APPENDIX 1 (From D.N.Hutton's Report of January 1989)

Relocation of Permanent Transects

Maps showing how to relocate the transects at each site are given in appendices 1,2 and 3. (See appendix 7 for identification code used on transect marker posts.)

Scords Wood, Toys Hill.

See appendix - 1.

O.S. Landranger, Sheet 188.

Map Ref. TQ 427 521

Recorded Sept 1988.

One transect line running at 80 degrees. Origin 80m from N,E. corner of the FOX & HOUNDS Public house at 60 degrees.
Length, 650m marked with steel angle posts.
Steel markers at 0, 30, 60, 93, 120, 180, 210, 240, 270, 300, 360, (bridle way) 370, 390, 410, 440, 470, 500, 530, 590, 620, 650m.

Westfield Wood.

See appendix - 2.

Landranger Sheet 188

Grid Ref. TQ 755607

Transect A. (recorded April and September 1988.) Length 90m.
0 -60m at 90 degrees,
60 - 90m at 120 degrees.
Steel markers at 0, 10, 20, 30, 40, 50, 60, 69, 75, 80, 90, 110, 120m.

Parsonage Wood.

see appendix -3

Landranger Sheet 188

Map Ref: TQ 797 329

One transect. (recorded October 1988.) Length , 90m
At 120 degrees.
Steel markers at 0, 10, 20, 39, 45, 48, 60, 64, 68, 70, 80, 90m

The Permanent Transects.

Setting up and recording.

The central transect line (A-B) was marked using steel angle iron posts c.75m in length, driven 2/3 of their length into the ground. The transect line followed a pre-determined compass bearing, which to a certain extent was determined by the degree of inpenetrablity of the fallen trees.
Recording was based on the method outlined in Perterken and Backmeroff 1988.
(The following description is based on their work.)

The following procedure was used to mark the boundaries of the transect in 30m sections 10m wide were marked out and recorded, then the next half section was marked out. Fig 1. shows the layout of the transect.

1. Following the permanently marked centre line a 30m tape measure was laid out and secured between points A and B of the first section to be recorded.
N.B. In storm damaged woodland it is often not possible to lay the tape at ground level for obvious reasons, thus errors in plotting may have occurred

2. With the use of a compass, a 10m tape was laid from point A to 90 degrees to the centre line. A cane was inserted at 10m, thus establishing one corner of the transect (X).

3) A second 10m tape was then placed at point at right angles to the centre line on the same line on the line laid in step 2. A cane was again inserted at 10m, thus establishing the fourth corner of the first section (Z).

4. The transect margin X-Z was marked with another 30m tape, after first checking that the compass bearing was the same as that of the centre line. Small inaccuracies were corrected at this stage.

5. Steps 1-4 were repeated to demarcate the other half section ABYW. and the whole procedure was repeated for successive sections untill the whole transect had been recorded.

The following procedure was used to record the trees and shrubs in each half section.

1. A cross tape was laid between the positions of all trees and shruds within 3m of the cross tape were recorded on a graph paper chart at a scale of 1cm to 1m. All individuals within the bounds of ABZX which had once reached a height of 1.3m were recorded.

Tree and shrub individuals are plotted and numbered in Two sets which are recorded on separate schedules. One set includes all individuals with their point of origin inside the bounds of ABZX, (titled A-X) the other set between AWYB (titled A-W).

Selected trees just outside these bounds have been recorded (No. recorded in brackets) where these were thought to be exerting a significant influence on the area within the transect (eg a large area of fallen canopy within the transect.)

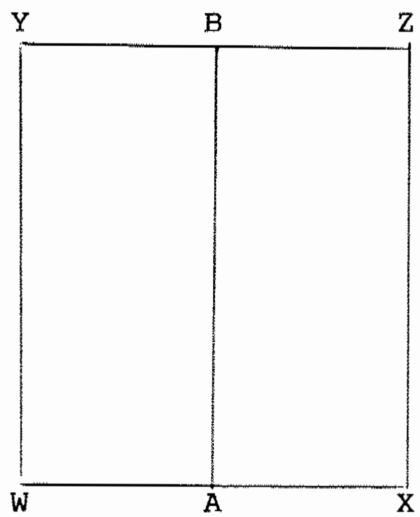
3. The girths (in m at 1.3m height) of all stems were measured with a steel tape measure.
In many cases it was not possible to take girths at 1.3m, in which case a diameter reading across the stem was taken and as such indicated as such on the schedule (see App.4).

Copppice stools - mature coppice, all stems measured at 1.3m
- small coppice, main stems measured others estimated and described in 'additional notes'.
stems less than .05m girth recorded as <.01 D.B.H.
Taxus baccata - girth measurement taken at point lower than 1.3m where necessary and specified on schedule (see app.4)

Measurement and plotting of root plate and pit disturbance areas was carried out by first plotting of both sides of the lower half of the root plate, then plotting the point or points of maximum radius (usually measuring with the steel tape). The shape of any irregularities was then drawn freehand onto the chart.

4. In some cases it was useful to use trees which had crossed both 30m tapes as reference points for recording the positions of root plates.

Figure 1. Transect Layout.



The schedule Explanation

Each chart is accompanied by two schedules,
1 A - X which lists all individuals with their point of origin inside the bounds of ABZX.
2 A - W which lists all individuals with their point of origin inside the bounds of ABYW.
Selected trees just outside thes bounds (nos in brackets.)

Column 1 Tree / shrub number. (Bracketed if outside transect.)
Column 2 Species. (Bracketed if dead.)
Column 3 D.B.H. Diameter at breast height (1.3m) Derived from girth measurement. (All measurements in metres.) see below for special cases.
Column 4 Growth form. Ref Peterken 1981.
Column 5 Heigt category. See below.

D.B.H.

- indicates that a girth measurement could not be taken, so a diameter across the top of the trunk was taken. (reading is therefore estimated.)

- indicates measurement taken at other than 1.3m (specified)

Height Category.

EC Emergent Canopy
C Canopy
SC Sub-Canopy
S Shrub layer
Sa Sapling

The Key

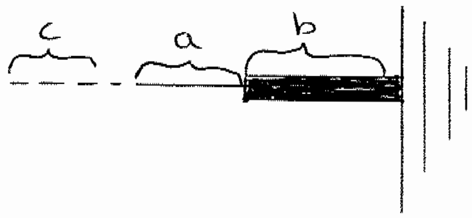
On - Standing tree / shrub (n) - tree / shrub outside transect

[n] - leaning tree / shrub = direction of lean
[n] =angle of lean

* - broken, (att.) if still attached.

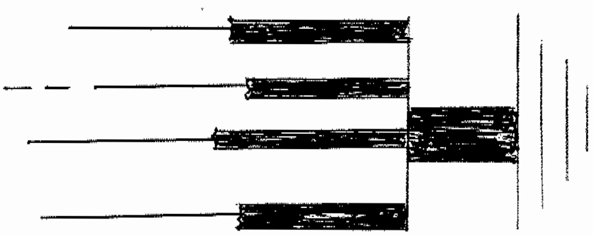
[o] - dead stump / standing tree.

- dead wood



a+b - total length of tree to top of crown.
c - estimated length of canopy.
b - distance to first major stem division.

root plate and pit disturbance area



Pollard - a - 'primary' stems
b - 'secondary' stems
c - 'tertiary' stems

Main stem(b) diameter represented as 1mm = .10m (to nearest .10m)

eg
<0.05 - 0.09 = <1mm
0.01 - 0.19 = 1mm
0.02 - 0.29 = 2mm
0.03 - 0.39 = 3mm
ect...

- standing canopy (includes leaning canopies)

- fallen canopy.

All individuals were living at time of recording unless specified in schedule.
Selected individuals under 1.3m in height are recorded eg Fe (Js) c.50(h)
= *Fraxinus exelsior* sapling c.50m in height.

Key to Species

Ac - Acer campestre
Ap - Acer Psuedoplatanus
Bp - Betula pendula
Bpub- Betula pubescens
Ca - Corylus avellana
Cb - Carprinus betulus
Cm - Crataegus monogyna
Cs - Castanea sativa
Fe - Fraxinus excelsior
Fs - Fagus sylvatica
Ia - Ilex aquifolium
Lp - Lonicera periclymenum
Ps - Pinus sylvestris
Qr - Quercus robur
Qp - Quercus petraea
Tb - Taxus baccata
Tc - Tilia cordata
Sn - Sambucus nigra
Sar - Sorbus aria
Sauc- Sorbus aucuparia

Shorthand notation used to record growth forms of woodland trees and shrubs. From Peterken 1981

TREES.
Single-stemmed individuals in the mature canopy and tall subordinate strata.

Ts Standard trees in a coppice with standards system.
Tn Self-sown trees. Reserved in a coppice for trees which are comtempoary with existing coppice growth.
Tc Trees which have been promoted from coopice by singling or neglect. This can include mature trees with two trunks.
Tp Planted trees.
Tx Other trees, generally of uncertain origin.

Note that combinations are possible. Thus Tsp is a standard which has been planted.

COPPICE.
Trees and shrubs which have been cut and allowed to grow from the stump.

Cs Small coppice, cut close to the ground.
Cl Large coppice, cut well above the ground.
Ct Coppice growth from the cut stump of a tree.

POLLARDS.
Trees cut more one meter above ground level and allowed to grow again from the stump.

Pc Low pollards, or very high-cut coppice, say 1.0 - 2.5m above the ground.
Px Pollards cut more than 2.5m above the ground.

SHRUBS.
Ss Small shrub.
Sl Large shrub, more than 5.0m high with a broad crown.
Sc Climber.
St Young tree usually above 3.0m high (post dating last coppice).

JUVENILES.
Js Seedlings, germinated in last two years.
Jp Saplings.
Jv Suckers.
Jl Layers.

Long term monitoring

of vegetation changes in

The Mens, West Sussex.

A Whitbread
H Montgomery
S Davey
R Sharp

February 1993

CONTENTS

1 INTRODUCTION

Ecologists have long been interested in the importance of natural dynamics in ecosystems. Long term changes in vegetation and development of natural communities perhaps following disturbance involving processes like succession and patch dynamics have long been studied. Such studies have given rise to divergent views of community organisation in relation to disturbance. One view emphasises autogenic succession towards a steady state community, the so called climatic climax, affected only by endogenous disturbance (first described by Clements, 1916). Another stresses the role of natural, broad-scale disturbance brought about by external catastrophic events.

The value of the steady state climax concept has been the subject of much critical examination (Connell 1978, Henry & Swan 1974, Jones 1945, Loucks 1970, Webb 1958, White 1979 and others). No forest is stable in the sense of being unchanging, even the most stable system is never in complete equilibrium, nor is it free from disturbed areas in which secondary succession is evident (Pickett & White 1985). A climax equilibrium seldom exists because of catastrophic initiation of fresh seral development or because of the time lag in adjustment to a continually changing environment. Forests exposed to disturbance are a mosaic of seral stages (Strong 1977), each disturbance setting succession back to earlier development stages.

In order to examine such effects as autogenic succession, patch dynamics, responses to disturbance and the way they relate to forest structure and composition, long term studies in unmanaged woodland are required. These studies enable these processes to be observed as they take place. Our direct knowledge of a particular forest is generally very short term, often an understanding may be based on just a one day survey. This can lead to an unrealistic view of forest vegetation, perhaps seeing it as an unchanging entity. What is needed is an appreciation of rates and directions of changes, and the nature of the effects at different scales of patchiness within the ecosystem.

The role of natural disturbance as an initiator of vegetation dynamics is now recognised as a fundamental factor influencing the development of communities. Every ecosystem is subject to a range of disturbances, varying from those which barely alter the structure of the system to those which dramatically change it (Bormann & Lickens 1979). Disturbance plays a major role in the generation and maintenance of species diversity, acting as an important selective force in the evolution of plant strategies (Bazzaz 1983, Grime 1979, Martinez-Ramos et al 1988, White 1979). Disturbance can enhance species diversity by preventing competitive exclusion, reducing species dominance and releasing resources for less competitive species (Connell 1978). It also increases environmental heterogeneity enabling specialisation and resource partitioning (Grubb 1977).

The study of natural disturbance in forest ecosystems is quite well established in America but, with some notable exceptions (eg Peterken & Jones 1987) relatively little has been done on the subject in British woodlands. There are two main reasons for this. Firstly there are no natural forest systems in Britain (and few semi-natural systems) in which natural disturbance is allowed free rein. Management almost invariably has a far greater influence on woodland structure and composition than does natural disturbance. Secondly most disturbance events are very infrequent, on a human timescale, so until recently have not attracted systematic examination.

The windstorm which hit the south-east of Britain during the small hours of 16th October 1987, however, provided a rare opportunity to examine the effects of a large disturbance event. Britain is particularly subject to strong winds. Billham (1938) for example lists 43 occasions between 1909 and 1936 with gusts of over 90 mph, including 10 over 100mph. Severe gales causing extensive wind damage affect some part of Britain every 15 years (Miller 1985). The three previous catastrophic windstorms occurred in 1953, 1968 and 1976, however all these occurred in January and further to the north of Britain. The 1987 storm was unusual in that it occurred in the south-east of Britain at a time when most trees were still in full-leaf. Return periods for both the highest gusts and the highest hourly mean windspeeds have been estimated at around 200years (Burt & Mansfield 1988). The 1987 storm was a catastrophic event of unusual severity but was certainly not unique.

In order to study the effects of natural disturbance in relation to natural forest vegetation dynamics it was important to find suitable study sites on which to base long term studies. These sites should, ideally, have the following characteristics:

1 The woodland structure should be as close as possible to a natural forest, rather than coppice or plantation.
2 The species composition should be as near natural as possible, and in particular should be free from exotics.
3 The site should be as large as possible so that operations on the fringe have less of an influence on the bulk of the site.
4 Sites should cover the range of conditions where storm damage occurred.
5 Ideally there should be data on the wood before the storm.
6 There must be some long term administrative control over the site by an organisation with some commitment to ecological research. Thus most sites will be nature reserves.

Such a combination of conditions is, in practice, very rare. No woodland in Britain is truly natural and even in apparently near-natural stands the influence of management which may have ceased aver a century ago can still be detected. However, a number of potential sites were examined by the then Nature Conservancy Council (now English Nature) and long term monitoring projects established. The basic methodology followed that of Peterken and Backmeroff (1988), which looks at long term monitoring in woodland nature reserves in general, though the details of experimental design varied from site to site.

One site that was selected for study was The Mens in West Sussex.

This is a site owned by the Sussex Wildlife Trust, which fulfils most of the above criteria. Though it has received varying intensities of management throughout history, it has now remained essentially unmanaged for over 100 years. In structure and species composition it can now arguably be regarded as a near-natural forest.

2 THE STUDY SITE

The Mens is an irregularly shaped block of woodland between Petworth and Billingshurst, West Sussex. The greatest length, between NGR points TQ016219 and TQ033249, is 3.5km, the width varies from 0.2 to 1.7km, and the area is 155.1ha.

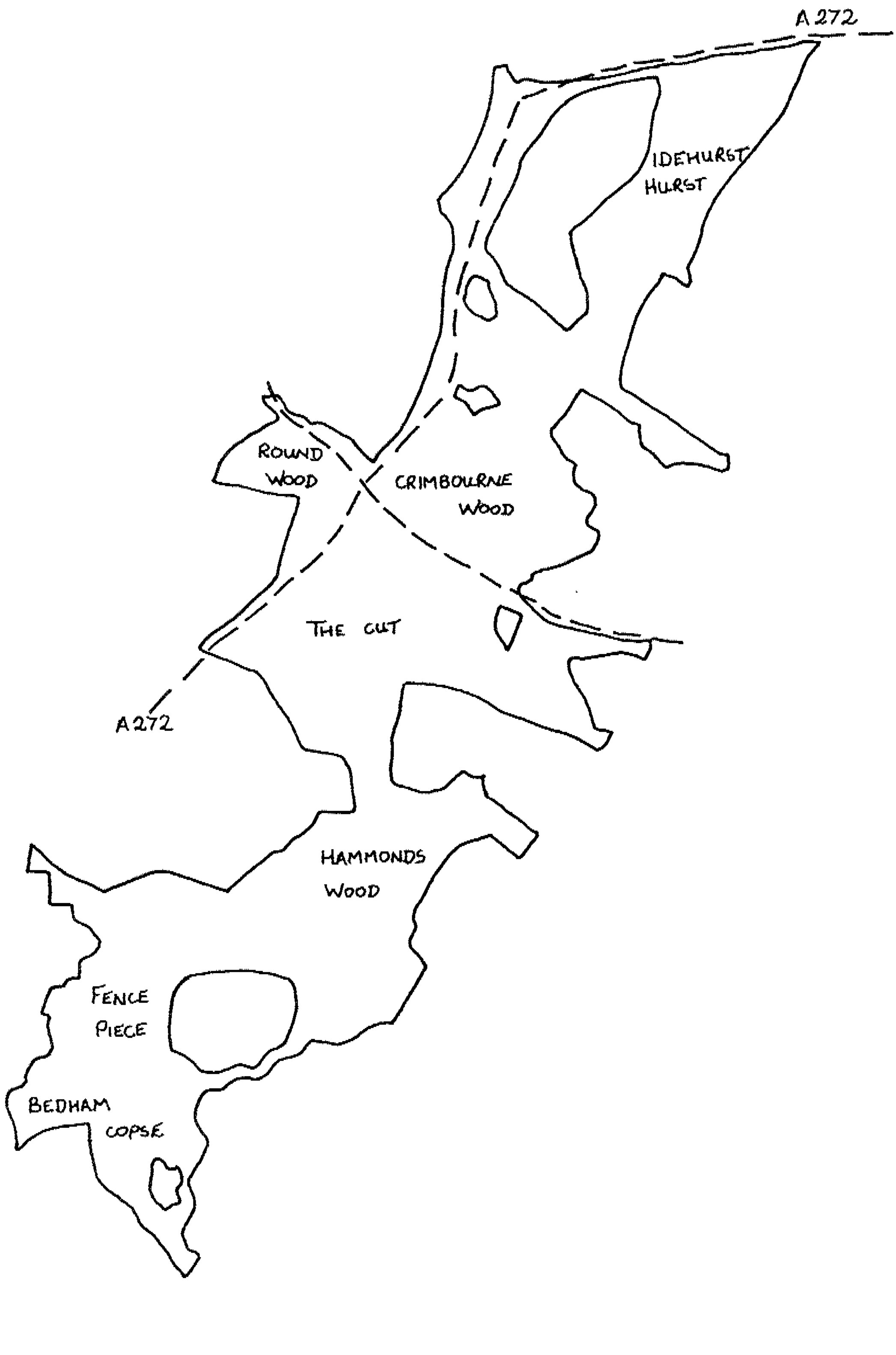
Most of the site lies on Weald Clay deposits, but in the south there is a north-east facing escarpment of Lower Greensand. the Weald Clay in this part of Sussex is a stiff yellow clay interbedded with layers of sandstone, though in The Mens many of the islands of sandstone have been enclosed for agriculture so are excluded from the reserve. A narrow band of Paludina limestone crosses the centre of the site.

Soils are of the brown earth type, and soil surveys in the site have showed no evidence of past cultivation in the form of mixing of the soil horizons (Tittensor 1977). Soils are generally fairly acidic, with pH measurements of between 3.4 and 4.2, but the presence of several base-loving species of ground flora suggest that soils are not uniformly acidic.

The Mens lies within the area formerly known as Bedham Common. A partial reconstruction of the history has been made by Tittensor (1977). The earliest reference to the site, in 953 AD describes the site as "swine pasture" and refers to some parts at least as common woodland. Further references to rights of "pannage" in 1300 imply a continuing use as swine pasture and common woodland. A map of 1650 shows that five of the nine areas into which the Mens is divided were mostly woodland, whilst the other areas were probably a form of parkland with scattered trees. In 1753 there was a temporary enclosure of certain areas to allow the regeneration of timber trees and underwood, with a resulting loss of commoners rights. Various publications during the nineteenth century suggest that the extent of woodland cover fluctuated and that only Hammonds Wood and Fence Piece, towards the south of the Mens, remained continuously under tree cover after 1650.

To summarise, deductions from the documentary information and wider historical and archaeological considerations suggest that the primeval forest cover remained largely undisturbed until Anglo-Saxon times when right of swine-pasture, presumably among trees, was established. In the Middle Ages wood was taken for glass making and for iron smelting. Coppicing and pollarding have certainly been practised and some of the older trees still existing show evidence of pollarding in particular. It is thought that management reduced considerably in intensity throughout the nineteenth century and by 1882 the site had become largely neglected.

Figure 1 Compartments within The Mens.



3 METHODS

The Mens is a particularly valuable study site in which to examine the effects of the 1987 storm because a method had already been established to study changes in vegetation structure.

In 1974 a 100m grid system was accurately plotted throughout the site based on the national ordnance survey grid. The intersections of this grid were then used as locations for sample quadrats. Thus the 155ha of the site were divided up on a 100m grid system giving 155 grid intersections for the 155 quadrats.

Each grid intersection marked the central point of a circular quadrat of area 314sq m (radius 10m). This represented a 3% sample area. The original 1974 survey data is not now available, but the same quadrat locations were examined in 1988/89 to assess the structure of vegetation at The Mens around the time of the 1987 storm. Within each 3·14sq m quadrat the following information was recorded:

- Exact location of each tree and shrub above 1.5m in height.

- Its species.

- Its girth at breast height (gbh). Where a tree was multi-stemmed the gbh was measured for each major stem, with stems below 1.5m high being noted as subsidiaries.

- Notes about each individual tree, particularly its state of health, dead branches, rot hollows, etc.

- If a tree had fallen the following was recorded:
  - Whether it was alive or dead.
  - Whether it fell as a result of the 1987 storm.
  - Its direction of fall.
  - Its angle of lean, from the horizontal, if just leaning.

- Location and direction of fall of all major fallen branches.

- a list of ground flora and epiphyte species present, including all vascular plants, bryophytes, lichens and notable fungi.

From the above data it was possible firstly to analyse the effects of the 1987 storm. In addition, however, it was also possible to reconstruct the pre-storm nature of the site.

Five years after the storm, in 1992/93, a further survey of the site was planned in order to examine how the site had developed in the intervening period. Resources were not available to carry out a complete re-survey of all quadrats. Consequently a sample re-survey was carried out in which a smaller number of quadrats was examined.

Selection of samples for re-survey was based on a classification of the site into broad woodland types. These types were defined as follows:

- Oak dominated woodland (if a species contained over 60% of the basal area for the quadrat then it was deemed to be dominant) with no storm damage.
- Oak dominated woodland with storm damage.
- Beech dominated woodland with no storm damage.
- Beech dominated woodland with storm damage.
- Mixed woodland (ie no one species contains 60% of the basal area for the quadrat, so no one species is deemed to be dominant) with no storm damage.
- Mixed woodland with storm damage.

Figure 2 Locations of sample quadrats within The Mens.