1113

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A COMPARISON OF 1986 and 1987 CAESIUM ACTIVITIES OF VEGETATION IN WEST CUMBRIA

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C O N T E N T S

1 SUMMARY

Vegetation from sites within and around the restricted area of West Cumbria, initially visited in late May 1986, has been resampled and analysed for ^{137}Cs activity. At most sites the ^{137}Cs activity of vegetation has declined to less than 30% of the 1986 value. However there are areas where the caesium activity still warrants the continuation of restrictions on the movement and slaughter of sheep. Those sites where the ^{137}Cs activity of vegetation has remained comparatively high were found to have low pH, organic soils.

2 INTRODUCTION

A nationwide survey of the ^{137}Cs activity of vegetation resulting from deposition of fallout from the Chernobyl accident was conducted by the ITE in late May 1986. Particularly intensive sampling was conducted in Cumbria due to initial indications that higher deposition had occurred in part of the county. In West Cumbria, North Wales and areas of Scotland, the caesium activity of vegetation was sufficiently high to cause tissue levels in sheep grazing these areas to exceed the limit, of 1000 Bq kg^{-1} wet weight, recommended by the Group of Experts established under article 31 of the Euratom Treaty meeting in Luxembourg of 1000 Bq kg^{-1} wet weight. Consequently it was necessary to place restrictions on the slaughter and movement of sheep from these areas.

Although the caesium activity of vegetation declined rapidly in most areas, in large upland areas of West Cumbria and North Wales it remained comparatively high. It became evident that caesium uptake by vegetation was occurring and that the need for restrictions in 1987 would be dependent on the caesium activity in the grazed vegetation of the new growing season.

The ^{137}Cs activity of vegetation, collected from the same West Cumbria sample sites as were used in late May 1986, following the Chernobyl accident, has been measured to provide a comparision between activities in May 1986 and May 1987. The results should help to determine the potential for reducing the size of the restricted area in 1987.

This report presents ^{137}Cs results for 70 sites in and around the restricted area of West Cumbria. A similar report giving 1987 caesium activities of vegetation within the restricted area of North Wales is also being prepared (Beresford et al.).

3 MATERIALS AND METHODS

The selection of sampling sites was stratified using a land classification developed by ITE, and has been described in detail by Horrill (1987). Fifty-eight sample sites, within the current or previously restricted area of West Cumbria, were revisited in May and early June 1987. Additional samples were collected from 12 sites around, but outside the area which had been restricted. The location of sample sites is shown in Figure 1.

Vegetation was clipped from 1 m^2 or 2 m^2 quadrats to a height of 1 cm above ground level. Dead vegetation and species other than grasses were avoided. The samples were dried at 80° C, weighed, ground and counted in plastic containers (130 ml) on a NaI (Tl) detector to determine ^{137}Cs activity. The 10 most active samples were recounted on a high resolution germanium detector.

Soil samples (20 x 20 x 20 cm) were taken from all sites. Soils were allocated to a series of textural categories on the basis of the estimated content of clay, silt, sand and organic matter. Soils dominated by material from one category were simply given one category name (eg silt). Soils given 2 names (eg sand/silt) had significant quantities of material from 2 categories, the first category being present in greatest quantity (sand in this examples). "Loam" was used for soils with significant quantities of material from 3 or more categories (eg sand, clay and organic matter). The categories were:-

1. Clay: particles of less than 2 μm diameter;

2. Silt: particles of 2-40 μm diameter;

3. Sand: particles of 50 μm - 2 mm diameter;

4. Loam: mixed;

5. Organic: - humified plant material.

Soil pH was determined using an antimony electrode pH meter.

4 RESULTS

Table 1 compares the ^{137}Cs activity of vegetation collected in 1987 to that taken in 1986, together with land classification, soil classification and soil pH. Only 8 of the 70 samples were found to be above 1000 Bq kg^{-1} dry weight in the resampling, the maximum being 2190, compared with 15 samples which were above 10,000 Bq kg^{-1} dry weight in 1986. Thirty-eight samples in 1987 were below the detectors limit of detection (300 Bq kg^{-1}). A contour map of 1987 ^{137}Cs results is presented in Figure 2. The south western fells can be seen to be the area where ^{137}Cs activity of vegetation remains highest.

The ^{134}Cs activity and the ^{134}Cs:^{137}Cs ratio (approximately 1:2.77) of the 10 most active samples is shown in Table 2.

Figure 3 compares ^{137}Cs activity of 1987 vegetation samples with both soil class and pH. The majority of samples >300 Bq kg^{-1} dry weight can be seen to be from sites with low pH, organic soils.

5 DISCUSSION

Outside the currently restricted area the ^{137}Cs activity of vegetation collected in 1987 was less than 1000 Bq kg^{-1} dry weight. Generally, ^{137}Cs activities were higher within the restricted area, the highest being 2190 Bq kg^{-1} dry weight (National Grid Reference 317503).

Those sites (starred in Table 1) where the ^{137}Cs activity of vegetation has remained proportionately high have low pH, organic soils and belong to upland land classes. The only exception to this was sample number 2 which was collected from a tidally inundated saltmarsh on the Ravenglass Estuary contaminated by liquid effluent from the Sellafield Reprocessing Plant. Other sites along the coast which received high deposition of ^{137}Cs in May 1986 are now all below 300 Bq kg^{-1} dry weight.

On the pessimistic assumption that the transfer coefficient (caesium activity of muscle Bq kg^{-1} fresh wt/daily intake of caesium) for both ^{134}Cs and ^{137}Cs (current ratio approximately 1:2.77) to lamb muscle is 0.79 (Howard et al. 1987), then restrictions will need to remain in force in those areas where the ^{137}Cs activity of vegetation exceeds 1500 Bq kg^{-1} dry weight.

The samples in this report were taken at previously sampled, specific locations one year after the original survey to enable a comparison of current levels in vegetation with those of vegetation shortly after the deposition. The results should not be used to predict seasonal variations of the ^{137}Cs activity of vegetation over the coming year.

6 ACKNOWLEDGMENTS

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7 REFERENCES

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Table 1

Sample	Grid Reference	ITE Land Classification	Restriction Status	^{137}Cs Activity of Vegetation 1986 Bq kg^{-1} dry wt	1987 Bq kg^{-1} dry wt	Decrease in ^{137}Cs Activity (1986-1987) Bq kg^{-1} dry wt	Soil Classification	Soil pH
1	318491	4	Restricted	10370	< 300	>10070	Loam	6.2
2	309495	8	Restricted	10060	940	9120	Silt	6.5
3	309497	8	Restricted	10800	300	10500	Sand/Silt	5.9
4	327502	9	Restricted	4890	730	4160*	Organic	3.8
5	319497	9	Restricted	11200	1150	10050	Organic	4.1
6	316490	9	Restricted	10470	1790	8680*	Organic	3.3
7	307509	11	Restricted	12370	990	11380	Organic Silt/	4.1
8	311507	12	Restricted	8510	1340	7170*	Organic/Sand	3.6
9	321502	12	Restricted	6440	360	6080	Organic	5.0
10	310506	12	Restricted	7230	1050	6180*	Organic	3.7
11	317503	12	Restricted	10480	2190	8290*	Silt/Organic	3.4
12	313484	13	Restricted	9500	820	8680	Organic/Silt	4.8
13	320509	15	Restricted	6190	440	5750	Silt/Sand	5.2
14	325502	15	Restricted	3140	380	2760	Organic/Sand	4.1
15	314515	15	Restricted	11970	580	11390	Silt/Organic	4.2
16	322499	15	Restricted	10570	1130	9440	Organic	4.0
17	314492	15	Restricted	15340	980	14360	Organic	3.9
18	322509	16	Restricted	7220	< 300	> 6920	Organic	4.6
19	315510	16	Restricted	11740	1050	10690	Organic	3.8
20	313508	16	Restricted	11200	1970	9230*	Organic	3.8
21	310492	1	Derestricted	1070	< 300	> 770	Clay	6.1
22	304525	2	Derestricted	1590	< 300	> 1290	Silt/Clay	6.2
23	306518	2	Derestricted	13320	< 300	>13020	Clay/Silt	6.6
24	332524	4	Derestricted	2400	< 300	> 2100	Clay	5.4
25	323496	4	Derestricted	3730	< 300	> 3430	Silt/Organic	5.1
26	301511	6	Derestricted	3190	< 300	> 2890	Loam	5.5
27	301513	6	Derestricted	2810	< 300	> 2510	Loam	5.7
28	329505	9	Derestricted	5080	550	4530	Organic	4.0
29	317523	9	Derestricted	8250	< 300	> 7950	Silt/Sand	4.7
30	338506	9	Derestricted	1930	< 300	> 1630	Organic	4.6
31	330519	10	Derestricted	1180	< 300	> 880	Organic	3.9

Table 1 continued

Sample	Grid Reference	ITE Land Classification	Restriction Status	^{137}Cs Activity of Vegetation 1986 Bq kg^{-1} dry wt	1987 Bq kg^{-1} dry wt	Decrease in ^{137}Cs Activity (1986-1987) Bq kg^{-1} dry wt	Soil Classification	Soil pH
32	316523	10	Derestricted	6670	< 300	> 6370	Silt/Clay	5.5
33	330505	10	Derestricted	3110	400	2710	Organic/Silt	4.0
34	340513	11	Derestricted	1720	< 300	> 1420	Silt/Sand	5.6
35	317525	11	Derestricted	3520	< 300	> 3220	Silt/Clay	4.1
36	338505	12	Derestricted	1980	< 300	> 1680	Silt/Sand	4.1
37	303512	12	Derestricted	12080	< 300	> 11780	Clay/Silt	4.7
38	331521	12	Derestricted	2400	< 300	> 2100	Silt/Sand	4.5
39	331515	12	Derestricted	2040	< 300	> 1740	Organic	2.8
40	337506	12	Derestricted	1030	< 300	> 730	Clay/Silt	5.9
41	336522	15	Derestricted	980	370	610*	Organic	3.6
42	328520	15	Derestricted	4980	350	4630	Organic	3.3
43	320526	15	Derestricted	4210	470	3740	Organic/Silt	3.4
44	325498	15	Derestricted	9740	810	8930	Organic	3.3
45	316521	16	Derestricted	7060	510	6550	Loam	4.5
46	326499	16	Derestricted	8800	< 300	> 8500	Organic	4.2
47	339508	16	Derestricted	2630	< 300	> 2330	Organic	3.3
48	340509	16	Derestricted	2110	< 300	> 1810	Silt/Sand	4.5
49	299526	1	Unrestricted	12000	< 300	> 11700	Silt/Sand	4.6
50	307487	8	Unrestricted	2360	< 300	> 2060	Organic/Sand	6.0
51	308506	12	Restricted	7270	< 300	> 6970	Organic/Sand	6.6
52	322505	15	Restricted	6190	360	5830	Organic	4.5
53	328529	10	Derestricted	2120	390	1730*	Organic	4.1
54	331527	14	Derestricted	2770	550	2220*	Organic	3.7
55	333530	14	Derestricted	2300	< 300	> 2000	Organic	3.3
56	324528	14	Derestricted	2600	830	1770*	Organic/Silt	3.9
57	329512	14	Derestricted	3210	690	2520*	Organic	3.5
58	331531	15	Derestricted	3080	370	2710	Organic	3.3
59	331533	15	Derestricted	2670	< 300	> 2370	Organic	4.1
60	336511	16	Derestricted	1610	< 300	> 1310	Organic	3.7
61	328487	1	Unrestricted	2090	< 300	> 1790	Silt	4.7
62	315535	3	Unrestricted	1460	< 300	> 1160	Clay/Sand	6.4
63	341528	3	Unrestricted	730	< 300	> 430	Organic	4.5
64	334538	3	Unrestricted	470	< 300	> 170	Loam	5.2

Table 1 continued

Sample	Grid Reference	ITE Land Classification	Restriction Status	^{137}Cs Activity of Vegetation 1986 Bq kg^{-1} dry wt	1987 Bq kg^{-1} dry wt	Decrease in ^{137}Cs Activity (1986-1987) Bq kg^{-1} dry wt	Soil Classification	Soil pH
65	295512	5	Unrestricted	2320	<300	>2020	Silt/Clay	6.6
66	310531	6	Unrestricted	3340	<300	>3040	Clay/Silt	5.3
67	302535	8	Unrestricted	6670	<300	>6370	Loam	6.4
68	342517	9	Unrestricted	2320	490	1830*	Organic	4.1
69	332496	11	Unrestricted	5660	550	5110	Organic	3.3
70	326538	11	Unrestricted	540	<300	> 240	Clay/Silt	6.6

Table 2

Caesium activity of vegetation
(Bq kg^{-1} dry wt)

Sample	^{134}Cs	^{137}Cs	$^{134}Cs:^{137}Cs$
5	570	1570	1:2.75
6	770	2150	1:2.79
7	330	880	1:2.67
8	500	1400	1:2.80
10	410	1170	1:2.85
11	870	2210	1:2.54
16	440	1360	1:3.09
17	480	1340	1:2.79
19	470	1280	1:2.72
20	850	2310	1:2.72

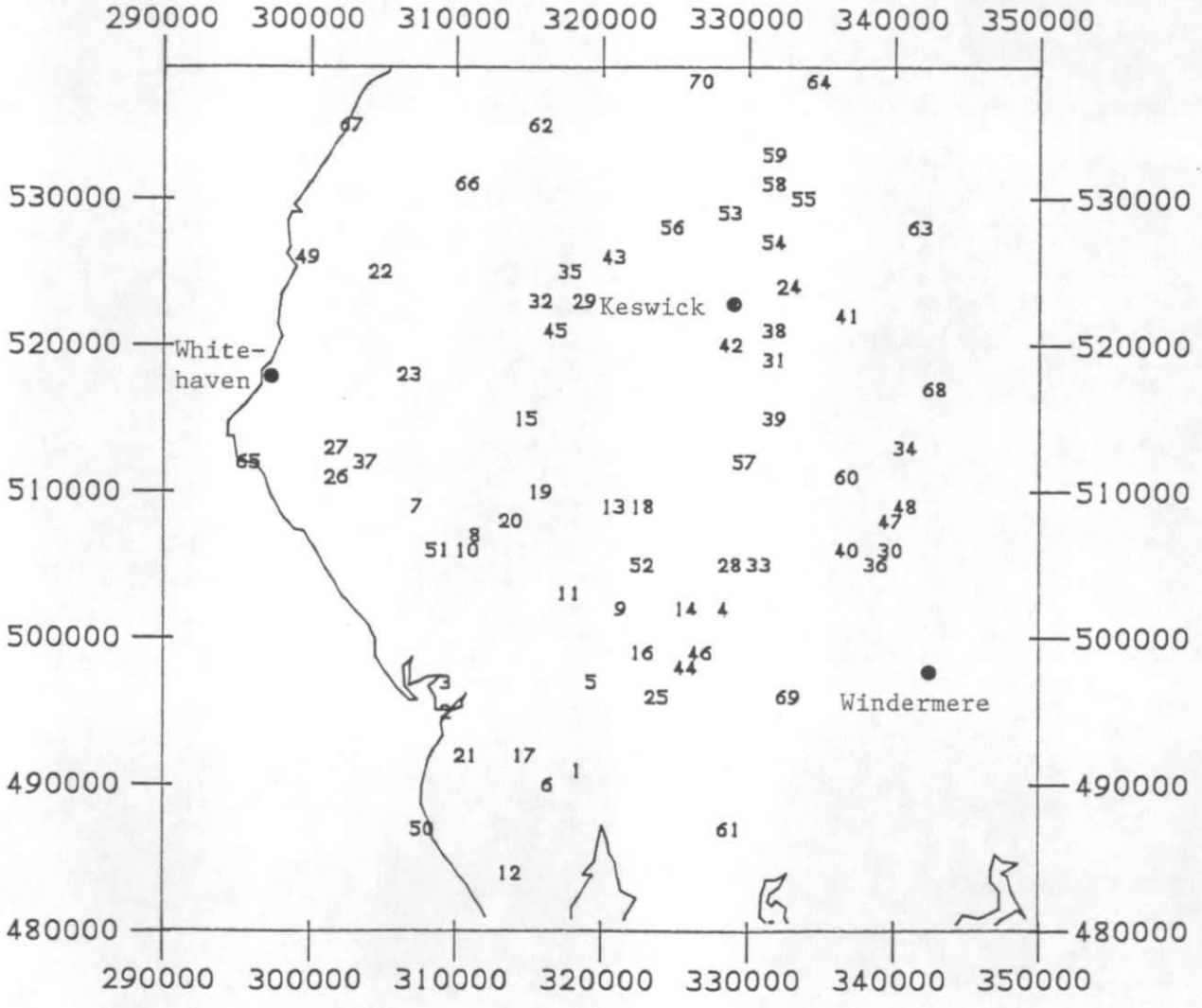

Figure 1. Location of sample sites

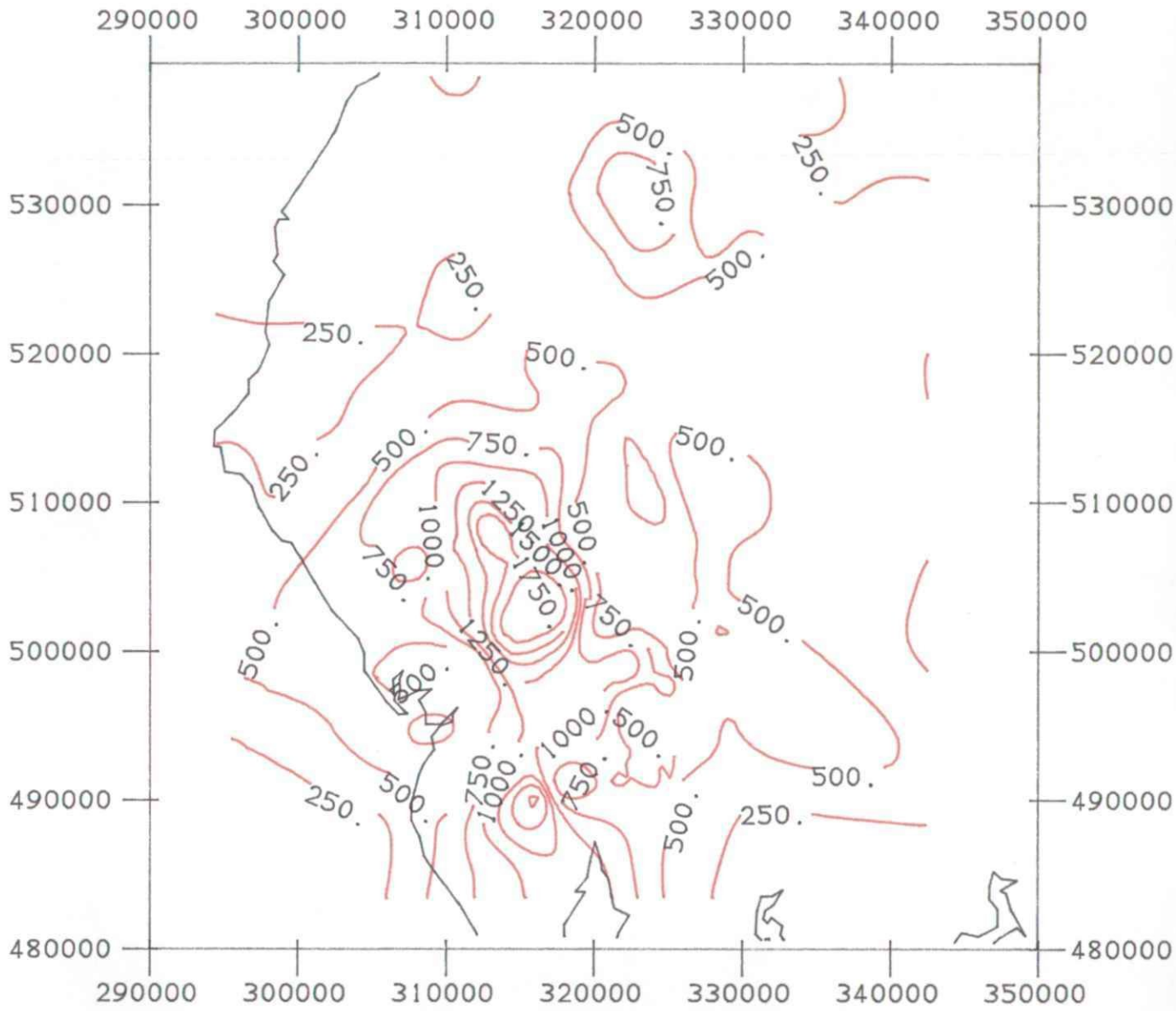

Figure 2. ^{137}Cs activity of vegetation (Bq kg^{-1} dry wt) in West Cumbria May/June 1987

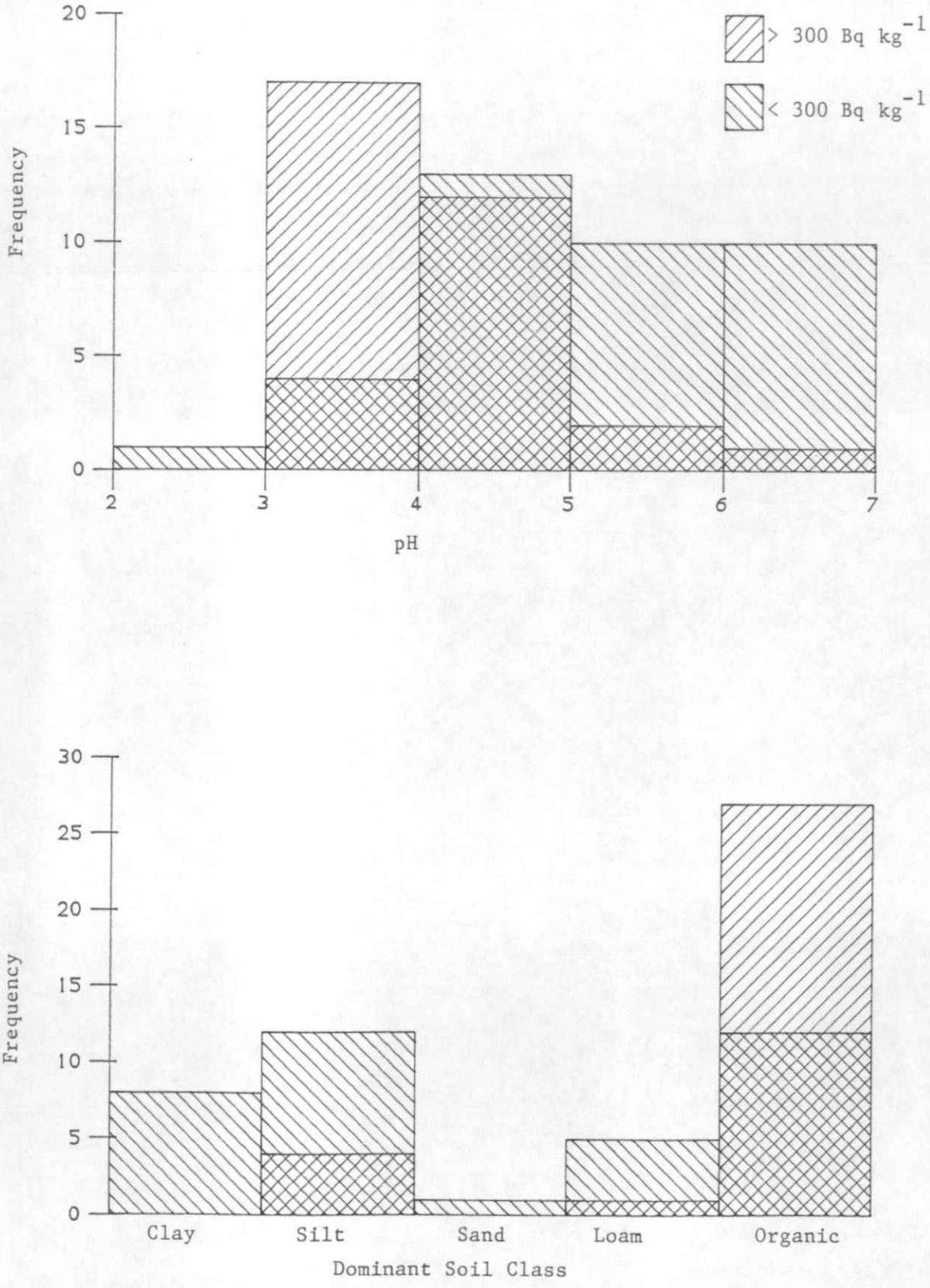

Figure 3. Comparison of the number of vegetation samples above and below 300 Bq kg^{-1} with soil pH and classification.