## *The effect of ridge and furrow cultivation and hut circles on the species composition of grassland in Northumberland*


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# THE EFFECT OF RIDGE AND FURROW CULTIVATION AND HUT CIRCLES ON THE SPECIES COMPOSITION OF GRASSLAND IN NORTHUMBERLAND

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## SUMMARY

(1) Three main types of ridge and furrow can be found in Britain which differ greatly in the size of the microtopographical features they present and time that they were made. Prehistoric cultivation forms low, narrow ridges whilst those of 18/19th century cultivation are wider and higher. Medieval cultivation has the broadest ridges and the greatest height difference exists between the ridges and furrows of any of the cultivation types.

(2) The vegetation present on prehistoric, medieval, 18/19th century cultivation ridge and furrow and hut circles, which are associated with prehistoric cultivation, was recorded together with that of areas outside those cultivated on three sites in Northumberland.

(3) Ninety-five species were recorded from one hundred and ten plots together with information on the slope, aspect, altitude, pH and soil texture.

(4) The data on the species present was analysed using the programs TWINSPAN and DECORANA. The ordination produced by DECORANA suggests that the major axes of variation relate to moisture availability and base status with site characteristics being important in determining the species present in many samples.

(5) The environmental variables including those of the types of cultivation and the hut circles were then entered in the program CANOCO. The most important of these relate to soil characteristics which may reflect the relative base status and moisture holding capacity of different soils. However, the CANOCO results also show that 18/19th century cultivation has the most distinctive flora of the cultivation types with several species occuring mainly or only in these areas. This is probably a result of fertiliser input during cultivation which together with the relatively short time in which leaching has been able to take place has produced soils with a high base status, although reseeding following the transition to pasture is also implicated. In addition, the vegetation present on the hut circles is similar throughout the three sites reflecting the dry, acidic nature of the habitat.

(6) Differences between the DECORANA sample scores of the ridges and furrows show that each cultivation type appears to effect moisture availability and hence vegetation present in direct relation to the size of the microtopographical feature. The most significant differences occur on those of medieval cultivation where there is the largest height difference between the ridges and the furrows. 18/19th century cultivation shows less significant differences and prehistoric cultivation the least reflecting the relative size of these features.

(7) Differences in base status of the ridges and furrows using the DECORANA scores reflect the time available for leaching since cultivation ceased and the potential of the soil to be leached. Significant differences therefore invariably occur on those

of prehistoric cultivation whilst they are only significant on medieval cultivation where the soil is readily leached. The ridges and furrows of 18/19th century cultivation only seem to differ in base status where management appears to have been less intense.

(8) It is suggested that a much more extensive study will be needed to verify these findings and that this should include an assessment of moisture availability.

## INTRODUCTION

Areas which were formerly cultivated and are now used for grazing show evidence of their past use by the presence of ridge and furrow. These are microtopographical features and they visibly affect the species composition of the vegetation in different ways depending on how they were formed. Three main types of ridge and furrow are recognised in Britain each reflecting a different agricultural practice.

### Prehistoric

The earliest descernable form of ridge and furrow is thought to date from a period extending from the early Iron Age to Romano-British in date whose existence has only been recognised within the last ten years. They are referred to as 'cord rig' due to the long thin nature of the ridges which are on average only 1.4 m wide and at most 15 cm high (Topping 1989). It is believed that they were mainly produced using the prehistoric plough or ard and that the ploughing was uniaxial or multiaxial depending on the intensity of cultivation. There are over 70 known occurences of cord rig earthworks in Northumberland although it has mainly survived in the upland margins beyond the reach of the medieval plough, however, remnants occur above this and it has been found to extend up to the 420 m contour (Topping 1989). In places that have been the subject of archaeological research it is also possible to identify the remains of the circular huts used by the farmers who created the cord rig. These consist of low stone walls of around 4 m in diameter the upper surfaces of which are now partly covered in vegetation.

### Medieval

Little is known of the cultivation patterns left by the Anglians and the next recognisable form of ridge and furrow dates from after the Norman conquest and was created from the eleventh century to the seventeenth. This medieval ridge and furrow has been called broad rig and is the most obvious of the three types in the field due to it's size and the characteristic reversed 'S' shape of the cultivation markings. The width of most ridges in Northumberland is between 3.5 m and 15 m with an average of 11 m and a height difference between the ridges and furrows of approximately 1 m (Butlin 1973). It was predominantly formed by teams of oxen pulling a heavy mouldboard plough and was part of an open field system in which land was subdivided by a double furrow (Hoskins 1955). Medieval ploughing reached the 300 m contour in the uplands and evidence is much more extensive than that for cord rig, due partly to the shorter time elapsed since cultivation and partly to the widespread abandonment of settlements during the sixteenth and seventeenth centuries brought about by climatic and population changes.

Post Enclosure

Following enclosure during the eighteenth and nineteenth centuries the open field system ceased to exist and was replaced by fields which were more easily worked by one man. Horses provided the power and ploughs were lighter although much improved in design (Blandford 1976) resulting in ridges and furrows which are at most 30 cm high and between 2 m and 6 m wide (Butlin 1973).

There has been some speculation as to whether the different types of ridge and furrow reflect a response to climatic variation as well as to the agricultural systems and technologies of the time. O'Danachair (1970) discovered a degree of regional variation in the form of ridged cultivation in Ireland which depended on the texture and the humidity of the soil, the concern being to protect the seeds from excessive moisture. He found that the wetter the ground the narrower the ridge and that few areas were too dry for ridged cultivation. It may be coincidental that the narrow cultivation markings associated with cord rig were formed during a period of low temperatures and increased cyclonic activity, and that those of medieval cultivation were formed when warmer conditions prevailed in the British Isles (Lamb 1971) but the possibility remains that they were produced in response to climatic conditions.

Northumberland provides evidence of each of the three types of cultivation which has largely been preserved because of the marginal nature of land to the west of the county and the tendency for it to be used for pasture at times of worsening climate or agricultural change in the lowlands. It is particularly suitable for this study as the types can be found in close proximity.

Differences in microtopography cause variations in soil moisture and this is a controlling factor in the distribution of many grassland species. The types of cultivation form very different microtopographical features and I believe that these may have correspondingly different effects on soil moisture and therefore species distribution. A further effect may also result from the length of time elapsed since cultivation ceased as this is a factor which contributes to species diversity and leaching is a continuous process whose effects are more substantial over a lengthy period. The vegetation present on the hut circles provides an interesting comparison with that on the formerly cultivated land because of the well drained and potentially leached nature of the habitat which has otherwise been subject to similar climatic and grazing influences.

Although differences in the vegetation of ridges and furrows is widely recognised there seems to be little direct analysis of it. Harper and Sagar (1953) sampled ridge and furrow grassland near Oxford and found a marked distribution of *Ranunculus* species with *Ranunculus bulbosus* occupying the tops of the ridges, *Ranunculus acris* the sides and *Ranunculus repens* the furrows which they attributed to seedling establishment in the differing moisture conditions in the heavy clay soils. Although the literature provides no further clue as to the nature of these ridges and furrows a transect showing the abundance of the species (Harper 1977) indicates that the ridges are approximately 10 m wide which would suggest that they are medieval in origin. The other cultivation types appear not to have attracted the interest of ecologists.

The aim of this study is to assess the effects of the different types of ridge and furrow and the presence of hut circles to the species composition of grassland. The following questions were considered : (i) whether any species can be found which are associated with a particular type of ciltivation or the presence of hut circles, and (ii) what effect do the ridges and furrows of each type of cultivation have on the overall species composition?

## METHODS

### *Study Sites*

Three study sites were chosen each of which contained evidence of prehistoric, medieval and 18/19th century cultivation together with hut circles. They occupy widely different locations in Northumberland as shown in figure 1 and each represents an area in which there is a concentration of cord rig earthworks. The sites were chosen so as to be similar in slope , aspect, altitude and grazing pressure as these factors are known to effect species distribution and a further consideration concerned the availability of archaeological survey work as it was important to confirm the type and location of the ridge and furrow.

#### Hartside

The most northern site is on Hartside Hill which is bordered by the river Breamish in the foothills of the Cheviots. This area which is part of the Ingram Valley has been extensively surveyed and photographed by the Royal Commission for Historic Monuments and contains prehistoric (National Grid Reference NY981153), medieval (NY984156) and 18/19th century cultivation (NY978153) together with hut circles (NY976154) in close proximity as shown in figure 2. These are present at an altitude of between 230 m and 240 m , with an aspect of 160 degrees and a variation in slope of between 6 and 9 degrees.

**Figure 1** Sites in Northumberland

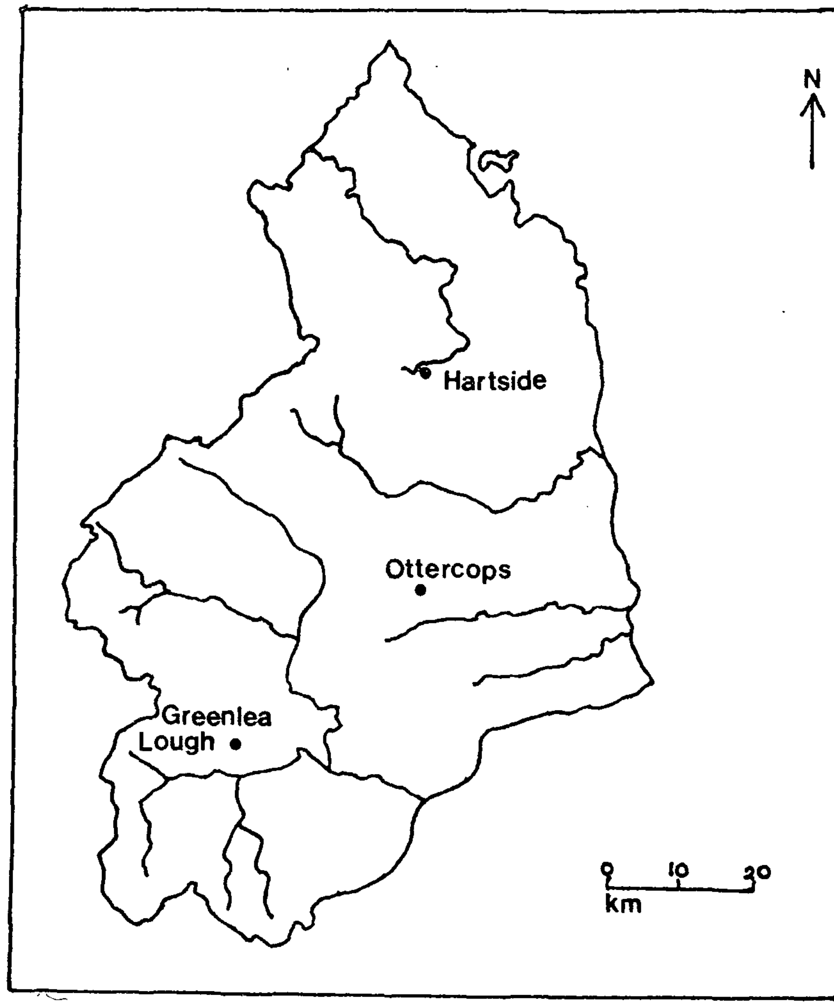



**Figure 2** Hartside Hill

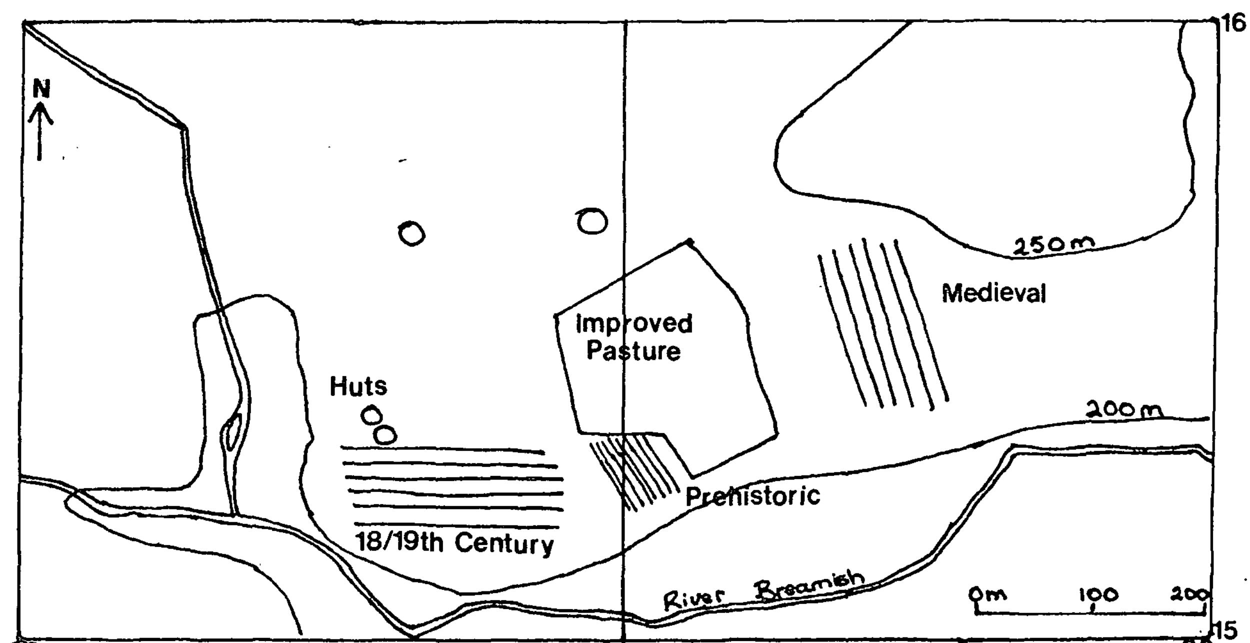


**Figure 3** Ottercops

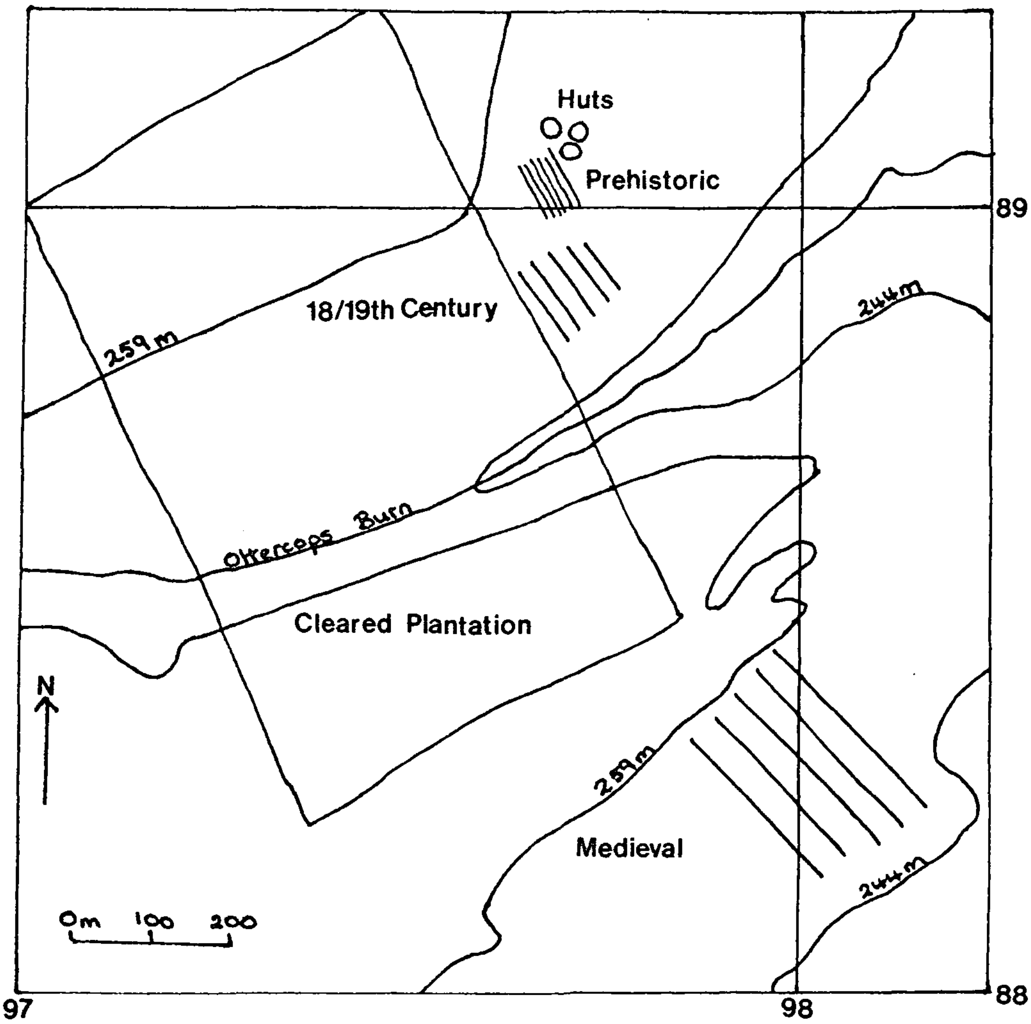
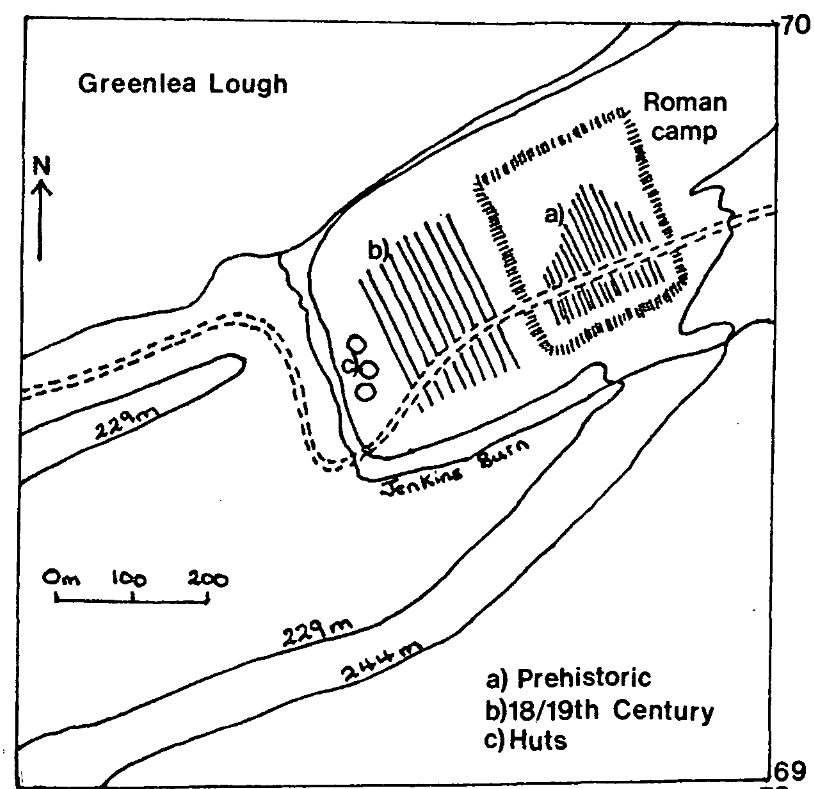



**Figure 4** Greenlea Lough



The soils are either clay loam or peaty loam in texture and have the highest moisture content of the three sites with water present in the furrows in places, most noticeably so in those of medieval cultivation. The excessive moisture is probably due to runoff from higher land as the site is of intermediate position on the hillside but this is exacerbated by the presence of colluvial clay below the soil in the worst effected areas and where the soil lies above gravel drainage is much improved. The area is grazed by sheep and cattle and though they tend to remain within the area bordered by the river Breamish and exert a low grazing pressure this is the most difficult variable to control as grazing is selective and they show preference for certain areas.

### Ottercops

Ottercops Burn crosses Hartington Moor 1 km north of the A696 in mid-Northumberland. The area is part of the Wallington Hall Estate which is now owned by the National Trust and is let to tenant farmers. It has been studied and mapped by the Archaeology Department of Newcastle University and although this is not complete sufficient work has been carried out to locate prehistoric (NY977891) and 18/19th century cultivation (NY977889) together with hut circles (NY977892) within a small area as shown in figure 3. The medieval cultivation (NY979883) used for this study is in an adjacent area and similar in slope, aspect, altitude and grazing pressure. All types of cultivation and hut circles are present at an altitude of between 245 m and 255 m, within an aspect of 160 and 175 degrees and a with a variation in slope of between 6 and 9 degrees. They are grazed by sheep and cattle who are free to wander the Moor and therefore grazing pressure is low. The soils of Ottercops are predominantly peaty loam in texture although those of medieval cultivation have an increased organic matter content with those of prehistoric and 18/19th century cultivation being described by Carroll and Bendelow (1979) as stagnohumic gley soils and those of the medieval cultivation as humic gley soils. The parent material is boulder clay in each case but that under the medieval cultivation is effected by high groundwater.

### Greenlea Lough

Greenlea Lough is situated approximately 1 km north of the Roman Wall and the area studied lies immediately south of it and is therefore the most southerly site of the three. The land is owned by the National Trust and because of the presence of Roman camp remains it has been a source of interest to archaeologists. It provides the most extensive evidence of prehistoric cultivation (NY778697) of any of the three sites, which largely been preserved because of the overlying camp, together with the associated hut circles (NY774696) and 18/19th century cultivation (NY776696) in close proximity as shown in figure 4. The medieval cultivation (NY774679) whilst not in the immediate vicinity is again similar in most respects so that for all areas altitude varies between 235 m and 240 m, aspect 155 and 160 degrees and slope 5 and 8 degrees. The soils of Greenlea Lough are either clay loam or peaty loam in texture and have been strongly influenced by the underlying solid geology. Across the area carboniferous limestone and sandstone outcrop in bands which are thinly covered with boulder clay. The soil charachteristics change in relation to the geology and Carroll and Bendelow (1979) recognise a series of soils including rankers with a humic horizon over sandstone, stagnohumic gleys over drift and stagnopodzols with an ironpan over sandstone or drift. Samples were taken from the cord rig over thin drift on sandstone and limestone with medieval cultivation and 18/19th century cultivation on thin drift over limestone which is reflected in the differing soil conditions. The area is grazed by sheep and cattle which also use the adjacent hill land so that grazing pressure is relatively low.

The range of slope, aspect and altitude has therefore been severely restricted so that over the three sites slope varies between 5 and 9 degrees, aspect 155 and 175 degrees and altitude 230 m and 250 m. Within a site there is even less variability so that it is possible to reduce any effects attributable to them even further.

*Experimental Methods*

The field work was carried out during the months of June, July and August in 1991 and although the time alloted was essentially short this reduced the chances of species composition changing over the period of study and enabled a more accurate comparison of the three sites to be made.

The species composition of the ridges and furrows of each type of cultivation and also that of an uncultivated area adjacent to it was determined at each site together with the species composition of the hut circles and it was therefore necessary to consider each of these as an homogenous stand of vegetation (Mueller-Dombois and Ellenberg 1974). Shimwell (1971) recognises the importance of ridges and furrows as sampling units because they contain different community types and samples were positioned on them as he suggests.

Three representative plots each measuring each measuring 5 m by 5 m were examined on each set of ridges and furrows and within each sampling was carried out using a 0.25 $m^2$ quadrat measuring 1 m by 0.25 m. The number of 0.25 $m^2$ quadrats required to accurately represent the vegetation of the ridges and furrows was determined initially by carrying out t-tests on the number of species recorded as an increasing number of quadrats were used until additional ones had no significant effect. This showed that eight would be required and therefore this number was used throughout the study on the ridges, furrows, outside areas and hut circles.

Within a plot measuring 5 m by 5 m the quadrat was positioned at regular intervals eight times on both the ridges and furrows according to the nature of the cultivation. Thus on prehistoric cultivation it was orientated parallel to the earthworks whilst on the broad medieval ridges it was positioned at right angles to them. All species present within the quadrat were identified either in the field or by the removal of samples and a record kept of those present in each case. Finally the plot was examined for any additional species which had not been recorded from within a quadrat and these recorded as such.

An area outside of that showing evidence of cultivation was similarly divided into three plots measuring 5 m by 5 m and within each the quadrat was positioned at regular intervals in eight different places so as to obtain a representative sample of the vegetation. All species present within the quadrats were again recorded together with any additional ones present in the plot.

The vegetation present on the hut circles was sampled by positioning the quadrat at regular intervals a total of eight times on the circular remains of the walls of these structures and recording all species present within it each time. An adjoining area which did not show evidence of cultivation was also sampled in an identical manner to that outside those cultivated.

In addition to the sampling of the vegetation the aspect, slope, altitude, soil profile, soil texture and pH of the A horizon was investigated. These were determined for each set of ridges or furrows, area outside and hut circle and recorded with the species information. The aspect was obtained using a compass and a measure of the degree of slope found using a clinometer in the field whilst large scale Ordnance Survey maps provided an accurate assessment of the altitude. The soil profile was examined using a soil sampler in several places on each area to determine the depth and characteristics of each horizon up to a depth of 1 m where possible and an assessment made of the texture of the A horizon by hand from the same sample. Samples were also obtained for pH analysis from the A horizon by using a trowel to lift a piece of turf and remove some of the soil below the litter layer which was then placed in a plastic bag and returned to the laboratory for analysis as soon as possible. The pH was determined after the addition of distilled water, until a standard consistency was obtained, using electrometic electrodes. However, this can only provide a general indication of pH as this is dependant on the amount of water added and a variation of as little as 15 $cm^3$ can result in a pH difference of 0.15 (Russell 1977).

The species data from the eight quadrats obtained in each situation was combined to form a sample unit which therefore represents an area of 2 $m^2$ and for which there is accompanying information on slope, aspect, altitude and soil characteristics.

## ANALYSES

The data were anaysed using a variety of multivariate techniques, namely TWINSPAN (TWo-way INdicator SPecies ANalysis), DECORANA (DEtrended CORrespondence ANAlysis) and CANOCO (CANOnical Community Ordination) which are designed for ecologists who have collected species information on a number of samples. These use the species present to position the samples and thereby enable their relationships to be determined.

TWINSPAN is part of the Cornell Ecology Programs series. It classifies samples using the species present and then classifies the species according to their occurence in the samples in order to construct a two-way table which is similar to that outlined by Mueller-Dombois and Ellenberg (1974). Classification is carried out by repeated dichotomization based on the presence of differential species which have clear ecological preferences and can therefore be used to identify particular environmental conditions based on the scores of differential species in them and those on the species by using the attributes already assigned to them (Hill 1979b).

Data which is entered for analysis in TWINSPAN has to be in the condensed format and sample order of ORDIFLEX (an earlier Cornell program). Each species was therefore given a numerical code and for each 2 $m^2$ sample it was necessary to enter the species present together with the number of quadrats, between one and eight, from which it was recorded with additional species from within the plot but outside the quadrats being given the value of 0.5. Because differential species are essentially qualitative it is not possible to use qualitative data with them. The program therefore requires the use of 'pseudospecies' which retain much of the quantitative informaton and can be considered as indicators of abundance (Hill 1979b). Four pseudospecies cut levels were thus entered as input paramters corresponding to the presence of the species in one or two, three or four, five or six and seven or eight quadrats respectively.

It is also possible to allow for variation in a number of other input parameters including the weight given to pseudospecies, number of samples used, minimum group size per division, maximum number of indicators per division and maximum number of species in the final tabulation. However, alteration of these was not particularly useful and the final analysis uses all species and samples and default values to obtain divisions.

The two-way table produced by TWINSPAN shows the heirachy of the divisions in binary notation along the top and left hand margins. It provides an assessment of the similarities and differences between the samples and a clear visual representation of the species present in each whilst the accompanying output indicates which species are responsible for these divisions.

DECORANA is based on the method of reciprocal averaging whereby having established a set of species scores, sample scores are defined as the mean score of the species that occur in them and then new species scores are calculated such that they are the mean of the scores of the samples in which the species occur (Hill 1973). However, DECORANA has certain advantages over this method in that it removes the tendancy of the second and higher axes to be correlated with the first by demanding that there should be no systematic relation of any kind between them. In addition, it rescales the axes so that the ends are no longer contracted as in reciprocal averaging enabling more meaningful results to be obtained from the resulting ordination (Hill 1979a).

The data matrix was entered in an unaltered form from that used in TWINSPAN and the program allows for the alteration of various input parameters. It is possible to allow for the transformation of data, downweighting of rare species, rescaling of the axes and to alter the number of segments used in the detrending of the second and subsequent axes. The default values were used in the formation of the axes as it is not advisable to alter these (Hill 1979a) and the final analysis gives equal weight to all species and includes all samples.

The output shows the progress of the calculation and the ordinations of the species and the samples. In addition, the eigenvalues which are shown for each axis provide an indication of the variation attributed to them. Output also takes the form of a machine readable copy of the ordinations which can then be used to produce a graphical representation of both species and samples. These enable the relationships between them to be examined in several dimensions and the major causes of variation to be determined.

The program CANOCO includes a set of techniques for relating the species composition of communities to their environments. These include weighted averaging, reciprocal averaging, detrended correspondence analysis and canonical correspondence analysis. Canonical correspondence analysis was the method employed in this case and this uses a combination of ordination and multiple regression whereby the multiple regression model is inserted in the ordination model. As a result of this the ordination axes appear as linear combinations of the environmental variables and species and sample scores are response curves with respect to the axes (Ter Braak 1985).

The data input required included the environmental variables in addition to the data matrix as used in the previous analyses. They were entered in the form of a table with information on the slope, aspect, altitude, pH, depth of the A horizon, soil texture, type of cultivation and microtopographical situation for each sample. CANOCO allows for the alteration of a number of input parameters including the removal of samples or environmental variables, transformation of species data and the use of covariables which are variables with known or uninteresting effects on the species whose effects are partialled out from the ordination (Ter Braak 1985).

The output from CANOCO includes a correlation matrix showing the correlations between the environmental variables, species scores and two sets of sample scores the second set of which are linear combinations of the environmental variables. There is also a table of canonical coefficients for the variables and of t-values for the coefficients. The canonical coefficients provide an indication of how important the variables are in determining species variation and t-values of over 2.1 indicate only that the variable has an effect that is uniquely attributable to it as the student t-test is not appropriate (Ter Braak 1985). The sample scores and species scores can be used to construct a graphical representation of the relationship between them and the variables can then be added in linear form as arrows using the biplot scores which are also obtained in the output. The angle between the arrow and the axis indicates how much the variable contributes to it and the length of the arrow how much species distribution differs along it. A perpendicular dropped from a sample or species to the arrow extended either side of the origin indicates the relative positions of their weighted averages with respect to the variable with those at the head of the arrow having the highest (Ter Braak 1986). It is not possible to include all the variables recorded at once in CANOCO because the program automatically deletes those which it finds can be predicted from others as being collinear. The variables peat, furrow and outside were therefore excluded to obtain the initial ordination of the samples and canonical coefficients although they were subsequently included to determine their effects.

At first variables were removed from the analysis to determine whether a smaller set including those of cultivation and hut circles could be found which would explain a similar amount of variation by examining the regression coefficients. This was unsuccessful and new variables were then created to represent the sites as these are a major source of variation. The sites and types of cultivation together with hut circles were then entered as the variables of interest and both sets of sample scores examined to see if there were other major sources of variation. Finally, the types of cultivation were entered with the sites as covariables whose effects are partialled out.

## RESULTS

A total of 95 species were recorded from 110 quadrats located over the three sites. The species and the samples together with the numbers which have been used throughout to represent them are shown in appendix 1 and the environmental data and quadrat data in appendices 2 and 3 respectively.

# TABLE 1

| | | | |
|---|---|---|---|
| | | 00000000000C00C0001100000000000000C000C0000C00000000111111000000011100000000000000000000000000000000000111111111 | |
| | | 66637777777889967700889366673344455544533334466668881111192499931112222222235554555411000000000999888000000001 | |
| | | 46892345689080290101791701276801578934301236735745612347896934555697812359444568012201478935612678123456723890 | |
| | | GGGHGGGGGGGGGGGGGOOGGGHHHHGHHHHHHHHHHHHHHHHHHGGGGGGGGGGGOOHGGGHGGOOOOOOOHHHHHHHHH0000000000000000GGGOOO000000 | |
| | | LLLALLLLLLLLLLLLLTTLLLAAAALAAAAAAAAAAAAAAAALLLLLLLLLLLTTALLLALLLTTTTTTTAAAAAAAAATTTTTTTTTTTTTTLLLTTTTTTTTT | |
| | | CCCVVVVVVVVVMMMCCHHMMMVHHHVVVVVVHHHCCMCCCVVCCCHHHCCCCCHCMMMCCCCCCCCCCCCMMMMMMMCVVVVVVVVVVHHHHHHMMMMMMMM | |
| | | FFFFRFRFROOOFFFOOOOORRRFOOOFRRRFOTTTOOFRFRFOORRROOORFRFOOOFFOOOFRFOOORFRROFROOORRFROOOFOOORRFRFTTTTTTRFRRFFOOO | |
| 24 | PERBELL | --1121222-1--1-434--21-----------------------2111--------------------------------------------------------------- | 00000 |
| 45 | AUTLEON | ---------------32----2------------------------------------------------------------------------------------------ | 00000 |
| 50 | LANPLAN | -1-2-2-------1-34432444--1-------------------221-1241------3---------------------------------------------------- | 00000 |
| 101 | PRATRIF | ------------------------1--------------------------------------------------------------------------------------- | 00000 |
| 5 | MOLBROM | ---2-------------------------2-----1---------------------------------------------------------------------------- | 000010 |
| 13 | PERLOLI | 12444444444444444---3-4444444--31-3221---2323221----------1222----------------------------------1-1------------- | 000010 |
| 20 | FLATRIS | -----------142-----344-----21-------------------------------------------------1--------------------------------- | 000010 |
| 23 | PRAALOP | -------1-------------------------------------------------------------------------------------------------------- | 000010 |
| 55 | AQUPTER | ---------------------------343----21221---2-2-----------------------1------------------------------------------- | 000010 |
| 72 | LATVICI | ---------------------------2------------------------------------------------------------------------------------ | 000010 |
| 95 | HOLCERA | ----------------------------------------1----------------------------------------------------------------------- | 000010 |
| 96 | VULCIRS | ---1433332321-2-----1---21132111---1---1222--------------------------------------------------------------------- | 000010 |
| 97 | MOLHOLC | ----------------------------------------1----------------------------------------------------------------------- | 000010 |
| 74 | RUTBRAC | 1---21214444----1---------------2--333-2---1-411---2----11---1--------------------------------12----2---- | 000011 |
| 26 | ROTCAMP | -----------------1--232--1-------333------------------------------------1-----2---1---1------1----------- | 000100 |
| 65 | MEDSTEL | 11---1---21------1---------2----------------------------------------------------------------1-------2-- | 000100 |
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| 87 | PALSPHA | --------------------------------4------------------------------------------------------------------------1 | 000100 |
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| 21 | MILACHI | ---13333444432244444--4----------1-3-------------421------2----------1----------------------434-32-------- | 000101 |
| 38 | RADHYPO | ------------11------223---------------------------------1--------2--------------------------------2--------- | 000101 |
| 27 | PRACARD | -------------11-----------------1--2--1131--------------------3----1------1-------------------------------- | 00011 |
| 35 | PALEPIL | ---------------------------------2----11--------------------1------------------------------------------------- | 00011 |
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| 60 | MINSANG | --------------------------------------------------------------1----------------------------------------------- | 001010 |
| 62 | PROSAGI | 2---1---------------------------------------1--1233443211-1-------------------------------------11--------- | 001010 |
| 79 | SPLHYLO | ---------------------------------------------1------------------------------------------------------------ | 001010 |
| 93 | NIGCARE | ------------------------------------------1--------------------------------------------------------------- | 001010 |
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| 103 | ARVEQUI | -------------------------------------------------------------1---------------------------------------------- | 001010 |
| 49 | OFFPILO | ------------------1-----------------------------221--------------------------------------1------------- | 001011 |
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| 77 | PRAEURY | 2-------1------21---2-1--1-------------12--21444444444444211-1--244-----------------3-----1---211-1234-424134-- | 011 |
| 80 | HORMNIU | ----------------------------------------112--1---1----1--------1--1---------------------1-----------1-- | 011 |
| 81 | UNDMNIU | ---------------------------------------1-11------2------------------------------------------1---------11- | 011 |
| 2 | CAPAGRO | 33224444444443443333434443444434344444344422234444444444444444433444-44443444444444444414443344444434444344444444431 | 100 |
| 8 | CAEDESC | 1--------------------------------------------------------------------------------------------1---------- | 100 |
| 32 | ARVCIRS | 2222-----------22321-1-2122-12---------------12---------1---------111-----------------23-4322-213--------------- | 100 |
| 90 | CORLOTU | ---------------------21-------------------------------------1-----1---------------------22--------------------- | 100 |
| 4 | ODOANTH | 1--21222423--1-344444441434--2-121--11221--444444444343444344444-444444344423444444334444444434434424444444443 | 101 |
| 10 | OVIFEST | 1-22----3324-2-344344441122-442344431322 24-44444444-4-324321-2-323423444424-2344444444444444444444443444444444 | 101 |
| 40 | CONJUNC | -----------1-----------------------------------1----------2----------------------------------------13-----1- | 101 |
| 46 | CAMLUZU | --1-1-2--1-212-334--4442412-34233344--2-1--44444344-----1-1-444-3-1-24232321114423144444444444444444-4444243 | 101 |
| 9 | FIEDESC | ---------------------------------11---1-2-----------------------------------------13221---------------------- | 1100 |
| 14 | CAEMOLI | --------------------------1--1-----34--1--1--------------3--------------344444443-------------------------- | 1100 |
| 28 | OVACARE | ------------------1----1---1----1--22---11---------------1-23143-342--212-2-4333422-4----------------22-------3---- | 1100 |
| 110 | BINCARE | --------------------------------------------------------------2----------------1-1---------------------- | 1100 |
| 15 | STRNARD | 111---------------34----111-32----1---2----2244444444444---43-23-4424444444442-3334312-4444444444444443444444444 | 110100 |
| 86 | SQURHYT | -1-------1---------132--322---1-2-4332-211-234444444434324-22-34-44444444444----44-424444444444444444444444443444 | 110100 |
| 36 | SAXGALI | ----------------------1---12--14431-1-----1---1------1-----------------1-----324221-1---442311--423444444444 | 110101 |
| 39 | ARTJUNC | -------------------------------------------------------------34-----------------------------------------444 | 110101 |
| 53 | EREPOTE | ------------------11-2--1--21132---2-11--233442334-------1221--2--21423422-444444444444444444442434224444444444 | 110101 |
| 108 | PANCARE | --------------------------------------------------1-----------------------------------------------------211 | 110101 |
| 11 | RUBFEST | --------------2---1--------2--31--1----11--------2----------------12-12-22---1---231-23------2---11-----2-- | 11011 |
| 33 | PALCIRS | ----------------------------------44-3-4-21----------------------1-1---1-4211----433234323333--------------- | 11011 |
| 43 | MONLATH | --------------------------------1--------------------------------------------------------1----------------- | 11011 |
| 67 | DIOURTI | -----------------------------------------1-----------------------------------------2----------------------- | 11011 |
| 3 | STOAGRO | -------1--------------------1-1-------1---11---------------------212-21-121-1233112 2-1-12----------2-------2 | 11100 |
| 41 | EFFJUNC | ------------------------------------------------------------------------232------------------------------- | 111010 |
| 42 | SQUJUNC | ------------------------------------------------------------311---------------12---------------2------- | 111010 |
| 44 | PRALATH | -----------------------------------------------------------------------444--------------------------------- | 111010 |
| | | | 111010 |
| 68 | MYRVACC | --------------------------------------------------------------------------1-------------------------------- | 111010 |
| 76 | CONEURY | ------------------------------------------------------------------1--1------------------------------------ | 111010 |
| 78 | UNDEURY | --------------------------------------------------------------1-----1------------------------------------- | 111010 |
| 94 | TRIRHYT | --------------------------------------------------------------22----1------------------------------------- | 111011 |
| 88 | CUSLOPH | -----------------------------------------------------------1----------------------------------------------1- | 111100 |
| 35 | PURPSEU | -------------------------------------------------------------------111-21-------1-2213-3233---1-----------421 | 111101 |
| 7 | DECDANT | ---------------------------------------1-----------------------------------------------21321-2--------------32- | 111101 |
| 18 | SUBCPOA | --------------------------------------------------------------------------------------1----------------- | 111101 |
| 25 | LUNBOTR | --------------------------------------------------------------------------------------1----------------- | 111101 |
| 48 | SYLPEDI | -----------------------------------------------------------------------------------11------------------- | 111101 |
| 52 | SERPOLY | -------------------------------------------1------------------------------------------2----1-123------------- | 111101 |
| 70 | OFFVERO | ----------------------------------------------------------------------1------------11-11--11---------------- | 111101 |
| 71 | SERVERO | -----------------------------------------------------------------------------------1---1----------------- | 111101 |
| 89 | PILCARE | -----------------------------------------------------2----11---------------------33-1-331243---------------- | 111101 |
| 91 | TAMTHUI | ---------------------------------------------------------------------------------------122---------------- | 111101 |
| 58 | ACSRUME | ---------------------------------------------------------------------------------------------2----------- | 111110 |
| 75 | SCODICR | ------------------------------------------------------------------------------------------212--2------ | 111110 |
| 82 | SCHPLEU | ---------------------------------------------------------------------------------32---31-4312132141442-2-- | 111110 |
| 99 | BURCAPS | -----------------------------------------------------------------------------------------------1--------- | 111110 |
| 100 | CHARUBU | --------------------------------------------------------------------------------------------1----------- | 111110 |
| 22 | PTAACHI | ----------------------------------------------------------------------------------------------------111 | 111111 |
| 73 | PALAULA | ---------------------------------------------------------------------------------------------------2--- | 111111 |
| 84 | COMPOLY | ---------------------------------------------------------------------------------------------------33- | 111111 |
| 106 | VULCALL | ------------------------------------------------------------------------------------------1-------- | 111111 |
| | | 00000000000000000000000000000000000000000000000000000111111111111111111111111111111111111111111111 | |
| | | 00000000000000000000000000000000000000011111111111111111111000000000000000000001111111111111111111111111 | |
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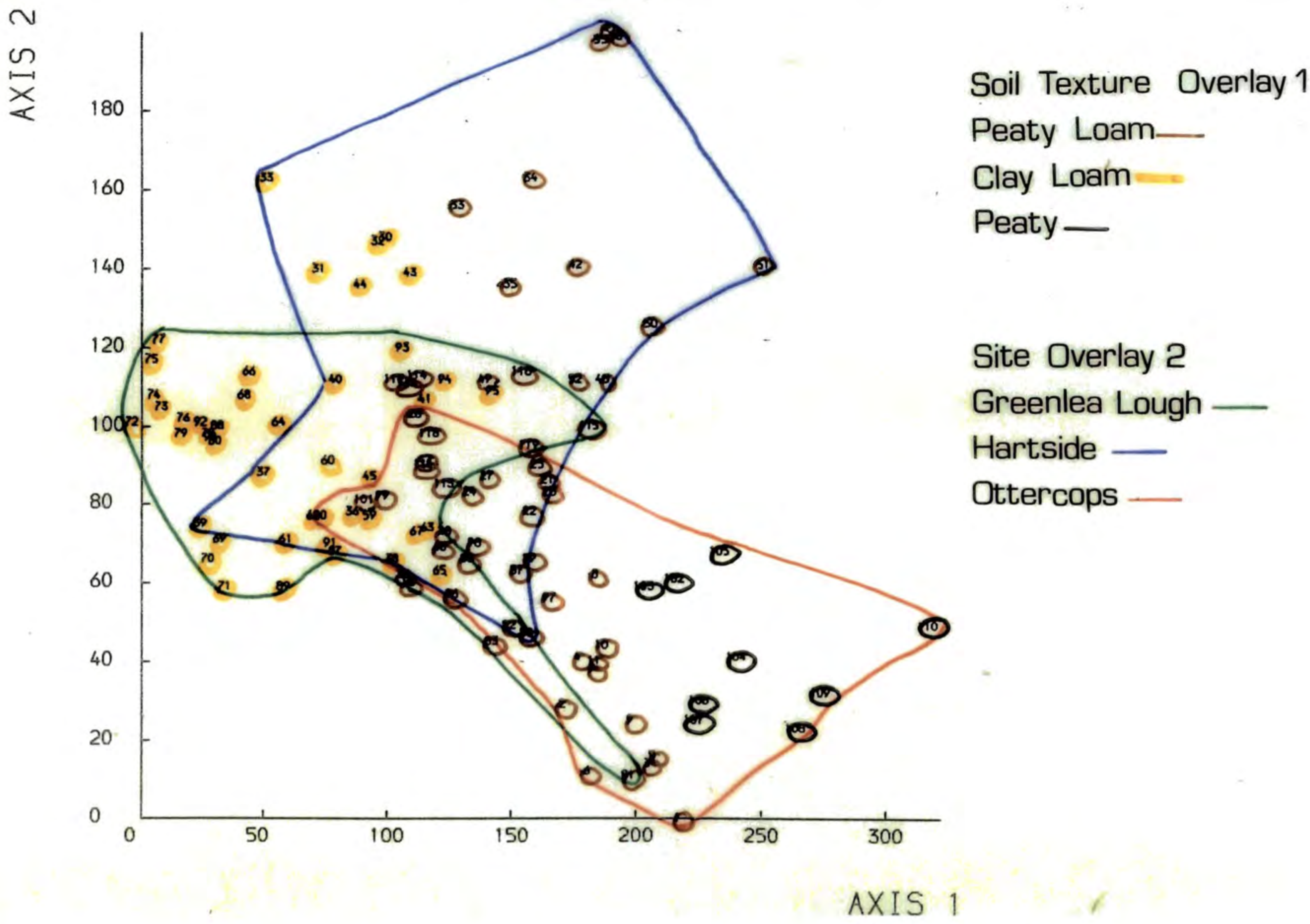
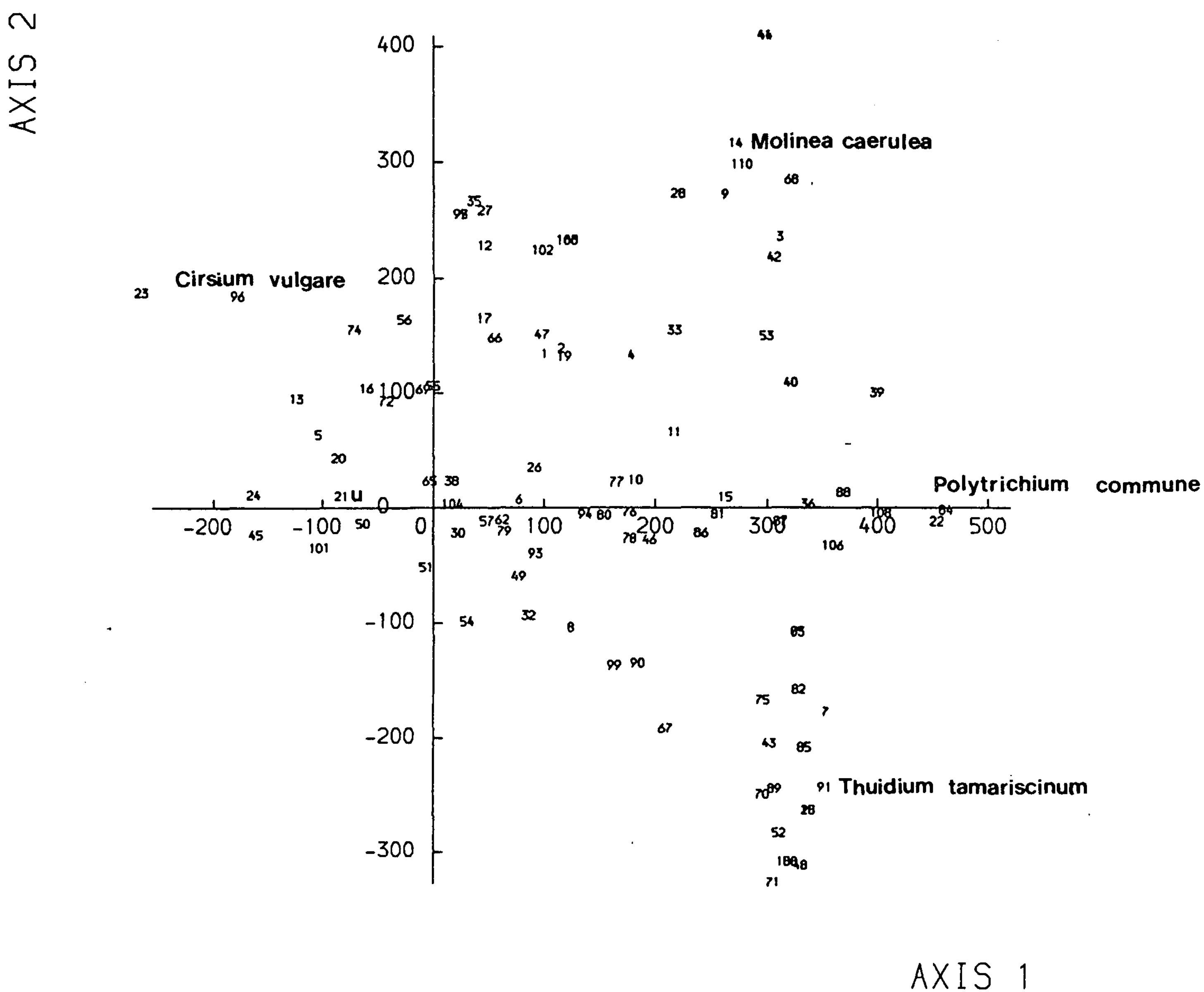
| | | 000000000000000111111110000000000000000111111100000111111111001110000111111110000111110000000000011111100000111 | |
| | | 0001111111111111000001110000000000011100011110011100011111111 00111111 00001000000011111000111000011 | |
| | | 0000000001110001 1 0000011111 0000001 000001 00111100011 | |

NORTHUMBERLAND RIDGE+FURROW (SAMPLES) 91 - AXIS 1 **Figure 5**



NORTHUMBERLAND RIDGE+FURROW 91 - AXIS 1 X 2 **Figure 6**



Initially data for 9 other samples were collected but the ridges and furrows were very indistinct in the field and these were not used in the analyses.

Table 1 of TWINSPAN shows the species recorded from each quadrat and indicates that some such as *Agrostis capillaris* and *Festuca ovina* are present in most situations. These are tolerant of a wide range of conditions with *Festuca ovina* able to achieve a high frequency on both acidic and calcareous sites due to the presence of distinct ecotypes which differ in their calcium nutrition (Snaydon and Bradshaw 1961) although it declines in sites of greater fertility due to the greater competitive ability of *Agrostis tenuis* (Mahmoud and Grime 1976). However, the majority of species are either restricted to one or two sites or are related to a specific type of cultivation. The species are characteristic of *Agrostis-Festuca* grassland and are similar to those described in the species poor *Agrosto-Festucetum* by McVean and Ratcliffe (1962), although the abundance of *Nardus stricta* in some situations would place these in the *Nardetum sub-alpinum* group. The *Agrostis-Festuca* grasslands are widespread throughout Northern England and of great agricultural and economic importance.

The relationships between the samples (as ordination scores) as revealed by DECORANA_ are shown in figure 5 and those between the species in figure 6. The first ordination axis of DECORANA accounts for 32% of the variation and from the ordination of species is related to the availability of soluble bases with species tolerating or preferring acidic conditions, such as *Polytrichum commune*, occuring towards the positive end of the ordination axis and those requiring more base rich conditions, such as *Cirsium vulgare*, towards the negative. This is related to soil type as shown in overlay 1 with the more mineral soils occuring at the positive end and the organic soils at the negative end. The second axis of DECORANA accounts for a further 19% of the variation and from the ordination of species it is related to moisture availibility. Those species which require or can tolerate a high soil moisture content, such as *Molinia caerulea*, occur at the positive end of the axis and those which require drier situations, such as *Thuidium tamariscinum*, at the negative. These results correspond with the widely accepted idea that base status and moisture availability are the most important determinants of species composition on *Agrostis-Festuca* grasslands with floristic gradients being observed by a number of workers (Rogers and King, 1972.,Ratcliffe, 1959).

Site is also important in determining the vegetation present although some samples from different sites have a similar species composition as shown on overlay 2 for DECORANA which shows the sites from which the samples were taken. The site characteristics are mainly determined by soil type and drainage with Greenlea Lough, from which more samples were taken on mineral soils, scoring lower values on the first axis of DECORANA than Ottercops which is characterised by peaty loam soils or Hartside which has a mixture of mineral and more organic soils. A further distinction occurs on the second axis with some samples on Hartside scoring more highly indicating that the drainage was poorer. Greenlea Lough is characterised by such species as *Lolium perenne*, *Poa annua*, *Achillea millefolium* and *Plantago lanceolata* in addition to those occuring on all three sites. However, those species are not present throughout and are confined to a few types of cultivation. *Lolium perenne* is confined to fertile soils (Beddows 1967) whilst *Achillea millefolium* (Warwick and Black 1981) and *Poa annua* (Hutchinson and Seymour 1982) have a distribution which is centred on disturbed areas of relatively high fertility so that they largely reflect the relative fertility of the site and it's intermediate water status. Species characteristic of Ottercops include *Nardus stricta*, *Galium saxatile*, *Potentilla erecta* and *Rhytidiadelphus squarrosus* all of which are abundant in acidic grasslands and are typically dryland species although they are also found in soligenous mire (Grime, Hodgson and Hunt 1988). Experiments have shown that growth is suppressed in *Nardus stricta* at high pH due to calcium toxicity (Jefferies and Willis 1964) and when grown on calcareous soils *Galium saxatile* grows poorly and exhibits root stunting and chlorosis thereby becoming less competitive (Tansley 1917). Field measurements and laboratory experiments have also shown that vagetative growth of *Potentilla erecta* is more vigorous on non-calcareous soil (Grime 1963) so that the species present reflect the relatively dry, acidic conditions of the site. The species which are characteristic of Hartside include *Molinia caerulea*, *Carex ovalis* and *Agrostis stolonifera*. *Molinia* is found mainly on damp moorland and heaths (Hubbard 1984)(Clapham, Tutin and Moore 1987) and it is also associated with a well oxygenated profile (Armstrong and Boatman 1967) and enriched nutrient supply (Loach 1966)(Hayati and Proctor 1990) as would be possibly present in hill runoff. *Agrostis stolonifera*, however, exploits a wide range of habitats due to it's capacity to form distinct ecotypes but is tolerant of wet situations which Jones (1973) suggested might be caused by an ability to precipitate iron oxide within the roots. Those species present therefore reflect the wet nature of the site.

The ordination of the samples by CANOCO is shown in figure 7 and the canonical coefficients and t-tests using most of the environmental variables in table 2. It is not possible to include all the variables at once in CANOCO because of collinearity and those of peat, furrow and outside were omitted when producing the results although subsequent analyses determined their effects. CANOCO confirms that the first axis which accounts in this case for only 26% of the variation is more strongly determined by soil type than any other factor.

**Figure 7**
CANOCO Sample Scores

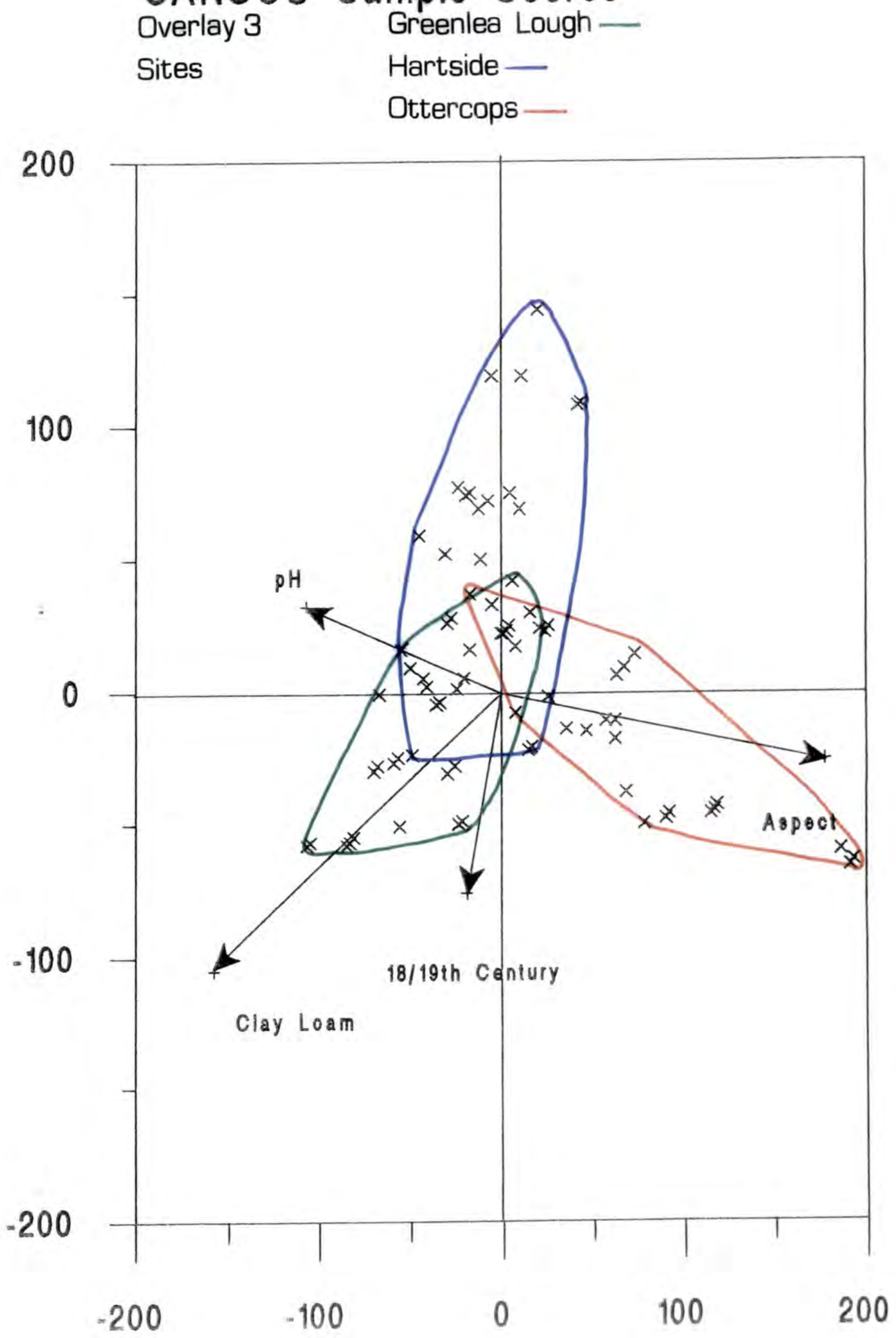


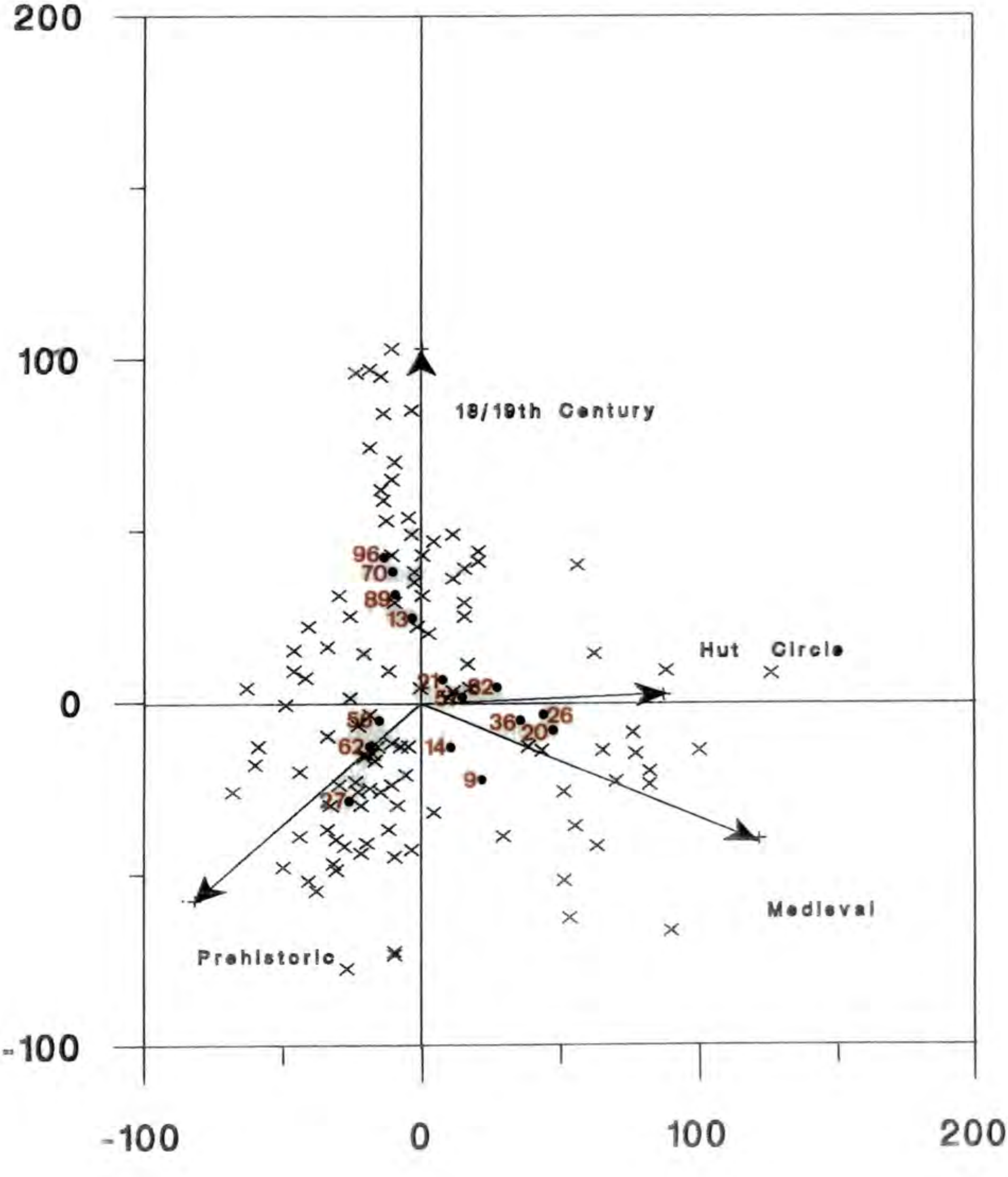
TABLE 2  CANOCO Canonical coefficients and their associated t-values

| | Axis 1 | | Axis 2 | |
|---|---|---|---|---|
| | coefficient | t-value | coefficient | t-value |
| Slope | 226 | 308 | 297 | 505 |
| Aspect | 228 | 370 | -245 | -496 |
| Altitude | -28 | -54 | -152 | -360 |
| pH | -156 | -390 | 189 | 588 |
| Depth of A horizon | -99 | -205 | -85 | -218 |
| Clay loam | -752 | -644 | -443 | -472 |
| Peaty loam | -633 | -580 | -98 | -112 |
| Prehistoric | -47 | -128 | 108 | 363 |
| Medieval | -226 | -516 | -126 | -357 |
| 18/19th century | -113 | -387 | -101 | -365 |
| Hut circle | 122 | 408 | -61 | -255 |
| Ridge | 119 | 340 | 15 | 52 |

CANOCO Types of Cultivation **Figure 8**

Overlay 4

Species



The second axis which accounts for a further 16% of the variation indicates that soil type is again the most important factor which may be related to corresponding variations in moisture holding capacity as moisture was not included as a variable. However, high t-values are associated with the other variables of slope, aspect, altitude, pH, depth of A horizon, type of cultivation, prescence of hut circles, ridge, furrow and outside indicating that they all make a unique contribution to species composition. Apart from soil type the most important variables are those of slope, aspect and medieval cultivation on the first axis. However, the narrow range recorded for slope and aspect means that these are unlikely to be of any major biological significance. The variables pH, clay loam, aspect and 18/19th century cultivation are shown as arrows on the CANOCO ordination of samples. Clay loam is the strongest of these indicating that species composition changes most with this variable and 18/19th century cultivation contributes much to the second axis. The results from using DECORANA and CANOCO are comparable as can be seen in overlay 3 of the sites on the CANOCO samples. However, in CANOCO they are constrained to be linear combinations of the environmental variables so the ordinations are slightly different.

Site characteristics are important factors in determining vegetation and when the sites and types of cultivation together with hut circles are used as the variables of interest in CANOCO the two sets of sample scores indicate that within a site these account for much of the variation. Because site is a factor determining vegetation the sites were therefore entered as covariables in CANOCO with prehistoric, medieval and 18th/19th century cultivation together with hut circles as the variables of interest. CANOCO removes the effect of the site covariables before producing an ordination of the samples on which the variables are represented by arrows as shown in figure 8. The numbers representing the more abundant species which contribute to each cultivation type are shown on overlay 4. A Monte Carlo permutation test was carried out on both the first and second axes which showed significance at the 1% level and therefore that the types of cultivation are significantly different in species composition. The strongest variable is that of medieval cultivation indicating that species distributions differ most with this type of cultivation. This is a reflection of the range of situations in which medieval cultivation is found and the different management regimes it has been subject to but may also be a response to the pronounced variations in microtopography resulting from this kind of cultivation. However, the 18/19th century cultivation variable is only slightly less strong and it is almost entirely responsible for determining the second axis indicating that some species are found only or mainly on this type of cultivation. A few species such as *Alopecuris pratensis* and *Poa subcaerulea* were very sparsely recorded although they were only found on this type of cultivation. However, *Cirsium vulgare* and *Lolium perenne* were more abundant and a high incidence was recorded from the 18/19th century cultivation on Greenlea Lough and Hartside. *Lolium perenne* has been cultivated in Britain since the seventeenth century (Beddows 1967) and it is now extensively sown as a forrage crop. It's presence is almost certainly due to seeding following the abandonment of cultivation and it is not found in native upland pastures unless soil fertility has been improved and lime applied (Milton 1940) .*Cirsium vulgare* is also found in fertile habitats and is intolerant of excessive waterlogging because it has a deep tap root (Grime, Hodgson and Hunt 1988) which may be a contributing factor to it's presence on Hartside. *Veronica officinalis* and *Carex pilulifera* occur almost exclusively on the 18/19th century cultivation of Ottercops and these are found in well drained, acidic situations reflecting the soil characteristics of the area. Further evidence of the difference between 18/19th century cultivation and the other types can be found in the correlations related to variables which describe soil charachteristics. The strongest of these relate to the depth of the A horizon and they show that 18/19th century cultivation is positively correlated with increasing depth and therefore soils tend to be deeper whilst those of medieval cultivation and the hut circles are negatively correlated and therefore shallower.

The vegetation associated with medieval and prehistoric cultivation and that found on hut circles is more closely related probably due to the more recent nature of 18/19th century cultivation. On prehistoric cultivation the sparsely recorded species include *Cerastium holosteioides* and *Eurychium confertum.* More abundant species which are characteristic of it include *Cardamine pratensis* which is almost exclusively confined to the cord rig on Hartside and *Sagina procumbens* which is found at Greenlea Lough. Both species require moderately fertile soils (Grime, Hodgson and Hunt 1986) but *Cardamine pratensis* is primarily a wetland species whilst *Sagina procumbens* prefers better drained soils so that their presence is probably related to the conditions in these situations. The success of *Cardamine pratensis* on wet areas which are grazed is due to it's reproduction by leaflets in contact with the soil (Salisbury 1965) as seed set is low in these situations. *Ranunculus repens* is a more widely recorded species and there is a higher incidence of it on the cord rig of Greenlea Lough than elsewhere. This is a species with a wide habitat range but it is most abundant where drainage is impeded (Harper 1957) and the shallow depth of the A horizon and poor drainage may help to explain it's presence here. The vegetation present on medieval cultivation and that on hut circles has certain similarities which seems to be related to the dry, acidic nature of some situations. For example, *Campanula rotundifolia* occurs almost exclusively on the medieval ridges of Greenlea Lough and the hut circles of Hartside whilst *Galium saxatile* occurs not only on the hut circles at all three sites but also on the medieval cultivation at Hartside and Ottercops. Both species prefer dry situations but *Galium saxatile* is tolerant of much greater acidity whilst *Campanula rotundifolia* is found in only mildly acidic habitats (Grime, Hodgson and Hunt 1988). *Deschampsia flexuosa* occurs mainly on hut circles and medieval cultivation at Hartside and Rogers and King (1972) recorded it from the most acidic and well aerated areas in similar grassland. Scurfield (1954) also reports that it prefers acidic conditions and Hackett (1965) found that this was due to the ability to tolerate high concentrations of aluminium.

Sparsely recorded species which are found only on medieval cultivation include *Aulacomnium palustre* and *Calluna vulgaris* both of which are found on Ottercops. More abundant species such as *Hypochoeris radicata, Trisetum flavescens* and *Molinea caerulea* are almost entirely confined to this type of cultivation at a particular site and reflect the combined effects of microtopography and site characteristics on the drainage and acidity of the area. *Hypochoeris radicata* is especially abundant on the medieval ridges of Greenlea Lough and has a preference for well drained, slightly acidic soils (Grime, Hodgson and Hunt 1988) being able to withstand drought due to the deep root system (Salisbury 1952). *Trisetem flavescens* is also present on the medieval cultivation at Greenlea Lough where it is more abundant on the ridges than the furrows. It is charachteristic of soils of high base status (Hubbard 1984) and only ever forms a minor component of grassland so that it has been little studied and therefore it's predisposition in this situation is difficult to explain. *Molinia caerulea* is, however, undoubtedly present on medieval cultivaion on Hartside due to the damp, nutrient rich conditions.

Thus whilst it is possible to detect species which are charachteristic of a cultivation type within a site, vegetation patterns are dominated by site charachteristics. However, the line representing hut circles contributes very strongly to the first axis indicating that a particular type of vegetation is associated with them. A few species are sparsely recorded and occur only on the hut circles including *Capsella bursa-pastoris* and *Rubus chamaemorus* both of which are present on Greenlea Lough. *Rumex acetosa*, however, occurs on the ridges and furrows at all three sites but is consistently present on the hut circles and this may be related to the higher instance of bare earth caused by treading in these situations as Putwain and Harper (1970) found that an absence of grass greatly increased it's abundance on acid soils. In addition, *Pleurozium schreberi* is mainly found on the hut circles of Ottercops and Greenlea Lough although it is also present on medieval cultivation at Ottercops and this is an indicator of acid soil conditions (Watson 1968). The relatve similarity of vegetation on the hut circles is almost certainly related to the unique nature of the habitat which is freely drained and acidic.

TABLE 3 Significant differences in the relationships between the ridges and furrows for the types of cultivation using t-tests on the DECORANA scores.

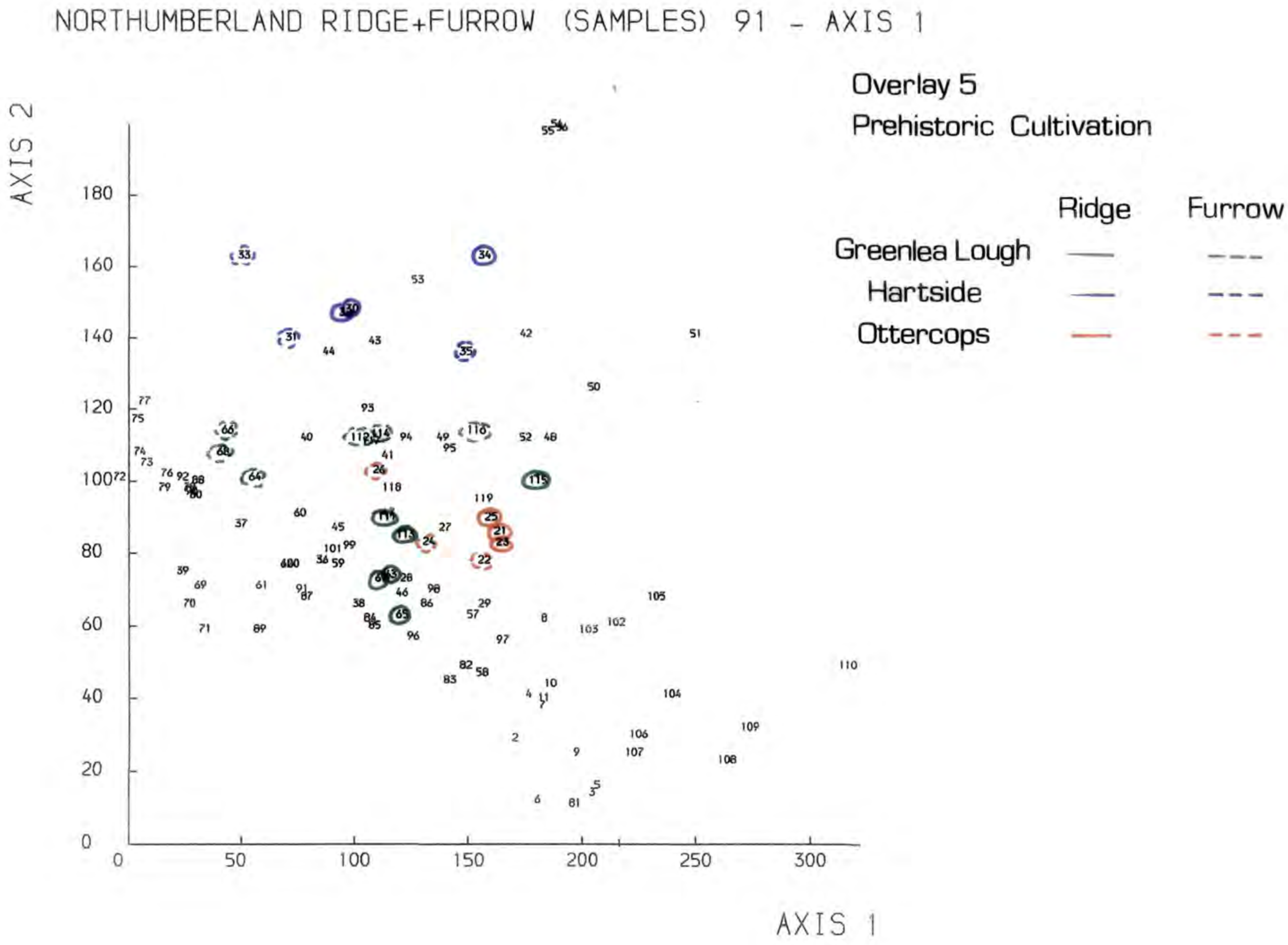
| | Axis 1 | Axis 2 |
|---|---|---|
| Medieval cultivation (all sites) | | *** |
| Hartside medieval | | * |
| Ottercops medieval | | *** |
| Greenlea Lough medieval | *** | *** |
| Prehistoric cultivation (all sites) | *** | |
| Hartside prehistoric | | |
| Ottercops prehistoric | *** | |
| Greenlea Lough prehistoric (on sandstone) | | *** |
| Greenlea Lough prehistoric (on limestone) | *** | *** |
| 18/19th century cultivation (all sites) | | |
| Hartside 18/19th century | | |
| Ottercops 18/19th century | *** | ** |
| Greenlea Lough 18/19th century | | ** |

A single charachter shows significance at the 0.1 level, a double one at the 0.05 level and a triple one at the 0.01 level.

The third axis accounts for a further 12% of variation in DECORANA and CANOCO and the fourth for approximately 9% in each. Because they represent residual variation in the data they are less meaningful and analysis has therefore been confined to the first two axes.

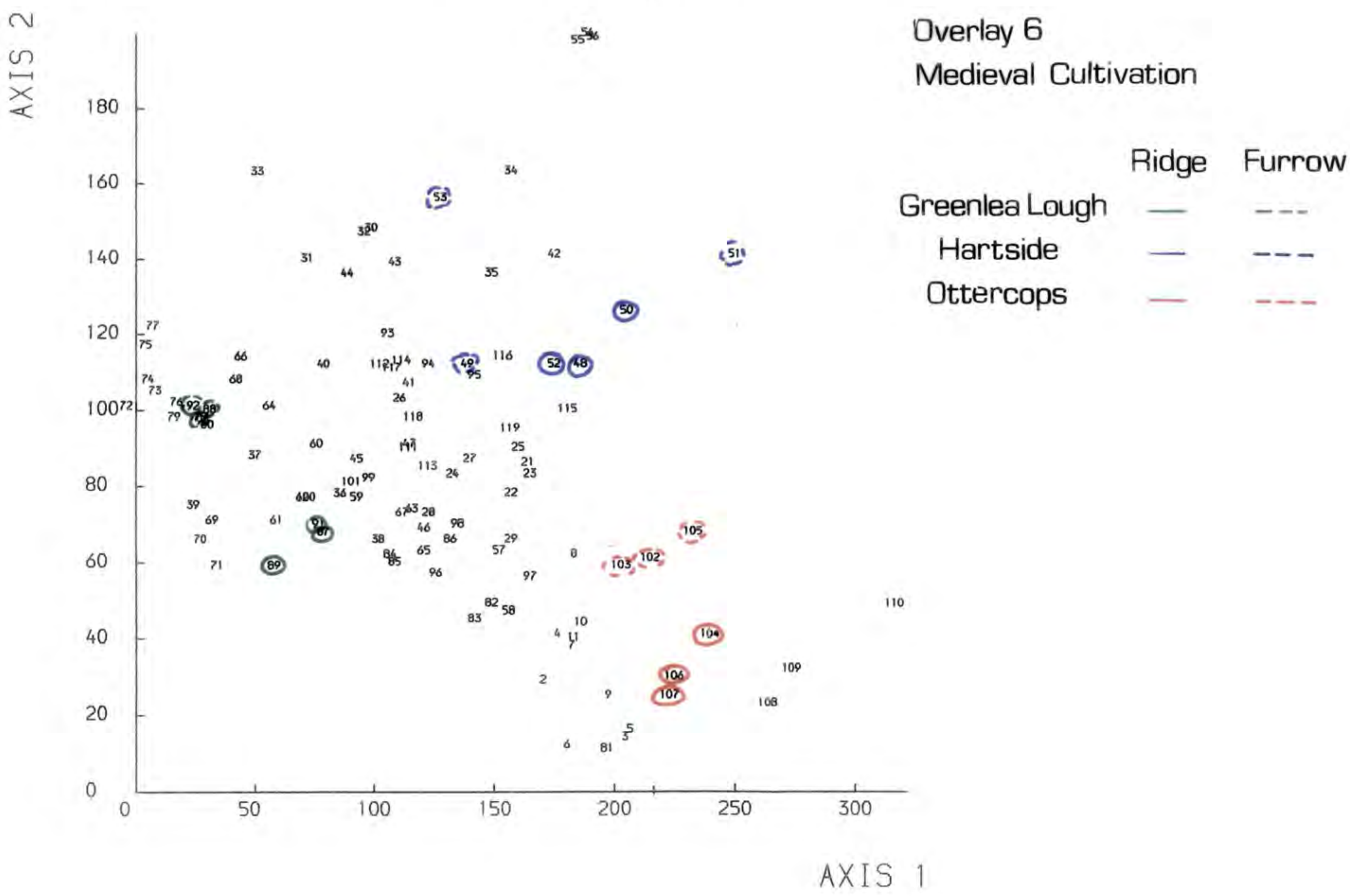
It was decided to examine the effect of the three types of cultivation by looking at the species composition using the DECORANA sample scores. These are especially valuable when comparing the species present on ridges and furrows for a particular type of cultivation as these features have had a similar management history and are usually similar in slope, aspect, altitude and soil type. It is therefore possible to compare differences between the ridges and furrows for a type of cultivation using the three sites and relate the differences on individual sites to the soil charachteristics of the area. The results of t-tests carried out on the differences between the ridges and furrows using the first two axes of DECORANA are shown in table 3.

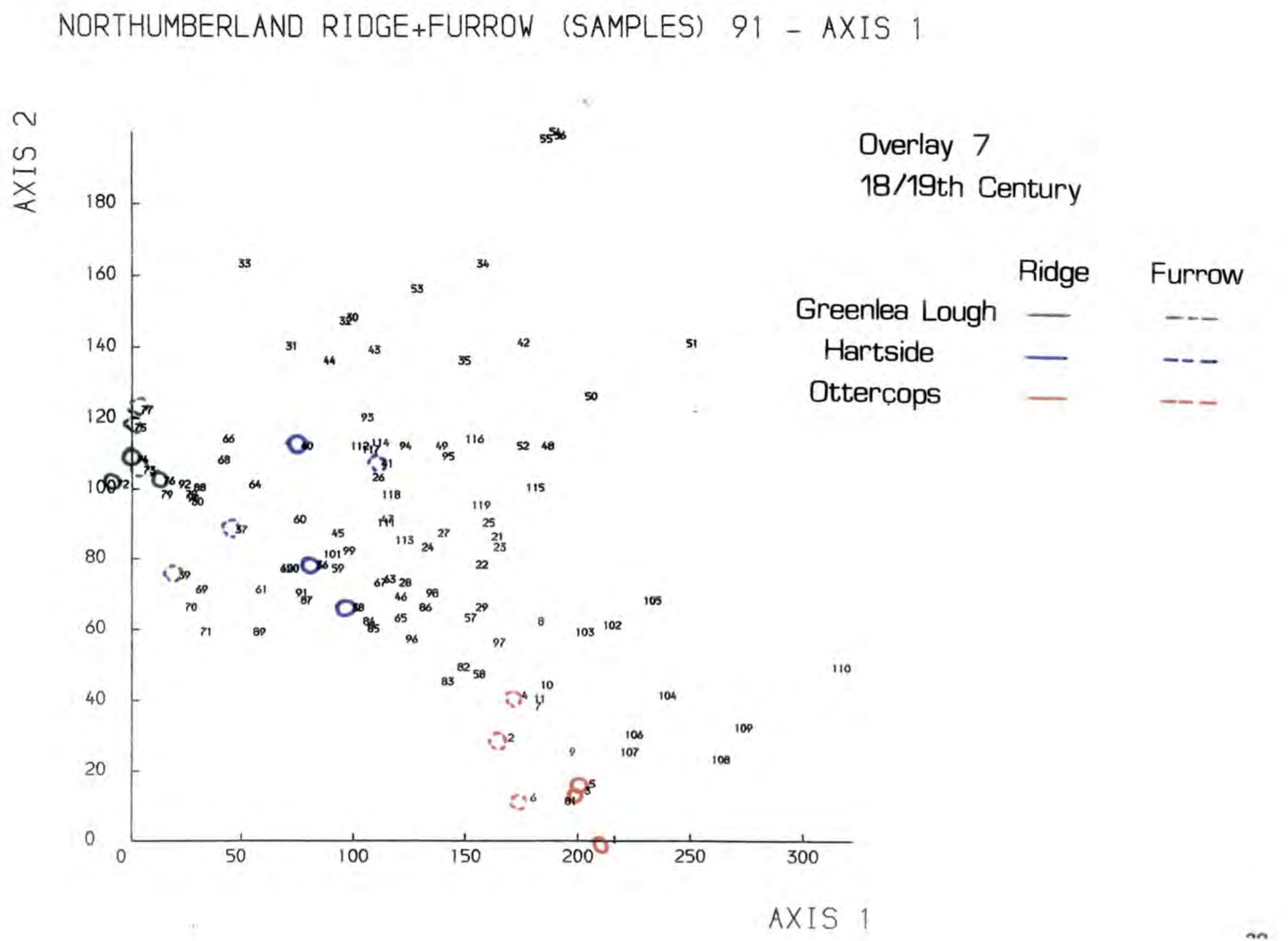
The ridges and furrows of prehistoric cultivation are shown on overlay 5 of the DECORANA sample scores. They are significantly different at the 0.01 level on the first axis when all samples are used showing that they differ in base status. This contrasts with there being no significant difference between them on the second axis which means they differ little in available moisture. The time elapsed since cultivation and thus for leaching to have occured may explain the differences on the first axis and the relatively small size of cord rig as a microtopographical feature why there is little difference on the second. However, only the cord rig on Ottercops provides exactly the same contrast. At Greenlea Lough two sets of cord rig ridge and furrow were examined which were adjacent to each other, one set of which was significant at the 1% level on the first axis and the other which showed no significance on it. The ridges and furrows of the set which showed significance were the highest in pH and the soil consisted of thin peaty loam over a narrow deposit of clay on limestone. The other set which showed no significance were lower in pH and the soil consisted of slightly thicker peaty loam over a thin deposit of clay on sandstone. It is probable that the underlying rock has contributed to the soil charachteristics and that derived from limestone has been more readily leached as a result. Both sets showed significant differences at the 1% level in moisture between the ridges and the furrows and this may be due to the relatively shallow depth of the A horizon over clay. The vegetation associated with the ridges of the cord rig of Greenlea Lough and Ottercops has certain similarities. A higher incidence of *Anthoxanthum odoratum, Festuca ovina, Rhytidiadelphus squarrosus* and *Potentilla erecta* is found here relative to the furrows. *Anthoxanthum odoratum* and *Festuca ovina* occupy a wide variety of habitats although each reaches maximum abundance in situations of low fertility (Grime, Hodgson and Hunt 1988).



NORTHUMBERLAND RIDGE+FURROW (SAMPLES) 91 - AXIS 1
Overlay 5
Prehistoric Cultivation
Ridge
Furrow
Greenlea Lough
Hartside
Ottercops
AXIS 2
AXIS 1

NORTHUMBERLAND RIDGE+FURROW (SAMPLES) 91 - AXIS 1




NORTHUMBERLAND RIDGE+FURROW (SAMPLES) 91 - AXIS 1
AXIS 2
AXIS 1
Overlay 7
18/19th Century
Ridge
Furrow
Greenlea Lough
Hartside
Ottercops

The highest frequency of *Potentilla erecta* is reached in acidic pastures of intermediate fertility and Balme (1953) found thar it was particularly common on incipient podzols developed over limestone as on the ridges of some of the cord rig of Greenlea Lough. The ridges and furrows of the cord rig on Hartside showed no significant differences in either moisture or base availability. An absence of any significant difference in base availability may be due to the samples being taken from a combination of mineral and organic soils making a statistical comparison unsuitable as they appear to differ in the ordination produced by DECORANA. Drainage is also variable on the cord rig at Hartside as the soils overlie clay and gravel which probably accounts for the fact that some ridges appear wetter than furrows. Because of the other variables effecting vegetation no generalisations are possible concerning the species present on Hartside.

The ridges and furrows of medieval cultivation are shown on overlay 6 of the DECORANA sample scores. These are not significantly different in base availability when all samples are considered but this may relate to it's presence on organic soils at Ottercops and Hartside, and the poor drainage at Hartside, as at Greenlea Lough there are significant differences at the 1% level. However, significant differences exist at the 1% level in moisture availability when all samples are used and this probably reflects the relatively large size of medieval cultivation as a microtopographical feature. The medieval ridges and furrows on Ottercops are significantly different at the 1% level in moisture availability but not in relation to base availability. This may be a reflection of the low base status of these organic soils and their limited capacity to be leached. A few species such as *Aulacomnium palustre* and *Juncus squarrosus* occur only in the furrows and *Plerrozium schreberi* is more abundant on the ridges than on the furrows. *Aulacomnium palustre* is most abundant on wet acid moor (Watson 1968) and *Juncus squarrosus* grows only in wet acid conditions because it has a very low calcium requirement (Jefferies and Willis 1964). By contrast, *Pleurozium schrebrei* has a preference for dry places (Phillips 1980) and acid soils (Watson 1968), conditions present on these ridges. At Hartside the medieval ridges and furrows are again not significantly different in base status but differ at the 10% level in moisture availability. The organic nature of the soil may account for an absence of any significant difference in base status and the shallow depth of the A horizon over clay and poor drainage may also prevent any major difference occuring between the ridges and furrows in moisture availability in this situation. However, the ridges and furrows at Greenlea Lough are significantly different at the 1% level in both base status and moisture availability. The ridges support higher populations of *Plantago lanceolata, Campanula rotundifolia* and *Prunella vulgaris* whilst *Lolium perenne* is more abundant in the furrows. *Plantago lanceolata* is most abundant in base rich situations (Grime, Hodgson and Hunt 1988) and some roots penetrate deeply which makes it able to avoid drought although susceptible to waterlogging (Harper and Sagar 1964). *Campanula rotundifolia* and *Prunella vulgaris* also prefer dry grassland with a high base status and are absent where there is excessive moisture. Thus these species are probably less abundant in the furrows because of their preference for a dry habitat. *Lolium perenne* , however, can tolerate a wide range of soil conditions (Rogers and Davies 1973) and soil fertility is the controlling factor in it's distribution (Beddows 1967). The enhanced nutrient status of the furrows due to leaching may well account for it's abundance there.

The ridges and furrows of 18/19th century cultivation are shown on overlay 7 of the DECORANA sample scores and these are not significantly different in either base status or moisture availability when all samples are used. An absence of any difference in base status is probably due to liming of the soils during cultivation and their relatively recent change from arable land which has provided little time for leaching to occur. However, a lack of difference in moisture availability is not recognised on all the sites and the same situation is only found at Hartside where drainage is complicated by the presence of soils over clay and gravel. This has resulted in an ordination of the samples dependant on the underlying material and therefore they are unsuitable for statistical comparison.

On Greenlea Lough there is no significant difference in base status but moisture availability is significant at the 5% level with the shallow depth of the A horizon probably contributing to moisture differences. A similar situation exists here to that of the cord rig with limestone beneath a thin layer of clay and whilst this may contribute to soil pH little leaching has occured. *Brachythecium rutabulum*, *Rumex acetosa* and *Luzula campestris* are all more abundant on the ridges. *Brachythecium rutabulum* and *Rumex acetosa* are tolerant of of a wide range of situations and there seems no obvious reason to explain their increased abundance but *Luzula campestris* was found by Rogers and King (1972) to be confined to the dry sites in similar grassland and it is not typically a wetland species (Grime, Hodgson and Hunt 1988).

The 18/19th century cultivation at Ottercops shows significant differences at the 1% level in base status and the 5% level in moisture availability. The differences in base status contrast markedly with those of the other sites and are difficult to explain with any degree of certainty. It is possible that they reflect a lack of fertilisation during cultivation and the absence of Lolium perenne suggests that the area was not reseeded when cultivation ceased and therefore was probably not intensively managed. The differences in moisture availability are probably related to the extent of this type of cultivation as a microtopographical feature. *Danthonia decumbens* and *Galium saxatile* are more abundant on the ridges and whilst the latter is a classic calcifuge, *Danthonia decumbens* has a distribution which shows a bias towards both mildly acidic and calcareous grassland (Grime, Hodgson and Hunt 1988). However, the presence of both is probably linked here to the acidity of the ridges.

Although it is possible to suggest reasons for the relative abundance of most species in the situations described these cannot be considered as necessarily those solely responsible as distribution is as likely to be effected by the presence of other species.

## DISCUSSION

The results indicate that the species composition varies with type of cultivation and the presence or absence of hut circles and that 18/19th century cultivation supports the most distinct species population. Many factors contribute towards these differences including soil charachteristics and drainage but the differences relating to 18/19th century cultivation will also be related to it's relatively recent transition to pasture. This will have allowed less time for species in the surrounding areas to colonise the ridge and furrow and limited the amount of leaching that has taken place. These areas are likely to have been well fertilized during use and the absence of a significant amount of leaching will therefore result in soils of high base status. This in itself may have prevented the immigration of some plants from the surrounding area but will also have encouraged the persistence of *Lolium perenne* and other plants that require a high base status. They are also the areas which are most likely to have been reseeded following their conversion to grassland and therefore certain species may be expected to be present only in these situations. The soils of 18/19th century cultivations have also been shown to have deeper A horizons than the other forms and this may be the result of the management they have experienced or reflect the situations chosen for cultivation at this time.

The areas of prehistoric and medieval cultivation have been used as pasture for a longer period and this has apparently enabled colonisation to take place from adjacent areas so that the vegetation present on them is more closely related. They have also been subject to longer periods of leaching so that the effects of any fertiliser added during cultivation will have been reduced allowing the immigration of species which require an intermediate or low base status.

There are also similarities between the vegetation present on some areas of medieval cultivation and the hut circles. This occurs where the medieval cultivation is situated on soils of low base status but similarities also exist between that on the medieval ridges and hut circles which is almost certainly due to the dry and leached nature of the soil in these situations. The vegetation present on the hut circles is similar at all three sites and undoubtedly reflects the dryness of the situation and length of time over which leaching has taken place resulting in increased acidity. The soils in these situations are also shallow and this will also restrict the species present so that only those that can tolerate the severe limitations posed by the habitat are found there.

The ridges and furrows of prehistoric cultivation differ in base status when all sites are considered and this is probably related to the effects of leaching which has taken place for at least 2000 years on these areas since cultivation. The presence of soils of low pH derived from sandstone is seen to prevent major differences occuring between the ridges and furrows probably as a result of their inherantly low base status but in all other cases, including those on more organic soils, leaching has taken place. This type of cultivation does not, however, result in differences between the ridges and furrows due to moisture except where drainage is impeded. Such a response is likely to result from the small height difference between the ridges and furrows and therefore their comparative similarity in water availability. Only where drainage is impeded are there significant differences and this is probably due to excessive moisture collecting in the furrows.

The pattern observed on medieval ridge and furrow in relation to moisture differences also seems to be related to the extent of this type of cultivation as a microtopographical feature. When all samples are used the ridges and furrows are significantly different and this is probably due to the movement of water from the ridges to the furrows because of the height difference between them. If this is so it may be that where ridge heights are lower due to cultivation having taken place over a shorter period (Butlin 1973) or where they have been reduced by wind erosion as happens on lighter soils these differences will be less pronounced. Major differences occur on Greenlea Lough and Ottercops and only on Hartside where drainage is poorer are they of less importance. Differences in base status on medieval ridge and furrow seem to exist only where the capacity for the soils to be leached is sufficient. Thus at Greenlea Lough there are significant differences whilst on the more organic soils of Ottercops and Hartside, where drainage is a complicating factor, differences are slight. Given sufficient time it may well be that these too would show differences in base status.

The ridges and furrows of 18/19th century cultivation also do not differ in base status and this is possibly an accurate assessment of the situation for these recently cultivated areas where leaching will have had the least effect. Only where it is likely that they were not limed are there significant differences but it seems possible that over a prolonged period these differences would become more widespread. The pattern displayed by the ridges and furrows in moisture availability using all the samples is however probably distorted by those of Hartside where drainage is variable. On the other sites the ridges and furrows differ in moisture availability but not to the same extent as those of medieval cultivation and this would seem to be a reflection of the lesser extent of this type of cultivation as a microtopographical feature.

Thus the types of cultivation appear to result in moisture differences which are a direct result of their size as a microtopographical feature with those of medieval cultivation showing the most significant followed by 18/19th century cultivation and prehistoric respectively. Differences in base availability relate to the time available for leaching to have taken place since cultivation and the potential of the soil to be leached so that those of prehistoric cultivation usually always show differences whilst those of medieval cultivation only show significant differences where the soil type is sufficiently high in base status.

However, in a study of this sort involving several sites and numerous variables such as soil type it is only possible to provide an indication of how effects appear to operate. In order to verify these initial findings it would be necessary to carry out a much more extensive study which would clarify whether the effects are universal or are specific to these situations. Such a study should also include an analysis of the moisture content of the soils as this would enable a more detailed interpretation of a CANOCO to be made and would ideally contain a detailed survey of grazing pressure.

The results show that moisture differences are present between the ridges and furrows of medieval cultivation and these findings are similar to those of Harper and Sagar (1953) who discovered that water relations were important in determining the distribution of some species on this type of cultivation. It is prehaps not surprising that this type of ridge and furrow has attracted the interest of ecologists as it forms the most extensive microtopographical feature and causes the most significant moisture differences. The potential also exists for major differences to be present in base status and it is therefore the most likely to present visible vegetation differences. Cord rig is, however, less widespread and the differences only usually relate to base status so that they are less noticeable in the field and this in addition to it's only recent recognition as a cultivation type has meant that it has almost certainly received almost no botanical interest. 18/19th century cultivation has also been less thoroughly investigated as it still retains many of the charachteristics imposed by man in terms of fertility and species composition and is therefore less interesting.

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## APPENDIX 1

SPECIES NUMBERS

1. Agrostis canina
2. Agrostis capillaris
3. Agrostis stolonifera
4. Anthoxanthum odoratum
5. Bromus mollis
6. Cyanosaurus cristatus
7. Danthonia decumbens
8. Deschampsia caespitosa
9. Deschampsia flexuosa
10. Festuca ovina
11. Festuca rubra
12. Holcus lanatus
13. Lolium perenne
14. Molinia caerulea
15. Nardus stricta
16. Poa annua
17. Poa pratensis
18. Poa subcaerulea
19. Poa trivialis
20. Trisetum flavescens
21. Achillea millefolium
22. Achillea ptarmica
23. Alopecuris pratensis
24. Bellis perennis
25. Botrychium lunaria
26. Campanula rotundifolia
27. Cardamine pratensis
28. Carex ovalis
30. Cerastium arvense
32. Cirsium arvense
33. Cirsium palustre
35. Epilobium palustre
36. Galium saxatile
38. Hypochoeris radicata
39. Juncus articulatus
53. Potentilla erecta
54. Prunella vulgaris
55. Pteridium aquilinum
56. Ranunculus repens
57. Rumex acetosa
58. Rumex acetosella
60. Sanguisorba minor
62. Sagina procumbens
65. Stellaria media
66. Trifolium repens
67. Urtica dioica
68. Vaccinium myrtillis
69. Veronica chamaedrys
70. Veronica offinalis
71. Veronica serpyllifolia
72. Vicia lathroides
73. Aulacomnium palustre
74. Brachythecium rutabulum
75. Dicranum scoparium
76. Eurynchium confertum
77. Eurynchium praelongum
78. Eurynchium undulatum
79. Hyloconium splendens
80. Mnium hornum
81. Mnium undulatum
82. Pleurozium schreberi
84. Polytrichium commune
85. Pseudoscleropodium purum
86. Rhytidiadelphus squarrosus
87. Sphagnum palustre
88. Lophocolea cuspidata
89. Carex pilulifera
90. Lotus corniculatus
91. Thuidium tamariscinum
93. Carex nigra

| | |
|---|---|
| 40. Juncus conglomeratus | 94. Rhytidiadelphus triquetus |
| 41. Juncus effuses | 95. Cerastium holosteoides |
| 42. Juncus squarrosus | 96. Cirsium vulgare |
| 43. Lathyrus montanus | 97. Holcus mollis |
| 44. Lathyrus pratensis | 99. Capsella bursa-pastoris |
| 45. Leontodon autumnalis | 100. Rubus chameamorus |
| 46. Luzula campestris | 101. Trifolium pratense |
| 47. Myosotis ramosissima | 102. Poterium sanguisorba |
| 48. Pedicularis sylvatica | 103. Equisetum arvense |
| 49. Pilosella offinarum | 106. Calluna vulgaris |
| 50. Plantago lanceolata | 108. Carex panicea |
| 51. Plantago major | 110. Carex binervis |
| 52. Polygalla serpyllifolia | |

SAMPLE NUMBERS

| | | |
|---|---|---|
| OT = Ottercops | C = Cord rig | O = Outside |
| GL = Greenlea Lough | M = Medieval | R = Ridge |
| HA = Hartside | V = 18/19th Century | F = Furrow |
| | H = Hut circle | |
| 1. OTVR | 46. HAVO | 83. GLHT |
| 2. OTVF | 47. HAVO | 84. GLHO |
| 3. OTVR | 48. HAMR | 85. GLHO |
| 4. OTVF | 49. HAMF | 86. GLHO |
| 5. OTVR | 50. HAMR | 87. GLMR |
| 6. OTVF | 51. HAMF | 88. GLMF |
| 7. OTVO | 52. HAMR | 89. GLMR |
| 8. OTVO | 53. HAMF | 90. GLMF |
| 9. OTVO | 54. HAMO | 91. GLMR |
| 10. OTVO | 55. HAMO | 92. GLMF |
| 11. OTVO | 56. HAMO | 93. GLMO |
| 21. OTCR | 57. HAHT | 94. GLMO |
| 22. OTCF | 58. HAHT | 95. GLMO |
| 23. OTCR | 59. HAHT | 96. OTHT |
| 24. OTCF | 60. HAHO | 97. OTHT |
| 25. OTCR | 61. HAHO | 98. OTHT |
| 26. OTCF | 62. HAHO | 99. OTHO |
| 27. OTCO | 63. GLCR | 100. OTHO |
| 28. OTCO | 64. GLCF | 101. OTHO |
| 29. OTCO | 65. GLCR | 102. OTMF |

| | | |
|---|---|---|
| 30. HACR | 66. GLCF | 103. OTMF |
| 31. HACF | 67. GLCR | 104. OTMR |
| 32. HACR | 68. GLCF | 105. OTMF |
| 33. HACF | 69. GLCO | 106. OTMR |
| 34. HACR | 70. GLCO | 107. OTMR |
| 35. HACF | 71. GLCO | 108. OTMO |
| 36. HAVR | 72. GLVR | 109. OTMO |
| 37. HAVF | 73. GLVF | 110. OTMO |
| 38. HAVR | 74. GLVR | 111. GLCR |
| 39. HAVF | 75. GLVF | 112. GLCF |
| 40. HAVR | 76. GLVR | 113. GLCR |
| 41. HAVF | 77. GLVF | 114. GLCF |
| 42. HACO | 78. GLVO | 115. GLCR |
| 43. HACO | 79. GLVO | 116. GLCF |
| 44. HACO | 80. GLVO | 117. GLCO |
| 45. HAVO | 81. GHHT | 118. GLCO |
| | 82. GLHT | 119. GLCO |

## APPENDIX 2

ENVIRONMENTAL DATA

| **Soil Texture** | **Age** | **Microtopography** |
|---|---|---|
| c=clay loam | p=prehistoric | r=ridge |
| p=peaty loam | m=medieval | f=furrow |
| pt=peaty | v=18/19th cent. | h=hut circle |
| | h=hut circle | o=outside |

| sample | slope | asp. | alt. | pH | dep.A | c,p,pt | p,m,v,h | r,f,h,o |
|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 170 | 245 | 5.9 | 20 | 010 | 0010 | 1000 |
| 2 | 9 | 170 | 245 | 6.2 | 15 | 010 | 0010 | 0100 |
| 3 | 9 | 170 | 245 | 5.7 | 20 | 010 | 0010 | 1000 |
| 4 | 9 | 170 | 245 | 6.4 | 15 | 010 | 0010 | 0100 |
| 5 | 9 | 170 | 245 | 6.2 | 15 | 010 | 0010 | 1000 |
| 6 | 9 | 170 | 245 | 6.1 | 12 | 010 | 0010 | 0100 |
| 7 | 9 | 170 | 245 | 6.2 | 20 | 010 | 0000 | 0001 |
| 8 | 9 | 170 | 245 | 6.2 | 20 | 010 | 0000 | 0001 |
| 9 | 9 | 170 | 245 | 6.2 | 18 | 010 | 0000 | 0001 |
| 10 | 9 | 170 | 245 | 6.2 | 15 | 010 | 0000 | 0001 |
| 11 | 9 | 170 | 245 | 6.2 | 20 | 010 | 0000 | 0001 |
| 21 | 6 | 170 | 250 | 6.8 | 9 | 010 | 1000 | 1000 |
| 22 | 6 | 170 | 250 | 6.8 | 8 | 010 | 1000 | 0100 |
| 23 | 6 | 170 | 250 | 6.8 | 8 | 010 | 1000 | 1000 |
| 24 | 6 | 170 | 250 | 6.8 | 6 | 010 | 1000 | 0100 |
| 25 | 6 | 170 | 250 | 6.8 | 8 | 010 | 1000 | 1000 |
| 26 | 6 | 170 | 250 | 6.8 | 6 | 010 | 1000 | 1000 |
| 27 | 6 | 170 | 250 | 6.8 | 10 | 010 | 0000 | 0001 |
| 28 | 6 | 170 | 250 | 6.8 | 10 | 010 | 0000 | 0001 |
| 29 | 6 | 170 | 250 | 6.8 | 10 | 010 | 0000 | 0001 |
| 30 | 8 | 160 | 230 | 6.8 | 15 | 100 | 1000 | 1000 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 31 | 8 | 160 | 230 | 6.8 | 10 | 100 | 1000 | 0100 |
| 32 | 8 | 160 | 230 | 6.8 | 27 | 100 | 1000 | 1000 |
| 33 | 8 | 160 | 230 | 6.8 | 21 | 100 | 1000 | 0100 |
| 34 | 8 | 160 | 230 | 6.8 | 13 | 010 | 1000 | 1000 |
| 35 | 8 | 160 | 240 | 6.8 | 10 | 010 | 1000 | 0100 |
| 36 | 8 | 160 | 240 | 6.8 | 8 | 100 | 0010 | 1000 |
| 37 | 8 | 160 | 240 | 6.8 | 4 | 100 | 0010 | 0100 |
| 38 | 8 | 160 | 240 | 6.8 | 8 | 100 | 0010 | 1000 |
| 39 | 8 | 160 | 240 | 7.0 | 5 | 100 | 0010 | 0100 |
| 40 | 8 | 160 | 240 | 6.8 | 6 | 100 | 0010 | 1000 |
| 41 | 8 | 160 | 240 | 6.9 | 5 | 100 | 0010 | 0100 |
| 42 | 8 | 160 | 230 | 6.8 | 10 | 010 | 0000 | 0001 |
| 43 | 8 | 160 | 230 | 6.8 | 10 | 100 | 0000 | 0001 |
| 44 | 8 | 160 | 230 | 6.8 | 10 | 100 | 0000 | 0001 |
| 45 | 5 | 160 | 240 | 6.8 | 5 | 100 | 0000 | 0001 |
| 46 | 5 | 160 | 240 | 6.8 | 5 | 100 | 0000 | 0001 |
| 47 | 5 | 160 | 240 | 6.8 | 5 | 100 | 0000 | 0001 |
| 48 | 9 | 160 | 240 | 6.5 | 5 | 010 | 0100 | 1000 |
| 49 | 9 | 160 | 240 | 6.6 | 3 | 010 | 0100 | 0100 |
| 50 | 9 | 160 | 240 | 6.6 | 5 | 010 | 0100 | 1000 |
| 51 | 9 | 160 | 240 | 6.6 | 4 | 010 | 0100 | 0100 |
| 52 | 9 | 160 | 240 | 6.5 | 5 | 010 | 0100 | 1000 |
| 53 | 9 | 160 | 240 | 6.5 | 3 | 010 | 0100 | 0100 |
| 54 | 9 | 160 | 240 | 6.6 | 3 | 010 | 0000 | 0001 |
| 55 | 9 | 160 | 240 | 6.6 | 4 | 010 | 0000 | 0001 |
| 56 | 9 | 160 | 240 | 6.6 | 3 | 010 | 0000 | 0001 |
| 57 | 6 | 160 | 240 | 6.8 | 2 | 010 | 0001 | 0010 |
| 58 | 6 | 160 | 240 | 6.8 | 2 | 010 | 0001 | 0010 |
| 59 | 6 | 160 | 240 | 6.8 | 1 | 100 | 0001 | 0010 |
| 60 | 6 | 160 | 240 | 6.8 | 5 | 100 | 0000 | 0001 |
| 61 | 6 | 160 | 240 | 6.8 | 4 | 100 | 0000 | 0001 |
| 62 | 6 | 160 | 240 | 6.8 | 4 | 100 | 0000 | 0001 |
| 63 | 5 | 155 | 240 | 6.3 | 4 | 100 | 1000 | 1000 |
| 64 | 5 | 155 | 240 | 6.4 | 3 | 100 | 1000 | 0100 |
| 65 | 5 | 155 | 240 | 6.3 | 2 | 100 | 1000 | 1000 |
| 66 | 5 | 155 | 240 | 6.4 | 2 | 100 | 1000 | 0100 |
| 67 | 5 | 155 | 240 | 6.3 | 4 | 100 | 1000 | 1000 |
| 68 | 5 | 155 | 240 | 6.4 | 3 | 100 | 1000 | 0100 |
| 69 | 5 | 155 | 240 | 6.5 | 5 | 100 | 0000 | 0001 |
| 70 | 5 | 155 | 240 | 6.5 | 5 | 100 | 0000 | 0001 |
| 71 | 5 | 155 | 240 | 6.5 | 5 | 100 | 0000 | 0001 |
| 72 | 5 | 155 | 240 | 6.8 | 6 | 100 | 0010 | 1000 |
| 73 | 5 | 155 | 240 | 6.8 | 4 | 100 | 0010 | 0100 |
| 74 | 5 | 155 | 240 | 6.8 | 4 | 100 | 0010 | 1000 |
| 75 | 5 | 155 | 240 | 6.8 | 4 | 100 | 0010 | 0100 |
| 76 | 5 | 155 | 240 | 6.8 | 5 | 100 | 0010 | 1000 |
| 77 | 5 | 155 | 240 | 6.8 | 3 | 100 | 0010 | 0100 |
| 78 | 5 | 155 | 240 | 6.8 | 3 | 100 | 0000 | 0001 |
| 79 | 5 | 155 | 240 | 6.8 | 4 | 100 | 0000 | 0001 |
| 80 | 5 | 155 | 240 | 6.8 | 3 | 100 | 0000 | 0001 |
| 81 | 5 | 155 | 240 | 6.8 | 3 | 010 | 0001 | 0010 |
| 82 | 5 | 155 | 240 | 6.8 | 2 | 010 | 0001 | 0010 |
| 83 | 5 | 155 | 240 | 6.8 | 3 | 010 | 0001 | 0010 |
| 84 | 5 | 155 | 240 | 6.8 | 4 | 010 | 0000 | 0001 |
| 85 | 5 | 155 | 240 | 6.8 | 4 | 010 | 0000 | 0001 |
| 86 | 5 | 155 | 240 | 6.8 | 3 | 010 | 0000 | 0001 |
| 87 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0100 | 1000 |
| 88 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0100 | 0100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 89 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0100 | 1000 |
| 90 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0100 | 0100 |
| 91 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0100 | 1000 |
| 92 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0100 | 0100 |
| 93 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0000 | 0001 |
| 94 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0000 | 0001 |
| 95 | 8 | 160 | 235 | 6.8 | 4 | 100 | 0000 | 0001 |
| 96 | 6 | 160 | 250 | 6.3 | 2 | 010 | 0001 | 0010 |
| 97 | 6 | 160 | 250 | 6.2 | 2 | 010 | 0001 | 0010 |
| 98 | 6 | 160 | 250 | 6.3 | 2 | 010 | 0001 | 0010 |
| 99 | 6 | 160 | 250 | 6.8 | 5 | 010 | 0000 | 0001 |
| 100 | 6 | 160 | 250 | 6.8 | 5 | 010 | 0000 | 0001 |
| 101 | 6 | 160 | 250 | 6.8 | 5 | 010 | 0000 | 0001 |
| 102 | 5 | 175 | 250 | 6.8 | 2 | 001 | 0100 | 0100 |
| 103 | 5 | 175 | 250 | 6.8 | 3 | 001 | 0100 | 0100 |
| 104 | 5 | 175 | 250 | 6.8 | 4 | 001 | 0100 | 1000 |
| 105 | 5 | 175 | 250 | 6.8 | 2 | 001 | 0100 | 0100 |
| 106 | 5 | 175 | 250 | 6.8 | 2 | 001 | 0100 | 1000 |
| 107 | 5 | 175 | 250 | 6.8 | 3 | 001 | 0100 | 1000 |
| 108 | 5 | 175 | 250 | 6.0 | 4 | 001 | 0000 | 0001 |
| 109 | 5 | 175 | 250 | 6.1 | 4 | 001 | 0000 | 0001 |
| 110 | 5 | 175 | 250 | 6.0 | 3 | 001 | 0000 | 0001 |
| 111 | 5 | 155 | 250 | 6.0 | 5 | 010 | 1000 | 1000 |
| 112 | 5 | 155 | 250 | 6.2 | 4 | 010 | 1000 | 0100 |
| 113 | 5 | 155 | 250 | 6.1 | 5 | 010 | 1000 | 1000 |
| 114 | 5 | 155 | 250 | 6.0 | 4 | 010 | 1000 | 0100 |
| 115 | 5 | 155 | 250 | 6.1 | 6 | 010 | 1000 | 1000 |
| 116 | 5 | 155 | 250 | 6.2 | 5 | 010 | 1000 | 0100 |
| 117 | 7 | 155 | 250 | 6.3 | 5 | 010 | 0000 | 0001 |
| 118 | 7 | 155 | 250 | 6.1 | 5 | 010 | 0000 | 0001 |
| 119 | 7 | 155 | 250 | 6.0 | 5 | 010 | 0000 | 0001 |

## APPENDIX 3

QUADRAT DATA

| Sample | Species numbers and occurences | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1.0 | 2 | 5.0 | 4 | 8.0 | 6 | 1.0 | 7 | 2.0 | 10 | 8.0 | 15 | 8.0 |
| 1 | 17 | 0.5 | 18 | 1.0 | 25 | 0.5 | 30 | 2.0 | 32 | 1.0 | 33 | 4.0 | 36 | 4.0 |
| 1 | 46 | 8.0 | 52` | 5.0 | 53 | 8.0 | 57 | 4.0 | 66 | 8.0 | 69 | 2.0 | 70 | 1.0 |
| 1 | 77 | 3.0 | 82 | 6.0 | 86 | 8.0 | 89 | 6.0 | | | | | | |
| 2 | 1 | 3.0 | 2 | 6.0 | 4 | 7.0 | 6 | 3.0 | 10 | 8.0 | 15 | 8.0 | 17 | 6.0 |
| 2 | 30 | 8.0 | 32 | 4.0 | 33 | 5.0 | 36 | 1.0 | 46 | 6.0 | 47 | 1.0 | 53 | 6.0 |
| 2 | 54 | 1.0 | 57 | 4.0 | 66 | 8.0 | 69 | 2.0 | 70 | 1.0 | 71 | 1.0 | 77 | 1.0 |
| 2 | 82 | 5.0 | 86 | 8.0 | 89 | 4.0 | | | | | | | | |
| 3 | 1 | 3.0 | 2 | 8.0 | 3 | 2.0 | 4 | 8.0 | 6 | 1.0 | 7 | 2.0 | 10 | 8.0 |
| 3 | 15 | 8.0 | 16 | 2.0 | 17 | 2.0 | 19 | 1.0 | 26 | 1.0 | 30 | 6.0 | 32 | 2.0 |
| 3 | 33 | 2.0 | 36 | 6.0 | 46 | 8.0 | 48 | 0.5 | 53 | 8.0 | 54 | 1.0 | 66 | 8.0 |
| 3 | 70 | 1.0 | 71 | 1.0 | 82 | 5.0 | 85 | 3.0 | 86 | 8.0 | 89 | 4.0 | 90 | 3.0 |
| 3 | 91 | 1.0 | | | | | | | | | | | | |
| 4 | 1 | 1.0 | 2 | 5.0 | 4 | 7.0 | 6 | 5.0 | 10 | 8.0 | 11 | 1.0 | 12 | 1.0 |
| 4 | 15 | 8.0 | 17 | 3.0 | 26 | 1.0 | 30 | 8.0 | 33 | 3.0 | 36 | 1.0 | 46 | 8.0 |
| 4 | 53 | 6.0 | 67 | 2.0 | 66 | 8.0 | 70 | 1.0 | 82 | 2.0 | 85 | 1.0 | 86 | 8.0 |
| 5 | 1 | 1.0 | 2 | 7.0 | 4 | 6.0 | 6 | 4.0 | 7 | 1.0 | 10 | 8.0 | 15 | 8.0 |
| 5 | 30 | 4.0 | 33 | 4.0 | 36 | 6.0 | 43 | 1.0 | 46 | 8.0 | 48 | 0.5 | 52 | 1.0 |
| 5 | 53 | 7.0 | 54 | 1.0 | 57 | 4.0 | 66 | 7.0 | 82 | 1.0 | 85 | 5.0 | 86 | 8.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 89 | 1.0 | 91 | 2.0 | | | | | | | | | | |
| 6 | 1 | 3.0 | 2 | 8.0 | 4 | 5.0 | 6 | 7.0 | 10 | 8.0 | 15 | 8.0 | 29 | 2.0 |
| 6 | 30 | 7.0 | 32 | 2.0 | 33 | 5.0 | 36 | 3.0 | 46 | 7.0 | 52 | 3.0 | 53 | 6.0 |
| 6 | 54 | 2.0 | 57 | 8.0 | 66 | 8.0 | 85 | 5.0 | 86 | 8.0 | 89 | 2.0 | 91 | 2.0 |
| 7 | 1 | 3.0 | 2 | 8.0 | 3 | 1.0 | 4 | 8.0 | 6 | 5.0 | 7 | 2.0 | 10 | 8.0 |
| 7 | 12 | 3.0 | 15 | 8.0 | 17 | 1.0 | 30 | 4.0 | 32 | 8.0 | 33 | 5.0 | 46 | 8.0 |
| 7 | 53 | 8.0 | 57 | 1.0 | 66 | 7.0 | 70 | 1.0 | 85 | 4.0 | 86 | 8.0 | 89 | 1.0 |
| 8 | 1 | 1.0 | 2 | 8.0 | 4 | 8.0 | 6 | 1.0 | 7 | 1.0 | 10 | 8.0 | 11 | 3.0 |
| 8 | 12 | 3.0 | 15 | 8.0 | 17 | 1.0 | 30 | 5.0 | 32 | 4.0 | 33 | 6.0 | 46 | 8.0 |
| 8 | 53 | 8.0 | 66 | 5.0 | 86 | 8.0 | | | | | | | | |
| 9 | 1 | 2.0 | 2 | 8.0 | 3 | 1.0 | 4 | 7.0 | 6 | 4.0 | 7 | 4.0 | 10 | 8.0 |
| 9 | 11 | 5.0 | 12 | 2.0 | 15 | 8.0 | 17 | 3.0 | 30 | 6.0 | 32 | 2.0 | 33 | 4.0 |
| 9 | 46 | 8.0 | 52 | 1.0 | 53 | 8.0 | 66 | 6.0 | 70 | 1.0 | 77 | 1.0 | 85 | 4.0 |
| 9 | 86 | 8.0 | 89 | 4.0 | 90 | 2.0 | | | | | | | | |
| 10 | 1 | 2.0 | 2 | 8.0 | 3 | 2.0 | 4 | 7.0 | 6 | 1.0 | 10 | 7.0 | 11 | 3.0 |
| 10 | 12 | 6.0 | 15 | 8.0 | 17 | 5.0 | 30 | 8.0 | 32 | 2.0 | 33 | 5.0 | 36 | 1.0 |
| 10 | 46 | 7.0 | 52 | 3.0 | 53 | 7.0 | 66 | 3.0 | 85 | 3.0 | 86 | 8.0 | 89 | 4.0 |
| 11 | 1 | 1.0 | 2 | 5.0 | 3 | 3.0 | 4 | 7.0 | 6 | 7.0 | 10 | 7.0 | 11 | 4.0 |
| 11 | 12 | 6.0 | 15 | 8.0 | 17 | 7.0 | 30 | 8.0 | 32 | 4.0 | 33 | 4.0 | 46 | 6.0 |
| 11 | 53 | 8.0 | 66 | 1.0 | 82 | 4.0 | 85 | 2.0 | 86 | 8.0 | 89 | 5.0 | | |
| 21 | 1 | 3.0 | 2 | 8.0 | 3 | 3.0 | 4 | 8.0 | 6 | 5.0 | 10 | 5.0 | 11 | 1.0 |
| 21 | 12 | 4.0 | 15 | 8.0 | 17 | 8.0 | 28 | 3.0 | 30 | 5.0 | 32 | 1.0 | 33 | 1.0 |
| 21 | 46 | 7.0 | 53 | 7.0 | 66 | 8.0 | 85 | 1.0 | 86 | 8.0 | | | | |
| 22 | 1 | 1.0 | 2 | 6.0 | 4 | 5.0 | 6 | 6.0 | 10 | 7.0 | 11 | 2.0 | 12 | 3.0 |
| 22 | 15 | 8.0 | 17 | 8.0 | 19 | 1.0 | 28 | 1.0 | 46 | 2.0 | 53 | 2.0 | 66 | 8.0 |
| 22 | 85 | 1.0 | 86 | 8.0 | | | | | | | | | | |
| 23 | 1 | 2.0 | 2 | 7.0 | 3 | 2.0 | 4 | 8.0 | 6 | 7.0 | 10 | 6.0 | 12 | 1.0 |
| 23 | 15 | 8.0 | 17 | 8.0 | 28 | 3.0 | 30 | 2.0 | 46 | 4.0 | 53 | 5.0 | 66 | 8.0 |
| 23 | 76 | 1.0 | 80 | 1.0 | 85 | 1.0 | 86 | 7.0 | | | | | | |
| 24 | 1 | 3.0 | 2 | 8.0 | 3 | 1.0 | 4 | 3.0 | 6 | 6.0 | 10 | 2.0 | 12 | 3.0 |
| 24 | 15 | 3.0 | 16 | 1.0 | 17 | 8.0 | 19 | 1.0 | 30 | 3.0 | 46 | 2.0 | 53 | 3.0 |
| 24 | 56 | 1.0 | 66 | 8.0 | 70 | 1.0 | 76 | 1.0 | 80 | 1.0 | 85 | 1.0 | 86 | 6.0 |
| 25 | 1 | 2.0 | 2 | 6.0 | 3 | 1.0 | 4 | 8.0 | 6 | 4.0 | 10 | 8.0 | 11 | 1.0 |
| 25 | 12 | 5.0 | 15 | 8.0 | 17 | 8.0 | 30 | 1.0 | 46 | 2.0 | 53 | 6.0 | 57 | 1.0 |
| 25 | 66 | 8.0 | 86 | 8.0 | | | | | | | | | | |
| 26 | 1 | 1.0 | 2 | 4.0 | 4 | 5.0 | 6 | 8.0 | 10 | 4.0 | 12 | 7.0 | 15 | 6.0 |
| 26 | 16 | 6.0 | 17 | 8.0 | 28 | 2.0 | 30 | 1.0 | 46 | 1.0 | 53 | 1.0 | 66 | 7.0 |
| 26 | 77 | 1.0 | 86 | 3.0 | | | | | | | | | | |
| 27 | 1 | 2.0 | 2 | 8.0 | 3 | 2.0 | 4 | 8.0 | 6 | 7.0 | 10 | 8.0 | 12 | 8.0 |
| 27 | 15 | 8.0 | 17 | 8.0 | 30 | 1.0 | 32 | 1.0 | 33 | 1.0 | 53 | 2.0 | 56 | 1.0 |
| 27 | 57 | 2.0 | 66 | 8.0 | 69 | 2.0 | 78 | 1.0 | 86 | 8.0 | 90 | 1.0 | 94 | 2.0 |
| 28 | 1 | 3.0 | 2 | 4.0 | 3 | 0.5 | 4 | 8.0 | 6 | 6.0 | 10 | 2.0 | 12 | 4.0 |
| 28 | 15 | 8.0 | 17 | 8.0 | 21 | 1.0 | 27 | 1.0 | 30 | 3.0 | 32 | 1.0 | 46 | 3.0 |
| 28 | 53 | 1.0 | 57 | 7.0 | 66 | 8.0 | 69 | 3.0 | 86 | 7.0 | 94 | 2.0 | | |
| 29 | 1 | 2.0 | 2 | 6.0 | 4 | 6.0 | 6 | 7.0 | 10 | 7.0 | 11 | 2.0 | 12 | 1.0 |
| 29 | 15 | 8.0 | 16 | 1.0 | 17 | 8.0 | 28 | 2.0 | 30 | 4.0 | 33 | 1.0 | 36 | 1.0 |
| 29 | 46 | 5.0 | 53 | 3.0 | 66 | 8.0 | 78 | 1.0 | 85 | 2.0 | 86 | 6.0 | 94 | 1.0 |
| 30 | 1 | 1.0 | 2 | 3.0 | 3 | 1.0 | 4 | 3.0 | 6 | 2.0 | 9 | 1.0 | 10 | 2.0 |
| 30 | 12 | 8.0 | 17 | 8.0 | 27 | 1.0 | 33 | 4.0 | 47 | 2.0 | 53 | 1.0 | 55 | 2.0 |
| 30 | 66 | 8.0 | 74 | 2.0 | 77 | 1.0 | 86 | 3.0 | 95 | 1.0 | 96 | 1.0 | 97 | 1.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 1 | 1.0 | 2 | 3.0 | 4 | 1.0 | 6 | 2.0 | 10 | 2.0 | 11 | 1.0 | 12 | 8.0 |
| 31 | 17 | 8.0 | 27 | 1.0 | 46 | 1.0 | 66 | 8.0 | 77 | 2.0 | 86 | 1.0 | 96 | 3.0 |
| 32 | 2 | 3.0 | 7 | 1.0 | 9 | 3.0 | 10 | 7.0 | 11 | 1.0 | 12 | 7.0 | 14 | 0.5 |
| 32 | 16 | 1.0 | 17 | 8.0 | 27 | 5.0 | 28 | 1.0 | 30 | 1.0 | 33 | 6.0 | 35 | 1.0 |
| 32 | 55 | 2.0 | 56 | 2.0 | 57 | 2.0 | 66 | 7.0 | 86 | 1.0 | 96 | 3.0 | | |
| 33 | 1 | 2.0 | 2 | 4.0 | 12 | 8.0 | 16 | 1.0 | 17 | 8.0 | 27 | 1.0 | 28 | 1.0 |
| 33 | 30 | 1.0 | 35 | 1.0 | 53 | 2.0 | 56 | 5.0 | 57 | 1.0 | 62 | 1.0 | 66 | 7.0 |
| 33 | 96 | 3.0 | | | | | | | | | | | | |
| 34 | 1 | 1.0 | 2 | 7.0 | 3 | 2.0 | 4 | 5.0 | 10 | 7.0 | 11 | 2.0 | 12 | 8.0 |
| 34 | 14 | 4.0 | 17 | 8.0 | 27 | 1.0 | 28 | 6.0 | 30 | 1.0 | 33 | 8.0 | 46 | 1.0 |
| 35 | 53 | 4.0 | 57 | 1.0 | 66 | 4.0 | 77 | 1.0 | 86 | 4.0 | | | | |
| 35 | 1 | 1.0 | 2 | 4.0 | 3 | 1.0 | 4 | 6.0 | 12 | 8.0 | 14 | 2.0 | 17 | 8.0 |
| 35 | 27 | 4.0 | 28 | 5.0 | 32 | 4.0 | 33 | 4.0 | 35 | 1.0 | 53 | 4.0 | 55 | 1.0 |
| 35 | 56 | 1.0 | 57 | 1.0 | 66 | 3.0 | 86 | 6.0 | | | | | | |
| 36 | 1 | 2.0 | 2 | 4.0 | 6 | 8.0 | 10 | 7.0 | 11 | 2.0 | 12 | 2.0 | 13 | 7.0 |
| 36 | 14 | 1.0 | 15 | 4.0 | 17 | 8.0 | 20 | 3.0 | 28 | 1.0 | 30 | 6.0 | 32 | 1.0 |
| 36 | 36 | 1.0 | 46 | 5.0 | 53 | 2.0 | 66 | 8.0 | 69 | 1.0 | 96 | 2.0 | | |
| 37 | 1 | 1.0 | 2 | 5.0 | 4 | 1.0 | 6 | 1.0 | 10 | 1.0 | 12 | 3.0 | 13 | 7.0 |
| 37 | 17 | 6.0 | 30 | 7.0 | 32 | 2.0 | 46 | 3.0 | 66 | 7.0 | | | | |
| 38 | 1 | 3.0 | 2 | 8.0 | 3 | 1.0 | 4 | 3.0 | 6 | 6.0 | 10 | 6.0 | 13 | 6.0 |
| 38 | 15 | 2.0 | 17 | 6.0 | 20 | 0.5 | 30 | 6.0 | 32 | 3.0 | 36 | 2.0 | 46 | 8.0 |
| 38 | 53 | 1.0 | 66 | 7.0 | 96 | 1.0 | | | | | | | | |
| 39 | 1 | 1.0 | 2 | 3.0 | 4 | 2.0 | 5 | 2.0 | 6 | 5.0 | 10 | 2.0 | 12 | 1.0 |
| 39 | 13 | 7.0 | 16 | 1.0 | 17 | 8.0 | 21 | 1.0 | 24 | 1.0 | 30 | 8.0 | 32 | 2.0 |
| 39 | 50 | 2.0 | 57 | 1.0 | 66 | 7.0 | 69 | 1.0 | 96 | 1.0 | | | | |
| 40 | 1 | 3.0 | 2 | 5.0 | 5 | 1.0 | 10 | 2.0 | 12 | 2.0 | 17 | 8.0 | 30 | 3.0 |
| 40 | 46 | 3.0 | 53 | 1.0 | 66 | 8.0 | 69 | 3.0 | 86 | 1.0 | 96 | 1.0 | | |
| 41 | 1 | 2.0 | 2 | 8.0 | 3 | 1.0 | 4 | 1.0 | 10 | 5.0 | 11 | 4.0 | 14 | 1.0 |
| 41 | 17 | 8.0 | 30 | 3.0 | 46 | 5.0 | 53 | 4.0 | 55 | 2.0 | 66 | 8.0 | 69 | 6.0 |
| 41 | 96 | 1.0 | | | | | | | | | | | | |
| 42 | 1 | 3.0 | 2 | 7.0 | 3 | 1.0 | 4 | 4.0 | 6 | 4.0 | 9 | 1.0 | 10 | 6.0 |
| 42 | 12 | 8.0 | 14 | 5.0 | 17 | 2.0 | 28 | 7.0 | 30 | 2.0 | 33 | 6.0 | 36 | 3.0 |
| 42 | 42 | 2.0 | 46 | 1.0 | 53 | 8.0 | 66 | 8.0 | 77 | 4.0 | 86 | 2.0 | | |
| 43 | 1 | 2.0 | 2 | 5.0 | 4 | 1.0 | 6 | 1.0 | 10 | 1.0 | 12 | 8.0 | 13 | 2.0 |
| 43 | 17 | 7.0 | 27 | 2.0 | 28 | 3.0 | 30 | 4.0 | 33 | 6.0 | 35 | 2.0 | 36 | 1.0 |
| 43 | 53 | 3.0 | 56 | 1.0 | 74 | 4.0 | 86 | 5.0 | | | | | | |
| 44 | 1 | 2.0 | 2 | 7.0 | 4 | 1.0 | 6 | 1.0 | 10 | 4.0 | 12 | 8.0 | 13 | 3.0 |
| 44 | 14 | 4.0 | 17 | 8.0 | 28 | 2.0 | 30 | 8.0 | 33 | 7.0 | 56 | 3.0 | 66 | 7.0 |
| 44 | 74 | 5.0 | 86 | 2.0 | | | | | | | | | | |
| 45 | 1 | 4.0 | 2 | 8.0 | 4 | 2.0 | 6 | 7.0 | 10 | 8.0 | 11 | 1.0 | 12 | 0.5 |
| 45 | 13 | 4.0 | 17 | 8.0 | 30 | 5.0 | 36 | 1.0 | 46 | 5.0 | 53 | 3.0 | 55 | 1.0 |
| 45 | 56 | 4.0 | 66 | 8.0 | 69 | 3.0 | 74 | 2.0 | 86 | 2.0 | | | | |
| 46 | 1 | 3.0 | 2 | 8.0 | 3 | 1.0 | 4 | 6.0 | 6 | 8.0 | 10 | 8.0 | 12 | 1.0 |
| 46 | 13 | 2.0 | 15 | 2.0 | 17 | 8.0 | 30 | 7.0 | 33 | 2.0 | 46 | 8.0 | 50 | 3.0 |
| 46 | 53 | 4.0 | 66 | 8.0 | 67 | 1.0 | 69 | 1.0 | 74 | 1.0 | 77 | 2.0 | 86 | 3.0 |
| 46 | 93 | 1.0 | | | | | | | | | | | | |
| 47 | 1 | 2.0 | 2 | 6.0 | 3 | 1.0 | 4 | 7.0 | 6 | 7.0 | 10 | 7.0 | 12 | 7.0 |
| 47 | 13 | 5.0 | 14 | 1.0 | 15 | 2.0 | 17 | 8.0 | 30 | 3.0 | 33 | 1.0 | 36 | 1.0 |
| 47 | 46 | 7.0 | 50 | 3.0 | 53 | 5.0 | 56 | 3.0 | 57 | 1.0 | 66 | 8.0 | 69 | 2.0 |
| 47 | 77 | 1.0 | 86 | 5.0 | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | 1 | 1.0 | 2 | 7.0 | 3 | 3.0 | 4 | 8.0 | 6 | 4.0 | 9 | 1.0 | 10 | 8.0 |
| 48 | 12 | 7.0 | 14 | 7.0 | 15 | 8.0 | 17 | 4.0 | 28 | 7.0 | 30 | 2.0 | 36 | 5.0 |
| 48 | 46 | 8.0 | 53 | 8.0 | 66 | 8.0 | 69 | 3.0 | 86 | 8.0 | | | | |
| 49 | 1 | 2.0 | 2 | 4.0 | 4 | 7.0 | 6 | 6.0 | 10 | 2.0 | 12 | 4.0 | 13 | 1.0 |
| 49 | 14 | 4.0 | 15 | 5.0 | 16 | 1.0 | 17 | 7.0 | 28 | 4.0 | 30 | 3.0 | 53 | 3.0 |
| 49 | 56 | 2.0 | 66 | 7.0 | 77 | 1.0 | 86 | 3.0 | 89 | 2.0 | | | | |
| 50 | 1 | 1.0 | 2 | 7.0 | 3 | 4.0 | 4 | 8.0 | 9 | 5.0 | 10 | 8.0 | 11 | 1.0 |
| 50 | 12 | 3.0 | 14 | 7.0 | 15 | 5.0 | 17 | 3.0 | 28 | 3.0 | 30 | 1.0 | 36 | 3.0 |
| 50 | 46 | 7.0 | 53 | 8.0 | 66 | 7.0 | 69 | 1.0 | 86 | 7.0 | 110 | 1.0 | | |
| 51 | 2 | 1.0 | 3 | 4.0 | 4 | 6.0 | 9 | 2.0 | 10 | 7.0 | 14 | 8.0 | 15 | 1.0 |
| 51 | 16 | 1.0 | 17 | 1.0 | 28 | 2.0 | 36 | 7.0 | 46 | 2.0 | 53 | 8.0 | | |
| 52 | 1 | 2.0 | 2 | 7.0 | 3 | 1.0 | 4 | 5.0 | 6 | 1.0 | 9 | 3.0 | 10 | 6.0 |
| 52 | 12 | 5.0 | 14 | 8.0 | 15 | 3.0 | 17 | 2.0 | 20 | 1.0 | 26 | 2.0 | 36 | 2.0 |
| 52 | 42 | 1.0 | 46 | 4.0 | 53 | 7.0 | 56 | 1.0 | 57 | 5.0 | 66 | 4.0 | 69 | 3.0 |
| 52 | 85 | 1.0 | 86 | 6.0 | | | | | | | | | | |
| 53 | 1 | 3.0 | 2 | 6.0 | 4 | 3.0 | 6 | 1.0 | 10 | 3.0 | 12 | 8.0 | 13 | 1.0 |
| 53 | 14 | 7.0 | 15 | 2.0 | 17 | 7.0 | 36 | 1.0 | 46 | 2.0 | 53 | 1.0 | 56 | 2.0 |
| 53 | 66 | 5.0 | | | | | | | | | | | | |
| 54 | 1 | 3.0 | 2 | 8.0 | 3 | 1.0 | 4 | 7.0 | 11 | 3.0 | 12 | 8.0 | 14 | 7.0 |
| 54 | 15 | 4.0 | 17 | 4.0 | 26 | 1.0 | 28 | 5.0 | 33 | 2.0 | 41 | 3.0 | 44 | 8.0 |
| 54 | 46 | 1.0 | 53 | 7.0 | 66 | 7.0 | | | | | | | | |
| 55 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 3.0 | 12 | 8.0 | 14 | 8.0 | 15 | 5.0 |
| 55 | 17 | 7.0 | 28 | 5.0 | 33 | 1.0 | 41 | 4.0 | 44 | 7.0 | 46 | 1.0 | 53 | 7.0 |
| 55 | 66 | 6.0 | | | | | | | | | | | | |
| 56 | 1 | 3.0 | 2 | 8.0 | 3 | 1.0 | 4 | 8.0 | 10 | 4.0 | 12 | 8.0 | 14 | 8.0 |
| 56 | 15 | 5.0 | 17 | 4.0 | 28 | 5.0 | 33 | 0.5 | 41 | 3.0 | 44 | 8.0 | 46 | 1.0 |
| 56 | 53 | 7.0 | 66 | 7.0 | 110 | 1.0 | | | | | | | | |
| 57 | 1 | 2.0 | 2 | 8.0 | 4 | 1.0 | 10 | 8.0 | 12 | 1.0 | 13 | 0.5 | 17 | 5.0 |
| 57 | 21 | 1.0 | 26 | 5.0 | 27 | 1.0 | 28 | 1.0 | 30 | 3.0 | 36 | 8.0 | 46 | 4.0 |
| 57 | 55 | 2.0 | 57 | 3.0 | 66 | 5.0 | 69 | 1.0 | 87 | 7.0 | | | | |
| 58 | 1 | 1.0 | 2 | 7.0 | 9 | 1.0 | 10 | 8.0 | 15 | 1.0 | 17 | 8.0 | 26 | 5.0 |
| 58 | 30 | 5.0 | 36 | 8.0 | 43 | 1.0 | 46 | 8.0 | 55 | 2.0 | 57 | 2.0 | 66 | 5.0 |
| 58 | 69 | 1.0 | 86 | 8.0 | | | | | | | | | | |
| 59 | 1 | 2.0 | 2 | 7.0 | 9 | 1.0 | 10 | 4.0 | 11 | 1.0 | 12 | 2.0 | 13 | 4.0 |
| 59 | 16 | 1.0 | 17 | 6.0 | 21 | 4.0 | 26 | 4.0 | 30 | 2.0 | 36 | 4.0 | 46 | 6.0 |
| 59 | 55 | 1.0 | 57 | 1.0 | 66 | 5.0 | 74 | 4.0 | 86 | 5.0 | 96 | 1.0 | | |
| 60 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 5 | 2.0 | 10 | 1.0 | 12 | 2.0 | 13 | 6.0 |
| 60 | 15 | 1.0 | 17 | 8.0 | 28 | 1.0 | 30 | 8.0 | 32 | 1.0 | 36 | 1.0 | 46 | 6.0 |
| 60 | 55 | 5.0 | 66 | 8.0 | 69 | 1.0 | 72 | 2.0 | 86 | 4.0 | 96 | 2.0 | | |
| 61 | 1 | 2.0 | 2 | 7.0 | 4 | 5.0 | 6 | 2.0 | 10 | 3.0 | 13 | 8.0 | 15 | 1.0 |
| 61 | 16 | 1.0 | 17 | 6.0 | 26 | 1.0 | 30 | 8.0 | 32 | 2.0 | 46 | 1.0 | 50 | 1.0 |
| 61 | 53 | 1.0 | 55 | 8.0 | 56 | 1.0 | 57 | 4.0 | 77 | 1.0 | 86 | 2.0 | 96 | 1.0 |
| 62 | 1 | 2.0 | 2 | 8.0 | 4 | 6.0 | 6 | 1.0 | 10 | 2.0 | 13 | 7.0 | 15 | 1.0 |
| 62 | 17 | 7.0 | 30 | 8.0 | 32 | 2.0 | 46 | 3.0 | 55 | 5.0 | 86 | 2.0 | 96 | 1.0 |
| 63 | 1 | 2.0 | 2 | 8.0 | 4 | 8.0 | 6 | 5.0 | 10 | 7.0 | 12 | 8.0 | 13 | 3.0 |
| 63 | 15 | 7.0 | 16 | 1.0 | 17 | 8.0 | 30 | 8.0 | 32 | 0.5 | 46 | 7.0 | 50 | 1.0 |
| 63 | 53 | 6.0 | 54 | 2.0 | 56 | 2.0 | 57 | 4.0 | 62 | 1.0 | 66 | 8.0 | 74 | 6.0 |
| 63 | 77 | 7.0 | 81 | 1.0 | 86 | 8.0 | | | | | | | | |
| 64 | 1 | 2.0 | 2 | 4.0 | 4 | 1.0 | 8 | 1.0 | 10 | 1.0 | 12 | 8.0 | 13 | 1.0 |
| 64 | 15 | 1.0 | 16 | 2.0 | 17 | 8.0 | 30 | 6.0 | 32 | 2.0 | 54 | 2.0 | 56 | 5.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 64 | 57 | 1.0 | 62 | 2.0 | 65 | 1.0 | 66 | 8.0 | 74 | 1.0 | 77 | 2.0 | | |
| 65 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 6 | 7.0 | 10 | 8.0 | 12 | 7.0 | 13 | 5.0 |
| 65 | 15 | 7.0 | 16 | 1.0 | 17 | 8.0 | 30 | 8.0 | 32 | 3.0 | 46 | 8.0 | 52 | 1.0 |
| 65 | 53 | 6.0 | 56 | 4.0 | 57 | 7.0 | 62 | 2.0 | 66 | 7.0 | 74 | 1.0 | 77 | 6.0 |
| 65 | 80 | 1.0 | 86 | 8.0 | | | | | | | | | | |
| 66 | 1 | 2.0 | 2 | 5.0 | 6 | 1.0 | 12 | 8.0 | 13 | 3.0 | 15 | 1.0 | 16 | 2.0 |
| 66 | 17 | 8.0 | 30 | 5.0 | 32 | 2.0 | 50 | 1.0 | 56 | 6.0 | 57 | 2.0 | 65 | 1.0 |
| 66 | 66 | 8.0 | 86 | 1.0 | | | | | | | | | | |
| 67 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 6 | 4.0 | 10 | 8.0 | 12 | 8.0 | 13 | 3.0 |
| 67 | 15 | 8.0 | 16 | 1.0 | 17 | 8.0 | 24 | 2.0 | 30 | 8.0 | 46 | 8.0 | 50 | 1.0 |
| 67 | 53 | 3.0 | 56 | 8.0 | 57 | 2.0 | 62 | 4.0 | 66 | 8.0 | 74 | 1.0 | 77 | 8.0 |
| 67 | 79 | 1.0 | 80 | 1.0 | 81 | 1.0 | 86 | 7.0 | | | | | | |
| 68 | 1 | 1.0 | 2 | 3.0 | 6 | 6.0 | 10 | 2.0 | 12 | 8.0 | 13 | 6.0 | 15 | 1.0 |
| 68 | 17 | 8.0 | 24 | 1.0 | 30 | 4.0 | 32 | 2.0 | 46 | 1.0 | 56 | 6.0 | 66 | 8.0 |
| 69 | 1 | 2.0 | 2 | 5.0 | 4 | 4.0 | 10 | 5.0 | 11 | 2.0 | 12 | 6.0 | 13 | 7.0 |
| 69 | 16 | 3.0 | 17 | 8.0 | 19 | 5.0 | 21 | 7.0 | 24 | 6.0 | 27 | 1.0 | 30 | 7.0 |
| 69 | 32 | 3.0 | 45 | 4.0 | 46 | 5.0 | 50 | 4.0 | 51 | 1.0 | 54 | 2.0 | 56 | 8.0 |
| 69 | 57 | 6.0 | 66 | 8.0 | 69 | 2.0 | 77 | 3.0 | | | | | | |
| 70 | 1 | 2.0 | 2 | 5.0 | 4 | 6.0 | 6 | 2.0 | 10 | 8.0 | 12 | 4.0 | 13 | 8.0 |
| 70 | 16 | 5.0 | 17 | 6.0 | 19 | 1.0 | 21 | 8.0 | 24 | 4.0 | 30 | 8.0 | 32 | 2.0 |
| 70 | 45 | 3.0 | 46 | 4.0 | 50 | 6.0 | 54 | 1.0 | 56 | 7.0 | 57 | 6.0 | 66 | 8.0 |
| 70 | 74 | 1.0 | 77 | 1.0 | | | | | | | | | | |
| 71 | 1 | 1.0 | 2 | 4.0 | 4 | 7.0 | 6 | 1.0 | 10 | 8.0 | 12 | 8.0 | 13 | 8.0 |
| 71 | 16 | 2.0 | 17 | 5.0 | 19 | 1.0 | 21 | 8.0 | 24 | 7.0 | 26 | 1.0 | 30 | 8.0 |
| 71 | 32 | 5.0 | 46 | 6.0 | 50 | 8.0 | 54 | 2.0 | 56 | 5.0 | 57 | 6.0 | 65 | 1.0 |
| 71 | 66 | 8.0 | | | | | | | | | | | | |
| 72 | 1 | 3.0 | 2 | 7.0 | 4 | 1.0 | 6 | 1.0 | 12 | 4.0 | 13 | 8.0 | 16 | 3.0 |
| 72 | 17 | 6.0 | 21 | 4.0 | 24 | 3.0 | 30 | 8.0 | 46 | 1.0 | 56 | 1.0 | 57 | 4.0 |
| 72 | 62 | 1.0 | 66 | 8.0 | 74 | 2.0 | 96 | 8.0 | | | | | | |
| 73 | 1 | 4.0 | 2 | 8.0 | 4 | 2.0 | 12 | 2.0 | 13 | 8.0 | 16 | 1.0 | 17 | 7.0 |
| 73 | 21 | 4.0 | 24 | 1.0 | 30 | 6.0 | 50 | 2.0 | 56 | 1.0 | 57 | 1.0 | 65 | 1.0 |
| 73 | 66 | 7.0 | 74 | 1.0 | 96 | 4.0 | | | | | | | | |
| 74 | 1 | 2.0 | 2 | 8.0 | 4 | 3.0 | 12 | 6.0 | 13 | 8.0 | 16 | 1.0 | 17 | 4.0 |
| 74 | 21 | 4.0 | 24 | 3.0 | 30 | 7.0 | 46 | 2.0 | 56 | 4.0 | 57 | 2.0 | 66 | 6.0 |
| 74 | 74 | 3.0 | 96 | 5.0 | | | | | | | | | | |
| 75 | 1 | 1.0 | 2 | 8.0 | 3 | 1.0 | 4 | 3.0 | 12 | 5.0 | 13 | 8.0 | 16 | 1.0 |
| 75 | 17 | 6.0 | 21 | 4.0 | 23 | 1.0 | 24 | 2.0 | 30 | 7.0 | 56 | 3.0 | 57 | 1.0 |
| 75 | 66 | 7.0 | 74 | 1.0 | 96 | 5.0 | | | | | | | | |
| 76 | 1 | 4.0 | 2 | 8.0 | 4 | 8.0 | 10 | 5.0 | 12 | 3.0 | 13 | 8.0 | 16 | 3.0 |
| 76 | 17 | 8.0 | 21 | 8.0 | 24 | 3.0 | 30 | 8.0 | 56 | 5.0 | 57 | 4.0 | 66 | 8.0 |
| 76 | 74 | 8.0 | 77 | 1.0 | 96 | 5.0 | | | | | | | | |
| 77 | 1 | 3.0 | 2 | 7.0 | 12 | 1.0 | 13 | 8.0 | 16 | 2.0 | 17 | 6.0 | 30 | 4.0 |
| 77 | 56 | 2.0 | 65 | 2.0 | 66 | 8.0 | 96 | 4.0 | | | | | | |
| 78 | 1 | 2.0 | 2 | 8.0 | 4 | 3.0 | 6 | 3.0 | 10 | 4.0 | 12 | 7.0 | 13 | 8.0 |
| 78 | 17 | 5.0 | 21 | 6.0 | 30 | 7.0 | 46 | 1.0 | 56 | 4.0 | 57 | 3.0 | 65 | 2.0 |
| 78 | 66 | 5.0 | 69 | 3.0 | 74 | 6.0 | 86 | 1.0 | 96 | 2.0 | | | | |
| 79 | 1 | 4.0 | 2 | 8.0 | 4 | 4.0 | 6 | 7.0 | 10 | 2.0 | 12 | 8.0 | 13 | 7.0 |
| 79 | 17 | 4.0 | 21 | 7.0 | 24 | 1.0 | 30 | 8.0 | 30 | 8.0 | 56 | 7.0 | 65 | 1.0 |
| 79 | 66 | 8.0 | 69 | 5.0 | 74 | 8.0 | 96 | 4.0 | | | | | | |
| 80 | 1 | 4.0 | 2 | 8.0 | 6 | 6.0 | 10 | 7.0 | 12 | 8.0 | 13 | 8.0 | 17 | 5.0 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80 | 21 | 8.0 | 30 | 8.0 | 40 | 0.5 | 46 | 3.0 | 56 | 6.0 | 57 | 2.0 | 66 | 8.0 |
| 80 | 69 | 2.0 | 74 | 6.0 | 96 | 3.0 | | | | | | | | |
| 81 | 1 | 1.0 | 2 | 4.0 | 4 | 3.0 | 6 | 1.0 | 8 | 1.0 | 10 | 8.0 | 15 | 7.0 |
| 82 | 17 | 8.0 | 30 | 7.0 | 36 | 3.0 | 46 | 8.0 | 53 | 2.0 | 57 | 3.0 | 62 | 1.0 |
| 82 | 66 | 5.0 | 74 | 1.0 | 75 | 1.0 | 77 | 1.0 | 82 | 2.0 | 86 | 8.0 | | |
| 83 | 1 | 4.0 | 2 | 8.0 | 4 | 6.0 | 10 | 8.0 | 11 | 1.0 | 15 | 4.0 | 16 | 1.0 |
| 83 | 17 | 7.0 | 21 | 3.0 | 30 | 8.0 | 36 | 4.0 | 38 | 3.0 | 46 | 7.0 | 53 | 3.0 |
| 83 | 57 | 5.0 | 66 | 7.0 | 69 | 1.0 | 74 | 2.0 | 75 | 3.0 | 77 | 8.0 | 82 | 1.0 |
| 83 | 86 | 8.0 | | | | | | | | | | | | |
| 84 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 12 | 7.0 | 13 | 2.0 | 15 | 7.0 |
| 84 | 17 | 8.0 | 21 | 7.0 | 24 | 1.0 | 30 | 8.0 | 36 | 1.0 | 40 | 1.0 | 46 | 5.0 |
| 84 | 49 | 2.0 | 50 | 3.0 | 51 | 1.0 | 53 | 4.0 | 54 | 1.0 | 56 | 7.0 | 57 | 7.0 |
| 84 | 62 | 5.0 | 66 | 8.0 | 77 | 8.0 | 80 | 2.0 | 81 | 1.0 | 86 | 8.0 | | |
| 85 | 1 | 2.0 | 2 | 8.0 | 4 | 8.0 | 6 | 1.0 | 10 | 8.0 | 12 | 8.0 | 13 | 1.0 |
| 85 | 15 | 6.0 | 17 | 8.0 | 21 | 3.0 | 24 | 1.0 | 30 | 8.0 | 46 | 8.0 | 49 | 2.0 |
| 85 | 50 | 6.0 | 51 | 2.0 | 53 | 5.0 | 54 | 1.0 | 56 | 5.0 | 57 | 5.0 | 62 | 7.0 |
| 85 | 66 | 8.0 | 77 | 8.0 | 86 | 8.0 | | | | | | | | |
| 86 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 11 | 2.0 | 12 | 8.0 | 15 | 8.0 |
| 86 | 17 | 8.0 | 21 | 1.0 | 24 | 1.0 | 30 | 8.0 | 46 | 8.0 | 49 | 0.5 | 50 | 1.0 |
| 86 | 53 | 7.0 | 54 | 1.0 | 56 | 3.0 | 57 | 7.0 | 62 | 7.0 | 66 | 8.0 | 77 | 8.0 |
| 86 | 86 | 8.0 | | | | | | | | | | | | |
| 87 | 1 | 4.0 | 2 | 7.0 | 4 | 6.0 | 6 | 8.0 | 10 | 8.0 | 12 | 7.0 | 17 | 8.0 |
| 87 | 20 | 4.0 | 24 | 3.0 | 26 | 3.0 | 30 | 7.0 | 38 | 2.0 | 46 | 7.0 | 50 | 7.0 |
| 87 | 53 | 1.0 | 54 | 1.0 | 56 | 2.0 | 57 | 2.0 | 66 | 8.0 | 69 | 1.0 | 77 | 3.0 |
| 87 | 86 | 4.0 | 96 | 1.0 | | | | | | | | | | |
| 88 | 1 | 4.0 | 2 | 5.0 | 6 | 4.0 | 12 | 8.0 | 13 | 6.0 | 17 | 8.0 | 20 | 1.0 |
| 88 | 21 | 4.0 | 30 | 4.0 | 38 | 1.0 | 46 | 1.0 | 56 | 2.0 | 57 | 8.0 | 66 | 8.0 |
| 88 | 69 | 3.0 | 96 | 1.0 | | | | | | | | | | |
| 89 | 1 | 2.0 | 2 | 8.0 | 4 | 8.0 | 6 | 8.0 | 10 | 8.0 | 12 | 8.0 | 13 | 5.0 |
| 89 | 17 | 8.0 | 20 | 8.0 | 24 | 1.0 | 26 | 4.0 | 30 | 7.0 | 32 | 1.0 | 38 | 3.0 |
| 89 | 45 | 3.0 | 46 | 8.0 | 50 | 8.0 | 54 | 2.0 | 56 | 1.0 | 57 | 4.0 | 66 | 8.0 |
| 89 | 69 | 4.0 | 86 | 2.0 | 90 | 2.0 | 101 | 1.0 | | | | | | |
| 90 | 1 | 3.0 | 2 | 6.0 | 4 | 1.0 | 6 | 1.0 | 10 | 2.0 | 12 | 8.0 | 13 | 7.0 |
| 90 | 17 | 8.0 | 20 | 6.0 | 21 | 3.0 | 24 | 1.0 | 30 | 3.0 | 38 | 1.0 | 46 | 2.0 |
| 90 | 50 | 1.0 | 57 | 6.0 | 66 | 8.0 | 69 | 5.0 | | | | | | |
| 91 | 1 | 4.0 | 2 | 8.0 | 4 | 8.0 | 6 | 7.0 | 10 | 8.0 | 12 | 7.0 | 17 | 7.0 |
| 91 | 20 | 6.0 | 21 | 7.0 | 26 | 3.0 | 30 | 7.0 | 38 | 4.0 | 46 | 7.0 | 50 | 6.0 |
| 91 | 53 | 3.0 | 57 | 1.0 | 66 | 8.0 | 69 | 1.0 | 77 | 0.5 | 90 | 1.0 | | |
| 92 | 1 | 3.0 | 2 | 7.0 | 6 | 6.0 | 12 | 8.0 | 13 | 8.0 | 17 | 8.0 | 19 | 1.0 |
| 92 | 20 | 2.0 | 21 | 3.0 | 27 | 1.0 | 30 | 6.0 | 57 | 8.0 | 66 | 8.0 | 69 | 5.0 |
| 92 | 96 | 3.0 | | | | | | | | | | | | |
| 93 | 1 | 2.0 | 2 | 8.0 | 4 | 8.0 | 6 | 8.0 | 10 | 1.0 | 12 | 8.0 | 13 | 3.0 |
| 93 | 17 | 3.0 | 19 | 8.0 | 29 | 1.0 | 40 | 2.0 | 46 | 8.0 | 53 | 3.0 | 56 | 8.0 |
| 93 | 66 | 8.0 | 102 | 2.0 | | | | | | | | | | |
| 94 | 1 | 4.0 | 2 | 8.0 | 4 | 8.0 | 6 | 8.0 | 12 | 8.0 | 13 | 3.0 | 15 | 2.0 |
| 94 | 17 | 5.0 | 19 | 8.0 | 29 | 6.0 | 30 | 2.0 | 39 | 4.0 | 46 | 8.0 | 53 | 1.0 |
| 94 | 56 | 8.0 | 60 | 1.0 | 66 | 8.0 | 74 | 1.0 | 77 | 1.0 | 80 | 1.0 | 86 | 5.0 |
| 94 | 90 | 1.0 | 103 | 1.0 | | | | | | | | | | |
| 95 | 1 | 3.0 | 2 | 7.0 | 4 | 6.0 | 6 | 7.0 | 10 | 2.0 | 12 | 8.0 | 13 | 2.0 |
| 95 | 15 | 4.0 | 17 | 1.0 | 19 | 8.0 | 28 | 5.0 | 30 | 1.0 | 38 | 3.0 | 39 | 7.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 95 | 46 | 7.0 | 56 | 7.0 | 66 | 7.0 | 86 | 6.0 | 102 | 1.0 | 110 | 2.0 | | |
| 96 | 1 | 6.0 | 2 | 8.0 | 4 | 4.0 | 6 | 3.0 | 10 | 6.0 | 13 | 1.0 | 15 | 6.0 |
| 96 | 17 | 8.0 | 21 | 8.0 | 30 | 4.0 | 36 | 1.0 | 46 | 7.0 | 53 | 3.0 | 57 | 4.0 |
| 96 | 66 | 8.0 | 77 | 1.0 | 80 | 1.0 | 82 | 1.0 | 86 | 8.0 | | | | |
| 97 | 1 | 5.0 | 2 | 8.0 | 4 | 7.0 | 6 | 4.0 | 10 | 8.0 | 11 | 2.0 | 15 | 8.0 |
| 97 | 17 | 8.0 | 21 | 4.0 | 28 | 2.0 | 30 | 4.0 | 46 | 8.0 | 49 | 1.0 | 52 | 1.0 |
| 97 | 53 | 8.0 | 57 | 1.0 | 66 | 6.0 | 82 | 3.0 | 85 | 1.0 | 86 | 8.0 | | |
| 98 | 1 | 3.0 | 2 | 8.0 | 4 | 6.0 | 6 | 3.0 | 10 | 6.0 | 12 | 4.0 | 13 | 1.0 |
| 98 | 15 | 8.0 | 17 | 8.0 | 21 | 8.0 | 26 | 1.0 | 28 | 2.0 | 30 | 5.0 | 46 | 8.0 |
| 98 | 53 | 5.0 | 66 | 8.0 | 77 | 1.0 | 81 | 1.0 | 82 | 1.0 | 86 | 8.0 | | |
| 99 | 1 | 4.0 | 2 | 8.0 | 4 | 8.0 | 6 | 6.0 | 10 | 6.0 | 12 | 7.0 | 15 | 8.0 |
| 99 | 17 | 7.0 | 21 | 2.0 | 30 | 1.0 | 32 | 1.0 | 50 | 5.0 | 56 | 1.0 | 57 | 8.0 |
| 99 | 66 | 8.0 | 74 | 1.0 | 77 | 3.0 | | | | | | | | |
| 100 | 1 | 3.0 | 2 | 6.0 | 4 | 8.0 | 6 | 7.0 | 10 | 5.0 | 12 | 7.0 | 15 | 5.0 |
| 100 | 16 | 2.0 | 17 | 8.0 | 21 | 8.0 | 30 | 3.0 | 32 | 2.0 | 50 | 5.0 | 57 | 6.0 |
| 100 | 66 | 8.0 | 69 | 1.0 | | | | | | | | | | |
| 101 | 1 | 1.0 | 2 | 4.0 | 4 | 7.0 | 6 | 8.0 | 10 | 8.0 | 11 | 1.0 | 12 | 8.0 |
| 101 | 15 | 7.0 | 16 | 3.0 | 17 | 8.0 | 19 | 1.0 | 21 | 8.0 | 28 | 1.0 | 32 | 1.0 |
| 101 | 49 | 1.0 | 50 | 3.0 | 53 | 1.0 | 57 | 5.0 | 66 | 8.0 | 86 | 1.0 | | |
| 102 | 1 | 6.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 15 | 8.0 | 28 | 4.0 | 36 | 8.0 |
| 102 | 46 | 8.0 | 53 | 8.0 | 57 | 0.5 | 74 | 2.0 | 77 | 1.0 | 82 | 3.0 | 86 | 8.0 |
| 103 | 1 | 6.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 15 | 8.0 | 19 | 8.0 | 36 | 8.0 |
| 103 | 46 | 8.0 | 53 | 8.0 | 57 | 3.0 | 77 | 4.0 | 86 | 4.0 | | | | |
| 104 | 1 | 4.0 | 2 | 8.0 | 3 | 2.0 | 4 | 8.0 | 10 | 5.0 | 11 | 1.0 | 15 | 8.0 |
| 104 | 36 | 8.0 | 40 | 1.0 | 46 | 8.0 | 53 | 8.0 | 82 | 7.0 | 86 | 8.0 | 106 | 1.0 |
| 105 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 15 | 8.0 | 36 | 8.0 | 40 | 5.0 |
| 105 | 42 | 3.0 | 53 | 8.0 | 77 | 8.0 | 82 | 1.0 | 86 | 6.0 | | | | |
| 106 | 1 | 4.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 15 | 8.0 | 36 | 8.0 | 46 | 8.0 |
| 106 | 53 | 8.0 | 57 | 3.0 | 75 | 2.0 | 77 | 3.0 | 82 | 6.0 | 86 | 8.0 | | |
| 107 | 1 | 1.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 15 | 8.0 | 36 | 8.0 | 46 | 8.0 |
| 107 | 53 | 8.0 | 57 | 5.0 | 77 | 7.0 | 82 | 8.0 | 86 | 8.0 | | | | |
| 108 | 1 | 1.0 | 2 | 8.0 | 4 | 8.0 | 7 | 4.0 | 10 | 8.0 | 11 | 2.0 | 15 | 8.0 |
| 108 | 22 | 1.0 | 36 | 8.0 | 39 | 8.0 | 46 | 2.0 | 53 | 8.0 | 65 | 2.0 | 77 | 8.0 |
| 108 | 80 | 1.0 | 81 | 1.0 | 82 | 2.0 | 84 | 4.0 | 85 | 6.0 | 86 | 8.0 | 108 | 2.0 |
| 109 | 1 | 1.0 | 2 | 5.0 | 4 | 8.0 | 7 | 2.0 | 10 | 8.0 | 12 | 1.0 | 15 | 8.0 |
| 109 | 22 | 1.0 | 36 | 8.0 | 39 | 8.0 | 40 | 1.0 | 46 | 8.0 | 53 | 8.0 | 81 | 1.0 |
| 109 | 84 | 4.0 | 85 | 2.0 | 86 | 8.0 | 88 | 1.0 | 91 | 2.0 | 108 | 1.0 | | |
| 110 | 2 | 1.0 | 3 | 3.0 | 4 | 4.0 | 10 | 6.0 | 15 | 8.0 | 22 | 1.0 | 36 | 8.0 |
| 110 | 39 | 8.0 | 46 | 5.0 | 53 | 8.0 | 84 | 6.0 | 85 | 1.0 | 86 | 6.0 | 87 | 1.0 |
| 110 | 93 | 5.0 | 108 | 1.0 | | | | | | | | | | |
| 111 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 7.0 | 12 | 7.0 | 15 | 7.0 | 17 | 8.0 |
| 111 | 30 | 1.0 | 56 | 8.0 | 57 | 5.0 | 62 | 4.0 | 66 | 8.0 | 74 | 3.0 | 77 | 8.0 |
| 111 | 80 | 1.0 | 86 | 8.0 | | | | | | | | | | |
| 112 | 1 | 4.0 | 2 | 8.0 | 4 | 4.0 | 12 | 8.0 | 15 | 6.0 | 16 | 1.0 | 17 | 8.0 |
| 112 | 56 | 8.0 | 57 | 2.0 | 62 | 2.0 | 66 | 8.0 | 77 | 8.0 | 86 | 4.0 | | |
| 113 | 1 | 5.0 | 2 | 8.0 | 4 | 8.0 | 10 | 8.0 | 12 | 8.0 | 15 | 8.0 | 17 | 8.0 |
| 113 | 30 | 3.0 | 38 | 1.0 | 56 | 5.0 | 57 | 7.0 | 62 | 1.0 | 66 | 8.0 | 77 | 8.0 |
| 113 | 86 | 8.0 | | | | | | | | | | | | |
| 114 | 1 | 3.0 | 2 | 8.0 | 4 | 5.0 | 12 | 8.0 | 15 | 7.0 | 17 | 8.0 | 56 | 7.0 |
| 114 | 57 | 1.0 | 62 | 1.0 | 66 | 8.0 | 77 | 8.0 | 86 | 4.0 | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115 | 1 | 2.0 | 2 | 7.0 | 4 | 8.0 | 6 | 1.0 | 10 | 5.0 | 12 | 8.0 | 15 | 7.0 |
| 115 | 17 | 5.0 | 28 | 5.0 | 42 | 4.0 | 46 | 4.0 | 53 | 2.0 | 57 | 1.0 | 77 | 2.0 |
| 115 | 86 | 8.0 | 88 | 1.0 | 89 | 1.0 | | | | | | | | |
| 116 | 1 | 2.0 | 2 | 7.0 | 4 | 7.0 | 10 | 2.0 | 12 | 8.0 | 15 | 6.0 | 17 | 8.0 |
| 116 | 28 | 7.0 | 42 | 1.0 | 56 | 2.0 | 57 | 1.0 | 77 | 7.0 | 86 | 7.0 | 89 | 1.0 |
| 117 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 4.0 | 12 | 8.0 | 17 | 8.0 | 30 | 2.0 |
| 117 | 56 | 6.0 | 57 | 3.0 | 66 | 3.0 | 77 | 8.0 | 86 | 3.0 | 108 | 1.0 | | |
| 118 | 1 | 4.0 | 2 | 8.0 | 4 | 8.0 | 10 | 3.0 | 12 | 8.0 | 17 | 8.0 | 28 | 1.0 |
| 118 | 30 | 3.0 | 36 | 1.0 | 46 | 1.0 | 56 | 4.0 | 57 | 4.0 | 62 | 1.0 | 66 | 8.0 |
| 118 | 74 | 1.0 | 77 | 7.0 | 80 | 1.0 | 81 | 2.0 | 86 | 8.0 | | | | |
| 119 | 1 | 3.0 | 2 | 8.0 | 4 | 8.0 | 10 | 5.0 | 12 | 8.0 | 15 | 3.0 | 28 | 2.0 |
| 119 | 42 | 1.0 | 46 | 1.0 | 56 | 0.5 | 57 | 2.0 | 66 | 1.0 | 77 | 8.0 | 86 | 7.0 |