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Soils of the Llyn Brianne Experimental Catchments:

A Progress Report

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and

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INTRODUCTION

The work by the Institute of Terrestrial Ecology on the soils of the experimental catchments has two initial objectives:

a) Identification of the main soil types (at series level), maps showing their distribution, and data on their relative proportions, in each catchment.

b) Provision of data on the chemical and physical properties of each soil type as they occur under the main vegetation/land use units. These data should cover all variables used in the hydrochemical models being developed.

The following report describes progress towards achieving these objectives.

Soil Distribution

The only published soil map covering all the experimental catchments is the 1:250,000 scale 'Soil map of Wales' (Soil survey of England and Wales 1985). Maps at c. 1:10,000 scale are available for the Forestry Commission owned forest catchments, ie. LI4, LI3 and approximately half of LI2. It is felt that 1:10,000 maps are required for each catchment; any smaller scale involves too much generalisation. Maps at this scale are being produced by a combination of free survey and a series of fixed transects. The proportions of each soil type in each catchment are then being calculated both from the maps and from the transect data. In catchments LI2, LI3 and LI4, transect data is being combined with that from the available Forestry Commission maps. Mapping has been completed in catchments CI3, CI4, CI5, LI1, LI2, LI3, LI4 and LI7: maps of CI4 and LI7 are included as examples along with data on the relative proportions of the main soil types. The remaining catchments will be mapped during spring 1987.

Mapping to-date has shown that the catchments contain the following soil series/subgroups:

Manod series	- brown podzolic soils
Hafren series	- ironpan stagnopodzols
Hiraethog series	- ferric stagnopodzols
Wilcocks series	- cambic stagnohumic gleysoils
Kielder series	- cambic stagnohumic gleysoils
Freni series	- humic gleysoils
Crowdy series	- raw peat soils

For the purposes of the project the raw peat soils are being sub-divided into interfluve peats and valley bench peats. It has also proved useful to recognise two variants of the Hafren series brown podzolic soils; one has a very dark brown surface horizons, of c. 10 cm, with a well developed subangular structure while the other variant has a 2-3 cm thick very dark grey organic rich surface horizon underlain by a greyish brown horizon. The latter variant can be usefully seen as an intergrade between the brown podzolic soils and ferric stagnopodzols, and has been mapped as such. This soil should not be confused with the 'Intergrade to thin iron soil' mapped by the Site Survey teams of the Forestry Commission; this 'Intergrade' is equivalent to some of the ferric stagnopodzols mapped by the Soil Survey of England and Wales.

The surveys have revealed a broad relationship between soil type and slope/altitude. The brown podzolic soils are generally restricted to relatively steep slopes (15°C) at upto c. 420 m, on south facing slopes and c. 380-400 m on north facing slopes. The Intergrades between brown podzolic soils and ferric stagnopodzols generally occur upslope of the brown podzolic soils but again on relatively steep slopes; they rarely occur above 450 m. Ferric stagnopodzols are usually found on sloping sites, c. 7°, at altitudes above about 450 m. Ironpan stagnopodzols can occur at similar altitudes to the ferric stagnopodzols but are most common around the edge of the interfluve peat areas, where the slope begins to increase.

The stagnohumic gleysoils are found on gently sloping sites at a wide range of altitudes, while the raw peat soils usually occupy almost level sites. The valley bench peats are usually flushed by laterally moving water derived from the adjacent slopes.

As noted above, the proportions of the various soil types in each catchment have been calculated both from the soil maps and from the transect records (Table 1 and 2). The two methods produce rather different results, in terms of percentage of catchment occupied by a given soil type; these differences are not surprising given the generalisation inherent in production of most soil maps. The transect data identifies the soil type occurring at a number of specific points while the map identifies the dominant soil in an area. Both sets of data show large variations in the relative proportions of the various soils between catchments. Thus, for example, catchment CI4 contains more than 40% peat while LI3 only contains 4% and CI3 some 18%. These differences must be taken into account when interpreting variations in drainage water chemistry between catchments and when assessing the impact of the various land management practices.

Table 1

Percentage occurrence of the main soil types based on transect data

	CI4	CI5	LI7
Humic rankers	5	-	-
Brown podzolic soils	14	9	26
Brown podzolic soils - ferric stagnopodzol intergrade	7	25	19
Ferric stagnopodzols	3	4	2
Ironpan stagnopodzols	3	4	2
Gleysoils		6	-
Humic gleysoils	2	7	10
Cambic stagnohumic gleysoils	22	25	18
Raw peat soils	41	8	21

Table 2

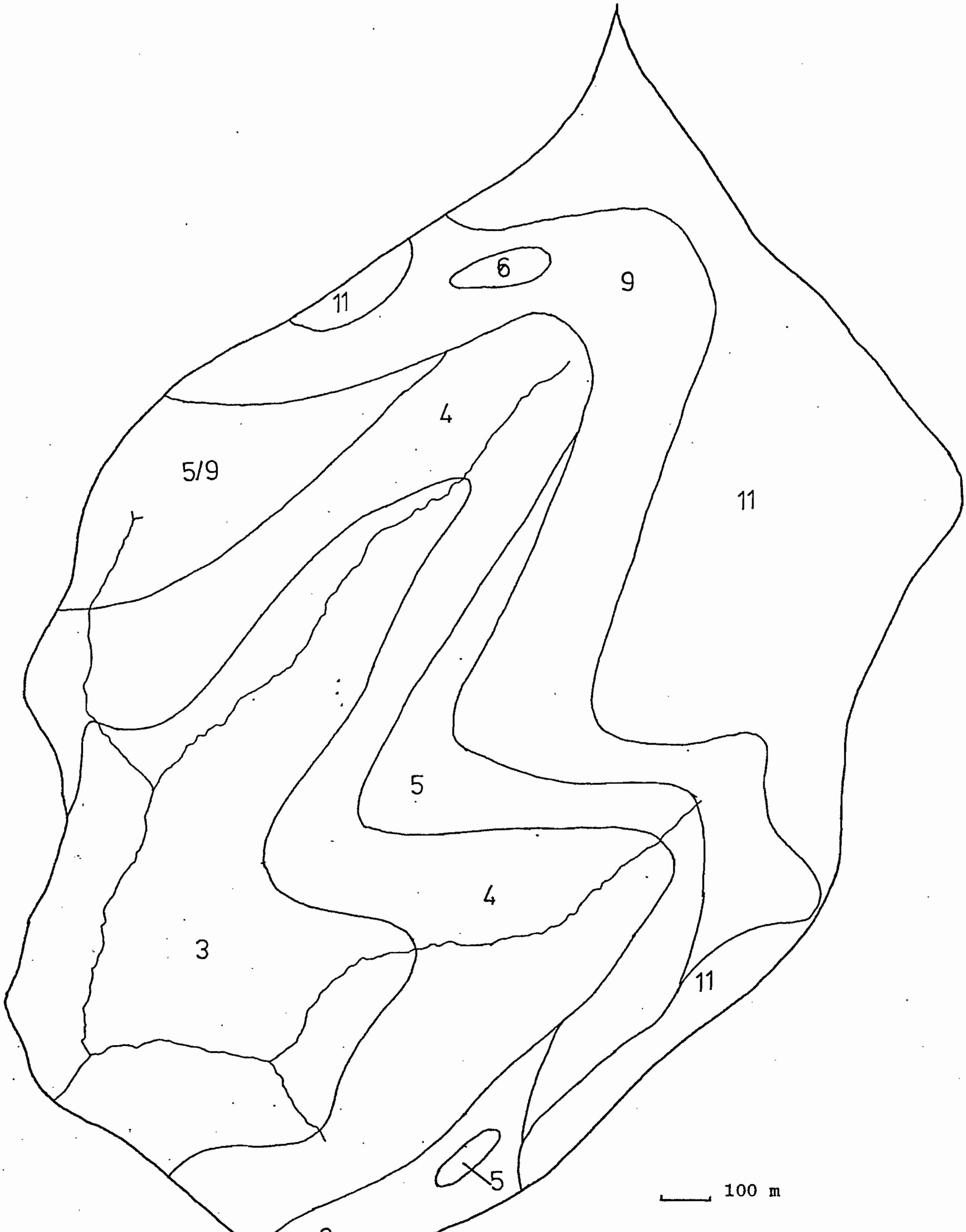
Percentage occurrence of the main soil types, calculated from the soil maps

		CATCHMENT						
Map Unit	Soil Type	CI3	CI4	LI1	LI2	LI3	LI4	LI7
1	Humic Rankers							
2	Brown Rankers					8		
3	Brown Podzolic Soils			22			12	18
3/4		15	18		1			22
4	B.P.S./F.S. Intergrades			24	19	37	5	8
4/5					23		1	
5	Ferric stagnopodzols	36		7		2	5	
6	Ironpan stagnopodzols			0.5	1	7	24	
7	Gleysoils							
7/8					5			
8	Humic gleysoils	15		18.5				
9	Cambic stagnohumic gleysoils	16	14		24	49	24	
10	Raw peat soils (flushed)	9	4			4	19	
11	Raw peat soils	9	54	24	28			36
5/9			11	5				
8/10								6

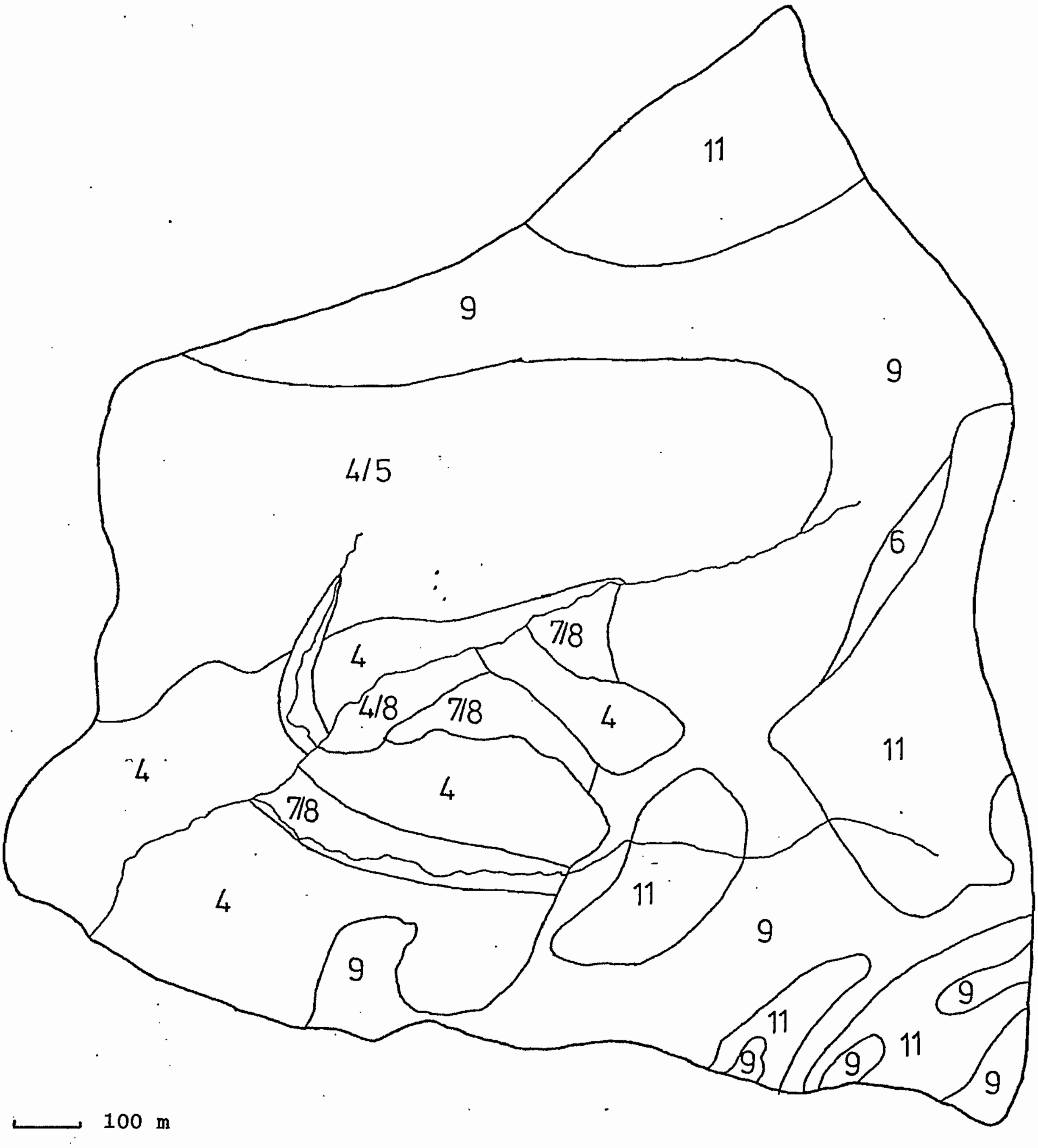
SOIL MAP LEGEND

Map Unit	Dominant soils
1	Humic rankers
2	Brown rankers
3	Brown podzolic soils
4	Brown podzolic soil - ferric stagnopodzol intergrade
5	Ferric stagnopodzols
6	Ironpan stagnopodzols
7	Gleysoils
8	Humic gleysoils
9	Cambic stagnohumic gleysoils
10	Raw peat soils (flushed)
11	Raw peat soils

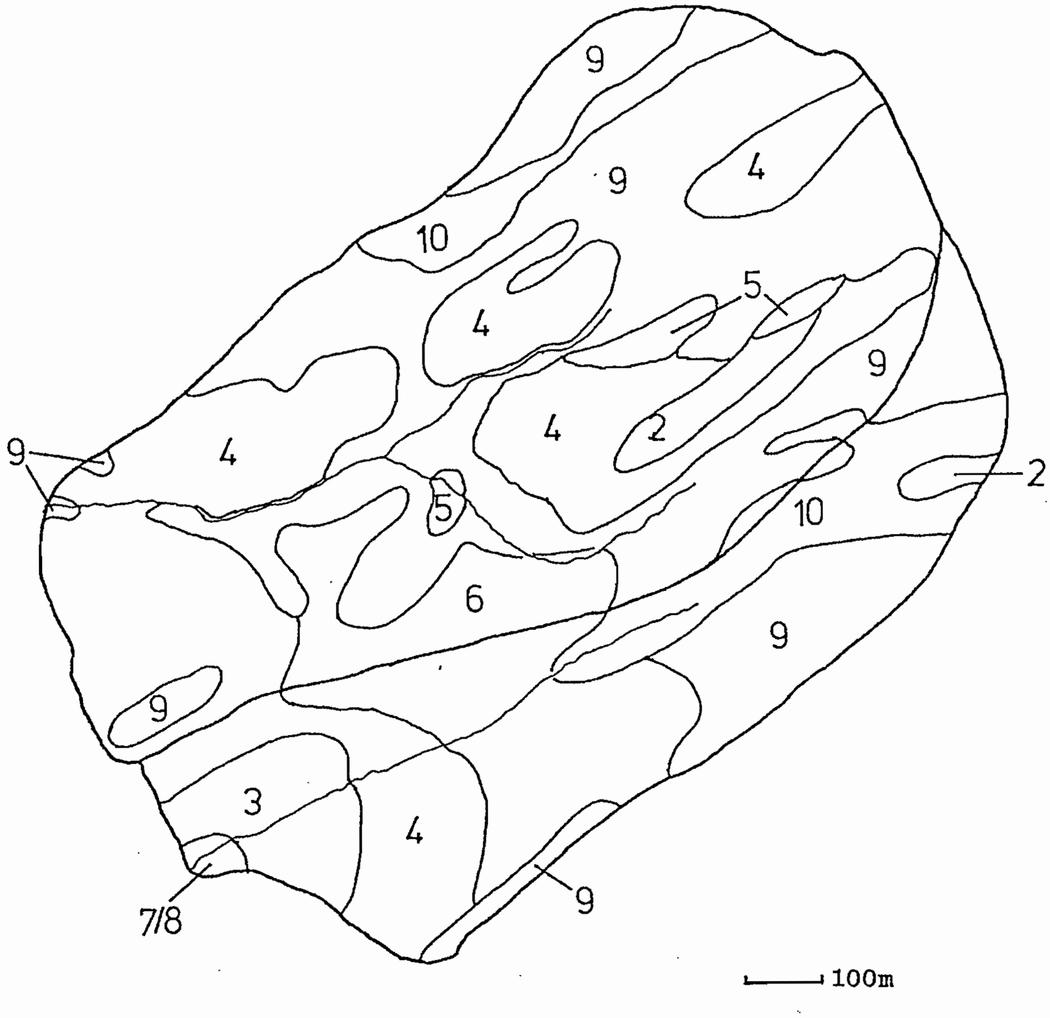
Complex uits are designed by the use of a combination of the numbers above, eg. 7/8 indicates a gleysol/humic gleysol complex.



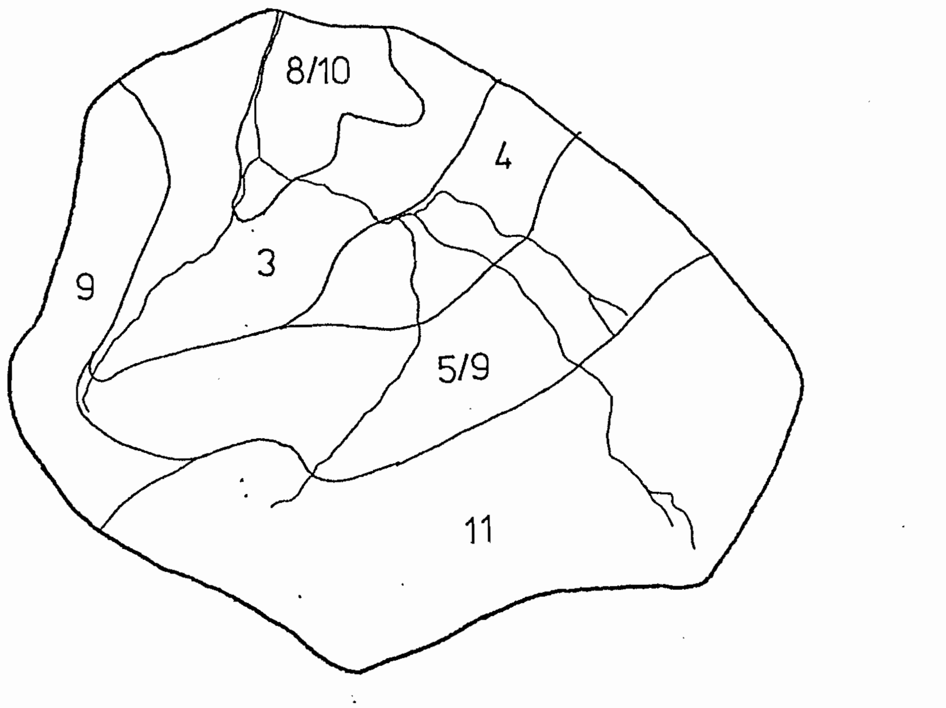
LI1: SOIL TYPES AND DISTRIBUTION



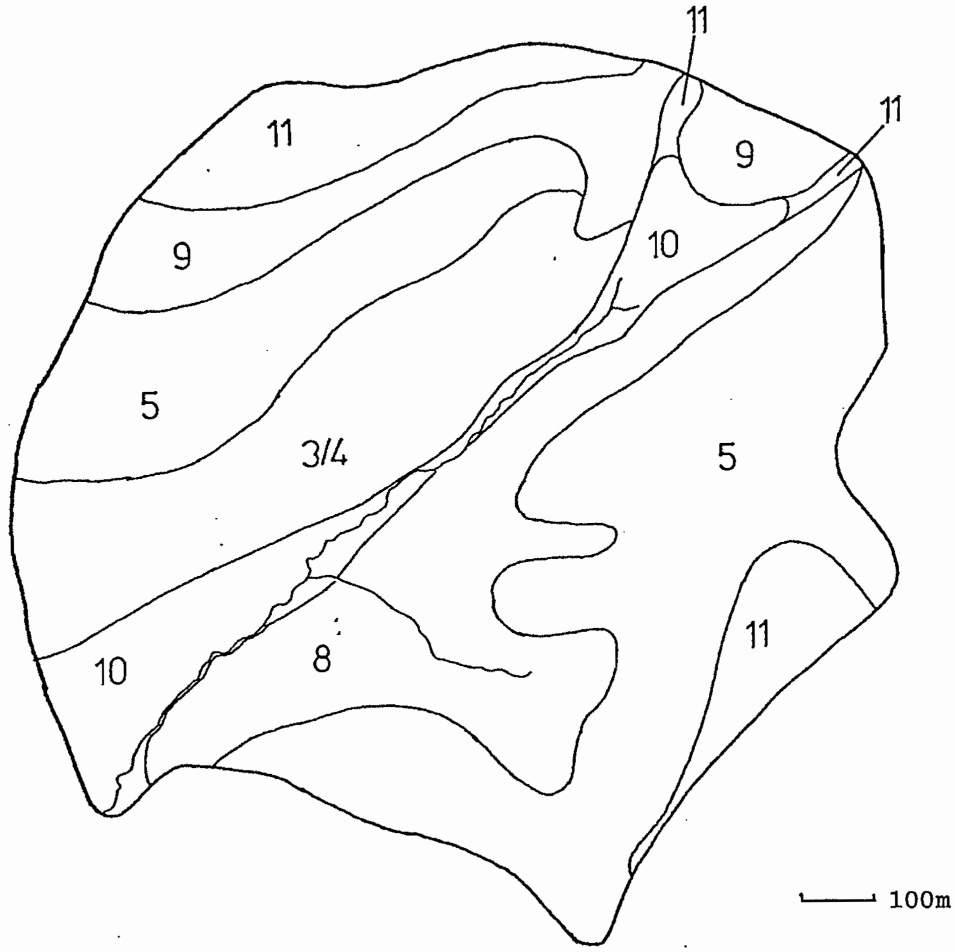
LI2: SOIL TYPES AND DISTRIBUTION



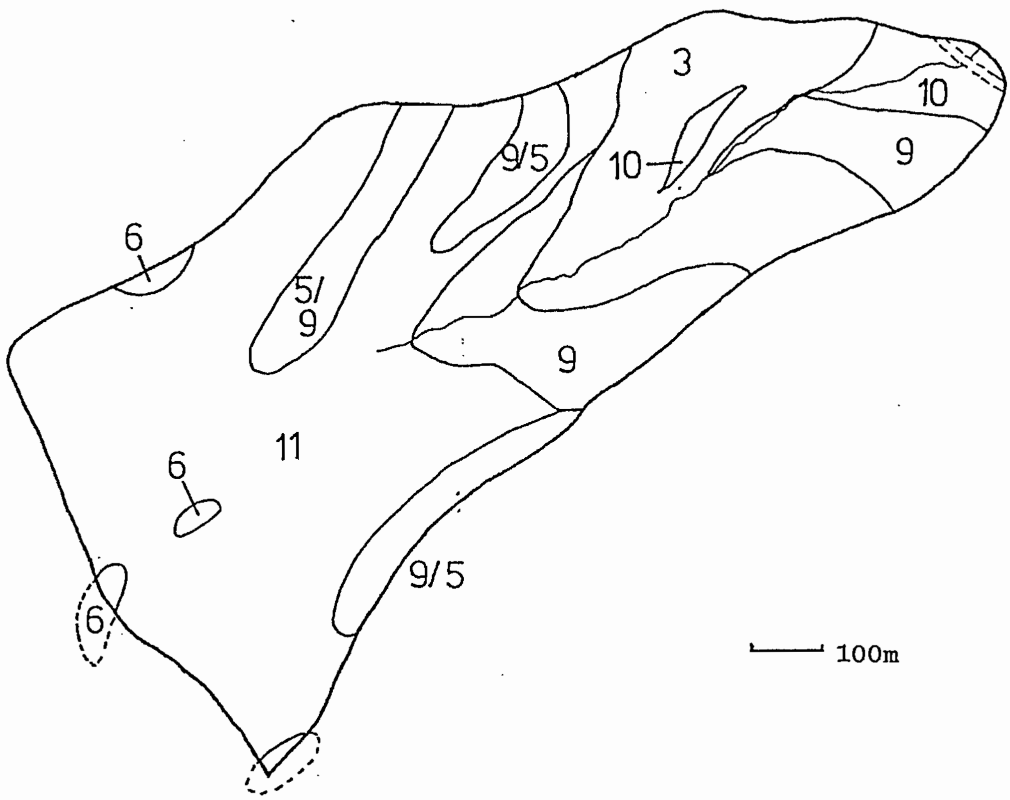
LI3/LI4: SOIL TYPES AND DISTRIBUTION



LI7: SOIL TYPES AND DISTRIBUTION



CI3: SOIL TYPES AND DISTRIBUTION



CI4: SOIL TYPES AND DISTRIBUTION

Soil Chemistry

The sampling scheme is intended to cover the major soil-vegetation combinations that occur in the Brianne area. To date, sampling has been confined to those sites which have soil water sampling equipment installed. Other important soil-vegetation combinations will be sampled during spring 1987. Soils that have been limed were sampled both before and after treatment.

At each site, three profiles were sampled, usually by Jarrett auger or by corer in the case of peats. Soil pH was determined immediately on return to the laboratory. Subsequent analyses were carried out on air-dried samples ground to pass a 2 mm sieve.

The following analyses were carried out on every sample:

1. pH: Measured in a 1:2.5 soil/liquid suspension using both water and 0.01 M $CaCL_2$.
2. Loss-on-ignition: Measured by ashing a sample at 375°C for 16 hours.
3. Exchangeable Na, K, Mn, Ca and Mg using ammonium acetate at pH 7.0.
4. Exchangeable Al and H using potassium chloride, 1M.
5. Pyrophosphate-extractable Al and Fe using potassium pyrophosphate.

The cation exchange capacity is calculated as the sum of 3. and 4. The base saturation is calculated as:

$$\text{Base Saturation \%} = \frac{\text{Exchangeable Na + K + Mn + Ca + Mg}}{\text{Cation Exchange Capacity}} \times 100$$

The following vegetation-soil combinations have been sampled and analysed:

SOIL	VEGETATION Agrostis/ Festuca	Molinia	Sitka spruce 12y	Sitka spruce 25y	Larch	Oak
Brown Podzolic Soil (B.P.S.)	C52	-	-	-	-	G11
Intergrade (B.P.S./F.S.P.)	C31	-	-	L41	L22	-
Ferric Stagno-podzol (F.S.P.)	-	C51/C61	-	-	-	-
Ironpan Stagno-podzol (I.S.P.)	-	-	L81	L21	-	-
Raw Peat (valley bottom)	-	C53/C62	-	-	-	-
Raw Peat (Interfluve)	-	C54/C63	-	L23	-	-
	--------------------- Site Code -----------------					

This sampling scheme enables a comparison to be made of similar soils under different vegetation types, for example, intergrade soils under Agrostis and under 25 year old Sitka spruce, or stagnopodzols under Molinia and under 12 year old Sitka spruce. The data are presented in the accompanying table.

Summary of soil chemical properties

Soil pH

All the soils are acid, pH 4.7, and all show an increase of about 0.5 pH units down the profile. The pH in 0.01M $CaCl_2$ solution is always lower than that in water, the difference being greatest in the organic horizons and smallest in the B and C (mineral) horizons.

Loss-on-ignition

Loss-on-ignition (LoI) decreases down the profile, with the values obtained falling readily into four groups:

O,P horizons	LoI	70%
Ah horizons	LoI	20%-40%
A,E horizons	LoI	5%-11%
B,C horizons	LoI	2%- 3%

Cation Exchange Capacity

Cation Exchange Capacity (CEC) is low (20 me $100g^{-1}$) in all the soils under study. It is highest in the organic horizons, decreasing down the profile:

Horizon	CEC (me 100 g^{-1})
O	15.0 $\pm$ 5.6
P	13.5 $\pm$ 5.9
Ah	16.2
A	5.4
E	9.4 $\pm$ 2.1
B	5.6 $\pm$ 1.4
C	4.0 $\pm$ 1.3

Exchangeable cations/base saturation

The exchange capacity of these soils is almost entirely satisfied by aluminium, resulting in base saturation values of less than 15% except in the interfluve peats (BS 65%). Values for exchangeable aluminium range from 0.9 me 100^{-1} in the interfluve peat at L23 to 11.7 me $100g^{-1}$ in the stagnopodzol O horizon at C61. Exchangeable hydrogen is present in much lower amounts. The following table is a summary of the range of values for each cation:

Cation	Range of values (me $100g^{-1}$)
Na	1.41 - 0.08
K	0.99 - 0.02
Ca	5.45 - 0.08
Mg	10.44 - 0.00
Mn	0.11 - 0.00
Al	13.58 - 0.94
H	4.67 - 0.00

Exchangeable base cations are found in decreasing amounts in the order

$Ca > Na \geqslant Mg > K \gg Mn$. Organic horizons, particularly the interfluve peats are highly dominated by Ca and Mg on the exchange complex. Manganese is present usually at less than 0.11 me $100g^{-1}$ but large amounts (0.37 me $100g^{-1}$) occur in the interfluve peats and in the valley bottom peats in CI6. It is noticeably absent from the stagnopodzol mineral horizons.

<u>Comparison of moorland soil types</u>

Brown podzolic soils, intergrades and ferric stagnopodzols are frequently found within the same catchment and can often be located by an associated vegetation cover:

Brown podzolic soil :	Agrostis/Festuca or bracken
Intergrades :	Agrostis/Festuca ± Molinia ± D. flexuosa
Ferric stagnopodzols:	Molinia (complete cover)

In the field, intergrades under Agrostis/Festuca can be distinguished from brown podzolic soils by the presence of a dark brown organic (Ah) layer up to 5 cm thick. The suborganic (E) horizon may also be light brown with some patches of light brownish grey. Ferric stagnopodzols have a thicker, black organic horizon up to 10 cm thick. The stagnopodzol E horizon has a definite grey colour.

Soil pH in the brown podzolic soil ranges from 4.05 (A horizons) to 4.43 (C horizon). This is not significantly different to the mineral horizons of the ferric stagnopodzol. The intergrade pH values are significnatly higher (P 0.005). Data for the intergrade Ah horizon are currently unavailable but a pH of 4.15 seems likely.

Cation exchange capacity (CEC) in the mineral horizons increases in the order BPS-IG-FSP but the only statistically significant difference is in the E horizon between the intergrade and the stagnopodzol. These differences could be explained in terms of increased weathering which tends to increase the CEC of soils. Organic matter is unlikely to account for the difference in the mineral horizons as the loss-on-ignition is lower in the stagnopodzol than in the brown podzolic soil.

Amounts of exchangeable K, Ca and Mg decrease in the order BPS-IG-FSP. Sodium does not show this pattern; it is lowest in the intergrade soil but amounts in the stagnopodzol are very similar to those in the brown podzolic soil. Amounts of all four cations would be expected to be lowest in the more intensively weathered soil (the stagnopodzol) but the high amounts of sodium could be a result of increased sea-salt capture by the Molinia cover.

Manganese, while present in the brown podzolic soil and the intergrade, is entirely absent from the stagnopodzol but without data on the redox potentials of these soils it is difficult to account for these differences.

Amounts of exchangeable aluminium increases in the order BPS-IG-FSP again reflecting the degree to which these soils are weathered and lleached. This increase is most marked in the E horizon, from 4.1 me $100g^{-1}$ in the brown podzolic soil to 10.1 me $100g^{-1}$ in the ferric stagnopodzol. The higher exchange capacity in the stagnopodzol is almost entirely satisfied by aluminium. Correspondingly, base saturation in the ferric stagnopodzol is very much lower than in the brown podzolic soil. The differences are significant in all three mineral horizons (P 0.005). Base saturation in all three horizons of the brown podzolic soil is greater than 20% but less than this in the intergrade and stagnopodzol, a feature which offers a useful chemical distinction between intergrades and brown podzolic soils. Stagnopodzols can be distinguished from intergrades by the absence of exchangeable manganese.

Pyrophosphate-extractable or 'free' iron oxide is often used to diagnose movement of iron from the E horizon to the B horizon (a classic feature of podzolisation). In the table it can be seen that the B horizons of the brown podzolic soil and the stagnopodzol contain greater amounts than the E horizons. This is not so for the intergrade soils under Agrostis although it is for the intergrade soils under larch and Sitka spruce.

The differences between the three soils described here are compatable with the concept of the development of a stagnopodzol profile from a brown podzolic soil profile by the processes of weathering and leaching. As the organic layer developes, increased organic acidity from this horizon accelerates weathring of the mineral fraction and the leaching of K, Ca and Mg. This in turn increases the exchange capacity most of which is occupied by aluminium released from the alumino-silicate lattice of the parent material. Stagnopodzol development, therefore, results in decreased base saturation. It is worth noting that a similar stagnopodzol samples in the same area has values for exchangeable Ca and Mg which are comparable with the brown podzolic soil. Although historical data for the area is scarce, it would seem likely that the soil has received lime in the past. If so, it has only slightly increased the base saturation while raising the pH to levels comparable with the brown podzolic soil.

Comparison of stagnopodzols under Molinia and two ages of Sitka spruce

Within the study area, stagnopodzols may be found under Molinia (ferric stagnopodzol, Hafren series) and also under Sitka spruce at 12 and at 25 years after planting (ironpan stagnopodzol, Hiraethog series). These are represented in the accompanying table by the soils C51, L81 and L21. As well as the variation in vegetation type and age, there is a difference in slope between L21 (level) and L81/C51 (both moderate slope). The stagnopodzol at L21 has a well developed ironpan whereas it is discontinuous in L81.

Soil pH values are markedly lower in L21 (25 year spruce) than in L81 (12 year spruce). L81 in turn is only slightly more acid than C51. Values for CEC are very similar in all three soils being highest (18 me $100g^{-1}$) in the O horizon and lowest in the C horizon (7 me $100g^{-1}$). The profiles under Sitka spruce have less Ca, K and Mg in the O horizon than the profile under Molinia. Greater uptake by the Sitka spruce crop may account for this.

Amounts of exchangeable aluminium are slightly higher in the stagnopodzol under 12 year old Sitka but lower under the 25 year old crop.

Base saturation is highest in the O horizon under Molinia and lowest under 12 year old Sitka spruce. This is a result of changes in the base cation/aluminium balance rather than an increase in the cation exchange capacity which is in contrast to the comparison of moorland soils.

All three soils have similar amounts of pyrophosphate-extractable iron in the B and E horizons. The amount is greater however in the C horizons under both ages of Sitka spruce than under Molinia. This suggests that the crop has had little effect on iron mobility in the stagnopodzol profile after 25 years.

Without further sampling, particularly of different soils within the same catchment, it is difficult to say whether these differences are due to the presence of Sitka spruce crop or to site differences, with slope possibly being the main factor.

Comparison of intergrade soils under Agrostis/Festuca, Sitka spruce and Japanese larch

By contrasting the soil profiles C31, L41 and L22 it is possible to make some comparison of the effects of 1) an evergreen standing crop (Sitka spruce) and 2) a deciduous conifer (Japanese larch) on intergrade soils.

Soil pH values are much lower under both spruce and larch than under Agrostis, for example the E horizon pH is 4.4 under Agrostis and 3.9 under Sitka spruce. These differences are evident in the C horizon (pH 4.6 of pH 4.2) which suggests that the crops have had a significant acidifying effect.

Amounts of exchangeable cations vary little between sites in the mineral horizons, but amounts of exchangeable calcium and magnesium are much greater in the Ah horizon under larch than under Sitka spruce.

Lime has not been applied since the land was acquired by the Forestry Commission in 195? so any lime would have been applied in excess of 35 years ago. This is unlikely however, given the low base saturation in the mineral horizons. The contrast in calcium and magnesium contents probably reflects the different patterns of nutrient cycling in the two tree crops. Exchangeable potassium in the E horizon decreases in the order C31-L41-L22 which may be a result of greater uptake by the conifers, larch having a greate requirement than spruce.

Cation exchange capacity also varies little in the mineral horizons between sites but it is significantly higher in the Ah horizon under larch than under Sitka spruce ($p \leqslant 0.005$). Exchangeable aluminium and hydrogen do not differ significantly between any two sites. The base saturation values in the Ah and C horizons of 122 are in excess of 30% which contrasts with the highly acid pH of this profile compared to C31.

Amounts of pyrophosphate-extractable iron vary significantly in the Ah, E and B. The decrease in the Ah and E horizons in the order C31-L41-L22 complements the increase in the B horizon. It is possible that some thirty-five years of coniferous growth have resulted in greater podzolisation (eluviation of iron from the E horizon) in the profiles of L41 and L22. This does not necessarily contradict the observation made above (comparison of ferric stagnopodzols under two ages of Sitka spruce) as in this case the soil is an intergrade and may be more susceptible to iron eluviation.

Comparison of brown podzolic soils under Agrostis/Festuca and under oak woodland

Below 300 m, the typical vegetation of catchments below the Brianne dam and in some areas bordering the lake is grazed oak woodland such as is found in the Gwenffrwd valley. Soil G11 was sampled in this valley and may be compared to soil C52 (brown podzolic under Agrostis/Festuca). Some profile characteristics differ: the brown podzolic under oak has an Ah horizon of variable depth (1-3 cm) being deepest where bracken has trapped greater quantities of oak leaf litter. The bright orange B horizon (zone of iron deposition) can extend to more than 90 cm deep in places. Under Agrostis/Festuca this horizon is not so thick.

The soil under oak is less acid than that under Agrostis/Festuca by some 0.4 pH units throughout the profile (mineral horizons). Loss-on-ignition is higher in the B and C horizons under oak; the values for the A horizons are similar.

The brown podzolic profile under oak has a higher exchange capacity and a much lower base saturation. Amounts of exchangeable sodium, magnesium and manganese are similar in the mineral horizons of both soils, but the profile under Agrostis/Festuca is higher in exchangeable calcium in the mineral horizons and also in potassium in the A horizon. Amounts of exchangeable hydrogen are similar in both soils but greater amounts of aluminium are found in the profile under oak. This extra aluminium accounts for most of the extra exchange capacity G11 hence the lower base saturation of this soil.

Conclusions from the chemical data

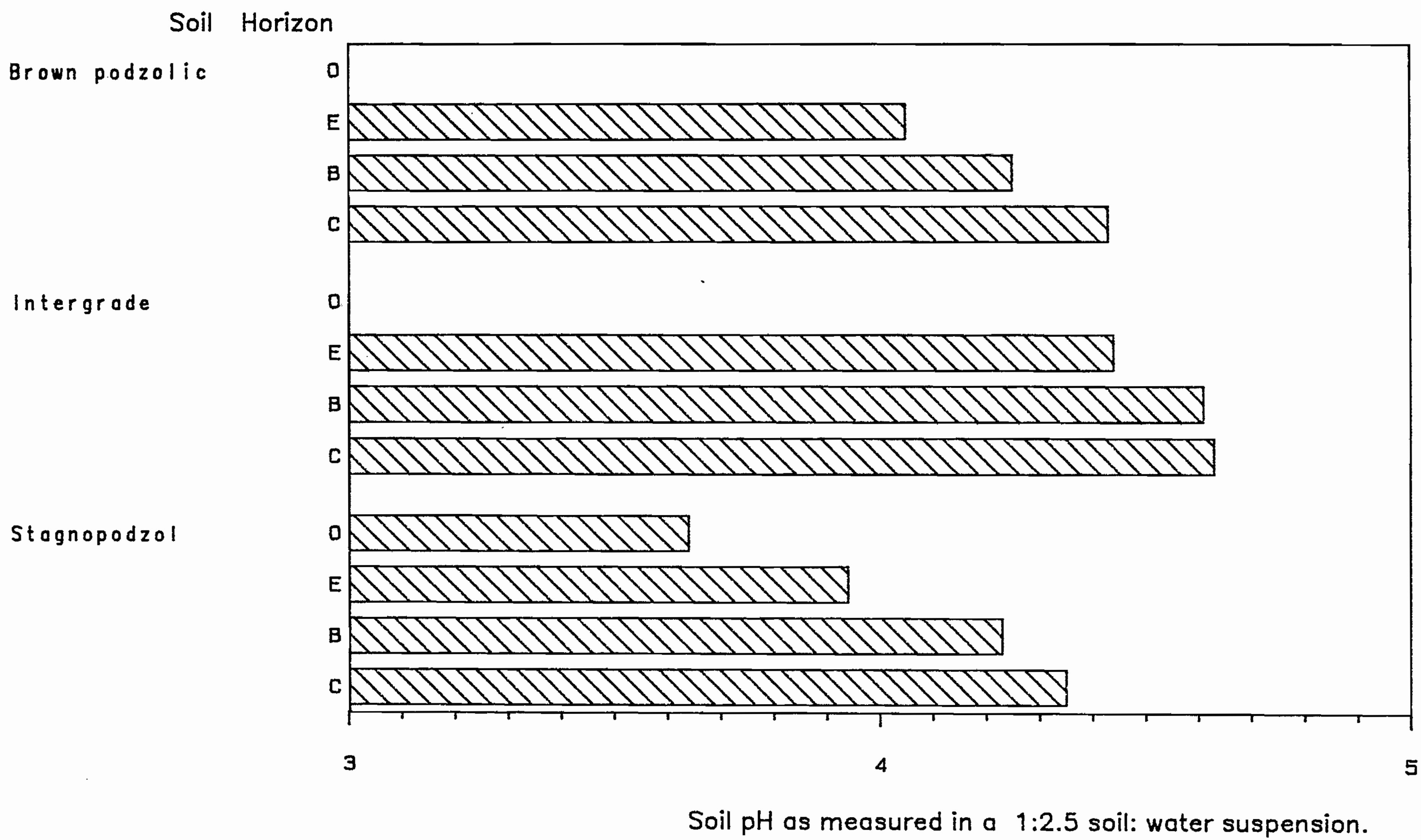
Similar soils have lower pH values under Sitka spruce than under Molinia. The cation exchange capacities are little different but base saturation values are lower under Sitka spruce.

Soils under larch are slightly lower in pH than those under Sitka spruce. The have much higher base saturation values in the organic horizon. This is most probably a consequence of the deciduous nature of the larch crop as opposed to the evergreen Sitka spruce crop.

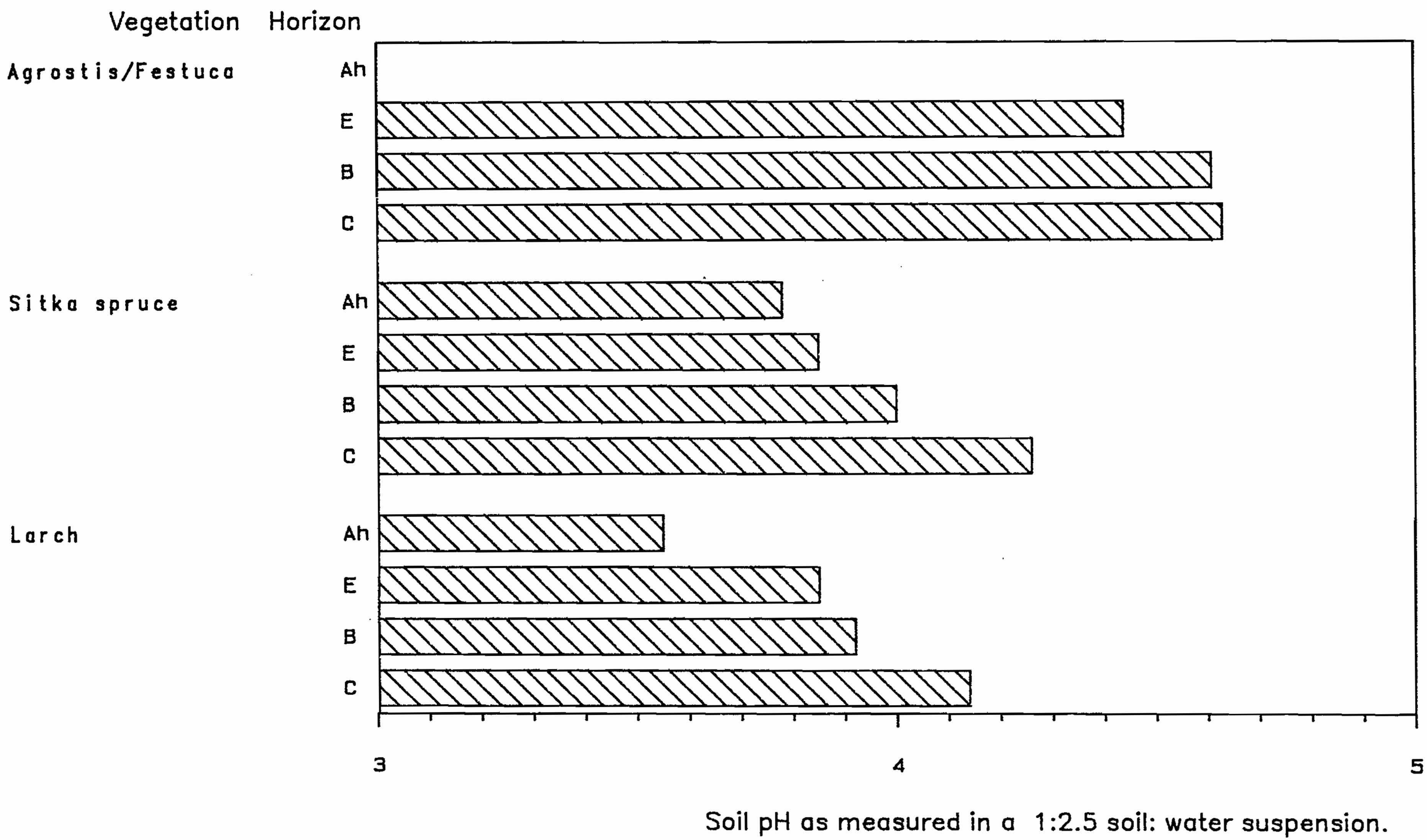
Brown podzolic soils under oak have higher pH values than those under moorland vegetation. This is in spite of a significantly lower base saturation.

In the moorland soils, exchangeable base cations and base saturation decrease and cation exchange capacity increases as the stagnopodzol profile develops. There is little change in pH.

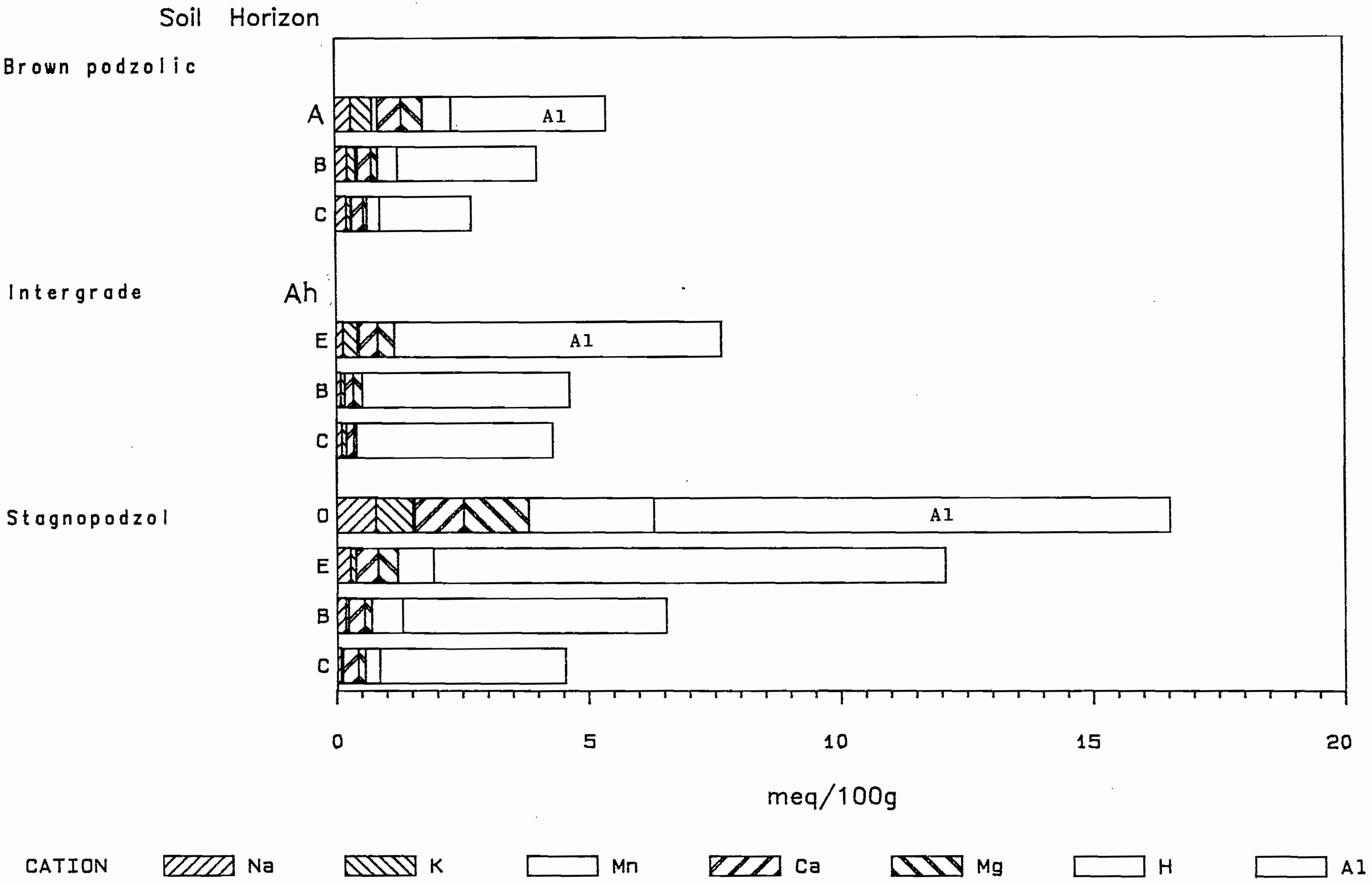
Horizon pH values of moorland soils.



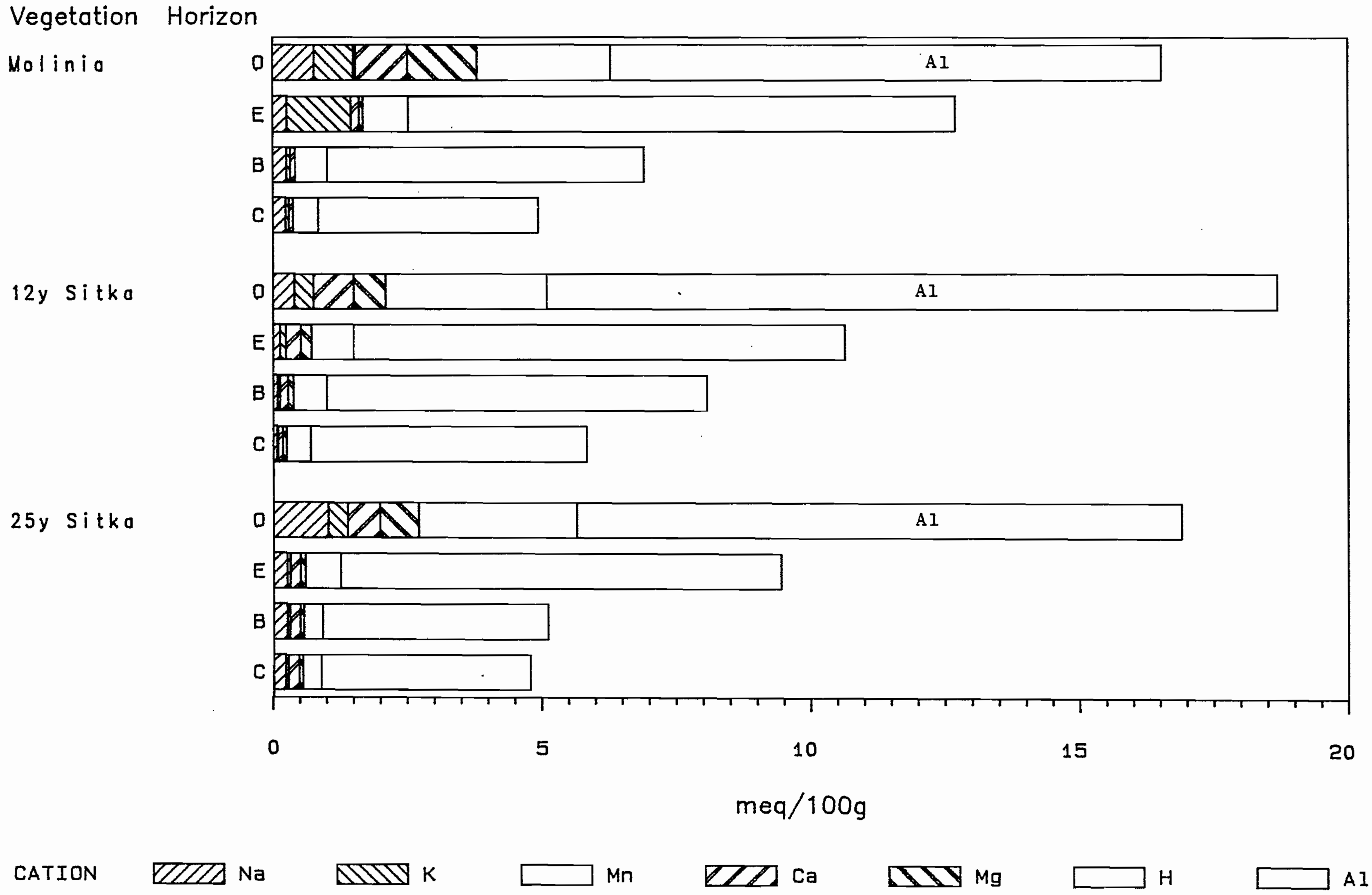
Horizon pH values of intergrade soils under Moorland and under forest.



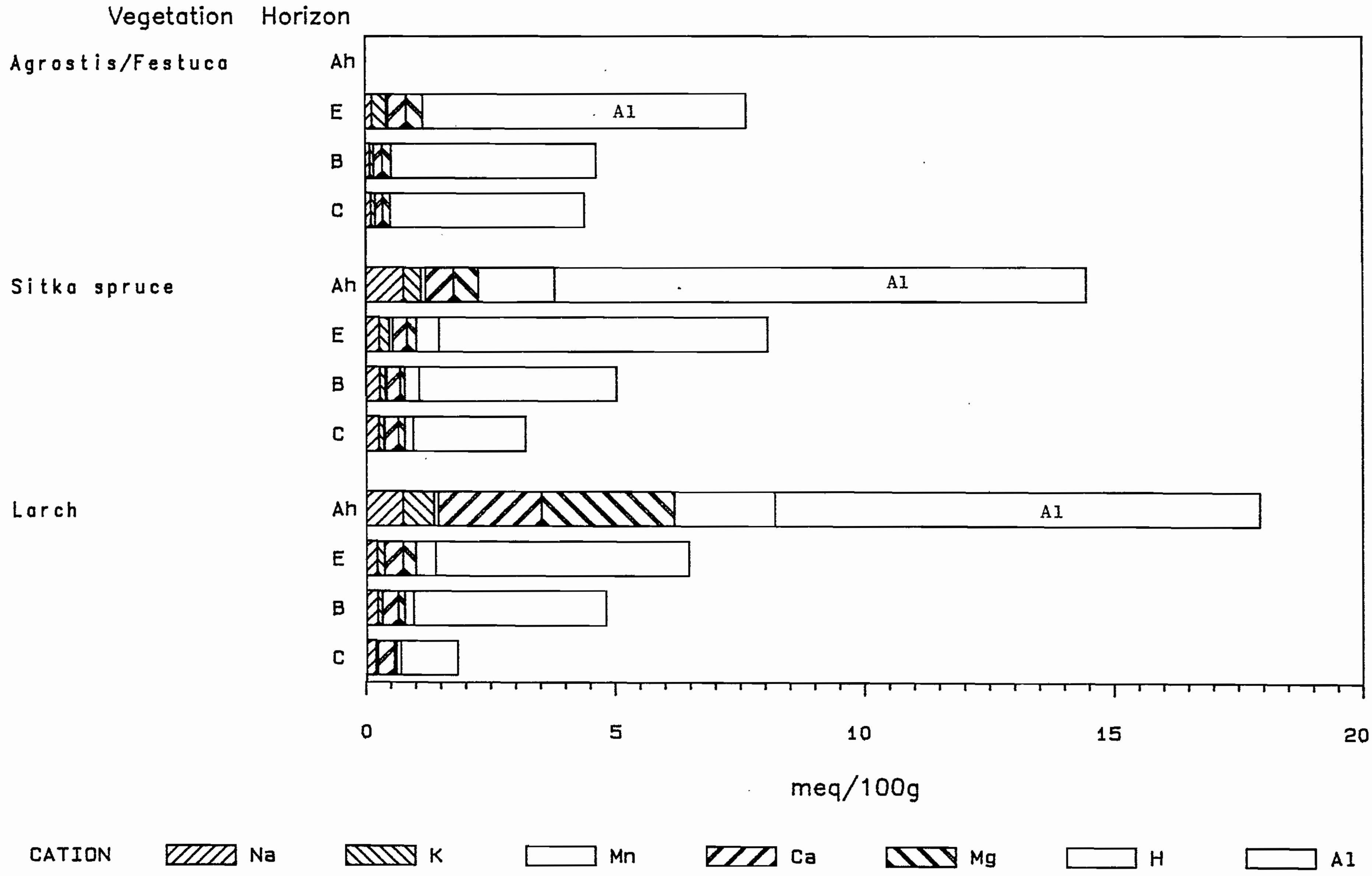
Exchangeable cations in three moorland soils.



Exchangeable cations in stagnopodzols under Molinia and Sitka spruce.



Exchangeable cations in intergrade soils under moorland and under forest.



EXCHANGEABLE CATIONS AND CATION EXCHANGE CAPACITIES FOR BRIANNE SOILS

All exchangeable cation values in meq/100g air-dry soil.

Site	Hz	pH H2O	pH CaCl	LoI %	Na	K	Mn	Ca	Mg	H	Al	CEC	BS	%AS	pFe	pAl
C31	E	4.44	3.62	11.1	0.15	0.29	0.03	0.37	0.33	0.00	6.47	7.64	15.3	84.7	0.96	0.21
C31	B	4.61	3.86	3.8	0.10	0.08	0.00	0.17	0.18	0.00	4.11	4.64	11.4	88.6	0.60	0.18
C31	C	4.63	3.91	2.3	0.12	0.09	0.00	0.15	0.15	0.00	3.89	4.40	11.6	88.4	0.43	0.16
C51	O	3.64	2.84	79.0	0.79	0.73	0.04	0.97	1.29	2.48	10.23	16.53	23.1	76.9	0.47	0.29
C51	E	3.94	3.15	9.4	0.28	0.12	0.00	0.15	0.07	0.84	10.16	11.62	5.3	94.7	0.19	0.15
C51	B	4.23	3.47	5.4	0.27	0.07	0.00	0.09	0.00	0.60	5.89	6.92	6.2	93.8	0.85	0.21
C51	C	4.35	3.61	3.4	0.25	0.06	0.00	0.08	0.00	0.47	4.09	4.95	7.9	92.1	0.17	0.17
C52	A	4.05	3.43	15.3	0.35	0.42	0.11	0.47	0.42	0.57	3.07	5.39	32.5	67.5	0.58	0.18
C52	B	4.25	3.62	5.5	0.25	0.17	0.04	0.27	0.13	0.39	2.76	4.01	21.4	78.6	0.72	0.24
C52	C	4.43	3.86	1.8	0.23	0.09	0.01	0.24	0.07	0.25	1.81	2.70	23.7	76.3	0.28	0.16
C53	O	3.93	3.10	80.4	1.04	0.99	0.03	2.47	2.60	1.53	5.41	14.07	50.7	49.3	0.34	0.20
C53	P	4.20	3.35	49.4	0.96	0.41	0.04	3.90	1.61	1.10	6.70	14.72	47.0	53.0	0.24	0.26
C54	O	3.89	2.77	94.5	1.56	0.67	0.00	3.07	9.66	3.13	1.79	19.88	75.3	24.7	0.08	0.10
C54	P	3.79	2.77	96.8	1.59	0.23	0.00	2.27	10.44	4.23	1.35	20.11	72.3	27.7	0.04	0.06
C61	O	4.06	3.34	44.4	0.74	0.58	0.03	1.50	2.11	1.31	11.73	13.50	26.8	73.2	0.44	0.18
C61	E	4.16	3.49	11.4	0.28	0.11	0.00	0.44	0.39	0.71	10.14	12.07	10.1	89.9	0.71	0.17
C61	B	4.32	3.89	5.9	0.18	0.06	0.00	0.32	0.14	0.61	5.23	6.54	10.7	89.3	1.06	0.27
C61	C	4.41	4.05	2.8	0.09	0.03	0.00	0.31	0.14	0.29	3.68	4.54	12.6	87.4	0.50	0.16
C62	O	4.45	3.79	85.4	1.03	0.66	0.12	1.47	2.11	1.11	9.77	16.27	33.1	66.9	0.43	0.38
C62	P	4.67	3.89	85.3	1.04	0.27	0.39	2.13	3.44	0.82	5.23	13.32	54.6	45.4	0.19	0.24
C63	O	5.38	4.67	80.9	1.06	0.45	0.66	3.93	3.88	0.77	3.29	14.04	71.1	28.9	0.92	0.12
C63	P	4.73	3.96	85.2	0.78	0.49	0.37	4.00	4.49	1.07	2.84	14.04	72.2	27.8	0.32	0.14
121	O	3.35	2.81	69.5	1.04	0.36	0.00	0.60	0.72	2.94	11.24	16.90	16.1	83.9	0.32	0.31
121	E	3.45	3.07	6.4	0.27	0.06	0.00	0.19	0.09	0.66	8.18	9.45	6.5	93.5	0.13	0.17
121	B	3.51	3.38	5.1	0.27	0.05	0.00	0.19	0.07	0.35	4.19	5.12	11.3	88.7	0.91	0.23
121	C	3.63	3.46	3.8	0.24	0.05	0.00	0.20	0.07	0.34	3.89	4.79	11.7	88.3	0.47	0.20
122	Ah	3.55	2.95	42.8	0.75	0.62	0.09	2.07	2.66	2.01	9.73	17.93	34.5	65.5	0.66	0.21
122	E	3.78	3.26	10.5	0.25	0.15	0.00	0.37	0.26	0.39	5.03	6.48	15.6	84.4	0.60	0.22
122	B	3.92	3.46	5.8	0.24	0.09	0.00	0.32	0.13	0.18	3.86	4.82	16.2	83.8	0.93	0.39
122	C	4.14	4.04	2.7	0.20	0.04	0.00	0.33	0.04	0.09	1.14	1.84	33.2	66.8	0.34	0.29
123	O	3.34	2.67	94.4	1.41	0.48	0.00	5.45	3.50	4.37	0.99	16.20	66.9	33.1	0.05	0.07
123	P	3.34	2.66	94.3	1.46	0.35	0.00	3.50	4.40	4.67	0.94	15.32	63.4	36.6	0.04	0.06
141	Ah	3.78	2.77	23.5	0.77	0.35	0.09	0.57	0.49	1.53	10.65	14.45	15.7	84.3	0.84	0.28
141	E	3.85	3.39	11.9	0.28	0.20	0.07	0.29	0.19	0.45	6.58	8.06	12.8	87.2	0.84	0.34
141	B	4.00	3.50	5.9	0.29	0.11	0.03	0.27	0.09	0.29	3.96	5.04	15.7	84.3	0.98	0.39
141	C	4.26	4.08	3.0	0.27	0.10	0.01	0.28	0.13	0.17	2.25	3.21	24.6	75.4	0.55	0.32
181	O	3.71	2.76	68.1	0.41	0.36	0.00	0.75	0.59	2.99	13.58	18.68	11.3	88.7	0.31	0.35
181	E	3.94	3.13	5.5	0.14	0.11	0.00	0.28	0.20	0.78	9.13	10.64	6.9	93.1	0.16	0.13
181	B	4.13	3.43	6.1	0.09	0.05	0.00	0.15	0.10	0.62	7.06	8.07	4.8	95.2	0.90	0.24
181	C	4.21	3.54	3.2	0.08	0.02	0.00	0.09	0.07	0.45	5.13	5.84	4.5	95.5	0.41	0.15
G11	Ah	4.35	3.19	29.4	0.43	0.75	0.09	0.64	0.89	1.76	6.68	11.24	24.9	59.4		
G11	A	4.36	3.49	14.8	0.31	0.33	0.09	0.27	0.33	0.52	5.41	7.26	18.3	74.5		
G11	B	4.59	3.90	9.9	0.27	0.23	0.01	0.13	0.14	0.32	4.06	5.16	15.1	78.7		
G11	C	4.87	4.41	4.4	0.25	0.13	0.01	0.08	0.13	0.17	1.56	2.33	25.8	66.9		