REPORT ID 72.

F (5)

Site Survey Report

Bennachie Forest

1. Bennachie, upper slopes and summit
2. Tillybin acquisition

North East Dalradian Highlands Forest Region

(Acid Igneous Lithology)

Report written by J Davidson
1983

Bennachie

1. Introduction

A soil survey and windthrow hazard assessment of potential plantable reserve on the middle and upper slopes of Bennachie was carried out by Site Survey Forester J Davidson during 1981 and 1982. The vast majority of the 745 ha surveyed was bare hill although the survey dips irregularly into the adjacent crop. Soil and windthrow hazard maps at 1:10,000 scale have been produced from field data.

2. Location

The hill of Bennachie, a few kilometres west of Inverurie, is a conspicuous landmark overlooking the adjacent lowlands; it can be located on OS 1:50,000 sheets 37 and 38, Strathdon and Aberdeen respectively. The relevant sections of these maps are reproduced as a composite in Appendix 1.

3. Climate

In their assessment of climatic conditions in Scotland, Birse and Dry (1970) considered two parameters: annual accumulated temperature above 5.6°C and potential water deficit. The middle and upper slopes of Bennachie are classified as SR, cold rather wet foothill and upland (550 - 825 day degrees above 5.6°C), the lower boundary of the survey coinciding with the interface between SR and MR, cool rather wet lowland foothill and upland (825 - 1100 day degrees above 5.6°C). Annual rainfall is of the order 950-1,000mm in normal years when a 0-25mm potential water deficit is to be expected.

Birse and Robertson (1970) assessed annual exposure and accumulated frost. The principal summit area is classed as vr, very exposed with rather severe winters (wind speed 6.2 - 8 m/s; 110 - 230 day degrees accumulated frost) which is gradually superseded by pr, exposed with rather severe winters (wind speed 4.4 - 6.2 m/s; 110 - 230 day degrees frost) on middle slopes and intermediate summits. The pr climatic division grades into mr, moderately exposed with rather severe winters (wind speed 2.6 - 4.4 m/s; 110 - 230 day degrees frost) on the north western perimeter below Hermit Seat and on the southern boundary.

Bennachie is in region 11A, Eastern Uplands sub-region, of the FC climatic zonation derived from the above data.

4. Topography

Bennachie is a discrete tongue of upland protruding eastwards from the main Grampian massif. The eastern slopes dominate the coastal lowlands whereas those facing north and south west overlook the Insch basin and the Howe of Alford respectively. The landform is typical of an acid igneous intrusive body that has subsequently been exposed by erosion of the overlying country rock: slightly convex side slopes and an extensive summit area incorporating a number of tops of similar height. Six summits exceed 460m, of these the highest point is the central summit, Oxen Craig (529m), although the Mither Tap (518m) on the eastern rim is undoubtedly the most dramatic and conspicuous of these rocky tors. An irregular and comparatively narrow fringe of generally steeper slopes segregates the plantations on either side of the hill from the upper slope/summit zone, albeit such a concise distinction is not so apparent in the vicinity of Hermit's Seat in the western sector. On south facing slopes

the survey extends down to 365m at the western end, to 305m adjacent to Bruntwood Tap and to 285m below the Mither Tap. The lower boundary on north facing slopes is relatively consistent at 280m throughout its length.

The middle and upper slopes of Bennachie and the adjoining Coreen Hills are sufficiently extensive to be demarcated as a zone of discrete uplands in the E(S) map (1:250,000) outlining a broad classification into relief zones.

5. Geology

Bennachie is a substantial intrusive igneous body, part of the Palaeozoic Forceful Newer Granite suite that was emplaced between late Silurian and early Devonian times and subsequently exposed by erosion of the surrounding country rock. The calc-alkaline acid igneous rocks, essentially granodiorites and adamellites, are generally loosely referred to as granite.

6. Parent material

A coarse textured, typically very stony and bouldery till derived from the underlying granitic rocks mantles most middle slopes which tends to merge into an extremely stony and bouldery residual drift on the extensive summit area and locally at intermediate levels.

7. Soils

Podzolic ironpan soils and their various phases account for approximately 67% of the area surveyed. The development of this striking profile can be attributed to the interaction of a number of factors, chiefly the lithology or the drift, climate and the preponderance of slightly convex slopes. The other salient soil type of this upland environment is a peatland (peat $>$ 45cm), unflushed blanket bog (15%), now considerably reduced in area due to active erosion and, apparently, exploitation for fuel to a limited extent in the recent past. Gley soils, however, tend to be confined to receiving sites. Rocky tors with their accompanying suite of rankers and skeletal soils, a typical granite landform, form conspicuous principal and intermediate summits, although their overall area is relatively insignificant (2.5%). Soil type and phase distribution is given in table 1, that of soil groups in table 2.

At least one suffix has been applied to the majority of all mineral and shallow peaty soil types mapped: in most instances one suffix sufficed, albeit occasionally two or even three were necessary for a complete site description. These suffixes identify observable morphological features of the profiles and are referred to as phases. The peaty or deeper peat phase is the most widespread. The extremely stony phase occurs over approximately 20% of the area. The deeper lying phase of induration (45-60cm from the ground surface) crops-up sporadically on middle slopes. The suffix 1, loamy phase, is ubiquitous to all peaty gleys other than the few units designated peaty podzolic gley where the suffix is not relevant. The ericaceous phase, a salient feature of this site type, is only recognised in respect of gley soils.

Surface boulders are common, and a major limiting site factor over about 45% of the area; two intensities, frequent and occasional, have been mapped where appropriate.

Numerous complexes have been differentiated in addition to discrete areas of individual soil types. Many of the mineral and shallow peaty soil complexes are a specific soil type and one or more phases. References to complexes of a certain soil type in the following sections refer to those units where it is the dominant constituent.

A soil survey of the region has been carried out by the Macaulay Institute for Soil Research, Aberdeen: sheet 76 (1/63,360) Inverurie and the regional memoirs 'The Soils of the Country round Aberdeen, Inverurie and Fraserburgh' contains much pertinent information relevant to the current survey. Till derived from granite is classified as the Countesswells association.

Table 1

Soil Type and Phase Distribution - Bennachie

Soil type number and relevant suffixes	Soil type	Distribution				PFl Code Nos
		Typical soil type or phase		Total		
		ha	%	ha	%	
3p 3ps	Typical podzol	15.5	2	15.5	2	22
4z		139	18.5			
4zs	Podzolic ironpan soil	85	11.5			35
4zp		213.5	29			
4zps		38.5	5	491	67	33
4zp(x) 4z(x)		23	3			33
6le		52.5	7			
6lpe		33.5	4.5	86	11.5	42
6ze	Peaty podzolic gley	11.5	1.5	11.5	1.5	43
11a	Calluna blanket bog	38.5	5	38.5	5	
11b	Calluna, Eriophorum vaginatum blanket bog	16.5	2.5	16.5	2.5	73
14	Eroded bog	59.5	8	59.5	8	
13r 13s	Rock and scree	18.5	2.5	18.5	2.5	83
	Totals	745	100	745	100	

Suffixes (phases of mineral and shallow peaty soils)

e ericaceous (Calluna dominant to frequent)
l loamy
p peaty or deeper peat: 3p 5-45cm peat
4zp 15-45cm peat
6lp 25-45cm peat
s extremely stony
(x) indurated (induration 45-60cm from the ground surface)

Table 2

Soil Group Distribution - Bennachie

Major soil group	Soil group	Distribution			
		Soil group		Major soil group	
		ha	%	ha	%
Soils with moderately leached subsoil	[illegible]	15.5	2	514.5	69
	Brown soils	499	67		
Soils with poorly leached subsoil	Peaty gley soils	97.5	13	97.5	13
Unflushed peatlands	Calluna, Eriophorum, Trichophorum bogs (unflushed blanket bogs)	55	7.5	114.5	15.5
	Eroded bogs	59.5	8		
Other soils	Rankers and skeletal soils	18.5	2.5	18.5	2.5
	Totals	745	100	745	100

Table 2

Soil Group Distribution - Bennachie

Major soil group	Soil group	Distribution			
		Soil group		Major soil group	
		ha	%	ha	%
Soils with well aerated subsoil	Podzols	15.5	2	514.5	69
	Ironpan soils	499	67		
Soils with poorly aerated subsoil	Peaty gley soils	97.5	13	97.5	13
Unflushed peatlands	Calluna, Eriophorum, Trichophorum bogs (unflushed blanket bogs)	55	7.5	114.5	15.5
	Eroded bogs	59.5	8		
Other soils	Rankers and skeletal soils	18.5	2.5	18.5	2.5
	Totals	745	100	745	100

7.1 Soils with aerated subsoil (514.5 ha; 69%)

Two soil groups are represented: podzols (15.5 ha; 2%) and ironpan soils (499 ha; 67%).

Podzols are confined to one small section on very steep, south facing slopes below the intermediate summits Bruntwood Tap and Garbet Tap. Peaty(5-45 cm peat) and extremely stony phase profiles predominate, the two phases frequently occurring in tandem; surface boulders are abundant.

The pre-eminence of the podzolic ironpan soil may be attributed to the interaction of a number of interdependent soil forming factors, principally the lithology of the drift, climate, landform and elevation. Ironpan soils occupy at least 70% of the area surveyed and field observations indicate that the soil type underlies most of the unflushed blanket bog too. In addition to the typical podzolic ironpan soil which predominates on middle slopes a sub-alpine variant is the characteristic profile on upper slopes: however, the latter has not been differentiated per se.

Podzolic ironpan soils have developed in a very stony and bouldery till, the stone content frequently appearing to be greater in topsoil horizons than in those of the subsoil. The ironpan is thin and continuous, invariably strongly developed and only slowly permeable to percolating water; it generally occurs between 55 and 70cm from the ground surface, occasionally at depths in excess of 80cm. Deeper lying ironpans frequently overlie an indurated horizon, albeit the degree of induration was usually hard to gauge in deep and very stony inspection holes; these pans support a deep, poorly drained gley profile in contrast to the underlying well aerated subsoil and parent material. However, in many profiles a yellowish brown subsoil horizon (Bs) either intervenes between the ironpan and indurated subsoil or merges into the parent material. The peaty phase (15-45cm peat) predominates, profiles with less than 15cm peat being confined to a few sites adjoining the existing plantation, notably the slopes below Hummel Craig and the Mither Tap. Although an indurated subsoil was often encountered in other profiles its depth from the surface was normally in excess of 60cm and thus outwith the prescribed depth; hence use of the suffix is confined to a few units on the survey perimeter. The extremely stony phase crops-up sporadically, generally intermingling with the more usual very stony profile. Podzolic ironpan soils mostly occur in discrete units, albeit these are frequently complexes of the various phases. Occasionally the complexes have a variable component of either unflushed blanket bog or eroded blanket bog.

The sub-alpine variant is the salient profile of the essentially residual drift on the extensive upper slope tract linking all the principal tops from Hermit Seat in the west to the Mither Tap on the south eastern rim. Locally, sub-alpine profiles extend well down onto north facing middle slopes, merging with the typical podzolic ironpan soil: for example those west of Craigshannoch, the crest of the Hummel Craig spur and below Hermit Seat. Inevitably slopes vary considerably, but are commonly very gentle. Surface boulders are a conspicuous site limiting factor: consequently profiles tend to be bouldery with a highly significant stone content, normally the upper end of the very stony class, occasionally extremely stony. The parent material is generally finely comminuted granitic detritus, and horizons tend to be poorly differentiated, especially those of the topsoil. The peat is typically less than 15cm and peaty phase profiles, if present, are normally a rather minor component of the matrix. The ironpan tends to be weakly developed and discontinuous, freely drained profiles without a pan conforming with a sub-alpine podzol. Podzolic

gleys may be found locally where site factors are favourable and odd pockets of a deep extremely stony humic skeletal soil are very occasionally encountered. Small pockets of scree occur in the unit skirting the rock and ranker complex of the highest summit, Oxen Craig. A few small and isolated upstanding remnants of deep peat suggest that blanket bog formerly covered at least some of these sites.

7.2 Soils with poorly aerated subsoil (97.5 ha; 13%)

Peaty gleys, the sole representative of the major soil group, occur in receiving sites, on straight slopes and on very gentle slopes where lateral water movement is retarded; the evolution of ironpan soils, on the other hand, is favoured by the convex slopes which predominate on this landform. Two variants of the typical profile have been delineated on the basis of peat depth: a shallow peat variant (5-25 cm peat) and a deeper peat phase (25-45 cm peat), the former being pre-eminent. Loamy and ericaceous phases are ubiquitous, the profiles being very stony, deep and generally poorly drained. An imperfectly drained podzolic peaty gley has been differentiated locally on southern slopes adjacent to Hermit Seat and the Mither Tap. Although peaty gleys have frequently been mapped as discrete entities many matrices have a variable admixture of ironpan soil and/or sometimes unflushed blanket bog.

7.3 Peatlands - peat > 45cm (114.5 ha; 15.5%)

The landform favours unflushed peatlands. Three members of this major soil group are found on Bennachie, These comprise: Calluna blanket bog (38.5 ha; 5%); Eriophorum vaginatum, Calluna blanket bog (16.5 ha; 2.5%) and eroded blanket bog (59.5 ha; 8%).

It is evident that unflushed blanket bog was formerly much more extensive, erosion having considerably reduced its overall area, a process which is still active. Consequently unflushed blanket bogs and their eroded counterparts regularly intermix and complexes are common.

The Calluna blanket bog tends to occur on slopes and has rarely been delineated as a discrete entity; complexes incorporating either ironpan soil or occasionally peaty gley are the characteristic site type.

The Eriophorum vaginatum, Calluna blanket bog is restricted to a few sites on gentle to very gentle upper slopes. A sizeable upstanding remnant of this peatland occurs on the saddle between Oxen Craig and the Mither Tap; the entire perimeter marches with eroded bog complexes and is precisely defined by a short step. Shallow pool bog occurs throughout the matrix on the very gentle sloped saddle immediately west of the Mither Tap; the peat depth is generally < 90cm. Weakly developed hagging is a prominent subsidiary component of the complex on the gentle slopes south west of the Oxen Craig summit. Cloud Berry, Rubus chamaemorus, is a conspicuous constituent of the vegetation community on these high elevation sites. The two unflushed blanket bog communities tend to intermingle locally, the dominant one being used in the unit notation: such a situation arises in the Eriophorum vaginatum, Calluna blanket bog/peaty gley complex on the southern slopes below Hermit Seat.

Eroded blanket bog is sporadically distributed over the extensive upper slope summit zone: on the generally steeper peripheral slopes between the latter and the plantations on either side eroded peatland is relatively uncommon. The most prominent concentrations of eroded bog occur on south facing slopes between Hermit Seat and Watch Craig and between Oxen Craig and Garbet Tap. Widely dispersed, isolated blocks

of eroded bog within ironpan soil matrices testify to the former extensive cover of unflushed blanket bog. Erosion is normally manifested in the form of hagging, very rarely as pool bog. The intensity of erosion is extremely variable; consequently pockets or larger areas of unflushed blanket bog occur within the matrices and each unit merits an individual appraisal regarding the severity of this limiting factor. Ironpan soils usually occur in the intervening ground stripped of peat where surface boulders may be an additional limitation.

7.4 Other soils (18.5 ha; 2.5%)

Although the main and intermediate summit tors and their associated ranker and skeletal complexes are conspicuous landmarks they occupy a negligible overall area; rock (8 ha) and scree (10.5 ha) predominate. Typically a core of rock outcrops is flanked by scree.

8. Windthrow hazard

Exposure was assessed in the field by the topex method at a number of stations selected at random. Subsequently windthrow hazard class was established from the exposure data, wind zone, elevation and soil type by the method described in Research Information Note 22/77 SILN, Windthrow Hazard Classification by T C Booth. Although Bennachie is an isolated and apparently exposed foothill it occurs within wind zone 5: this factor and the preponderance of ironpan soils have largely determined the pre-eminence of hazard classes 3 and 4 (91% of the overall area). Hazard class 5 (6.5%) is confined to the immediate vicinity of the various summit rock and ranker complexes. The influence of the various parameters on the ultimate score is cogently demonstrated in figure 1. Windthrow hazard class distribution is given in Table 3.

9. References

Assessment of Climatic Conditions in Scotland. The Macaulay Institute for Soil Research, Aberdeen.

1. Based on accumulated temperature and potential water deficit
   E L Birse and F T Dry (1970).

2. Based on exposure and accumulated frost
   E L Birse and L Robertson (1970).

The Soils of the Country round Aberdeen, Inverurie and Fraserburgh. R Glentworth and J W Muir, The Macaulay Institute for Soil Research, HMSO 1963.

Research Information Note 22/77 SILN Windthrow Hazard Classification by T C Booth.

Table 3

Windthrow Hazard Class Distribution - Bennachie

Hazard class	Top height at onset of throw (m)	Distribution	
		ha	%
2	22	19	2.5
3	19	349	47
4	16	328	44
5	13	49	6.5
	Totals	745	100

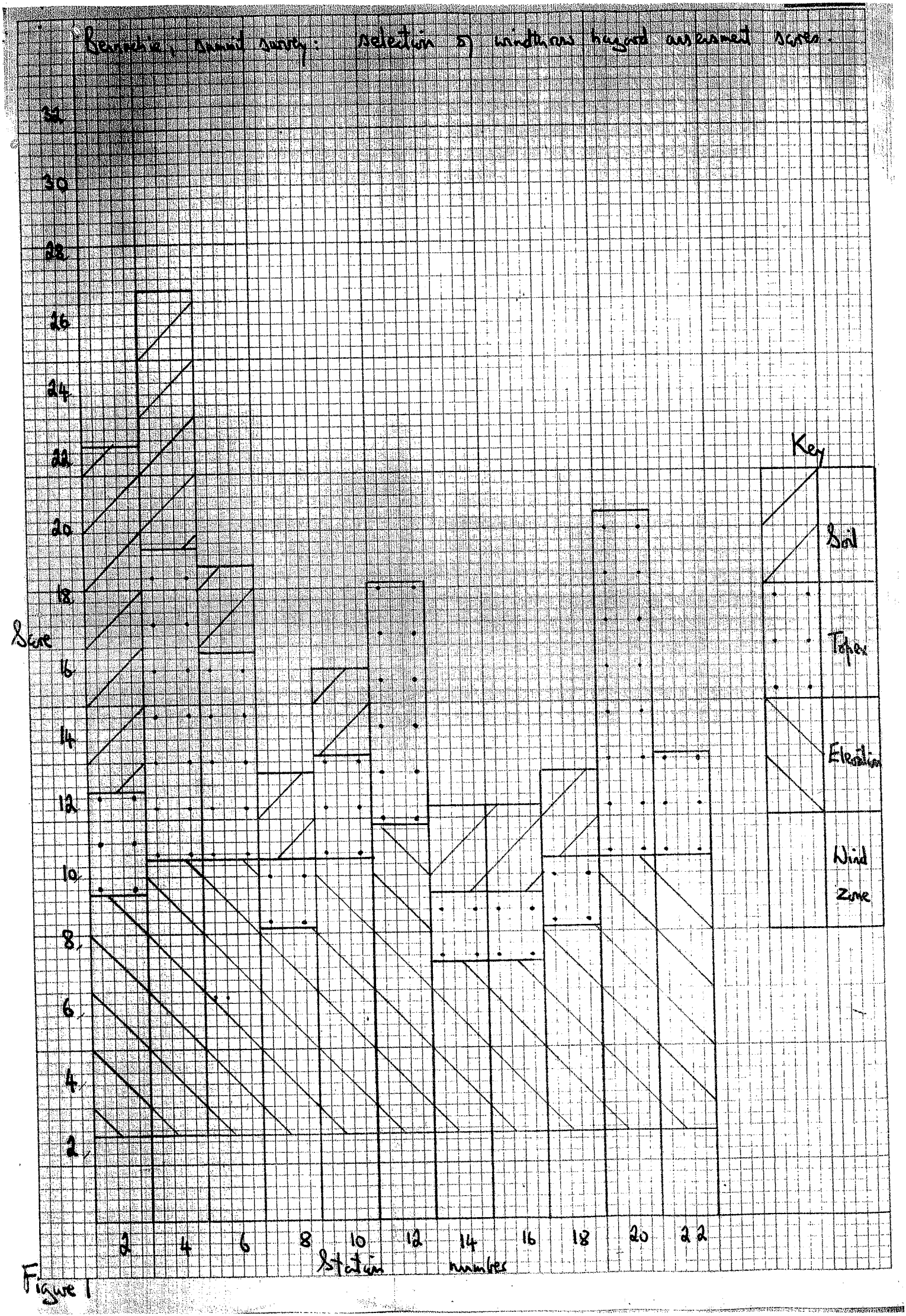


Figure 1

Tillybin

1. Introduction

The 55 ha Tillybin acquisition was surveyed by Site Survey Forester J Davidson in 1981. Soil and windthrow hazard maps at 1/10,560 scale have been drawn up from field data.

2. Location

The acquisition straddles two adjoining low hills a few kilometres south east of Kemnay; although not a composite block, the three components are contiguous with FC plantations. The southern boundary of the largest segment marches with Tillybin farm. The area can be located on OS 1:50,000 sheet 38, Aberdeen, the relevant section of which is reproduced in Appendix 1.

3. Climate

In their assessment of annual accumulated temperature above 5.6°C and potential water deficit Birse and Dry (1970) classified Tillybin and surrounding area as 1M, fairly warm moist lowland and foothill (1,100 - 1,375 day degrees above 5.6°C) Annual rainfall is normally between 850 and 900mm, and in average years a 25-50mm potential water deficit can be expected. In their assessment of annual exposure and accumulated from Birse and Robertson (1970) classed Tillybin and neighbourhood as mm, moderately exposed with moderate winters (wind speed 2.6 - 4.4 m/s; 50 - 110 day degrees accumulated frost).

The acquisition occurs within zone 11, Eastern Foothills, of the FC climatic classification based on the above data.

4. Topography

The acquisition is situated in an area of low, rounded hills, mostly on an extensive gentle sloped plateau, the remainder being opposing side-slopes and, to a limited extent, the intervening valley bottom. The elevation ranges from 90m at the eastern end of Lauchintilly Moss to around 120m on the southern boundary adjacent to Tillybin farm.

The lowland character of the site is recognised in the E(S) broad classification of relief zones. In the Macaulay regional memoirs the district is designated as the Skene lowlands.

5. Geology

Tillybin is underlain by coarse grained acid igneous rocks, Forceful Newer Granites of Caledonian age, part of the Hill of Fare intrusion.

6. Parent material

A coarse textured, very stony and bouldery till derived from acid igneous rocks mantles virtually the entire acquisition. Flushed peatland occupies the valley bottom contiguous with Lauchintilly Moss.

7. Soils

The comments on the use of suffixes and the interpretation of complexes in section 7 of the previous report are equally relevant to Tillybin.

Soils with well aerated subsoil predominate, specifically brown earths (61%), due to the interaction of climatic factors, parent material and suitable landform in this low elevation acquisition, albeit a significant proportion of these profiles appear to have been podzols whose topsoils have subsequently been modified by agricultural practices. Soils with poorly aerated subsoil, gley soils, account for almost the entire remaining area (38%), peatlands (peat > 45cm) occupying a negligible 1% although the name Bandshed Moss suggests a former peat cover over part of the acquisition which may have been exploited for fuel. Soil type and soil group distribution are given in tables 4 and 5 respectively.

Indurated subsoils are a salient characteristic of the brown earths and the podzolic gleys, the indurated horizon generally occurring between 45 and 60cm from the ground surface.

Surface boulders are a variable, albeit widespread site limitation.

Table 4. Soil Type and Phase Distribution - Tillybin

Soil type number and relevant suffixes	Soil type	Distribution				PFl Code No
		Typical soil type or phase		Total		
		ha	%	ha	%	
1c(x)	Typical brown earth	3.5	6.5	5.5	10	
1cg(x)		2	3.5			
1zc(x)	Podzolic brown earth	17.5	32	27.5	50	
1z(x)		7	12.5			
1zg(x)		3	5.5			
51pf	Ground-water gley	5	9	5	9	
6z(x)	Peaty podzolic gley	6	11	6	11	
7z(x)	Podzolic gley	2	3.5	2	3.5	
71	Surface-water gley	4	7.5	8.5	15.5	
71f		4.5	8			
8c	Juncus effusus bog	0.5	1	0.5		
..	Totals	55	100	55	100	

Suffixes (phases of mineral and shallow peaty soils)

c cultivated
f flushed
g slightly gleyed
l loamy
p peaty 51pf(5 - 45cm peat)
(x) indurated (induration 45 - 60cm from the ground surface)

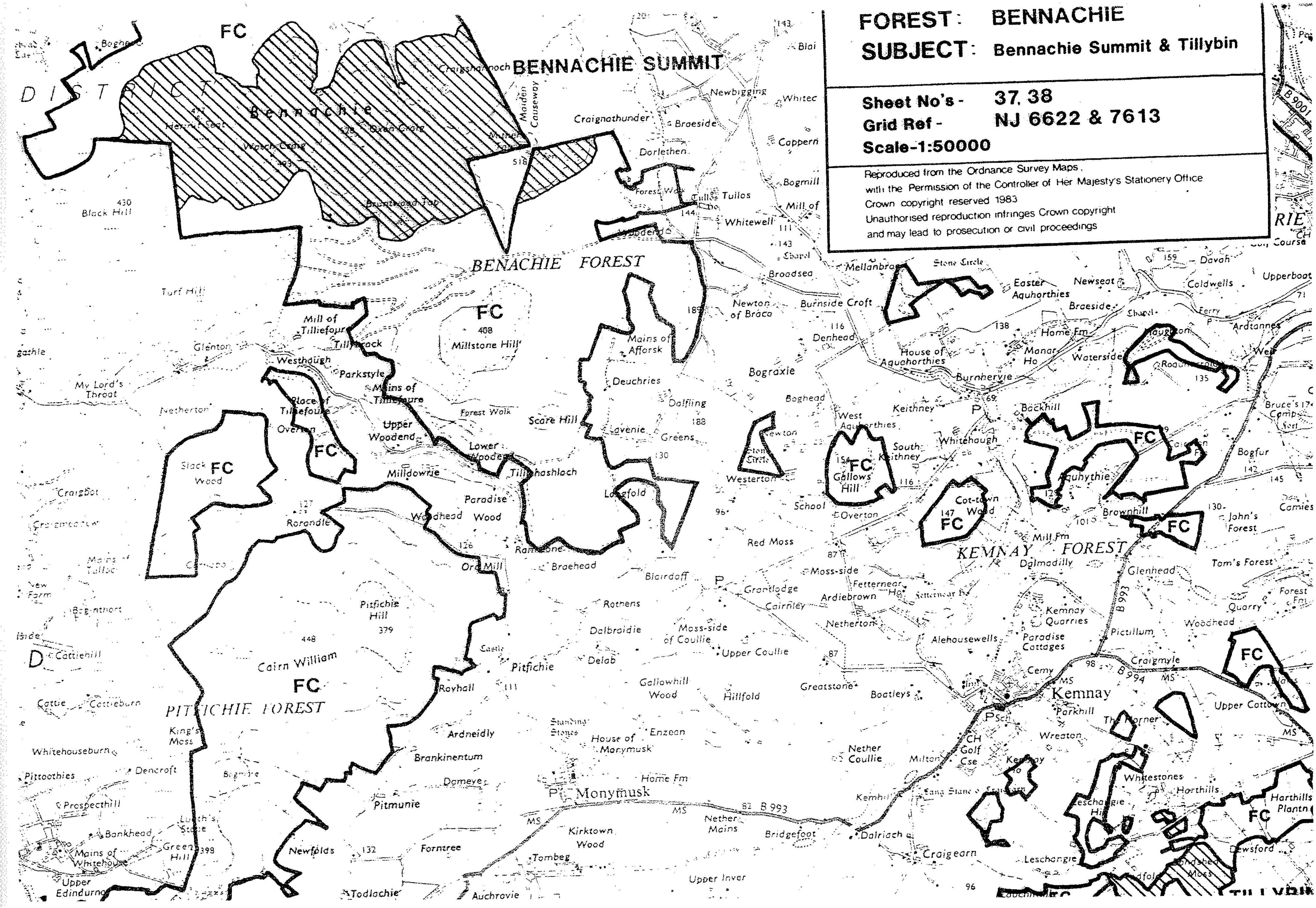
Table 5. Soil Group Distribution - Tillybin

Major soil group	Soil group	Distribution			
		Soil group		Major soil group	
		ha	%	ha	%
Soils with well aerated subsoil	Brown earths	33	60	33	60
Soils with poorly aerated subsoil	Ground water gley soils	5	9	21.5	39
	Peaty gley soils	8	11		
	Surface-water gley soils	8.5	19		
Flushed peatlands	Juncus bogs	0.5	1	0.5	1
	Totals	55		55	100

Table 6

Windthrow Hazard Class Distribution - Tillybin

Hazard class	Top height at onset of blow (m)	Distribution	
		ha	%
2	22	5.5	10
3	19	30	54.5
4	16	19.5	35.5
	Totals	55	100


FOREST: BENNACHIE
SUBJECT: Bennachie Summit & Tillybin
Sheet No's - 37, 38
Grid Ref - NJ 6622 & 7613
Scale-1:50000
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BENACHIE FOREST
KEMNAY FOREST
PITFICHIE FOREST
FC
Bennachie
Millstone Hill
Cairn William
Pitfichie Hill
Gallows Hill
Cot-town Wood
Slack Wood
Kemnay
Monymusk
Maiden Causeway
Black Hill
Turf Hill
B 993
B 994

Distribution:

Conservator E(S)	2
Forest District Manager	2
Chief Field Survey Officer	1
Field Survey Officer (Scotland)	1
Regional Chief Forester	1
Site Survey Forester	1
Drawing Office	1
Dr W O Binns	1
Dr D G Pyatt	1
Mr K Miller	1
Research Chief Forester	1
Alice Holt Library	1
Silv N (for circulation)	1
Macaulay Institute	
Mr R Grant	1
Headquarters, Aberdeen	1
Spare	6
	23