RANGE ECOLOGY RESEARCH

GLENFESHIE

MONITORING OF VEGETATION AND GRAZING USE

1969 - 71

For restricted circulation

GLENFESHIE

REPORT ON MONITORING OF VEGETATION

COMPOSITION AND GRAZING USE

1969-71

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The Nature Conservancy
Banchory.

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FOREWORD

Details of the management and development study at Glenfeshie have been described elsewhere. The Nature Conservancy is associated with the Estate in this programme which involves a number of changes affecting both the red deer population and various aspects of land management.

Three categories of investigational work are being conducted on the estate. Some work is being done to provide data to assist in the solution of immediate management problems. Other studies are being carried out to monitor the effects of management changes on the red deer and their habitat. Finally, Glenfeshie is being used as a research area for the study of a variety of ecological problems which form a part of the Conservancy's research programme in upland Britain.

This report describes only the work on the monitoring of certain habitat characteristics. The monitoring programme was designed not only to guide future management, but also as a contribution to a case-history study which is relevant to a considerable area of the Highlands, where the land-use and conservation problems are essentially similar to those at Glenfeshie.

This brief account of the work on habitat monitoring between 1969 and 1971 is supplementary to the 1970-71 annual report on Glenfeshie. It is intended for restricted circulation amongst those closely concerned with the project. The account is designed for information and communication and much detail has been omitted. Reports on the monitoring of the red deer population have been prepared separately.

I. A. Nicholson
Leader
Range Ecology Group

CONTENTS

1. Introduction

J. Miles

The background, aims and details of the Glenfeshie Management and Development Project are fully described in the "Glenfeshie Progress Report - 1966-69". At the outset it was agreed that it was necessary to describe an "ecological baseline" so that long term changes in the vegetation and deer population, that might occur as a result of proposed changes in management, could be monitored and evaluated. The deer studies began in 1966, and have been reported elsewhere (Glenfeshie - Red Deer Population and Performance 1966-70 and 1966-71). A reconnaissance map of the vegetation was made during 1967-69 and is lodged in the library. However, it was not until late in 1968 that the organization needed to cope with the vegetation monitoring could be developed. Also, by then, management and development proposals were clarified sufficiently for it to become clear what vegetation monitoring should be undertaken - there was never any question of trying to monitor all major parameters of the vegetation over the whole estate. Initial proposals for monitoring the vegetation were then formulated. Studies were carried out during 1969-71, and have now been completed. Most effort was concentrated in the main glen.

Management changes were in fact made some time before the vegetation monitoring was completed. However, there appears to have been negligible change in the vegetation so far (see section 4), so it is unlikely that the validity of the "before and after" comparison will have been materially affected.

The ability of the monitoring studies to fulfil management requirements is under continuous review. Thus, while most of the studies described in this report implemented the initial monitoring proposals, two, described in sections 3 and 5, were conceived later to give a more comprehensive description of conditions in the glen and, in the case of the mapping described in section 3, to contribute to experimental work. For descriptive purposes, and to assist in management and research, a soil survey was also carried out by the Macaulay Institute for Soil Research. The soil map, and data on the soils, have been lodged in the library, and no details are given in this report.

The aim of this report is to provide an overall description of what vegetation monitoring has been done. It does not, however, give all the details of methodology which are needed to repeat the studies at some future date, nor all the data collected, which are mostly of little interest until they can be compared with the results of future redescription. Copies of these details and data are being lodged in the Station libraries at Banchory and Speyside.

2. Tree and shrub regeneration

J. W. Kinnaird

Recent changes in the management of the estate may eventually affect the distribution and extent of conditions suitable for germination and establishment, and affect the growth of trees and shrubs.

The woodlands and juniper scrub in Glenfeshie were classified, and described in the "Glenfeshie Progress Report - 1966-69". On the basis of this classification, 16 permanent sample plots were selected in August 1969 to represent the range of woodland and scrub, and in addition four plots were selected on ground adjacent to woodland and scrub (potential woodland plots). The location of the plots is shown on Map 1.

Plots in pinewood, birchwood and potential woodland measured 500 m^2, and in each a random sample of 200 circular 15.5 cm diameter quadrats was taken. Plots in juniper scrub and flush woodland were 25 m^2 and 100 m^2 and only 50 and 100 samples respectively were taken. The occurrence of ground surface types was recorded as a percentage and the number of tree and shrub seedlings and saplings were noted. The height of all saplings was measured and samples were taken for ageing. The cover of ferns, dwarf shrubs, shrubs and trees was estimated. However, in all the juniper plots the location of each juniper bush was also mapped, and the height, diameter, crown depth and proportion grazed recorded for each bush.

There is considerable variation in both the seedling and sapling densities (Table 1) both between and within woodland types. The comparatively high density of saplings in some of the birch and potential woodland plots suggests that these sites are probably capable of regenerating satisfactorily if the grazing pressure were lower. In view of the scarcity of mature rowan trees in Glenfeshie, the number of rowan saplings is noteworthy.

MAP 1. Glenfeshie Woodlands

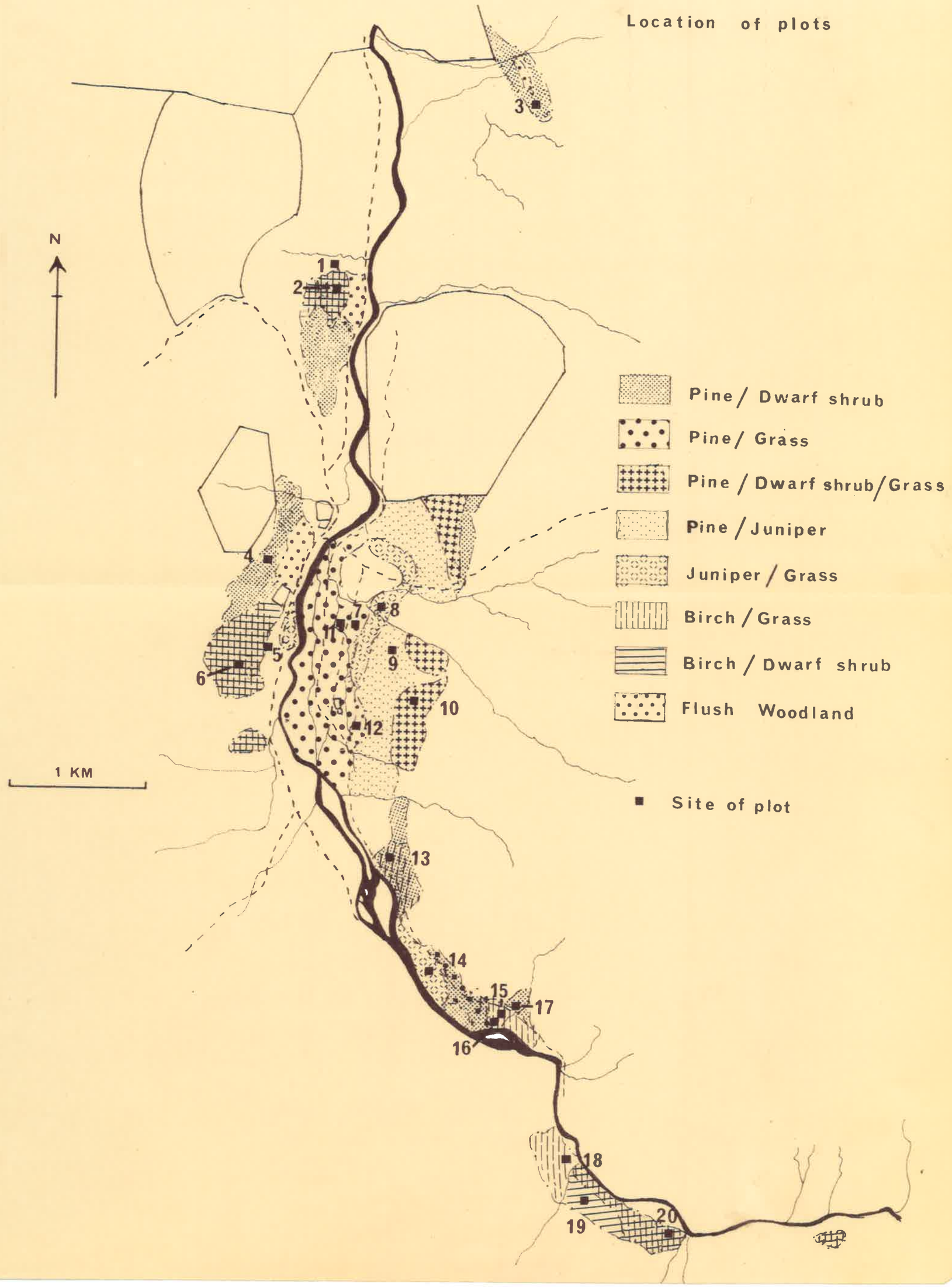


Table 1

	Seedlings 1 yr (No/m^2)					Saplings 1 yr and over (No/m^2)					
	Birch	Rowan	Juniper	Pine	Total	Birch	Rowan	Juniper	Pine	Willow	Total
A. Birch Plots											
2	6.25	0	0	0	6.25	0.75	0.25	0	0	0	1.00
6	1.25	0	0	0	1.25	0.5	0.25	0	0	0	0.75
13	6.03	0	0	0	6.03	3.25	0	0	0	0	3.25
16	14.00	0	0	0	14.00	0.25	0	0	0	0	0.25
18	1.75	0	0	0	1.75	1.25	1.75	0	0	0	3.00
19	5.25	0	0	0	5.25	2.00	1.75	0	0	0	3.75
20	7.75	0	0	0	7.75	1.25	0.50	0	0	0	1.75
Mean	6.04	0	0	0	6.04	1.32	0.64	0	0	0	1.96
B. Scots pine Plots											
3	0	0.5	0	1.0	1.5	0	0.25	0	0	0	0.25
4	0	0	0	0	0	0	0	0	0	0	0
7	0	0.25	0	0	0.25	0	0	0.25	0	0	0.25
11	0	0	0	0	0	0	0.25	0.25	0	0	0.5
17	0	0	0	0	0	0	0	0	0	0	0
Mean	0	0.15	0	0.20	0.35	0	0.1	0.1	0	0	0.2
C. Juniper Plots											
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0.5	0	0	0	0	0.5
14	0	0	0	0	0	0	0	0	0	0	0
Mean	0	0	0	0	0	0.17	0	0	0	0	0.17
D. Flush Woodland Plot											
12	2.0	0	0	0	2.0	0	0	0	0	0	0
E. Potential Woodland Plots											
1	3.75	0	0	0	3.75	3.75	0	0	0	0	3.75
5	0.25	0	0	0.25	0.5	0	0	0	0	0	0
10	0	0	0	0	0	0.25	0	0	0	0	0.25
15	7.0	0	0	0	7.0	10.5	0	0	0	0	10.5
Mean	2.75	0	0	0.06	2.81	3.63	0	0	0	0	3.62

3. Distribution of Callunetum, Agrosto-Festucetum and intermediate vegetation types on the main glen floor

D. Welch

The reconnaissance survey of the vegetation mentioned in the Introduction covered the whole estate. Detailed mapping of vegetation types has been done only on the floor of the main glen. This area was chosen for special treatment because changes are most likely to occur here where grazing pressures are heaviest, and because it contains most of the grasslands and stands of grassy Callunetum.

The proportions of Calluna and grass in a stand and the state of the Calluna plants are important determinants of the grazing value of vegetation to grazing animals, and also reflect the degree of recent utilisation, and the time elapsed since muirburn. It was therefore decided to base the mapping units on the relative proportions of Calluna and grass in the stands, and on the average height of the Calluna, using a five-point scale for both. Many small, fairly discrete stands of vegetation occur on the glen floor, and to minimise the errors likely on combining together different stands, all stands recognisable from aerial photographs or ground survey greater than about 500 m^2 have been recorded. Where just two or occasionally three vegetation types recur irregularly over a fairly large area, they have been mapped as a whole, and the components and their approximate proportions indicated.

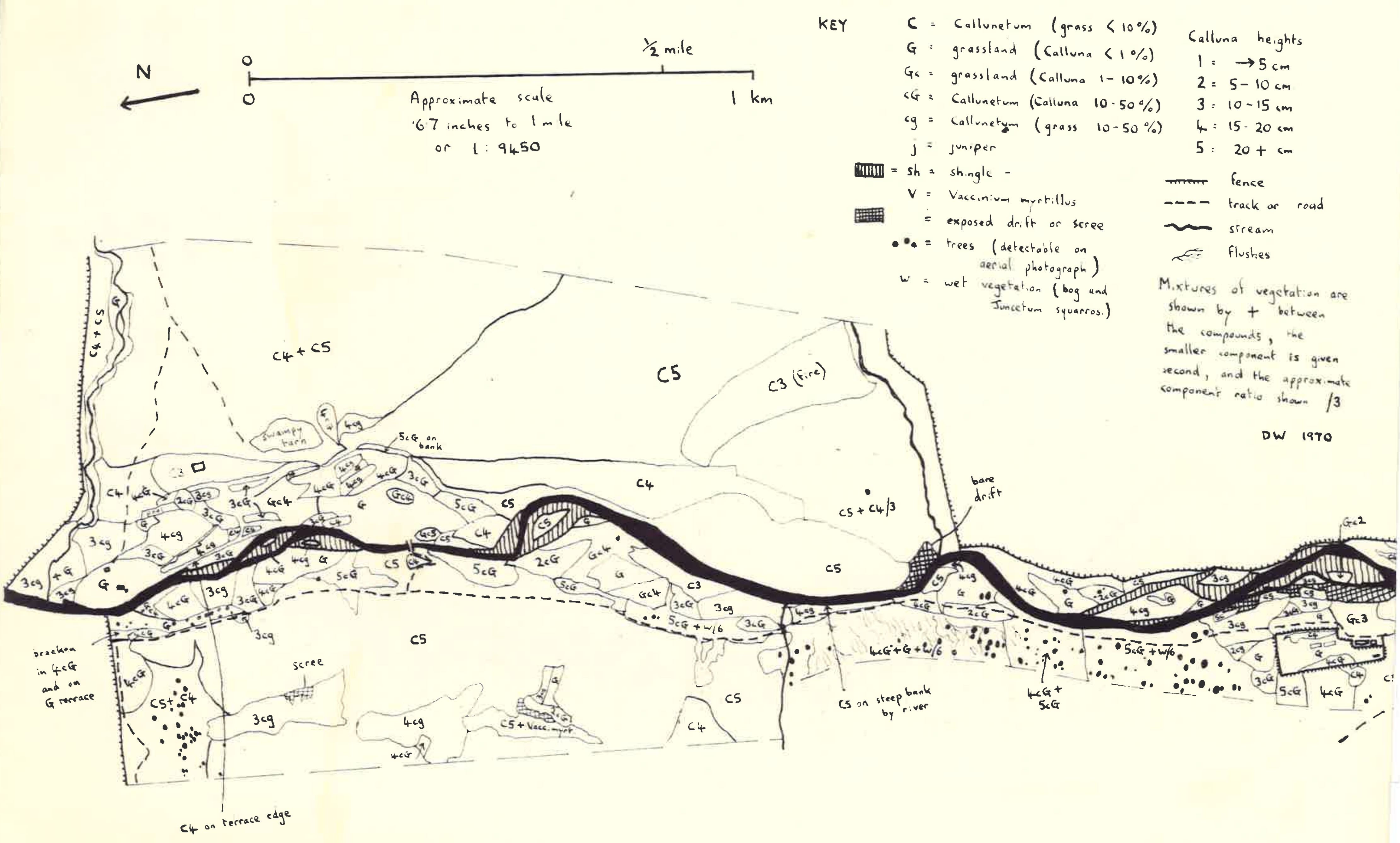
The outline of the map was obtained by tracing from the central parts of 1:7,500 scale aerial photographs. The boundaries of the vegetation units were determined initially from aerial photographs, but were subsequently modified where necessary on ground survey when the vegetation type was determined.

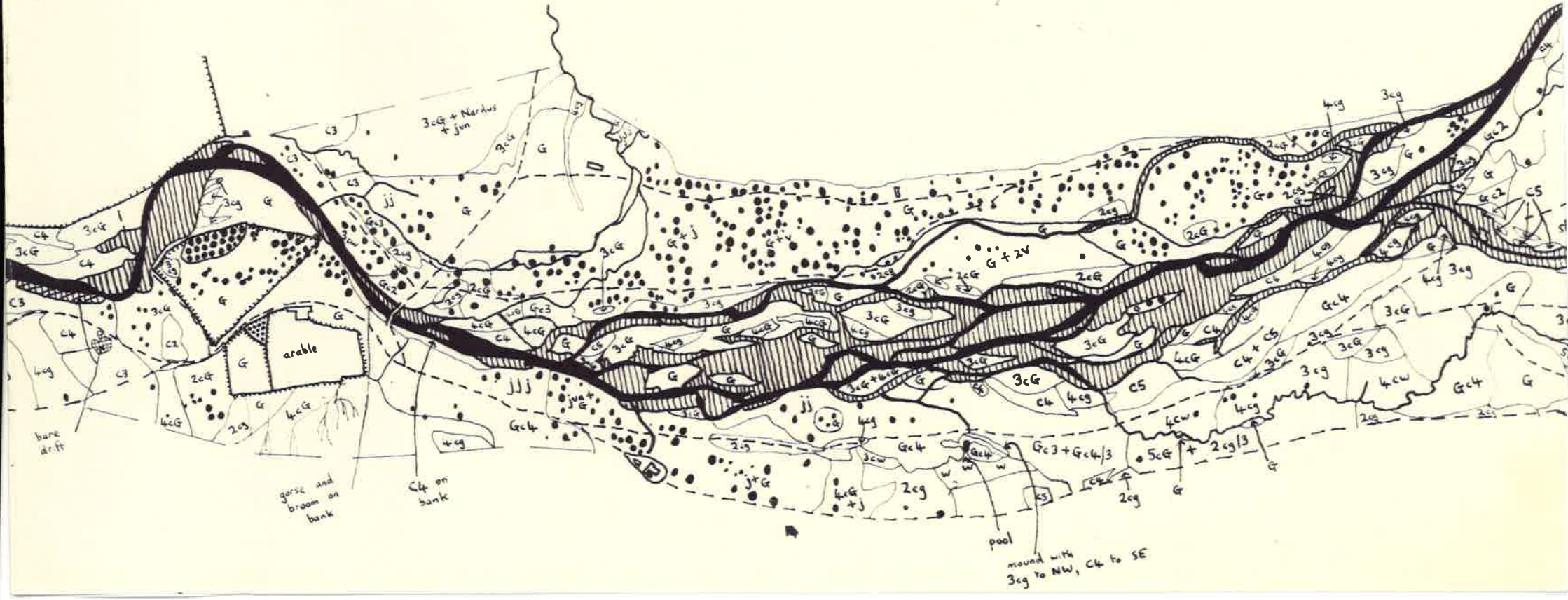
The vegetation in the 1150 ac (365 ha) area mapped is highly heterogenous (Map 2) due to the varying nature of the alluvial and glacial deposits, and the impact of grazing and burning. Both pure grassland and mature Callunetum occur in each mile length of the valley, and are sometimes contiguous. The grassy Calluneta (cg, cG) have greater extent than either the grasslands (G, Gc) or the pure Calluneta (C), except at the lower end of the glen where the mapping extended further from the river. These intermediate types may have been derived either from Callunetum subjected to heavy grazing, or grassland reverting to Callunetum, or direct from woodland with a mixed field layer; probably each of these processes has occurred in some part of the glen floor. In the "Confluence" area, ground showing ridges due to past cultivation now carries grassy Callunetum in places, but there are few signs of recent rapid change e.g. large Calluna bushes with few green shoots remaining. Also only a few stands showed clear indication that burning has taken place recently. Sustained, moderately heavy grazing has probably been the most important factor in keeping the Calluna short and creating the grassy Calluneta. Calluna averaged between 10 and 20 cm in height over half the total acreage of grassy Callunetum, but over 20 cm in most stands of pure Callunetum.

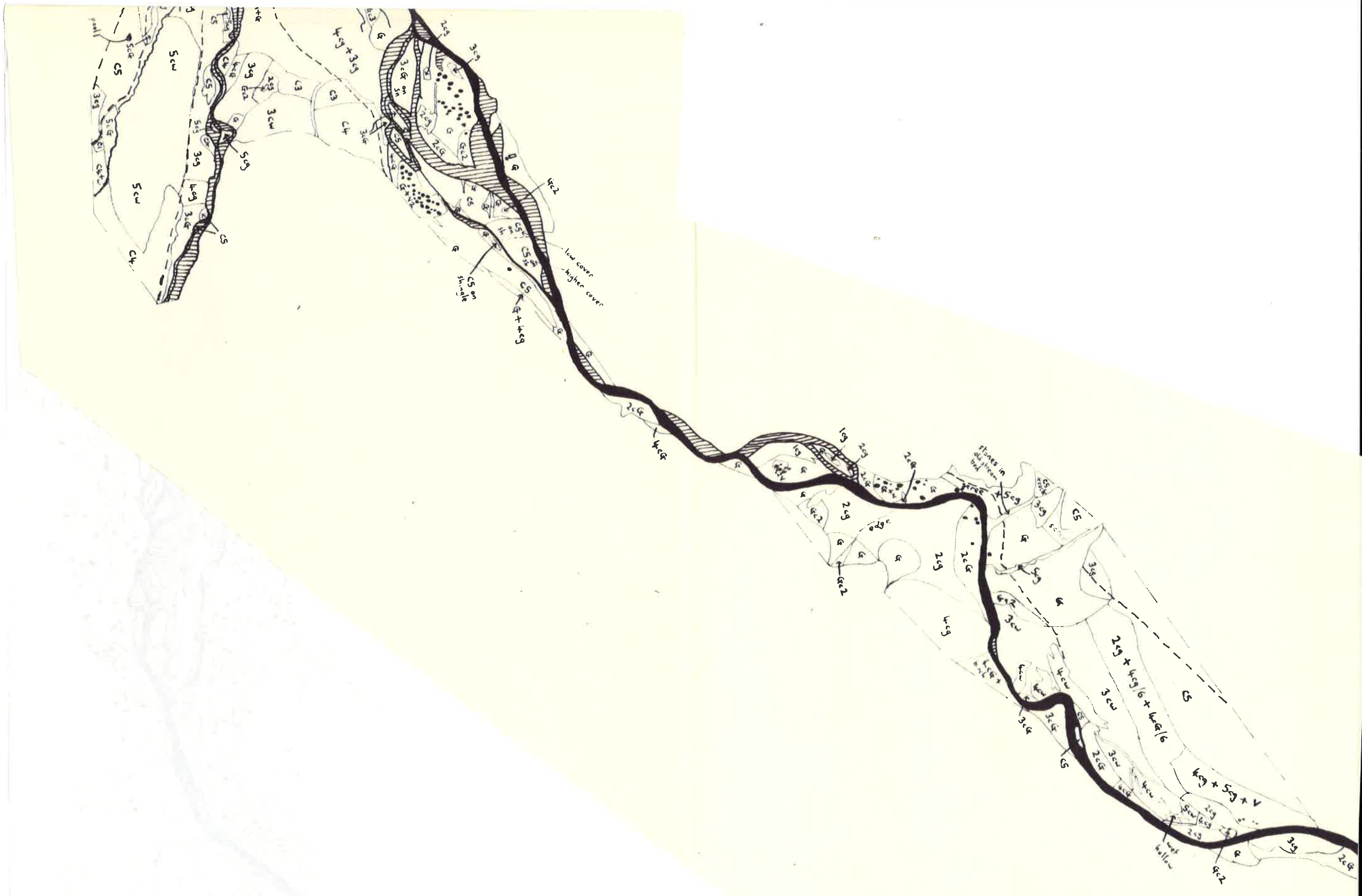
The grasslands tend to be more extensive in the vicinity of the Lodge and the heather shorter, but otherwise there are no major differences in vegetation between sectors of the glen floor. This would be compatible with herbivores coming to graze in the glen from the surrounding hills rather than from one end, and would imply that sheep and cattle have been much less important than deer in the recent past.

From these several observations it seems likely that the number of deer now present is insufficient to cause an overall reduction in the amount of Calluna, unless other agencies, such as fire or domestic herbivores, supplement their effect. If management reduces the deer pressure, a slow increase of Calluna at the expense of grass is likely to occur.

MAP 2


N
0
½ mile
1 km
Approximate scale
·67 inches to 1 mile
or 1 : 9450
KEY
C = Callunetum (grass < 10%)
G = grassland (Calluna < 1%)
Gc = grassland (Calluna 1 - 10%)
cG = Callunetum (Calluna 10 - 50%)
cg = Callunetum (grass 10 - 50%)
J = juniper
= sh = shingle -
V = Vaccinium myrtillus
= exposed drift or scree
= trees (detectable on aerial photograph)
w = wet vegetation (bog and Juncetum squarros.)
Calluna heights
1 = → 5 cm
2 = 5 - 10 cm
3 = 10 - 15 cm
4 = 15 - 20 cm
5 = 20 + cm
fence
track or road
stream
flushes
Mixtures of vegetation are shown by + between the compounds, the smaller component is given second, and the approximate component ratio shown /3
DW 1970
C4 + C5
C5
C3 (fire)
swampy tarn
5cG on bank
bare drift
C5 + C4/3
bracken in 4cG and on G terrace
C5 + C4
scree
3cg
4cg
C5 + Vacc. myrt.
C4 on terrace edge
C5 on steep bank by river
4cG + G + w/6
4cG + 5cG
5cG + w/6
5cG + w/6
Gc3
Gc2


3cG + Nardus + jun
arable
bare drift
gorse and broom on bank
C4 on bank
pool
mound with 3cg to NW, C4 to SE



4cg + 3cg
CS on shingle
G + 4cg
low cover
higher cover
stones in old stream bed
edge
wet hollow
2cg + 4cg/6 + 4cG/6
4cg + 5cg + V

4. Species composition of the grasslands and Calluneta

J. Miles

The vegetation of nine sites in the main glen was described during 21-29 July 1969. The sites comprised four in fertilised Agrostis-Festuca grassland, two in unfertilised grassland, two in fertilised Callunetum and one in unfertilised Callunetum. A further nine sites were described during 6-15 July 1970: two in pinewood and one in juniper scrub in the main glen, and six in grassland in the upper glen and corries. One of the pinewood sites described lies close to the forestry enclosure planted in 1967, on a grassland-Callunetum boundary where deer pressure seemed higher than nearby. The location of these 18 sites is shown on Map 3.

The vegetation was described by recording the presence of all species rooting in separate 5 cm squares of a 25 x 25 cm gridded quadrat. (Calluna and other dwarf shrubs were recorded by shoot presence.) The species in each quadrat were also rated on the Domin scale. Five quadrats were described and permanently marked at each site.

One quadrat at each of the nine sites described in 1969 was redescribed in 1970. The results are given in Tables 2 and 3. They indicate that there was no marked change in composition during the intervening year. Such small changes as were detected could be expected to result from normal annual fluctuations in composition.

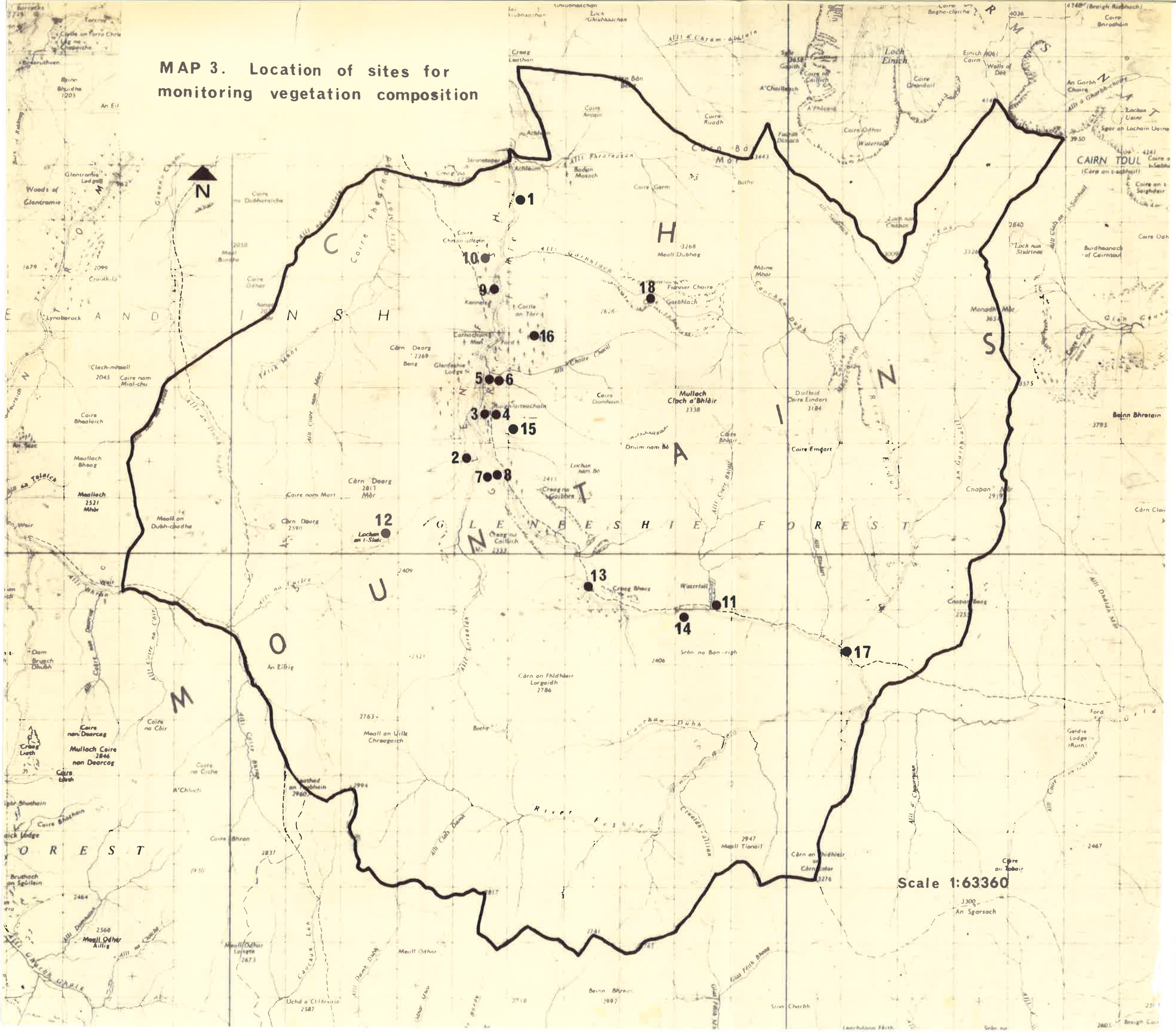
The Domin cover-abundance scale used is as follows:

10. Cover about 100%
9. Cover 75%
8. Cover 50-75%
7. Cover 33-50%
6. Cover 25-33%
5. Cover about 20%
4. Cover about 5%
3. Scattered, cover small
2. Very scattered, cover small
1. Scarce, cover small
+. Isolated, cover small

Table 2. Recording at Agrostis-Festuca grassland sites in Glen Feshie

Site*	1		2		3		4		5		6	
Year of description	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
Domin rating/presence in 25 squares	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P
Achillea millefolia		1 2			2 4	2 4					1 2	1 2
Agrostis tenuis	6 22	5 25	7 25	5 23	8 25	5 25	4 23	4 14	6 25	6 25	4 23	4 18
Anthoxanthum odoratum	3 9	3 9	4 20	6 22								
Bazzania sp.	+ 1											
Carex pilulifera	4 18	4 12	4 12	4 11	4 14	4 15	4 12	4 14	2 3	1 3	3 7	3 6
Cephaloziella byssacea	+ 1										+ 1	
Cladonia spp.	+ 1		+ 1	+ 1								
Dicranium scoparium	1 3		2 14	2 7			+ 1				+ 1	
Euphrasia officinalis agg.									+ 1	2 5		
Festuca rubra	7 24	7 24	6 25	6 20	5 24	7 23	8 24	7 24	8 25	8 25	6 19	7 22
Galium saxatile	5 23	5 22	5 23	5 22	3 23	3 8	6 25	5 23	4 23	4 21	5 25	5 23
G. verum					4 13	4 7						
Hylocomium splendens	4 23	8 25	3 24	5 16	5 20	4 15	8 25	5 24	4 18	4 21	6 25	5 23
Hypnum cupressiforme	1 2	3 8	3 14	1 3			3 15	3 8				
Lophocolea bidentata	+ 1		1 3		+ 1	+ 1	2 7	+ 1	+ 1		3 12	2 6
Luzula campestris	3 10	3 8	+ 1	1 2	+ 1	+ 1	3 10	4 18			+ 1	+ 1
Pleurozium schreberi	5 25	1 1	1 4		3 8	1 2	3 10	2 7	7 16	4 10	6 19	4 13
Polygala serpyllifolia										+ 1	1 2	
Polytrichum commune	1 2	+ 1	1 5	1 4	6 24	4 18		+ 1			8 24	5 24
Potentilla erecta			+ 1	+ 1			4 15	4 10			5 15	5 9
Pseudoscleropodium purum					1 5	2 5	+ 1				2 6	+ 1
Ptilium eiliare	3 20	1 4	1 3									
Ranunculus repens									2 3			
Rhytidiadelphus squarrosus	3 15	3 22	4 21	4 15	6 25	4 24	4 24	4 22	3 14	2 8	3 11	3 8
R. triquetrus	1 2	2 3	4 16	4 11		1 2	+ 1		1 2	1 3		
Sieglingia decumbens	1 2		3 10	1 2								
Vaccinium myrtillus								+ 1				
V. vitis-idaea							4 6	4 4	3 7			
Veronica chamaedrys									2 4	2 3		
Viola riviniana					2 3	4 7						

*1, 2, 3 and 5 - Fertilized grassland; 4 and 6 - Unfertilized grassland



MAP 3. Location of sites for monitoring vegetation composition

Table 3. Recording at Callunetum sites in Glen Feshie

Site*	7				8				9			
Year of description	1969		1970		1969		1970		1969		1970	
Domin rating/presence in 25 squares	D	P	D	P	D	P	D	P	D	P	D	P
Agrostis tenuis	2	3	2	4	3	17	3	11				
Anthoxanthum odoratum	3	6	2	4	1	3	4	7				
Calluna vulgaris	8	25	7	25	8	25	7	25	8	23	7	22
Campanula rotundifolia					1	2	1	2				
Carex pilulifera	2	3	2	4	2	4	1	3				
Cladonia spp.									4	6	3	9
Deschampsia flexuosa							2	2			1	2
Dicranum scoparium	4	11	4	9							+	1
Erica cinerea	3	5	3	7	+	1	+	1				
Euphrasia officinalis agg.	2	10	3	7	2	7	3	12				
Festuca rubra	4	20	5	20	4	14	4	16				
Galium saxatile	+	1			+	1	1	4				
Hylocomium splendens	3	9	4	11	4	22	5	25	6	25	8	23
Hypericum pulchrum					+	1						
Hypnum cupressiforme	7	25	6	24	6	24	4	14	4	12	6	24
Listera cordata	1	3	2	2								
Lophocolea bidentata					2	8					3	8
Luzula campestris	1	3	1	3	3	10	5	11				
Pleurozium schreberi	2	5							4	11	3	11
Polygala serpyllifolia					1	2						
Potentilla erecta	3	10	4	7	4	22	5	19				
Ptilium eiliare											+	1
Rhytidiadelphus triquetrus									5	18	3	19
Scapania sp.											1	3
Succiza pratensis	4	2	4	5	4	6	4	7				
Vaccinium myrtillus					1	2	1	2	2	2	2	2
V. vitis-idaea							2	2			1	2

* 7 - unfertilized Callunetum

8 and 9 - fertilized Callunetum

5. White clover establishment

J. Miles

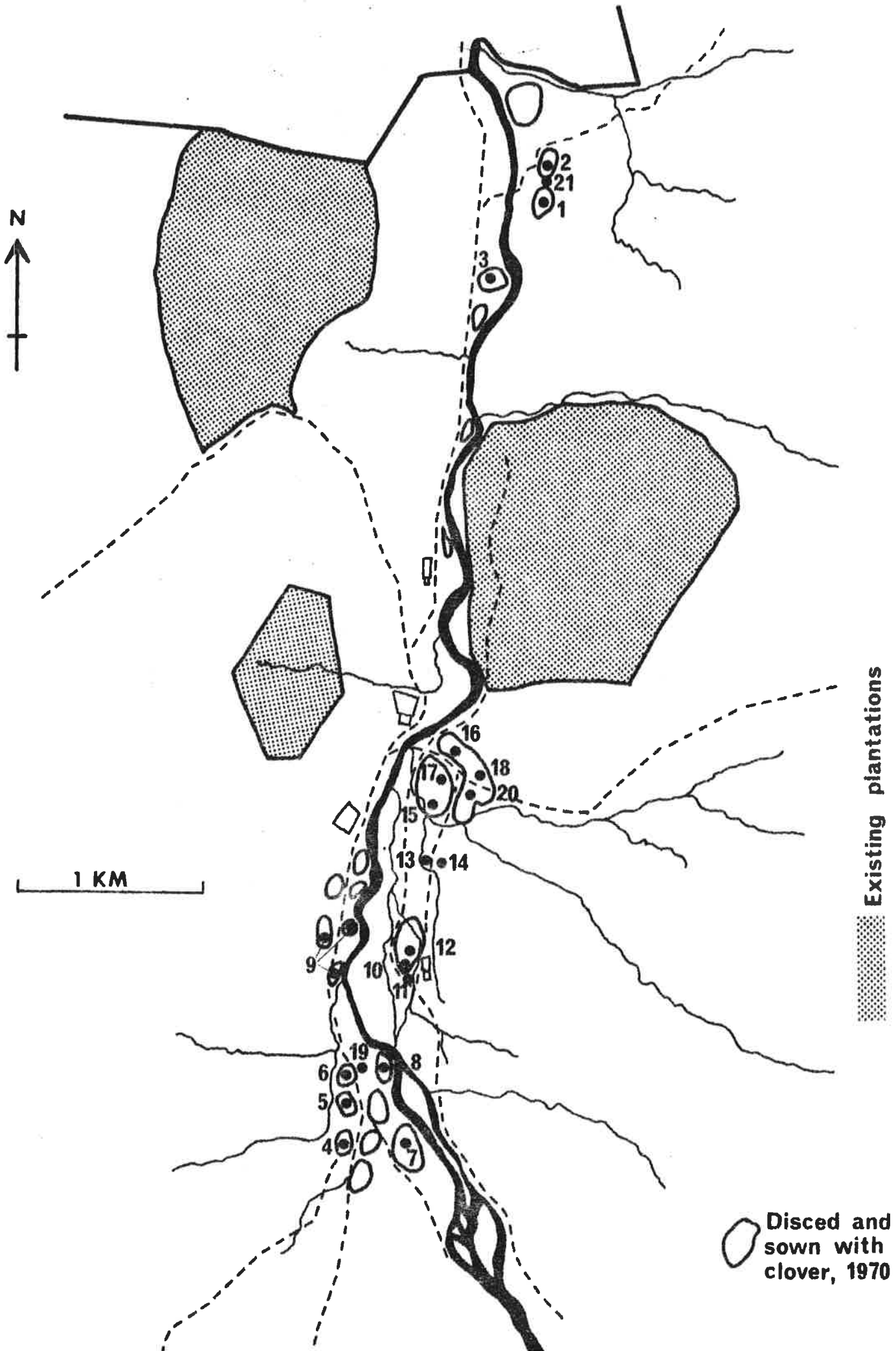
In the summer of 1970 about 13 hectares in the bottom of the main glen were disced and sown with white clover. This was done as a number of small patches, mainly in grassland but with some in Callunetum. All except one patch had been treated with ground limestone and basic slag in May 1969.

In July 1970, before the clover was sown, the cover, and percentage frequency in 25 x 25 cm quadtats, of white clover already present, were determined in 17 of these disced patches, 16 of which had previously been fertilized, and in four non-disced patches, two of which had been fertilized (Map 4). 100 quadrats were placed approximately equdistantly in each patch, and in each quadrat the cover of white clover was estimated by eye in units of 10%. The results are shown in Table 4.

Table 4. Clover-abundance of white clover in the main glen in July 1970.

Treatment	Area (see Map 4)	% Frequency in 25 x 25 cm quadrats	Mean % cover
Fertilized, disced and sown with clover	1	0	0.0
	2	6	0.9
	3	14	4.2
	4	7	2.6
	5	4	0.7
	6	25	6.9
	7	5	0.9
	8	4	0.7
	9	5	1.3
	12	6	3.3
	15	27	9.1
	16	17	5.4
	17	33	13.0
	18	0	0.0
Not fertilized, but disced and sown	10	8	2.2
Fertilized, but not disced or sown	13	56	26.2
	19	3	0.3
	20	23	10.6
	21	4	0.8
Neither fertilized, disced nor sown	11	11	3.0
	14	14	2.9

MAP 4. Location of sites for estimating clover abundance



6. Seasonal variation in herbivore use of different range types

D. Welch

Herbivore use was estimated by measuring the volumes of dung deposited in sample plots over given periods of time. Nine sites were examined, comprising six vegetation types. These were situated on the main glen floor except for one site, a Callunetum, on an adjacent slope (Map 5). The sites were chosen to allow comparison of the usage on similar stands of Agrosto-Festucetum and grassy Callunetum in different parts of the glen.

At each site eight 15 x 1 m plots were laid out over an area of about 0.4 ha. All dung was cleared from the plots before measurements were begun in June 1969. These took place at three-to four-week intervals, for 12 months, using water displacement in a cylinder, and the measured dung was not returned to the plots. Droppings of rabbits and hares were measured together, but dung from all other species was recorded separately.

The volumes of dung collected (Table 5) show that red deer neglected the Callunetum, and to some extent the pure grasslands, in comparison to the grassy Calluneta and Calluneto-Juncetum squarrosi. The grasslands had a variety of use, and it is clear that in the year under study cattle and horses must have had at least as much effect on the grasslands as the deer. Hares and rabbits could only have had marked effects at the Pony Bridge grassland, and stray sheep were present in negligible number.

It was found as expected that the deer spent much less time in the main glen in the April to September period than the rest of the year (Table 6). Nevertheless, the sites in the upper part of the glen were still visited quite regularly at this time. Substantial utilisation at the Calluneto-Juncetum squarrosi site was recorded in every month. Within the autumn, winter and early spring periods utilisation was related to the weather and herbage condition. At the grassy sites deer numbers were greater in the early part of the winter before the herbage died, whereas the Callunetum on the glen side was little used till January, and numbers were greatest in March and April when comparatively good weather encouraged the deer to leave the sheltered glen floor. At this time the pinewood beyond the confluence was very little used, but numbers rose sharply in May, presumably as grasses and Vaccinium myrtillus became available.

The present best estimate of the conversion factor for deer dung is that 25000 cc on 120 m^2 in one year indicates a density of 1 deer per acre. Thus the pressures on all the sites examined were much greater that the known average for the whole deer forest. The densities indicated are of interest in that they straddle the value likely to maintain a balance between heather and grass in the environmental conditions of Glenfeshie, and imply that in the absence of domestic livestock some of the purer grasslands are likely to revert slowly to Callunetum if the pattern of deer grazing does not change.

Table 5 Dung volumes deposited on plots totalling 120 m^2 over a twelve-month period from June 1969 to May 1970. 95% confidence limits are shown for the deer totals, based on the eight plots at each site

	Sheep	Cattle	Horse	Hares & Rabbits	Grouse	Roe	Red Deer
Agrosto-Festucetum							
A1 fertilised (Pony Br)	235	2685	4520	1317	0	0	6532 ± 1662
A2 fertilised (Ruigh-aiteachan)	243	5850	2635	28	0	18	7664 ± 3126
A3 control	240	296	2540	141	0	0	4585 ± 2023
Grassy Callunetum							
AC1 (Rails)	508	1505	2420	0	1	0	13600 ± 4582
AC2 (Confluence)	435	2080	0	5	0	0	17262 ± 4195
Calluneto-Juncetum squarrosi							
CJ1 (beyond Lodge)	525	650	0	15	15	0	27217 ± 4823
Callunetum							
C1 (Kennel Road)	0	0	0	66	445	0	5917 ± 1922
Birchwood							
SF1 (glen side beyond Rails)	95	0	0	0	0	33	7996 ± 3924
Pinewood							
SF2 (beyond Confluence)	355	0	0	0	0	0	7924 ± 1881

MAP 5.
Location of dung measurement sites

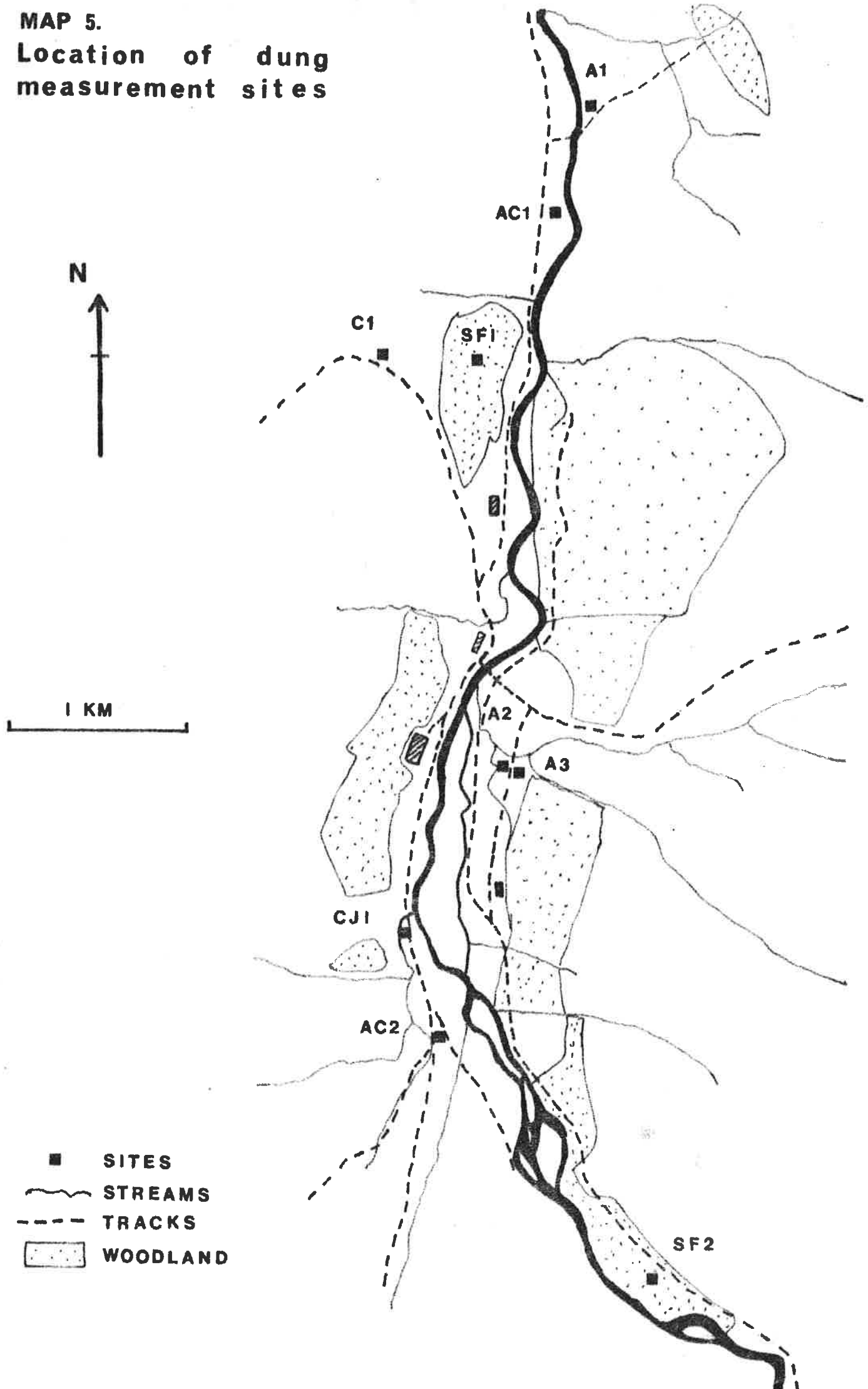


Table 6. Seasonal variation in the rates of deposition of red deer dung during four grazing periods: 1 = 1st June - 15th Sept 1969, 2 = 16th Sept - 13th Jan 1970, 3 = 14th Jan - 15th Apr, 4 = 16th Apr - 29th May.

Site	Rates of deposition of dung (cc/120m^2 / 30 days)			
	1	2	3	4
A1	1	996	820	18
A2	200	910	900	376
A3	153	410	576	433
AC1	75	2346	1040	517
AC2	219	2179	2322	438
CJ1	383	3872	2628	1568
C1	75	172	1386	486
SF1	165	786	1304	180
SF2	409	1171	192	813

7. Photography

I. S. Paterson

Good quality photographs can give a simple but effective record of habitat changes if the subjects are carefully selected at the outset. A small programme of photography was carried out in Glenfeshie, during the three summers of 1969-71. The subjects fall into two classes, panoramic views and details of specific subjects. All photographs were taken from marked points.

The panoramic views of both sides of the main glen show clearly the extent of woodland and scrub, heather and grassland, old heather fires, fences, tracks and buildings, as well as showing details of woodland and scrub structure and of grassland - Callunetum boundaries.

The remaining photographs are views of selected woodland and juniper scrub stands, eroded areas and grassland - Callunetum boundaries.

The photographs are filed at the Banchory station with the detailed records of the whole monitoring programme.