4 RESULTS

4.1 THE MENS BEFORE THE STORM

Basal areas

The raw data for girth at breast height (gbh) for each quadrat were converted into basal areas for each of the commoner tree species. Total basal area for each quadrat was also calculated. Basal areas within each quadrat were summed and calibrated so that all figures are in square meters of wood per hectare of ground surface (m^2 ha^{-1}). Table 1 shows the basal areas averaged over the 155 quadrats for each of the commoner species.

Basal area figures have also been plotted in figure 3 to show the distribution of basal area classes throughout the Mens. Thus total basal area for each quadrat has been calculated and plotted at its location on the map. Generally, old-growth, temperate, deciduous forests tend to have average total basal areas of around 30 $m^2 ha^{-1}$. Table 1 shows that the mean figure for The Mens is above this and figure 3 shows an apparently random pattern with very few quadrats having basal area less than 30 $m^2 ha^{-1}$. It is therefore likely that, in terms of basal areas, The Mens can be considered an old growth stand and that variation in figure 3 is predominantly natural random variation.

Figure 3 Distribution of basal area classes throughout The Mens.

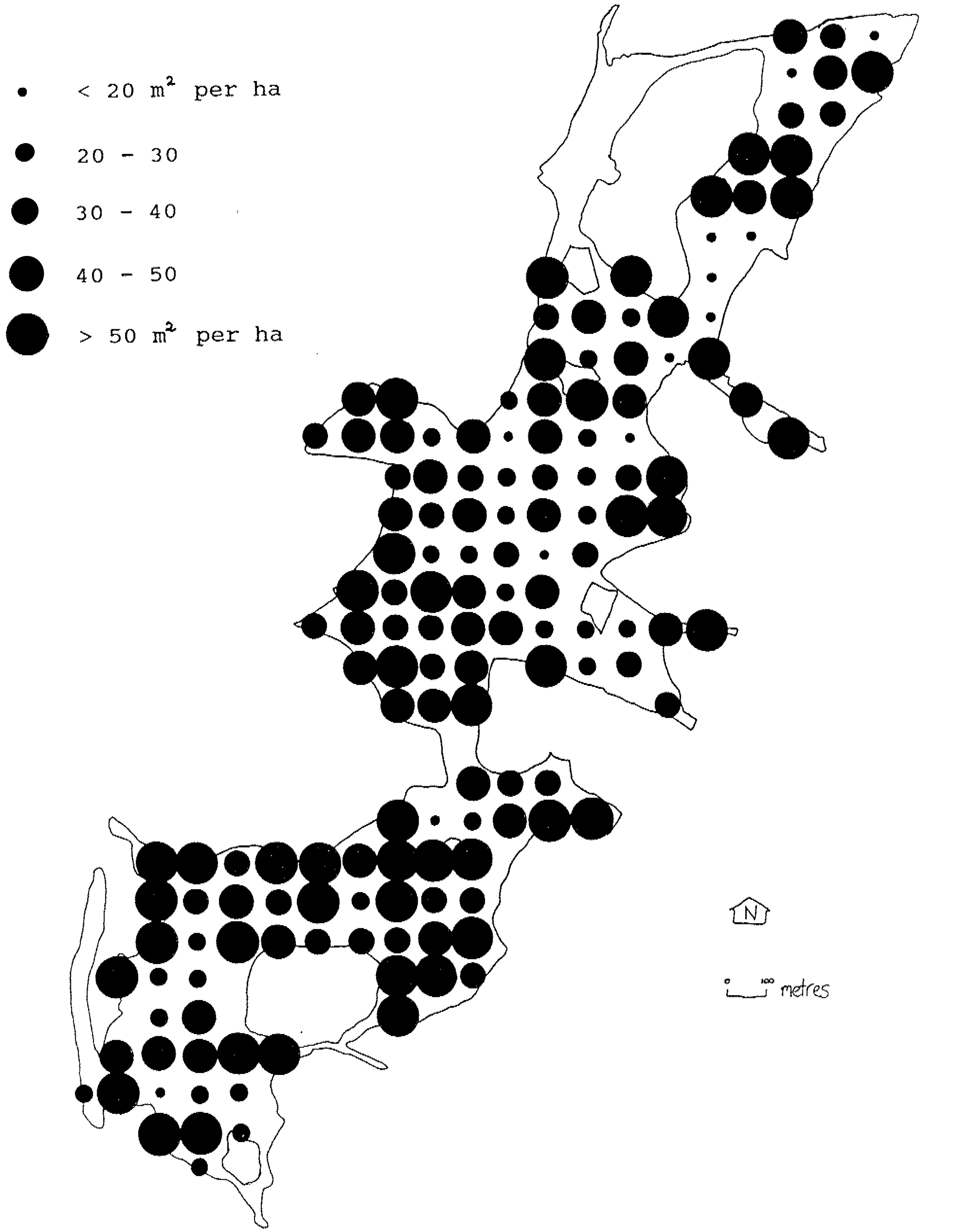


TABLE 1 Mean basal areas (m^2 per ha) and stem densities (per ha) for trees in The Mens before the 1987 storm.

	BASAL AREAS living	dead	% dead	DENSITY OF STEMS living	dead
Acer campestre	0.12	0	-	12.00	0
Betula pendula	0.18	0.04	18	10.80	1.27
Betula pubescens	0.02	+	-	8.20	0.42
Betula sp	0.03	0.10	77	2.76	1.91
Castanea sativa	0.51	+	-	2.12	0.85
Corylus avellana	0.20	0.02	9	89.00	5.30
Crataegus spp	0.31	0.01	3	151.20	4.88
Fagus sylvatica	19.27	0.64	3	278.00	16.5
Fraxinus excelsior	1.24	0.01	1	76.00	2.50
Ilex aquifolium	1.17	0.02	2	377.00	6.60
Prunus spinosa	0.02	+	-	16.30	0.63
Quercus petraea	5.47	0.03	1	39.60	0.63
Quercus robor	11.51	0.03	-	82.20	1.27
Quercus sp	1.74	0.31	15	13.5	5.50
Salix capraea	0.10	+	-	5.50	0.21
Sambucus nigra	0.02	0	-	12.70	0
Sorbus aucuparia	+	0	-	0.85	0
Taxus baccata	0.40	0	-	12.30	0
Others	0.28	0.96	77	15.50	24.8
Total	42.59	2.16	5	1212.00	75.0

KEY
S = Standing.
F = Fallen

Species distribution

The survey data can also be used to show the distribution of tree species within The Mens. The results here are presented in two main forms . Firstly, for the most abundant species, a pi diagram is drawn at the location of each quadrat and the proportion of the particular species is shown as a percentage of total living wood. Secondly, the less frequent species are shown on similar maps but presented simply in terms of presence or absence.

Figure 4 shows a distribution map for beech whilst figure 5 shows the distribution for the oak species. These diagrams show that beech tends to dominate on the lighter acidic soils in the south with pedunculate oak on the heavier soils in the north and with sessile oak in between.

Figures 6 to 9 show presence or absence species distribution maps for the remaining species. These collections of maps show a variety of patterns for the different species.

With some the pattern is very random. This may be either because they are generally infrequent on the site (eg wild service tree, great sallow and rowan) or because they are infrequent colonisers of particular transient conditions - for instance silver birch and ash may have colonised random openings in the canopy. Holly on the other hand is too ubiquitous to show any particular pattern. Some species - hazel and midland hawthorn for example - appear to show a preference for central and northern compartments whilst others - like yew and sweet chestnut -occur more in the south. This could reflect soil differences, species preferring heavier soils occurring on the more clayey soils to the north whilst those preferring light soils are more frequent on the sandstone outcrop of the south. In the case of maple there seems to be a weak correlation with the paludina limestone deposit which crosses the site, though its presence may also pick out more localised lime enrichment. Elder and sloe are also fairly random in distribution, perhaps reflecting a tendency towards gap colonisation and/or preference for edge habitats.

Figure 4 Proportion of beech present in each quadrat before the storm.

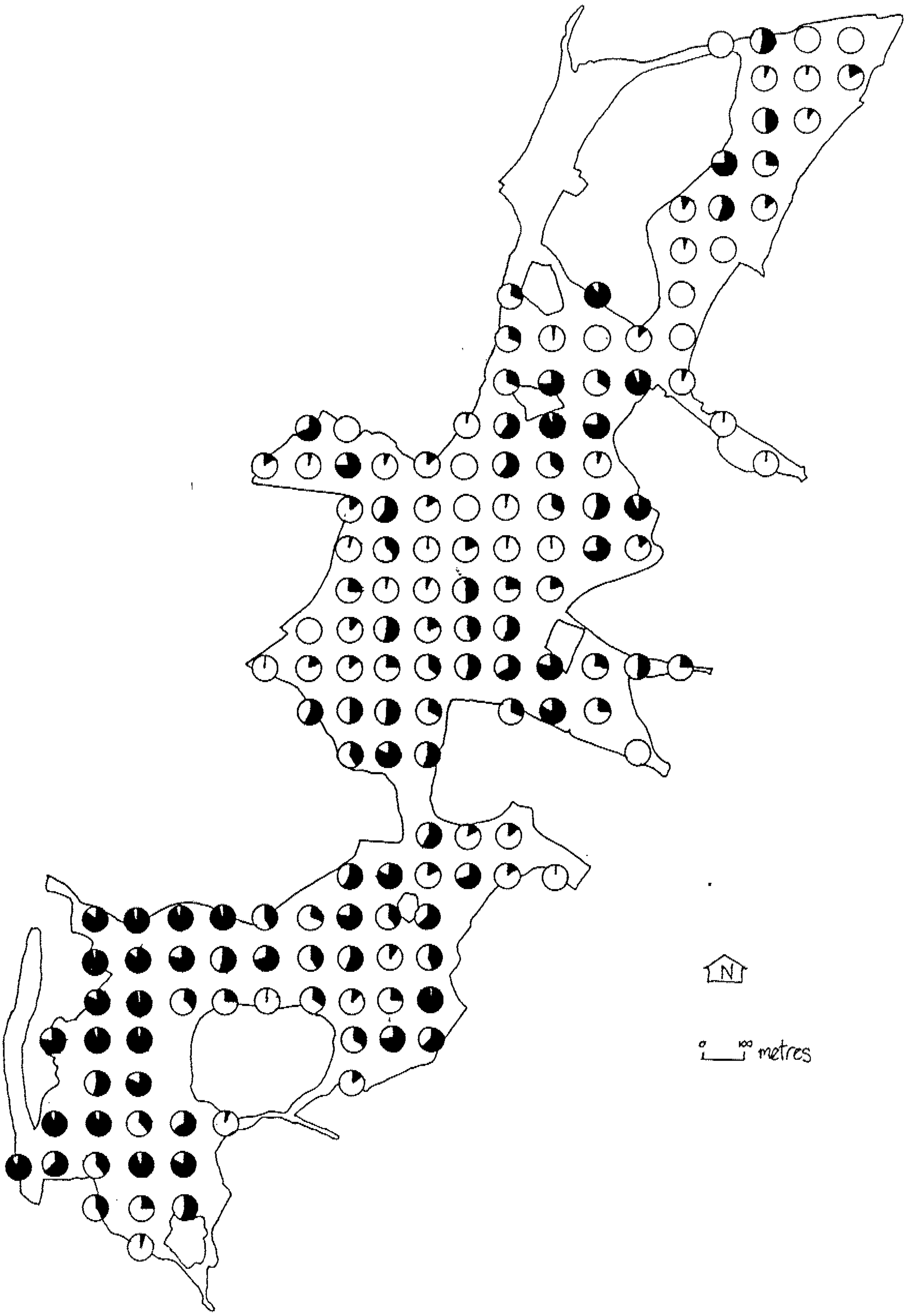


Figure 5 Proportion of oak present in each quadrat before the storm.

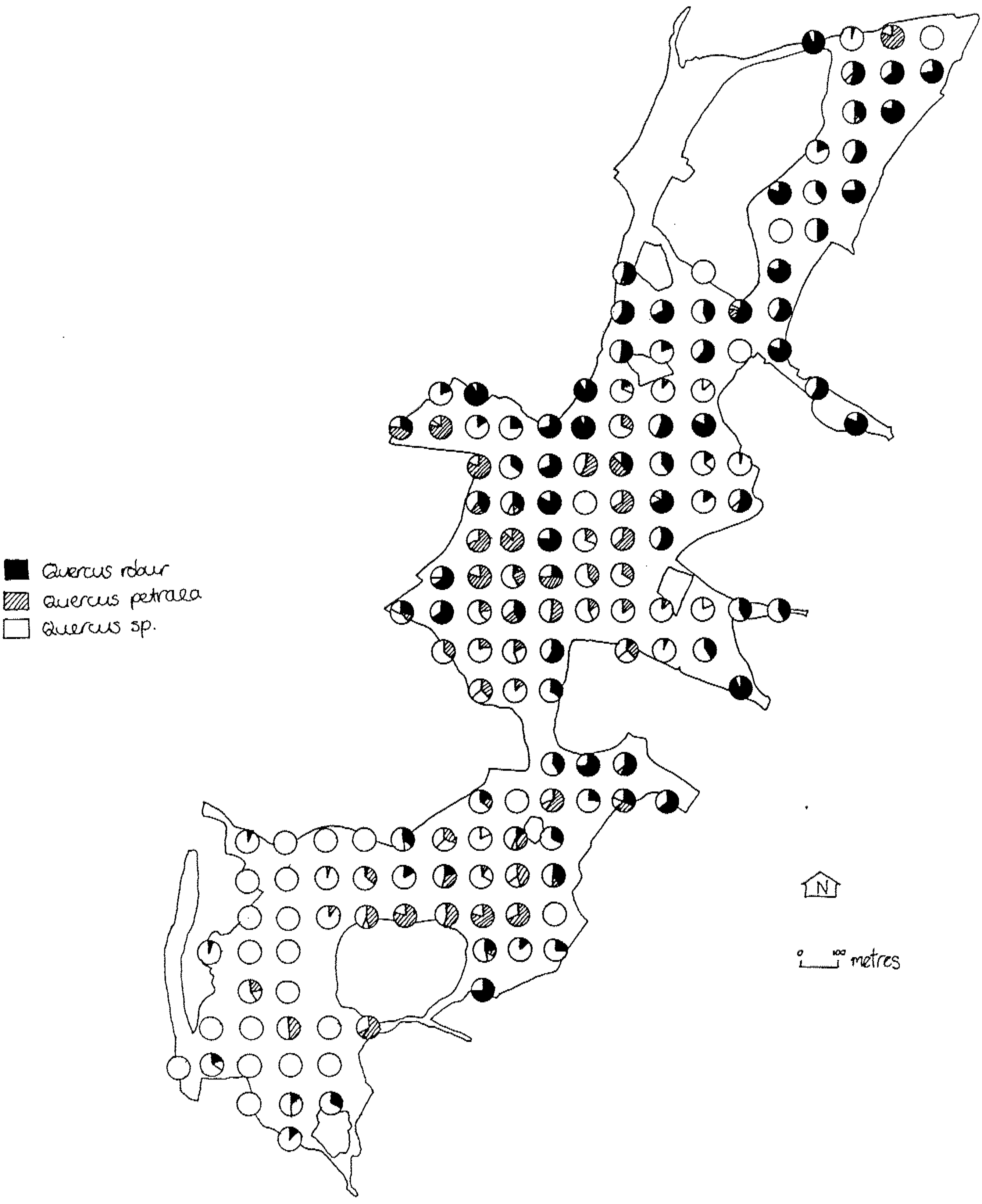
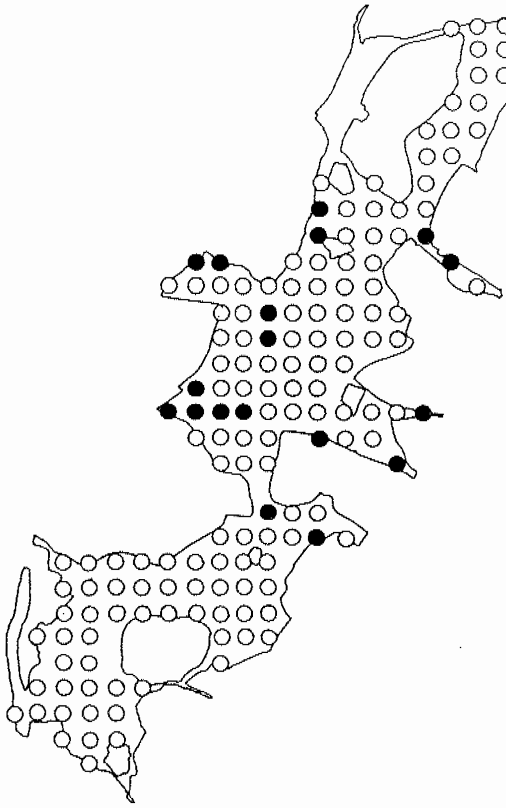
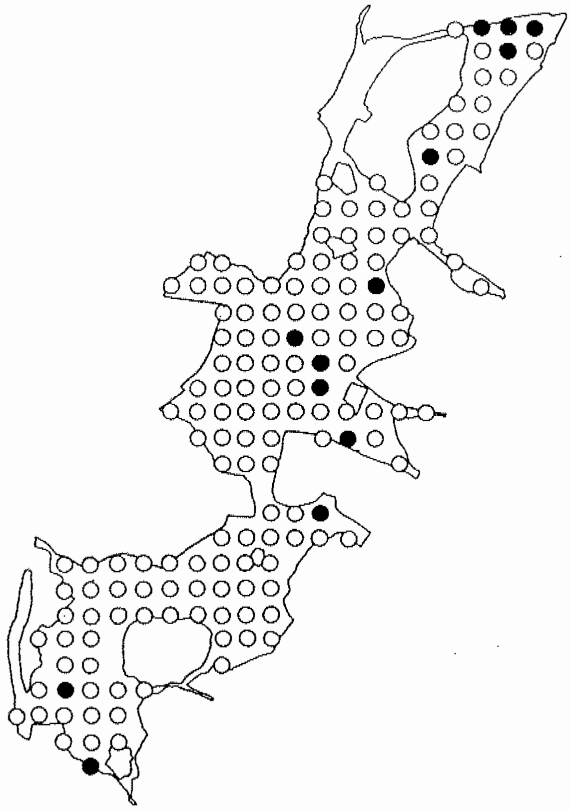


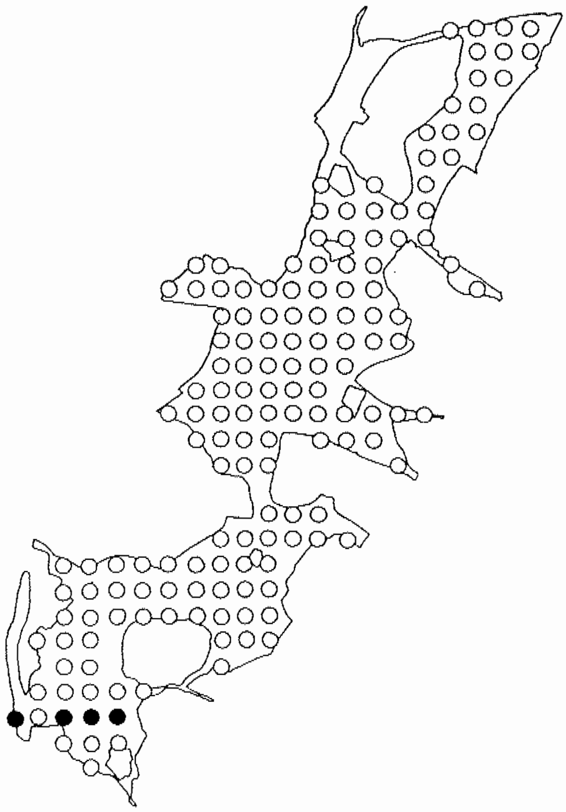
Figure 6 Species distribution maps



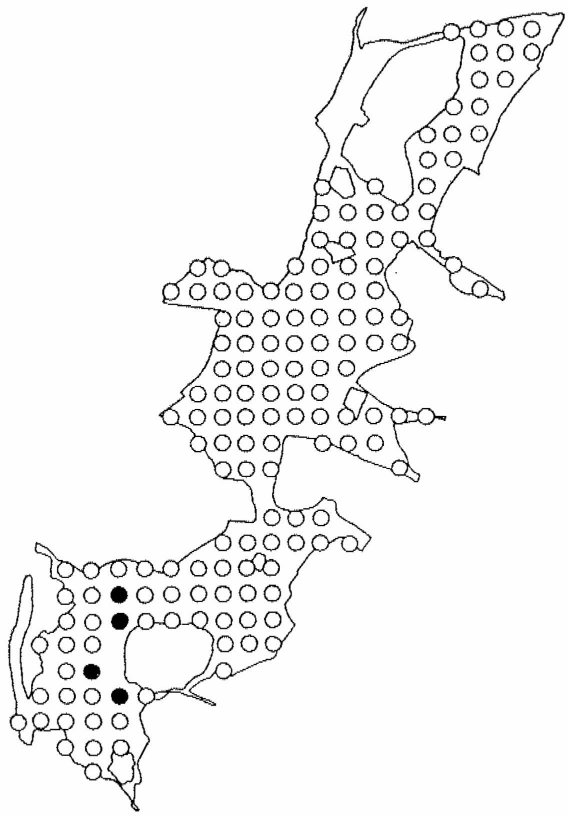
Acer campestre



Betula pendula

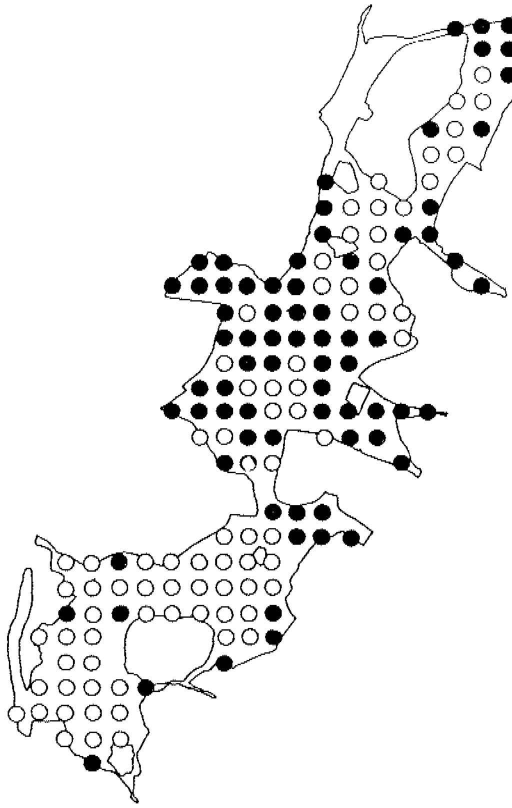


Betula pubescens

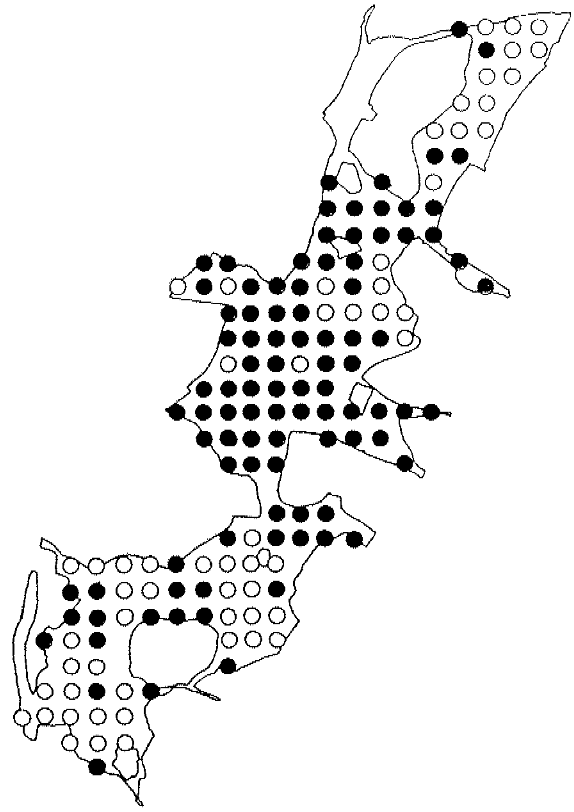


Castanea sativa

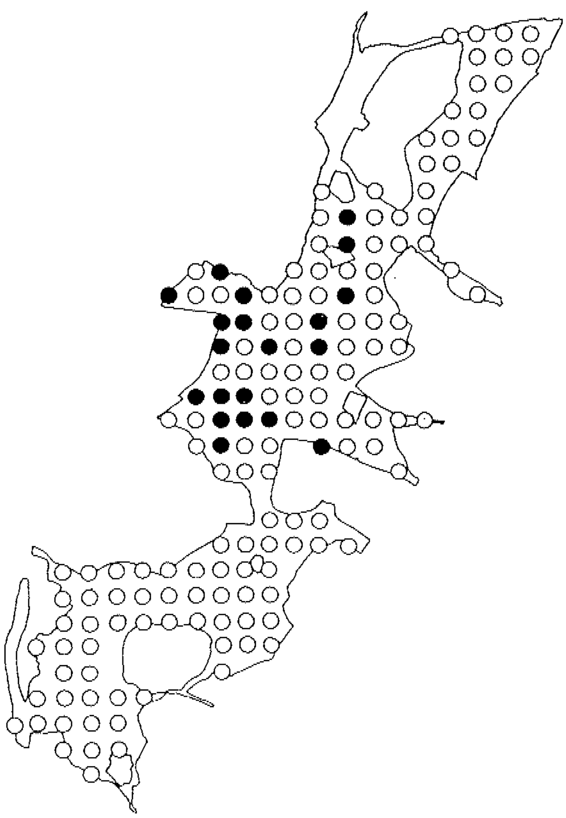
Figure 7 Species distribution maps



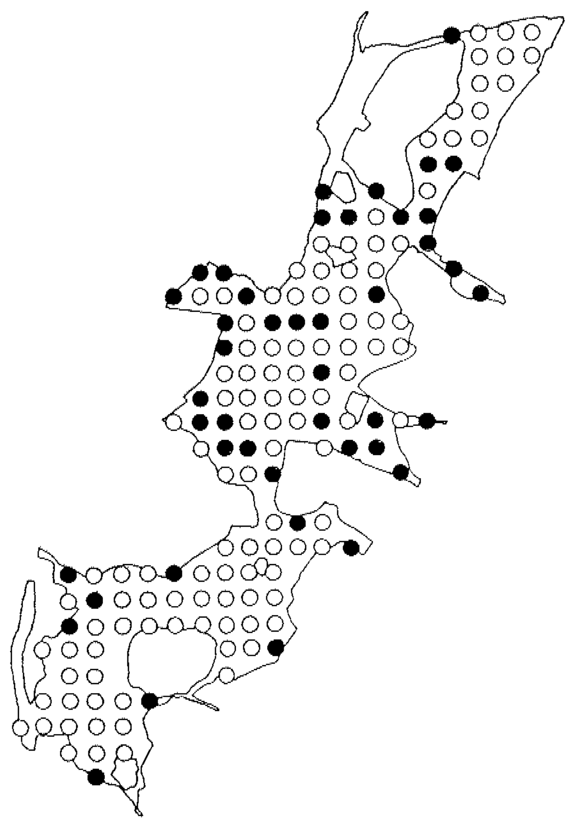
Corylus avellana



Crataegus monogyna

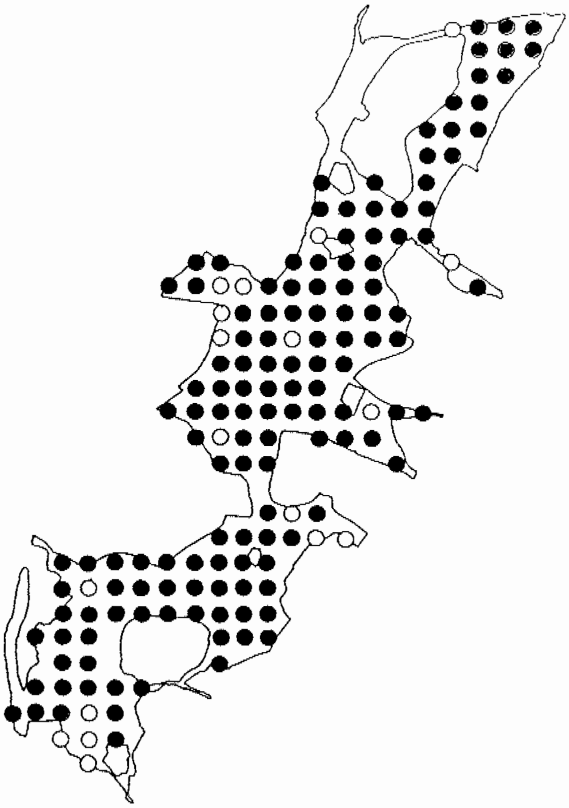


Crataegus oxyacanthoides

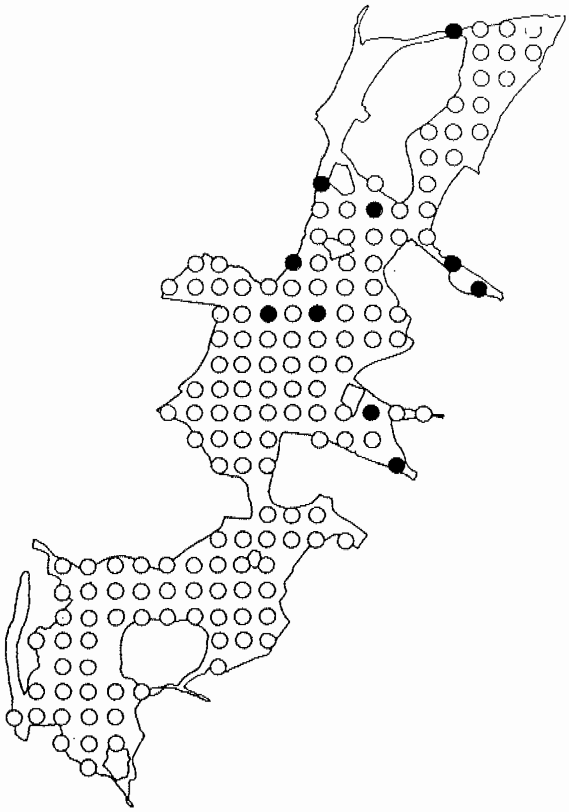


Fraxinus excelsior

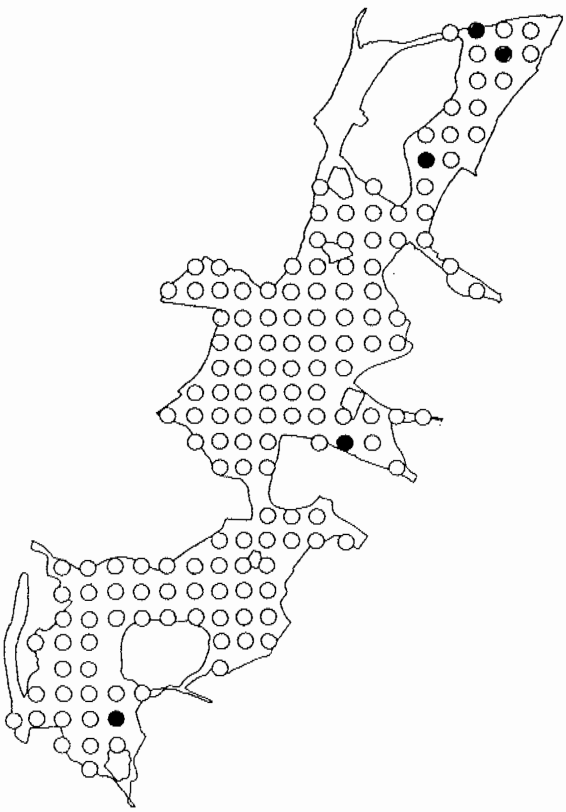
Figure 8 Species distribution maps



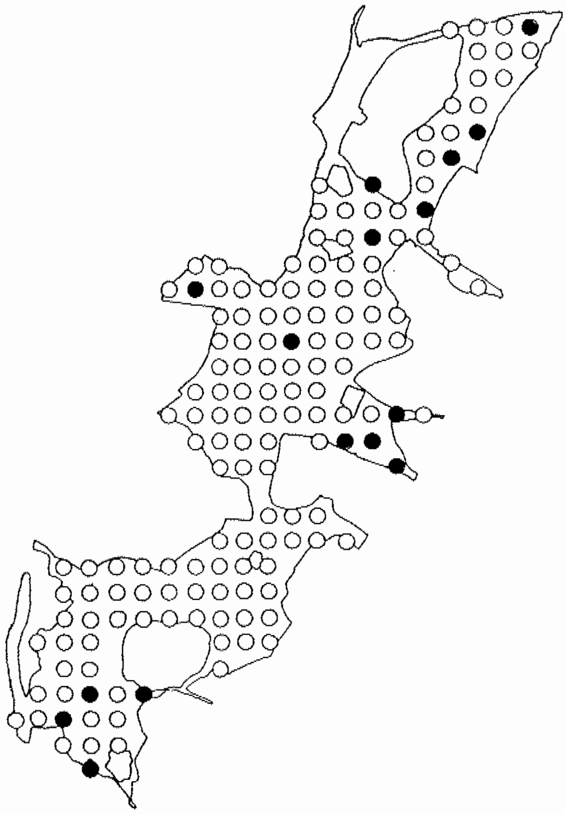
Ilex aquifolium



Prunus spinosa

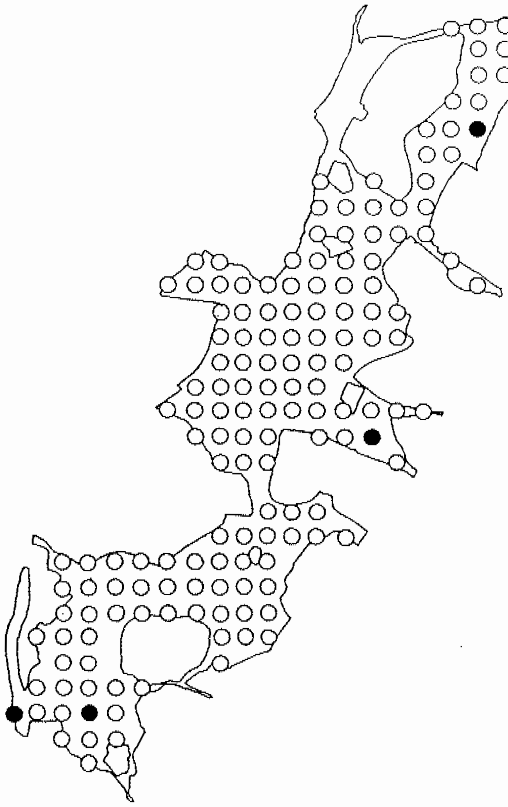


Salix caprea

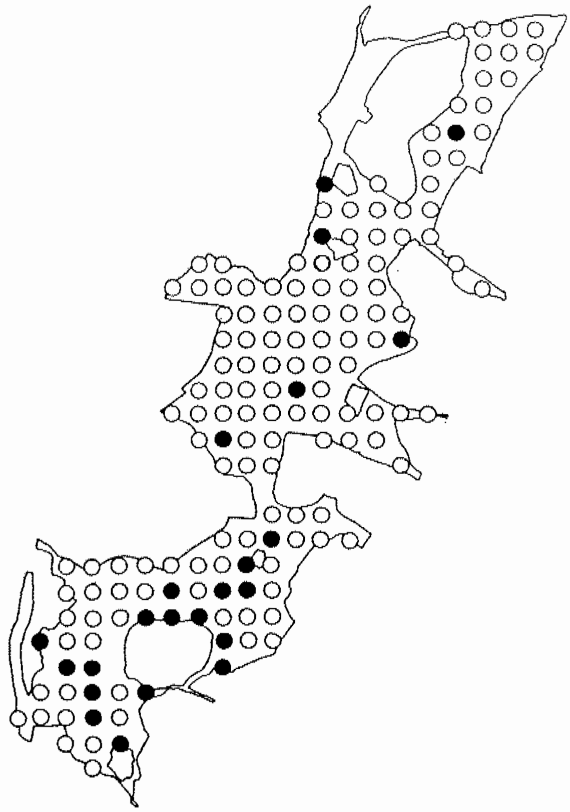


Sambucus nigra

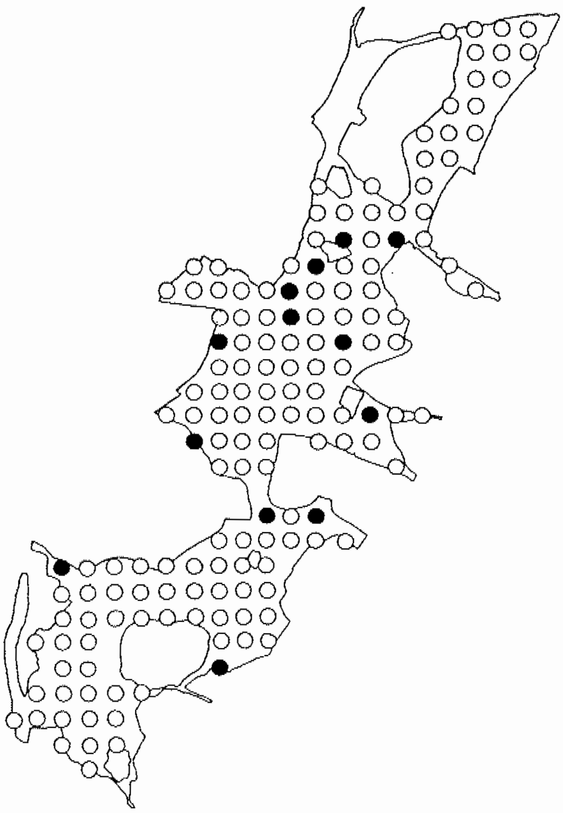
Figure 9 Species distribution maps



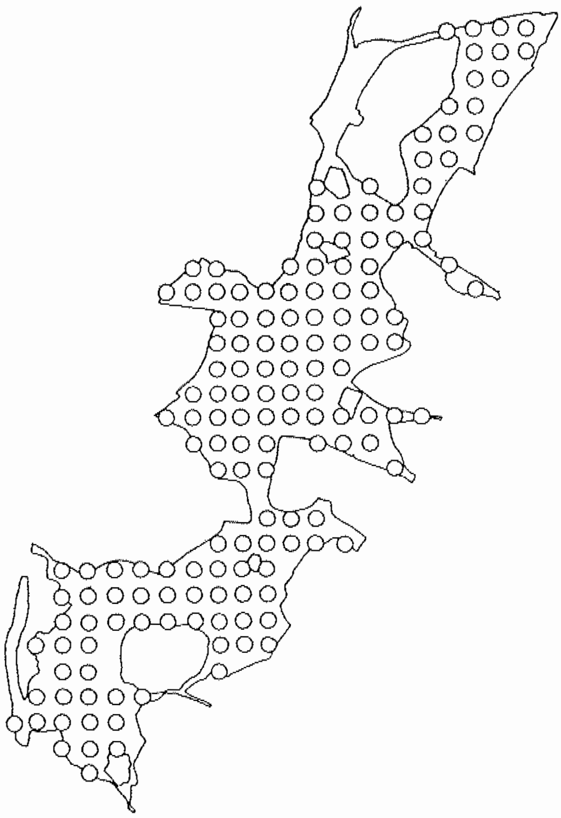
Sorbus aucuparia



Taxus baccata



Sorbus torminalis



Size distribution of trees in The Cut

The Cut is a relatively homogeneous area within The Mens. It was therefore selected as the area within which a more detailed examination of the size distribution of trees before the 1987 storm could take place.

The compartment was classified into oak dominated areas, beech dominated areas and stands of more mixed composition with no one species dominant. Dominance was judged from measurement of basal area within the quadrat. The level of 60% was arbitrarily chosen such that a quadrat where more than 60% of the basal area was made up of one particular species was judged to be dominated by that species. A sample of 6 oak dominated quadrats, 6 beech dominated and 6 mixed quadrats was selected and data within each class was summed. Size distribution of different species of trees was then examined within each class.

Figure 10 shows size distribution curves for both oak and beech in each of the three woodland types, based on size intervals of 20cm for gbh. The results show the following patterns:

- In oak dominated woodland there are no oaks in the smaller size classes.
- There are large numbers of beech trees of the smaller size classes in oak dominated woodland.
- This implies that beech regenerates in oak woodland, but that oak does not regenerate under its own canopy.
- In beech dominated woodland both oak and beech are frequent in the smaller size classes.
- This implies that both oak and beech are able to regenerate in beech dominated woodland.
- There are no oaks in the smaller size classes in mixed woodland.
- Beech is frequent in the smaller size classes and abundant in the medium size classes in mixed woodland.

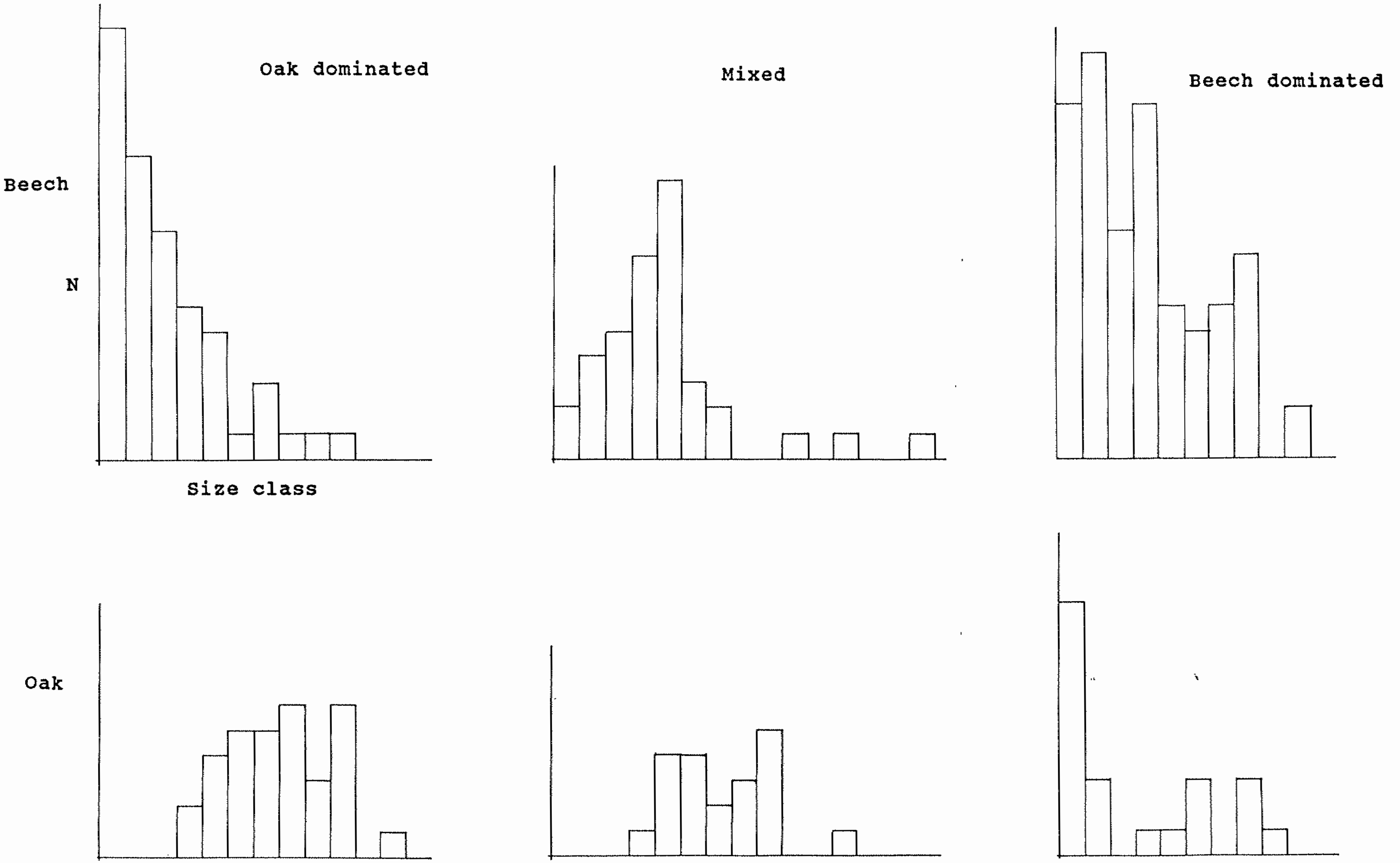


Figure 10 Size distribution of oak and beech trees in three woodland categories in The Cut.

4.2 THE EFFECTS OF THE 1987 STORM

Broad pattern of damage

Girth at breast height (gbh) measurements was converted into basal area and recalibrated to present as square meters of wood per hectare of ground surface ($m^2\ ha^{-1}$) for all windblown trees. Thus amounts of windthrow in each quadrat and for each species can be shown.

Figure 11 shows the distribution of storm damage throughout the site. It can be seen that storm damage is strongly correlated to topography at Bedham copse at the southern end of the site and on some of the slopes through Hammonds wood. But elsewhere there is no obvious pattern to the distribution of windthrow.

Direction of fall of trees was also calculated so the amount of wood which fell in any particular direction can be demonstrated. Figure 12a shows the direction of fall of all trees in the 155 quadrats, the length of each segment being proportional to the sum of the girths of trees that fell in that direction. It can be seen that there are two main components in terms of amounts of timber which fell in any one direction. A large volume of timber fell between North and 22 degrees and another large volume fell between 45 degrees and 67 degrees. However, significant amounts of timber fell in almost any direction, so there is a significant amount of randomness in terms of the way trees fell.

In figures 12b & 12c the same results are presented for the two halves of the wood. Figure 12b shows that in the southern half most trees fell between 45 and 67 degrees, whilst figure 12c shows that in the north most trees fell between north and 22 degrees.

Figure 11 Proportions of living wood brought down by the storm in each of the quadrats.
Contours are shown to demonstrate any correlation with topography.

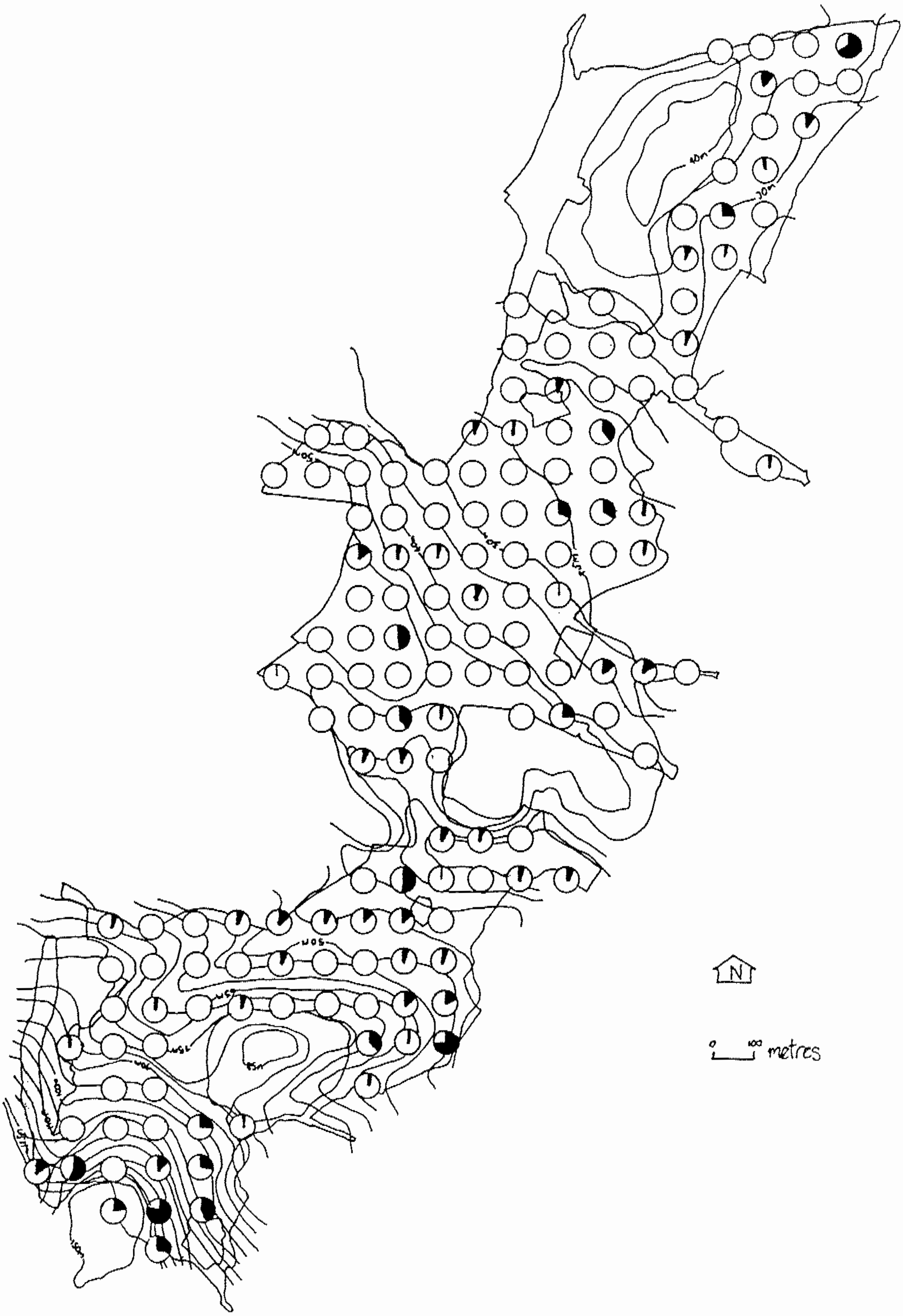


Figure 12a) Direction of fall of windblown trees in The Mens.

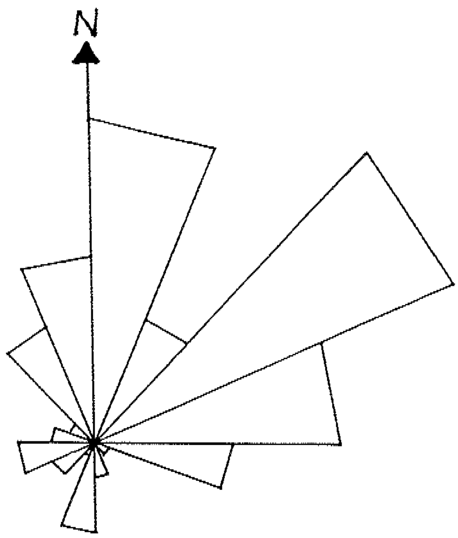
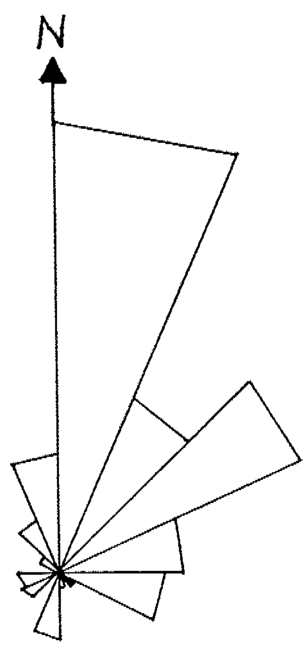


Figure 12c) Diretion of fall of trees in the northern half of The Mens.



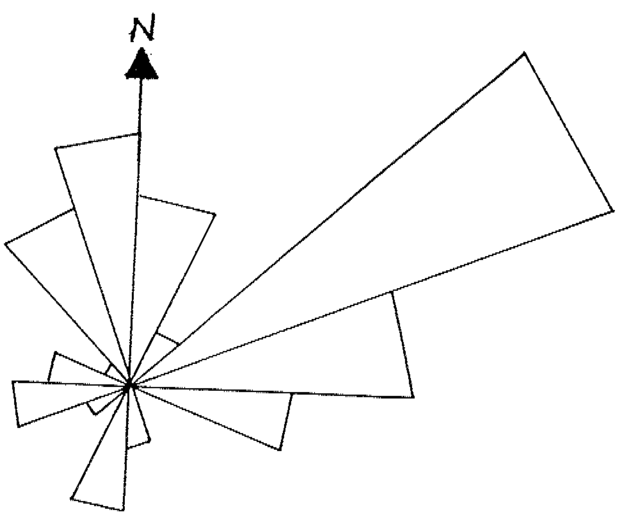


Figure 12b) Direction of fall of trees in the southern half of The Mens

Effect of the storm on different species

Table 2 shows the amounts of wood that fell as a result of the storm, firstly in terms of basal area (m^2 of wood per ha of land surface), and also in terms of percentage of wood windthrown. Overall about 8% of the wood, by basal area, blew over in the storm, and branches detached by the storm contributed a further 5%, by basal area, to the fallen wood.

There were, however, significant differences between the species. Unidentified oaks received the greatest proportional damage, but this is probably a recording artifact. A fallen, dead oak is less likely to have been identified to species so any fallen oak is more likely to have gone into this category, whilst standing oaks could more often be identified to species. Overall the oaks suffered about 3.6% windthrow, and <u>Quercus petraea</u> was apparently more vulnerable than <u>Quercus robur</u>. For a similar reason the "others" category may also be unrealistically high.

Sweet chestnut suffered the highest level of windthrow. This may be because most sweet chestnut happened to be present at the southern end of the site which, for topographical reasons, experienced highest windthrow. However, it also appears to be a fairly recent colonist to the site (most trees appear less than 100 years old) so trees may have reached full height but have not attained the windfirmness of older trees.

Shrubs like hazel and sallow also received high levels of damage. This may have been because they were prone to being crushed by falling trees. Other shrubs, like hawthorn and yew received very little damage.

Comparisons between oak and beech are interesting. Generally it appears that beech received significantly more damage than oak. Though this may be because beech grew in areas topographically prone to windthrow, the difference between the two species is too large for this to be the only factor.

TABLE 2 Amounts of wood which fell as a result of the 1987 storm.

Species	1	2	3	4
Acer campestre	0	0	0	0
Betula pendula	0.011	0.024	0.035	6.4
Betula pubescens	0.003	0	0.003	14.5
Betula sp	0	0	0	0
Castanea sativa	0.236	0.055	0.291	46.6
Corylus avellana	0.007	0.020	0.027	3.5
Crataegus spp	0.005	0.001	0.006	1.6
Fagus sylvatica	2.308	0.814	3.122	12.0
Fraxinus excelsior	0.001	0.031	0.032	0.1
Ilex aquifolium	0.075	0.039	0.114	6.4
Prunus spinosa	+	0.002	0.002	0
Quercus petraea	0.120	0.097	0.217	2.2
Quercus robur	0.044	0.411	0.455	0.4
Quercus sp	0.503	0.659	1.162	28.9
All Quercus	0.667	1.137	1.834	3.6
Salix capraea	0.010	0.008	0.018	10.5
Sambucus nigra	0	0	0	0
Sorbus aucuparia	0	0	0	0
Taxus baccata	0.014	0	0.014	3.5
Others	0.104	0.013	0.117	36.9
Totals	3.440	2.250	5.690	8.1

KEY

1 = Stems brought down by the storm, alive in winter 1988.

2 = Brought down by the storm, mainly as branches, dead by winter 1988.

3 = Total brought down by the storm (Col 1 + 2).

4 = Wood brought down by the storm and still alive in winter 1988 (col 1) as a % of trees living before the storm.

Storm damage to different woodland types

Figure 11 shows the broad pattern of the effects of the storm on the whole site, but it would be more valuable to learn whether the storm affected any one particular type of woodland more than another. In order to address this problem, one area within the Mens, The Cut, was selected for examination. This is a relatively homogeneous area in the centre of The Mens, away from areas where it appears that topography might have been the overriding factor determining the extent of storm damage.

Quadrats were categorised, according to a simple classification system, as either beech dominated (ie beech comprises more than 60% of the basal area for the quadrat), oak dominated (oak comprises more than 60% of the basal area) or mixed (no one species attaining 60% of the basal area).Within each category, storm damage was calculated for all the most frequent species, and as a total figure. Storm damage is measured as percentage of living basal area brought down by the storm. Windthrown trees (ie uprooted) and windsnapped trees (fallen branches or broken stems) are shown separately. The results are shown in table 3.

From these results the following patterns emerge:

1 Mixed stands were most heavily damaged, followed by beech, whilst oak stands were least damaged.

2 Beech trees experienced both more windthrow and windsnap than oak.

3 Beech generally experienced more windthrow than windsnap.

4 Oak experienced more windsnap than windthrow.

5 All trees experienced proportionally more damage in mixed quadrats, though this was particularly so with beech.

6 Shrubs like hazel and holly only suffered significant damage in mixed quadrats. This was where damage to larger trees was heaviest so presumably shrubs were crushed by falling trees.

TABLE 3 Storm damage to different woodland types in The Cut.

	All stands		Beech dominated		Oak dominated		Mixed stands	
	T	B	T	B	T	B	T	B
Betula spp	0	0	0	0	0	0	0	0
Corylus avellana	7.7	9	0	0	2.6	0	19.0	26
Crataegus spp	1.5	0	0	0	2.1	0	0.2	0
Fagus sylvatica	11.9	4	6.9	5	3.2	6	19	2.4
Fraxinus excelsior	0	0	0	0	0	0	0	0
Ilex aquifolium	7.8	0	0	0	0	0	11	0
Quercus spp	0.9	3.2	0	5	0.3	2.5	2.4	5
All trees	5.1	3.2	5	5	0.8	2.8	9.6	3

KEY
T = Trees - windthrown (as a % of living pre-storm basal area).
B = Branches etc - windsnapped (as a % of living pre-storm basal area).