixture of site-native tree species with few, if any, non-native species. Management could be either under a woodland (high forest) model – maintaining grazing and browsing at levels that permit regeneration in gaps and allow some advance regeneration to persist in shade – or under a wood-pasture model – permitting grazing and browsing that will allow sufficient regeneration on a long-term basis but may include periods when little regeneration is successful. Following designation and possible set-up treatments, it is expected that treatment will be the minimum necessary. On-going maintenance is likely to include regulating influences from outside (eg controlling invasion by exotics), providing suitable access, and acting as surrogate to natural processes (eg deer control). Acceptable responses to unwelcome events could include control of invasion by introduced trees and shrubs, for example sycamore or rhododendron, invading ground plants, such as Japanese knotweed, and invading animals, such as grey squirrel.

Since management of minimum intervention reserves is viewed as indefinite, sites with features or species that depend on interventionist management (usually open space species) that are too important to sacrifice should be excluded from consideration. Ideally, reserves should be considered only where such a long-term commitment can be reasonably assured, eg where they are in freehold ownership or on a satisfactory long-lease by a nature conservation or scientific organisation, or where the reserve is a small proportion of the total land holding such that the cost can be readily offset.

Sites that are particularly valuable as potential reserves are those already treated under minimum intervention, especially where this is long-standing, has been formally recognised and where there are records that can form the basis for long-term research and monitoring.

Gathering information on candidate sites

The aim was to produce a draft list of candidate minimum intervention reserves based on readily available information: this will then be reviewed more widely and alternative sites substituted as appropriate. Therefore in the first instance the following were considered most likely to include suitable sites and have sufficient information available on them to review their status:

- National Nature Reserves (NNRs);
- other Nature Reserves owned by the National Trust, RSPB, Wildlife Trusts or Woodland Trust;
- sites of Special Scientific Interest (SSSIs) currently under or that might come under a minimum-intervention agreement;
- other known minimum intervention reserves where woodland monitoring has been established.

Information on these was collected in three ways:

- Simon Scott (English Nature, Peterborough) selected from all SSSIs entered on English Nature's Site Information System (ENSIS) those that contained; designation type *reserve*; feature type *woodland*; management activity *non-intervention* for part of the site; and size ≥ 20 ha. This came up with 102 sites, their SSSI site name, the local English Nature team, grid reference, total area (ha), and the NVC woodland communities (where entered);
- Jeanette Hall (English Nature, Peterborough) provided a list of 49 NNRs with a main habitat of woodland or woodland pasture including a management regime of non-intervention. The general characteristics of these was available from ENSIS or from other published sources (eg Peterken 1981; Marren 1992, 1994);
- for other known minimum intervention reserves where woodland monitoring has been established information was gathered from published sources (Peterken & Backmeroff 1988; Whitbread 1991; Hall, Kirby & Morecroft 1999) and personal files.

This provided a list of 146 sites that were fitted to the classification in Table 1 according to the dominant woodland type present in the minimum intervention area. This list was then reviewed briefly with English Nature specialists and a shorter revised list produced. For these, detailed information was then sought as to the suitability of the site and any minimum intervention areas within them using the site management plan, biological surveys, and/or the SSSI citation, combined with telephone discussions with the site manager or English Nature Conservation Officer. In general most managers were pleased to have their site considered, but for some there were reservations because this long-term approach would need consideration. Hence, it is important to stress that the aim was to identify a range of potential sites, not dictate that these should be assigned to minimum intervention treatment. As a result of discussions, some additional sites were suggested. Brief details of these individual sites are given in Appendix 3.

What Minimum Intervention Reserves are available?

There are many existing minimum intervention areas that are potentially suitable (or nearly so) as representative minimum intervention reserves (Table 2). Details of the selection of five examples are given in Appendix 4 (The Mens SSSI, Langley Wood NNR, Wistman's Wood NNR, Monks Wood NNR, and Lady Park Wood NNR).

Nevertheless, site suitability varied considerably and for some site types there were few candidate sites in this initial list: further efforts will be needed to see whether such gaps can be filled. Moreover, the suitability of most may fall short or nearly so on at least one criterion. For example:

- the minimum intervention area may be close to or less than the desirable minimum threshold, especially if it is subdivided into smaller blocks;
- the site may be linear rather than compact in shape (particularly the case for upland ravine ashwoods);
- the site may be isolated;
- the security of the long-term management may not be set or untenable.

Also, the following may need discussion and agreement if the site is to be adopted as part of the series:

- on-going management and grazing levels;
- composition and management of buffer zones;
- set-up treatments;
- monitoring and the responsibility for this.

Thus, the candidate list and the summary details of the sites provides a basis on which to approach organisations and individuals for consideration, comment and advice on the suitability or otherwise of these or alternative woods.

Table 2 Provisional list of candidate minimum intervention reserves to represent thirty-four characteristic woodland types that intend to cover the range of original- and inherited-natural woodland types in England

Woodland type	Region	Candidate sites (potential minimum intervention area in ha)
(a) Lowland woodland types		
Acid-mesotrophic beech woodland	South	Epping Forest SSSI (c80) The Mens SSSI (155)
Acid-mesotrophic beech woodland	Chilterns	Naphill Common SSSI (c20)
Acid-mesotrophic beech wood pasture	New Forest	New Forest SSSI, 12 large sites: Anses Wood Bignell Wood Brately Wood Denny Inclosure Frame-Tantany Woods Great Woods Gritnam Wood, Great Huntley Bank & Brinken Wood (west) Mallard Wood Mark Ash Wood Ridley Wood Rushpole Wood Shave Wood, Hazel Hill, Brockishill Wood and French's Bushes
Calcareous-mesotrophic beech woodland	South	Ashford Hangers NNR (12) Beacon Hill NNR (7) Noar Hill SSSI (7)
Calcareous-mesotrophic beech woodland	Chilterns	Bisham Wood SSSI (30+)
Calcareous-mesotrophic beech woodland	Cotswolds	Cotswold Beechwoods NNR (8+7+4+6)
Calcareous-mesotrophic yew woodland	South	Kingley Vale NNR (c50)
Acidic-mesotrophic oak woodland	South	Epping Forest SSSI (c60) Fore Wood SSSI (15) Ham Street Woods NNR (40) Langley Wood NNR (65) Lower Woods SSSI (c20)
Acidic-mesotrophic oak woodland	Midlands	Broxbourne Woods NNR (>90) Swanton Novers NNR (36)
Acidic-mesotrophic oak wood pasture	New Forest	New Forest SSSI, 3 large sites: Bramshaw Wood, Frame-Tantany Woods, Lin, Red Shoot & Pinnick Woods
Calcareous-mesotrophic ash woodland	Midlands	Aversley Wood SSSI (?)
Calcareous-mesotrophic ash woodland	Midlands	Buckingham Thick Copse NNR (<45) Lincolnshire Limewoods NNR (27+37) Lineover Wood SSSI (7) Monks Wood NNR (c130) Wytham Woods SSSI (80/160)
Calcareous-mesotrophic ash woodland	South	None
Wet woodland on peat	East Anglia	Bure Marshes NNR (220)

Woodland type	Region	Candidate sites (potential minimum intervention area in ha)
Wet woodland on floodplains		New Forest SSSI, 6 sites Sims Wood NNR (salt-marsh transition) (?)
Wet woodland on streams, flushes, depressions	Throughout	Various wet stands in above sites (<10)
(b) Borderland woodland types		
Calcareous-mesotrophic-acid beech woodland	West Midlands	Lady Park Wood NNR (c25) Bigswear Wood SSSI (c40) Little Doward SSSI (30+)
Acidic-mesotrophic oak woodland	West Midlands	Chaddesley Wood NNR (c20) Nagshead SSSI (23) Wyre Forest NNR (50-60 future) Pepper Wood (7.5(-15))
Calcareous-mesotrophic ash woodland	West Midlands	Edge Wood SSSI (4) Highbury Wood NNR (18) Lady Park Wood NNR (c10) Morses Grove (10)
Calcareous-mesotrophic ash woodland	South-west	Adcombe Wood SSSI (20+) Cheddar Wood SSSI (c20) Ebbor Gorge NNR (25) Rodney Stoke NNR (17+7)
Calcareous-mesotrophic ash woodland	Peak District	Derbyshire Dales NNR (44+17+14) Dovedale Woodlands SSSI (56+13+14)
Calcareous-mesotrophic ash woodland	North-east	Castle Eden Dene NNR (67) Roche Abbey Woods SSSI (53)
Wet woodland on peat	West Midlands	Shropshire Meres SSSIs (<10?)
(c) Upland woodland types		
Acidic-mesotrophic oak woodland	North	Birk Gill SSSI (31) Dodgson Wood SSSI (129) Lodore-Troutdale Woods SSSI (large)
Acidic-mesotrophic oak woodland	North	Naddle Low Woods SSSI (large) Roudsea Wood NNR (25) Thornton and Twisleton Glens SSSI (c10)
Acidic-mesotrophic oak woodland	South-west	Bovey Valley Woods NNR (47) Millook Valley (50+) Yarner Wood NNR (11)
Acidic-mesotrophic oak wood pasture	North	Birkrigg and Keskadale Oaks SSSI (3+6) Johnny Wood SSSI (36) Lodore-Troutdale Woods SSSI (large) Naddle Low Woods SSSI (?) Seatoller Wood SSSI (?) Side Wood SSSI (c40) Stonethwaite Woods SSSI (c100)
Acidic-mesotrophic oak wood pasture	South-west	Horner Wood NNR (c300) Wistman's/Black Tor Copse NNR (4+6)

Woodland type	Region	Candidate sites (potential minimum intervention area in ha)
Calcareous-mesotrophic ash woodland	North	Colt Park Wood SSSI (9) Gait Barrows NNR (c25) Hawswick Wood SSSI (11) Howe Ridding Wood SSSI (c15) Ling Gill NNR (5) Lodore-Troutdale Woods SSSI (?) Naddle Low Woods SSSI (?) Scoska Wood NNR (10) Thornton and Twisleton Glens SSSI (c30)
Calcareous-mesotrophic ash woodland	South-west	Bovey Valley Woods NNR (13/21)
Calcareous-mesotrophic ash wood pasture	North	Lodore-Troutdale Woods SSSI (?) Naddle Low Woods SSSI (?) Seatoller Wood SSSI (?) Strans and Rais Wood (c25)
Wet woodland on peat	North	Kettlewell Carr (Lodore-Troutdale SSSI) (?) Finglandrigg Woods NNR (9) Lodore-Troutdale Woods SSSI (?) Malham Tarn NNR (4) Naddle Low Forest SSSI (?) Roudsea Wood NNR (?)
Wet woodland on floodplains	North	Grange Carr-Kidham Dub-Colywife Dub (Lodore-Troutdale Woods SSSI) (?)
Wet woodland on streams, flushes, depressions	North	Various wet stands in above sites (<10)
Wet woodland on streams, flushes, depressions	South-west	Various wet stands in above sites (<10)

Part 2: Proposals for Baseline Recording and Long-term Monitoring

Introduction

Peterken (2000a, b) discusses the use of minimum intervention reserves for scientific research and stresses that this is a fundamental purpose for their existence. Indeed, many reserves in Britain and Europe have already been put to such use and several countries have nationally co-ordinated and funded programmes for such research (Parviainen *et al* 1999).

Approaches to monitoring in minimum intervention reserves

The basic approach to monitoring in minimum intervention reserves and the methods used has been reviewed at the European level by members of the COST Action E4 (Parviainen *et al* 2000; Hochbichler *et al* 2000). They relied on experiences from major projects such as the Dutch Forest Reserves Programme, which began in 1983 and now includes a total of 60 minimum intervention reserves (Broekmeyer 1999), long-standing studies such as those in England at Denny Wood (Mountford *et al* 1999), Lady Park Wood (Peterken & Jones 1987, 1989; Peterken & Mountford 1996, 1998), and Wytham Woods (Kirby, Thomas & Dawkins 1996; Kirby & Thomas 1999), and from the advice of an expert working group comprising members from all EU and some other European countries.

The aim of quantitative monitoring would be to show (i) the state of the wood, (ii) how it is changing, and (iii) the factors that appear to be driving change (Peterken 2000a), taking into consideration three levels of surveillance (Table 3). Methods suitable for stand level studies may not be very efficient for assessing wood level change and vice versa. Thus, to assess changes across a series of minimum intervention reserves there needs to be some consistency and compatibility of methods, albeit that this has to be tempered by the requirements for surveillance at a particular site.

Table 3: Different levels that long-term monitoring in minimum intervention reserves needs to consider

<i>Level of surveillance</i>	<i>Purpose</i>
Stand level	To show how particular stands change in relation to internal and external events.
Wood level	To show whether stand level changes are typical of what is happening elsewhere in a wood and what the combined effect of different stand changes may be since they may be going in different directions.
Whole series level	To show whether similar changes are occurring in different woods across different landscapes.

There is general agreement that the key features to monitor in minimum intervention reserves are stand composition, ground vegetation, dead wood and soils, and specific factors that might influence these. Recording other features, for example breeding birds, should be welcomed but viewed as complementary rather than a fundamental aspect of monitoring. A range of monitoring methods should be employed, including assessments of the whole site, assessments based on small permanent plots laid out on a grid system, and assessments made from permanent transects located in selected 'core' areas. In Britain, these methods have been

applied only in isolation: for example, an array of 10 x 10 m plots at grid points was established between 1973 and 1976 in Wytham Woods (Dawkins & Field 1978; Horsfall & Kirby 1985), and a set of permanent transects were laid out in the 1940s in Lady Park Wood (Peterken & Backmeroff 1988).

Whole site assessments are intended to record large-scale features, notably canopy gaps and stand development phases. They are usually based on air photographs, stand inventories, or, exceptionally, large permanent plots, such as the permanent plots covering up to 5.5 ha in Draved Skov, Denmark, and the 19 ha stand map for Suserup Skov, Denmark (Emborg, Christensen & Heilmann-Clausen 1996). The largest known comparable plot in Britain is at Wistman's Wood, Dartmoor, but only measures 62 x 75 m (Mountford 1999). Such assessments show the extent, pattern and rate of change in stand structure, and can help relate this to stand characteristics, topography, and natural disturbances such as storm-damage.

Plots set out on a grid provide a representative sample and should be able to reliably detect changes in composition of the whole minimum intervention reserve. The density and size of plots will determine how much of the reserve is monitored. Grid dimensions range mostly from 50 m to 100 m and plot sizes from 100 m² to 500 m² (Dawkins & Field 1978; Hill & Radford 1986; Albrecht 1990; Davey 1991; Whitbread 1991; Broekmeyer 1999). Although 5-10 % coverage is generally considered adequate, this can still give unreliable results depending on what measure of change is been considered and the required level of accuracy (Van Den Meersschaut *et al* in press).

Permanent transects have proved to be an effective way of demonstrating and recording stand level change and the processes behind this (eg Peterken & Mountford 1996, 1998; Mountford *et al* 1999). Within these transects individual features are mapped, for example trees or pieces of dead logs, and their fate is followed over time. Transects enable transitions and groups to be studied, reveal information about spatial relationships within a stand and the patterns of change at the stand-scale, and can be easier to relocate if recording lapses (Peterken & Backmeroff 1988). The drawbacks are that they usually cover a limited area so are less likely to detect events, and can not provide information on the overall distribution and abundance of species or events.

The dimensions and abundance of transects varies, but typically they are selectively positioned to pass through the centre of a particular area of interest, eg the main woodland type or a particularly varied part of a site. 20 m-wide transects have become a popular means of monitoring minimum intervention reserves in Britain (Peterken & Backmeroff 1988; Hall, Kirby & Morecroft 1999), but wider transects of 40 m to 60 m width exist in Bialowieza Forest, Poland (Bernadzki *et al* 1998), and monitoring programmes in the Netherlands, Belgium, Denmark, France and Germany use a nested design with trees and shrubs recorded in a core transect of 70 x 140 m, a stand profile drawn for a central 10 x 100 m transect, and ground vegetation recorded along a central 2 x 100 m transect (Koop 1989; Broekmeyer 1999). At any one site the number of transects and their coverage varies, but most usually extend for a few hundred metres and in total cover only a small portion of the site. They may or may not be representative of the minimum intervention area stand as a whole.

Proposals for monitoring in minimum intervention reserves in England

In developing a programme of co-ordinated long-term monitoring in Britain, it is important to build off existing records, rather than necessarily replace these because they do not fit into a standardised programme. Although it is desirable to develop a standardised approach, this should not be seen as an absolute requirement: rather methods need to be tailored to a particular site, kept under review, and need to be opportunistic to make the best use of funding and other resources. Records may be valuable even if they are somewhat incomplete and non-representative (Peterken & Backmeroff 1988), although this should not be an excuse for poor recording design.

In addition, real difficulties are imposed by the human element involved in long-term studies (Peterken & Backmeroff 1988; Peterken 2000b). Special attention should be made to maintain the recording, the details of what was recorded and how it was done, the associated archive and duplicate copies, and knowledge of the importance of all these. Permanent plot and transect systems are expensive to set up and difficult to maintain. Unless the monitoring attached to this minimum intervention reserve programme is centrally co-ordinated, it will be difficult to maintain an overall picture of progress and standards.

It is axiomatic that we do not know how minimum intervention reserves might change precisely or which parts may be affected by future changes. However, experience has shown that through a combination of broad scale assessment and sampling, not only can changes be identified, but also the causal factors behind them can often be inferred, even if not recorded directly. The first requirement is for a broad scale assessment of the current state of the site, followed by more detailed records of particular aspects. Table 4 sets out a possible approach, and examples of how these might apply to particular minimum intervention reserves are given in Appendix 4.

Next steps

English Nature intends to use this and the companion report by Peterken (2000a) as a basis for discussion on development of a minimum intervention series and whether the methods set out in Table 4 are the most appropriate for long-term surveillance in such sites.

Table 4: Provisional list of features to record and monitor in minimum intervention reserves in England

Feature to record/monitor	Method	Rationale
Map of reserve	Map boundaries, internal compartments, main physical features, and adjacent ground using at least 1:10,000 scale ordnance survey map (can be computerised on a GIS).	Defines extent of reserve, minimum intervention and other compartments, important physical features, and provides a basis for overlaying other features involved in monitoring.
Map of soil/geology	Map extent of major soil/geological associations on to reserve map using 1:250,000 scale (or better) Soil Survey map to identify broad soil types and approximate boundaries. Aim eventually to build up a more precise map including localised soil variations (eg along streams or in wet hollows) (can be added to computerised reserve map).	Defines type and extent of soils and provides basis to monitor soils and vegetation.
Map of vegetation	Map extent of major NVC communities and/or Peterken stand types, major compartments (based on differences in composition and structure), and areas of open space/canopy gaps (see monitoring of structure/open space below) using site/soil map and by field walking (can be added to computerised reserve map). Problems in definitions should be noted in accompanying descriptions.	Defines composition and extent of main vegetation types and provides basis to monitor vegetation.
Quantitative assessment of vegetation	Supplement the above vegetation map with some temporary sample plots to provide a more quantitative account of the abundance and condition of the main canopy, understorey and ground species. These need not take long to record and may not be directly linked to subsequent permanent plot recording, although this will often be desirable.	Provides overall assessment of the structure and composition of vegetation and variation in this across site. Can be used as a basis to detect rare features that may not be reflected in permanent vegetation sample systems.
Soil status	Record soil pH and total nitrogen about every ten years in association with vegetation monitoring plots using Environmental Changes Network protocol, and consider archiving samples for future analysis (see Sykes & Lane 1996).	Changes in soil pH and nitrogen can strongly influence vegetation and these have changed on some sites in last 30 years. The underlying causes (air pollution/ eutrophication) are thought to still be operating.

Feature to record/monitor	Method	Rationale
Adjacent landscape	Surrounding habitats within 500 m of the edge zone of minimum intervention areas should be classified and mapped (Phase 1 level or similar); previous landuse can be identified from older 1:10,000 scale air photographs and changes should be recorded as they occur or at least about every ten years.	Surrounding landuse may affect the quality of the minimum intervention area, and the edge zone may become a source of invasive species or other pressures.
Stand structure/ open space	Open spaces and canopy gaps should be mapped for the site using maps of vegetation (see above) and/or 1:10,000 air photographs; recent and older 1:10,000 scale air photographs should be acquired and a decadal archive of air photographs maintained.	Canopy gap and open space dynamics are an important aspect of stand changes and landscape patterns will not often be fully recorded in vegetation sample systems.
Tree/shrub and ground vegetation (1)	Tree/shrub and ground vegetation should be systematically recorded across the site based on a grid system about every ten years. Minimum plot size of 100 m ² for tree/shrub and 4 m ² sub-plots for ground vegetation. Temporary plots can be used except where a permanent system exists already, but the positions should be locatable to the relevant stand, ie within 30 m. A basic system of about 30 plots is likely to be needed, plus additional ones in any particularly distinct and important stands. Precise recording methodology should follow standard protocols (eg Sykes & Lane 1996; Hochbichler <i>et al</i> 2000), unless previous survey method demands some additional or alternative recording.	Provides a quantitative, statistically valid sample to detect changes in trees/shrubs and ground vegetation at the site scale.
Dead wood	The grid plot and transect monitoring should include snags (standing dead trees) and large fallen dead logs (>1 m length and 12.5 cm mid-diameter), and at each grid plot a single 25 m long dead wood transect should be recorded using the line intercept method (Kirby <i>et al</i> 1998). The dimensions, quality, origin, and position (in permanent plots/transects) of each piece should be recorded.	Provides a quantitative and statistically valid sample to detect changes in dead wood levels and quality.

Feature to record/monitor	Method	Rationale
Tree/shrub and ground vegetation (2)	<p>Tree/shrub and ground vegetation should also be recorded along permanent transects about every ten years. At least one 20 m-wide transect should be established in the main vegetation type. Others may be positioned to cross through transitions or other interesting parts of the site. In most sites it is unlikely that there will be the resources to establish and maintain more than three. Trees and shrubs should be recorded following standard protocols (eg Mountford & Peterken 1998; Mountford, Peterken & Burton 1998). Consideration should be given to recording snags and fallen large dead wood pieces (see above), epiphytes (see below), and a continuous central line or sub-set of 4 m² ground vegetation plots.</p>	<p>Provides a quantitative sample to detect actual changes in trees/shrubs, ground and epiphytic vegetation, and dead wood at the site scale, and an effective way of demonstrating and quantifying stand level processes.</p>
Other desirable measurements	<p>A set of fixed-point photographs taken at selected points around the site. Photographs should be taken when recording permanent plots/transects.</p> <p>Epiphytes growing on tree trunks and/or boughs recorded in small c20-50 cm square permanent quadrats placed on tree trunks at four aspects and at various heights around permanently known trees about every ten years. These should be located within the permanent vegetation transect. Sampling needs to be well planned to ensure it is statistically valid.</p> <p>Veteran trees ≥ 1 m dbh mapped, individually tagged, and their condition assessed every decade or so.</p> <p>Changes in bird populations recorded based on the Common Bird Census.</p> <p>Changes in butterfly populations recorded based on the Butterfly Monitoring Scheme.</p> <p>Historical records collected to explain the current condition (eg historical management and livestock grazing, major events, information on original-natural composition).</p> <p>Annual record of numbers and type of livestock, and estimates made for deer, rabbits, grey squirrels, etc.</p> <p>A continuous diary of major events, eg storms, defoliation episodes.</p>	<p>Provides a quantitative and potentially statistically valid sample to detect changes in biotic features of scientific importance</p> <p>Provides information to qualify the existing condition of the site and its naturalness, changes in grazing pressure, localised events that effect the vegetation and other features being monitored.</p>

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Appendix 1. Common and scientific names of trees and shrubs used in text

Common name	Scientific name
Alder	<i>Alnus glutinosa</i>
Alder buckthorn	<i>Frangula alnus</i>
Apple or crab apple	<i>Malus sylvestris</i>
Ash	<i>Fraxinus excelsior</i>
Aspen	<i>Populus tremula</i>
Beech	<i>Fagus sylvatica</i>
Birch, downy birch, silver birch	<i>Betula</i> sp., <i>B. pubescens</i> , <i>B. pendula</i>
Blackthorn	<i>Prunus spinosa</i>
Box	<i>Buxus sempervirens</i>
Buckthorn	<i>Rhamnus catharticus</i>
Cherry or wild cherry, bird cherry	<i>Prunus avium</i> , <i>P. padus</i>
Chestnut or sweet chestnut, horse chestnut	<i>Castanea sativa</i> , <i>Aesculus hippocastanum</i>
Dogwood	<i>Cornus sanguinea</i>
Elder	<i>Sambucus nigra</i>
Elm, smooth-leaved elm, wych elm	<i>Ulmus</i> sp., <i>U. minor</i> , <i>U. glabra</i>
Field maple	<i>Acer campestre</i>
Fir or silver fir	<i>Abies alba</i>
Guelder rose	<i>Viburnum opulus</i>
Hawthorn, midland hawthorn	<i>Crataegus monogyna</i> , <i>C. laevigata</i>
Hazel	<i>Corylus avellana</i>
Holly	<i>Ilex aquifolium</i>
Hornbeam	<i>Carpinus betulus</i>
Larch	<i>Larix</i> sp.
Lime, large-leaved lime, small-leaved lime	<i>Tilia</i> sp., <i>T. platyphyllos</i> , <i>T. cordata</i>
Oak, pedunculate oak, sessile oak, red oak, Turkey oak	<i>Quercus</i> sp., <i>Q. robur</i> , <i>Q. petraea</i> , <i>Q. rubra</i> , <i>Q. cerris</i>
Pine or Scots pine	<i>Pinus sylvestris</i>
Privet	<i>Ligustrum vulgare</i>
Rhododendron	<i>Rhododendron ponticum</i>
Rowan	<i>Sorbus aucuparia</i>
Sallow	<i>Salix caprea</i>
Service or wild service	<i>Sorbus torminalis</i>
Spindle	<i>Euonymus europaeus</i>
Sycamore	<i>Acer pseudoplatanus</i>
Wayfaring-tree	<i>Viburnum lanata</i>
Whitebeam, rock whitebeam	<i>Sorbus aria</i> , <i>S. rupicola</i>
Willow, crack willow, goat willow, grey willow	<i>Salix</i> sp., <i>S. fragilis</i> , <i>S. caprea</i> , <i>S. cinerea</i>
Yew	<i>Taxus baccata</i>

Appendix 2. Provisional list of thirty-four characteristic woodland types to cover the range of original- and inherited-natural woodland types in England

- 1 Lowland acid-mesotrophic beech woodland in the South-east
- 2 Lowland acid-mesotrophic beech woodland in the Chilterns
- 3 Lowland acid-mesotrophic beech wood pasture in the New Forest
- 4 Lowland calcareous-mesotrophic beech woodland in the South-east
- 5 Lowland calcareous-mesotrophic beech woodland in the Chilterns
- 6 Lowland calcareous-mesotrophic beech woodland in the Cotswolds
- 7 Lowland calcareous-mesotrophic yew woodland in the South-east

- 8 Borderland calcareous-mesotrophic-acid beech woodland in the West Midlands

- 9 Lowland acidic-mesotrophic oak woodland in the South-east
- 10 Lowland acidic-mesotrophic oak woodland in the Midlands
- 11 Lowland acidic-mesotrophic oak wood pasture in the New Forest

- 12 Borderland acidic-mesotrophic oak woodland in the West Midlands

- 13 Upland acidic-mesotrophic oak woodland in the North
- 14 Upland acidic-mesotrophic oak woodland the South-west
- 15 Upland acidic-mesotrophic oak wood pasture in the North
- 16 Upland acidic-mesotrophic oak wood pasture in the South-west

- 17 Lowland calcareous-mesotrophic ash woodland in the Midlands
- 18 Lowland calcareous-mesotrophic ash woodland in the South

- 19 Borderland calcareous-mesotrophic ash woodland in the West Midlands
- 20 Borderland calcareous-mesotrophic ash woodland in the South-west
- 21 Borderland calcareous-mesotrophic ash woodland in the Peak District
- 22 Borderland calcareous-mesotrophic ash woodland in the North-east

- 23 Upland calcareous-mesotrophic ash woodland in the North
- 24 Upland calcareous-mesotrophic ash woodland in the South-west
- 25 Upland calcareous-mesotrophic ash wood pasture in the North

- 26 Lowland wet woodland on peat in East Anglia
- 27 Lowland wet woodland on floodplains
- 28 Lowland wet woodland on streams, flushes, depressions throughout
- 29 Lowland wet woodland on salt-marsh transitions

- 30 Borderland wet woodland on peat in the West Midlands

- 31 Upland wet woodland on peat in the North
- 32 Upland wet woodland on floodplains
- 33 Upland wet woodland on streams, flushes, depressions in the North
- 34 Upland wet woodland on streams, flushes, depressions in the South-west

Appendix 3. Details of candidate minimum intervention woodland reserves

(see Appendix 1 for scientific names)

Adcombe Wood SSSI

Adcombe Wood, Somerset (grid ref: ST 2217), is a 36 ha Woodland Trust reserve. It is part of the Prior's Park and Adcombe Wood SSSI and occupies sloping ground in the Blackdown Hills. Most of the site is dominated by pedunculate oak, ash and hazel formerly managed as coppice-with-standards, and in Adcombe small-leaved lime is locally abundant. NVC communities W8a, W8d, W8e, and W10c are present, and 20 ha or more can be assigned to minimum intervention.

Ashford Hangers NNR

Ashford Hangers NNR (grid ref: SU 7427) covers 147 ha and forms a large part of the Wealden Edge Hangers SSSI, Hampshire. It is owned and managed by Hampshire County Council/Hampshire Wildlife Trust. There is a block of about 12 ha of over-stood coppice W12a-c/W8e-f beech-ash woodland on Reston Round Hills and Happersnapper Hangers on an east-facing escarpment probably of 14/15th century origin that is dedicated to minimum intervention management. Other parts of the reserve (Ridge Hanger-Ashford Hanger, Ashford Hill-Berryfield Hanger-Shoulder of Mutton) could be considered for minimum intervention. There are 4 permanent plots including ground flora records that were established in 1988 on Ashford Hill & Ridge Hanger.

Aversley Wood SSSI

Aversley Wood, Cambridgeshire (grid ref: TL 163819), is a 62 ha SSSI owned by the Woodland Trust. It is a W8 ash-maple woodland growing on heavy clay soils. It has a coppice-with-standards structure, and is dominated by pedunculate oak, ash and field maple. Otherwise, elms occupy some areas, and wild service is also present. Apart from the ride network, only 3-4 ha has been managed in recent years. Muntjac deer are a problem and control is being considered. The site management plan is under review and some management for Black Hairstreak is likely. The Trust would consider an area here for minimum intervention. Note that it is close and similar to Monks Wood.

Beacon Hill NNR

Beacon Hill NNR (grid ref: SU 6022), Hampshire, is a 40 ha reserve with woodland growing on chalk slopes. There is a 7 ha block of storm-damaged W12 beech woodland regenerating to ash and some adjacent intact beech stands that are unmanaged.

Bigsweir Wood SSSI

Bigsweir Wood, Gloucestershire (grid ref: SO 544056), is a 48 ha SSSI in the lower Wye Valley that is mostly (45 ha) owned by the Woodland Trust. It overlies Devonian sandstone and quartz conglomerate and has fairly acid soils. The canopy is dominated by sessile oak with some beech, small-leaved lime and birch. The understorey is mainly of hazel, small-leaved lime

and beech with occasional rowan and holly. The ground flora is mainly bramble, bracken, male fern and ivy with some bluebell, dog's mercury, bilberry, cow-wheat and greater woodrush. The site management plan is under review, and the current minimum intervention approach, save for sycamore and deer control, is likely to remain in large areas.

Birk Gill Wood SSSI

Birk Gill (grid ref: SE 130820) is a 31 ha upland oakwood in North Yorkshire. It is an SSSI in private ownership (estates of Lord Downshire and Lord Swinton), but no silvicultural management occurs and only a small amount of sheep grazing occurs. The wood occupies a narrow valley cut through shales and grits and is relatively undisturbed due to its inaccessibility. It is dominated by sessile oak with rowan and holly throughout, and some silver birch at the western end (probably W17). Alder occurs along the river and in places forms dense thickets. There is good regeneration particularly along the northern boundary.

Birkrigg and Keskadale Oaks SSSI

Birkrigg (3 ha) and Keskadale Oaks (6 ha) (approx. grid ref: NY 2019) are high altitude, stunted, oak wood pastures in the Lake District. They are part of Buttermere Fells SSSI and are owned by the National Trust. The woodland is assigned to minimum intervention, and is dominated by sessile oak, with some rowan, holly, birch, hawthorn, pine and larch, and conforms to W17 in the NVC. In Keskadale Oaks an enclosure has been erected. J.M.Sykes of the Institute of Terrestrial Ecology has undertaken monitoring at least during the late 1970s and apparently through the 1980s. It is not known if this has been continued. A series of sampling points based on a grid have been laid out in both woods: in Keskadale the grid is 40m and sampling points total 54. The woods have been divided into 3 sections and recording in each is on a six year cycle. At each point the nearest tree in each of four quadrants and within 30 m is recorded, and ground vegetation is recorded in a single 2 x 2 m subplot. In and around the enclosure in Keskadale there are 35 subplots where tree seedlings appear to have been recorded and tagged.

Bisham Wood SSSI

Bisham Wood SSSI (grid ref: SU 8585) is an 84 ha woodland that is part of area of 155 ha owned by The Woodland Trust. It is mainly on steep slopes over the river Thames at Marlow, Berkshire. Most of the site has thin free-draining soils on a chalk escarpment, but above it has wet clays and base-poor sands and gravels. Most of the woodland is beech high forest, representing a southern outlier of the Chiltern beechwoods. It is remarkable for the diversity of ground flora and woodland types represented. Beech occurs with ash, cherry, wych elm, field maple, yew, holly and sycamore on the chalk slope and oak, ash, wych elm, birch, sweet chestnut and cherry on the acid plateau soils. Some conifers and other exotics have been planted and sycamore is invading areas. There are some small patches of hazel coppice, alder woodland with willow along the watercourse at the slope base, some hornbeam woodland on wood banks and a few wild service. The main NVC communities are W12a, W14, and W8. There is the potential to have 30 ha or more as minimum intervention, ie the long term intention is to treat significant areas as minimum intervention. However, the Woodland Trust is in the process of eradicating rhododendron, and there is also significant public access to some parts, including horse riding and safety zones along all boundaries where tree surgery work will continue.

Black Tor Copse and Wistman's Wood NNR

Black Tor Copse (grid ref: SX 566890) and Wistman's Wood (grid ref: SX 612773) are small 6-4 ha western upland oakwoods, situated about 15 km apart on Dartmoor, Devon. Both are managed by EN and assigned to minimum intervention. They are wood pastures being grazed by sheep and cattle. NVC types W17b/c/e predominate. In Wistman's a small permanent plot was recorded in 1921, expanded in 1965 and recorded again in 1978, and expanded again in 1987 and re-recorded in 1997. In addition, a small permanent regeneration plot has been recorded since the mid-1970s. Fixed-point photos are taken at both.

Bovey Valley Woodlands NNR

Bovey Valley Woodlands (grid ref: SX 770810) cover 87 ha and are part of the East Dartmoor Woods and Heaths NNR, Devon. The site is mainly western acidic oakwood, with sessile oak, pedunculate oak and silver birch on well-drained ground, and alder, ash, aspen and sallow with pedunculate oak and birch on wetter ground. Some areas are remnant coppice-with-standards with pedunculate oak and ash growing over hazel, and some are remnant sessile oak coppice with holly and rowan grow in the understorey. Sycamore is locally dominant and invading elsewhere. Monitoring includes fixed-point photos. There are four woodland blocks. Woodash/Water Cleave (31 ha) is mainly W11a (13 ha) and W8e (8 ha), with sycamore is highly invasive throughout northern part, and a small block of W14 beech present and some secondary areas present. Houndtor Wood (East) (16 ha) is mainly W17b and Neadon Cleave (18 ha) is mainly W11a. Rudge Wood (13 ha) is mainly pedunculate oak-sycamore-hazel-(holly-ash) and predominately W8b (7 ha). The management policy in all is minimum intervention, but sycamore, beech and other exotics are to be controlled by progressive cutting. Adjacent to the NNR is a Woodland Trust reserve, Hisley Wood SSSI, which includes 3ha of wet woodland W7a/b in minimum intervention.

Broxbourne Woods NNR

Broxbourne Woods NNR (grid ref: TL 3308) is split into two main woodland blocks: Wormley-Bancroft-Derry's Wood and Hoddesdonpark Wood. Wormley Wood covers 143 ha and is a Woodland Trust reserve with about 90 ha in minimum intervention: these are predominately W10a and W16a hornbeam-dominated stands, but also include W10/W8a along several streams and a small pocket of W10a/W7b. Adjacent is Derry's Wood which covers about 90ha and may become minimum intervention following removal of (larch) conifers: this is predominately W16a/W10(a). In Hoddesdonpark Wood there is on-going work to diversify the stand structure by creating gaps and new regeneration, and following this some blocks may be left to minimum intervention: this stand is W16a/(b).

Buckingham Thick Copse NNR

Buckingham Thick Copse NNR (grid ref: SP 708432) is a 45 ha woodland in Northamptonshire. The woodland contains ancient semi-natural stands growing mainly on clay soils that range from slightly acid to neutral. The main canopy species are pedunculate oak and ash, including a notable number of large 3-400 year old oaks. Silver birch forms a widespread but minor component. Sweet chestnut dominates as mature coppice in some compartments, and as occurs scattered standards elsewhere. A few crack willow, hornbeam, beech, horse chestnut, larch, pine, fir, and sycamore are present. The understorey is typically composed of

ash, hazel, common and midland hawthorn, field maple, rose, willow, dogwood, guelder rose, spindle, and a little holly and box. NVC type is W8. Management policy is to leave about 40% of the woodland (18 ha), mainly the oak/ash high forest compartments, to minimum-intervention. Sweet chestnut is to be selectively controlled by cutting. Monitoring includes a tree health survey. However, the site manager says whole site is more-or-less minimum intervention.

Bure Marshes NNR

Bure Marshes NNR (grid ref: TG 3316) is situated on fenland peats in the flood plain of the River Bure, and contains probably the finest example of swamp Alder Carr in Britain. It contains about 270 ha of alder/willow fen carr, mainly of W5 and W2a with small amounts of W2b type. An area of about 50 ha is to be removed, leaving the rest as minimum intervention.

Castle Eden Dene NNR

Castle Eden Dene (grid ref: NZ 435397) is a 221 ha NNR in Durham, stretching up a Magnesian limestone gorge from the coast near Peterlee. It is among the largest and least disturbed woods in NE England, and is best described as a northern ravine ash/yew wood. In the centre of the reserve there is a core native woodland area. Here much of the woodland, especially the steep hangers lining the ravine, is ancient semi-natural. Some appears as scrub ash, hazel and yew, the latter forming groves of W13 woodland that are amongst the most extensive in the country. The rest is mainly W8b/f ash-dominated woodland with wych elm, including some large surviving trees, some hazel, spring-line alder, and pedunculate oak, and frequent sycamore. Beyond the core native woodland area, there are various blocks of conifers or beech or sycamore. There has been a programme to control sycamore, rhododendron and beech, which will affect parts of the core native woodland to varying amounts. Thereafter, an area of up 67 ha could be minimum intervention.

Chaddesley Wood NNR

Chaddesley Wood NNR (grid ref: SO 9173) covers about 100 ha of gently sloping ground in north Worcestershire. The soils are generally acid and either loam or clay loam surface water gleys, or free-draining brown earths. The northern half of the wood contains oak high forest with some ash, birch aspen and minor species including wild service and hornbeam, with holly and hazel in the understorey. The southern half has largely been replanted with conifers. Much of the semi-natural stands are Peterken types 6Dc/Cc, or NVC types W10a (dominant) and W16b. Compartments 14-16 (Coalpit Coppice area) cover about 20 ha and are minimum intervention areas. These have oak high forest with some hazel understorey, and either *Rubus-Holcus* or *D. flexuosa/V. myrtillus* ground flora. Compartment 2 adjoins and could be included as minimum intervention.

Cheddar Wood SSSI

Cheddar Wood SSSI (grid ref: ST 445552) covers 87 ha and is part managed Somerset Avon Wildlife Trust who have a short-lease from the owners Barden Aggregates. It is dominated by W8 stands dominated by small-leaved, ash, pedunculate oak and hazel growing on steep slopes on Carboniferous limestone in the Mendip Hills. Field maple, whitebeam, yew, wych elm, wild service, wayfaring-tree, dogwood and spindle also occur. Much of the upper part of

the wood is secondary. Perhaps 20ha of minimum intervention could be established, though longer-term lease arrangement would be necessary to provide security for long-term management by minimum intervention.

Colt Park NNR

Colt Park Wood (grid ref: SD 774775) is part of the Ingleborough NNR and was purchased by the Nature Conservancy Council in 1962. It is a long-thin 8.5 ha upland ash woodland growing on limestone pavement at 440m above sea level. The main tree is ash associated with some bird cherry, birch, rowan, hazel, hawthorn, guelder rose and blackthorn. The wood is in minimum intervention and fenced against sheep. At the southern end young trees have been planted in an attempt to extend the wood by 1 ha. 15 short permanent transects were established 1959 and recorded in 1977 & 1989, and 25 200m² plots on 50m grid were established in 1978 by J.M. Sykes of the Institute of Terrestrial Ecology.

Cotswold Beechwoods NNR

The Cotswold Commons and Beechwoods NNR contains 7 woods totalling 342 ha, the largest of which are Workman's Wood (120 ha) (grid ref: SO 9011), Buckholt Wood (100 ha) (SO 9013), and Saltridge Wood (51 ha) (SO 8911). These woods generally have a high forest structure dominated by beech with some ash, pedunculate oak, and some areas of sycamore. Associated tree species include wych elm, field maple, and whitebeam, and characteristic understorey species are holly, yew, hazel and hawthorn. The stands mainly conform to NVC W12a (Peterken types 8Ca/b) with occasional blocks of W14 and W8e. Most of the woods are prescribed for management by selection/shelterwood forestry systems. There are a few blocks of minimum intervention, the largest being in Workman's Wood (8 ha block of mainly W12a), Buckholt Wood (c7ha block of mainly W12a/c), Brockworth Wood (c.4 ha block of mainly W12a/b), and Saltridge Wood (several blocks totalling 6 ha of mixed W14/W12a/c/ W8f). There is interest in developing minimum intervention areas. Six permanent transects and six permanent plots were established in the 1990s in parts of Buckholt and Saltridge Wood.

Dendles Wood NNR

Dendles Wood NNR (grid ref: SX 615620) is a 29 ha western acid oak-beechwood on the edge of the Dartmoor plateau, Devon. It is heavily grazed and is more like wood pasture. The upper wooded slopes are dominated by pedunculate oak and the lower by beech, with some ash, sweet chestnut, sycamore, silver fir, larch, and Scots pine present. Heavy grazing has reduced the understorey but some hazel, holly and rowan are scattered throughout, and in wetter areas some willow and alder buckthorn occur. Oakwood type W10e/W11a covers 6 ha, beechwood type W15b-c covers 9 ha, and mixed deciduous stands cover 9 ha. The whole site is prescribed for minimum-intervention treatment, with some cutting of sycamore and rhododendron expected. It is beyond the considered 'native' range of beech and the structure suggests that the change to beech dominance is quite recent. A permanent transect was established in 1988 and recorded in 1999.

Derbyshire Dales Ashwoods NNR

The Derbyshire Dales NNR contains 5 sites totalling 342 ha, the largest of which are Cressbrook Dale (126 ha) (SK 173735), Lathkill Dale (121 ha) (SK 190657), and Monk's

Dale (57 ha) (SK 135745). Woodland in these dales grows on steep-sided calcareous valleys derived from Carboniferous limestone. They are dominated by ash, and in ancient sites have wych elm associated. Small-leaved lime is present in variable quantities, and pedunculate oak occurs in western dales. The understorey is mostly hazel with rowan and field maple. On rock outcrops, yew and rock whitebeam are present. Woodland shrubs include bird cherry, dogwood and guelder rose. The woods mainly conform to NVC type W8g, with some areas of W9a and W8d. Minimum intervention is prescribed for 44 ha of Lathkill Dale, 17 ha of Cressbrook Dale, and 14 ha of Monk's Dale. Sycamore is present in these areas and is to be controlled by cutting.

Derwent Gorge and Muggleswick Woods NNR

Derwent Gorge (grid ref: NZ 052493) and Muggleswick Woods (grid ref: NZ 063483) form a 71 ha NNR. They support ravine woodland developed over predominately acid substrates, and grades from sessile oak stands with some yew on acid cliffs, into ash-wych elm stands on lower slopes, and alder stands in the valley bottoms and on flushed ground. The majority of the woods are semi-natural, but there are small patches of sycamore and old beech/conifer plantings. The woodland types include equivalent oak types W10/W11/W17, equivalent ash types W8/W9, and W7 alder stands. Minimum intervention is prescribed for 5.8 ha in five small compartments (9a = 0.7 ha; 9c = 1.7 ha; 14b = 0.9 ha; 16a = 0.5 ha; 16c = 2 ha), where limited control of sycamore and beech is anticipated. Much of the rest of the wood is undergoing removal of sycamore and/or beech to restore semi-natural woodland: potentially 50ha will then be assigned to minimum intervention. Overall the site is probably not appropriate as a representative minimum-intervention site: present compartments are too small and much of the rest is under-going restoration to semi-natural woodland.

Dodgson Wood SSSI

Dodgson Wood SSSI (grid ref: SD 302925) is beside Coniston Water in The Lake District. It is one of several sites owned by The National Trust and managed more-or-less as minimum intervention. It covers 129 ha, is not grazed by livestock, and the manager thought that it ought to be possible to assign large tracts to long-term minimum intervention. There are extensive stands of sessile oak, some small-leaved lime present, and juniper scrub on the higher ground. The wood shows a general transition from lake shore alder wood and ash-hazel, through hazel-sessile oak with yew and holly, to higher level birch-oak without hazel. Small fast-flowing streams have wych elm and lime stools with bird cherry. The woodland communities include W11, W17, W9 and W7.

Dovedale Woodlands SSSI

The Dovedale Woodlands (grid ref: SK 1455) are owned by The National Trust and comprise three non-intervention wooded blocks growing along a Carboniferous limestone gorge in the Derbyshire Dales. Dovedale Wood includes 56 ha of Dovedale Ashwood which extends to c.130 ha along the west-side of the lower part of Dovedale. It is part of one of the three NCR Grade 1* woodlands which are considered as the best-developed ashwoods on Carboniferous limestone in Britain. The canopy is dominated by ash and wych elm. Planting has introduced some patches of beech, but most larch have been removed. Sycamore is frequent throughout, there are some pure ash stands, and birch is frequent. Some yew and small-leaved lime are present. Most canopy trees are about 60-100 years age, shrubs are diverse and patchily

abundant, and the wood is very lightly grazed by sheep. The Nabs woodland (13 ha) is towards the centre of Dovedale and grows on very steep slopes and rock gullies. It has a varied structure and high biological interest. It is dominated by un-even aged ash, including some fine old trees, with wych elm and hazel on the lower slopes and some fine old field maple, and a few lime. The canopy is open, there are some dead elms and much dead wood, and much regeneration and shrub growth including dogwood, privet, crab apple, hawthorn, blackthorn, buckthorn, rowan, rock whitebeam and elder. Sheep lightly grazes the area. Iron Tors woodland (14 ha) grows on very steep slopes at the northern end of Dovedale. It probably contains ancient woodland fragments that have spread onto adjacent ground to form fairly extensive ash-wych elm woodland, with sycamore and pine planted amongst this. The older parts have some good canopy trees and an open structure with shrubby growth of hazel, dogwood and field maple, and numerous ash and sycamore seedlings. The younger stands have hawthorn, blackthorn, sycamore and ash below. The wood is lightly grazed.

Ebbor Gorge NNR

Ebbor Gorge (grid ref: ST 525485) is a 41 ha NNR in the Mendip Hills, Somerset. It consists of a steep-sided ravine cut into Carboniferous limestone, and is mostly covered by calcareous ash woodland with a varied age and canopy structure. The canopy is dominated by ash, with pedunculate oak co-dominant in one area. Local stands of beech, field maple, whitebeam and hornbeam occur, and hazel dominates the understorey. Associated shrubs include dogwood, spindle, way-fairing tree, guelder rose and wild privet. About 25 ha is to be managed by minimum intervention, but much of this encompasses secondary woodland and only about 10 ha of ancient semi-natural woodland is minimum intervention. The manager thought Rodney Stoke may be a better candidate as a minimum intervention reserve.

Edge Wood SSSI

Edge Wood (grid ref: SJ 6100) is owned by the National Trust. It is part of Wenlock Edge SSSI, Shropshire, and grows on a narrow, steep, scarp slope of Silurian limestone. The woodland is W8 ash-sessile oak-hazel woodland with some wych elm, hawthorn, spindle, blackthorn, and holly. A block of 4 ha is managed as minimum intervention.

Epping Forest SSSI

Epping Forest (grid ref: TQ 4198) contains about 1,620 ha of beech-hornbeam-pedunculate oak-birch woodland. Three areas totalling 140 ha (Epping Thicks 63 ha, Great and Little Monk Wood 48 ha, and Blackbush Plain 29 ha) are designated for minimum intervention. Management work in these areas will be limited and involve only small or low ground pressure machinery, unless existing access routes allow otherwise. The work will be peripheral and involve maintenance or clearance of small glades, removal of obstructions from main pathways, removal of alien species such as sycamore or grey squirrel and a small amount of maiden pollarding. Epping Thicks has mixed soils, several small streams, and three adjacent blocks of minimum intervention woodland. These are mainly oak-hornbeam woodland with beech maidens/pollards, dominant in the south. There are patches of dense holly with some fine oak and hornbeam pollards, a number of windblown trees, and some extensive tracts of bracken and bramble, birch, and holly, and some beech and hornbeam have developed in clearings (W10/16 + W15/14). Great Monk Wood has acid soils and areas of impeded drainage. It is dominated by beech, many of which are pollards. Some oak and hornbeam are

present, and there is widespread beech mortality. There is considerable regeneration of beech and hornbeam and very little ground vegetation except for moss carpets and some wavy hair-grass, the odd clump of heather, some bracken. Bramble is not extensive (W15/14). Streams deeply incise the area and these are well vegetated where there is no canopy. Little Monk Wood is a mosaic of mature and regenerated woodland, predominately of beech. Many of the older trees have fallen, large areas have no pollards, there are clearings and areas of regrowth, maiden oaks are frequent, and the ground flora is sparse. Blackbush Plain (29 ha) has acid, mixed soils with some gravel. It is a mature oak/hornbeam woodland with some beech, which was designated for minimum intervention in 1996. Transition from pollard woodland to high forest is well under way with much windthrow and mixed species regeneration. Some fine oak pollards remain, parts are impenetrable with holly, logs and bramble, and the ground flora in many areas is dominated by bracken (W10/16). Lower Forest is not designated as minimum intervention, but no work is planned over about 100 ha of oak-hornbeam wood-pasture with ash, field maple and holly (W8/10?). This area contains a high proportion of pollards, especially hornbeam, although many have now fallen and are filling with bramble and tree regeneration.

Finglandrigg Wood NNR

Finglandrigg Wood (grid ref: NY 275568) in Cumbria is a 97 ha NNR with 61 ha of woodland/scrub. The site is based on acid peaty soils derived from raised bog development, and much is woodland. The most notable woodland is on the peat on Little Brampton Moss. This covers 9ha and shows a gradation from W4 to W1 woodland, and then to mire community M27. The wettest areas are dominated by grey willow over a fen flora. On slightly drier soils the ground flora is more mossy and downy birch becomes the dominant, with some grey willow and self-sown Scots pine. Locally there is some alder. On even drier ground birch and pine predominate, with some oak and rowan, and rarely aspen. The corresponding woodland communities are W1, W4a/a, W11a, W17c, and W18. Little Brampton Moss is under minimum intervention management.

Fore Wood

Fore Wood (grid ref: TQ 753128) is a 55 ha RSPB reserve in Sussex, and includes 21.5 ha of SSSI. Half is chestnut-dominated with sparse pedunculate oak and birch, and half is neglected hornbeam coppice with pedunculate oak, ash, hazel, aspen, birch, field maple, and willow. The site contains ghyll woodland growing on steep ravines cut by streams into the underlying sandstone. Here alder and ash form a closed canopy and humid conditions more typical of western Atlantic woods. About 15 ha in 2-3 pieces are to be left as minimum intervention.

Gait Barrows NNR

Gait Barrows NNR (grid ref: SD 480772), north Lancashire, will have a block of about 25 ha of minimum intervention yew-ash woodland on limestone pavement. Part of this is already within the reserve, but part is currently being purchased.

Golitha NNR

Golitha NNR (grid ref: SX 222685) covers 18 ha and occupies south-facing slopes along the Fowey Valley, Cornwall. The soils are acid brown earths derived from granite and killas, and

the river is fast-flowing and includes a series of rapids known as Golitha Falls. The reserve includes a part of the 38 ha Draynes Wood SSSI. The woodland is composed of three main types: managed and derelict sessile oak coppice, mixed oak/ash high forest, and planted beech-dominated forest. Hazel and holly occur as infrequent shrubs throughout, and in wetter near the river alder and willow grow. Thus, on the upper slopes W10e oak woodland occurs, whilst W16b oak woodland occupies the lower, more acid and boulder-strewn areas. W14 beech woodland is dominant over the flat area of the valley floor. W8e occurs in two blocks of unmanaged oak-ash high forest. Small patches of alder woodland type W7b occur beside the river. The W8e oak-ash high forest is to be treated as minimum intervention, and some derelict coppice stands will be treated as such. Beech is to be controlled by removing saplings and seed sources. This site would not be suitable as a representative minimum intervention reserve: overall the site is quite small and areas for minimum intervention very small.

Ham Street Woods NNR

Ham Street Woods NNR (grid ref: TR 011341) is a 97 ha woodland in Kent, which is part of a larger fragmented woodland block known as Orlestone Woods. It is situated on the southern edge of the Weald Clay as it slopes down to Romney Marsh. About two-thirds of the site is high forest. Here, pedunculate oak predominates, though sessile oak occurs frequently and hybridization is common. Other standards include wild service, wild cherry and ash, and smaller numbers of field maple, beech, silver birch and downy birch. Parts of the site have been managed to produce hornbeam high forest. Understorey species include guelder rose, elder, midland hawthorn, holly, hazel, and, rarely, yew, spindle, and a little holly and box. Small patches of aspen high forest have been established, and this species is found throughout the site. Coppice occupies about one-third of the site and includes five main types: hornbeam, hazel, sweet chestnut, mixed and alder. Most of the woodland conforms to W10b, with small blocks of W10a present. Along the main stream W8b grows, possibly grading into alder woodland in places. Minimum intervention is applied to about 40 ha, most of which is within one large block. This area includes significant areas of W10b and W10a woodland. Permanent plots were established in 1964 and recorded in 1988, and a permanent transect was established in 1988.

Hawkswick Wood SSSI

Hawkswick Wood (grid ref: SD 946714) is a 11.5 ha upland W8/9 ashwood in the Yorkshire Dales. It is an SSSI in private ownership by the Arncliffe estates. At present there is an FC woodland grant scheme, but with little active management. The wood occupies a steep south-west facing slope on Carboniferous limestone, which is exposed in a scar along the upper slope and here yew, rock whitebeam, and spindle occur. Below there is an open woodland of ash with an understorey of hawthorn and hazel.

Highbury Wood NNR

Highbury Wood NNR (grid ref: SO 540085) is a 46 ha woodland in the lower Wye Valley, Gloucestershire. It has mainly calcareous soils derived from Carboniferous limestone. The main woodland species are ash, wych elm, sessile and pedunculate oak, hazel, field maple, small-leaved lime, beech and sycamore, with NVC types W8a/e-f, W10a and W12c and Peterken stand types 1A, 1C, 1D, 2C, 3A, 3B, 4Bb, 4C, 5A, 5B, 8Ca and 8Eb recorded. Much of the reserve is to be treated as coppice, but about 18 ha are dedicated to minimum

intervention. The majority (c.12 ha) of this is W8e woodland on steep slopes with ash and hazel most abundant, some wych elm, small-leaved lime, hawthorn, and field maple, and a few oak, birch, cherry, yew and holly. In addition, within this there are some strips of W12c woodland with beech, yew and small-leaved lime abundant, some ash and a little whitebeam, wych elm and holly. Otherwise, the minimum intervention area includes a block of mainly secondary ash/sycamore woodland. Monitoring plots were established in the 1990s to record the spread of sycamore, which has the potential to spread through the site, and there is a series of fixed-point photos.

Horner Woods NNR

Horner Woods NNR (grid ref: SS 895440) is a National Trust woodland covering 331 ha on the northern edge of Exmoor. Most of the woodland is upland oakwood with sessile oak, downy birch, holly and rowan most frequent. The main woodland types are W11a/b/d and W17b with some areas of W16 (b) and W10a/e. Nearly all the site is to be maintained by minimum intervention, with rhododendron to be cut out.

Howe Ridding Wood SSSI

Howe Ridding Wood (grid ref: SD 4388) is owned by Cumbria Wildlife Trust and is part of Whitbarrow SSSI, Cumbria. It is a proposed NNR, covers 26 ha, and has ashwood growing on steep limestone slopes with scree above. Perhaps 15-20 ha could be assigned to minimum intervention, although the central strip is being actively managed as coppice-with-standards.

Johnny Wood SSSI

Johnny Wood SSSI (grid ref: NY 252143) in The Lake District is one of several sites owned by The National Trust and managed more-or-less as minimum intervention. It is a 36 ha wood-pasture site grazed by sheep and growing on steep slopes. Some small areas may need to be excluded from a minimum intervention approach. W17 and W11 communities are most frequent, but there are also small stands of W9 and W7b along streams or in boulder scree, and W4 is occasional in peaty hollows. Most of the wood is oak-dominated, with some birch, rowan, holly and hazel. Some small areas have ash and hazel and sparse bird cherry and wych elm, and others birch, willow, ash and hazel. There are a few sycamore to the north-east, and a few larch and Scot's pine on some of the crags. The upper slopes have the most varied canopy structure and composition.

Kingley Vale NNR

Kingley Vale NNR (grid ref: SU 822107) has extensive W13 yew-dominated stands and is considered the finest yew woods in Europe. The yew grow mainly on chalk slopes but with older stands on the valley gravel and coombe deposits of the valley floor. The older valley stands are estimated at 500 years old and include significant amounts of oak and ash, whereas most of the yew-dominated stands on the escarpment are about 200 years old. Some gap phase regeneration of ash and elder has occurred. The yew-dominated stands form four main minimum intervention blocks, include stands on the escarpment and the valley below, and collectively cover about 50 ha.

Lady Park Wood NNR

Lady Park Wood NNR (grid ref: SO 5414) is a 44 ha woodland in the lower Wye Valley, owned by the Forestry Commission. It overlies Carboniferous limestone but in places there are substantial glacial drift deposits, and soils range from calcareous rendzinas to acid silty soils. The main trees are beech, ash, small- and large-leaved lime, sessile oak, birch, and wych elm, whilst hazel, hawthorn, field maple, and many other shrub species are present. About 33 ha of the reserve are under minimum intervention management, and these can be divided into about 25 ha of beech-rich W12-15 woodland above a central dividing cliff-line and about 8 ha of elm-rich W8 woodland below this. There has been considerable monitoring based mainly on nine permanent transects established in the 1940-50s and recorded many times since. In addition there is another permanent transect in an 11 ha managed compartment (established 1985), a set of scattered permanent ground flora plots (established in 1979), and more permanent ground flora and small mammal plots established in the 1990s.

Langley Wood NNR

Langley Wood (grid ref: SU 225202) is a 220 ha NNR in Wiltshire. It is considered to be one of the best remaining examples of lowland, ancient semi-natural, oak-birch-hazel-lime woodland growing on slowly permeable, slightly acid, fine loamy and silty soils. Bordering the New Forest, it is effectively an ungrazed version of the Forest woodland. It has a large area dominated by mature standard oaks and coppice regrowth that has been under minimum intervention for 60-80 years. Most of the wood conforms to W10 lowland mesotrophic oak woodland. At present there are 65 ha of semi-natural stands under minimum intervention, but following removal of conifers, rhododendron, sycamore and/or sweet chestnut, a total of 146 ha are planned for minimum intervention. Two permanent transects were established in the 1980s and recorded in the 1990s.

Lincolnshire Limewoods NNR (Hatton Wood and Great West and Cocklode Woods)

Hatton Wood (grid ref: TF 165750) and Great West and Cocklode Woods (grid ref: TF 105765) are part of the Bardney Limewoods NNR, a cluster of 10 semi-natural small-leaved lime dominated woods. The Lincolnshire Limewoods grow on gently sloping ground and exhibit a composition close to the natural woodland that was prevalent in lowland Britain 5-8,000 years ago. In addition to extensive tracts of pure small-leaved lime, other canopy forming species are ash, pedunculate oak and birches, with sessile oak typical where a greater depth of acid sandy drift overlies the underlying clays. In more calcareous areas, wild cherry, wych elm, and field maple occur. Shrubs include hazel, holly, alder buckthorn, and midland hawthorn. Alder occupies low-lying wet areas. Peterken stand type = 4A (equivalent NVC = W10). Within the NNR, the 37 ha site of Hatton Wood, and 27 ha of the 51 ha site of Great West and Cocklode Woods have been assigned to minimum intervention.

Lineover Wood

Lineover Wood, Gloucestershire (grid ref: SO 987190), is a 50 ha reserve owned by the Woodland Trust, and includes the 20 ha Lineover Wood SSSI. Part of the reserve has been largely replanted with conifers and is being restored to native woodland, but the SSSI area is an outstanding example of ancient semi-natural mixed coppice woodland in the Cotswolds. The W8 dominated stands include ash, pedunculate oak, whitebeam, small-leaved lime, and

large-leaved lime growing over hazel, field maple and hawthorn and a little wayfaring-tree, dogwood and spindle. Subject to eradication of a small element of sycamore, a 7 ha area is to remain as minimum intervention.

Ling Gill NNR

Ling Gill NNR (grid ref: SD 803778) is a 5 ha sub-alpine wooded ravine cut into Carboniferous limestone and extends for about 1 km. Here, ash and wych elm grow only in sheltered areas, and rowan, bird cherry, aspen, and especially downy birch extend up to the more exposed areas. Hawthorn and hazel are well represented as shrubs, and some willow is present. Otherwise, a small population of sycamore and larch exist. The woodland is mainly W9a/b, but a small and important area of the rare W4b present. Rabbits are generally inhibiting regeneration. The whole site is to be treated as minimum intervention, with gradual control of sycamore and larch.

Little Doward SSSI

Little Doward, Herefordshire (grid ref: SO 5416), is an 83 ha Woodland Trust reserve and includes part of the Upper Wye Gorge SSSI. It includes areas of ash and beech woodland corresponding to NVC types W8a/e/f/g, W10a/e, W12a/c, W14, and W15. There are significant old growth beech stands within area that are to be restored to wood pasture. Within the SSSI, beech is dominant in association with pedunculate and sessile oak, ash, silver birch, small- and large-leaved lime. The shrub layer is mainly hazel, wych elm, field maple, hawthorn and many other species including rare whitebeams. Potentially 30 ha or more could be assigned to minimum intervention. The site management plan is under review, and the proposal is to return it to wood pasture with significant areas as minimum intervention.

Lodore-Troutdale Woods SSSI

Lodore-Troutdale Woods SSSI (grid ref: NY 265180) is a collection of woods covering over 300 ha in The Lake District, and is one of several sites owned by The National Trust and managed more-or-less as minimum intervention. Most are wood pasture, but some have been recently enclosed. Some small areas may need to be excluded from a minimum intervention approach. The bulk are oak-dominated, with some tracts of ash, birch and alder woodland. These woods include outstanding examples of the range of woodland communities found in Borrowdale. There are many extensive areas of oak-birch W11 and W17 woodland, some significant stands of ash W9 woodland and W7/W4 flush communities, W7/W5/W4/W3 riverside woodland (Grange Carr-Kidham Dub-Colywife Dub), and a lakeside transitions to willow-alder swamp W5 woodland (Kettlewell Carr). Some parts have been effected by conifer and beech planting.

Lower Woods SSSI

Lower Woods SSSI (grid ref: ST 743876) covers 284 ha and are owned by Gloucestershire Wildlife Trust. This is an extensive ancient woodland on damp, slightly acid or slightly calcareous clay soils. The main NVC types are W10 and W8c communities, with pedunculate oak and ash common, hazel abundant, and wild service, sessile oak, alder, willow, field maple, holly, hawthorn, midland hawthorn, silver birch, dogwood, spindle, privet and guelder rose present. The current site management plan does not consider the idea of a substantial block of

minimum-intervention woodland, but the site manager thought that perhaps 20 ha compartment blocks in Burnt Wood could be assigned to this.

Malham Tarn NNR

Malham Tarn (SD 890672) is an upland site on the Pennines in north-west Yorkshire, owned by The National Trust as an NNR. At one end of the tarn there are a few hectares of W3-willow and W4-birch woodland growing on peat in amongst mire communities. The interior of these stands are left unmanaged, but the marginal willow is periodically cut back.

Millook Valley SSSI

Millook Valley, Cornwall (grid ref: SX 179980), covers 50ha+, is a Woodland Trust reserve, and is part SSSI and part pSSSI. It is an upland western valley oakwood, with NVC communities W8, W9, W10 and W11, and is particularly noted for its epiphytes which are regionally important. The site management plan is under review. There is an intention to reintroduce controlled livestock grazing in some areas, undertake light thinning and limited sycamore control in others, but otherwise the majority of wood is likely to continue to be minimum intervention having not been managed for over 50 years.

Monks Wood NNR

Monks Wood (grid ref: TL 2080) covers 157 ha and is considered to be the best of the few remaining examples of eastern, ancient semi-natural, ash-oak-maple woodland growing on heavy calcareous clay loams and gleys. Most conforms to W8 woodland, with ash as the main canopy dominant, along with widespread field maple and some pedunculate oak. Minor trees include birches, wild service, a stand of smooth-leaved elm, aspen and sallows. In many places there is an understorey of mostly hazel, midland and common hawthorn and their hybrids. Other understorey species include blackthorn, crab apple, dogwood, privet, elder, spindle and guelder rose. It has about 130 ha of mature woodland that has been under minimum intervention for 80-85 years. Four permanent transects were established in the 1980s and recorded in the 1990s, and other plots have been recorded.

Morses Grove

Morses Grove, Gloucestershire (grid ref: SO 68517), is a 10 ha Woodland Trust reserve. It was formerly coppice-with-standards, and following a period of growth towards high forest, was thinned by the previous owner in the last 10 years to leave a diverse mix of semi-mature and uneven aged timber comprising mainly oak and ash, with some other trees present including small-leaved lime. Silver birch has regenerated extensively and the wood is very overgrown with bramble which makes access difficult. Bluebell is abundant throughout. The main NVC type is W8. The management plan is currently under review and the whole site could be set aside as minimum intervention.

Naddle Forest SSSI

Naddle Forest SSSI (grid ref: NY 495145) covers 506 ha and part of this is an RSPB Reserve adjacent to Haweswater in the Lake District, Cumbria. The reserve woodland covers perhaps 100ha and several blocks of woodland/wood pasture are dedicated to minimum intervention.

This is an upland sessile oakwood growing on steep slopes with ash-stripes on flushed ground and alder-birch stands on wet ground. The slopes of Naddle Forest grade from W17 sessile oak-downy birch-rowan woodland on the upper slopes to W11 sessile oak-downy birch-rowan-hazel woodland on the lower. Running down through these are strips of W9 ash-hazel-sycamore-hawthorn-holly-bird cherry woodland growing on flushed soils. Sycamore has been removed from Naddle Forest but more removal is due. Below the Haweswater dam are small stands of W4c downy birch-alder-goat willow and W7b alder-downy birch-ash woodland. The Mirkside Woods have similar W17 and W11 woodland, but also include a larger area of W7b alder woodland and extensive W9 ash-stripes. Collectively these two woodlands probably hold the largest extent of ash-stripe woodland in the Lake District. Most of Naddle Forest and Mirkside are now enclosed against livestock and most of these are effective against deer too, although a few parts are experimentally sheep-grazed during Nov-Dec. Some open areas in enclosures have been planted. Thus the site provides contrasting areas of woodland and wood-pasture.

Nagshead SSSI

Nagshead (grid ref: SO 6008) is an RSPB reserve in the Forest of Dean, Gloucestershire, and is an SSSI. There are 308 ha of mixed woodland of which 23 ha of acid oakwood (W10/16) is minimum intervention (management plan is under review in 2000/1). This area was planted in 1814 with pedunculate oak, was heavily grazed by sheep until the late 1940s, and last thinned in 1974. It is now more-or-less closed mature high forest dominated by oak with some birch, wild cherry, Scots pine, larch, sweet chestnut and sycamore. An understorey of mainly holly with some rowan has developed strongly since enclosure. The main ground flora species are bracken, bluebell and bramble. Management is limited to control of understorey chestnut, sycamore and holly to favour any oak regeneration.

Naphill Common SSSI

Naphill Common SSSI (grid ref: SU 8497) is a Chiltern beechwood, in Buckinghamshire, which is a registered common land with common rights to firewood and grazing. It covers 71 ha, is owned by West Wickham Estate, and presently has no commoners exercising rights. The management is currently under discussion, and it may be managed by low-intensity thinning with one c.20 ha minimum intervention block. There is also interest in reintroducing low-level livestock grazing. The woodland is on a plateau above the Chilterns scarp and has acid clay soils over the chalk bedrock. The stands have a near-natural structure, containing many large ancient oak and beech pollards surrounded by century-old growth that developed following the cessation of grazing. In places oak is dominant, whilst elsewhere birch and wild cherry are locally abundant with frequent rowan and occasional whitebeam, crab apple and ash. The understorey contains much holly and some hawthorn, hazel, yew, field maple, blackthorn.

New Forest

The New Forest contains about 3500 ha of semi-natural Ancient and Ornamental Woodland, most of which is oak and/or beech wood pasture. All of this woodland is minimum intervention, but there are extensive proposals to pollard holly, Turkey oak is to be controlled in many places, patches of exotics like sycamore, sweet chestnut, and red oak are to be removed, and some of the Ancient & Ornamental regeneration plots are to be thinned and new ones constructed. Discussions with Jonathan Spencer (Ecologist for New Forest) and a review

of the Atlas of Ancient & Ornamental Woodlands shows the following to be of particular interest for this project:

New Forest: Anses Wood

Anses Wood (grid ref: SU 2212) is mainly old-growth beech with abundant pedunculate and sessile oak over holly on clay soils, and has several internal grassy lawns on flushes surrounded by willow and birch. To the north there is a corridor of ash rich woodland on alluvial soils. A large regeneration plot, now with dense beech and birch, has poplar clones planted in which are due for removal. The holly understorey is also due for pollarding. A permanent transect was established in the 1980s by H. Koop and remains part of Dutch Forest Reserves Programme.

New Forest: Avon Water Woodlands, Highland Water-S. Ocknell Wood, and Queens Bower

Avon Water Woodlands (South-East) (grid ref: SZ 2499), Highland Water-S. Ocknell Wood (grid ref: SU 2410), and Queens Bower (excluding North end) (grid ref: SU 2804) all contain areas of riparian ash woodland along water courses, and were proposed for selection as a near-natural woodland in the 1999 Ancient & Ornamental plan.

New Forest: Beaulieu River woodland

This woodland (grid ref: SU 3805) is proposed for selection as near-natural woodland in the 1999 Ancient & Ornamental management plan. It includes one of the best example of residual alluvial forest in Britain. There is a core area along the Beaulieu River flood plain that is regularly flooded and has well-developed ash riverine woodland. On drier ground ancient oaks, beeches and alders occur within younger stands of beech, oak and holly on drier soils and oak, ash, hazel and alder on moister soils. Alder carrs occur on permanently wet mineral soils, and a single hornbeam is present. Two regeneration plots were felled and planted with beech and had some Scots pine birch and oak natural regeneration. The plan is to create gaps in these and pollard some young poles of edges of new glades. Some Scots pine along the margins and rhododendron patches are to be cut out. A permanent transect was established in the 1980s by H. Koop and remains part of Dutch Forest Reserves Programme.

New Forest: Bignell Wood

Bignell Wood (grid ref: SU 2813) is a large complex of ancient pasture woodland, parkland and grazed high forest on the northern edge of the New Forest. Clay soils predominate with pockets of gravel and sands giving rise to podsoils. Beech and pedunculate oak are dominant along with some dense holly. There are two small streams with some associated carr, ash and maple, and a few patches that have been disrupted by storms. Scattered Turkey oaks and some clumps of rhododendron are to be cut out. The whole wood is down for holly pollarding, and some young edge trees are to be pollarded.

New Forest: Bramshaw Wood

Along with Great Wood, this site is proposed for selection as near-natural woodland in the 1999 Ancient & Ornamental management plan. Bramshaw (grid ref: SU 2411) is one of the most extensive and impressive areas of high forest woodland in western Europe and one of the

richest for lichens. There is an extensive stand of tall sessile oak growing on brown earths and ground water gleys. There are three regeneration plots that were planted with beech or beech and oak, but only minimal thinning is proposed in one. Extensive holly pollarding is proposed and small patches of rhododendron and are to be cut out.

New Forest: Bratley Wood

Bratley Wood (grid ref: 2208) is a large ancient pasture with infertile sandy soils. It is dominated by large beech and oak, but many parts severely disrupted by drought and storms. Small amounts of Scots pine, Turkey oak and sweet chestnut are to be removed, some younger trees and limited amounts of holly are down for pollarding. A permanent transect was established in the 1980s by H. Koop and remains part of Dutch Forest Reserves Programme.

New Forest: Brinken Wood (east)

Brinken Wood (grid ref: SU 2705) was proposed for selection as near-natural woodland in the 1999 Ancient & Ornamental management plan. In the east part there is 22 ha of floodplain ash woodland with oak, beech and holly growing amongst frequent ash, field maple, hawthorn and, in the wettest parts, alder and willow. Most of the area is scheduled for holly pollarding.

New Forest: Denny Inclosure

Denny Inclosure (east half and Littleholm Hill Enclosure) (grid ref: SU 3206) is a proposed for minimum-intervention area. It is mainly mature beech-oak-holly woodland growing on acid clays. Although it was enclosed in 1870, it has largely the appearance of wood pasture because high browsing levels returned from about 1970. It has been studied since the mid-1950s: a permanent transect was by Southampton University and most recently has been recorded by Ed Mountford and George Peterken.

New Forest: Frame-Tantany Woods

Frame-Tantany (grid ref: SU 3603) and its associated Ancient & Ornamental wood-pastures form one of the most extensive tracts and complex areas in the New Forest. The site covers a plateau of clay with small amounts of gravel. The woodland varies from open parkland oak and birch, to dense oak and beech stands with holly understorey. There are distinct areas of grazed high forest sessile oak, hazel is locally frequent in Stubbs Wood and ash occurs in flushed areas, a strip of streamside alder/willow occurs to the north, and oak, ash, hazel, field maple, wild service and hawthorn occur along a stream gutter. A few patches have been disrupted by drought/storms, and seven large regeneration plots were established. There are plans to cut out small areas of rhododendron and exotic trees, create some young pollards along glade edges and track sides, and holly pollarding is planned for a large central part.

New Forest: Great Wood

Along with Bramshaw Wood, this site is proposed for selection as near-natural woodland in the 1999 Ancient & Ornamental management plan. Great Wood (grid ref: SU 2515) lies in a sheltered valley and has sessile oak, beech and holly stands, often with dense holly. Willow carrs marked flushed ground, while alder and some ash the streams. A single stool of small-

leaved lime here is the only known in the New Forest. Extensive holly pollarding is proposed and small patches of rhododendron and laurel are to be cut out.

New Forest: Gritnam Wood, Great Huntley Bank & Brinken Wood (west)

This extensive area of wood pasture lies at the heart of the New Forest near Lyndhurst (grid ref: SU 2705). It includes more deeply-incised sections of the Highland Water and sloping areas above this in Great Huntley Bank and Brinken Wood (west), and Gritnam Wood on a higher ridge of clay. Here, beech, oak and holly woodland prevails with frequent hawthorn and crab apple, together with marginal stands of oak and birch where the wood has encroached onto heathland. Three regeneration plots were planted with beech and now also include much self-sown birch. There are plans to cut out small areas of rhododendron and a few marginal blocks with exotic trees, create some young pollards along stream edges, woodland fringes, and, in Gritnam and Brinken, in the old regeneration plots. Most of Gritnam and two large blocks of Great Huntley Bank are scheduled for holly pollarding.

New Forest: Lin, Red Shoot & Pinnick Woods

This large Ancient & Ornamental wood pasture (grid ref: SU 1908) has free-draining sandy or gravelly soils over clay in Lin Wood, mainly heavy clay soils in Red Shoot Wood, and a clay slope through Pinnick Wood. These are largely dominated by sessile oak over holly, with beech very rare, some pedunculate oak, hawthorn, crab apple, ash, field maple, yew, and hazel, and a few hornbeam present. Some edges have sweet chestnut/sycamore, and these are to be cut out. 15 ha of Red Shoot Wood is a priority areas of holly management and parts of Lin Wood are identified for holly pollarding. Two large parts of Pinnick are old regeneration plots: all planted beech and exotics in these are to be cut out. A permanent transect was established in the 1980s by H. Koop and remains part of Dutch Forest Reserves Programme.

New Forest: Mallard Wood

This is a large Ancient & Ornamental old-growth oak-beech (and ash) wood pasture on level ground along narrow flood plain of Beaulieu River (grid ref: SU 3209), with mainly clay soils with some sandy soils on higher ground and alluvium on flood plain. It is dominated by beech and pedunculate oak with patchy holly scrub, but the flood plain has open stands of oak with some alder, beech and ash, patches of blackthorn, and three young wych elm, perhaps the only elms in the Open Forest. 21 ha are down for extensive and 6 ha for smaller-scale holly management.

New Forest: Mark Ash Wood

This wood (grid ref: SU 2407) comprises extensive stands of well-structured beech-oak-holly high forest, with oak and beech of huge sizes well represented. The centre and south parts have large areas where old beech stands have broken up following the 1976 drought and later storms. There are two important bog woodland valley mires with alder/sallow carrs. Old trees were cut and new beeches planted during the 1960s in one old regeneration plot and across the wood, and some patches with Scots pine and sweet chestnut exist. There are plans to cut out small areas of rhododendron and exotic trees, cut limited numbers of new pollards across the wood, undertake extensive holly pollarding, and perhaps protect, plant and encourage

natural tree regeneration. A permanent transect was established in the 1980s by H. Koop and remains part of Dutch Forest Reserves Programme.

New Forest: Ridley Wood

This wood (grid ref: SU 2005) occupies a clay ridge and was formerly managed as coppice. Now it is mainly pedunculate oak, beech, holly and some birch with several disrupted parts and a large Ancient & Ornamental regeneration plot now dominated by beech and birch with a few oak and crab apple. There are plans to cut pollards some of the beech in the old regeneration plot and holly is being pollarded. Studies of woodland regeneration and the long-term development have been undertaken, and a permanent transect (20 x 180 m) was established in 1999/2000 by Sean Cooch (Forestry Commission).

New Forest: Rushpole Wood

Rushpole Wood (grid ref: SU 3109) occupies an area of low hills and shallow valleys. It is predominately old beech with little oak, except in former heaths where young oak is frequent. Holly is common and quite dense in places, and some hazel occurs. Otherwise, there are small stands of alder and sallow in mires, and some stands of alder along streams. In 1969 extensive felling of old beeches caused massive controversy. Two regeneration plots were planted with beech, oak, Scots pine and chestnut. A permanent transect was established in the 1980s by H. Koop and remains part of Dutch Forest Reserves Programme. There are plans to cut out small areas of rhododendron, cut out scattered and blocks of exotic trees, create some young pollards in the regeneration plots and along edges, and to pollard holly in many parts.

New Forest: Shave Wood, Hazel Hill, Brockishill Wood and French's Bushes

These extensive wood pastures and heathy glades and lawns lie in an area of shallow valleys and hills north of Lyndhurst (grid ref: SU 2911). The woods are of extensive beech and pedunculate oak with a dense holly understorey in many areas. Sallow is present in flushes, but most soils are acidic and free-draining such that bilberry is characteristic of the woodlands. There is widespread regeneration of oak and beech on the fringes of established stands, and drought and storms have disrupted various parts of the woodland. In Shave wood there are two large regeneration plots, but only limited pollarding of planted beech is anticipated. Much of French's Bushes and large parts of Shave Hill are due for holly pollarding.

Noar Hill SSSI

Noar Hill (grid ref: SU 744317) is a privately-owned beechwood SSSI situated on the Wealden edge chalk escarpment in Hampshire. The beech hanger woodland (evidently W14/12) has been allowed to develop with minimal interference and has broken up in recent decades and is undergoing regeneration by ash. 7 ha are set-aside as non-intervention under a management agreement between English Nature and the owner. Two permanent transects and ground flora and regeneration plots were established in the late 1980s-early 1990s.

NW Midlands Mosses and Meres

The Meres and Mosses of the NW Midlands are concentrated in Cheshire and north Shropshire. They form about 60 open water meres or pools and fewer peatland mosses. Wet

alder/willow carr occurs on the margins of some of the meres and across some of the mosses. The following sites have the best developed semi-natural wet woodland. Brownheath Moss (SJ 4630) covers about 5 ha and is unlike other meres because of the fen and carr rather than acid bog vegetation, with much of site dominated by alder/goat willow carr. Sweat Mere (SJ 4330) covers about 15 ha and is a small mere grading from open water, to alder/grey willow carr, and then to pedunculate oak/downy birch woodland on dry peat, with some hybrid poplars present. Shrawardine Pool (SJ 3916) covers about 18ha and is a shallow mere overgrown by swamp, fen and carr, with grey willow/alder W2 woodland inside a ring of alder W6d/(W5) woodland, and drier W10a woodland beyond with oak, sycamore, ash, Scots pine and larch. Hencote Pool (SJ 4916) covers about 12 ha and is a peat-filled basin with bog, fen and carr woodland, the latter being swamp carr on very wet peat dominated by alder and grey willow with frequent crack willow and rich fen ground flora, grading to drier woodland dominated by pedunculate oak and ash. Oss Mere (SJ 5643) is a shallow mere surrounded on two sides by reedswamp and alder carr, and with an area of woodland on dry peat: the main area of woodland covers about 6 ha. Morton Pool (SJ 3024) is a small pool with fen and carr vegetation around it, dominated by alder and grey willow with some bird cherry and alder blackthorn, grading from W5b/(W2) around pool to W6 above. The total area of woodland is small at about 1.5 ha. Chartley Moss (SK 027283) is a 106 ha wooded basin mire, with an unwooded acid peat bog raft grading to stunted and then taller and denser Scots pine stands, downy birch/pedunculate oak woodland on drier peat areas, and a discrete fen woodland area of alder, ash and sallows where nutrient-rich spring water surfaces. Cole Mere (SJ 4333) is an open mere surrounded mostly by woodland, but only including a small c1 ha area of good quality alder carr with most of the woodland being secondary sycamore plantation. Bomere and Shomere Pools (SJ 5008) have a larger associated block of woodland but much is secondary birch on peat and on drier ground is mainly oak and wild cherry with some conifers and rhododendron. Brown Moss (SJ 5639) also has some associated woodland but this is mainly secondary birch-oak.

Pepper Wood

Pepper Wood (grid ref: SO 9475) is a 54 ha reserve in Worcestershire owned by the Woodland Trust. It is only a mile from the similar Chaddersely Wood NNR. The stands are dominated by oak and birch, though with an exceptional diversity of tree and shrub species including wild service and both large and small leaved lime. It is thought that the wood was traditionally managed as coppice-with-standards. However little management took place after the site was clear felled in 1948/49 until the Trust began to establish a coppice-with-standards system over a third of the site in 1985. In a 7.5 ha minimum intervention area there has been little or no management for approximately 50 years. There may be scope to increase this area up to at least 15 ha, encompassing an area scheduled for management as high forest.

Roche Abbey Woods SSSI

Roche Abbey Woods SSSI, South Yorkshire (grid ref: SK 5490), covers 53 ha and is underlain by Magnesian limestone. This is a private wood owned by Lord Scarborough, and is the largest of its type in south Yorkshire, with old-growth calcareous sessile-oak-ash-wych elm and sessile oak-ash-lime stands growing on valley slopes and rocky crags, and some valley bottom alder and willow carr. The site has been little managed, but is rather narrow and part-modified by conifers. There is no agreement to manage the site by minimum intervention.

Rodney Stoke NNR

Rodney Stoke (grid ref: ST 490510) is a 38 ha NNR in the Mendip Hills, Somerset. It consists of woodland, scrub and grassland. The two wooded areas amount to 27 ha. Ash is dominant, pedunculate oak co-dominant, and some field maple, whitebeam, wych elm and small-leaved lime occur. The understorey is sparse but rich, with mainly hazel and some wild privet, spindle, dogwood, hawthorn, way-fairing tree, guelder rose, buckthorn and crab apple. Three stand types are present, (2C, 3B, 4B) and the woodland is type W8a-d. The objective for the site is to maintain it as an example of largely unmanaged dry Mendip ashwood. Two high forest blocks covering 7.4 ha and about 17 ha are mostly dedicated to minimum intervention. 105 200 m² plots on a 50 m grid were established in 1978 by J.M. Sykes of the Institute of Terrestrial Ecology.

Roudsea Wood & Mosses NNR

Roudsea Wood & Mosses NNR (grid ref: SD 3383) is located in the south of Cumbria adjacent to the Morecombe Bay Estuary. It is a large site with a range of habitats and includes woodland growing on contrasting soils derived from calcareous limestone and acid slates. Minimum intervention is applied to at least 25 ha of the oak-dominated woodland. This is mainly W11a/b woodland, with sessile oak dominant and varying amounts of hazel, holly and downy birch, and mainly wavy hair-grass, bracken, bilberry, honeysuckle and wood sorrel in the ground vegetation. Several wet peaty-filled hollows occur within the oak woodland, and are mainly W5c woodland dominated by alder with birch, alder buckthorn, and blackthorn. 80 200 m² plots on a 100m grid were established in 1978 by J.M.Sykes of the Institute of Terrestrial Ecology.

Scoska Wood NNR

Scoska Wood NNR (grid ref: SD 915725) is only 10 ha and only about half is ashwood, although there is some adjacent woodland within the whole of the SSSI. The stands are mainly ash with an understorey of hazel and hawthorn. Sycamore, downy birch and bird cherry also occur, but wych elm and old trees are lacking, suggesting the site is largely recent in origin. The woodland classifies as W9 and contains the largest example of W9b sub-community. Rabbits are seriously compromising regeneration of the wood. The woodland area could be managed as minimum intervention, but regeneration needs active encouragement.

Seatoller Wood SSSI

Seatoller Wood SSSI (grid ref: NY 235128) adjoins Johnny Wood in The Lake District, and is one of several sites owned by The National Trust and managed more-or-less as minimum intervention. It covers about 80 ha, occupies steep slopes, some of which are inaccessible, and has suffered greatly from heavy grazing and remains as a wood pasture. Much of the northern end is W17/11 oak-dominated with some birch over sparse hazel, holly and rowan. This is broken by many W9 and W7 streamside and flush strips/patches, where hazel is prominent along with ash and occasional bird cherry, and the south part is more complex with more small valleys, streams and boulder fields, and includes an extensive area of W9a/b with ash and hazel and some sycamore. The slopes at the south end of the site are similar but also have frequent ash pollards. The central section is steep, difficult to traverse, and contains much flushed ground. Hazel, ash, oak, rowan, holly, hawthorn, wych elm and some bird cherry thickets

occur, including some old elm, ash and oaks, and frequent ash pollards along the hillside base. Dead wood is frequent and the ground vegetation ranges from W11b to W9a to a herb and grass rich form of W9b. The stream sides have affinities to W7b.

Side Wood SSSI

Side Wood SSSI, part of Pillar and Ennerdale Fells SSSI in The Lake District (grid ref: NY 135123), is one of several sites owned by The National Trust and managed more-or-less as minimum intervention. It is about 40 ha, is treated as wood-pasture, provides one of the best examples of upland birch-oak woodland in West Cumbria, and has an altitudinal succession from lake margin woodland to heath and montane communities. It is mostly oak-dominated W17 and W11 woodland. The majority of the oak is pedunculate and these form frequent large oak standards. The open grown oak and infilled by younger downy birch, there are ash standards through the wood which increase along flush-lines, and occasional old large rowans. The canopy is variable and some gaps are present. There is little understorey, with occasional bird cherry, hawthorn, holly and, along-flush-lines, some hazel. Many of the oak standards have been recorded and tagged, and a series of 0.25 ha enclosure plots were established in the early 1990s along a transect line upslope from the wood to the summit heath to assess the effects of grazing on various parts of the hill.

Sims Wood NNR

Sims Wood (grid ref: SU 398017) is part of the North Solent NNR, near the New Forest, and has transitional W10-W6 woodland to salt-marsh that are perhaps the most extensive in England. It is owned by Beaulieu Estate and managed as an NNR by English Nature.

Stonethwaite Woods SSSI

Stonethwaite Woods SSSI (grid ref: NY 2613) is in The Lake District and one of several sites owned by The National Trust and managed more-or-less as minimum intervention. It covers about 102 ha of steep craggy ground either side of Stonethwaite Beck and is treated as wood-pasture apart from one recent enclosure. Some small areas may have to be excluded from a minimum intervention approach. On the east side of the valley, W17 covers nearly all the area. Sessile oak is dominant in association occasional holly and rowan, whilst hazel is abundant in areas of W11, ash is occasional (including some pollards) with a few sycamores at the base of the slope, and a few bird cherry and yew occur in the northwest corner. At the top, there is a sharp transition to bracken and heath with an odd oak, birch, rowan and juniper. Young trees are frequent in upper areas, but browsing is heavy. On the west side of the valley the woodland is on precipitous slopes with more topographical variation and is interspersed with bracken, grass, flushed glades and block scree. The core woodland is W17, dominated by oak with a sparse understorey of hazel, rowan and holly. Stream beds are sharply delineated by ash, hazel, rowan, wych elm, oak and birch woodland. On one face there is an area of W9b/W7b woodland with a herb rich ground flora. Throughout there are some poorly defined stands of W11b where hazel is abundant and some ash and bird cherry. On higher ground the canopy becomes more mixed with less oak, and birch, rowan, hazel and bird cherry better represented. Wych is frequent on stream stands and yew is frequent on Bull Crag and aspen on Alisongrass Crag. The canopy thins high up, glades are more frequent and communities of W9, W11 and W17 increase. On crags there is stunted inaccessible woodland. At the north end there is a little larch on the upper slopes and sycamore lower down. Overall, dead wood is

frequent, grazing is quite high, crag woodland is well-represented, but W9 and W7 are poorly-represented.

Strans and Rais Wood

Strans and Rais Wood (grid ref: SD 9178) are owned by The National Trust, and are already managed more-or-less as minimum intervention. Both are ash-dominated wood pastures grazed by sheep, and cover about 25ha and occupy steep-sloping ground above the head of Upper Wharfedale in The Yorkshire Dales National Park. They have a high diversity of native trees and shrubs, some mature wych elms, and some rare dead wood invertebrates. Strans includes some high quality limestone pavement and areas of rich ground vegetation on thin calcareous soils. It is grazed lightly by sheep, whereas Rais is threatened by a lack of tree regeneration due to overgrazing, and much of the wood comprises only occasional small groups and individual trees. The intention is to reduce grazing to facilitate natural regeneration of trees. Pollution has damaged the epiphytic lichen flora in both woods.

Swanton Novers NNR

Swanton Novers NNR (grid ref: TG 015313) in north Norfolk comprises four woodland blocks covering 82 ha. The woods have notable stands of bird cherry-alder, maple-ash-lime, acid pedunculate oak, and acid sessile oak-lime, and a small stand of hornbeam. Six adjacent compartments in Swanton Novers Great Wood totalling 35.5 ha are assigned to minimum intervention: these are mainly oak-dominated stands but some wet alder-bird cherry stands also occur.

The Mens

The Mens (grid ref: TQ 025231) is a 155 ha reserve owned by Sussex Wildlife Trust. It is mostly a high forest dominated by either beech and/or oak (mainly pedunculate), with mainly holly, hazel, and hawthorn in the understorey. Wealden Clays or Lower Greensand underlie most of the site, and give rise to either clay-loam or sandy loam soils over clay. The woodland classifies mostly as W14, and where beech is absent, as W10. The whole site is assigned to minimum intervention. A grid of permanent plots were established in 1988 and re-recorded in 1992 (part), 1994 (part) & 1998 (part), and a set of canopy gap studies were recorded in 1988 and re-recorded in 1998.

Thornton and Twisleton Glens SSSI

Thornton and Twisleton Glens (grid ref: SD 695745 and SD 705745) is a 60 ha site in the Yorkshire Dales. It is a private SSSI owned by several parties. The site is divided into two distinct gorges with contrasting ash and oak woodland. The limestone ashwood covers about 40 ha; is principally ash with an understorey of hazel; wych elm is frequent by the river; yew on cliffs; and about 30 ha owned by the Woodland Trust and the Ingleton Scenery Company could become a minimum intervention reserve. The oakwood covers about 20 ha; is principally pedunculate oak with silver birch; and about 10 ha owned by the Woodland Trust, the Ingleton Scenery Company, and a local quarry company could become a minimum intervention reserve.

Tudeley Wood

Tudeley Wood is a 280 ha RSPB reserve (grid ref: TQ 6244), leased on a short period from the Teachers family. There are about 30 ha of minimum intervention W10 oak-bramble-hazel stands with some W8 on valley sides/along streams. It is not an SSSI and discussion would be needed to make it a candidate minimum intervention reserve.

Wyre Forest NNR

Wyre Forest NNR is a large oak-dominated woodland in the West Midlands (grid ref: SO 7676). Two blocks of W10/16 mature oak high forest derived from coppice, covering c50-60 ha, are currently proposed for minimum intervention following 5 years work to 'naturalise' the stands: this will involve small-scale felling, winching over of tress, ring-barking of trees, and control of non-native sycamore and most conifers.

Wytham Woods SSSI

Wytham Woods (grid ref: SP 4608) is owned by Oxford University and contains about 250 ha of minimum intervention woodland. This can be divided into three broad categories of roughly equal area: ancient, secondary and plantation. The ancient woodland has a long history of management as coppice, but was largely abandoned in the early twentieth century. The secondary woodland has grown up naturally in the last 200 years or so, after the abandonment of wood pasture, pasture or cultivation. Here the most prominent trees are ash and sycamore. The derelict oak-hazel coppice-with-standards is mainly W8a, and the secondary ash or sycamore dominated stands W8e. Neither of these woodland types is actively managed today. The oldest plantations are beeches of approximately 200 years old, which are now interesting habitats for invertebrates, but most plantations are 40-50 years old. A grid of permanent plots were established in c1974 and recorded in 1991/2, permanent Environmental Change Network plots have been recorded since 1992, and the site has been used for long-term bird monitoring by Oxford University.

Yarner Wood NNR

Yarner Wood NNR, Dartmoor (grid ref: SX 785788), covers about 150 ha and is mainly W17b upland oakwood. There are four blocks of minimum intervention totalling 11 ha, the largest amounting to 5.1 ha and 3.65 ha. Compared to the nearby Bovey Woodlands, the minimum intervention blocks are small.

Appendix 4: Model accounts of selected sites

1. Monks Wood

Woodland type: Lowland calcareous-mesotrophic ash woodland

Location: 10 km NE of Huntingdon, Cambridgeshire

National grid reference: TL 2080

Ownership: Owned by English Nature

Status: National Nature Reserve, Site of Special Scientific Interest, Nature Conservation

Review site

Size of Reserve: 157 ha

Size of Minimum Intervention Area: 34 ha (present), 92 ha (present including *de facto* area), 130 ha (potential)

Reasons for inclusion

In this series Monks Wood forms the most easterly example of ancient semi-natural calcareous ash woodland growing in the English Midland lowlands. It is considered to be the best of the few remaining examples of such ash-oak-maple woodland growing on heavy, calcareous, clay loams and gleys. Its present composition may be close to the original-natural. The site has one of the highest vascular plant counts in the English lowlands, includes many rare and localised species, and has an exceptionally rich invertebrate fauna. There is a substantial area of mature woodland that has been under minimum intervention for 80-85 years, a substantial inventory, some well-established long-term monitoring projects and numerous scientific papers and reports on its development, and long-term management by minimum intervention can be well assured.

Description of woodland

Most of the woodland conforms to NVC W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* community. Ash is the main canopy dominant, along with widespread field maple and some pedunculate oak. Minor trees include birch, wild service, aspen, willow and a stand of smooth-leaved elm. In many places there is an understorey of mostly hazel and midland and common hawthorn and their hybrids, with some blackthorn, crab apple, dogwood, privet, elder, spindle and guelder rose.

Up to 130 ha could be included as minimum intervention stands. This would include all of the areas that have been left to natural development since virtual clear-felling in 1915-20. At present only 34 ha of this are dedicated to minimum intervention, though another 58 ha are *de facto* minimum intervention.

Management of minimum intervention area

The main immediate threat to the minimum intervention area is from muntjac deer. Since the mid-1980s these have become numerous and caused serious damage to the ground flora, shrub growth, and tree regeneration (Cooke 1994, 1998; Cooke *et al* 1998; Crampton *et al* 1998; Mountford & Peterken 1998). Otherwise, there is no immediate threat from non-native trees (although sycamore has colonised since 1973 (Wells 1994)), and the stands are developing naturally towards old-growth status, with some accumulations of dead wood and canopy gaps

having developed (Mountford & Peterken 1998). The elm stands have been reduced by Dutch elm disease, which spread naturally through Britain after being introduced. However, there is some elm regeneration from sprout growth and the stands appear capable of sustaining themselves despite on-going infection. Some ride-side management along the edges of minimum intervention compartments is anticipated, including coppicing of blackthorn blocks to conserve butterfly populations.

Inventory, research and monitoring

Baseline information includes maps of the distribution of trees, shrubs, ground vegetation, soils and topography, and inventories of most plant and animal components (Steele & Welch 1973). Studies that provide a possible basis for a long-term monitoring, include those on butterflies, vascular plants, macro-moths, muntjac deer (Massey & Welch 1994), and stand dynamics (Peterken & Backmeroff 1988; Peterken 1994; Welch 1994; Crampton *et al* 1998; Mountford & Peterken 1998).

Proposed research and monitoring (see Table 4)

The existing vegetation maps should be developed into a compartmentalised site map. This should show the distribution of the main vegetation types (NVC communities and Peterken stand types), soil types, and structural areas (based on a quantitative assessment of stand structure). It may be useful to map the distribution of particular trees, eg elm, wild service, hornbeam, and base the work on the existing maps provided by Steele and Welch (1973). This map could then form the basis for long-term monitoring.

The vegetation plots recorded by Crampton *et al* (1998) should be developed into a complete system of small plots where tree/shrub, ground vegetation, and dead wood components are monitored. The plots should be spaced out on a grid or other relocatable system and include samples of all of the main woodland types and additional distinct or important types (eg the elm stand), as revealed by a quantitative assessment of the stands.

The four permanent tree and shrub transects recorded by Mountford & Peterken (1998) should be continued, and the need for further transects assessed based on the quantitative assessment of the stands. The 35 x 70 m tree and shrub plot initiated by Steele in 1964 and recorded by Welch (1994a) and Crampton *et al* (1998) could be developed into a large permanent plot supplementary to the transects.

The Rothampstead moth trap recording by the Institute of Terrestrial Ecology (Welch 1994b) and fixed-point ground photographs should be continued, a diary of major events, annual deer numbers, and climate records (made by the Institute of Terrestrial Ecology) should be kept, and provision made to maintain all records in an archive.

There is scope to extend monitoring to include soils, adjacent land-use, structure/open space, ground vegetation within the permanent transects, epiphytic mosses and lichens on tree trunks, location and condition of veteran trees, and common bird counts. The existing Butterfly Monitoring Scheme (Pollard & Yates 1994) runs only along rides in the wood: this could be extended to include routes through minimum intervention stands. Research into the past-composition of the wood might be possible if suitable wet hollow sites are present where pollen, charcoal, and plant fossils have been preserved.

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2. Langley Wood

Woodland type: Lowland acidic-mesotrophic oak woodland

Location: Between the villages of Redlynch and Hamptworth, south-east Wiltshire

National grid reference: SU 2220

Status: National Nature Reserve, Site of Special Scientific Interest

Ownership: Leased to English Nature from family trust

Size of Reserve: 218 ha

Size of Minimum Intervention Area: 65 ha (present), 146 ha (future)

Reasons for inclusion

In this series Langley Wood forms an extensive example of ancient semi-natural acidic-mesotrophic oak woodland in lowland southern England. It is considered to be one of the best remaining examples of such oak-birch-hazel-lime woodland growing on slowly permeable, slightly acid, fine loamy and silty soils. It is a large wood, with about 180 ha of continuous semi-natural broadleaved high forest, and contains features of primitive forest that are rarely found together elsewhere. Amongst the various stand types is oak-lime woodland, the original condition of much natural woodland in the English lowlands. The vascular flora is richer than any other wood in southern England, and bryophyte, epiphyte, invertebrate and bird flora/fauna are likewise exceptionally rich. Bordering the New Forest, it is effectively an ungrazed version of the Forest woodlands. It has a large area dominated by mature standard oaks and coppice regrowth that has been under minimum intervention for 60-80 years. There are some good basic records of the wood, a few established long-term monitoring transects, and long-term management by minimum intervention is well-assured.

Description of woodland

The woodland mostly conforms to NVC W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* community. There are about 32 ha of conifer plantations, stands undergrown by rhododendron, and stands with non-native sycamore and sweet chestnut. The semi-natural stands have largely been untreated since they were coppiced last during 1920-40. Pedunculate oak and birch are the usual canopy trees and these grow over an understorey of mainly hazel and hawthorn. In places sessile oak is present, and ash, small-leaved lime, sweet chestnut and sycamore are locally abundant. Alder predominates along the wetter valley bottoms. Minor tree species include aspen, beech, field maple, willow, hornbeam, wild cherry, and yew, whilst minor understorey species include alder buckthorn, blackthorn, crab apple, dogwood, guelder rose, and holly.

The present minimum intervention area is 65 ha, but in the long-term it is planned that 146 ha will be under minimum intervention. The 32 ha with conifers, rhododendron, sycamore and sweet chestnut are undergoing removal before being retained as coppice or left to minimum intervention.

Management of minimum intervention area

There are three immediate potential threats to the minimum intervention area. Groups and scattered individuals of non-native sycamore, sweet chestnut, and rhododendron are present at the margins of the minimum intervention area. A programme to convert non-native stands to

semi-natural woodland and cut out scattered individuals is well underway. Deer are present in significant numbers and include sika and muntjac. These are being controlled by the owner of the wood and have not greatly inhibited natural stand development. Grey squirrels are abundant and only controlled close to neighbouring plantations. Within the minimum intervention area they have badly damaged the majority of the larger pole beech and are inhibiting its recruitment into the canopy.

Although much of the wood is oak standards over coppice, there is little need to alter the structure as these are developing naturally towards old-growth status and some accumulations of dead wood and canopy gaps have developed (Mountford, Peterken & Burton 1998). Some management of rides that run through minimum intervention compartments is anticipated.

Inventory, research and monitoring

Baseline information includes descriptions of the woodland by compartments, maps of the distribution of Peterken stand types and woodland banks, and inventories of ground vegetation, epiphytes, fungi (limited), flies, moths, and birds.

Trees and shrubs were recorded in 1987 and 1996 along two permanent 20 m-wide transects (Mountford, Peterken & Burton 1998). In 1998, two 50 x 50 m deer exclosures were erected and recorded to help gauge the impact the deer population is having. A structural assessment of whole wood based on a series of small plots has just been completed. A further permanent transect is planned and this will include a section of alder riverine woodland.

Proposed research and monitoring (see Table 4)

The existing vegetation and compartment maps and stand structure assessment should be developed into a compartmentalised site map showing the distribution of vegetation types, soil types, and structural areas. It may be useful to map the distribution of beech, hornbeam, and perhaps sycamore and sweet chestnut. This map could then form the basis for long-term monitoring.

The system of small plots used to assess stand structure should be used to monitor changes in tree/shrub, ground vegetation, and dead wood components. The permanent transects recorded by Mountford, Peterken & Burton (1998) should be continued and further transects considered based on the recent assessment of stand structure.

There is scope to extend monitoring to include soils, adjacent land-use, structure/open space, ground vegetation within the permanent transects, epiphytes on tree trunks, location and condition of veteran trees, common bird counts, and butterfly transects. A series of fixed-point ground photographs could be established, and a diary of major events and annual deer numbers kept. Historical records could be collected to help explain the current condition. Research into the past-composition of the wood might be possible if suitable wet hollow sites are present where pollen, charcoal, and plant fossils have been preserved. Provision should be made to maintain all records in an archive.

Site reference

MOUNTFORD, E.P., PETERKEN, G.F. & BURTON, D. 1998. Long-term monitoring and management of Langley Wood: a minimum-intervention National Nature Reserve. Peterborough: *English Nature Research Reports*, No. 302.

3. Lady Park Wood

Woodland types: Borderland calcareous-mesotrophic beech woodland and borderland calcareous-mesotrophic ash woodland

Location: 4 km north-east of Monmouth, Gloucestershire/Gwent border

National grid reference: SO 5414

Status: National Nature Reserve, Site of Special Scientific Interest, Nature Conservation Review site

Ownership: Owned by Forestry Commission and leased by English Nature and Countryside Council for Wales under Nature Reserve Agreement for 99 years from 1984

Size of Reserve: 44 ha

Size of Minimum Intervention Area: 33 ha

Reasons for inclusion

In this series Lady Park Wood provides examples of ancient semi-natural calcareous-mesotrophic beech woodland and calcareous-mesotrophic ash woodland growing in the borderlands between England and Wales. The wood grows on moderate to steep slopes cut through Carboniferous limestone above the river Wye, and includes a range of soil types from calcareous rendzina to acid silty loam. It is considered to be one of the best remaining examples of beech-ash-lime-oak and ash-wych elm-lime woodland growing in region, and includes features of the original-natural woodland, with both small- and large-leaved lime present and beech growing on the edge of its 'native' range. There is a substantial area of mature woodland that has been under minimum intervention for about 100 years, and the stands form a complex mosaic and house one of the richest mixtures of native trees and shrubs in Britain. There are some good basic records for the wood, a well-established long-term monitoring programme based on a series permanent transects and ground vegetation plots, which also incorporate an adjacent managed compartment, and several scientific papers and unpublished reports on natural developments. Long-term management by minimum intervention is well assured.

Description of woodland

The woodland was traditionally managed as coppice-with-standards, but is now mainly minimum intervention (33 ha), save for a compartment (11 ha) to the south that is managed as high forest/coppice. The minimum intervention stands can be divided into old- and young-growth, which have been more-or-less untreated since last been coppiced about 100 and 55 years ago respectively.

The wood is divided by a central cliff-line where yew predominates in NVC W12c *Fagus sylvatica-Mercurialis perennis*, *Taxus baccata* sub-community woodland. Above this cliff-line the main trees in the high forest old-growth stands are beech, ash, small- and large-leaved lime, and sessile oak. In addition in the young-growth stands there is much birch and in the understorey hazel. Minor trees and shrubs include aspen, blackthorn, crab apple, dogwood, field maple, guelder rose, hawthorn, holly, privet, willow, spindle, wayfaring-tree, whitebeam, wild cherry, and wild service. These stands conform mostly to W14 *Fagus sylvatica-Rubus fruticosus* woodland on the lower slopes, but at the top of the wood, where the soils become calcareous, beech and lime fade and leave a strip of ash-dominated woodland conforming to W8e *Fraxinus excelsior-Acer campestre-Mercurialis perennis*, *Geranium robertianum* sub-

community woodland. Below the cliff-line the ground slopes steeply down towards the river Wye, and the soils are fertile, flushed and calcareous. The stands are a form of W8e woodland with wych elm, ash, lime, and hazel abundant, and have been greatly disturbed by Dutch elm disease.

Management of minimum intervention area

There are several potential threats to the minimum intervention area. Scattered individuals of non-native sycamore occur close to the river Wye and have infiltrated the stand margins nearby. These, and seed source trees growing outside the reserve on the riverbanks, have been cut out in the past, and further control is planned. Deer have increased greatly during the past decade and appear to use the reserve as a refuge. They are inhibiting tree regeneration and have heavily grazed the ground vegetation. Efforts to control numbers are being made by the Forestry Commission. Grey squirrels are abundant but are no longer controlled. They have severely debarked many young beech poles in the young-growth stands and managed compartment and are inhibiting development of beech into the canopy (Mountford 1997; Mountford & Peterken 1999). Dutch elm disease, although having spread naturally, was introduced to Britain and has devastated the elm population. However, there are a few surviving mature trees and regeneration of new elms is substantial (Peterken & Mountford 1998). Felling in the surrounding plantation woodland may have facilitated windblow within the reserve.

Inventory, research and monitoring

Baseline information includes maps of the distribution of Peterken stand types, NVC communities, and soil types, a complete enumeration of trees in various compartments, and inventories of vascular plants, bryophytes, lichens, birds and small mammals. Historical records have been collated.

Studies that provide a possible basis for a long-term monitoring include those on small mammals, ground vegetation, dead wood, and stand dynamics (Bartelink, van Dijk & Hiele 1987; Kirby 1992; Berry 1994; Mountford 1994, 1997; Mountford & Peterken 1999; Monument 1997; Peterken & Backmeroff 1988; Peterken & Jones 1987, 1989; Peterken & Mountford 1995, 1998, 1999).

In particular, there are nine permanent 20 m wide transects in the minimum intervention area, established in the 1940-50s and re-recorded many times since, where changes in trees and shrubs have been recorded. A tenth permanent transect was established 1985 in the managed compartment. A set of 72 randomly placed small permanent plots, established in 1979 and partly re-recorded in 1997, have trees and shrubs, ground vegetation and soil pH recorded. Six permanent plots, established in 1994, had small mammals, trees and shrubs, and ground vegetation recorded. A comprehensive fixed-point ground photograph record based on the permanent transects was initiated in 1979. Plans to monitor changes in bird populations were made based on surveys at fixed points along the permanent transects.

Proposed research and monitoring (see Table 4)

The existing vegetation maps should be developed into a compartmentalised site map. This would show the distribution of the NVC communities and Peterken stand types, soil types,

and structural areas (based on a quantitative assessment of stand structure). It may be useful to show the existing distribution of particular trees, eg beech, small- and large-leaved lime, wild service, sycamore. This map could then form the basis for long-term monitoring.

The system of small plots should be recorded to monitor changes in the tree and shrub, ground vegetation, and dead wood components. Similarly, recording of the permanent tree and shrub transects and the system of fixed-point ground photographs should be continued. Both of these provide a quantitative assessment of stand structure through the wood. Otherwise, the small mammal plot and bird monitoring programme could be usefully continued.

There is scope to extend monitoring to include soils, adjacent land-use, structure/open space, ground vegetation within the permanent transects, epiphytic mosses and lichens on tree trunks, and location and condition of veteran trees. A diary of major events and annual deer numbers should be kept. There appears to be no suitable wet hollow sites where pollen, charcoal, and plant fossils have been preserved. The record archive should be up-dated.

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4. The Mens

Woodland type: Lowland acidic-mesotrophic beech woodland

Location: 7 km west of Billingham, West Sussex

National grid reference: TQ 0323

Status: Sussex Wildlife Trust Nature Reserve, Site of Special Scientific Interest, Nature Conservation Review site

Ownership: Owned by Sussex Wildlife Trust

Size of Reserve: 155 ha

Size of Minimum Intervention Area: 155 ha

Reasons for inclusion

In this series The Mens provides an extensive example of ancient semi-natural acid-mesotrophic beech woodland growing in lowland southern England. It is considered to be one of the best remaining and most extensive examples of beech-oak-holly woodland growing mainly on slowly heavy clay soils on The Weald. The wood is within the 'native' range of beech, and is large and near-continuous, structurally complex, and dominated by old-growth stands where large trees and accumulations of dead wood are present. The fungal and lichen floras are very rich, the bryophyte flora and insect fauna are important, the breeding bird community is diverse, and woodland butterflies and moths are well represented. Small-leaved lime, the potential original-natural woodland dominant, remains present in small quantities. There are some good basic records of the wood, a large number of small permanent plots to base long-term monitoring on, and the commitment to management by minimum intervention is well-assured.

Description of woodland

The woodland was traditionally managed as a wood-pasture, but has been allowed to develop into high forest with little intervention having taken place during the 20th century. The stands were part-opened during the Great Storm of 1987, especially on the southern slopes. Most of the woodland is dominated beech and/or oak (mainly pedunculate), with mainly holly, hazel, and common and midland hawthorn in the understorey. Some silver and downy birch, ash, and sweet chestnut also make canopy trees. Other minor species include crab apple, elder, field maple, goat willow, small-leaved lime, wild service, and yew. The main NVC community is W14 *Fagus sylvatica-Rubus fruticosus* woodland, along with some areas of W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland.

Management of minimum intervention area

There are a few potential threats to the minimum intervention area. Deer appear to be increasing and may be inhibiting tree regeneration: numbers and their effects on vegetation need monitoring. Grey squirrels are abundant but not controlled. They have severely debarked many young beech poles released in canopy gaps and are inhibiting the development of young beech into the canopy. The wood has several houses adjacent to it, and the threat of exotic escapees needs to be monitored. Sweet chestnut is present in the south of the wood, where it is accepted as part of the present-natural composition.

Inventory, research and monitoring

Baseline information includes inventories of vascular plants, bryophytes, lichens, fungi, and animal groups (Tittensor and Tittensor 1977), and a published review of historical records (Tittensor 1978).

A set of 155 small circular plots placed at the intersections of a 100 x 100m grid throughout the wood provides a basis for long-term monitoring of ground vegetation, dead wood, and stand dynamics. These were established in 1974 (though this data is not available), fully re-recorded in 1988, and part re-recorded in 1992, 1994 and 1998 (Davey 1989, 1991; Whitbread *et al* 1993; Whitbread & Montgomery 1994; Cooke 1994; Mountford, 2000). In addition, a set of gap studies were established in part of the reserve in 1987 and re-recorded in 1998 (Whitbread 1988, 1991, 1994; Mountford, 2000). Changes in bird populations were monitored based on surveys at fixed points from 1988 to 1990 following the storm of 1987 (Fuller 1991; Fuller, Henderson & Marchant 1994).

Proposed research and monitoring (see Table 4)

A site map showing the main NVC communities, soil types, and structural areas (based on a quantitative assessment of stand structure) should be developed. It may be useful to show the existing distribution of particular trees, eg lime, wild service, sweet chestnut. This map could then form the basis for long-term monitoring.

The grid of small plots provides a suitable basis to monitor changes in the tree and shrub, ground vegetation, and dead wood components, and provides a quantitative assessment of stand structure through the wood. The canopy gap studies form a basis for some additional permanent transects/plots to monitor vegetation change in more detail. Monitoring of birds could be usefully re-continued.

There is scope to extend monitoring to include soils, adjacent land-use, structure/open space, epiphytes, veteran trees, and butterflies. A series of fixed-point ground photographs could be established, and a diary of major events and annual deer numbers kept. Further historical records might be available. Research into the past-composition of the wood might be possible if suitable wet hollow sites are present where pollen, charcoal, and plant fossils have been preserved. Provision should be made to maintain all records in an archive.

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5. Wistman's Wood

Woodland type: Upland acidic-mesotrophic oak wood pasture

Location: 4 km north of Princetown, Dartmoor, Devon

National grid reference: SX 612773

Status: National Nature Reserve, Site of Special Scientific Interest, Nature Conservation Review site

Ownership: Owned by the Duchy of Cornwall and managed by English Nature under a Nature Reserve Agreement

Size of Reserve: 3.5 ha

Size of Minimum Intervention Area: 3.5 ha

Reasons for inclusion

In this series Wistman's Wood provides an example of ancient semi-natural acidic-mesotrophic oak wood pasture growing on the uplands of Dartmoor, south-west England. It is a renowned stunted oakwood growing at high-altitude, a rare habitat type in Europe and south-west England, and lies within the post-glacial zone naturally dominated by oak (Simmons, 1964; Bennett, 1989). Along with Black Tor Copse it represents one of the two remaining high altitude oakwoods on Dartmoor and evidence shows it to be ancient. The lichen and bryophyte communities are rich and the trees span a wide-range of ages, including some that are probably over 300 years old. Wistman's has long developed with minimal interference and provides a useful comparison to most other upland oakwoods where coppice has been the traditional management. There are abundant descriptions and photographs resulting from the wood's early fame, and it contains the oldest known permanent plot from British woodland. Long-term management by minimum intervention is well-assured.

Description of woodland

Wistman's Wood is situated at 400m above sea-level in the valley of the West Dart river and forms a long, narrow, 3.5 ha wood in three main parts. These occupy sheltered, south-west facing slopes where a bank of large granite boulders (clitter) is exposed (Brunsdon, 1964; Greenslade, 1968). The wood has been managed as wood-pasture for centuries, though grazing by sheep and cattle has recently been reduced under an Environmentally Sensitive Area agreement. There is no active management, save for a small experimental enclosure.

The vegetation mostly conforms to NVC W17a *Quercus petraea-Betula pubescens-Dicranum majus* woodland, *Isothecium myosuroides-Diplophyllum albicans* sub-community. Pedunculate oak dominates the wood, with occasional rowan, holly, hawthorn, hazel, and willow. The oaks are generally stunted and grow with contorted branches characteristically covered in a variety of lichens and mosses. During the 20th century the older oaks have shown unmistakable signs of increased vigour, and a new generation of straight and mostly single-stemmed trees has developed and approximately doubled the area of the wood (Proctor *et al* 1980; Mountford 1999).

Management of minimum intervention area

The main threat is from over-grazing, but livestock levels have been reduced since 1995. Visitor pressure is substantial in the most accessible southern part of the wood, and clearly impacts on the vegetation growing on boulders.

Inventory, research and monitoring

Wistman's Wood have been the subject of much study. Baseline information includes NVC communities, Peterken stand types, vascular plants, bryophytes, lichens, invertebrates, and mammals (Proctor 1962; Archibald 1966; Courtney & Hardy 1967; Hawksworth 1972; Spalding 1988; Page 1995, 1999). A complete enumeration of trees was carried out in 1965 (Archibald 1966; Proctor *et al* 1980). The geology, topography, soils, and climate have been studied (Brunsdon 1964; Simons 1965; Greenslade 1968; Courtney & Staines 1971), and consideration has been on the origin of the wood (Simmons 1964; Archibald 1966). Hemming (1994) took cores from trees in a dendro-climatological study of the wood. Historical references to the wood were collated by Proctor *et al* (1980), whilst Backmeroff (1987) and Page (1995, 1999) list recent studies.

Several existing studies already constitute long-term monitoring. The photographic archive spans over a hundred years (Proctor *et al* 1980). Early fixed-point ground photographs have been collated, and a comprehensive set of new fixed-point photographs was taken in 1983 and 1993. A permanent plot measuring 62 x 75 m where trees have been recorded in 1965, 1979, 1987 and 1997, includes an area first recorded in 1921, the earliest known from British woodland (Christy & Worth 1922; Proctor *et al* 1980; Mountford 1999). A permanent plot established in 1973 and recorded almost every year since has monitored changes in saplings within the wood (Mountford, Page & Peterken 2000). An archive of past events has been maintained.

Several other baseline studies provide a potential basis for long-term monitoring. Courtney & Hardy (1967) mapped vegetation along a transect within an enclosure erected in 1965, and this was re-recorded and a new transect set up by Brown (1983). Findon (1974) established two 10 x 10 m plots and two transects where trees were recorded and cores taken. Roberts & Marren (1971) examined ground vegetation in the wood along transects and studied the effects of the enclosure by mapping trees within this. Several studies of bryophytes have been made (Bines, Hardy & Laxton 1965; Barnett 1996; Brealey 1996), and a base line to monitor changes in bryophytes was established in 1997 (Brealey & Barnett 1997). Cadwallader & Roberts (1972) and Jones (1992) examined visitor use. A new permanent plot to studying tree regeneration has recently been established.

Proposed research and monitoring (see Table 4)

A site map showing the main NVC communities, soil types, and structural areas (based on a quantitative assessment of stand structure) should be developed. It may be useful to show the existing distribution of particular trees, eg rowan, holly, willow. This map could then form the basis for long-term monitoring.

The recording of the permanent tree and shrub plot, the permanent regeneration plots, and the system of fixed-point ground photographs should be continued. Further permanent plots or

transects should be considered based on a quantitative assessment of stand structure. The possibility of using existing studies, notably those by Courtney & Hardy (1967), Brown (1983), Findon (1974), and Roberts & Marren (1971), as a basis for long-term monitoring should be reviewed. The diary of major events and livestock numbers and the provision to maintain all records in an archive should be continued.

A grid of small plots through the wood and around the margins would provide a suitable basis to monitor changes in tree and shrub, ground vegetation, and dead wood components across the whole wood. It would also provide a quantitative assessment of stand structure. There is scope to extend monitoring to include structure/open space and veteran trees. Research into the past-composition of the wood might be possible based on the peat deposits near the wood. There are plans to undertake further invertebrate surveys: these could form a basis for long-term monitoring.

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