Environmental Science Fieldwork

By Martin Yeo

Investigation into How Time After Burning Influences Biodiversity in Managed Heathland

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Investigation into How Time After Burning Influences Biodiversity in Managed Heathland

Martin Yeo

Abstract

By recording altitude, soil pH, soil moisture, soil organic content and numbers of every plant species and investigating the relationships between them I was able to find that the proportions of plants on a recovering heathland are constantly changing and if left the area would slowly develop into woodland. I also found that time after burning had little effect on soil properties, which allows an area to quickly recover after being burnt. There was evidence that locational factors would influence the speed of plant recovery through influencing soil properties. More data is required to increase reliability of conclusions.

CENTRE – ASSESSED WORK PLAN SHEET

A2 ENVIRONMENTAL SCIENCE

NOVEMBER 2007

Centre Name: Brockenhurst College Centre No: 58801

Candidate Name: Martin Yeo Candidate No: 6582

INVESTIGATION TITLE

Investigation into How Time After Burning Influences Flora Biodiversity in Managed Heathland
After my pilot study, I realised that I cannot universally use biodiversity figures because different species displayed completely different numbers (grasses would always have numbers in 1000s, but heathers would never exceed about 650). I have come up with an alternative title:

Investigation into How Time After Burning Influences Plant Numbers and Species in Managed Heathland
While biodiversity is an analysis of plant numbers and species anyway, this title is more open ended, as I plan to analyse the data in different ways. For example, I could looks specifically at heather plants to give an indication of heathland recovery.

AIM OR HYPOTHESIS

1. Biodiversity will remain reasonably similar throughout the recovery period after burning.
2. Heather species will be dominant throughout the succession period.
3. The soil properties will remain largely the same independent of the time after burning.

After my pilot study, I realised that these hypotheses were not valid ones. Biodiversity calculations could not form the basis of my study for reasons explained above; these differences in numbers also indicated that I could not really quantify dominance and it would be unwise to attempt this. So my new hypotheses are detailed below:

1. The proportions of different plants will remain reasonably similar throughout the recovery period after burning.
2. The soil properties will remain largely the same independent of the time after burning.
3. Locational factors will influence soil properties, which in turn will influence the speed of recovery.

BRIEF DESCRIPTION OF OBJECTIVES/DESIGN/TECHNIQUES
(Include, where appropriate, justification of procedures/control/techniques including statistical techniques)

• Compare areas of different ages since burning to simulate the recovery of an area after a controlled burn. I have a sequence of areas that have been burnt from 1999 to 2007, but I am missing any areas burnt during the 05/06 season. I also have areas proposed to be burnt this year, which have been assigned a minimum age of 16 years; and I have three control areas, which are at least 25 years old. I can perform my analyses on all these areas, and compare the results to try and find any trends/non-trends that may support my hypotheses.

- Measure soil temperature, pH, moisture content & organic content.

I shall measure temperature on site using a soil thermometer, and also take a soil sample. This sample will be analysed later in the lab for pH, moisture and organic content. The pH is measured by dissolving the soil in water, adding soil indicator and comparing the water colour to a colour chart. Moisture content is the difference in mass before and after drying in a 110°C oven, and organic content is the difference in mass before and after burning the dried sample at a much higher temperature (which should combust most organic material).

- Measure biodiversity using systematic sampling in each area.
  As mentioned above, I will not be using biodiversity as my main figure, although I may use it for certain species of plant depending on what trends I need to identify in the data (this will be decided after collection). I will now be simply counting the plants in different species, which can be compared in different ways after fieldwork to suit purpose.
- Possibly analyse one area due to be burned soon – analyse just before burning & just after burning.
  I have since found out (it was not originally known) that the areas proposed for burning will be quite late in the burning season, around March, which is too late for me to conduct this part of my study. Instead, the areas proposed for burning this year will just be used as older areas in my main study, which will be useful in analysing further progression beyond 7 years of recovery.

- Further analysis will include other independently determined data.

To prove/disprove my hypotheses I will also need to determine locational factors and rate of recovery. Locational factors will be anything else that I can say about each quadrat, particularly height, as this tends to indicate the proximity to water. Using contours it is also theoretically feasible to work out the aspect of each quadrat. Rate of recovery will be quantified by how quickly an area can return to the same approximate plant proportions as before burning (of course this is simulated by looking at the plant proportions in older areas).

- I will use a variety of statistical tests to analyse my data.

I anticipate that I will not be able to use just one test on my data, and I will need to use different ones to determine different trends and relationships. For example, in order to work out how much influence time of day has on soil temperature, I may simply wish to construct a chart and analyse to gradient. But to work out the influence time after burning has on the number of heather species, I could use Spearman's Rank or Pearson's Product Moment. In order to determine what tests I will be using, I will need to collect the data first and work out which tests would be appropriate for which relationships.

TIMETABLE

16/07 to 28/07 (2007) – take measurements from selected heath areas.
This was first rescheduled to a week in August, but I have since realised that it will take longer than anticipated, and is also dependent on relatively dry weather. The study will now take place over the months of August and September.
Winter 2007/2008 – study area(s) planned for burning before & after.
As mentioned above, this will no longer be possible.

Plan Sheet

SIGNATURE OF CANDIDATE	**DATE**
COMMENTS FROM TEACHER	
PLAN APPROVED BY TEACHER YES / NO	
SIGNATURE OF TEACHER	**DATE**

Investigation into How Time After Burning Influences Biodiversity in Managed Heathland

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Risk Assessment

Location: heathland around Andrews Mare Pond (GF: 2510 & 2511)

Hazard	Likelihood 1 = low 2 = moderate 3 = high	Severity 1 = minor 2 = moderate 3 = high	Action What can I do to reduce the likelihood of a hazard, and its severity?
Transport to site *Cycling*	2	2	Wear safe, visible clothing Cycle carefully
Location *Fairly remote*	2	2	Have someone else with me
Terrain *Heathland, valley*	1	1	Careful of contours
Equipment *Soil thermometer* *Quadrat(s)*	1	1	
Water *Long Brook stream* *Marsh at bottom of valley* *Andrews Mare Pond*	2	2	Avoid marsh & stream (stick to paths) Have someone else with me
Animals *Ponies, cattle* *Possibility of snakes* *Ticks*	2 to 3	2 to 3	Be sensible Watch out for snakes Wear full body cover
Other people *Potentially dangerous given remoteness*	2	2	Take whistle & mobile Have someone with me Or tell someone where I'm going
Traffic *A31 – fenced* *B road with moderate traffic*	1	2	Be sensible near road Do not attempt to cross A31 – use underpass

Worrying hazards:

- **Cycling –** I am an experienced cyclist and I know what to do in most situations.
- **Remote location –** the area is local to me and I have been there many times. Nevertheless I will be sensible and make sure someone at least knows where I am going.
- **Water –** there are many potential water dangers in the area, so I will need to have someone with me if I need to go in/close to the bog or pond for any reason.
- **Animals –** particularly hazardous, but I will be safe so long as I am vigilant.
  Anti-venom is kept at any local health institution including vets should I need it.
- **Other people –** there have been occasional reports of strange people on the heath, but I will take appropriate caution (see above).

Signed- student__________________________________ Date________________

Lecturer____Date________________

Investigation into How Time After Burning Influences Biodiversity in Managed Heathland

Introduction

Aim: To investigate the changes in flora and soil conditions of a heathland recovering after controlled burning.

The main principle behind this recovery is secondary succession. Succession is defined as "the change in plant and animal communities in an area over time from pioneers to the climax community". Primary succession takes place on completely new land (e.g. bare rock), but secondary succession takes place on cleared land, such as heathland cleared by burning. In secondary succession, species are much quicker to re-colonise in comparison with primary succession; this is because the area is already fertile with a healthy soil ecosystem and seeds in the ground. There are no 'seral stages' in secondary succession, where the conditions would gradually change over time to favour different species, and it is my belief that after a short period of time similar flora to those before burning will have recovered the area.

I want to know whether these conceptions about secondary succession are true, using managed heathland as my subject. I live very close to the heathland area that I will be studying, and I am keen to know how management has kept it in the condition it is in today.

Hypotheses

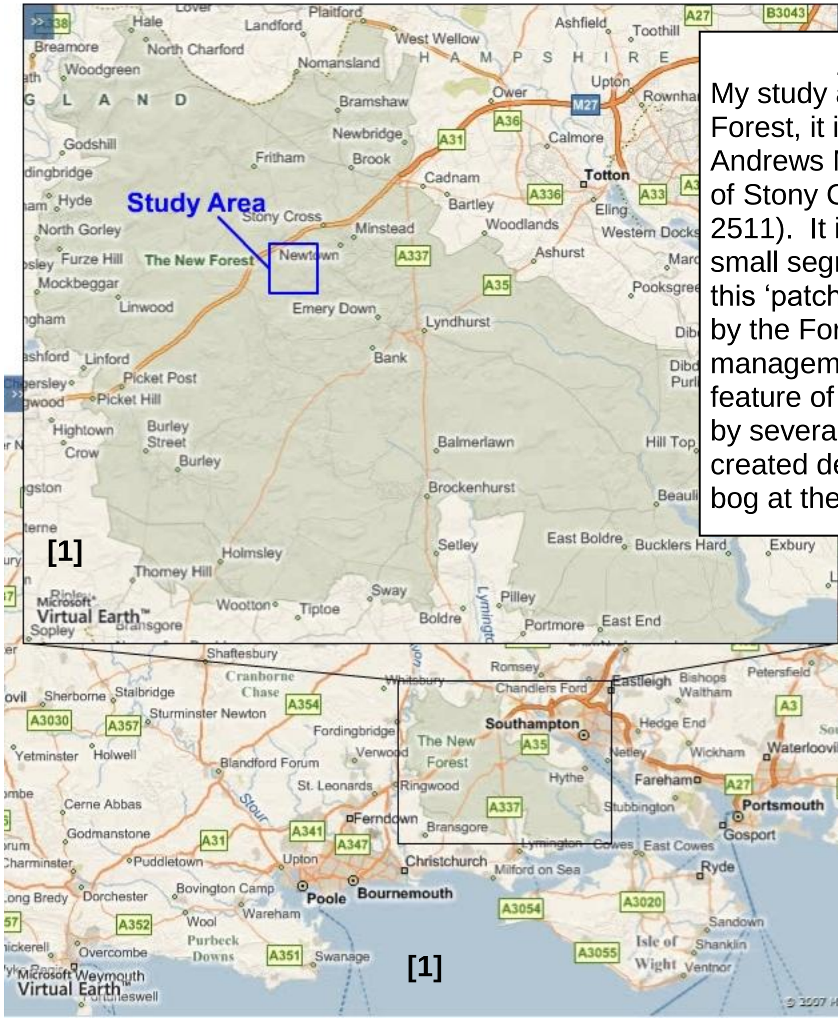
1. The proportions of different plants will remain reasonably similar throughout the recovery period after burning.
2. The soil properties will remain largely the same independent of the time after burning.
3. Locational factors will influence soil properties, which in turn will influence the speed of recovery.

Previously Published Work

To help me get a better idea of what I should expect from this study, I have researched the work of others on a similar subject by looking at the abstracts of their reports. Article 1, on the restoration of heathland habitat in Poole Basin (Dorset), found that many heathland areas had been invaded by other species, such as *Pinus sylvestris, Betula spp.* and *Pteridium aquilinum*. It studies the effect of management in trying to remove these species, and found that it was more successful for some species, such as *P. sylvestris* and less successful for others such as *Betula spp.* [7] This gives me an idea of some of the plants other than heather that I could expect to see, and perhaps there will be a relation between time since burning and the presence of these invasive species. Article 2, on heathland management for grazing in southern England, found that grazing generally increases biodiversity and heath plant cover, while reducing the cover of larger shrubs such as those mentioned above. [8] This is interesting, because it shows that despite a change in the motive for burning in the New Forest (mentioned in Background to Burning), grazing is shown to still play an important role in maintaining biodiversity.

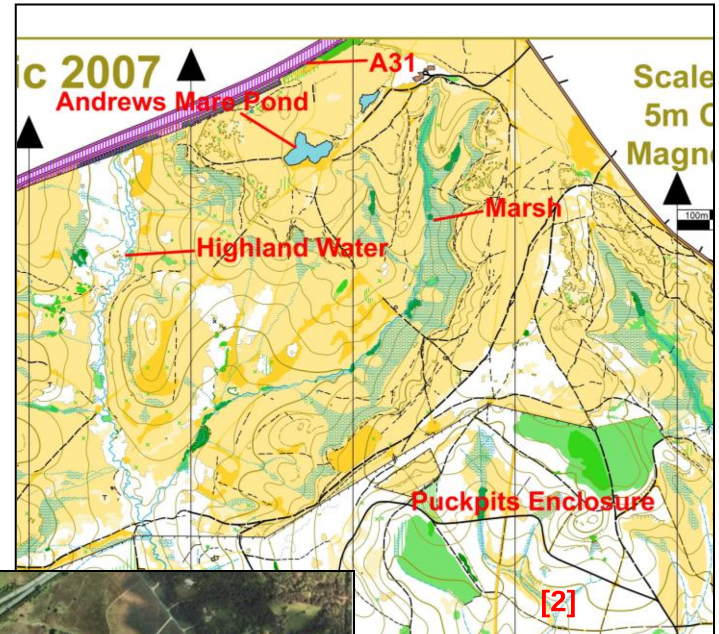
Article 3 is about the recovery of a heathland after burning, concentrating particularly on stages in the lifecycle of *Calluna vulgaris*, and is set in NE Scotland. The findings are that *C. vulgaris* will recover as expected in most phases of its life cycle, except when in the 'degenerate' phase, when it will not recover properly and others will take its place. Another key finding is that after burning the first plants to recover are those with special adaptations for quick recovery, but after about 1 year, the species composition is similar to what it was before the burning, which is more or less what I have predicted. Most importantly the recovery bears no resemblance to primary succession, as I stated at the start of this section. It was found that if burning did not recur with a frequency of about 10 to 15 years (specific to this area in Scotland), the *C. vulgaris* passed into degenerate phase and other plants, such as trees, could start to colonise, demonstrating the need for burning if one wishes to maintain the heathland habitat. [9]

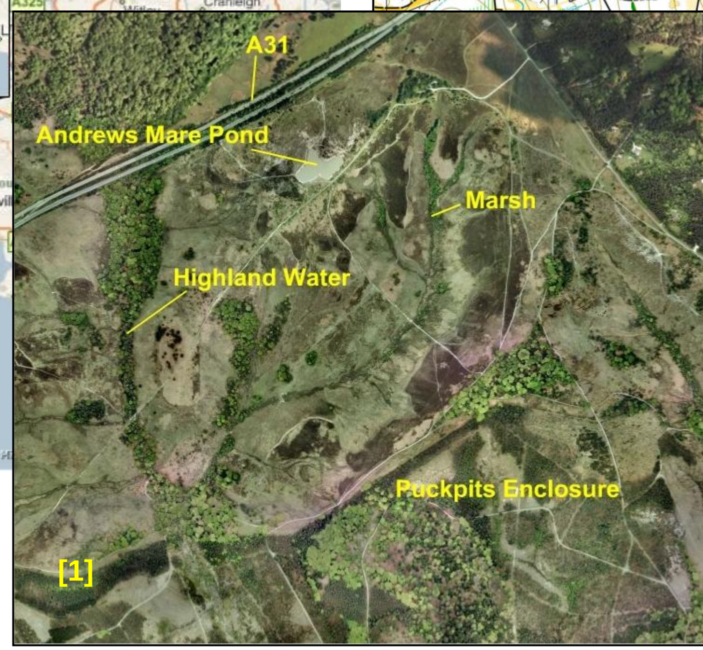
Introduction



The Study Area

My study area is in the New Forest, it is the heath area around Andrews Mare Pond to the south of Stony Cross (GF: 2510 and 2511). It is heathland made from small segments of different ages, this 'patchwork' has been created by the Forestry Commission management scheme. The main feature of the area is that it is cut by several rivers, which have created deep valleys and areas of bog at the bottom of these.





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Introduction

Conservation Status

My study area has been assigned several statuses normally as part of New Forest heathland. The New Forest as a whole is classified as a SSSI for the value of the vast expanses of natural land, including its relatively large heathland areas. These are credited with being ideal habitats for many reptiles including the rare smooth snake (*Coronella austriaca*) and sand lizard (*Lacerta agilis*).

Different parts of the study area fall beneath different classifications of SAC. The higher dry heath is classified as H2 *Calluna vulgaris* – *Ulex minor* heath, and is valuable due to the unique way in which it is managed through grazing and burning, which creates ideal habitat for many rare species. The lower wet heath is classified as M16 *Erica tetralix* – *Sphagnum compactum* heath, which is important for rare plant species such as marsh gentian (*Gentiana pneumonanthe*) and several dragonfly species including the rare blue-tailed damselfly (*Ischnura pumilio*). Again it is the unique management that sustains this particular type of heath. There is also a very special type of habitat known as bog woodland (Fig 1.1) in my area, where birch and willow are able to secure themselves on the bog and create a small forested area; little is known about this habitat as of yet but there is evidence from study of ancient pollen that they have existed for a long time.

New Forest heath is a particularly important SPA site, as it supports a variety of rare bird species. The habitat provides specific conditions for ground nesting birds like lapwing (*Vanellus vanellus*), curlew (*Numenius arquata*) and European nightjar (*Caprimulgus europaeus*); the gorse that grows on the dry heath provides nesting for the Dartford warbler (*Sylvia undata*).

The marsh/bog areas in my study area are Ramsar sites as well, as they are counted as internationally important wetland features and are regarded as the archetypal British mire. It preserves many rare/important species of plant and invertebrate. This is put down to the undeveloped nature of the area that the mires can remain intact. [4]

Background to Burning

The New Forest has recently become a national park, but the heath is still managed by the Forestry Commission as it was before the national park status. Small areas of heath are burnt in rotation – heather dominated areas in a 23 to 24 year cycle and gorse dominated areas in a 12 to 13 year cycle. This segmented burning prevents a monoculture developing, which would reduce the biodiversity, but instead creates a wide variety of slightly different habitats. The cut and burn programme, as it is known, is currently reclaiming a lot of overgrown heath, some of which has started to develop into forest (Fig 1.2). As a consequence there is plenty of heath that is yet to complete a single cycle. [2]

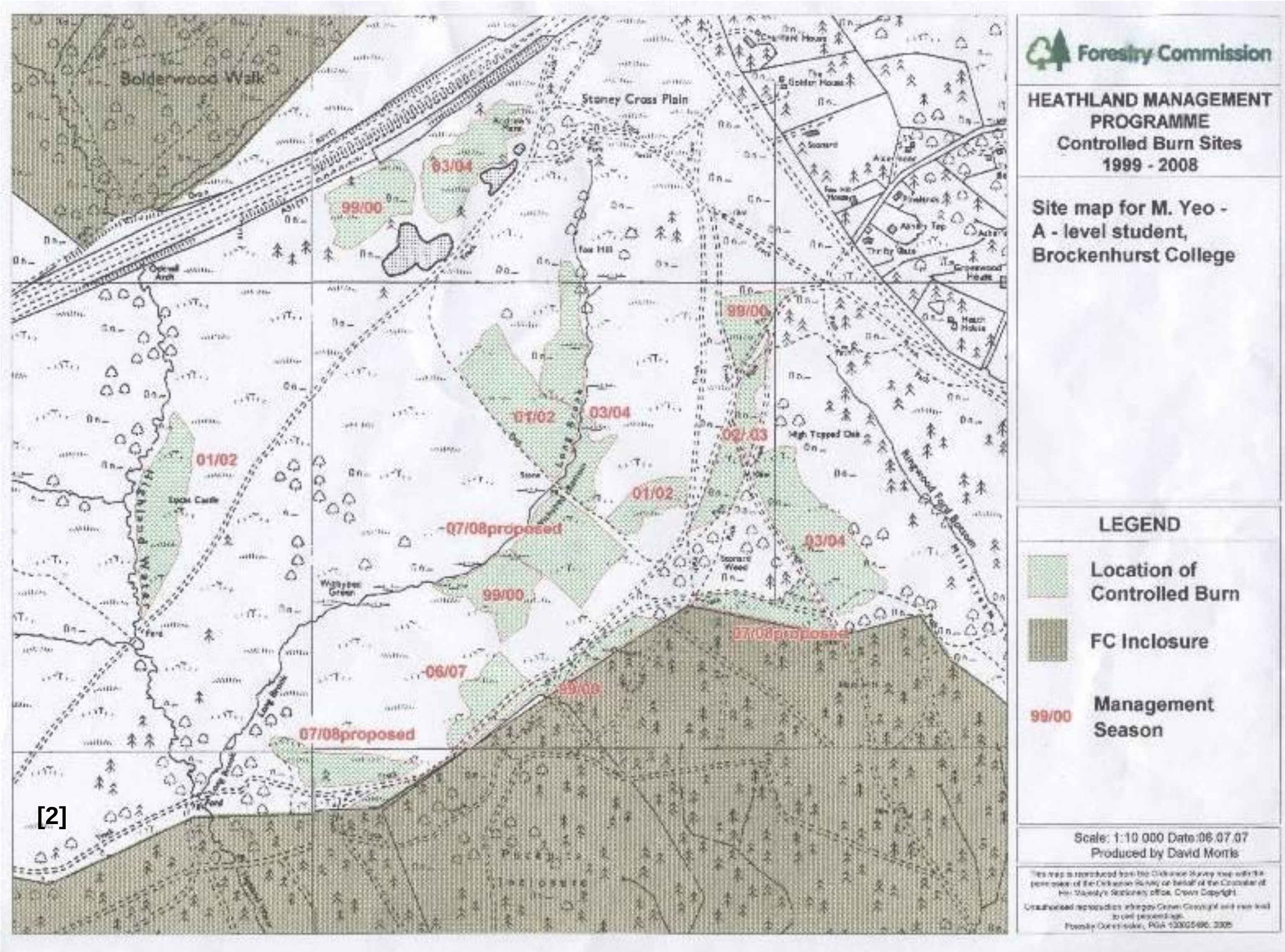
Bog woodland:

Figure 1.1

The area shown in these extracts has clearly thinned out between the mapping and more recent photography.

Figure 1.2

Introduction



I have been provided with a map from the Forestry Commission that documents the most recent years of burning back to 1999 (overleaf). Proper documentation of burning has not been kept long before this, so it would be unwise to analyse many others, as I cannot be sure of the true age.

Hypotheses
1. The proportions of different plants will remain reasonably similar throughout the recovery period after burning.
2. The soil properties will remain largely the same independent of the time after burning.
3. Locational factors will influence soil properties, which in turn will influence the speed of recovery.

So I need a way to quantify:

- **Proportions of Different Plants –** I plan to use species frequency as my sampling method, as this is more accurate than percentage cover (where one individual of one species occupies a different amount of space than an individual from a different species). This involves counting plants inside a quadrat, which sounds time consuming. I will need to see how long this would take in my pilot study; if it takes too long then I shall develop an accurate method of estimating the numbers of each species in a quadrat.
- **Soil Properties –** it would be a good idea to measure as many soil properties as well, as at this stage I cannot predict which ones may show any variation, nor for what reason they would vary. With the equipment available to me, I am able to measure:
  - **Soil temperature –** I will use a basic soil thermometer with 0.5°C graduations.
  - **Soil pH –** although there is a fieldwork kit for testing soil pH, I feel it would be more time efficient to measure this in the laboratory. Therefore I will be taking soil samples at each site using a soil core extractor (normally used for planting bulbs) and storing the samples in a polythene bag marked appropriately. The lab process involves dissolving the soil in distilled water using barium sulphate, then adding soil indicator and comparing the colour of the water next to a colour chart.
  - **Soil moisture content –** with the equipment I have, this must be done in the lab. Having tested pH, the remainder of each soil sample will be weighed out before being heated in an oven at 110°C for 24 hours in order to evaporate all the water. After this process the sample is weighed again and the difference in mass is the mass of the soil moisture.
  - **Soil organic content –** having been weighed, the dried soil sample is then heated to a much higher temperature (around 700°C) in order to combust the organic molecules present. The mass of these will be lost as gas molecules (e.g. CO_2) are formed from components of the previous molecules. After heating the burnt sample will be weighed again and the mass lost since drying is taken as the mass of organic content.
- **Locational Factors –** I will try to record any locational variables that I think may have an influence on the results (e.g. altitude/topography).
- **Speed of Recovery –** although recovery is technically taking place throughout the entire time between two burns, for this purpose I will define an area as recovered when it has returned to approximately the same plant proportions as before burning.

Ideally to get the most accurate information on recovery I would study several areas over their full recovery sequence. Unfortunately this would take at least 12 years and could take as long as 24, so I cannot do this. Instead, I have many areas spanning an 8 year period; so I will use these different areas to simulate the first 7 years of recovery in a heathland habitat (one of the ages is for those proposed for burning this year, so those areas are much older). This is a compromise, as it is obvious that each area is different due to locational factors, and there are many unwanted variables to consider such as aspect. I will use my pilot study to get a full idea of the variables that need to be controlled or at least accounted for.

One specific variable that strikes me is that the level of soil moisture could significantly influence my results – plant numbers and species in particular – and the area I am sampling has a full range from dry heath through to valley mires. In order to get enough primary data, I will need to take advantage of every area marked on the heath management map – I cannot afford to avoid any areas regardless of soil moisture. It would be possible to take soil moisture into account when analysing my results, but first I need to know to what degree it will influence plant numbers and species. This is a question for my pilot study, and I will devise a method to find the answer.

I intend to use systematic sampling of the area as I feel this is a more thorough approach. The sampling will be stratified by separating each smaller area on the heath management map, each of which will be counted as separate data sets. I have therefore divided the entire area into a grid, each square is $100m^2$, this grid allows me to decide the pattern of quadrat placement. The total size of all the managed areas is approximately 397 $500m^2$, sampling should normally aim to sample 10 to 20% of the parent population. 10% would be equal to 39 $750m^2$, which would take far too long; so I will need to sample much less than the recommended percentage. I do not think this will compromise my study too much because there are no dramatic changes across the heath that I will miss by sampling less. What percentage I study will be subject to how long it takes to sample one quadrat, which I will test in my pilot study.

One time saving measure is to use larger quadrats, meaning I do not have to set up as many, in turn allowing me to devote more of my time to sampling. I also predict that larger quadrats will be more representative of the area because I have less chance of missing the scarcer species by leaving less, but larger, gaps between the quadrats. Therefore I have decided that my quadrats will be 10x10m ($100m^2$), subject to testing on my pilot study.

Site 13 line transect:

Figure 2.1

<u>Questions for Pilot Study</u>

1. **Does soil moisture influence plant numbers and species?**
   If this is true, then I cannot treat wet and dry areas as the same.
   I will have to treat wet and dry as two separate sets of data.
   Conduct belt transect along Site 13 NW-SE (Fig 2.1), this covers the full range of moisture from dry to bog and is within one site so time since burning is not a variable.
   Take measurements from a $4m^2$ quadrat (SE side of line) every 40 metres.
   Measure soil moisture for each sample point on a relative scale from 1 to 5 as this is only a pilot study.
   Record numbers of each species at each quadrat.
2. **To what degree do different species cluster together?**
   If species group together, I will need to be careful to ensure that the results do not display biased/skewed results by missing certain species.
   The greater the clustering, the larger/denser the quadrats will need to be to ensure accurate results.
   Measure approximate area of typical cluster.
3. **How long does it take to count the frequency of all species in a $100m^2$ area?**
   I hope to use species density as my sampling method, I need to know how long it would take to sample a given area in order to plan my fieldwork.
   Set out a 10x10 metre quadrat and time how long it takes to count the frequency of each species.
4. **What species are not on my identification sheet?**
   Some species (e.g. the genus *Sphagnum*) are not on the sheet I have been given.
   If I find any in my sampling area I will need to be able to identify these by finding extra material.
   As I am sampling, record a description and likely identification of any species missing from the original sheet (possibly take a sample home?)

<u>Conclusions from Pilot Study</u>

First of all, I was able to conclude that it is unrealistic to count the number of each species when I am sampling such a large area. The thick cover that occurs in heathland makes it far too difficult to efficiently determine how many plants there are. This presents a problem , because I need to know precise numbers in order to perform most statistical analyses, and percentage cover is not an accurate enough alternative – I will need to devise a new system for counting numbers.

Does soil moisture influence plant numbers and species?

While I was not able to use the method I hoped (see above), I was able to make some observations from which solid conclusions can be drawn:

- Travelling towards the bottom of the valley, the soil moisture remains similar for a long distance before increasing suddenly.
- When this change does occur, species diversity increases suddenly as well:
  - The dry heath is dominated by *Calluna vulgaris*, with healthy populations of *Polytrichium spp.* and *Pteridium aquilinium*.
  - Travelling downhill (still dry heath) *C. vulgaris* still dominates, but now with wet heath species in evidence – *Molina caerulea* in large numbers, and low numbers of *Erica tetralix*.
  - Closer to the wet heath but still with a lower soil moisture, *C. vulgaris* has dwindled slightly, with an increase in both *M. caerulea* and *E. tetralix*.
  - The next point I sampled showed a dramatic change as the soil was obviously waterlogged. The area was dominated by *Juncus articulatus* and *M. caerulea*, had a high number of *Myrica gale* with moderate numbers of *Narthecium ossifragum* and *E. tetralix*. There was also a tussock of *Scirpus caespitota*. This is an obvious increase in the number of species, most of which had healthy populations.
  - The high rainfall around the time of study made it dangerous for me to study the true bog area on my own, but I can draw my conclusions from the areas I did study.

So soil moisture does show positive correlation with plant species and affects the numbers within species, I will therefore need to allow for this when analysing my results.

To what degree do different species cluster together?

While there are patches of certain species (e.g. *P. aquilinium*), on closer examination these are not single species areas, but create an illusion in situations where the other species are not visible. This should not influence to size/intensity of my quadrats.

How long does it take to count the frequency of all species in a 100m^2 area?

If I had counted each individual plant, I predict this could have taken as much as an hour. However by this point I had realised that this would be unrealistic and instead I used percentage cover as an interim method (having not yet thought of an alternative). This took 30 minutes but could easily be cut down to 20, and I will have assistance most of the time, which will cut the time down further.

What species are not on my identification sheet?

I found that when using the whole sheet most species could be identified. Some only went as far as genus (e.g. *Agrostis spp.*) but these particular plants couldn't or didn't need to be identified more accurately.

Modifications to Method

For the 100m^2 quadrat I experimented with percentage cover; this worked well for the higher percentage species such as *C. vulgaris*, but some species occupied a very small area that would return decimal percentages. When analysed, this would create unreliable results that are not truly representative of the proportions of different species. Some tests/calculations are not applicable to percentages, such as the calculation for biodiversity or the chi-squared test.

My solution to this is to combine percentage cover and species frequency – for thick cover species such as heathers and *Pteridium aquilinium* I can use the area (or percentage of quadrat) to provide an approximate number of plants. This will be different for each species, and may be subject to other factors (in some areas *Pteridium aquilinium* can be fairly sparse). This way I can streamline the sampling without compromising the analysis.

This does, however, create another issue that would not be present using percentage cover alone. Plant numbers for different types of plants are non-comparable because individuals of different species occupy different amounts of space and can survive in varying densities. To give an example, in the space that one individual of *C. vulgaris* grows, approximately 4000 blades of *Agrostis* grass can grow. I have devised a mathematical solution to this – I will analyse the number of one species (n) in a quadrat as a percentage of the average for that species (MEAN) across all quadrats: $\frac{n}{MEAN}\times 100$ (note that MEAN ignores blank readings).

This effectively creates a hybrid between percentage cover and species frequency, removing the most important limitations (specific to my study) of each method. Having experimented with some artificial numbers (Table 2.1), it seems to me that this creates figures comparable between different sorts of plants. When analysing my data, this calculation will allow me to look at the numbers of plants in relation to their averages in a quantified manner. I cannot tell what use to me this is as yet, because how I analyse the data depends on what trends the data shows once I have collected it.

Species	Number	MEAN	$\frac{n}{MEAN}\times 100$
Calluna vulgaris	100	250	40
Agrostis spp.	16000	33000	48

Table 2.1

Judging by the time it took to sample a quadrat, I have decided that the maximum I can reasonably sample is 3% of the parent population. This still amounts to 114 quadrats, which if I allow 20 minutes for each quadrat, will take 38 hours, but I predict that most quadrats will take 15 minutes or less. For systematic sampling, I have marked squares on the grid for the sample area in a uniform pattern (Fig 2.2), the total area of these squares is approximately 3% of the area. Where these squares fall within a managed area of heath, this will be the location of a quadrat. I have had to doctor this slightly to ensure the correct number of quadrats fall within each area, but this doctoring is minor.

Here is an extract of my systematic pattern for sampling. The site will be sampled if the square appears within a site.

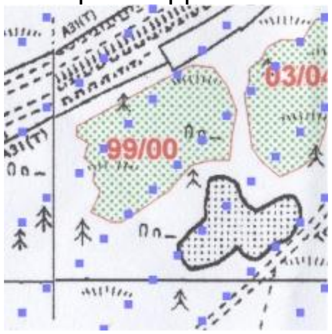


Figure 2.2

Subsequent to my pilot study, the Forestry Commission has provided me with details of areas that to the best of their knowledge have not been burned for at least the last 25 years. These would be the best areas to act as controls for my study, as they should display as close as possible the natural state of a heathland habitat, with which I can compare the data for managed areas of heathland. As with controls in the lab, this will mean treating them exactly the same as any other area when sampling so as to remove any other variables. Sampling these increases the total area to 434 500m^2, the total quadrats to 130 and the total time to slightly over 43 hours.

In light of my pilot study, which gives insight into the nature of my fieldwork, I have constructed a variables table and a brief summary of the main limitations.

Variable	Influence on Results	Ways to Reduce Influence
Topography	Can affect species, soil moisture, aspect (thus influencing soil temperature).	This is an inevitable, uncontrollable variable. It is important that I record these variables to get a better understanding of factors influencing the dependent variables. The influence can in some way be reduced by the volume of data I am collecting. I will work out the altitude of each quadrat, which may help.
Time of Day	Will influence soil temperature to a significant degree.	It would be unreasonable to only collect data at a certain time of day, as this would take too long. There is no obvious solution, but there is also no way to tell the degree of influence, so I will simply record the time at each quadrat for later analysis.

There are of course limitations with my method:

- Mosses and lichens cannot be included in the counting, as it is impossible to identify separate individuals.
- Other plants, such as reeds and grasses, produce many blades from one individual, and I am not able to identify how many blades (or equivalent) constitute one plant. With plants like this I shall simply have to estimate the number of blades and record them as if one blade is one plant. Thankfully my calculation method mentioned above allows for this sort of limitation.
- Many similar species (particularly *Agrostis* species) are difficult to identify between. To do so would take too long and therefore the identification has been simplified to the genus.
- 43 hours is a long time, this is largely due to the large age range I need to cover, with multiple samples in each area. But I am prepared to spend this long on my project.
- The large area means that even with this much sampling, I am only sampling 3% of the parent population.
- This is not a completely controlled environment, and there is little I can do to control many factors such as weather and topography. What I can do is try to allow for these factors in my analysis, by recording information that may be useful for doing this.

Weather	Can influence soil temperature and soil moisture.	It is important to try and complete the study in as short a time space as possible to prevent large changes in the weather. Rain should not be too much of a problem, as it will be too difficult to perform the study in such conditions. I will take a log of the conditions on each of my study days, in case I need to work out what has caused variations.
Vegetation Cover	This can influence the insolation of the ground that I take the temperature reading from.	I will try to pick relatively open sections of ground close to the centre of each quadrat to make the cover relatively constant.
Soil Moisture	Influences the kind of plants that grow, the pilot study showed that the species were more diverse in wetter areas. Will also influence soil temperature and likely organic matter, too.	Once I have seen the data I will be able to work out how much soil moisture does influence these factors. It is likely that I may have to separate the data depending on the moisture content.

Lab Work

The lab work, however, is a far more controlled environment and the only unwanted variables will have influenced the soil sample before it was collected in the field. In the lab, I will measure the soil pH, moisture content and organic content. The pH is measured by dissolving the soil in water (this needs barium sulphate in order to make it soluble) and indicator, which will turn the appropriate colour.

The moisture content is measured by observing the change in mass before and after drying a sample in an oven. The organic content is measured by observing the change in mass before and after combusting the organic material to various gases (e.g. CO_2); this needs a temperature of around 700°C, which ideally I would like to achieve with a furnace. Unfortunately this is not available, so I will have to use a Bunsen burner to achieve these temperatures, burning each sample individually; this gives a greater opportunity for variability but I have to work with the equipment that is available to me. The Bunsen burner will be in a fume cupboard to protect from all the gases given off, but this also means that only one gas tap will be available to me, so I cannot use multiple Bunsen Burners to increase time efficiency.

<table>
<tr><th>Variable</th><th>Influence on Results</th><th>Ways to Reduce Variable</th></tr>
<tr><td>Time drying/burning</td><td>The longer the time, the more mass will be lost.</td><td>The time length should always be the same.
For drying, the larger oven means that 30 samples can be left for 24 hours, ensuring all water has evaporated.
For burning it is not possible to spend this long because I must use a Bunsen Burner, so it may not be able to burn all the organic mass off with the time constraints of personally observing each sample.
Therefore every sample will be burnt for 5 minutes.
The proportion of organic matter in the sample will directly influence how much burns in 5 minutes, even if not all the organic matter is burnt off.</td></tr>
<tr><td colspan="3">I have a particular worry about burning the soil for just 5 minutes. Because I am burning for a limited time, I could have a problem relating to the percentage of organic matter burnt:
• If none of the samples can finish burning organic matter within five minutes, then the proportion of organic matter will influence how fast the sample burns, and the results will be proportional to the level of organic matter.
• If all the samples can finish burning organic matter within five minutes, then the results will actually tell us the real amount of organic matter present.
• If some of the samples will finish burning and some will not, then we have a problem, as both factors will influence the results at the same time.

Ideally I would like to conduct a pilot study for lab-work, so I could determine which of the scenarios I have presented are true. Unfortunately my time in the lab is limited, so I cannot. I predict that at 700°C, with fairly small sample masses, all of the organic matter will burn off in all the samples within the 5 minutes provided, therefore there should not be a problem.</td></tr>
<tr><td>Equipment</td><td>Using different equipment may produce different readings for mass.</td><td>I will use the same balance, Bunsen Burner, and oven for all my repeats.</td></tr>
</table>

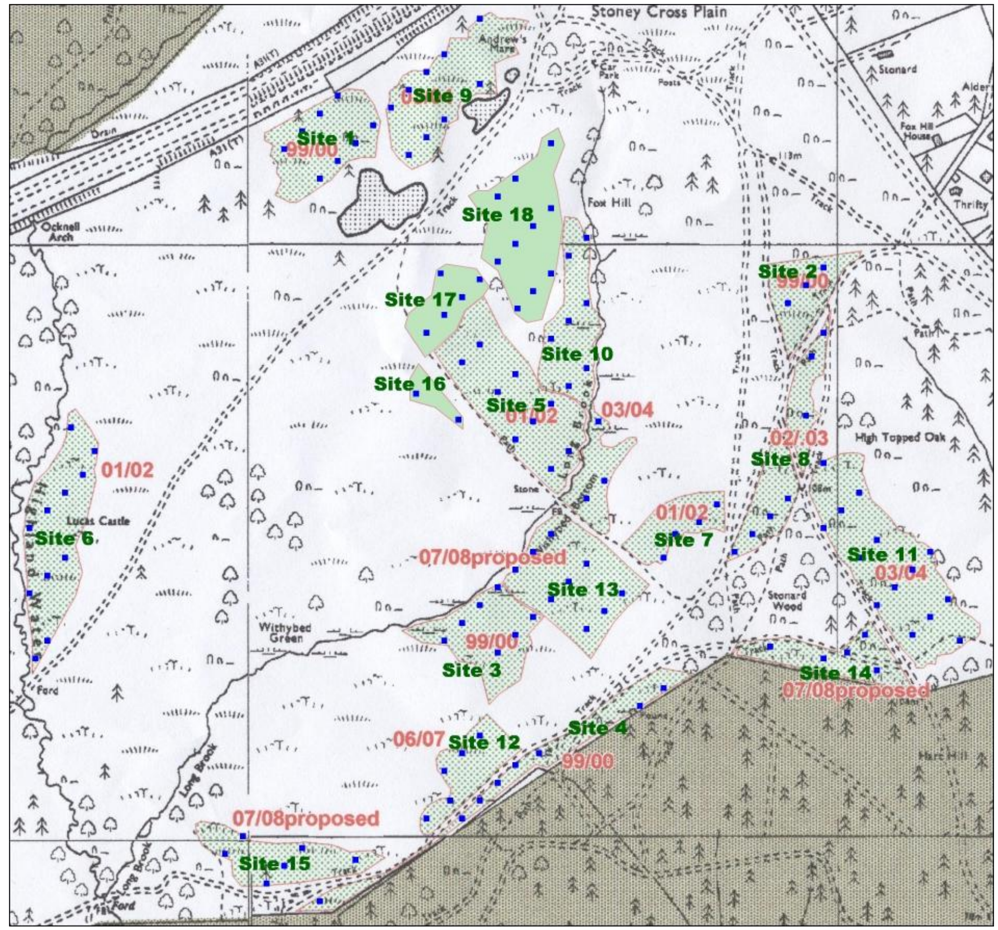
Soil Surface Area	Different samples have different consistencies (e.g. powdery or sticky), which will give them different surface areas. Different surface areas influence how much soil has oxygen readily available, which is required for combustion. So a higher surface area increases the rate of combustion.	There is little I can do about this problem, because the whole point of sampling soil is that I will collect different types. Influencing the speed of burning, however, is a problem if not all organic mass burns within 5 minutes (see above problem). Again a pilot study would be useful to see if this has much effect. But as I have said before, at 700°C I do not expect combustion rate to cause too much of a problem as all organic matter should be burnt in that time.
Soil Mass	As with surface area, the total mass will increase how much soil is in contact with oxygen at any time. So a higher total sample mass will probably increase combustion rate.	If there is indeed a pronounced influence, which would also require not all organic matter to burn in 5 minutes, then I can at least observe this one. Since I am recording mass during these experiments, it would be obvious to me if samples with greater mass were to supposedly have greater organic mass.

Limitations:
- It is obvious from the table above that one of the major problems stems from time constraints in the lab – samples can only be burnt five minutes each.
- I would much rather have a furnace for burning, but there is not one available.
- It is also clear that while measuring soil pH and moisture content will be fairly accurate, there is much more potential for error when measuring soil organic content.

The main areas have an obvious age since burning, and I have assigned minimum ages for those proposed for burning this year and the control areas, with help from Dave Morris at the forestry commission. Only in this way can I properly quantify my data.

This map shows my final sampling plan, the blue squares being the quadrats. Site 16, 17 and 18 are the control sites, which were added later.

Site #	Season Burnt	Age/years	Approximate Area/m^2	# Quadrats
1	99/00	7.5	26,000	8
2	99/00	7.5	11,250	3
3	99/00	7.5	22,500	7
4	99/00	7.5	25,000	8
5	01/02	6.5	30,000	9
6	01/02	6.5	35,000	11
7	01/02	6.5	14,000	4
8	02/03	5.5	22,750	7
9	03/04	4.5	30,000	9
10	03/04	4.5	32,500	10
11	03/04	4.5	48,000	14
12	06/07	0.5	15,000	5
13	07/08	16.5	30,000	9
14	07/08	16.5	17,500	5
15	07/08	16.5	20,000	6
16	Control	25.0	32,500	10
17	Control	25.0	17,500	5
18	Control	25.0	5,000	2
			434,500	130



Investigation into How Time After Burning Influences Biodiversity in Managed Heathland
Data Collection Procedures

Field Work

Equipment: tent pegs x 3, 10m string x 2, compass, soil thermometer, soil core extractor, plant identification sheet, soil sample bags, permanent pen, log sheets, sampling map, pencil.

Procedure

1. Select a quadrat & assign a number in order of the quadrats sampled in that particular site.
   E.g. Quadrat 5 in Site 13 would be the 5th quadrat sampled in that site.
2. Locate the quadrat area as accurately as possible, using compass directions & pacing where necessary. Set up axes (N & E) using pegs & string.
3. Record quadrat on log sheet, including time sampling started.
4. Insert soil thermometer into an open space of ground close to the centre of the quadrat.
5. Extract core of soil using tool, place in a sample bag marked with permanent pen (quad & site number).
6. Remove soil thermometer & take reading, Step 5 should have allowed enough time for correct temperature reading to be reached.
7. Scan quadrat for species & note down each different one that is seen.
8. Do a more detailed scan in order to accurately estimate the numbers of each species.
9. Dismantle quadrat & select next quadrat – repeat procedure.

Principles

- Do not count continuous cover species such as mosses & lichens, as it is impossible to identify an individual organism.
- For lower number species, always over-estimate slightly because there are always some concealed individuals. This is not such an issue for larger numbers as this a wider estimate anyway.
- Constant cover of certain plants can be said to produce these numbers (estimated):
  - Heather species & *Myrica gale* – 25 per 4m^2.
  - *P. aquilinum* – 100 per m^2.
  - Grasses – 1000 per m^2.

Lab Work

pH Test

Equipment: soil pH test tube, bung x 2, barium sulphate, soil indicator, distilled water, spatula.

1. Bung one end of test tube.
2. Add spatula of soil sample.
3. Add spatula of barium sulphate.
4. Fill tube with distilled water to 1st line.
5. Add soil indicator to 2nd line.
6. Bung other end of test tube, & mix thoroughly by inverting & shaking.
7. Compare colour of solution to pH colour chart.

Moisture & Organic Content

Equipment: crucible x 30, oven set to 110°C, heat proof mat, tripod, crucible support, Bunsen Burner, 2dp balance, large spatula.

1. Take mass of crucible.
2. Add a large spatula of soil sample to crucible & weigh again, note down mass minus crucible mass.
3. Place crucible in oven and repeat steps 1-3 for all 30 crucibles.
4. Start oven & leave for at least 24 hours.
5. Turn off oven & allow samples to cool.
6. Re-weigh all samples, subtracting crucible mass.
   The original sample mass minus this mass will give the moisture content (which has been dried in the oven).
7. Burn each sample in turn using the Bunsen equipment.
8. Allow samples to cool, & re-weigh again, subtracting crucible weight.
   The weight from Step 6 minus this weight will give the organic content (which has been burned off).

Field work took longer than anticipated, but I was able to build up a consistent, efficient procedure. I tested my sampling method by re-sampling site 2,1 (the first site I sampled) for plant numbers, the results returned were similar enough to confirm that my sampling method was consistent.

Lab work also went better than expected, although I could not sample all soil (see below). It was clear that all the soil organic matter had burnt off before 5 minutes because the crucible had stopped smoking before this point.

Changes to Method

Because I was able to conduct an informative pilot study for my fieldwork, that method remaining the same, I simply learnt how best to conduct sampling efficiently. However, I was not able to conduct a test study for my lab-work, and I discovered there were changes to be made. I was not able to perform my procedures on all the soil samples, as I had hoped, because it would have used too many chemicals (for pH) and been too time consuming.

Instead I had to make a stratified selection of samples to try and achieve a reasonable representation of all the samples. I have used these known values to predict approximate values for other similar quadrats that I did not test. Due to the wide range of data in each field that I observed, this could potentially negatively influence any trends in my data.

The predictions have been made for each quadrat with unknown pH, moisture and organic content, by projecting values from the nearest, most similar quadrat with known values onto the quadrat needing values. pH is copied straight across (originally measured to the nearest 0.5), moisture and organic content (which have precise 2dp values) are projected to the nearest 5%.

Recorded Variables

Quadrat: each quadrat was numbered according to site number and quadrat number within the site, so the fourth quadrat from site three would be numbered as 3,4.
Age (years): allocated according to the season in which site was last burnt. Because sampling was performed in summer and burning seasons are in winter, these are 'x'.5 values. Quadrats marked for burning the next season were given 16.5 years, as this will be the approximate time since they were last burnt if they are marked for burning again, although the exact records are not readily available. Quadrats recorded as 25.0 years old are not recorded as having been burnt since records began around 25 years ago. These may be even older but this is the best arbitrary value to assign so that I can plot age on graphs.
Altitude (nearest 5m): the original map supplied did not have contours on, so I imposed my quadrat mapping onto an orienteering map, which was adjusted to the same scale as the original map; it had contour intervals of 5m. The altitude was determined by viewing which contour the quadrat was closest to.
Date and Time Sampled: recorded as I moved from quadrat to quadrat.

Soil Temperature (°C): measured on a soil thermometer, each graduation worth 0.5°C. Sometimes it could be seen that the temperature was between two graduations, in which case an 'x'.25 value was recorded.
Soil pH: recorded from analysis of soil samples back in the lab. Soil was mixed with Barium Sulphate (to dissolve some of the soil constituents), distilled water and soil indicator (to give the colour) in a bespoke test tube and shaken. Then I waited for the soil to settle back down and compared the colour of the solution to a colour chart that came with the testing kit. Colour chart ranged from pH 4.0 to 8.0 in graduations of 0.5
Soil Moisture and Organic Content (%): recorded from analysis of soil samples back in the lab, percentage derived as a proportion of the

mass of each in comparison to the original sample mass. Soil samples weighed, then dried at 110°C for 24 hours, change in mass taken to be the mass of water. Soil samples then heated to over 500°C by Bunsen burner to burn off organic content as various gaseous compounds; change in mass before and after burning taken to be the mass of organic content.

Plant Numbers: numbers of each plant were estimated by looking at percentage cover and density, and using knowledge of how the plant grows.
% Mean Plant Numbers: for much of the analysis I used these figures instead, as it made plants that grow in completely different numbers comparable. The equation used was $\frac{n}{MEAN} \times 100$, where n was the number of plants for that quadrat, and MEAN was the average number of this plant across all quadrats ignoring blank readings.
Notes: anything unusual about the quadrat was noted.

Interpretation

To interpret the data in relation to the original hypotheses, I will need to investigate many relationships, both expected and unwanted (which then need to be allowed for). First of all it is clear that there are many factors influencing the type of vegetation in different areas, many of these are difficult to identify and even more difficult to quantify. It is thankful therefore that I have collected such a large volume of data because I can use averages, or perhaps compare areas of similar vegetation.

In some cases data is influenced so much by unwanted variables that it is difficult to use that data in proving/disproving my hypotheses, for example soil temperature is influenced by both insolation (indicated by linear variations over time of day) and soil moisture. I will start with a detailed analysis of my recorded soil variables and possible relationships with other variables. This is followed up by any techniques to reduce the influence of unwanted variables and the significance of each for my study in relation to original hypotheses.

Hypotheses

1. The proportions of different plants will remain reasonably similar throughout the recovery period after burning.
2. The soil properties will remain largely the same independent of the time after burning.
3. Locational factors will influence soil properties, which in turn will influence the speed of recovery.

Soil Temperature

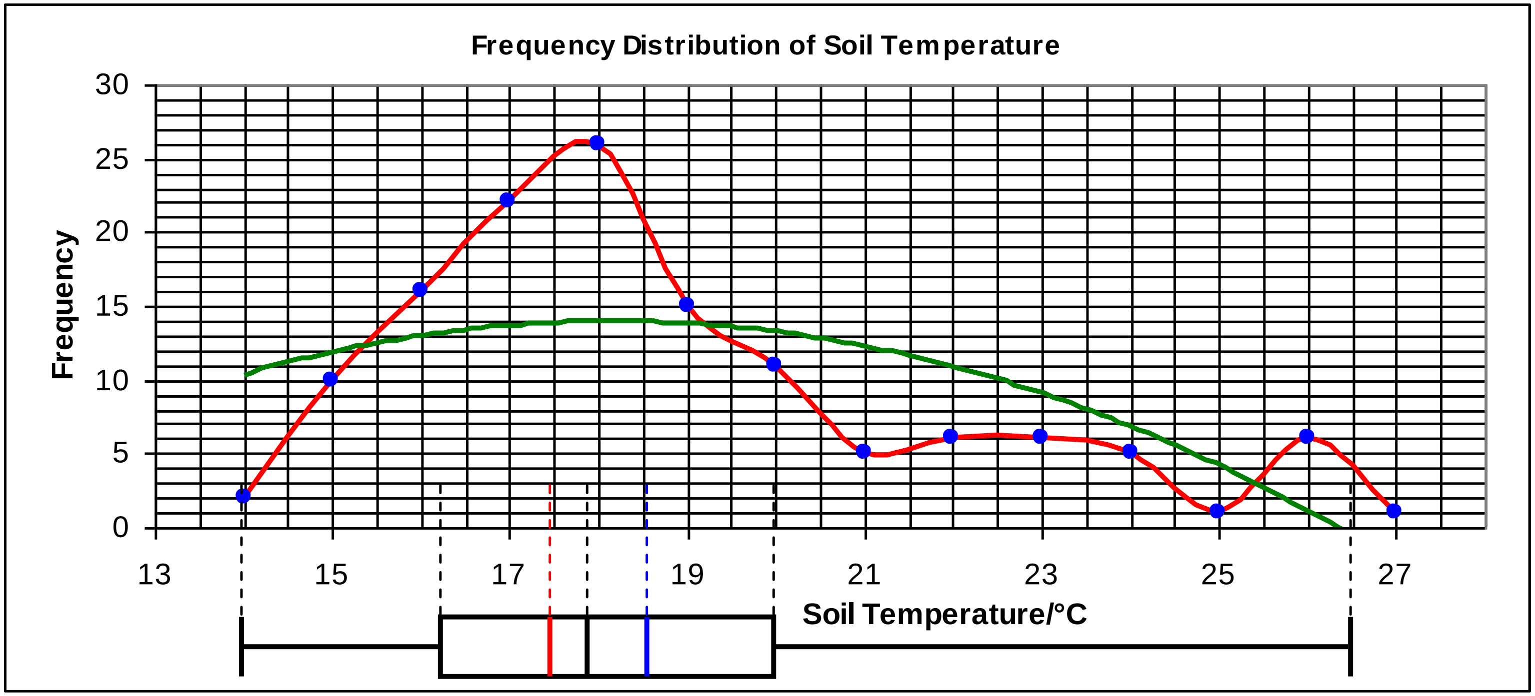


Chart 3.01 (added later): frequency intervals used were ≥14, ≥15 etc. up to 27°C. The box plot displays minimum and maximum values, inter-quartile range (the box), mean (blue), median (black) and mode (red). Green line = polynomial 2 trend line.

Chart 3.01:
This is an interesting distribution, as it shows aspects of normal distribution between 14 and 21°C, and then there is a collection of results in higher temperatures but lower frequencies. This can be seen by the way the mode and median are around the highest frequency temperatures, but the mean is offset slightly by these higher values. Consequentially the green trend line does not show anything near a classic normal distribution shape. The inter-quartile range also centres around the lower section on the graph, where there is a higher density of results. This means that most of the quadrats were within the temperature range with the highest density of results, varying within this range, and then those quadrats with less cover make up the anomalous section at higher temperatures. I observed some of these quadrats in the field, where I noted that there was little or no soil cover, giving higher temperature readings.

Relationships

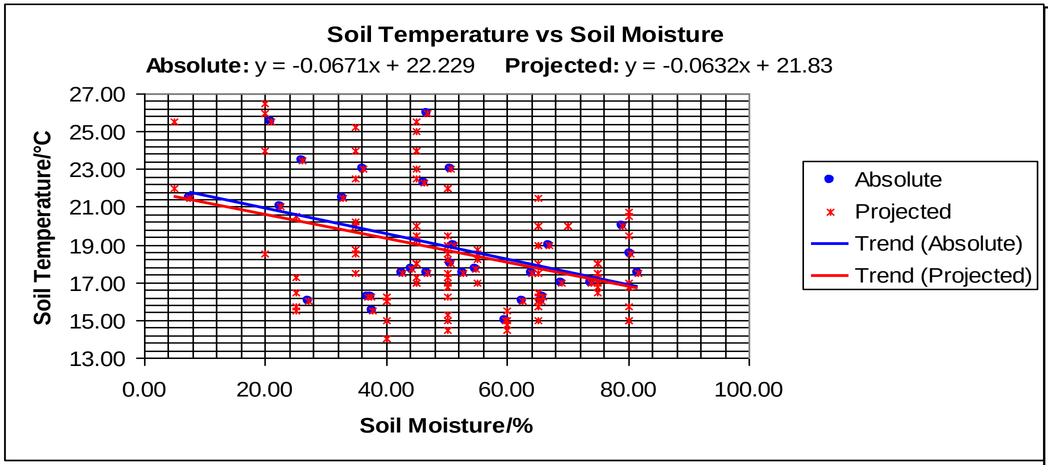


Chart 3.1: showing the influence of soil moisture on soil temperature for known moisture values (blue) and predicted moisture values (red). Soil temperature readings were taken for all quadrats.

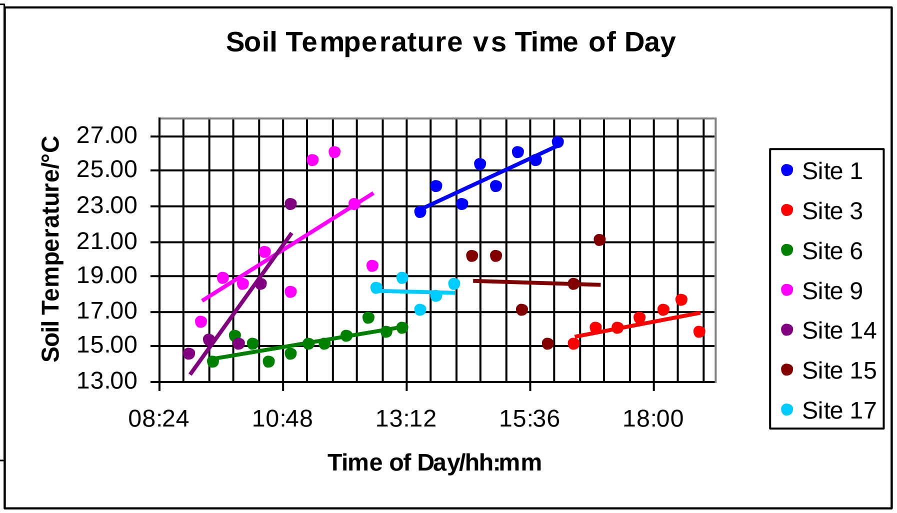


Chart 3.2: showing the influence of time of day on soil temperature in selected sites. Sites are separated because of different conditions and different sampling days. The only sites used are ones with 5 quadrats or over (sufficient size to show reliable trend) and all quadrats must have been sampled on the same day (different days, different temperatures).

Chart 3.1

This graph serves two purposes – most importantly it shows the negative correlation between soil moisture and soil temperature, which I observed in the field but was not sure how absolute the trend was. I expect that this is due to the high specific heat capacity of water, which makes water an effective temperature buffer, reducing the variations in relation to its surroundings. So the more water present in the soil, the less diurnal variation in temperature (the Sun being the direct source for the majority of the heat in soil). Soil with less water will heat up much more readily during the day (when I was measuring) and cool down much more readily at night. If I took readings at night I would expect a reverse trend of this, as any water in the soil will retain heat absorbed during the day, keeping the soil warmer than if it contained less water.

Secondly it shows the accuracy of my projection from the measured values for soil moisture to those that I estimated would be similar (see Changes to Method). The trend lines are very similar, demonstrated by the formulae, although the gradient values themselves should be ignored because the x and y values are on completely different scales. This similarity is significant because it means I should be able to use my projections of soil conditions for other data to be analysed and still be confident that the sample is an accurate representation of the parent population. Also notice the shallow gradient of the trend lines, although they are still representing what I am sure is a significant trend; I think this results from the many uncontrollable factors influencing all of my data, and may indicate that trends are likely to only ever have weak correlation as a consequence.

I have calculated Spearman's Rank Correlation Coefficients for the absolute values. Full details of the calculations can be found in the raw data section of the Appendix. It has now become clear that this will be the main statistical test for my data, as I want to investigate the strength and directions of various relationships, most of which are in continuous data sets. For this test the null hypothesis should be that there is no significant relationship between soil moisture and soil temperature. The absolute values were found to have a value of **-0.32** (remember we are looking at negative correlation, which is lower than the critical value for 30 degrees of freedom and 0.05 probability of **-0.306** [11]. This means that the null hypothesis should be rejected and I can say that there is a significant negative correlation between soil moisture and soil temperature. More encouragingly the relationship is significant at 95% confidence limits, though I was expecting that – due to all the other factors influencing the data – I would be using lower confidence limits. I found it impractical to use Spearman's Rank on the projected values, mainly because the calculation uses a particular ranking system that is not effective when many values are the same, as with my projected values. It is also difficult to find critical value tables that go up to 130 degrees of freedom.

Chart 3.2
This graph shows how in most cases, soil temperature increases with time of day, as in general a positive correlation is shown between the two variables. Logically this should mean that insolation influences soil temperature, as during the times of day I was sampling, the soil was spending more time under sunlight as time went on. The steepest lines seem to be found at the beginning of the day, when not only is insolation taking place, but the Sun's rays are increasing in strength up to around 14:00, although I believe that just being under consistent sunlight would gradually increase soil temperature anyway. This strengthens the argument that soil temperature cannot be analysed with any meaningful relationship to my original hypotheses, but is a graph worth using to demonstrate the problems I will have with some data.

Again the graph shows that there must be other influential factors involved, as Sites 3, 15 and 17 show no useful correlation (even by the weak correlation standards that I expect); it is interesting that these three sites were all sampled towards the end of the day, reinforcing that argument that the strength of the Sun's rays have a significant influence on soil temperature. The differing strengths of correlation also suggest other environmental factors influence these values. In fact, Chart 3.1 is showing one of these other factors, as it has been shown that there is a definite correlation between soil moisture and temperature; this is a perfect demonstration of how it is near impossible to control all variables in the field.

Date Sampled	17/08/2007	17/08/2007	17/08/2007	17/08/2007	17/08/2007	17/08/2007	07/09/2007	22/09/2007	22/09/2007
Soil Temperature/°C	16.25	17.50	15.75	16.00	15.75	16.25	18.50	15.00	16.75

Table 3.1: extract showing how the date sampled influences soil temperature in Site 13.
17/08/2007 was recorded as "Cool, dry weather during a time of occasional showers."
07/09/2007 was recorded as "Hot, dry weather during a dry period."
22/09/2007 was recorded as "Cool, humid weather during a dry period."

This table shows how, regardless of other conditions, soil temperature will vary with the weather that day. This and Chart 3.2 demonstrate how the influences of conditions on any particular day override any other significant influence that may have relevance to my original hypotheses.

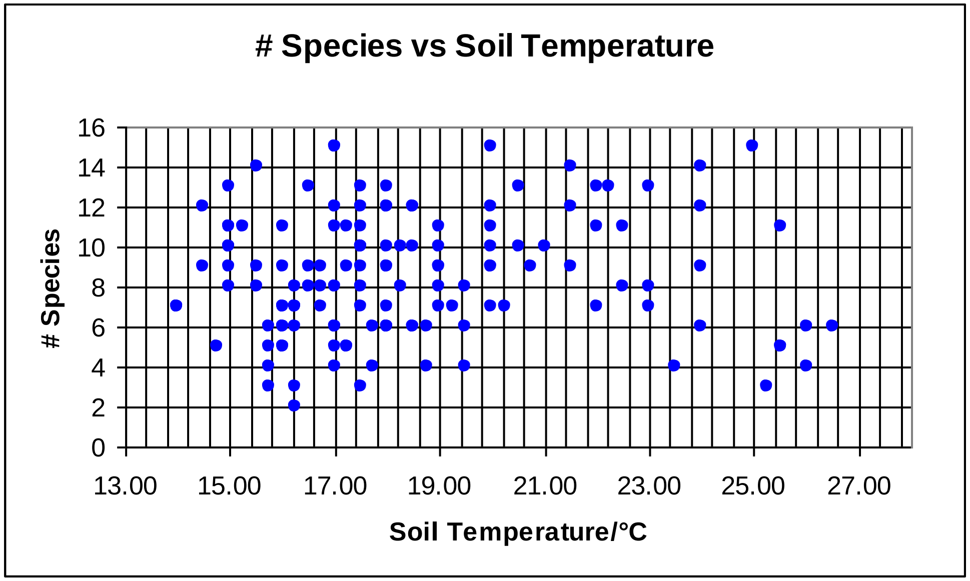


Chart 3.3: showing how there is little or no meaningful relationship between soil temperature and the number of species in the quadrat.

<u>Reducing Unwanted Influence</u>

It would be near impossible to allow for the variations mentioned above, mainly because temperature depends on the conditions on the day sampled and the time of day sampled, as demonstrated on Chart 3.2 and Table 3.1. Chart 3.3 shows how there is no relationship worth pursuing between soil temperature and (in this example) the number of species, which also indicates that soil temperature will not have a distorting influence on other relationships; I think it is fair to say that there is no point in trying to allow for the differences in soil temperature and I can conclude that this variable has <u>very little relevance to my original hypotheses</u>. I have however been able to prove part of hypothesis 3, that locational factors will influence soil properties, although soil temperature in this case will have little bearing on speed of recovery. I do not believe that this space has been wasted on a factor that has little influence, as quite a lot of the space has been used to demonstrate this, and the data has been useful to demonstrate the accuracy of my projections using Chart 3.1.

<u>Soil pH</u>

pH did not vary much across the heathland, with most readings being either 4.0 or 4.5 in addition to occasional readings of 5.0 and 5.5. There was one particular anomaly of pH 7.0, which I think was probably down to an unknown error in the measurement technique, considering that the quadrat (**15,3**) was not exceptional in any other way. The acidic pH (very acidic for soil) is typical of heathland habitat, and is probably caused by leaching in areas where water capacity of the soil is low.

Chart 3.4

This is definitely not a normal distribution, and there is little value is drawing a box plot because it would be highly distorted by the asymmetrical results. It almost appears as if this is one half of a normal distribution curve, and that other techniques may have returned lower pH than 4.0; I

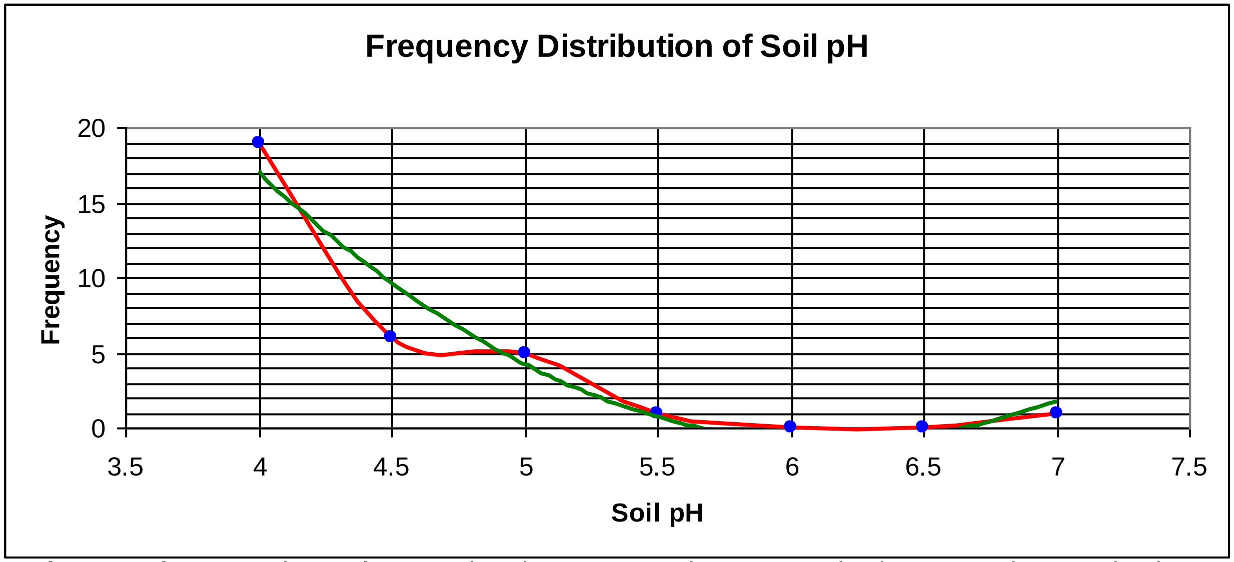


Chart 3.4: frequency intervals were already present as the measured values – used categorised colours of the soil indicator to determine pH. Values taken from known rather than projected. Green line = polynomial 2 trend line.

would not find this surprising considering the nature of some of the soils in the sample area. This idea is backed up by the green trend line, which also shows a shape expected of half a normal distribution curve. The colour chart I was using went from pH 4.0 to 8.0, a generalised range for all soils. Perhaps half of the values that I recorded as 4.0 where in fact 3.5 and possible 3.0 – this is a limitation of the equipment I used, I could instead have used a specialised indicator designed for my acidic pH range, perhaps designed a titration for very accurate measurements (although this would be very time consuming), or used a pH meter (which are expensive and notoriously temperamental).

Relationships

If my ideas about leaching are correct, then I would expect those soils with higher moisture content to have a higher pH, as more moisture indicates less leaching, and more ions would be held in the soil; I will plot this data on a scatter graph to see if there is a relationship. There is also likely to be a relationship between pH and organic content for two reasons. Soil organisms will influence the pH of their environment by absorbing and releasing certain chemicals, some of which influence pH. The other significant reason is that organisms have certain pH tolerances, so I can predict that the lower the pH, the lower the organic content; this is likely to be the overriding factor of the two. I can plot the relationship of pH with both moisture and organic on the same graph, as they are both measured using the same units.

Chart 3.5

These relationships are interesting, as there appears to be very little influence of soil moisture on pH, and a much stronger correlation between organic content and pH. As predicted, this second correlation is negative presumably because it is far more difficult for soil organisms to maintain their specific internal conditions when in soil of a pH so far away from these conditions.

It is definitely worth running a Spearman's Rank Correlation test on this data, as graphical trends are not always an accurate representation (especially when influenced by anomalies). This isn't an ideal statistical test because it uses ranking and there are only 5 ranks of pH in the data, but it should be an effective enough analysis. The null hypothesis is that there will be no meaningful relationship between soil moisture/organic content and soil pH, and that any apparent correlation is down to chance.

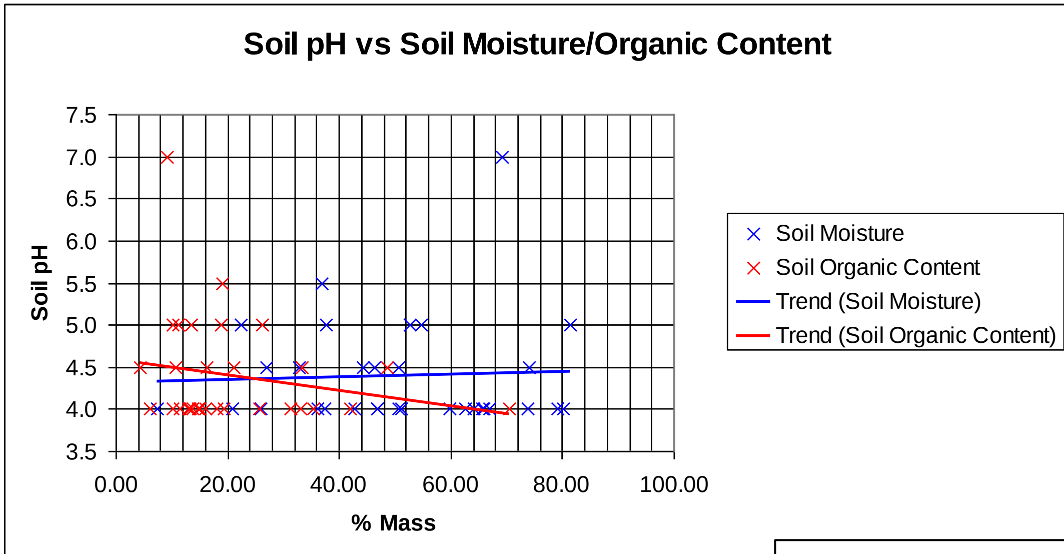


Chart 3.5: showing the influence of soil moisture on pH, and the organic content and pH. Values taken from the quadrats with kr (rather than projected ones).

The value returned for moisture was **0.056**, which is obviously going to be below the critical values for any meaningful level of significance (e.g. 0.25). This was to be expected from looking at the graph. The value returned for organic content was **-0.024**, which is very surprising considering that on the graph the trend for organic content looks stronger than that for moisture, not the other way round. With an even lower value this will also be well below the critical value for a reasonable significance level. So for both cases I should accept the null hypothesis. Because Spearman's Rank returns the *probability* of results being significant or due to chance, it seems that this test has confirmed that the trends seen on the graphs were indeed down to chance rather than showing any real trends. It is also worth noting that Spearman's Rank is probably not as influenced by the anomaly of pH 7.0 as the Excel trend lines are. A good thing that comes from this is that this is one less relationship to factor out when analysing other data.

It is known that different plant (and other) species have different pH tolerances, so this should possibly show as a relationship in my data. I will select several different types of plant (e.g. a heather and a grass) and plot them against soil pH.

Chart 3.6

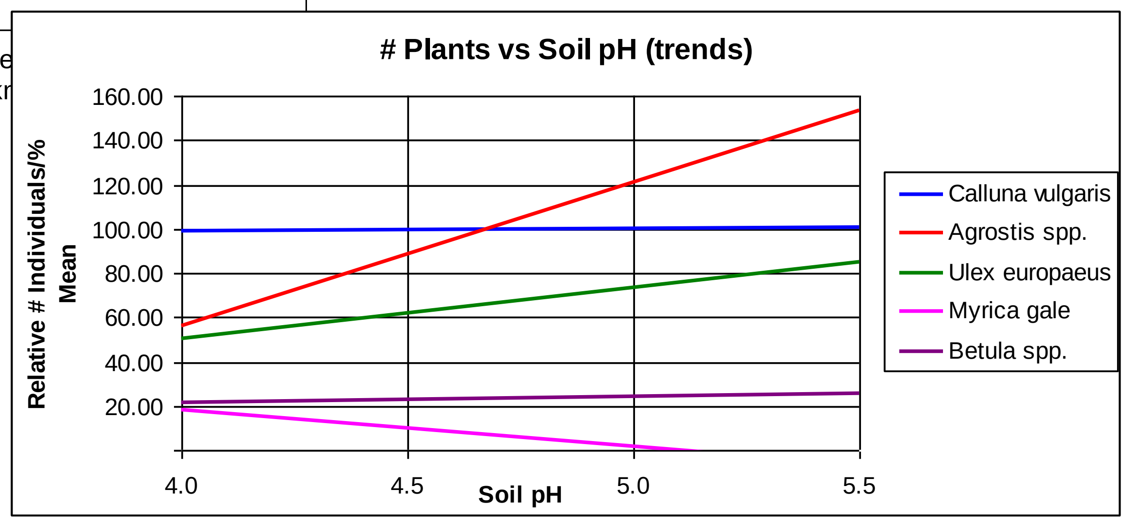


Chart 3.6: showing the influence of soil pH on a selection of plant species using projected pH values. Specific points are omitted, only trends are shown. Values for pH 7 anomaly also omitted.

When dealing with a relationship like this, is it often difficult to work out if these are ‘real’ or just chance. So again I will need to use a statistical test. Although Spearman’s Rank is not ideal for categorised data (pH), I have no better tests at my disposal. Because of the limitations of this test, I will just be using the known soil values and the corresponding figures for these (using projected pH values would generate even more ties), the graph however displays trends derived from projected values as well.

Starting with ***C. vulgaris***, a value of **0.011** was returned, which indicates practically no relationship at all, regardless of the level of confidence used. ***Agrostis spp.*** returned a value of **0.155**, which is still below the critical value even for 75% confidence limits (which I have predicted to be close to 0.2 by looking at values I do know, no actual critical values for low confidence limits could be found). This is surprising, because on the graph this appears to be the strongest correlation, so if the values agree then none of the correlations will be over the confidence limits. The value for ***U. europaeus*** is **-0.155**, which is both the reverse direction to the trend line on the graph, and also apparently has the same strength as *Agrostis*. This is proof for me that for this purpose, Spearman’s Rank does not work properly; the main contributing factor to this is ties in the data, generated not only by categorised pH values but also because I estimated the numbers of plants many of the values for number of plants will also be tied. This is particularly prominent with *U. europaeus* as the estimates were generally low numbers, which are more likely to be the same. For what it is worth, ***M. gale*** was **0.402** (ridiculously high and in the wrong direction according to the graph) and ***Betula*** was **0.395** (also very high). To add yet more error, these last two plants had a lot of ‘0’ values, which would also throw values off. Using the absolute values meant that values for the higher two pH’s were rare, which could also generate inaccuracy.

Using the graph alone (which I consider to be reasonably reliable), I would say definite trends can be found for *Agrostis* and *M. gale*, and possibly for *U. europaeus*. I interpret the virtually flat line for *C. vulgaris* as a sign of the versatility of the plant, contributing to making it by far the most widespread plant on the study area. The relatively strong positive correlation for *Agrostis* probably shows that, as a common grass, it is adapted to less extreme conditions, so while it can survive in healthy numbers even at the lower pH values, more neutral pH’s allow the grass to thrive and sometimes dominate. *U. europaeus* is more surprising, as this is considered a typical heathland plant and would be expected to be tolerant of lower pH; it may be that other factors unfavourable to the species cause low pH and therefore indirectly cause this perceived relationship. However the correlation seen on the graph is not very strong, and we cannot be certain that a verifiable relationship exists – this in fact may be the real reason. *M. gale* has a noticeable negative trend, disappearing from the graph altogether

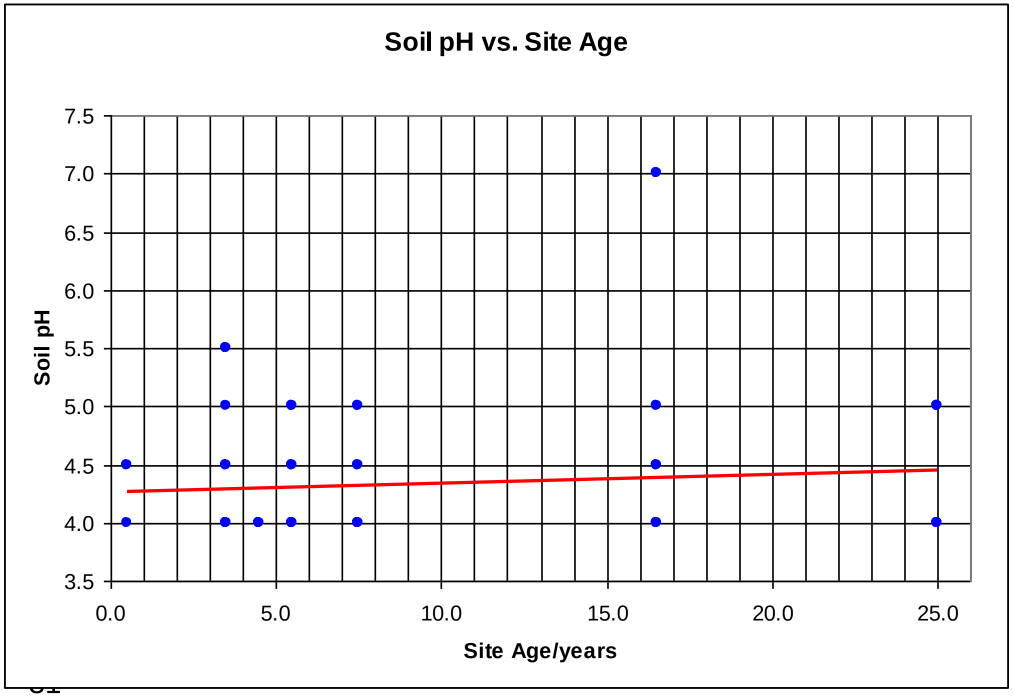


Chart 3.7: showing relationship between site age and soil pH, using projected pH values

by around pH5; rather than pH tolerance, I expect the real reason for this relationship is that, as I suggested for *U. europaeus*, other conditions influencing *M. gale* numbers also serve to influence soil pH. This seems quite likely, as the environment of *M. gale* is a very specific bog environment, which probably means that the soil is normally the same pH, consequentially no *M. gale* is found at higher pH's because the environment it lives in does not have higher pH's. *Betula* has very little trend, and I would not interpret it as significant; as with *C. vulgaris*, it was found (in young sapling form) all over the study area, in some places at surprisingly high numbers (e.g. about 50 in a quadrat). Clearly larger specimens do not survive, presumably eaten by ponies before achieving significant size (birch is a known part of the New Forest Pony diet [10]); so one could label *Betula* as an opportunistic species – if 'predation' was removed I would predict that much of the area would quickly be covered by young birch trees. Another part explanation will be that with the younger areas there hasn't been enough time for the birch to grow much larger, although this doesn't explain the phenomenon in older areas.

Because I have shown that for some species it is possible for pH to influence their numbers, it may be sensible to focus on one pH when looking for other plant relationships.

Chart 3.7
This shows that there is basically no influence between site age and soil pH, and because projected values are being used the influence of the pH7 anomaly (which was projected to just 3 quadrats) is reduced, which is reassuring in case this anomaly is due to a measuring error. This is the first sign that one of my hypotheses is correct – I predicted that soil properties would be independent of time after burning, which was irrelevant for soil temperature but for pH it has been possible to prove that this is true. I will need to wait and see if the same is true for moisture and organic content. Another positive that can be drawn from this is that site age is not an unwanted factor influencing pH relationships.

Chart 3.8

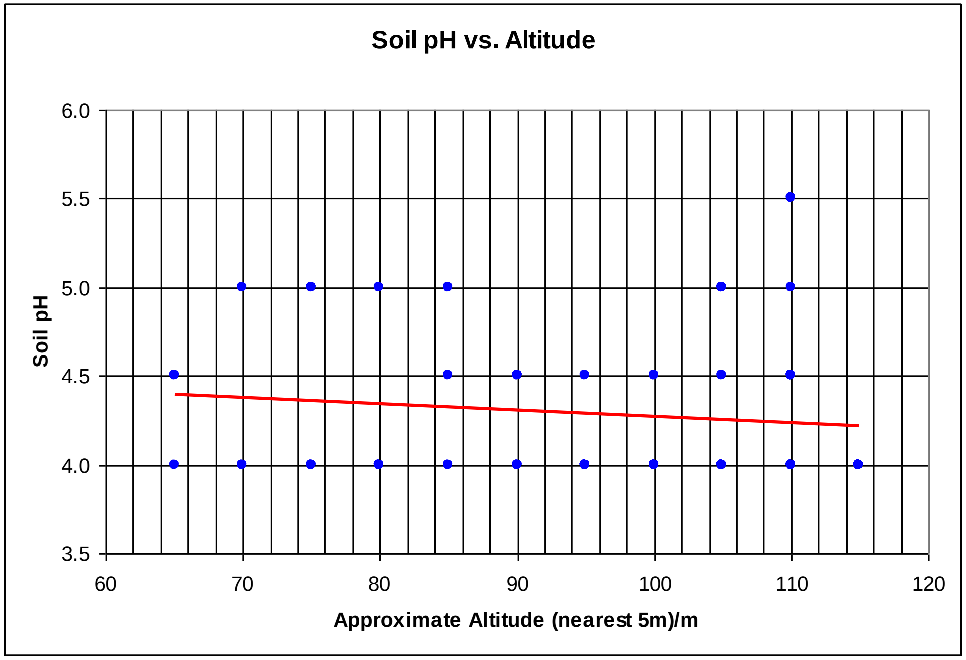


Chart 3.8: influence of quadrat altitude (height above sea-level) on soil pH, pH7 excluded as it produced a noticeably stronger trend and is probably a procedural error.

There is clearly no meaningful relationship between soil pH and altitude, which, together with Chart 3.5, demonstrates that locational factors have little influence on pH, which unlike with soil temperature contradicts the third hypothesis. This lack of relationships makes those observed on Chart 3.6 all the more reliable and accurate.

Reducing Unwanted Influence

As I mentioned, there is very little unwanted influence with soil pH, as I could only find one graph that showed significant relationships. But as I also said, it may be necessary to focus on one particular pH when looking at other relationships involving plant numbers, as Chart 3.6 shows that some relationships could be otherwise offset by the influence of soil pH. This should not be too difficult, as around 60% of the pH recordings were 4.0, which judging by the lack of other relationships should cover most types of quadrat (age, moisture etc.).

Significance for Original Hypotheses

As discussed previously at the relevant points, relationships for pH have supported hypothesis 2 (Chart 3.7), but contradicted hypothesis 3 (Charts 3.5 and 3.8).

Soil Moisture

Out of all the soil lab-work (pH, moisture, organic content), I consider the soil moisture readings to be the most precise and reliable, as the recordings are on a continuous scale (unlike pH) and using the drying oven eliminated most potential human error (unlike organic content). Consequentially I will trust relationships seen here more than other factors such as organic content, which I believe was less accurate.

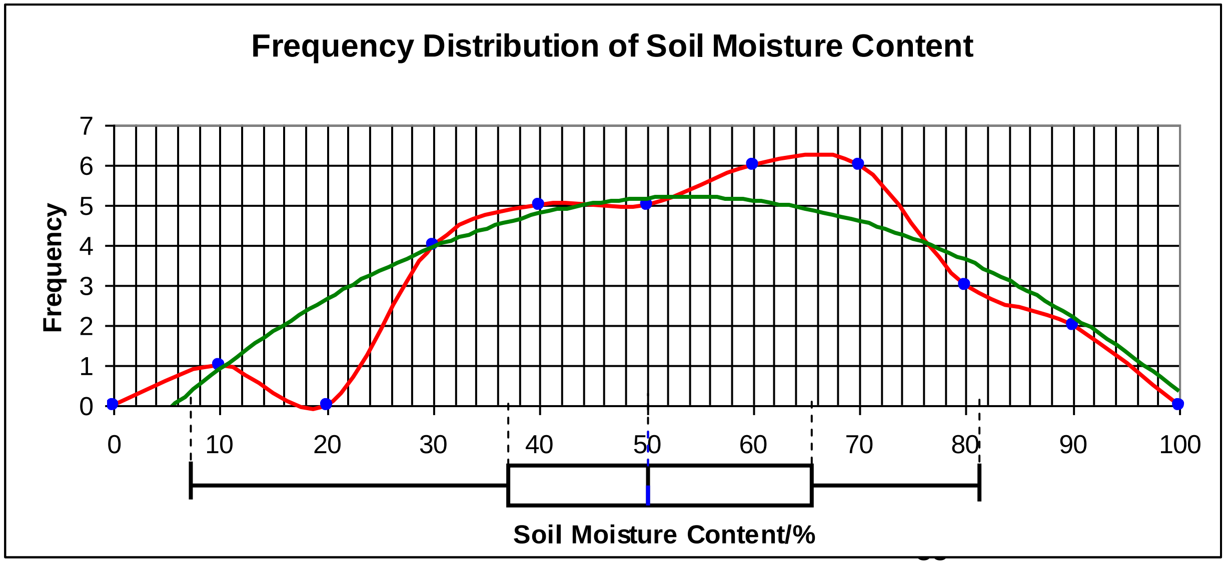


Chart 3.9: frequency intervals used were ≥10, 20 etc. up to ≥100. The box plot displays minimum and maximum values, inter-quartile range (the box), mean (blue) and median (black); no mode due to continuous nature of data. Green line = polynomial 2 trend line. Values taken from known rather than projected.

Chart 3.9

This chart displays classic normal distribution – the curve is almost completely symmetrical, as is the inter-quartile range around the median. The mean and median are practically the same – 50.46 and 50.63 respectively (this is why there is just one line, with two colours). If it weren't for the single value below 10% the entire box plot would be close to symmetrical. And as is characteristic of normal distribution, at least 95% of the data is within 2 standard deviations (18.96) of the mean. To me this demonstrates the wide variation in types of site around my study area. Some of the upland parts had very thin, dry soil and in some places no soil at all. But the lowland parts close to rivers had deeper, waterlogged soil. This distribution should allow for a full analysis of relationships with other factors as I have a full spread of data.

Relationships

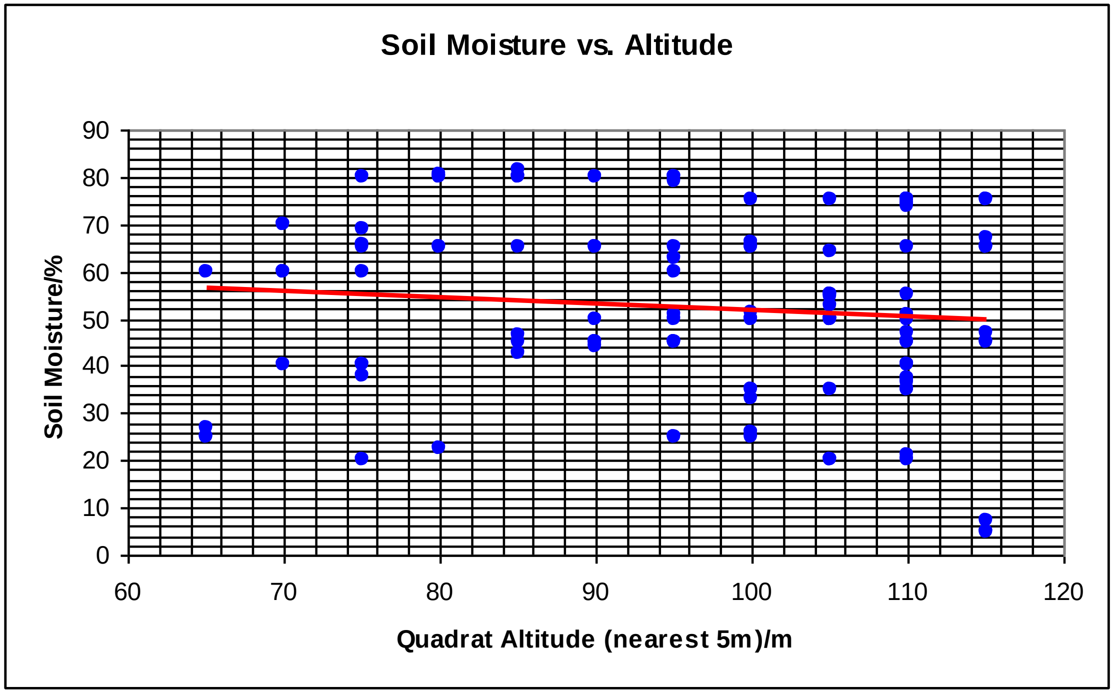


Chart 3.10: influence of quadrat altitude (height above sea-level) on soil moisture using projected soil moisture values.

I have already seen that there is no relationship between soil pH and soil moisture. I will start by investigating a relationship that logic states should exist: that the lower the altitude (and hence the closer to water courses), the higher the soil moisture.

Chart 3.10

There appears to be no relationship between altitude and soil moisture, for which there may be a number of reasons. The weather conditions were always going to be an issue, because although I could not do any sampling when it was raining, I may have sampled the day after a rainstorm when the soil would contain much more moisture than the day before the rainstorm. It would be worth investigating any possible relationship somehow. And although water bodies would be generally found at lower altitudes, they are not all found at the same level; so a quadrat at around 90m may be closer to a river (and so have higher soil moisture) than a quadrat at 70m. It would be difficult to quantify the proximity to a water feature, not to mention unnecessarily time consuming.

Unfortunately, due to the sparseness of the soil samples tested, there was no way to investigate the influence that sampling on different days has on soil moisture and still be confident that several other factors (e.g. being part of a marsh) have not influenced the moisture content instead. The moisture values are at least approximate, i.e. the recent rainfall levels could not change moisture content from 30% to 80%, so this is not very worrying, although there will definitely be some unknown influence.

Chart 3.11

Compared to some of the relationships I have observed, this could be significant. It seems from the trend line that the higher the moisture content, the lower the organic content. This is not really surprising, given that moisture and organic content are measured as proportions of the entire soil, so the higher one percentage is, the lower another percentage must be. The general trend appears to be a higher moisture content and a lower organic content, with one noticeable anomaly of 8% moisture and 70% organic, which can be explained by the tiny size of the sample (0.27g), which was not ideal. This is to be expected, as organic content is normally listed as around 5% of the total mass (obviously most of my readings were greater than that, probably because heathland soils are different to typical soil), while 50% is air and water in varying proportions.

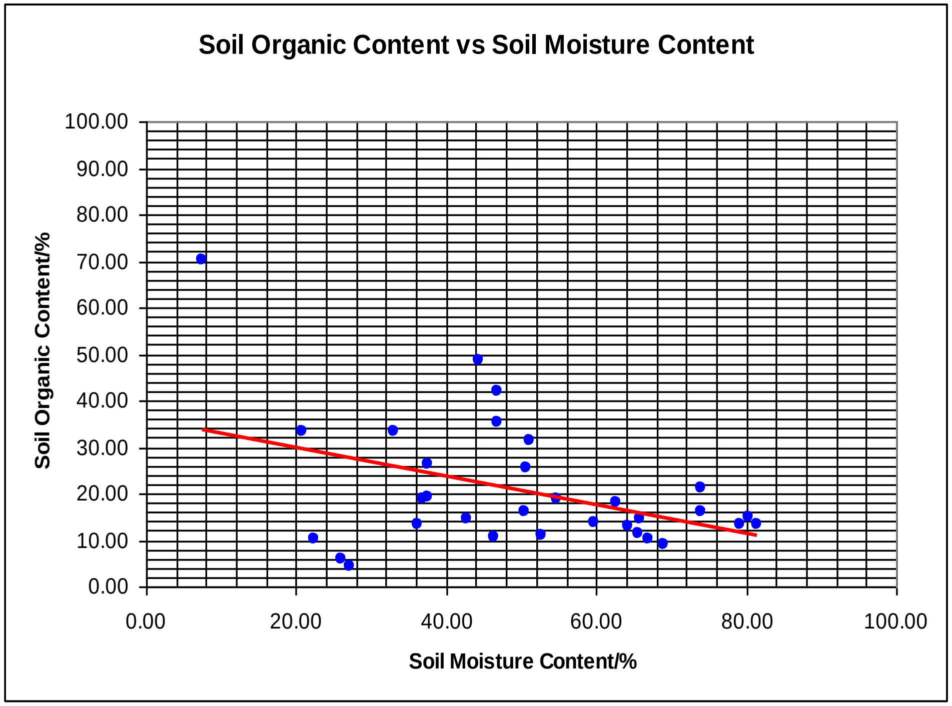


Chart 3.11: relationship between organic content and moisture, using known values.

It is not worth running any statistical tests on this, as the relationship seen is not one that needs confirming, and has little significance to my hypotheses, although it will need to be taken into account when looking at other relationships.

Chart 3.12

An interesting relationship, there does not appear to be much correlation. It will be definitely worth running a Spearman's Rank calculation on this to clarify, although I will only run the calculation for absolute values, as projected values will give too many tied values for number of species. The value returned was **0.221**, which was much higher than I expected, and the reliability is not too questionable as there was only a small number of tied values for number of species. 0.221 is once again within low confidence limits, but importantly it is above the predicted value for the lower limit of 75% (around 0.2). However it is lower than the value for 80% of 0.24, so I can be 75%

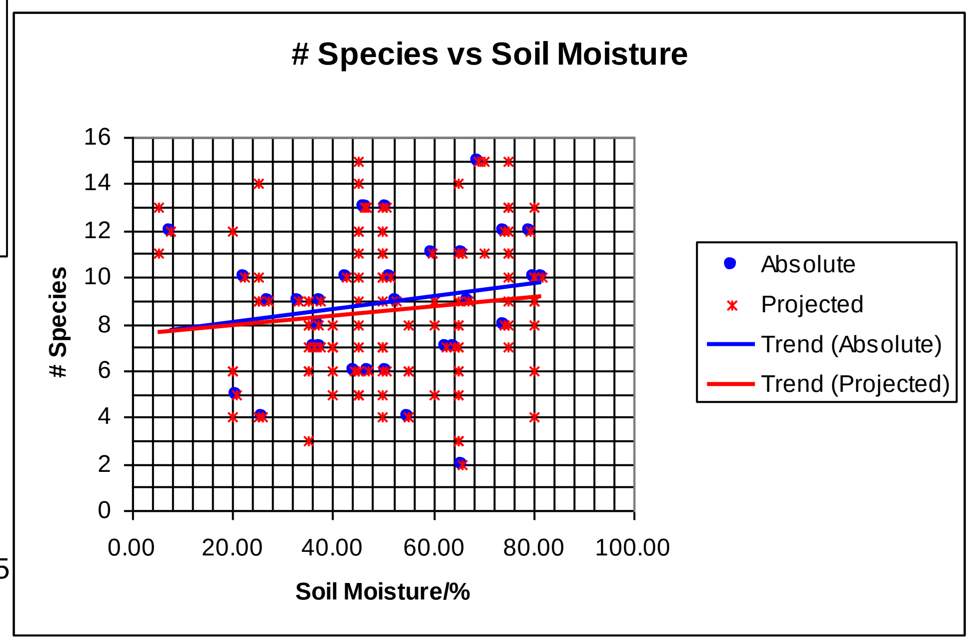


Chart 3.12: influence of soil moisture on number of species in a quadrat, showing both absolute and projected soil moisture values.

confident that soil moisture content is directly proportional to the number of species in the corresponding quadrat.

When looking at some of my field observations this is not particularly surprising, as I found much greater diversity of species in the marshland areas in comparison to drier upland areas. It seems that in marshy areas, despite the domination by cover of *M. gale*, many other species can still coexist in the same quadrat; whereas in areas where *C. vulgaris* dominates, only 2 or 3 other species could coexist. The reason the confidence level is low is that this was a rather general trend I observed, and there were definitely several exceptions at both ends of the scale, such as dry areas with few *C. vulgaris* individuals but many other species; or a marsh area dominated by *M. caerulea*. This is relevant to hypothesis 3, in that soil properties may influence speed of recovery.

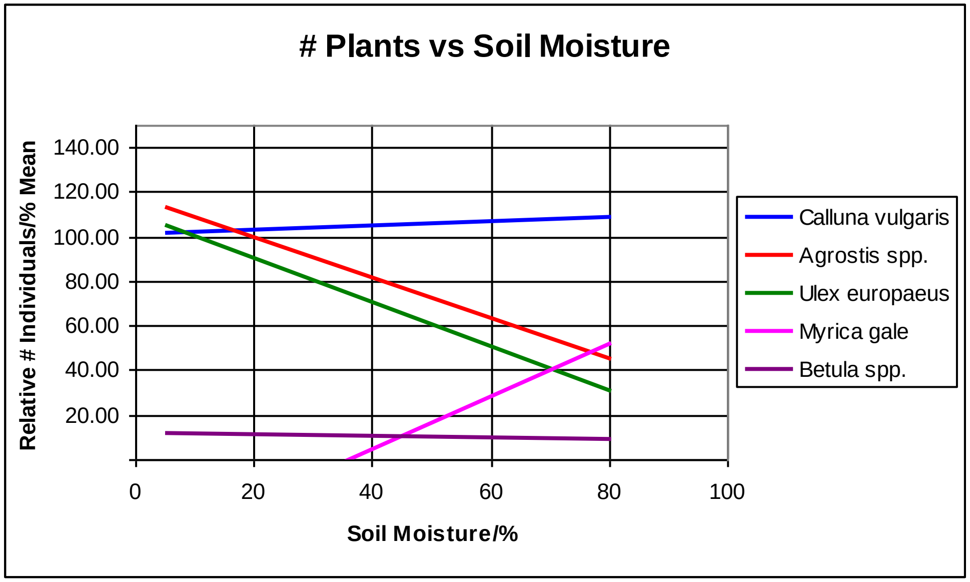


Chart 3.13: influence of soil moisture on a selection of plant species, using projected moisture values for quadrats with soil pH of 4. Specific points omitted, only trends shown.

Chart 3.13

As with when I drew a similar graph using soil pH in place of moisture, there are some plants that seem significantly influenced by soil moisture, and others that experience minimal influence. As I stated when analysing that relationship, I have limited this analysis to quadrats with soil pH4 values attributed to them (~60% of the entire data set) to eliminate the influence that pH may have.

I performed Spearman's Rank calculations on these data sets. Originally I just used the absolute values so as to stay within small sample size as is conventionally used with Spearman's, but it was soon obvious that this gave completely different values to the correlations seen on the graph. So I have extended the calculations to projected values as well, which increases the number of tied values for soil moisture (projected values are rounded to the nearest 5), but not enough to significantly alter the correlation coefficient. Unfortunately *M. gale* and *Betula* had a value of 0 in many quadrats, which gave erroneous values for this calculation, but the other 3 plants had values that made more sense.

C. vulgaris returned a value of **0.00**, which although slightly different to the graph, reinforces the idea that there is no relationship between soil moisture and the number of *C. vulgaris*. As I said with soil pH, this demonstrates the versatility of the species, which is what has allowed it to colonise the whole area and be present in all but one quadrat. ***Agrostis*** returned a value of **-0.25**, which with a sample size of 81 is 95% significant [12]. This further reinforces my impression that *Agrostis* is best adapted to less extreme values, as numbers are lower where soil moisture is very high, although it does seem to be able to survive at low soil moistures. Chart 3.6 showed that *Agrostis* is also in greater numbers at more neutral pH. ***U. europaeus*** returned a value of **-0.18**, which by looking at the graph used above I would say is likely to be 90% significant. This is slightly surprising, as the graph shows *Agrostis* and *U, europaeus* as having similar trends; this difference could be real and the graph could be slightly wrong, but I think this is the influence of 38 quadrats containing no *U. europaeus* distorting the calculation. In any case this also shows that *U. europaeus* is best adapted to less extreme conditions similar to *Agrostis*; which explains why both species tended to be found in the upland areas, furthest away from any water bodies. As explained previously, the other two species were distorted too much by quadrats containing no individuals; for the record ***M. gale*** returned **0.60**, which actually seems too strong, and ***Betula*** returned **0.31**, which completely contradicts the graph.

Just looking at the trends on the graph, *M. gale* has a strong positive correlation between numbers and soil moisture. This is not surprising, given that this is a wetland plant, and I only ever saw it in waterlogged areas. This is such a strong relationship (seen not only from the graph but by just looking at the raw data) that I may use *M. gale* as an indicator of waterlogged/wetland quadrats. *Betula* shows practically no relationship, similar to what was seen with Chart 3.6, and again I would say that this is a good demonstration of the versatility of the plant, surviving in all sorts of conditions in equal numbers (at least in sapling form).

The similarities between Chart 3.6 and Chart 3.13 are striking, which is all the more surprising given that it appeared there was no relationship between soil pH and moisture content according to Chart 3.5. It may be that the categorised pH values meant that a trend that was actually present was not shown, or it may be that other environmental factors caused an indirect relationship that makes 3.6 and 3.13 similar.

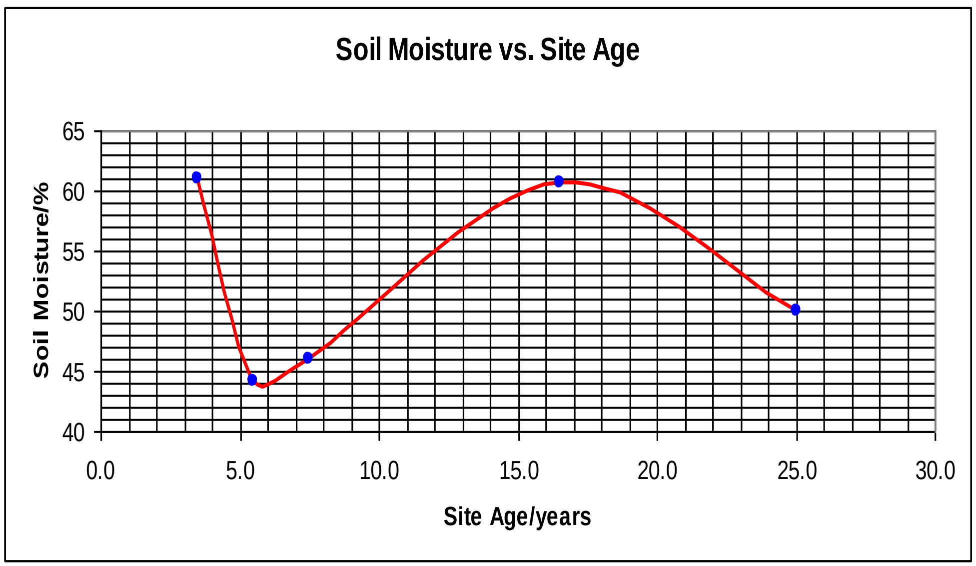


Chart 3.14: influence on site age on soil moisture. Values taken from a spreadsheet of averages for site ages where enough sites were available to take averages from (e.g. 0.5 years had to be omitted).

-

Chart 3.14
I chose this format of analysis because it can distinguish several trends in one lineage, as it has done here. When I input the raw data and used a normal Excel trend line, the line was flat. Of course how to read into this relationship is another matter – why is there a large drop around 5/6 years, which has risen back again by 16 years?

This could possibly be a misleading trend caused by similar locations of all sites of a particular age. To investigate this I have drawn **Figure 3.1**, which shows the locations of the sites in question. This map very effectively disproves that idea, as it shows that not only are areas of the same age spread over the entire of the area (so under differing conditions), but also that they have the full range of soil moisture between them. The only exception to this are the 25 year old sites, which are all located in the same area and have a more restricted range of soil moisture.

I do not think this means I should discount 25 year old sites from this analysis, because it seemed that the age of these sites (which is actually a minimum of 25 years remember) had resulted in the conditions being uniform even in parts where proximity to water should have logically resulted in variation from the norm. It seems that over the long period of time *C. vulgaris* had come to dominate (this will be discussed later) and that soil conditions had changed as a result. I would predict that if there was a site of this age on another area it would actually be very similar despite the different location. This will all be discussed in more detail at the relevant section.

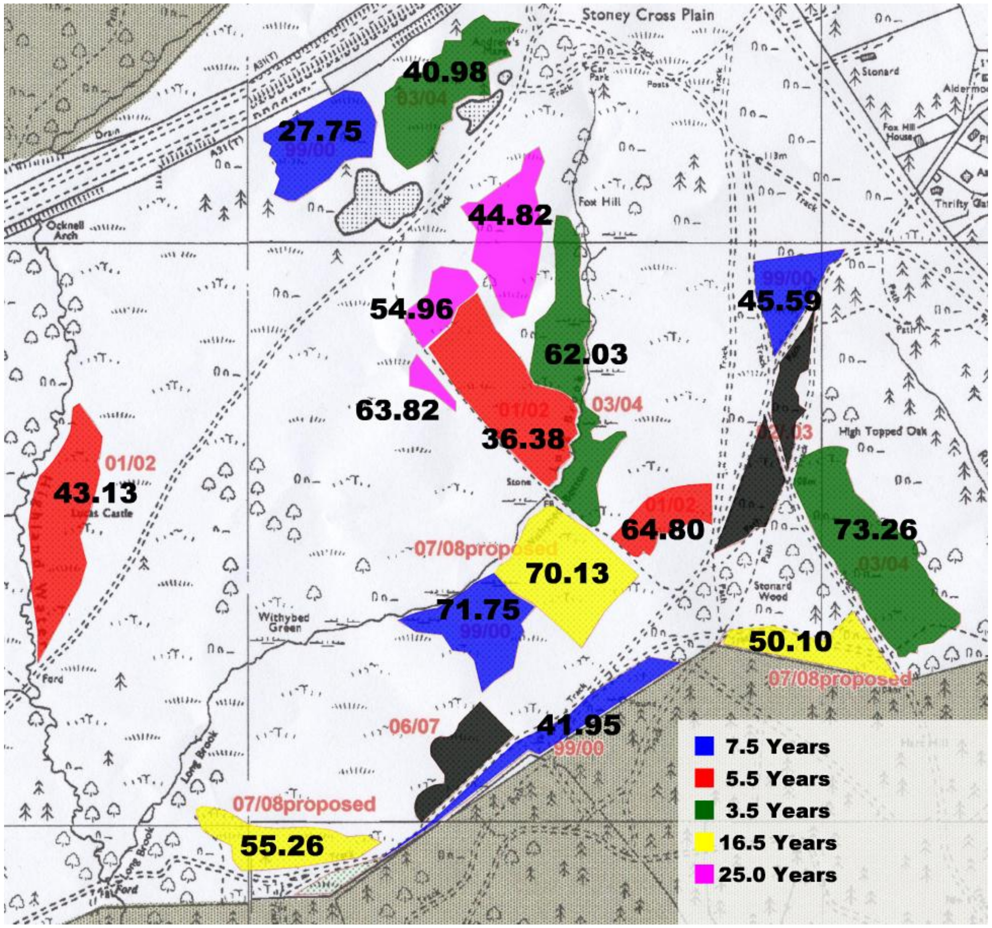


Figure 3.1: a locational perspective of site age and soil moisture content. Black areas were discounted from the age averages; bold text denotes soil moisture/%.

I believe that vegetation has a significant role to play in the changes in soil moisture, although even when using averages locational factors must have had some effect. As an area ages, the vegetation will stabilise the soil moisture level, and this I think is a significant conclusion that can be drawn.

I have contradicted hypothesis 1 somewhat, by highlighting that although the vegetation starts off diverse, most areas will become dominated by *C. vulgaris*, thus indicating that the proportions of plants will change over time since burning; this cannot be conclusively discussed until proper relationships are investigated. In the same stroke, it seems that hypothesis 2 could also be wrong in some cases. And looking at this map supports hypothesis 3, in that the clustering of similar soil moisture values indicates that locational factors influence soil properties.

<u>Reducing Unwanted Influence</u>

Given the influence of soil moisture on the number of plants and number of species, it may be necessary to distinguish between waterlogged areas and drier areas. I will separate analysis into two categories – quadrats where *M. gale* is present and those where it is not, as *M. gale* is present in all waterlogged areas and absent anywhere else so is a good indicator. I do not need to account for the relationship between organic and moisture content as this is to be expected anyway.

Relevance to Original Hypotheses

Chart 3.12 has given the first sign that soil conditions will influence the speed of recovery (hypothesis 3), as waterlogged areas tend to have more species in them. Chart 3.14 has contradicted hypothesis 2, by showing that soil conditions may increase in stability as an area gets older. So in terms of the hypotheses, soil moisture has contradicted what was seen with soil pH, although I think that perhaps soil pH trends would agree with soil moisture if measurement methods were improved.

Soil Organic Content

I am not particularly confident about measurements of organic content, as I discovered at one point that if the Bunsen flame was positioned even slightly off the centre of the crucible then the soil would not burn effectively. I repeated some of the most noticeably incorrect measurements but I am still not sure if my readings are representative of the true organic content.

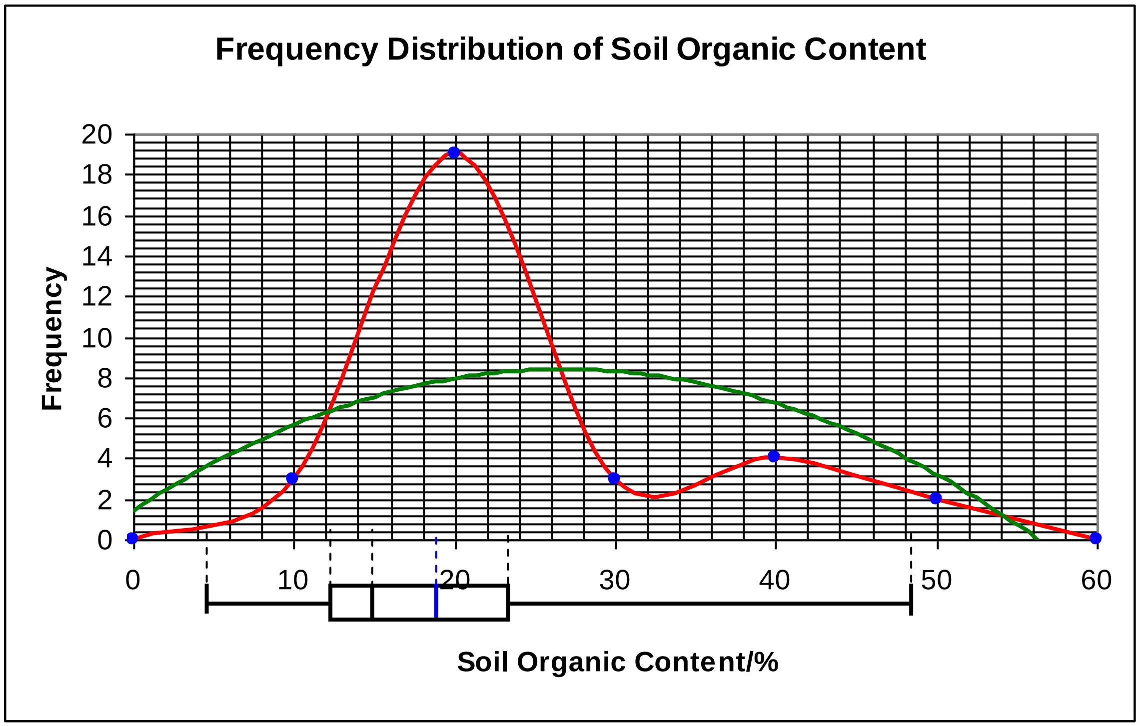


Chart 3.15: frequency intervals used were ≤10, 20 etc. up to 60%. The box plot displays minimum and maximum values, inter-quartile range (the box), mean (blue) and median (black); no mode due to continuous nature of data. Green line = polynomial 2 trend line. Values taken from known rather than projected. Anomalous value of over 70% was excluded because it was not representative of the quadrat.

Chart 3.15

Having excluded the very high value anomaly, this distribution doesn't look extremely far off normal, although it doesn't really fit the criteria very well. The mode and median are about 4% apart and only the left hand side of the graph is of typical shape – the right hand side being far more spread out. This also means that 95% of the data is not within 2 standard deviations (STDEV = 13.86) of the mean.

I believe that part of the explanation for this is the inaccuracies in measurement, because logically if soil moisture displayed a good normal distribution then organic content should do the same.

I would be very cautious about accepting any relationships that show up with organic content as a result of the dubious nature of the results. Nevertheless I should investigate various relationships briefly so I can follow up any significant trends that arise. The first prediction that I can make is that certain plants may influence soil organic content (or the relationship may work the other way round), so I will look at the relationship with several selected plants. As mentioned previously, I shall rule out the influence of soil moisture (or at least water-logging) by separating quadrats into those with *M. gale* and those without.

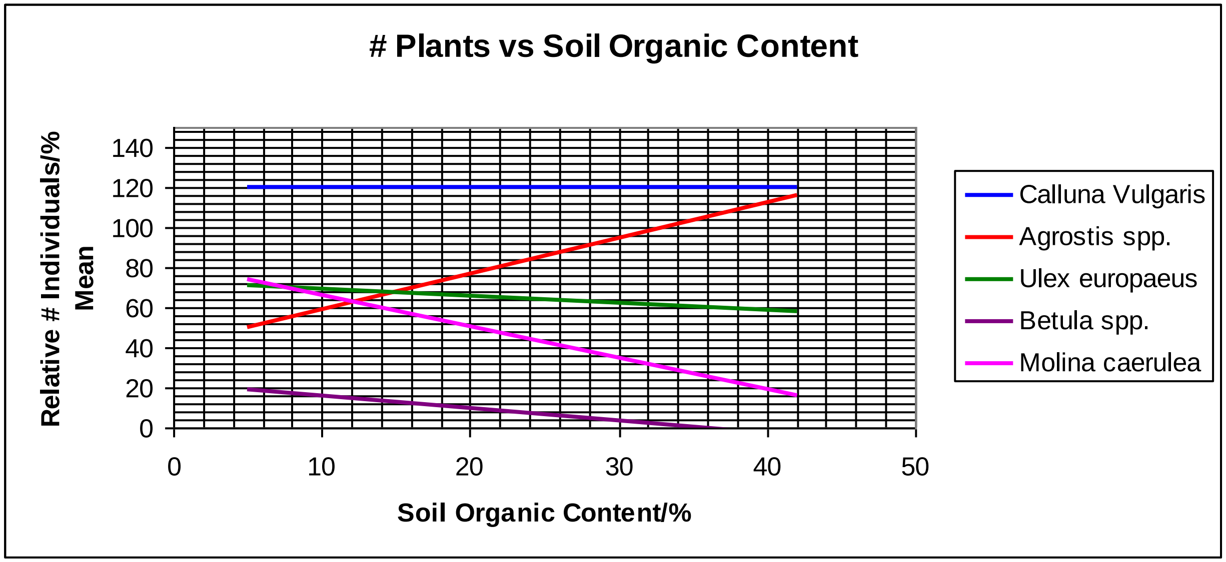


Chart 3.16: influence of soil organic content on a selection of plants. Figures are from projected values, from quadrats without *M. gale* and all pH4. Specific points omitted, only trends shown. 70% anomaly ignored.

Chart 3.16
These relationships are interesting, I was hoping to do the same for common wetland plants in quadrats where *M. gale* was present, but there were not enough quadrats to give accurate trends. As is normal, I shall run Spearman's Rank calculations on each plant before drawing any conclusions. The predicted critical value for 75% confidence and 62 degrees of freedom is around 0.17. I shall run through all plants before finding reasons for any relationships because I am not sure whether organic content influences plant numbers or the other way round.

C. vulgaris, as is seen on the graph, returned the very low value of **0.037**. ***Agrostis***, which appears to be the strongest relationship on the graph, gave the value of **0.143**, which is still lower than the lowest acceptable critical value. ***U. europaeus*** gave the value of **-0.063**, which backs up the graph. ***Betula*** had too many 0 values to give a reliable correlation co-efficient, which was **0.130 –** completely different to the graph. ***M. caerulea***, which is the other major trend, gave a very surprising value of **0.130** also, except this time it seems to be a legitimate value; the only explanation I can find for the opposition of the trend on the graph is several anomalously high plant number readings, which would greatly influence a trend line but not influence a Spearman's Rank co-efficient.

So although none of the values were higher than the critical value, I feel there will still be some small relationship. Both the noticeable relationships were grasses, and if the anomalies are discounted for *M. caerulea* then both are positive with a similar strength. Even when the ability of a single grass plant to grow multiple blades is taken into account, grass plants will still produce higher root densities than many other plants such as heathers and bracken (*P. aquilinum*). So a quadrat with more grass will result in a higher soil organic content from the increased root density. This seems like a reasonable explanation for the relationship.

Chart 3.17

These trends look surprisingly significant, and worth running a Spearman's Rank calculation on. Admittedly because the altitude values are estimated to the nearest 5m, there will be some ties, but these will be few enough for the result to still be viable. I will run the calculation on the trend including *M. gale*, because both trends are similar and this one has slightly more data to use. The result is equally surprising – **0.375**, which is above the critical value of 0.369 for 29 degrees of freedom at 95% confidence, making this among the most significant (and reliable enough) correlations so far. As I said before, I cannot be sure that this relationship really exists, but at this level of confidence I can be sure that there would still be a relationship (perhaps weaker) if the measuring technique were more accurate.

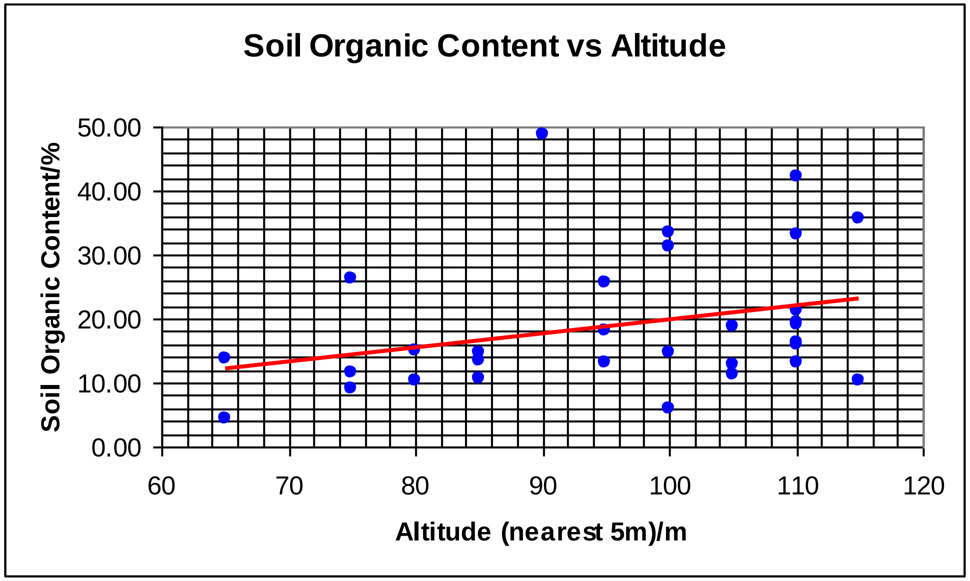


Chart 3.17: influence of altitude on soil organic content, using known rather than projected values. 70% anomaly ignored.

So I must find an explanation for this unexpected relationship. Having seen the previous relationship between grasses and organic content, I will perform a quick Spearman's Rank calculation on the relationship between *Agrostis* and altitude; I will do this for *all* pH4 quadrats, as a larger data set increases accuracy. The value returned for this was **0.378**, which for 81 degrees of freedom is well above the critical value for 99.9% significance. Such high significance levels for both organic content and *Agrostis* numbers in relation to altitude cement the relationship between *Agrostis* numbers and organic content. This relationship may end up providing explanations for various other relationships with organic content.

The relationship supports hypothesis 3, as the locational factor (altitude) has indirectly influenced soil organic content. This is also the first piece of evidence of a plant directly influencing another factor.

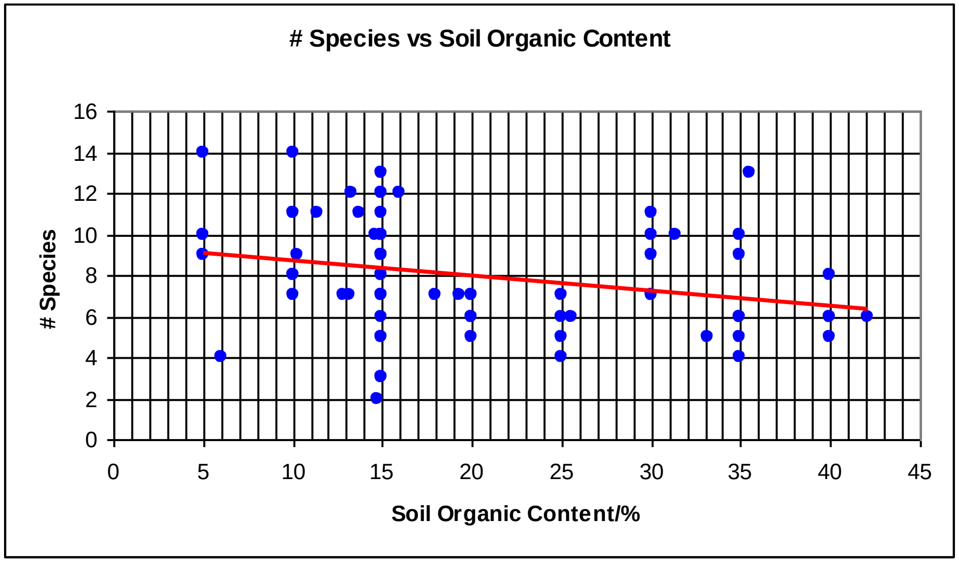


Chart 3.18: influence of soil organic content on # species in quadrats of pH4 and using projected values. 70% anomaly ignored.

Chart 3.18

This trend also looks as if it could be significant, and with a Spearman's Rank value of **-0.288** at 76 degrees of freedom it is *just* 99% significant. The most likely explanation is, as I predicted, that as numbers of *Agrostis* increase, thus increasing organic content, then the numbers of other species decrease. If this is the main/only reason for the relationship then there is no relation to the original hypotheses, although it is important as giving evidence for the way that plants can influence soil properties.

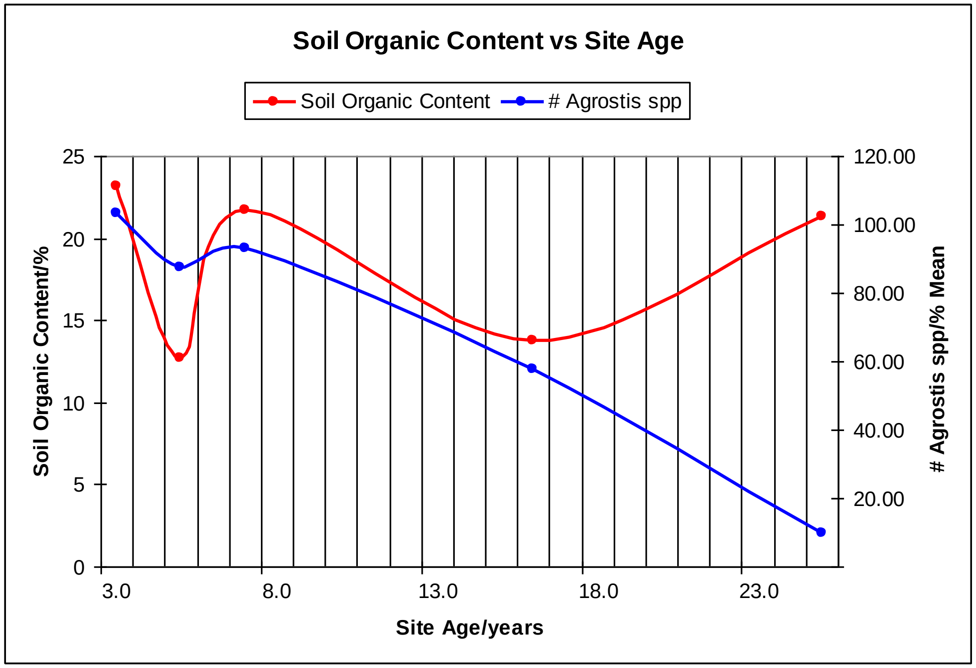


Chart 3.19: influence of site age on both soil organic content and numbers of *Agrostis spp*. Values used are averages for each site age where enough sites were available to take averages from.

Relevance to Original Hypotheses

Chart 3.19

I included *Agrostis* numbers in this because I wanted to see whether the apparently random fluctuations were mainly caused by this variable. Up to 16 years this could be said to be at least some of the reason, as both curves behave in a similar way, but then between 16 and 25 years the trends go in reverse directions.

I have noticed in other situations that the 25 [plus] year sites have been different to all others, presumably because they have had much more time to stabilise. Unfortunately due to the low sample numbers for soil and the potential inaccuracies in measuring organic content, I do not believe that I should read too much into the influence of site age. So for this study I can say that site age has little influence on soil organic content, supporting hypothesis 2.

Reducing Unwanted Influence

It seems that the only noticeable relationship I could find was with numbers of grass species. There may be other relationships but I would need to improve my data collection method to get anything more reliable. Therefore there is no need to allow for this relationship because I would really be allowing for numbers of certain species, which are taken to be variable and influenced by several other factors.

I have been able to find support for hypothesis 2 in Chart 3.19, but in my opinion it is actually more significant that I have found evidence that a plant can influence soil properties directly, as has been seen from analysis from charts 3.16, 3.17 and 3.18. This is not part of my original hypotheses, but may have further consequences for other analyses.

Site Age and Plants

Having worked out all the background influences that may cloud this part of the study, I am ready to proceed with the most relevant part of the study – investigating the various influences that site age has on numbers and distribution of plant species and individuals. I will not be analysing waterlogged quadrats, as they have now been separated to control variables, but there are not enough waterlogged quadrats to allow a reliable independent analysis. I will start with a simple analysis of the influence of site age on the number of species present in quadrats.

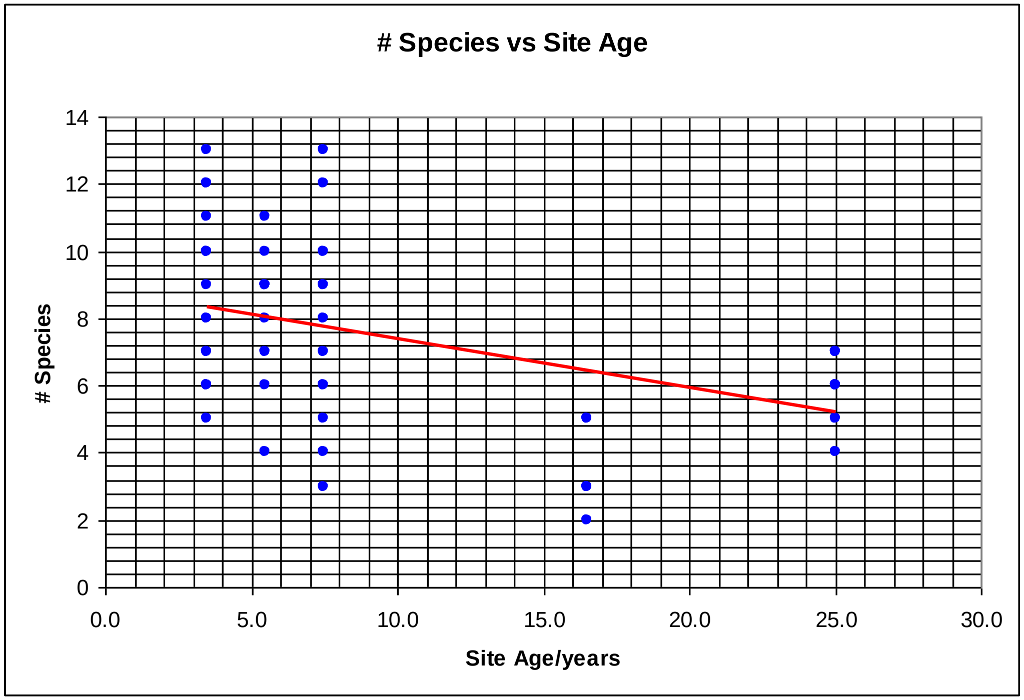
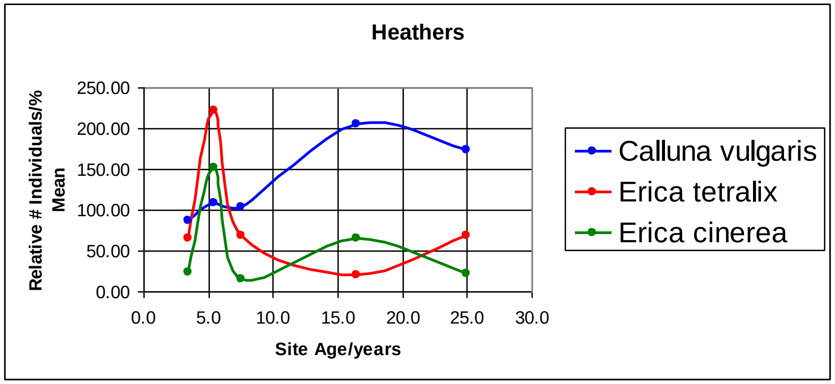


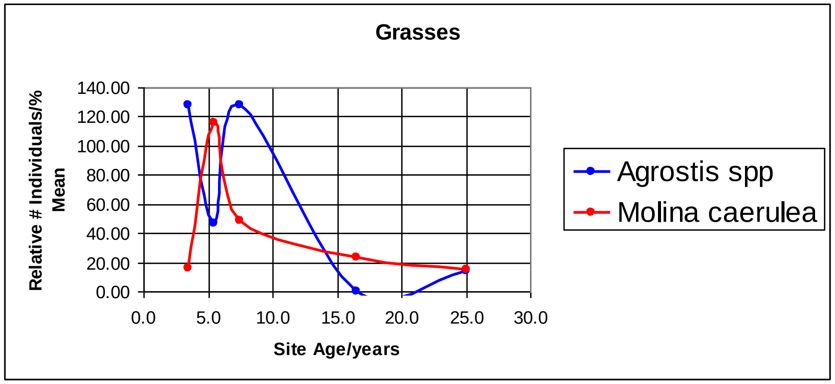
Chart 3.20: uses data from ages with enough sites to be reliable (as is used in age averages). All quadrats are pH4 and *M. gale* is absent.

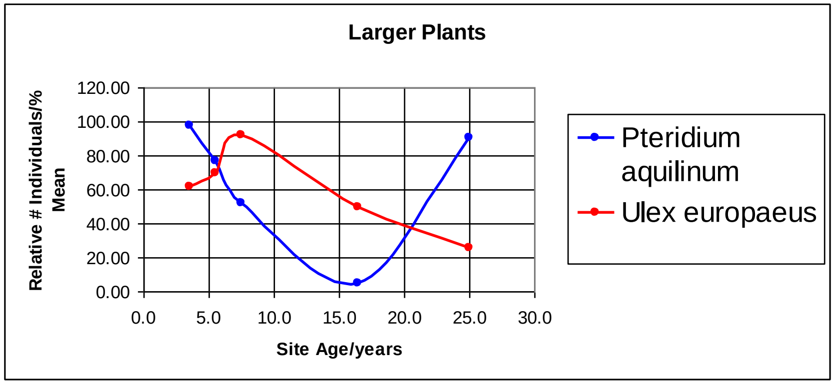
Chart 3.20
The restriction of quadrats in this case seems to have been particularly useful, because it has left me with a single type of environment to analyse trends from. The most striking example is sites of age 16.5 years, where the type of habitat varied greatly from site to site, with Site 14 even being semi-wooded. By restricting to non-waterlogged soils with a pH of 4, I have removed these sites and have been left with quadrats of a more typical heathland habitat.

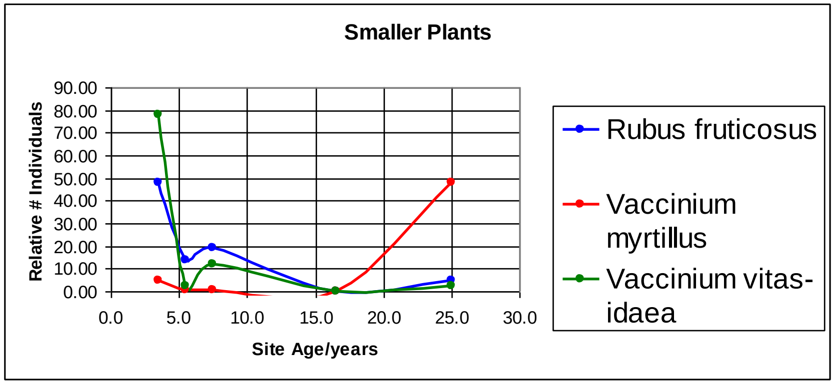
Although it is clear to me that this relationship is real, I will run a Spearman's Rank calculation on it to see how strong the relationship is. I will not ignore the relationship if it is not said to be significant, because this may be down to tied site age ranks, and this was one of the few relationships that was obvious enough for me to notice it in the field. The value returned was **-0.419**, which conforms to the graph and is 99.9% significant at 57 degrees of freedom (critical value 0.331). Even when the influence of tied age values is taken into account, this is more than enough to show that the correlation is a strong one.

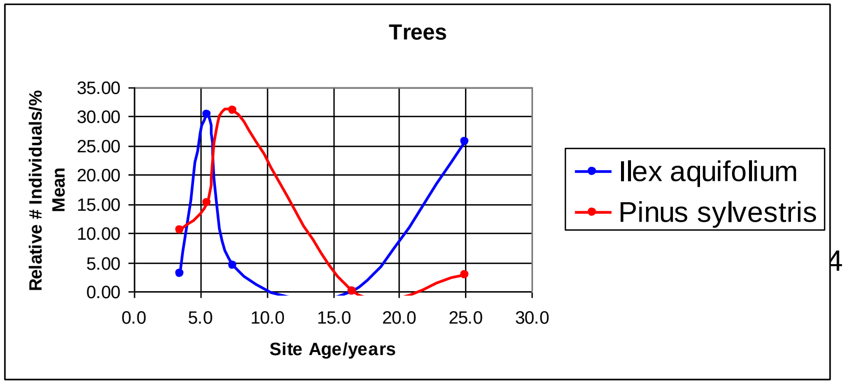
This is good evidence of secondary succession in action, with initial opportunism – indicated by both the high numbers of species and the greater range – followed by stabilisation of just a few species. I would predict from this evidence that most typical heathland areas would take a similar path to what is seen here. This discovery contradicts hypothesis 1, where I predicted that the proportions of plants would remain reasonably similar after burning; this was based on the fact that I predicted the 'recovery period' to be less than 4 years in length, but in fact it seems that stabilisation takes most of the lifetime of the site (remember than 16.5 year old sites were scheduled for burning, and 25 year old sites are an exception). The next step is to find out what plants are the ones that survive which ones die off after recovery.











Charts 3.21 a-e: showing relationship between site age and numbers of various plants – values taken from age averages spreadsheet again. Averages used are of pH4 quadrats without *M. gale*.

Charts 3.21 a-e
First of all it is clear that there are two particularly significant points on this graph – 5.5 years and 16.5 years. At these points many of the curves peak or trough, indicating that there is something significant about them; this significance is either generated by the nature of the data and how it was measured and analysed, or these are fundamental points about secondary succession in typical heathland. I am particularly interested in 16.5 years because this is the point at which most heath areas are burnt, and according to Article 3 from the introduction [9] is the point after which *C. vulgaris* 'stands' will pass into degenerate phase.

There is significant evidence that the changes around 5.5 years have been brought about by an unusually high number of 'wetter' quadrats than is found at other sites. These were not waterlogged but merely supported more hydrophilic species such as *E. cinerea* or *M. caerulea* and less mesophilic species such as *Agrostis*. Something that could have made 16.5 years significant is the fact that by selecting pH4 quadrats without *M. gale* I have eliminated much of the 16.5 year quadrats, leaving behind those of typical heathland variety. This makes the graphs less reliable, but it is unlikely to be a coincidence that this was one of if not the most heather dominated site in the area (excluding the 3 waterlogged quadrats), which I would hypothesise is because this is the point where heather species have reached the peak of their domination, just before they start to slip into degenerate phase. Another argument for this being a real occurrence rather than something generated by the data is that the latter half of the graph makes sense with the data as it is. Ultimately I will not know if this is genuine or not without an extension to the study over many sites of each age and under similar conditions.

Assuming that the point at 16.5 years is genuine, then this is evidence of the sort of timeline that Article 3 described. After the area has developed and many opportunistic species have re-colonised, the heather (mostly *C. vulgaris*) begins to dominate as it develops, which is why so many plants have a downturn in numbers at this point, while *C. vulgaris* and to a lesser extent *E. cinerea* (interestingly *E. tetralix* is more like the other plants) have an upturn. The areas of 25 years or older have not been integrated into the current burn cycle, so they represent the degenerate phase of *C. vulgaris*, where the heather is no longer quite as competitive as it once was, allowing other species to encroach. Notable examples of this are *P. aquilinum*, *V. myrtillus* and *I. aquifolium*. Interestingly this trend does not extend significantly to grasses, probably because the heather, however less competitive, still covers most of the ground space, so species that grow in a sort of 'mat' do not stand much chance of re-colonisation.

In theory, if the area is left unmanaged for even longer the heather will degenerate further, and slower-growing species, i.e. trees, will be able to grow to a size where they can survive long-term. This is the point where primary succession could be said to take over from secondary, as the heathland has fully recovered from burning and now proceeds down the natural path of primary succession.

This particular section would have been far more accurate under more controlled conditions, with a less sporadic distribution of ages. It is particularly annoying that for the first 3 years I had only one site, representing 0.5 years. Although what I saw on that site was interesting, it cannot be effectively analysed as I have nothing even close as a reference point.

As for my hypotheses, this very clearly contradicts hypothesis 1, as the proportions of plants change quite dramatically over the recovery period. It is also significant for hypothesis 3 as it shows that the recovery period cannot really be quantified if plant proportions change over time. I was planning on defining this as the age at which plant proportions stop changing, but for many reasons this will not be possible – for one thing I would require far more sites, which would need to be of all ages and be under similar conditions otherwise for comparison. But to see how soil conditions affect speed of recovery I would then need another set under different conditions.

Unlike soil conditions, there are not so many relationships I can look at, these were the main ones that have significance to my study.

Conclusions

First of all, I have found that it is very difficult to control all variables in fieldwork data, it would require a much larger study than I have the time and resources for. I have had to investigate many relationships in order to account for the viability of some variables and to reduce any unwanted influence in various places. Outside of actually testing my hypotheses I have observed interesting trends and phenomena, most significantly that in some cases plants can directly influence soil properties rather than the other way round.

Hypothesis 1 – The proportions of different plants will remain reasonably similar throughout the recovery period after burning.
I had anticipated that after a very short rebound period this hypothesis would turn out to be true. But in fact Charts 3.20 and 3.21 a-e have shown that this is not the case, as the rebound period appears to last at least up to the time that an area is normally burnt. After this period the area begins to de-generate and undergo primary succession, meaning that plant proportions will continue to change but probably more slowly. So in fact there doesn't appear to be any time where the proportions of plants stay the same. I can categorically state that this hypothesis should be rejected.

Hypothesis 2 – The soil properties will remain largely the same independent of the time after burning.
Although with Chart 3.14 I claimed to have found some relationship, I am not so sure having finished my data interpretation. There is no conclusive proof that it was site age causing these variations, as they appeared to be fairly random. Given I was even looking at averages and the variations were still large, I would predict that something to do with the sites of each age was having an influence, but I cannot tell what. So this renders the hypothesis half correct, as the soil properties appear to be independent of time after burning, but they do not remain the same over the time period. Although if the wording itself is followed this hypothesis should be rejected, as soil properties vary a lot, the principle should be accepted, as it has nothing to do with time after burning.

Hypothesis 3 – Locational factors will influence soil properties, which in turn will influence the speed of recovery.
This was in fact the hypothesis that I devoted the most time to, although indirectly because it was often while investigating unwanted relationships that needed cancelling out. The second half of the hypothesis has turned out to be impossible to investigate, as I found that there was no way of quantifying speed of recovery within the bounds of my study (see above). The first half was still possible to investigate, though. The only chart supporting this part was 3.1; with evidence against present in 3.5, 3.8, and 3.10. One could argue for further support from organic content, but this was mainly down to *Agrostis* numbers. If this hypothesis is extended to the influence on individual and species numbers (which would affect speed of recovery), then there is support for this part in charts 3.6, 3.12 and 3.13; evidence against was given in 3.3. Again more support could be found in organic content, but in this case the relationship was reversed. Although there is no one piece of evidence, I think this hypothesis should be accepted, as it is clear that on occasions locational factors influence soil properties, and that if the study were larger and more precise one could predict that these would influence speed of recovery because they have influence on plant numbers.

Environmental Significance
There is much emphasis on the environmental importance and value of heathland habitat, as shown by the various states of protection they are under. Investigation of hypothesis 1 has shown that burning is required periodically to prevent degeneration, primary succession and ultimately loss of the classic habitat. Burning also appears to present opportunities for many species during the early stages of recovery (under 10 years), which would not be so common if the heathland was left to naturally develop into woodland. Hypothesis 2 has shown that burning itself does not cause long term damage to the area as the soil conditions are not affected by burning; this allows quick recovery afterwards. Looking at this evidence, it appears that burning is a fully justified method of maintaining the habitat, and of course to some extent it replicates natural conditions, where fires may have occasionally swept an area.

Hypothesis 3 had shown that some areas may be more suitable for this management than others, as some sites such as waterlogged areas appear to behave in different ways to the heathland that needs to be preserved. Some parts may not have required burning before, but were burnt nonetheless; unfortunately I could not investigate this in detail because waterlogged habitats (the most prominent example) were few in number, so did not display enough variety to be investigated.

Difficulties Encountered

Field work

The first major difficulty encountered was the weather – it was near impossible to perform a study in the rain because the equipment was not as easy to use in damp conditions and it was very difficult to write or even keep the paper intact. Another problem caused by the weather was altering soil conditions from day to day; this was of course particularly significant for soil moisture, although I still seem to have some meaningful results. It would be difficult to avoid the influence of weather conditions, although I should have anticipated that this would be a problem.

In some places it was difficult to collect soil samples or even insert the soil thermometer, both because the soil was too thin (sometimes hardly there) and other times because the soil was held together very tightly with root networks. This was not a major problem but definitely a setback. The height of bracken was a problem in several areas, as this hindered movement and soil collection, as well as making estimation of other plant species more difficult. The height of bracken also presented a slight health risk in the form of ticks, although the precaution of wearing full body cover meant that none bit me. I am glad that I conducted a pilot study, as I was able to modify my method accordingly to prevent any larger errors in the field.

Animals were not a major problem, but dogs got in the way occasionally by investigating. Ponies and cattle moving through the area sometimes meant I had to wait to set out a quadrat in the space I had designated for it, and because the pony drift was happening at the time of my sampling there were times when I had to at least make my presence known to already alarmed ponies.

The only environmental impact that I may have had was in trampling plants, some of which do not recover easily, but this was unavoidable and I did my best to not unnecessarily trample any plants, particularly fragile ones. Any disturbance I caused to an area would be too temporary to cause any impact, and I was careful not to litter of leave food anywhere.

Lab work

Obviously not being able to sample all the soil was the biggest problem I faced (especially having collected all the samples). This has also made my data more difficult to analyse (see below). Ideally I would have had the time and resources to sample all the soil, but even assuming this was impossible I should have investigated the lab work earlier, as I would have then known that I would not be able to analyse every sample. This would have meant that I could have carefully selected which samples I should take to be representative of the area, which would have also saved time. As it was I chose the sites in a hurry, leaving some 'holes' in my data that had to be estimated by looking at similar quadrats not as close by.

Burning organic content also proved to be difficult, as I found that if the flame was not directly beneath the crucible the contents would not burn, with very little margin of error. This meant that I had to repeat a high proportion of the analyses on my samples to get reliable results. This error would have been eliminated if I'd had access to a kiln or furnace, which I could have left at a high temperature for a long period of time similar to what I did when measuring moisture content, which produced far more accurate results.

By looking at the distribution of pH, I came to the conclusion that the measuring method is flawed. pH is put into set categories according to colour, but this method is very generalised and only really useful for comparing diverse soils against one and other. But most of my soils were recorded as pH4.0, which is the lowest on the scale. This indicates two things, one is that I would need a scale that went lower than pH4.0, and another is that I need a more precise method for measuring because most soils got the same value due to the heavily categorised system. There would be several methods for improvement, the easiest of which would be to find an indicator with a more limited range, as this system effectively uses universal indicator. Other methods include titrations and pH probes, both of which are time consuming and can be temperamental. So in a future study I would look for or devise a special kit for acid heathlands.

There were few safety issues with the lab-work as none of the chemicals or equipment I was using were particularly hazardous, although I did have to be careful about what was going on around me in the lab. I will have caused very little environmental impact because I was using very small volumes of chemical.

Data Analysis

Problems that I did not experience directly, but indirectly at a later stage, have been put in this category. Certainly the wide range of sites that I was working with has limited the potential of my study, even with 130 quadrats. This variety meant that once many variables were cancelled out the sample size was much smaller than originally, which decreased reliability. Also having a non-even spread of site ages to study meant that I could only draw conclusions about some ages – those with enough quadrats to analyse. Having more quadrats from the first few years would have helped enormously, as I only had one pre-3.5 year site, which meant that I could not analyse it because it was on its own and I had nothing to compare it to.

Testing my hypotheses would have required a wide spread of site ages in sites that were otherwise under conditions similar to each other, and then to test hypothesis 2 I would need another set under a different set of conditions. This could possibly be achieved if I was able to travel further and more often, finding the right combination by looking across a wider range of the New Forest, as the Forestry Commission manage all the heathland, of which there is a lot.

This was the main limitation, but it manifested itself in several different forms and making relationships difficult to identify in some cases.

The sparseness of analysed soils created problems later when I tried to find relationships between soil and other factors, because there was not always enough data. This is particularly annoying because I tried to avoid this by studying many quadrats but this has now been limited by the amount of soil samples I have been able to analyse.

Other Sources of Error

Any piece of equipment will produce error, but thankfully I did not use much equipment to acquire data. I expect the soil thermometer had quite a high percentage error, as it is a cheap graduated piece of equipment, and graduated equipment is normally quite inaccurate, as is cheap equipment – in this case the alcohol used in the thermometer may not be a particularly good indicator of temperature. I still think that the thermometer was accurate enough, and it produced predictable relationships (such as soil temperature vs. time of day). The balances used for weighing soil samples went to 2 decimal places, which is enough to eliminate any significant error that would actually influence my data and any trends within it, so there would be no need to go more precise.

Improvements

So the most significant improvement I would like would be to have a much larger range, where I could pick and choose which sites I wanted to use rather than being forced to use all the sites in a small area. As I have said, this would allow me to have a range of ages and control all other factors, but having many areas would also give flexibility to set up small studies into other phenomena, such as how the recovery in waterlogged areas differs.

An obvious improvement, which I consider to be an improvement rather than a correction to my method because it is more of a stretch, would be to analyse all soil samples. This would increase the accuracy when studying some of the relationships considerably and having more quadrats with full data would also increase the flexibility of the study.

I would like to have been able to measure some other soil properties, given the equipment to do so. One of the studies I looked at in the introduction measured various ion concentrations (e.g. Mg^{2+}). This would have been useful because it seemed with this study I was obliged to investigate any possible relationship in case it was the main factor influencing another variable; so with more variables I would be more likely to discover the main factors influencing particular variables. This would require more expensive equipment than what I had available to me.

Knowing now which species are the best to use in analyses, I could streamline my study by ignoring exact numbers of other species and just recording their presence. This would save much time and effort but requires the benefit of hindsight to look at which organisms are ‘indicator’ organisms.

Extensions

Although I was using a control area, it was still in a sense managed to some degree because it displayed characteristics of being burnt further back in time, and the same ‘artificial’ wildlife was present. What I would like to look at is how this heathland differed from completely natural heathland, such as that resulting from sand dune succession of the Isle of Purbeck. Here I could also study how heathland fits into pure uninterrupted primary succession and how much of the differences are down to this sort of succession.

As mentioned briefly above, with enough data on the relevant areas I could study how recovery differs in waterlogged parts of the heathland, which I could not do this time due to extreme lack of data. But with more areas to choose from I could deliberately select waterlogged quadrats for one section of the study; this would be an interesting investigation as are clearly a lot of factors that differ in waterlogged quadrats, resulting in a completely different system.

Uses and Applications of the Study

As discussed at the end of the interpretation, I have made a contribution to proving that burning of heathland is a justified management method for retaining this sort of habitat, and that burning should happen in the mid-teens (17 years in the case of this area). Given the amount of data I collected on plant numbers, there may be other applications for the raw data from this investigation, although it should be noted that although the replicate study has proven my estimation technique to be consistent, it may not indicate the real number of plants in the quadrat so should probably not be compared to others' data without the % mean calculation.

Ultimately there have been too many problems with my study to give any precise applications for the findings, as they are currently not reliable enough. If some of the corrections and improvements were followed then I might be able to find more meaning in the data. Currently it can only be used to back up theories/concepts rather than find new ones.

Bibliography

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   Aerial photography of study area.
   Larger scale maps indicating location of study area.

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   2007 1:10,000 orienteering map of study area (from Kevin Bracher).

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    Do New Forest Ponies eat birch?

11. OCR Maths Statistics Data Sheet
    Extensive Spearman's Rank critical values table.

12. Barcelona Field Studies Centre (http://geographyfieldwork.com/SpearmansRank.htm)
    Graph for predicting Spearman's Rank with higher sample sizes.

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1. Rachel Hughes and Mike Farrington (Brockenhurst College)
   Advice and support for coursework.
2. Dave Morris (Forestry Commission)
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3. Berry Stone (Forestry Commission)
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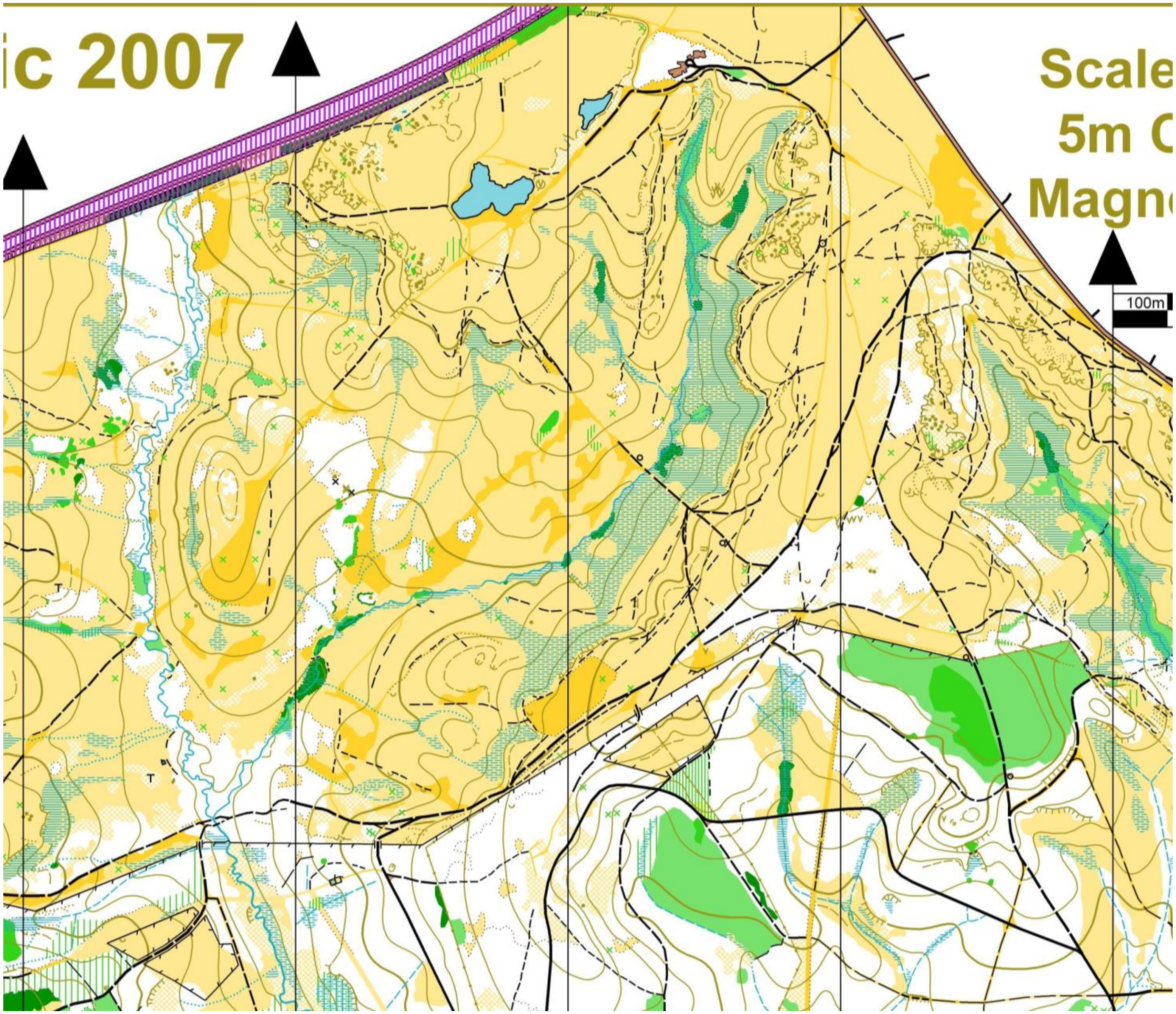
   Help on some of fieldwork, particularly in identifying species that I could not.
5. Dell Computers, Microsoft Office and Macromedia Flash
   Enabling me to process, publish and print my project.

Appendix Contents

Aerial Photograph



2007 Orienteering Map

Orange and cream indicate open areas.

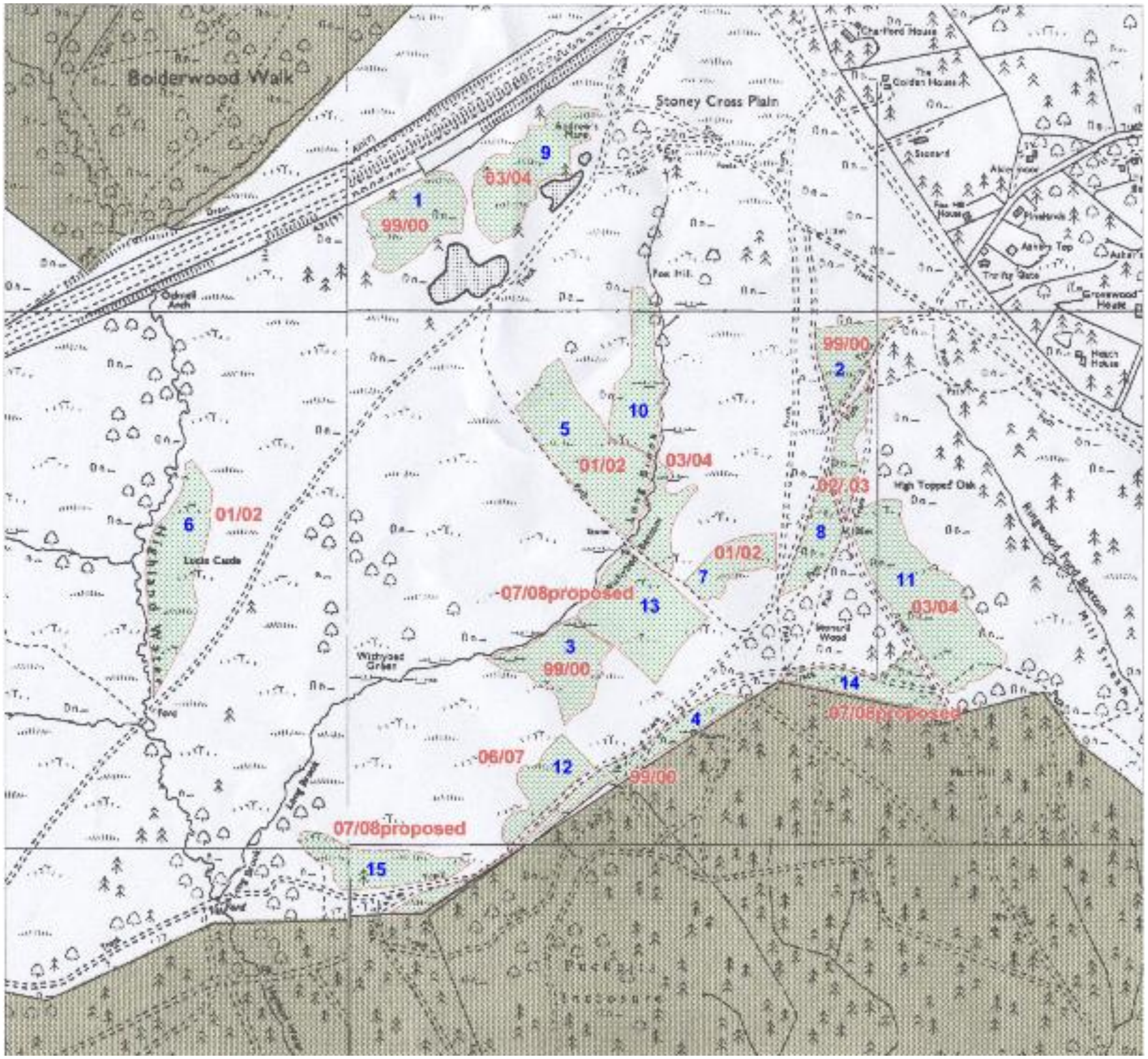
White indicates forested areas.

Green indicates thick vegetation.

Blue indicates water (dashed areas are marshes).

Brown lines are contours of other topographical features.

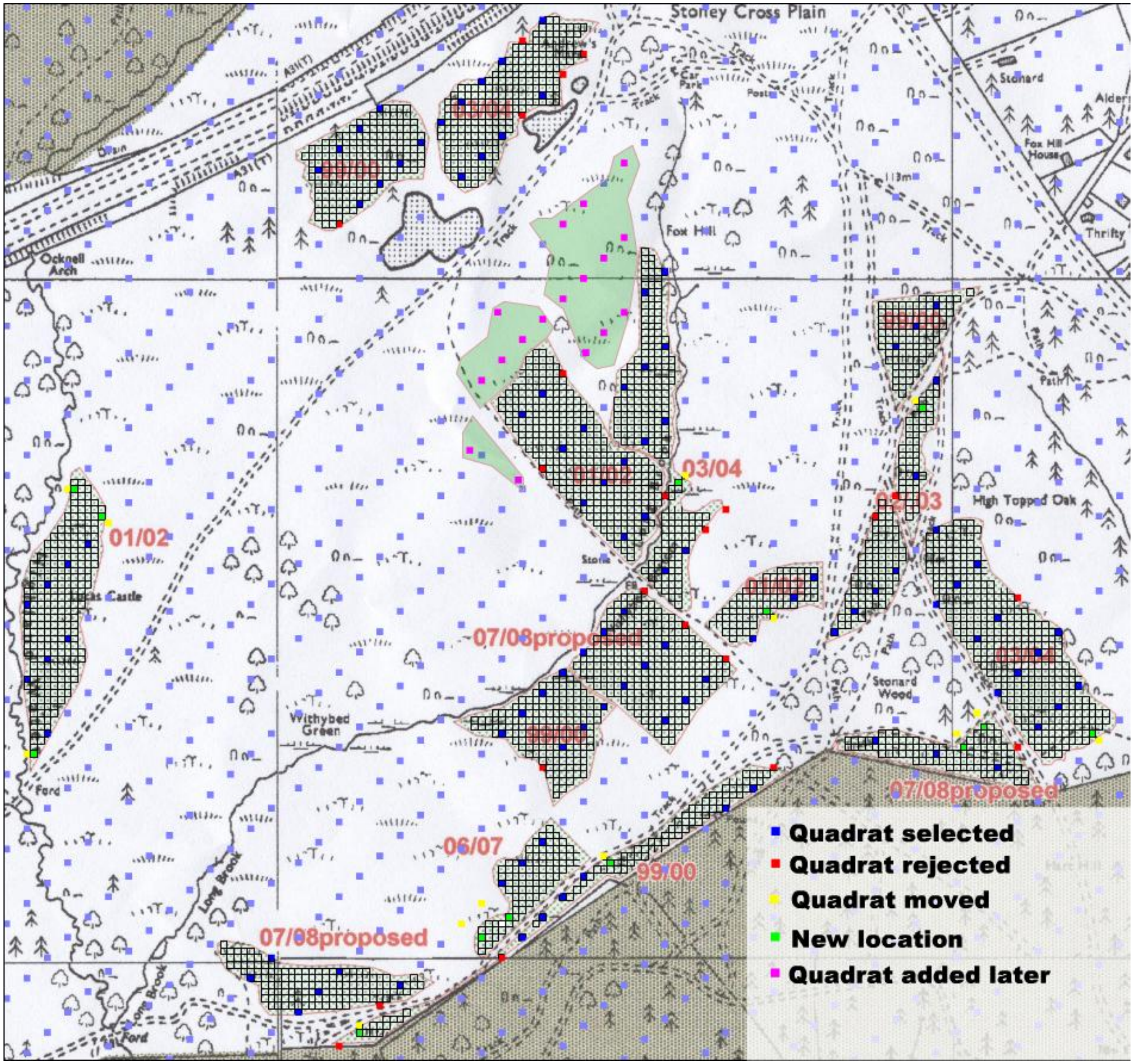
Appendix I



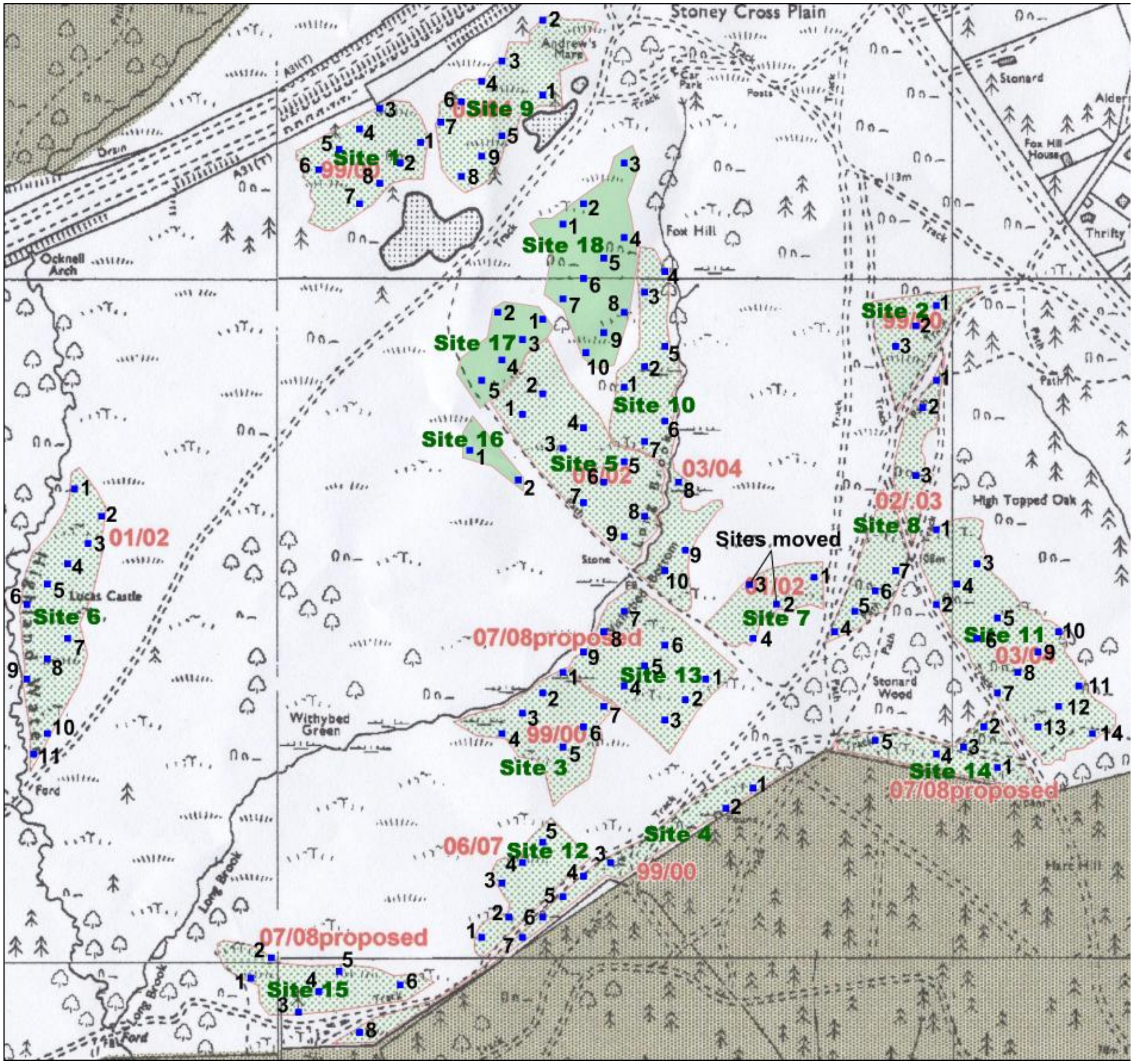
Forestry Commission Map

Contains details of management sites and when they were last burnt. Also contains the numbers that I assigned to each site.

Appendix I



Details of quadrat placement



Numbers and locations of each quadrat after sampling

Notes for Appendix II

- In the raw data and % mean sections, known soil data is shown as bold, projected data is grey, and on the rare occasion when data had to be projected from an unintended quadrat the values are underlined.
- The raw data section is just the data as I recorded it.
- The % mean section is similar but with the % mean calculation performed on all plant numbers, thus also enabling more central tendency calculations to be worked.
- The soil spreadsheet contains the raw data and subsequent calculations for soil moisture and organic content. It contains all other information on quadrats the soil of which was sampled – raw data first and then % mean below that.
- The anomaly part of the soil section indicates where error in burning off the organic content necessitated repeating the experiment.
- The central tendency calculations ignore values of 0.

Quadrat	1,1	1,2	1,3	1,4	1,5
Age (years)	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	110	110	110	105	105
Date Sampled	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007
Time Sampled	13:30	13:50	14:20	14:40	15:00
Soil Temperature/℃	22.50	24.00	23.00	25.25	24.00
Soil pH	4.0	4.0	**4.0**	4.0	4.0
Soil Moisture/%	35	35	**36.15**	35	20
Soil Organic Content/%	15	15	**13.18**	15	35
Calluna vulgaris	300	275	100	75	375
Erica tetralix	25	40	20		75
Erica cinerea	25	25			10
Agrostis spp.	20000	80000	95000	80000	40000
Molina caerulea	40000	1000	1000		5000
Deschampsia flexuosa					
Pteridium aquilinum					
Ulex europaeus	40	5	30		50
Rubus fruticosus			10		
Vaccinium myrtillus					
Vaccinium vitas-idaea		50			
Potentilla erecta	10	10	20		
Rumex acetosella					
Galium saxatile					
Hieracium umbellatum					
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.		2000			
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus	15			10	
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.					
Ilex aquifolium					
Quercus robur					
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes		50% wet, 50% dry		Hardly any soil at all	
Species	8	9	7	3	6

Quadrat	1,6	1,7	1,8	2,1	2,2
Age (years)	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	105	110	110	115	115
Date Sampled	05/09/2007	05/09/2007	05/09/2007	13/08/2007	13/08/2007
Time Sampled	15:25	15:45	16:10	13:00	13:35
Soil Temperature/℃	26.00	25.50	26.50	20.00	17.50
Soil pH	4.0	**4.0**	4.0	4.0	**4.0**
Soil Moisture/%	20	**20.85**	20	45	**46.77**
Soil Organic Content/%	35	**33.18**	35	35	**35.48**
Calluna vulgaris	450	325	400	100	25
Erica tetralix		10	10	100	100
Erica cinerea					
Agrostis spp.	35000	7500	55000	50000	20000
Molina caerulea	3000	1000	2500	10000	10000
Deschampsia flexuosa					
Pteridium aquilinum				1250	7000
Ulex europaeus	15	25	15	25	15
Rubus fruticosus			10	10	50
Vaccinium myrtillus					50
Vaccinium vitas-idaea					5
Potentilla erecta				50	30
Rumex acetosella					30
Galium saxatile					10
Hieracium umbellatum				50	
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus					
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.					
Ilex aquifolium					
Quercus robur					
Sorbus aucuparia				1	1
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes	Very thin soil	Only patches of soil			
Species	4	5	6	10	13

Quadrat	2,3	3,1	3,2	3,3	3,4	3,5
Age (years)	7.5	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	115	80	75	75	80	85
Date Sampled	13/08/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007
Time Sampled	14:25	16:30	16:55	17:20	17:45	18:15
Soil Temperature/°C	18.00	15.00	16.00	16.00	16.50	17.00
Soil pH	4.0	4.0	**4.0**	4.0	4.0	5.0
Soil Moisture/%	45	65	**65.69**	65	65	80
Soil Organic Content/%	35	10	**11.44**	10	10	15
Calluna vulgaris		150	200	75	100	15
Erica tetralix	20	50	25	25		275
Erica cinerea		50	25	50		275
Agrostis spp.	40000	7500	10000		35000	
Molina caerulea		25000	5000	100000	2000	100000
Deschampsia flexuosa						
Pteridium aquilinum	8500	3500	8500		5000	
Ulex europaeus						
Rubus fruticosus	250				15	
Vaccinium myrtillus						
Vaccinium vitas-idaea		15	30		20	
Potentilla erecta	75	50	50		25	
Rumex acetosella	100					
Galium saxatile	50					
Hieracium umbellatum						
Melampyrum pratense	5					
Digitalis purpurea						
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale		450	300	125	350	
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum				15		
Juncus squarrosus		3000	100			
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.				10		
Betula spp.						
Ilex aquifolium		5	10			
Quercus robur						
Sorbus aucuparia	1					
Malus sylvestris						
Pinus sylvestris						
Fagus sylvatica						
Notes						
Species	9	11	11	7	8	4

Quadrat	3,6	3,7	4,1	4,2	4,3	4,4
Age (years)	7.5	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	85	85	105	105	100	100
Date Sampled	22/09/2007	22/09/2007	21/08/2007	21/08/2007	02/09/2007	02/09/2007
Time Sampled	18:35	18:55	14:15	14:45	13:00	14:00
Soil Temperature/℃	17.50	15.75	17.50	17.00	21.50	17.50
Soil pH	**5.0**	5.0	4.5	4.5	**4.5**	4.5
Soil Moisture/%	**81.54**	80	50	50	**32.94**	35
Soil Organic Content/%	**13.39**	15	15	15	**33.33**	35
Calluna vulgaris	65	100	50	25	400	550
Erica tetralix	225	100	10		15	50
Erica cinerea	225	100				
Agrostis spp.	2000		10000	50000	30000	5000
Molina caerulea	80000	60000			1500	5000
Deschampsia flexuosa						
Pteridium aquilinum	40		3500	5000	200	300
Ulex europaeus	5				20	50
Rubus fruticosus			100	100		
Vaccinium myrtillus			2000	250		
Vaccinium vitas-idaea	10			35		
Potentilla erecta				25		
Rumex acetosella				200	1000	25
Galium saxatile				150	100	50
Hieracium umbellatum				10	15	
Melampyrum pratense						
Digitalis purpurea						
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale	125	200				
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum	5	20				
Juncus squarrosus						
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.			200	25		
Ilex aquifolium			20			
Quercus robur						
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris			5			
Fagus sylvatica			5			
Notes						
Species	10	6	10	11	9	8

Appendix II - Raw Data

Quadrat	4,5	4,6	4,7	4,8	5,1	5,2
Age (years)	7.5	7.5	7.5	7.5	5.5	5.5
Altitude (nearest 5m)	100	95	95	85	100	100
Date Sampled	02/09/2007	02/09/2007	02/09/2007	02/09/2007	05/09/2007	05/09/2007
Time Sampled	14:30	15:00	15:30	16:00	16:45	17:15
Soil Temperature/℃	20.00	19.25	18.00	17.50	20.50	23.50
Soil pH	4.5	4.0	4.0	**4.0**	4.0	**4.0**
Soil Moisture/%	35	45	45	**42.68**	25	**26.04**
Soil Organic Content/%	35	15	15	**14.63**	5	**6.01**
Calluna vulgaris	575	425	425	375	75	50
Erica tetralix	175	50	25	150	125	575
Erica cinerea	20		25	25	150	250
Agrostis spp.	60000	1000	50000	20000		
Molina caerulea	500	9000	5000	3000	100000	50000
Deschampsia flexuosa						
Pteridium aquilinum	125	50	50	25		
Ulex europaeus	15	15	5	20	20	
Rubus fruticosus						
Vaccinium myrtillus			10		5	
Vaccinium vitas-idaea				5		
Potentilla erecta	50		100			
Rumex acetosella	20					
Galium saxatile						
Hieracium umbellatum						
Melampyrum pratense						
Digitalis purpurea						
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale						
Euphorium nemorosa						
Scirpus caespitosa					1000	
Narthecium ossifragum					40	
Juncus squarrosus						
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.			15	10		
Ilex aquifolium			5		5	
Quercus robur						
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris		3	3	20	10	
Fagus sylvatica						
Notes		Thin soil. Animal tracks.	Animal tracks			
Species	9	7	12	10	10	4

Quadrat	5,3	5,4	5,5	5,6	5,7
Age (years)	5.5	5.5	5.5	5.5	5.5
Altitude (nearest 5m)	95	95	90	90	90
Date Sampled	07/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007
Time Sampled	09:15	09:45	13:45	14:10	14:30
Soil Temperature/℃	17.25	15.50	24.00	22.50	24.00
Soil pH	4.0	4.0	4.5	4.5	4.5
Soil Moisture/%	25	25	45	45	45
Soil Organic Content/%	5	5	10	10	10
Calluna vulgaris	75	150	75	250	300
Erica tetralix	25	150	25	25	30
Erica cinerea	25	150	50	50	35
Agrostis spp.	20000		35000	4250	25000
Molina caerulea	500	50000	7500	2000	2500
Deschampsia flexuosa					
Pteridium aquilinum	1000	500	10	4000	3500
Ulex europaeus	5			50	50
Rubus fruticosus				150	100
Vaccinium myrtillus		10			
Vaccinium vitas-idaea				30	200
Potentilla erecta	50	100	50	125	100
Rumex acetosella	4000	500	50		50
Galium saxatile					
Hieracium umbellatum					
Melampyrum pratense					
Digitalis purpurea			25		
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia				100	25
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale		50	200		
Euphorium nemorosa					
Scirpus caespitosa		500	100		
Narthecium ossifragum		5			
Juncus squarrosus		250	200		
Andromeda polifolia		50			
Pinguicula vulgaris			5		
Hypericum elodes			50		
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.		35			
Ilex aquifolium					
Quercus robur					
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes					
Species	9	14	14	11	12

Quadrat	5,8	5,9	6,1	6,2	6,3	6,4
Age (years)	5.5	5.5	5.5	5.5	5.5	5.5
Altitude (nearest 5m)	85	85	70	75	75	75
Date Sampled	07/09/2007	07/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007
Time Sampled	14:50	15:05	09:30	09:55	10:15	10:35
Soil Temperature/℃	22.25	25.00	14.00	15.50	15.00	14.00
Soil pH	**4.5**	4.5	5.0	**5.0**	5.0	5.0
Soil Moisture/%	**46.35**	45	40	**37.64**	40	40
Soil Organic Content/%	**10.67**	10	25	**26.20**	25	25
Calluna vulgaris	200	75	150	50	50	425
Erica tetralix	25	10	35		15	100
Erica cinerea	50	10			5	100
Agrostis spp.	75000	6750	55000	80000	90000	40000
Molina caerulea	500	250	750		250	3000
Deschampsia flexuosa						
Pteridium aquilinum		800	3250	2500	100	400
Ulex europaeus	30	20	10		35	
Rubus fruticosus	10	15		40		
Vaccinium myrtillus						
Vaccinium vitas-idaea	15	35				
Potentilla erecta	250	65	300	100	60	50
Rumex acetosella	50	75				
Galium saxatile						
Hieracium umbellatum	40	20				
Melampyrum pratense						
Digitalis purpurea		5		5		
Cytisus scoparius						
Mentha spp.				40		
Polygala serpyllifolia		5				
Lonicera spp.						
Sedum spp.						
Viola palustris				40		
Myrica gale						
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum						
Juncus squarrosus						
Andromeda polifolia						
Pinguicula vulgaris	25	50				
Hypericum elodes				40		
Lobelia dortmanna	5					
Potamogeton spp.						
Betula spp.						
Ilex aquifolium						
Quercus robur						
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris						
Fagus sylvatica						
Notes						
Species	13	15	7	9	8	7

Quadrat	6,5	6,6	6,7	6,8	6,9	6,10	6,11
Age (years)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Altitude (nearest 5m)	70	65	75	70	65	65	65
Date Sampled	23/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007
Time Sampled	11:00	11:20	11:40	12:05	12:30	12:50	13:10
Soil Temperature/℃	14.50	15.00	15.00	15.50	16.50	15.75	16.00
Soil pH	4.0	**4.0**	4.0	4.0	4.5	4.5	**4.5**
Soil Moisture/%	60	**59.69**	60	60	25	25	**27.04**
Soil Organic Content/%	15	**13.78**	15	15	5	5	**4.40**
Calluna vulgaris	175	275	200	75	100	50	150
Erica tetralix	75	75	75	25	50		10
Erica cinerea	25	50	75		25		10
Agrostis spp.	25000	55000	50000	15000	30000	20000	65000
Molina caerulea	4000	2000	1000		1000		750
Deschampsia flexuosa							
Pteridium aquilinum	3250	3500	1500	10000	8000	2500	7500
Ulex europaeus	30	25			20		
Rubus fruticosus		75	15	50		100	
Vaccinium myrtillus				10			
Vaccinium vitas-idaea		10					
Potentilla erecta	100	250	50	125	100		250
Rumex acetosella							500
Galium saxatile							
Hieracium umbellatum							5
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus	25		500		125		
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.		10					
Ilex aquifolium							
Quercus robur				5			
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes							
Species	9	11	9	8	9	4	9

Quadrat	7,1	7,2	7,3	7,4	8,1
Age (years)	5.5	5.5	5.5	5.5	4.5
Altitude (nearest 5m)	115	110	100	105	115
Date Sampled	17/08/2007	17/08/2007	17/08/2007	17/08/2007	13/08/2007
Time Sampled	13:50	14:15	14:35	14:55	14:50
Soil Temperature/℃	20.00	20.00	18.00	17.50	25.50
Soil pH	4.0	4.0	4.0	**4.0**	4.0
Soil Moisture/%	65	65	65	**64.21**	5
Soil Organic Content/%	15	15	15	**12.89**	70
Calluna vulgaris	575	600	500	425	225
Erica tetralix	150	200	200	50	100
Erica cinerea	100		25	150	5
Agrostis spp.	2000	1000		1000	60000
Molina caerulea	2500	100	4000	5000	1500
Deschampsia flexuosa					
Pteridium aquilinum	20		125	100	200
Ulex europaeus	20		25	30	30
Rubus fruticosus		50			25
Vaccinium myrtillus		10			
Vaccinium vitas-idaea					10
Potentilla erecta					10
Rumex acetosella					
Galium saxatile					
Hieracium umbellatum					
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus					
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.					
Ilex aquifolium	2	20			2
Quercus robur	5				
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes		Holly dense in one area - this area has higher biodiversity.			
Species	9	7	6	7	11

Quadrat	8,2	8,3	8,4	8,5	8,6
Age (years)	4.5	4.5	4.5	4.5	4.5
Altitude (nearest 5m)	115	115	115	115	115
Date Sampled	13/08/2007	13/08/2007	17/08/2007	17/08/2007	17/08/2007
Time Sampled	15:15	15:40	11:30	11:55	12:15
Soil Temperature/°C	21.50	22.00	19.00	19.00	19.00
Soil pH	**4.0**	4.0	**4.0**	4.0	4.0
Soil Moisture/%	**7.41**	5	**66.95**	65	65
Soil Organic Content/%	**70.37**	70	**10.26**	10	10
Calluna vulgaris	250	10	100	250	375
Erica tetralix	75		100	100	150
Erica cinerea	10				
Agrostis spp.	20000	1000	80000	20000	10000
Molina caerulea	1250				
Deschampsia flexuosa					
Pteridium aquilinum	600	25	150	100	150
Ulex europaeus	45	20	75	25	
Rubus fruticosus	30	100	10	20	
Vaccinium myrtillus	35	5		1000	2000
Vaccinium vitas-idaea		20		10	
Potentilla erecta	15		200		10
Rumex acetosella		1000			
Galium saxatile	20		50		
Hieracium umbellatum			50	10	
Melampyrum pratense					
Digitalis purpurea		100			
Cytisus scoparius					
Mentha spp.		15			
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus					
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.	5	20		40	50
Ilex aquifolium		1			10
Quercus robur		5		5	
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes		Area impovershed & bare. R. acetosella were very small with yellow leaves			
Species	12	13	9	11	8

Quadrat	8,7	9,1	9,2	9,3	9,4
Age (years)	4.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	115	110	110	110	110
Date Sampled	17/08/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007
Time Sampled	13:20	09:15	09:40	10:05	10:30
Soil Temperature/℃	21.50	16.25	18.75	18.50	20.25
Soil pH	4.0	**5.5**	5.5	5.5	5.5
Soil Moisture/%	65	**36.92**	35	35	35
Soil Organic Content/%	10	**18.97**	20	20	20
Calluna vulgaris	35	450	325	275	200
Erica tetralix	10	150	25	10	5
Erica cinerea		75	25	25	10
Agrostis spp.	60000	40000	70000	80000	85000
Molina caerulea		10000	20000	5000	4000
Deschampsia flexuosa		20			
Pteridium aquilinum	75				
Ulex europaeus	10	5	10	15	5
Rubus fruticosus	100				5
Vaccinium myrtillus	2000				
Vaccinium vitas-idaea					
Potentilla erecta	200				
Rumex acetosella	1500				
Galium saxatile	1000				
Hieracium umbellatum					
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.	10				
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus					
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.	30				
Ilex aquifolium					
Quercus robur	5				
Sorbus aucuparia	1				
Malus sylvestris					
Pinus sylvestris		2			
Fagus sylvatica					
Notes	Many dead plants with red leaves - area possibly burnt illegally. Young plants.	Shallow soil	Shallow soil	Shallow soil	Shallow soil
Species	14	8	6	6	7

Quadrat	9,5	9,6	9,7	9,8	9,9
Age (years)	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	110	110	110	110	110
Date Sampled	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007
Time Sampled	11:00	11:25	11:50	12:15	12:35
Soil Temperature/℃	18.00	25.50	26.00	23.00	19.50
Soil pH	4.0	4.0	**4.0**	4.0	4.0
Soil Moisture/%	45	45	**46.90**	45	45
Soil Organic Content/%	40	40	**42.07**	40	40
Calluna vulgaris	550	375	200	350	425
Erica tetralix	10	35	25	50	25
Erica cinerea	5				
Agrostis spp.	25000	50000	85000	70000	30000
Molina caerulea	1000	2000	1250	2500	3250
Deschampsia flexuosa					
Pteridium aquilinum					
Ulex europaeus		25	15	30	
Rubus fruticosus			5	10	
Vaccinium myrtillus					
Vaccinium vitas-idaea				5	2
Potentilla erecta					
Rumex acetosella					
Galium saxatile					
Hieracium umbellatum					
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus				5	
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.					
Ilex aquifolium					
Quercus robur					
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris	5				5
Fagus sylvatica					
Notes	Shallow soil	Shallow soil	Shallow soil	Shallow soil	Shallow soil
Species	6	5	6	8	6

Quadrat	**10,1**	**10,2**	**10,3**	**10,4**	**10,5**	**10,6**
Age (years)	3.5	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	95	100	105	105	100	90
Date Sampled	22/09/2007	22/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007
Time Sampled	12:00	12:20	11:05	11:30	11:55	12:20
Soil Temperature/℃	16.75	19.00	19.00	22.00	18.25	20.75
Soil pH	4.0	**4.0**	4.0	4.0	4.0	4.0
Soil Moisture/%	50	**51.21**	50	50	50	80
Soil Organic Content/%	30	**31.40**	30	30	30	15
Calluna vulgaris	10	50	50	100	75	25
Erica tetralix		10	25	30	50	35
Erica cinerea		5	125	10	25	50
Agrostis spp.		70000	40000	50000	70000	15000
Molina caerulea		2500		250	250	50000
Deschampsia flexuosa						
Pteridium aquilinum	7000	2000	3000	7500	3500	
Ulex europaeus		35		10		
Rubus fruticosus	350	100		50	100	
Vaccinium myrtillus			10			
Vaccinium vitas-idaea	200	25			150	
Potentilla erecta	25	25	25	100	200	150
Rumex acetosella						
Galium saxatile			50			
Hieracium umbellatum						
Melampyrum pratense						
Digitalis purpurea						25
Cytisus scoparius						
Mentha spp.	15					
Polygala serpyllifolia			25	35		
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale				30		500
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum						
Juncus squarrosus					25	
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.	35					
Ilex aquifolium						
Quercus robur						
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris						
Fagus sylvatica						10
Notes						
Species	7	10	9	11	10	9

Quadrat	10,7	10,8	10,9	10,10	11,1
Age (years)	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	90	95	95	95	115
Date Sampled	07/09/2007	07/09/2007	07/09/2007	07/09/2007	13/08/2007
Time Sampled	13:15	15:25	15:45	16:05	16:10
Soil Temperature/℃	22.00	20.50	19.50	20.00	18.00
Soil pH	4.0	4.0	4.0	**4.0**	4.0
Soil Moisture/%	50	80	80	**79.09**	75
Soil Organic Content/%	30	15	15	**13.24**	15
Calluna vulgaris	25	250	25	60	375
Erica tetralix		75	50	50	100
Erica cinerea		15	50	25	
Agrostis spp.	30000	5000		10000	250
Molina caerulea		40000	10000	30000	750
Deschampsia flexuosa					
Pteridium aquilinum	10000			5	450
Ulex europaeus					15
Rubus fruticosus	100	5		50	10
Vaccinium myrtillus	250				30
Vaccinium vitas-idaea	25	50		20	
Potentilla erecta		50		20	
Rumex acetosella	250	50			
Galium saxatile					
Hieracium umbellatum					
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia					
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale		375	100	600	
Euphorium nemorosa					
Scirpus caespitosa			10000		
Narthecium ossifragum		5	40		
Juncus squarrosus			80000	200	
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.		5			5
Ilex aquifolium		2		5	1
Quercus robur					
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes					
Species	7	13	8	12	10

Quadrat	11,2	11,3	11,4	11,5	11,6
Age (years)	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	115	110	110	105	110
Date Sampled	13/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007
Time Sampled	16:40	10:00	10:30	11:00	11:25
Soil Temperature/℃	17.50	18.00	17.00	17.25	18.00
Soil pH	4.0	4.0	**4.0**	4.0	4.0
Soil Moisture/%	75	75	**73.91**	75	75
Soil Organic Content/%	15	15	**16.02**	15	15
Calluna vulgaris	200	500	75	200	30
Erica tetralix	50	50	75	100	75
Erica cinerea	15			15	
Agrostis spp.	30000	8000	50000	70000	50000
Molina caerulea	10000	200	10000	250	250
Deschampsia flexuosa					
Pteridium aquilinum	4000	100	3000	500	2500
Ulex europaeus	30	10	15	5	20
Rubus fruticosus	50		150	30	50
Vaccinium myrtillus	5	30			200
Vaccinium vitas-idaea	5			30	5
Potentilla erecta			100	100	200
Rumex acetosella	500		250	20	50
Galium saxatile			100		50
Hieracium umbellatum			15		
Melampyrum pratense					
Digitalis purpurea					
Cytisus scoparius					
Mentha spp.					
Polygala serpyllifolia			2		
Lonicera spp.					
Sedum spp.					
Viola palustris					
Myrica gale					
Euphorium nemorosa					
Scirpus caespitosa					
Narthecium ossifragum					
Juncus squarrosus					
Andromeda polifolia					
Pinguicula vulgaris					
Hypericum elodes					
Lobelia dortmanna					
Potamogeton spp.					
Betula spp.	5				
Ilex aquifolium					3
Quercus robur					
Sorbus aucuparia					
Malus sylvestris					
Pinus sylvestris					
Fagus sylvatica					
Notes					
Species	12	7	12	11	13

Quadrat	11,7	11,8	11,9	11,10	11,11	11,12
Age (years)	3.5	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	110	110	110	100	110	110
Date Sampled	15/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007
Time Sampled	11:50	15:15	15:45	16:15	16:45	17:15
Soil Temperature/℃	18.00	16.75	17.00	17.00	17.50	16.50
Soil pH	4.5	4.5	**4.5**	4.5	4.5	4.5
Soil Moisture/%	75	75	**73.99**	75	75	75
Soil Organic Content/%	20	20	**21.11**	20	20	20
Calluna vulgaris	50	50	250	35	25	10
Erica tetralix	5	10	50	50	75	15
Erica cinerea				10	20	
Agrostis spp.	10000	4000	2500	40000	10000	10000
Molina caerulea			300	1000	1000	
Deschampsia flexuosa						
Pteridium aquilinum	6500	8000	1500	3750	1500	8500
Ulex europaeus			5	10	10	20
Rubus fruticosus				25	150	2500
Vaccinium myrtillus	100	1500	2500	100	1000	2000
Vaccinium vitas-idaea				10		10
Potentilla erecta				50		
Rumex acetosella	75			50		500
Galium saxatile				50	100	100
Hieracium umbellatum		5				5
Melampyrum pratense						
Digitalis purpurea						
Cytisus scoparius	1					
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						20
Sedum spp.						
Viola palustris						
Myrica gale						
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum						
Juncus squarrosus						
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.	50		10		5	100
Ilex aquifolium		10		10		
Quercus robur				1		
Sorbus aucuparia						
Malus sylvestris		2				
Pinus sylvestris	1					
Fagus sylvatica						
Notes	Shallow soil					
Species	9	8	8	15	11	13

Quadrat	11,13	11,14	12,1	12,2	12,3	12,4
Age (years)	3.5	3.5	0.5	0.5	0.5	0.5
Altitude (nearest 5m)	110	105	90	95	90	95
Date Sampled	15/08/2007	15/08/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007
Time Sampled	17:45	18:10	13:45	14:10	14:35	14:55
Soil Temperature/℃	18.00	17.50	17.00	14.75	17.75	17.00
Soil pH	4.5	**5.0**	4.5	4.0	**4.5**	4.5
Soil Moisture/%	75	**52.72**	45	60	**44.25**	45
Soil Organic Content/%	20	**11.14**	50	35	**48.67**	50
Calluna vulgaris	50	3	625	175	175	300
Erica tetralix	10		85	175	15	75
Erica cinerea			85	175	15	25
Agrostis spp.	20000	1000				
Molina caerulea			7500	80000	5000	10000
Deschampsia flexuosa						
Pteridium aquilinum	5000	2500			200	
Ulex europaeus					10	5
Rubus fruticosus	50	75				
Vaccinium myrtillus	1500					
Vaccinium vitas-idaea		75				
Potentilla erecta	50	35				
Rumex acetosella	300					
Galium saxatile						
Hieracium umbellatum	50	5				
Melampyrum pratense	2					
Digitalis purpurea						
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale						
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum						
Juncus squarrosus				500		
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.	10		1			
Ilex aquifolium	2	15				
Quercus robur		1				
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris			10			
Fagus sylvatica						
Notes			Beehives close by	Beehives close by	Area still half dead, higher diversity in a sunken patch.	Thin vegetation
Species	12	9	6	5	6	5

Quadrat	12,5	13,1	13,2	13,3	13,4	13,5
Age (years)	0.5	16.5	16.5	16.5	16.5	16.5
Altitude (nearest 5m)	95	100	100	100	85	90
Date Sampled	23/09/2007	17/08/2007	17/08/2007	17/08/2007	17/08/2007	17/08/2007
Time Sampled	15:15	15:40	16:00	16:20	16:45	17:05
Soil Temperature/℃	17.25	16.25	17.50	15.75	16.00	15.75
Soil pH	4.5	**4.0**	4.0	4.0	4.0	4.0
Soil Moisture/%	45	**65.88**	65	65	65	65
Soil Organic Content/%	50	**14.70**	15	15	15	15
Calluna vulgaris	300	600	625	600	475	425
Erica tetralix	125		5	10	15	50
Erica cinerea	25				75	75
Agrostis spp.						
Molina caerulea	8000				6000	10000
Deschampsia flexuosa						
Pteridium aquilinum		500	5	200		
Ulex europaeus	5				30	30
Rubus fruticosus						
Vaccinium myrtillus						
Vaccinium vitas-idaea						
Potentilla erecta						
Rumex acetosella						
Galium saxatile						
Hieracium umbellatum						
Melampyrum pratense						
Digitalis purpurea						
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale						
Euphorium nemorosa						
Scirpus caespitosa						
Narthecium ossifragum						
Juncus squarrosus						
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.						
Ilex aquifolium						
Quercus robur						
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris						
Fagus sylvatica						
Notes	Thin vegetation					
Species	5	2	3	3	5	5

Quadrat	13,6	13,7	13,8	13,9	14,1	14,2
Age (years)	16.5	16.5	16.5	16.5	16.5	16.5
Altitude (nearest 5m)	90	80	80	80	110	110
Date Sampled	17/08/2007	07/09/2007	22/09/2007	22/09/2007	17/08/2007	17/08/2007
Time Sampled	17:25	16:35	15:30	15:55	09:00	09:25
Soil Temperature/℃	16.25	18.50	15.00	16.75	14.50	15.25
Soil pH	4.0	**4.0**	4.0	4.0	4.5	4.5
Soil Moisture/%	65	**80.28**	80	80	50	50
Soil Organic Content/%	15	**15.00**	15	15	15	15
Calluna vulgaris	400	375	100	75	200	125
Erica tetralix		50	75	50	40	4
Erica cinerea	50	25	50	50		
Agrostis spp.		5000			10000	5000
Molina caerulea	2250	5000	75000	75000		
Deschampsia flexuosa			100			
Pteridium aquilinum		10			2500	6000
Ulex europaeus					50	
Rubus fruticosus		35			250	200
Vaccinium myrtillus					1250	2000
Vaccinium vitas-idaea		100				
Potentilla erecta		100	150	50		
Rumex acetosella						150
Galium saxatile					750	200
Hieracium umbellatum					50	5
Melampyrum pratense					20	
Digitalis purpurea						
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.						
Viola palustris						
Myrica gale		450	200	250		
Euphorium nemorosa						
Scirpus caespitosa			100			
Narthecium ossifragum			100	50		
Juncus squarrosus			3000	5000		
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes				35		
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.					40	150
Ilex aquifolium						
Quercus robur					10	10
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris						
Fagus sylvatica						
Notes	Site included several animal tracks - less plants.				More moss than other areas	More moss than other areas
Species	3	10	10	9	12	11

Quadrat	14,3	14,4	14,5	15,1	15,2	15,3
Age (years)	16.5	16.5	16.5	16.5	16.5	16.5
Altitude (nearest 5m)	110	110	110	70	70	75
Date Sampled	17/08/2007	17/08/2007	17/08/2007	04/09/2007	04/09/2007	04/09/2007
Time Sampled	10:00	10:25	11:00	14:30	15:00	15:30
Soil Temperature/°C	15.00	18.50	23.00	20.00	20.00	17.00
Soil pH	4.5	4.5	**4.5**	7.0	7.0	**7.0**
Soil Moisture/%	50	50	**50.52**	70	70	**69.09**
Soil Organic Content/%	15	15	**16.26**	10	10	**9.14**
Calluna vulgaris	350	150	25	175	200	325
Erica tetralix	50	75		15	50	10
Erica cinerea				5		10
Agrostis spp.	2000	20000	55000	80000	70000	10000
Molina caerulea				5000	2000	10000
Deschampsia flexuosa						
Pteridium aquilinum	250	2000	5000	300	350	500
Ulex europaeus		5	5	20	10	
Rubus fruticosus	100	400	100			
Vaccinium myrtillus	500	1250	50			5
Vaccinium vitas-idaea			5			
Potentilla erecta	10	125		500	300	50
Rumex acetosella	100		150	59		
Galium saxatile	100	50	50	150		
Hieracium umbellatum			10	400	400	
Melampyrum pratense		5				
Digitalis purpurea				30	20	
Cytisus scoparius						
Mentha spp.			125			
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.				20	40	
Viola palustris					50	
Myrica gale						20
Euphorium nemorosa						10
Scirpus caespitosa						
Narthecium ossifragum						
Juncus squarrosus						
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.	100	5	20	5		5
Ilex aquifolium	5					20
Quercus robur	15	5	5	20		5
Sorbus aucuparia						
Malus sylvestris						
Pinus sylvestris	10					5
Fagus sylvatica						1
Notes			Definite boundary between bracken & grass			Large scots pine.
Species	13	12	13	15	11	15

Quadrat	15,4	15,5	15,6	16,1	16,2	17,1
Age (years)	16.5	16.5	16.5	25.0	25.0	25.0
Altitude (nearest 5m)	75	75	80	95	95	105
Date Sampled	04/09/2007	04/09/2007	04/09/2007	22/09/2007	22/09/2007	22/09/2007
Time Sampled	16:00	16:30	17:00	14:30	14:55	12:40
Soil Temperature/℃	15.00	18.50	21.00	16.00	16.00	18.25
Soil pH	4.0	5.0	**5.0**	4.0	**4.0**	5.0
Soil Moisture/%	80	20	**22.46**	65	**62.64**	55
Soil Organic Content/%	15	10	**10.18**	20	**17.98**	20
Calluna vulgaris	100	400	100	600	450	550
Erica tetralix		50	30	75	75	75
Erica cinerea	100	25	20	75	25	25
Agrostis spp.		40000	85000		7500	500
Molina caerulea	10000			6000	2500	10000
Deschampsia flexuosa						
Pteridium aquilinum	150	300	150	40	20	25
Ulex europaeus		40	10	10		5
Rubus fruticosus						
Vaccinium myrtillus					400	
Vaccinium vitas-idaea	10	20				
Potentilla erecta		250	200			
Rumex acetosella						
Galium saxatile						
Hieracium umbellatum		200	100			
Melampyrum pratense						
Digitalis purpurea		10				
Cytisus scoparius						
Mentha spp.						
Polygala serpyllifolia						
Lonicera spp.						
Sedum spp.		25				
Viola palustris		15	35			
Myrica gale	100					
Euphorium nemorosa						
Scirpus caespitosa	2000					
Narthecium ossifragum	10					
Juncus squarrosus	21250					
Andromeda polifolia						
Pinguicula vulgaris						
Hypericum elodes						
Lobelia dortmanna						
Potamogeton spp.						
Betula spp.	10					
Ilex aquifolium						
Quercus robur						
Sorbus aucuparia						
Malus sylvestris			1			
Pinus sylvestris						3
Fagus sylvatica						
Notes			Large rowan			
Species	10	12	10	6	7	8

Quadrat	**17,2**	**17,3**	**17,4**	**17,5**	**18,1**	**18,2**	**18,3**
Age (years)	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Altitude (nearest 5m)	110	105	105	105	110	110	110
Date Sampled	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007
Time Sampled	13:10	13:30	13:50	14:10	09:00	09:25	09:45
Soil Temperature/℃	18.75	17.00	17.75	18.50	16.00	16.25	16.25
Soil pH	5.0	5.0	**5.0**	5.0	4.0	**4.0**	4.0
Soil Moisture/%	55	55	**54.79**	55	40	**37.50**	40
Soil Organic Content/%	20	20	**18.86**	20	20	**19.27**	20
Calluna vulgaris	475	500	525	550	350	200	300
Erica tetralix	150	75	50	100	25		
Erica cinerea		10		10			
Agrostis spp.					1000	25000	5000
Molina caerulea	9000	15000	8500	20000			1000
Deschampsia flexuosa							
Pteridium aquilinum	70	40	150	200	3000	5000	4000
Ulex europaeus		5		10		15	10
Rubus fruticosus						20	50
Vaccinium myrtillus					200	1500	1000
Vaccinium vitas-idaea							
Potentilla erecta							
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum						20	
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes							
Species	4	6	4	6	5	7	7

Quadrat	18,4	18,5	18,6	18,7	18,8	18,9	18,10
Age (years)	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Altitude (nearest 5m)	110	110	105	105	105	100	95
Date Sampled	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007	07/09/2007	07/09/2007
Time Sampled	10:10	10:30	10:50	11:10	11:35	10:40	10:15
Soil Temperature/°C	16.25	16.00	16.25	17.25	19.50	19.00	18.00
Soil pH	4.0	4.0	4.0	4.0	4.0	4.0	**4.0**
Soil Moisture/%	40	40	50	50	50	50	**50.74**
Soil Organic Content/%	20	20	25	25	25	25	**25.62**
Calluna vulgaris	125	575	425	600	575	600	500
Erica tetralix	25	10	15	75	50	125	50
Erica cinerea						10	25
Agrostis spp.	15000	500		100			
Molina caerulea	1500		3000	200	5000	2500	2000
Deschampsia flexuosa							
Pteridium aquilinum	6000	1500	3500	60	100	250	1500
Ulex europaeus						3	25
Rubus fruticosus							
Vaccinium myrtillus	200	200	250				
Vaccinium vitas-idaea	10						
Potentilla erecta							
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium		5	20				
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris						2	
Fagus sylvatica							
Notes							Large path running through quadrat
Species	7	6	6	5	4	7	6

Quadrat					
Age (years)					
Altitude (nearest 5m)					
Date Sampled					
Time Sampled					
	Mean		**Standard Deviation**	**Minimum Value**	**Lower Quartile**
Soil Temperature/°C	18.55		2.97	14.00	16.25
Soil pH	4.34		0.57	4.00	4.00
Soil Moisture/%					
Soil Organic Content/%					
	Mean	**Frequency (/132)**			
Calluna vulgaris	254	130			
Erica tetralix	65	115			
Erica cinerea	51	72			
Agrostis spp.	33164	100			
Molina caerulea	13258	98			
Deschampsia flexuosa	60	2			
Pteridium aquilinum	2308	95			
Ulex europaeus	20	74			
Rubus fruticosus	124	52			
Vaccinium myrtillus	652	39			
Vaccinium vitas-idaea	36	35			
Potentilla erecta	102	58			
Rumex acetosella	400	29			
Galium saxatile	159	20			
Hieracium umbellatum	70	21			
Melampyrum pratense	8	4			
Digitalis purpurea	28	8			
Cytisus scoparius	1	1			
Mentha spp.	41	5			
Polygala serpyllifolia	32	6			
Lonicera spp.	20	1			
Sedum spp.	521	4			
Viola palustris	35	4			
Myrica gale	246	18			
Euphorium nemorosa	10	1			
Scirpus caespitosa	2283	6			
Narthecium ossifragum	29	10			
Juncus squarrosus	6718	17			
Andromeda polifolia	50	1			
Pinguicula vulgaris	27	3			
Hypericum elodes	42	3			
Lobelia dortmanna	5	1			
Potamogeton spp.	10	1			
Betula spp.	35	29			
Ilex aquifolium	8	22			
Quercus robur	7	14			
Sorbus aucuparia	1	4			
Malus sylvestris	2	2			
Pinus sylvestris	6	14			
Fagus sylvatica	5	3			
Notes					
Species					

Quadrat				
Age (years)				
Altitude (nearest 5m)				
Date Sampled				
Time Sampled				
	Median	Upper Quartile	Maximum Value	Mode
Soil Temperature/℃	17.88	20.00	26.50	17.50
Soil pH	4.00	4.50	7.00	4.00
Soil Moisture/%				
Soil Organic Content/%				
Calluna vulgaris				
Erica tetralix				
Erica cinerea				
Agrostis spp.				
Molina caerulea				
Deschampsia flexuosa				
Pteridium aquilinum				
Ulex europaeus				
Rubus fruticosus				
Vaccinium myrtillus				
Vaccinium vitas-idaea				
Potentilla erecta				
Rumex acetosella				
Galium saxatile				
Hieracium umbellatum				
Melampyrum pratense				
Digitalis purpurea				
Cytisus scoparius				
Mentha spp.				
Polygala serpyllifolia				
Lonicera spp.				
Sedum spp.				
Viola palustris				
Myrica gale				
Euphorium nemorosa				
Scirpus caespitosa				
Narthecium ossifragum				
Juncus squarrosus				
Andromeda polifolia				
Pinguicula vulgaris				
Hypericum elodes				
Lobelia dortmanna				
Potamogeton spp.				
Betula spp.				
Ilex aquifolium				
Quercus robur				
Sorbus aucuparia				
Malus sylvestris				
Pinus sylvestris				
Fagus sylvatica				
Notes				
Species				

Investigation into How Time After Burning Influences Plant Numbers and Species in Managed Heathland

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Appendix II - % Mean

Quadrat	1,1	1,2	1,3	1,4	1,5	1,6	1,7
Age (years)	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	110	110	110	105	105	105	110
Date Sampled	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007
Time Sampled	13:30	13:50	14:20	14:40	15:00	15:25	15:45
Soil Temperature/℃	22.50	24.00	23.00	25.25	24.00	26.00	25.50
Soil pH	4.0	4.0	**4.0**	4.0	4.0	4.0	**4.0**
Soil Moisture/%	35	35	**36.15**	35	20	20	**20.85**
Soil Organic Content/%	15	15	**13.18**	15	35	35	**33.18**
Calluna vulgaris	118.29	108.43	39.43	29.57	147.86	177.44	128.15
Erica tetralix	38.59	61.75	30.88		115.78		15.44
Erica cinerea	49.32	49.32			19.73		
Agrostis spp.	60.31	241.23	286.46	241.23	120.61	105.54	22.62
Molina caerulea	301.70	7.54	7.54		37.71	22.63	7.54
Deschampsia flexuosa							
Pteridium aquilinum							
Ulex europaeus	197.63	24.70	148.22		247.04	74.11	123.52
Rubus fruticosus			8.06				
Vaccinium myrtillus							
Vaccinium vitas-idaea		139.22					
Potentilla erecta	9.80	9.80	19.59				
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.		383.69					
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus	0.22			0.15			
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes		50% wet, 50% dry		Hardly any soil at all		Very thin soil	Only patches of soil
Total Plants	776	1026	540	271	689	380	297
Species	8	9	7	3	6	4	5
Mean	96.98	113.97	77.17	90.32	114.79	94.93	59.45
Standard Deviation	104.53	125.83	104.37	131.52	81.97	64.76	60.85
Minimum	0.22	7.54	7.54	0.15	19.73	22.63	7.54
Lower Quartile	31.40	24.70	13.83	14.86	57.23	61.24	15.44
Median	54.82	61.75	30.88	29.57	118.20	89.82	22.62
Upper Quartile	138.13	139.22	93.83	135.40	141.05	123.51	123.52
Maximum	301.70	383.69	286.46	241.23	247.04	177.44	128.15

Appendix II - % Mean

Quadrat	1,8	2,1	2,2	2,3	3,1	3,2	3,3
Age (years)	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	110	115	115	115	80	75	75
Date Sampled	05/09/2007	13/08/2007	13/08/2007	13/08/2007	22/09/2007	22/09/2007	22/09/2007
Time Sampled	16:10	13:00	13:35	14:25	16:30	16:55	17:20
Soil Temperature/℃	26.50	20.00	17.50	18.00	15.00	16.00	16.00
Soil pH	4.0	4.0	**4.0**	4.0	4.0	**4.0**	4.0
Soil Moisture/%	20	45	**46.77**	45	65	**65.69**	65
Soil Organic Content/%	35	35	**35.48**	35	10	**11.44**	10
Calluna vulgaris	157.72	39.43	9.86		59.15	78.86	29.57
Erica tetralix	15.44	154.38	154.38	30.88	77.19	38.59	38.59
Erica cinerea					98.65	49.32	98.65
Agrostis spp.	165.84	150.77	60.31	120.61	22.62	30.15	
Molina caerulea	18.86	75.43	75.43		188.56	37.71	754.26
Deschampsia flexuosa							
Pteridium aquilinum		54.16	303.29	368.28	151.65	368.28	
Ulex europaeus	74.11	123.52	74.11				
Rubus fruticosus	8.06	8.06	40.28	201.39			
Vaccinium myrtillus			7.67				
Vaccinium vitas-idaea			13.92		41.77	83.53	
Potentilla erecta		48.99	29.39	73.48	48.99	48.99	
Rumex acetosella			7.50	24.99			
Galium saxatile			6.29	31.45			
Hieracium umbellatum		71.67					
Melampyrum pratense				62.50			
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale					183.05	122.03	50.85
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							51.72
Juncus squarrosus					44.66	1.49	
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							100.00
Betula spp.							
Ilex aquifolium					61.80	123.60	
Quercus robur							
Sorbus aucuparia		100.00	100.00	100.00			
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes							
Total Plants	440	826	882	1014	978	983	1124
Species	6	10	13	9	11	11	7
Mean	73.34	82.64	67.88	112.62	88.92	89.32	160.52
Standard Deviation	72.47	48.66	83.50	110.94	58.95	99.94	263.28
Minimum	8.06	8.06	6.29	24.99	22.62	1.49	29.57
Lower Quartile	16.29	50.28	9.86	31.45	46.82	38.15	44.72
Median	46.48	73.55	40.28	73.48	61.80	49.32	51.72
Upper Quartile	136.82	117.64	75.43	120.61	125.15	102.78	99.32
Maximum	165.84	154.38	303.29	368.28	188.56	368.28	754.26

Appendix II - % Mean

Quadrat	3,4	3,5	3,6	3,7	4,1	4,2	4,3
Age (years)	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Altitude (nearest 5m)	80	85	85	85	105	105	100
Date Sampled	22/09/2007	22/09/2007	22/09/2007	22/09/2007	21/08/2007	21/08/2007	02/09/2007
Time Sampled	17:45	18:15	18:35	18:55	14:15	14:45	13:00
Soil Temperature/℃	16.50	17.00	17.50	15.75	17.50	17.00	21.50
Soil pH	4.0	5.0	**5.0**	5.0	4.5	4.5	**4.5**
Soil Moisture/%	65	80	**81.54**	80	50	50	**32.94**
Soil Organic Content/%	10	15	**13.39**	15	15	15	**33.33**
Calluna vulgaris	39.43	5.91	25.63	39.43	19.72	9.86	157.72
Erica tetralix		424.54	347.35	154.38	15.44		23.16
Erica cinerea		542.57	443.92	197.30			
Agrostis spp.	105.54		6.03		30.15	150.77	90.46
Molina caerulea	15.09	754.26	603.41	452.55			11.31
Deschampsia flexuosa							
Pteridium aquilinum	216.64		1.73		151.65	216.64	8.67
Ulex europaeus			24.70				98.81
Rubus fruticosus	12.08				80.56	80.56	
Vaccinium myrtillus					306.91	38.36	
Vaccinium vitas-idaea	55.69		27.84			97.45	
Potentilla erecta	24.49					24.49	
Rumex acetosella						49.98	249.91
Galium saxatile						94.34	62.89
Hieracium umbellatum						14.33	21.50
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale	142.37		50.85	81.36			
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum			17.24	68.97			
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.					579.42	72.43	
Ilex aquifolium					247.19		
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris					83.33		
Fagus sylvatica					93.75		
Notes							
Total Plants	611	1727	1549	994	1608	849	724
Species	8	4	10	6	10	11	9
Mean	76.42	431.82	154.87	165.66	160.81	77.20	80.49
Standard Deviation	72.95	315.00	222.84	152.20	176.12	62.54	80.72
Minimum	12.08	5.91	1.73	39.43	15.44	9.86	8.67
Lower Quartile	22.14	319.88	19.11	72.06	42.75	31.43	21.50
Median	47.56	483.55	26.74	117.87	88.54	72.43	62.89
Upper Quartile	114.75	595.49	273.23	186.57	223.30	95.90	98.81
Maximum	216.64	754.26	603.41	452.55	579.42	216.64	249.91

Investigation into How Time After Burning Influences Plant Numbers and Species in Managed Heathland

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Appendix II - % Mean

Quadrat	4,4	4,5	4,6	4,7	4,8	5,1	5,2
Age (years)	7.5	7.5	7.5	7.5	7.5	5.5	5.5
Altitude (nearest 5m)	100	100	95	95	85	100	100
Date Sampled	02/09/2007	02/09/2007	02/09/2007	02/09/2007	02/09/2007	05/09/2007	05/09/2007
Time Sampled	14:00	14:30	15:00	15:30	16:00	16:45	17:15
Soil Temperature/°C	17.50	20.00	19.25	18.00	17.50	20.50	23.50
Soil pH	4.5	4.5	4.0	4.0	**4.0**	4.0	**4.0**
Soil Moisture/%	35	35	45	45	**42.68**	25	**26.04**
Soil Organic Content/%	35	35	15	15	**14.63**	5	**6.01**
Calluna vulgaris	216.87	226.73	167.58	167.58	147.86	29.57	19.72
Erica tetralix	77.19	270.16	77.19	38.59	231.57	192.97	887.68
Erica cinerea		39.46		49.32	49.32	295.95	493.24
Agrostis spp.	15.08	180.92	3.02	150.77	60.31		
Molina caerulea	37.71	3.77	67.88	37.71	22.63	754.26	377.13
Deschampsia flexuosa							
Pteridium aquilinum	13.00	5.42	2.17	2.17	1.08		
Ulex europaeus	247.04	74.11	74.11	24.70	98.81	98.81	
Rubus fruticosus							
Vaccinium myrtillus				1.53		0.77	
Vaccinium vitas-idaea					13.92		
Potentilla erecta		48.99		97.97			
Rumex acetosella	6.25	5.00					
Galium saxatile	31.45						
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa						43.80	
Narthecium ossifragum						137.93	
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.				43.46	28.97		
Ilex aquifolium				61.80		61.80	
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris			50.00	50.00	333.33	166.67	
Fagus sylvatica							
Notes			Thin soil. Animal tracks.	Animal tracks			
Total Plants	645	855	442	726	988	1783	1778
Species	8	9	7	12	10	10	4
Mean	80.57	94.95	63.13	60.47	98.78	178.25	444.44
Standard Deviation	96.31	103.38	55.91	52.83	108.73	220.90	357.66
Minimum	6.25	3.77	2.17	1.53	1.08	0.77	19.72
Lower Quartile	14.56	5.42	26.51	34.46	24.21	48.30	287.78
Median	34.58	48.99	67.88	46.39	54.82	118.37	435.19
Upper Quartile	112.11	180.92	75.65	70.84	135.60	186.40	591.85
Maximum	247.04	270.16	167.58	167.58	333.33	754.26	887.68

Appendix II - % Mean

Quadrat	5,3	5,4	5,5	5,6	5,7	5,8	5,9
Age (years)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Altitude (nearest 5m)	95	95	90	90	90	85	85
Date Sampled	07/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007
Time Sampled	09:15	09:45	13:45	14:10	14:30	14:50	15:05
Soil Temperature/℃	17.25	15.50	24.00	22.50	24.00	22.25	25.00
Soil pH	4.0	4.0	4.5	4.5	4.5	**4.5**	4.5
Soil Moisture/%	25	25	45	45	45	**46.35**	45
Soil Organic Content/%	5	5	10	10	10	**10.67**	10
Calluna vulgaris	29.57	59.15	29.57	98.58	118.29	78.86	29.57
Erica tetralix	38.59	231.57	38.59	38.59	46.31	38.59	15.44
Erica cinerea	49.32	295.95	98.65	98.65	69.05	98.65	19.73
Agrostis spp.	60.31		105.54	12.82	75.38	226.15	20.35
Molina caerulea	3.77	377.13	56.57	15.09	18.86	3.77	1.89
Deschampsia flexuosa							
Pteridium aquilinum	43.33	21.66	0.43	173.31	151.65		34.66
Ulex europaeus	24.70			247.04	247.04	148.22	98.81
Rubus fruticosus				120.84	80.56	8.06	12.08
Vaccinium myrtillus		1.53					
Vaccinium vitas-idaea				83.53	556.88	41.77	97.45
Potentilla erecta	48.99	97.97	48.99	122.47	97.97	244.93	63.68
Rumex acetosella	999.66	124.96	12.50		12.50	12.50	18.74
Galium saxatile							
Hieracium umbellatum						57.34	28.67
Melampyrum pratense							
Digitalis purpurea			90.91				18.18
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia				312.50	78.13		15.63
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale		20.34	81.36				
Euphorium nemorosa							
Scirpus caespitosa		21.90	4.38				
Narthecium ossifragum		17.24					
Juncus squarrosus		3.72	2.98				
Andromeda polifolia		100.00					
Pinguicula vulgaris			18.75			93.75	187.50
Hypericum elodes			120.00				
Lobelia dortmanna						100.00	
Potamogeton spp.							
Betula spp.		101.40					
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes							
Total Plants	1298	1475	709	1323	1553	1153	662
Species	9	14	14	11	12	13	15
Mean	144.25	105.32	50.66	120.31	129.38	88.66	44.16
Standard Deviation	321.20	117.28	41.81	93.49	148.49	77.68	49.45
Minimum	3.77	1.53	0.43	12.82	12.50	3.77	1.89
Lower Quartile	29.57	20.67	14.06	61.06	63.37	38.59	16.90
Median	43.33	78.56	43.79	98.65	79.34	78.86	20.35
Upper Quartile	49.32	119.07	88.52	147.89	126.63	100.00	49.17
Maximum	999.66	377.13	120.00	312.50	556.88	244.93	187.50

Appendix II - % Mean

Quadrat	6,1	6,2	6,3	6,4	6,5	6,6	6,7
Age (years)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Altitude (nearest 5m)	70	75	75	75	70	65	75
Date Sampled	23/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007	23/09/2007
Time Sampled	09:30	09:55	10:15	10:35	11:00	11:20	11:40
Soil Temperature/℃	14.00	15.50	15.00	14.00	14.50	15.00	15.00
Soil pH	5.0	**5.0**	5.0	5.0	4.0	**4.0**	4.0
Soil Moisture/%	40	**37.64**	40	40	60	**59.69**	60
Soil Organic Content/%	25	**26.20**	25	25	15	**13.78**	15
Calluna vulgaris	59.15	19.72	19.72	167.58	69.00	108.43	78.86
Erica tetralix	54.03		23.16	154.38	115.78	115.78	115.78
Erica cinerea			9.86	197.30	49.32	98.65	147.97
Agrostis spp.	165.84	241.23	271.38	120.61	75.38	165.84	150.77
Molina caerulea	5.66		1.89	22.63	30.17	15.09	7.54
Deschampsia flexuosa							
Pteridium aquilinum	140.81	108.32	4.33	17.33	140.81	151.65	64.99
Ulex europaeus	49.41		172.92		148.22	123.52	
Rubus fruticosus		32.22				60.42	12.08
Vaccinium myrtillus							
Vaccinium vitas-idaea						27.84	
Potentilla erecta	293.92	97.97	58.78	48.99	97.97	244.93	48.99
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea		18.18					
Cytisus scoparius							
Mentha spp.		97.56					
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris		114.29					
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus					0.37		7.44
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes		96.00					
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.						28.97	
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes							
Total Plants	769	825	562	729	727	1141	634
Species	7	9	8	7	9	11	9
Mean	109.83	91.72	70.26	104.12	80.78	103.74	70.49
Standard Deviation	98.46	68.34	98.97	73.85	49.82	69.11	57.46
Minimum	5.66	18.18	1.89	17.33	0.37	15.09	7.44
Lower Quartile	51.72	32.22	8.48	35.81	49.32	44.69	12.08
Median	59.15	97.56	21.44	120.61	75.38	108.43	64.99
Upper Quartile	153.33	108.32	87.32	160.98	115.78	137.58	115.78
Maximum	293.92	241.23	271.38	197.30	148.22	244.93	150.77

Appendix II - % Mean

Quadrat	6,8	6,9	6,10	6,11	7,1	7,2	7,3
Age (years)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Altitude (nearest 5m)	70	65	65	65	115	110	100
Date Sampled	23/09/2007	23/09/2007	23/09/2007	23/09/2007	17/08/2007	17/08/2007	17/08/2007
Time Sampled	12:05	12:30	12:50	13:10	13:50	14:15	14:35
Soil Temperature/°C	15.50	16.50	15.75	16.00	20.00	20.00	18.00
Soil pH	4.0	4.5	4.5	**4.5**	4.0	4.0	4.0
Soil Moisture/%	60	25	25	**27.04**	65	65	65
Soil Organic Content/%	15	5	5	**4.40**	15	15	15
Calluna vulgaris	29.57	39.43	19.72	59.15	226.73	236.58	197.15
Erica tetralix	38.59	77.19		15.44	231.57	308.76	308.76
Erica cinerea		49.32		19.73	197.30		49.32
Agrostis spp.	45.23	90.46	60.31	196.00	6.03	3.02	
Molina caerulea		7.54		5.66	18.86	0.75	30.17
Deschampsia flexuosa							
Pteridium aquilinum	433.27	346.62	108.32	324.95	0.87		5.42
Ulex europaeus		98.81			98.81		123.52
Rubus fruticosus	40.28		80.56			40.28	
Vaccinium myrtillus	1.53					1.53	
Vaccinium vitas-idaea							
Potentilla erecta	122.47	97.97		244.93			
Rumex acetosella				124.96			
Galium saxatile							
Hieracium umbellatum				7.17			
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus		1.86					
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium					24.72	247.19	
Quercus robur	72.16				72.16		
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes						Holly dense in one area - this area has higher biodiversity.	
Total Plants	783	809	269	998	877	838	714
Species	8	9	4	9	9	7	6
Mean	97.89	89.91	67.22	110.89	97.45	119.73	119.06
Standard Deviation	140.05	103.04	37.29	118.93	96.48	137.65	116.43
Minimum	1.53	1.86	19.72	5.66	0.87	0.75	5.42
Lower Quartile	36.34	39.43	50.16	15.44	18.86	2.27	34.96
Median	42.75	77.19	70.43	59.15	72.16	40.28	86.42
Upper Quartile	84.74	97.97	87.50	196.00	197.30	241.89	178.74
Maximum	433.27	346.62	108.32	324.95	231.57	308.76	308.76

Appendix II - % Mean

Quadrat	7,4	8,1	8,2	8,3	8,4	8,5	8,6
Age (years)	5.5	4.5	4.5	4.5	4.5	4.5	4.5
Altitude (nearest 5m)	105	115	115	115	115	115	115
Date Sampled	17/08/2007	13/08/2007	13/08/2007	13/08/2007	17/08/2007	17/08/2007	17/08/2007
Time Sampled	14:55	14:50	15:15	15:40	11:30	11:55	12:15
Soil Temperature/℃	17.50	25.50	21.50	22.00	19.00	19.00	19.00
Soil pH	**4.0**	4.0	**4.0**	4.0	**4.0**	4.0	4.0
Soil Moisture/%	**64.21**	5	**7.41**	5	**66.95**	65	65
Soil Organic Content/%	**12.89**	70	**70.37**	70	**10.26**	10	10
Calluna vulgaris	167.58	88.72	98.58	3.94	39.43	98.58	147.86
Erica tetralix	77.19	154.38	115.78		154.38	154.38	231.57
Erica cinerea	295.95	9.86	19.73				
Agrostis spp.	3.02	180.92	60.31	3.02	241.23	60.31	30.15
Molina caerulea	37.71	11.31	9.43				
Deschampsia flexuosa							
Pteridium aquilinum	4.33	8.67	26.00	1.08	6.50	4.33	6.50
Ulex europaeus	148.22	148.22	222.33	98.81	370.55	123.52	
Rubus fruticosus		20.14	24.17	80.56	8.06	16.11	
Vaccinium myrtillus			5.37	0.77		153.45	306.91
Vaccinium vitas-idaea		27.84		55.69		27.84	
Potentilla erecta		9.80	14.70		195.95		9.80
Rumex acetosella				249.91			
Galium saxatile			12.58		31.45		
Hieracium umbellatum					71.67	14.33	
Melampyrum pratense							
Digitalis purpurea				363.64			
Cytisus scoparius							
Mentha spp.				36.59			
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.			14.49	57.94		115.88	144.86
Ilex aquifolium		24.72		12.36			123.60
Quercus robur				72.16		72.16	
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes				Area impovershed & bare. R. acetosella were very small with yellow leaves			
Total Plants	734	685	623	1036	1119	841	1001
Species	7	11	12	13	9	11	8
Mean	104.86	62.23	51.95	79.73	124.36	76.45	125.15
Standard Deviation	106.52	67.82	64.77	108.59	125.67	56.22	108.02
Minimum	3.02	8.67	5.37	0.77	6.50	4.33	6.50
Lower Quartile	21.02	10.59	14.01	3.94	31.45	21.98	25.06
Median	77.19	24.72	21.95	55.69	71.67	72.16	134.23
Upper Quartile	157.90	118.47	69.87	80.56	195.95	119.70	168.79
Maximum	295.95	180.92	222.33	363.64	370.55	154.38	306.91

Appendix II - % Mean

Quadrat	8,7	9,1	9,2	9,3	9,4	9,5	9,6
Age (years)	4.5	3.5	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	115	110	110	110	110	110	110
Date Sampled	17/08/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007	05/09/2007
Time Sampled	13:20	09:15	09:40	10:05	10:30	11:00	11:25
Soil Temperature/℃	21.50	16.25	18.75	18.50	20.25	18.00	25.50
Soil pH	4.0	**5.5**	5.5	5.5	5.5	4.0	4.0
Soil Moisture/%	65	**36.92**	35	35	35	45	45
Soil Organic Content/%	10	**18.97**	20	20	20	40	40
Calluna vulgaris	13.80	177.44	128.15	108.43	78.86	216.87	147.86
Erica tetralix	15.44	231.57	38.59	15.44	7.72	15.44	54.03
Erica cinerea		147.97	49.32	49.32	19.73	9.86	
Agrostis spp.	180.92	120.61	211.08	241.23	256.31	75.38	150.77
Molina caerulea		75.43	150.85	37.71	30.17	7.54	15.09
Deschampsia flexuosa		33.33					
Pteridium aquilinum	3.25						
Ulex europaeus	49.41	24.70	49.41	74.11	24.70		123.52
Rubus fruticosus	80.56				4.03		
Vaccinium myrtillus	306.91						
Vaccinium vitas-idaea							
Potentilla erecta	195.95						
Rumex acetosella	374.87						
Galium saxatile	628.93						
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.	24.39						
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.	86.91						
Ilex aquifolium							
Quercus robur	72.16						
Sorbus aucuparia	100.00						
Malus sylvestris							
Pinus sylvestris		33.33				83.33	
Fagus sylvatica							
Notes	Many dead plants with red leaves - area possibly burnt illegally. Young plants.	Shallow soil	Shallow soil	Shallow soil	Shallow soil	Shallow soil	Shallow soil
Total Plants	2133	844	627	526	422	408	491
Species	14	8	6	6	7	6	5
Mean	152.39	105.55	104.57	87.71	60.22	68.07	98.25
Standard Deviation	177.37	76.48	69.98	81.71	89.92	80.31	60.68
Minimum	3.25	24.70	38.59	15.44	4.03	7.54	15.09
Lower Quartile	30.64	33.33	49.35	40.62	13.72	11.26	54.03
Median	83.74	98.02	88.78	61.72	24.70	45.41	123.52
Upper Quartile	192.19	155.34	145.18	99.85	54.52	81.35	147.86
Maximum	628.93	231.57	211.08	241.23	256.31	216.87	150.77

Investigation into How Time After Burning Influences Plant Numbers and Species in Managed Heathland

Martin Yeo

Appendix II - % Mean

Quadrat	9,7	9,8	9,9	10,1	10,2	10,3	10,4
Age (years)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	110	110	110	95	100	105	105
Date Sampled	05/09/2007	05/09/2007	05/09/2007	22/09/2007	22/09/2007	07/09/2007	07/09/2007
Time Sampled	11:50	12:15	12:35	12:00	12:20	11:05	11:30
Soil Temperature/°C	26.00	23.00	19.50	16.75	19.00	19.00	22.00
Soil pH	**4.0**	4.0	4.0	4.0	**4.0**	4.0	4.0
Soil Moisture/%	**46.90**	45	45	50	**51.21**	50	50
Soil Organic Content/%	**42.07**	40	40	30	**31.40**	30	30
Calluna vulgaris	78.86	138.01	167.58	3.94	19.72	19.72	39.43
Erica tetralix	38.59	77.19	38.59		15.44	38.59	46.31
Erica cinerea					9.86	246.62	19.73
Agrostis spp.	256.31	211.08	90.46		211.08	120.61	150.77
Molina caerulea	9.43	18.86	24.51		18.86		1.89
Deschampsia flexuosa							
Pteridium aquilinum				303.29	86.65	129.98	324.95
Ulex europaeus	74.11	148.22			172.92		49.41
Rubus fruticosus	4.03	8.06		281.95	80.56		40.28
Vaccinium myrtillus						1.53	
Vaccinium vitas-idaea		13.92	5.57	556.88	69.61		
Potentilla erecta				24.49	24.49	24.49	97.97
Rumex acetosella							
Galium saxatile						31.45	
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.				36.59			
Polygala serpyllifolia						78.13	109.38
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							12.20
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus		0.07					
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.				101.40			
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris			83.33				
Fagus sylvatica							
Notes	Shallow soil	Shallow soil	Shallow soil				
Total Plants	461	615	410	1309	709	691	892
Species	6	8	6	7	10	9	11
Mean	76.89	76.93	68.34	186.93	70.92	76.79	81.12
Standard Deviation	93.30	80.00	58.84	203.81	70.46	78.07	92.63
Minimum	4.03	0.07	5.57	3.94	9.86	1.53	1.89
Lower Quartile	16.72	12.46	28.03	30.54	19.07	24.49	29.58
Median	56.35	48.02	60.96	101.40	47.05	38.59	46.31
Upper Quartile	77.67	140.56	88.68	292.62	85.13	120.61	103.67
Maximum	256.31	211.08	167.58	556.88	211.08	246.62	324.95

Appendix II - % Mean

Quadrat	10,5	10,6	10,7	10,8	10,9	10,10	11,1
Age (years)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	100	90	90	95	95	95	115
Date Sampled	07/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007	07/09/2007	13/08/2007
Time Sampled	11:55	12:20	13:15	15:25	15:45	16:05	16:10
Soil Temperature/℃	18.25	20.75	22.00	20.50	19.50	20.00	18.00
Soil pH	4.0	4.0	4.0	4.0	4.0	**4.0**	4.0
Soil Moisture/%	50	80	50	80	80	**79.09**	75
Soil Organic Content/%	30	15	30	15	15	**13.24**	15
Calluna vulgaris	29.57	9.86	9.86	98.58	9.86	23.66	147.86
Erica tetralix	77.19	54.03		115.78	77.19	77.19	154.38
Erica cinerea	49.32	98.65		29.59	98.65	49.32	
Agrostis spp.	211.08	45.23	90.46	15.08		30.15	0.75
Molina caerulea	1.89	377.13		301.70	75.43	226.28	5.66
Deschampsia flexuosa							
Pteridium aquilinum	151.65		433.27			0.22	19.50
Ulex europaeus							74.11
Rubus fruticosus	80.56		80.56	4.03		40.28	8.06
Vaccinium myrtillus			38.36				4.60
Vaccinium vitas-idaea	417.66		69.61	139.22		55.69	
Potentilla erecta	195.95	146.96		48.99		19.59	
Rumex acetosella			62.48	12.50			
Galium saxatile							
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea		90.91					
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale		203.39		152.54	40.68	244.07	
Euphorium nemorosa							
Scirpus caespitosa					437.96		
Narthecium ossifragum				17.24	137.93		
Juncus squarrosus	0.37				1190.84	2.98	
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.				14.49			14.49
Ilex aquifolium				24.72		61.80	12.36
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica		187.50					
Notes							
Total Plants	1215	1214	785	974	2069	831	442
Species	10	9	7	13	8	12	10
Mean	121.52	134.85	112.09	74.96	258.57	69.27	44.18
Standard Deviation	128.44	111.66	144.21	85.90	399.50	80.90	60.12
Minimum	0.37	9.86	9.86	4.03	9.86	0.22	0.75
Lower Quartile	34.51	54.03	50.42	15.08	66.74	22.64	6.26
Median	78.87	98.65	69.61	29.59	87.92	44.80	13.42
Upper Quartile	184.87	187.50	85.51	115.78	212.94	65.65	60.46
Maximum	417.66	377.13	433.27	301.70	1190.84	244.07	154.38

Appendix II - % Mean

Quadrat	11,2	11,3	11,4	11,5	11,6	11,7	11,8
Age (years)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Altitude (nearest 5m)	115	110	110	105	110	110	110
Date Sampled	13/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007
Time Sampled	16:40	10:00	10:30	11:00	11:25	11:50	15:15
Soil Temperature/℃	17.50	18.00	17.00	17.25	18.00	18.00	16.75
Soil pH	4.0	4.0	**4.0**	4.0	4.0	4.5	4.5
Soil Moisture/%	75	75	**73.91**	75	75	75	75
Soil Organic Content/%	15	15	**16.02**	15	15	20	20
Calluna vulgaris	78.86	197.15	29.57	78.86	11.83	19.72	19.72
Erica tetralix	77.19	77.19	115.78	154.38	115.78	7.72	15.44
Erica cinerea	29.59			29.59			
Agrostis spp.	90.46	24.12	150.77	211.08	150.77	30.15	12.06
Molina caerulea	75.43	1.51	75.43	1.89	1.89		
Deschampsia flexuosa							
Pteridium aquilinum	173.31	4.33	129.98	21.66	108.32	281.63	346.62
Ulex europaeus	148.22	49.41	74.11	24.70	98.81		
Rubus fruticosus	40.28		120.84	24.17	40.28		
Vaccinium myrtillus	0.77	4.60			30.69	15.35	230.18
Vaccinium vitas-idaea	13.92			83.53	13.92		
Potentilla erecta			97.97	97.97	195.95		
Rumex acetosella	124.96		62.48	5.00	12.50	18.74	
Galium saxatile			62.89		31.45		
Hieracium umbellatum			21.50				7.17
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius						100.00	
Mentha spp.							
Polygala serpyllifolia			6.25				
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.	14.49					144.86	
Ilex aquifolium					37.08		123.60
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							133.33
Pinus sylvestris						16.67	
Fagus sylvatica							
Notes						Shallow soil	
Total Plants	867	358	948	733	849	635	888
Species	12	7	12	11	13	9	8
Mean	72.29	51.19	78.96	66.62	65.33	70.54	111.01
Standard Deviation	55.48	70.18	45.55	67.03	61.89	92.02	124.45
Minimum	0.77	1.51	6.25	1.89	1.89	7.72	7.17
Lower Quartile	25.82	4.47	54.25	22.92	13.92	16.67	14.59
Median	76.31	24.12	74.77	29.59	37.08	19.72	71.66
Upper Quartile	99.08	63.30	117.05	90.75	108.32	100.00	157.54
Maximum	173.31	197.15	150.77	211.08	195.95	281.63	346.62

Appendix II - % Mean

Quadrat	11,9	11,10	11,11	11,12	11,13	11,14	12,1
Age (years)	3.5	3.5	3.5	3.5	3.5	3.5	0.5
Altitude (nearest 5m)	110	100	110	110	110	105	90
Date Sampled	15/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007	15/08/2007	23/09/2007
Time Sampled	15:45	16:15	16:45	17:15	17:45	18:10	13:45
Soil Temperature/℃	17.00	17.00	17.50	16.50	18.00	17.50	17.00
Soil pH	**4.5**	4.5	4.5	4.5	4.5	**5.0**	4.5
Soil Moisture/%	**73.99**	75	75	75	75	**52.72**	45
Soil Organic Content/%	**21.11**	20	20	20	20	**11.14**	50
Calluna vulgaris	98.58	13.80	9.86	3.94	19.72	1.18	246.44
Erica tetralix	77.19	77.19	115.78	23.16	15.44		131.22
Erica cinerea		19.73	39.46				167.70
Agrostis spp.	7.54	120.61	30.15	30.15	60.31	3.02	
Molina caerulea	2.26	7.54	7.54				56.57
Deschampsia flexuosa							
Pteridium aquilinum	64.99	162.48	64.99	368.28	216.64	108.32	
Ulex europaeus	24.70	49.41	49.41	98.81			
Rubus fruticosus		20.14	120.84	2013.94	40.28	60.42	
Vaccinium myrtillus	383.63	15.35	153.45	306.91	230.18		
Vaccinium vitas-idaea		27.84		27.84		208.83	
Potentilla erecta		48.99			48.99	34.29	
Rumex acetosella		12.50		124.96	74.97		
Galium saxatile		31.45	62.89	62.89			
Hieracium umbellatum				7.17	71.67	7.17	
Melampyrum pratense					25.00		
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.				100.00			
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.	28.97		14.49	289.71	28.97		2.90
Ilex aquifolium		123.60			24.72	185.39	
Quercus robur		14.43				14.43	
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							166.67
Fagus sylvatica							
Notes							Beehives close by
Total Plants	688	745	669	3458	857	623	771
Species	8	15	11	13	12	9	6
Mean	85.98	49.67	60.81	265.98	71.41	69.23	128.58
Standard Deviation	125.04	48.86	49.33	539.42	73.76	80.37	87.02
Minimum	2.26	7.54	7.54	3.94	15.44	1.18	2.90
Lower Quartile	20.41	14.89	22.32	27.84	24.93	7.17	75.23
Median	46.98	27.84	49.41	98.81	44.63	34.29	148.94
Upper Quartile	82.54	63.30	90.39	289.71	72.50	108.32	167.44
Maximum	383.63	162.48	153.45	2013.94	230.18	208.83	246.44

Appendix II - % Mean

Quadrat	12,2	12,3	12,4	12,5	13,1	13,2	13,3
Age (years)	0.5	0.5	0.5	0.5	16.5	16.5	16.5
Altitude (nearest 5m)	95	90	95	95	100	100	100
Date Sampled	23/09/2007	23/09/2007	23/09/2007	23/09/2007	17/08/2007	17/08/2007	17/08/2007
Time Sampled	14:10	14:35	14:55	15:15	15:40	16:00	16:20
Soil Temperature/℃	14.75	17.75	17.00	17.25	16.25	17.50	15.75
Soil pH	4.0	**4.5**	4.5	4.5	**4.0**	4.0	4.0
Soil Moisture/%	60	**44.25**	45	45	**65.88**	65	65
Soil Organic Content/%	35	**48.67**	50	50	**14.70**	15	15
Calluna vulgaris	69.00	69.00	118.29	118.29	236.58	246.44	236.58
Erica tetralix	270.16	23.16	115.78	192.97		7.72	15.44
Erica cinerea	345.27	29.59	49.32	49.32			
Agrostis spp.							
Molina caerulea	603.41	37.71	75.43	60.34			
Deschampsia flexuosa							
Pteridium aquilinum		8.67			21.66	0.22	8.67
Ulex europaeus		49.41	24.70	24.70			
Rubus fruticosus							
Vaccinium myrtillus							
Vaccinium vitas-idaea							
Potentilla erecta							
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus	7.44						
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes	Beehives close by	Area still half dead, higher diversity in a sunken patch.	Thin vegetation	Thin vegetation			
Total Plants	1295	218	384	446	258	254	261
Species	5	6	5	5	2	3	3
Mean	259.06	36.26	76.71	89.13	129.12	84.79	86.90
Standard Deviation	237.47	21.09	40.96	67.45	151.97	140.04	129.68
Minimum	7.44	8.67	24.70	24.70	21.66	0.22	8.67
Lower Quartile	69.00	24.77	49.32	49.32	75.39	3.97	12.05
Median	270.16	33.65	75.43	60.34	129.12	7.72	15.44
Upper Quartile	345.27	46.48	115.78	118.29	182.85	127.08	126.01
Maximum	603.41	69.00	118.29	192.97	236.58	246.44	236.58

Appendix II - % Mean

Quadrat	13,4	13,5	13,6	13,7	13,8	13,9	14,1
Age (years)	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Altitude (nearest 5m)	85	90	90	80	80	80	110
Date Sampled	17/08/2007	17/08/2007	17/08/2007	07/09/2007	22/09/2007	22/09/2007	17/08/2007
Time Sampled	16:45	17:05	17:25	16:35	15:30	15:55	09:00
Soil Temperature/℃	16.00	15.75	16.25	18.50	15.00	16.75	14.50
Soil pH	4.0	4.0	4.0	**4.0**	4.0	4.0	4.5
Soil Moisture/%	65	65	65	**80.28**	80	80	50
Soil Organic Content/%	15	15	15	**15.00**	15	15	15
Calluna vulgaris	187.29	167.58	157.72	147.86	39.43	29.57	78.86
Erica tetralix	23.16	77.19		77.19	115.78	77.19	61.75
Erica cinerea	147.97	147.97	98.65	49.32	98.65	98.65	
Agrostis spp.				15.08			30.15
Molina caerulea	45.26	75.43	16.97	37.71	565.69	565.69	
Deschampsia flexuosa					166.67		
Pteridium aquilinum				0.43			108.32
Ulex europaeus	148.22	148.22					247.04
Rubus fruticosus				28.20			201.39
Vaccinium myrtillus							191.82
Vaccinium vitas-idaea				278.44			
Potentilla erecta				97.97	146.96	48.99	
Rumex acetosella							
Galium saxatile							471.70
Hieracium umbellatum							71.67
Melampyrum pratense							250.00
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale				183.05	81.36	101.69	
Euphorium nemorosa							
Scirpus caespitosa					4.38		
Narthecium ossifragum					344.83	172.41	
Juncus squarrosus					44.66	74.43	
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes						84.00	
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							115.88
Ilex aquifolium							
Quercus robur							144.33
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes			Site included several animal tracks - less plants.				More moss than other areas
Total Plants	552	616	273	915	1608	1253	1973
Species	5	5	3	10	10	9	12
Mean	110.38	123.28	91.11	91.53	160.84	139.18	164.41
Standard Deviation	71.78	43.61	70.68	87.92	170.92	164.81	121.01
Minimum	23.16	75.43	16.97	0.43	4.38	29.57	30.15
Lower Quartile	45.26	77.19	57.81	30.57	53.83	74.43	77.06
Median	147.97	147.97	98.65	63.26	107.22	84.00	130.11
Upper Quartile	148.22	148.22	128.19	135.39	161.74	101.69	212.80
Maximum	187.29	167.58	157.72	278.44	565.69	565.69	471.70

Investigation into How Time After Burning Influences Plant Numbers and Species in Managed Heathland

Martin Yeo

Appendix II - % Mean

Quadrat	14,2	14,3	14,4	14,5	15,1	15,2	15,3
Age (years)	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Altitude (nearest 5m)	110	110	110	110	70	70	75
Date Sampled	17/08/2007	17/08/2007	17/08/2007	17/08/2007	04/09/2007	04/09/2007	04/09/2007
Time Sampled	09:25	10:00	10:25	11:00	14:30	15:00	15:30
Soil Temperature/℃	15.25	15.00	18.50	23.00	20.00	20.00	17.00
Soil pH	4.5	4.5	4.5	**4.5**	7.0	7.0	**7.0**
Soil Moisture/%	50	50	50	**50.52**	70	70	**69.09**
Soil Organic Content/%	15	15	15	**16.26**	10	10	**9.14**
Calluna vulgaris	49.29	138.01	59.15	9.86	69.00	78.86	128.15
Erica tetralix	6.18	77.19	115.78		23.16	77.19	15.44
Erica cinerea					9.86		19.73
Agrostis spp.	15.08	6.03	60.31	165.84	241.23	211.08	30.15
Molina caerulea					37.71	15.09	75.43
Deschampsia flexuosa							
Pteridium aquilinum	259.96	10.83	86.65	216.64	13.00	15.16	21.66
Ulex europaeus			24.70	24.70	98.81	49.41	
Rubus fruticosus	161.12	80.56	322.23	80.56			
Vaccinium myrtillus	306.91	76.73	191.82	7.67			0.77
Vaccinium vitas-idaea				13.92			
Potentilla erecta		9.80	122.47		489.86	293.92	48.99
Rumex acetosella	37.49	24.99		37.49	14.74		
Galium saxatile	125.79	62.89	31.45	31.45	94.34		
Hieracium umbellatum	7.17			14.33	573.38	573.38	
Melampyrum pratense			62.50				
Digitalis purpurea					109.09	72.73	
Cytisus scoparius							
Mentha spp.				304.88			
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.					3.84	7.67	
Viola palustris						142.86	
Myrica gale							8.14
Euphorium nemorosa							100.00
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.	434.57	289.71	14.49	57.94	14.49		14.49
Ilex aquifolium		61.80					247.19
Quercus robur	144.33	216.49	72.16	72.16	288.66		72.16
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris		166.67					83.33
Fagus sylvatica							18.75
Notes	More moss than other areas			Definite boundary between bracken & grass			Large scots pine.
Total Plants	1548	1222	1164	1037	2081	1537	884
Species	11	13	12	13	15	11	15
Mean	140.71	93.98	96.98	79.80	138.75	139.76	58.96
Standard Deviation	141.27	86.51	86.21	92.74	181.16	169.02	64.51
Minimum	6.18	6.03	14.49	7.67	3.84	7.67	0.77
Lower Quartile	26.28	24.99	52.22	14.33	14.62	32.29	17.09
Median	125.79	76.73	67.33	37.49	69.00	77.19	30.15
Upper Quartile	210.54	138.01	117.45	80.56	175.16	176.97	79.38
Maximum	434.57	289.71	322.23	304.88	573.38	573.38	247.19

Appendix II - % Mean

Quadrat	15,4	15,5	15,6	16,1	16,2	17,1	17,2
Age (years)	16.5	16.5	16.5	25.0	25.0	25.0	25.0
Altitude (nearest 5m)	75	75	80	95	95	105	110
Date Sampled	04/09/2007	04/09/2007	04/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007
Time Sampled	16:00	16:30	17:00	14:30	14:55	12:40	13:10
Soil Temperature/℃	15.00	18.50	21.00	16.00	16.00	18.25	18.75
Soil pH	4.0	5.0	**5.0**	4.0	**4.0**	5.0	5.0
Soil Moisture/%	80	20	**22.46**	65	**62.64**	55	55
Soil Organic Content/%	15	10	**10.18**	20	**17.98**	20	20
Calluna vulgaris	39.43	157.72	39.43	236.58	177.44	216.87	187.29
Erica tetralix		77.19	46.31	115.78	115.78	115.78	231.57
Erica cinerea	197.30	49.32	39.46	147.97	49.32	49.32	
Agrostis spp.		120.61	256.31		22.62	1.51	
Molina caerulea	75.43			45.26	18.86	75.43	67.88
Deschampsia flexuosa							
Pteridium aquilinum	6.50	13.00	6.50	1.73	0.87	1.08	3.03
Ulex europaeus		197.63	49.41	49.41		24.70	
Rubus fruticosus							
Vaccinium myrtillus					61.38		
Vaccinium vitas-idaea	27.84	55.69					
Potentilla erecta		244.93	195.95				
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum		286.69	143.34				
Melampyrum pratense							
Digitalis purpurea		36.36					
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.		4.80					
Viola palustris		42.86	100.00				
Myrica gale	40.68						
Euphorium nemorosa							
Scirpus caespitosa	87.59						
Narthecium ossifragum	34.48						
Juncus squarrosus	316.32						
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.	28.97						
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris			66.67				
Pinus sylvestris						50.00	
Fagus sylvatica							
Notes			Large rowan				
Total Plants	855	1287	943	597	446	535	490
Species	10	12	10	6	7	8	4
Mean	85.45	107.23	94.34	99.46	63.75	66.84	122.44
Standard Deviation	97.40	94.16	80.16	85.34	62.59	71.65	105.43
Minimum	6.50	4.80	6.50	1.73	0.87	1.08	3.03
Lower Quartile	30.35	41.23	41.17	46.29	20.74	18.90	51.67
Median	40.05	66.44	58.04	82.60	49.32	49.66	127.59
Upper Quartile	84.55	167.70	132.51	139.93	88.58	85.52	198.36
Maximum	316.32	286.69	256.31	236.58	177.44	216.87	231.57

Appendix II - % Mean

Quadrat	17,3	17,4	17,5	18,1	18,2	18,3	18,4
Age (years)	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Altitude (nearest 5m)	105	105	105	110	110	110	110
Date Sampled	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007	22/09/2007
Time Sampled	13:30	13:50	14:10	09:00	09:25	09:45	10:10
Soil Temperature/℃	17.00	17.75	18.50	16.00	16.25	16.25	16.25
Soil pH	5.0	**5.0**	5.0	4.0	**4.0**	4.0	4.0
Soil Moisture/%	55	**54.79**	55	40	**37.50**	40	40
Soil Organic Content/%	20	**18.86**	20	20	**19.27**	20	20
Calluna vulgaris	197.15	207.01	216.87	138.01	78.86	118.29	49.29
Erica tetralix	115.78	77.19	154.38	38.59			38.59
Erica cinerea	19.73		19.73				
Agrostis spp.				3.02	75.38	15.08	45.23
Molina caerulea	113.14	64.11	150.85			7.54	11.31
Deschampsia flexuosa							
Pteridium aquilinum	1.73	6.50	8.67	129.98	216.64	173.31	259.96
Ulex europaeus	24.70		49.41		74.11	49.41	
Rubus fruticosus					16.11	40.28	
Vaccinium myrtillus				30.69	230.18	153.45	30.69
Vaccinium vitas-idaea							27.84
Potentilla erecta							
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum					28.67		
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium							
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris							
Fagus sylvatica							
Notes							
Total Plants	472	355	600	340	720	557	463
Species	6	4	6	5	7	7	7
Mean	78.71	88.70	99.98	68.06	102.85	79.62	66.13
Standard Deviation	76.04	84.64	85.49	61.69	85.97	67.76	86.39
Minimum	1.73	6.50	8.67	3.02	16.11	7.54	11.31
Lower Quartile	20.97	49.71	27.15	30.69	51.39	27.68	29.27
Median	68.92	70.65	100.13	38.59	75.38	49.41	38.59
Upper Quartile	115.12	109.64	153.50	129.98	147.75	135.87	47.26
Maximum	197.15	207.01	216.87	138.01	230.18	173.31	259.96

Appendix II - % Mean

Quadrat	18,5	18,6	18,7	18,8	18,9	18,10	
Age (years)	25.0	25.0	25.0	25.0	25.0	25.0	
Altitude (nearest 5m)	110	105	105	105	100	95	
Date Sampled	22/09/2007	22/09/2007	22/09/2007	22/09/2007	07/09/2007	07/09/2007	
Time Sampled	10:30	10:50	11:10	11:35	10:40	10:15	
							Mean
Soil Temperature/℃	16.00	16.25	17.25	19.50	19.00	18.00	18.55
Soil pH	4.0	4.0	4.0	4.0	4.0	**4.0**	4.34
Soil Moisture/%	40	50	50	50	50	**50.74**	
Soil Organic Content/%	20	25	25	25	25	**25.62**	
Calluna vulgaris	226.73	167.58	236.58	226.73	236.58	197.15	
Erica tetralix	15.44	23.16	115.78	77.19	192.97	77.19	
Erica cinerea					19.73	49.32	
Agrostis spp.	1.51		0.30				
Molina caerulea		22.63	1.51	37.71	18.86	15.09	
Deschampsia flexuosa							
Pteridium aquilinum	64.99	151.65	2.60	4.33	10.83	64.99	
Ulex europaeus					14.82	123.52	
Rubus fruticosus							
Vaccinium myrtillus	30.69	38.36					
Vaccinium vitas-idaea							
Potentilla erecta							
Rumex acetosella							
Galium saxatile							
Hieracium umbellatum							
Melampyrum pratense							
Digitalis purpurea							
Cytisus scoparius							
Mentha spp.							
Polygala serpyllifolia							
Lonicera spp.							
Sedum spp.							
Viola palustris							
Myrica gale							
Euphorium nemorosa							
Scirpus caespitosa							
Narthecium ossifragum							
Juncus squarrosus							
Andromeda polifolia							
Pinguicula vulgaris							
Hypericum elodes							
Lobelia dortmanna							
Potamogeton spp.							
Betula spp.							
Ilex aquifolium	61.80	247.19					
Quercus robur							
Sorbus aucuparia							
Malus sylvestris							
Pinus sylvestris					33.33		
Fagus sylvatica							
Notes						Large path running through quadrat	
Total Plants	401	651	357	346	527	527	
Species	6	6	5	4	7	6	
Mean	66.86	108.43	71.36	86.49	75.30	87.88	
Standard Deviation	82.23	93.98	104.80	98.12	96.36	64.24	
Minimum	1.51	22.63	0.30	4.33	10.83	15.09	
Lower Quartile	19.25	26.96	1.51	29.37	16.84	53.24	
Median	46.24	95.00	2.60	57.45	19.73	71.09	
Upper Quartile	64.19	163.60	115.78	114.57	113.15	111.94	
Maximum	226.73	247.19	236.58	226.73	236.58	197.15	

Appendix II - % Mean

Quadrat				
Age (years)				
Altitude (nearest 5m)				
Date Sampled				
Time Sampled				
		Standard Deviation	Minimum Value	Lower Quartile
Soil Temperature/℃		2.97	14.00	16.25
Soil pH		0.57	4.00	4.00
Soil Moisture/%				
Soil Organic Content/%				
	Frequency (/132)	Standard Deviation (% Mean)	Minimum Value	Lower Quartile
Calluna vulgaris	131	75.12	1.18	29.57
Erica tetralix	116	109.06	6.18	38.59
Erica cinerea	73	112.68	9.86	29.59
Agrostis spp.	100	84.03	0.30	23.75
Molina caerulea	99	179.53	0.75	8.49
Deschampsia flexuosa	2	94.28	33.33	66.67
Pteridium aquilinum	96	119.54	0.22	6.23
Ulex europaeus	75	71.41	14.82	49.41
Rubus fruticosus	52	278.96	4.03	15.10
Vaccinium myrtillus	39	120.29	0.77	4.60
Vaccinium vitas-idaea	35	141.16	5.57	27.84
Potentilla erecta	58	93.61	9.80	37.96
Rumex acetosella	29	194.50	5.00	12.50
Galium saxatile	20	158.87	6.29	31.45
Hieracium umbellatum	21	169.93	7.17	14.33
Melampyrum pratense	4	101.55	25.00	53.13
Digitalis purpurea	8	112.08	18.18	31.82
Cytisus scoparius	1		100.00	100.00
Mentha spp.	5	118.05	24.39	36.59
Polygala serpyllifolia	6	111.45	6.25	31.25
Lonicera spp.	1		100.00	100.00
Sedum spp.	4	189.14	3.84	4.56
Viola palustris	4	42.06	42.86	85.71
Myrica gale	18	71.00	8.14	43.22
Euphorium nemorosa	1		100.00	100.00
Scirpus caespitosa	6	168.47	4.38	8.76
Narthecium ossifragum	10	103.38	17.24	21.55
Juncus squarrosus	17	291.32	0.07	0.37
Andromeda polifolia	1		100.00	100.00
Pinguicula vulgaris	3	84.55	18.75	56.25
Hypericum elodes	3	18.33	84.00	90.00
Lobelia dortmanna	1		100.00	100.00
Potamogeton spp.	1		100.00	100.00
Betula spp.	29	136.16	2.90	14.49
Ilex aquifolium	22	83.64	12.36	27.81
Quercus robur	14	75.41	14.43	72.16
Sorbus aucuparia	4	0.00	100.00	100.00
Malus sylvestris	2	47.14	66.67	83.33
Pinus sylvestris	14	84.23	16.67	50.00
Fagus sylvatica	3	84.55	18.75	56.25
Notes				
Total Plants				
Species				
Mean				
Standard Deviation				
Minimum				
Lower Quartile				
Median				
Upper Quartile				
Maximum				

Appendix II - % Mean

Quadrat			
Age (years)			
Altitude (nearest 5m)			
Date Sampled			
Time Sampled			
	Median	**Upper Quartile**	**Maximum Value**
Soil Temperature/°C	17.88	20.00	26.50
Soil pH	4.00	4.50	7.00
Soil Moisture/%			
Soil Organic Content/%			
	Median	**Upper Quartile**	**Maximum Value**
Calluna vulgaris	78.86	162.65	246.44
Erica tetralix	77.19	115.78	887.68
Erica cinerea	49.32	98.65	542.57
Agrostis spp.	75.38	165.84	286.46
Molina caerulea	30.17	75.43	754.26
Deschampsia flexuosa	100.00	133.33	166.67
Pteridium aquilinum	38.99	151.65	433.27
Ulex europaeus	74.11	148.22	370.55
Rubus fruticosus	40.28	80.56	2013.94
Vaccinium myrtillus	30.69	191.82	383.63
Vaccinium vitas-idaea	55.69	90.49	556.88
Potentilla erecta	61.23	122.47	489.86
Rumex acetosella	24.99	124.96	999.66
Galium saxatile	47.17	70.75	628.93
Hieracium umbellatum	28.67	71.67	573.38
Melampyrum pratense	62.50	109.38	250.00
Digitalis purpurea	81.82	95.45	363.64
Cytisus scoparius	100.00	100.00	100.00
Mentha spp.	36.59	97.56	304.88
Polygala serpyllifolia	78.13	101.56	312.50
Lonicera spp.	100.00	100.00	100.00
Sedum spp.	6.24	101.68	383.69
Viola palustris	107.14	121.43	142.86
Myrica gale	81.36	150.00	244.07
Euphorium nemorosa	100.00	100.00	100.00
Scirpus caespitosa	32.85	76.64	437.96
Narthecium ossifragum	60.34	137.93	344.83
Juncus squarrosus	2.98	44.66	1190.84
Andromeda polifolia	100.00	100.00	100.00
Pinguicula vulgaris	93.75	140.63	187.50
Hypericum elodes	96.00	108.00	120.00
Lobelia dortmanna	100.00	100.00	100.00
Potamogeton spp.	100.00	100.00	100.00
Betula spp.	43.46	115.88	579.42
Ilex aquifolium	61.80	123.60	247.19
Quercus robur	72.16	126.29	288.66
Sorbus aucuparia	100.00	100.00	100.00
Malus sylvestris	100.00	116.67	133.33
Pinus sylvestris	83.33	145.83	333.33
Fagus sylvatica	93.75	140.63	187.50
Notes			
Total Plants			
Species			
Mean			
Standard Deviation			
Minimum			
Lower Quartile			
Median			
Upper Quartile			
Maximum			

	A	B	C	D	E	F	G	H	I
1	**Quadrat**	**1,3**	**1,7**	**2,2**	**3,2**	**3,6**	**4,3**	**4,8**	**5,2**
2	**Age (years)**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	5.5
3	**Altitude (nearest 5m)**	110	110	115	75	85	100	85	100
4	**Date Sampled**	05/09/2007	05/09/2007	13/08/2007	22/09/2007	22/09/2007	02/09/2007	02/09/2007	05/09/2007
5	**Time Sampled**	14:20	15:45	13:35	16:55	18:35	13:00	16:00	17:15
6									
7	**Original Mass**	2.96	2.11	1.03	3.32	4.93	2.52	4.10	6.49
8	**Mass After Drying**	1.89	1.67	0.60	0.92	0.91	1.69	2.35	4.80
9	**Mass After Burning**	1.50	0.97	0.57	0.83	0.25	0.85	1.75	4.41
10									
11	**Moisture Content**	1.07	0.44	0.43	2.40	4.02	0.83	1.75	1.69
12	**Organic Content**	0.39	0.70	0.03	0.09	0.66	0.84	0.60	0.39
13									
14	**Anomaly?**			Anomaly	Anomaly				
15									
16				1.24	3.06				
17				0.66	1.05				
18	**Procedure Repeated**			0.22	0.70				
19									
20				0.58	2.01				
21				0.44	0.35				
22									
23	**% Moisture**	36.15	20.85	46.77	65.69	81.54	32.94	42.68	26.04
24	**% Organic**	13.18	33.18	35.48	11.44	13.39	33.33	14.63	6.01
25									
26	**Temperature/°C**	23.00	25.50	17.50	16.00	17.50	21.50	17.50	23.50
27	**pH**	4.0	4.0	4.0	4.0	5.0	4.5	4.0	4.0
28									
29	***Calluna vulgaris***	100	325	25	200	65	400	375	50
30	***Erica tetralix***	20	10	100	25	225	15	150	575
31	***Erica cinerea***				25	225		25	250
32	***Agrostis spp.***	95000	7500	20000	10000	2000	30000	20000	
33	***Molina caerulea***	1000	1000	10000	5000	80000	1500	3000	50000
34	***Deschampsia flexuosa***								
35	***Pteridium aquilinum***			7000	8500	40	200	25	
36	***Ulex europaeus***	30	25	15		5	20	20	
37	***Rubus fruticosus***	10		50					
38	***Vaccinium myrtillus***			50					
39	***Vaccinium vitas-idaea***			5	30	10		5	
40	***Potentilla erecta***	20		30	50				
41	***Rumex acetosella***			30			1000		
42	***Galium saxatile***			10			100		
43	***Hieracium umbellatum***						15		
44	***Melampyrum pratense***								
45	***Digitalis purpurea***								
46	***Cytisus scoparius***								
47	***Mentha spp.***								
48	***Polygala serpyllifolia***								
49	***Lonicera spp.***								
50	***Sedum spp.***								
51	***Viola palustris***								
52	***Myrica gale***				300	125			
53	***Euphorium nemorosa***								
54	***Scirpus caespitosa***								
55	***Narthecium ossifragum***					5			
56	***Juncus squarrosus***				100				
57	***Andromeda polifolia***								
58	***Pinguicula vulgaris***								
59	***Hypericum elodes***								
60	***Lobelia dortmanna***								
61	***Potamogeton spp.***								
62	***Betula spp.***							10	
63	***Ilex aquifolium***				10				
64	***Quercus robur***								
65	***Sorbus aucuparia***			1					
66	***Malus sylvestris***								
67	***Pinus sylvestris***							20	

	A	B	C	D	E	F	G	H	I
1	Quadrat	1,3	1,7	2,2	3,2	3,6	4,3	4,8	5,2
68	*Fagus sylvatica*								
69	Notes		Only patches of soil						
70									
71									
72	*Calluna vulgaris*	39.43	128.15	9.86	78.86	25.63	157.72	147.86	19.72
73	*Erica tetralix*	30.88	15.44	154.38	38.59	347.35	23.16	231.57	887.68
74	*Erica cinerea*				49.32	443.92		49.32	493.24
75	*Agrostis spp.*	286.46	22.62	60.31	30.15	6.03	90.46	60.31	
76	*Molina caerulea*	7.54	7.54	75.43	37.71	603.41	11.31	22.63	377.13
77	*Deschampsia flexuosa*								
78	*Pteridium aquilinum*			303.29	368.28	1.73	8.67	1.08	
79	*Ulex europaeus*	148.22	123.52	74.11		24.70	98.81	98.81	
80	*Rubus fruticosus*	8.06		40.28					
81	*Vaccinium myrtillus*			7.67					
82	*Vaccinium vitas-idaea*			13.92	83.53	27.84		13.92	
83	*Potentilla erecta*	19.59		29.39	48.99				
84	*Rumex acetosella*			7.50			249.91		
85	*Galium saxatile*			6.29			62.89		
86	*Hieracium umbellatum*						21.50		
87	*Melampyrum pratense*								
88	*Digitalis purpurea*								
89	*Cytisus scoparius*								
90	*Mentha spp.*								
91	*Polygala serpyllifolia*								
92	*Lonicera spp.*								
93	*Sedum spp.*								
94	*Viola palustris*								
95	*Myrica gale*				122.03	50.85			
96	*Euphorium nemorosa*								
97	*Scirpus caespitosa*								
98	*Narthecium ossifragum*					17.24			
99	*Juncus squarrosus*				1.49				
100	*Andromeda polifolia*								
101	*Pinguicula vulgaris*								
102	*Hypericum elodes*								
103	*Lobelia dortmanna*								
104	*Potamogeton spp.*								
105	*Betula spp.*							28.97	
106	*Ilex aquifolium*				123.60				
107	*Quercus robur*								
108	*Sorbus aucuparia*			100.00					
109	*Malus sylvestris*								
110	*Pinus sylvestris*							333.33	
111	*Fagus sylvatica*								
112									
113	Total Plants	540	297	882	983	1549	724	988	1778
114	Species	7	5	13	11	10	9	10	4
115	Mean	77.17	59.45	67.88	89.32	154.87	80.49	98.78	444.44
116	Standard Deviation	104.37	60.85	83.50	99.94	222.84	80.72	108.73	357.66
117	Minimum	7.54	7.54	6.29	1.49	1.73	8.67	1.08	19.72
118	Lower Quartile	13.83	15.44	9.86	38.15	19.11	21.50	24.21	287.78
119	Median	30.88	22.62	40.28	49.32	26.74	62.89	54.82	435.19
120	Upper Quartile	93.83	123.52	75.43	102.78	273.23	98.81	135.60	591.85
121	Maximum	286.46	128.15	303.29	368.28	603.41	249.91	333.33	887.68
122									

Investigation into How Time After Burning Influences Flora Biodiversity in Managed Heathland

Martin Yeo

Appendix II - Soil

	A	J	K	L	M	N	O	P	Q
1	Quadrat	5,8	6,2	6,6	6,11	7,4	8,2	8,4	9,1
2	Age (years)	5.5	5.5	5.5	5.5	5.5	4.5	4.5	3.5
3	Altitude (nearest 5m)	85	75	65	65	105	115	115	110
4	Date Sampled	07/09/2007	23/09/2007	23/09/2007	23/09/2007	17/08/2007	13/08/2007	17/08/2007	05/09/2007
5	Time Sampled	14:50	09:55	11:20	13:10	14:55	15:15	11:30	09:15
6									
7	Original Mass	3.56	2.98	4.20	3.18	3.92	0.27	3.65	1.88
8	Mass After Drying	1.91	1.88	1.76	2.32	1.30	0.25	1.11	1.08
9	Mass After Burning	1.53	1.85	1.68	2.18	1.29	0.06	1.03	1.07
10									
11	Moisture Content	1.65	1.10	2.44	0.86	2.62	0.02	2.54	0.80
12	Organic Content	0.38	0.03	0.08	0.14	0.01	0.19	0.08	0.01
13									
14	Anomaly?		Anomaly	Anomaly		Anomaly	Anomaly	Anomaly	Anomaly
15									
16	Procedure Repeated		2.71	3.92		3.80		3.51	1.95
17			1.69	1.58		1.36		1.16	1.23
18			0.98	1.04		0.87		0.80	0.86
19									
20			1.02	2.34		2.44		2.35	0.72
21			0.71	0.54		0.49		0.36	0.37
22									
23	% Moisture	46.35	37.64	59.69	27.04	64.21	7.41	66.95	36.92
24	% Organic	10.67	26.20	13.78	4.40	12.89	70.37	10.26	18.97
25									
26	Temperature/℃	22.25	15.50	15.00	16.00	17.50	21.50	19.00	16.25
27	pH	4.5	5.0	4.0	4.5	4.0	4.0	4.0	5.5
28									
29	*Calluna vulgaris*	200	50	275	150	425	250	100	450
30	*Erica tetralix*	25		75	10	50	75	100	150
31	*Erica cinerea*	50		50	10	150	10		75
32	*Agrostis spp.*	75000	80000	55000	65000	1000	20000	80000	40000
33	*Molina caerulea*	500		2000	750	5000	1250		10000
34	*Deschampsia flexuosa*								20
35	*Pteridium aquilinum*		2500	3500	7500	100	600	150	
36	*Ulex europaeus*	30		25		30	45	75	5
37	*Rubus fruticosus*	10	40	75			30	10	
38	*Vaccinium myrtillus*						35		
39	*Vaccinium vitas-idaea*	15		10					
40	*Potentilla erecta*	250	100	250	250		15	200	
41	*Rumex acetosella*	50			500				
42	*Galium saxatile*						20	50	
43	*Hieracium umbellatum*	40			5			50	
44	*Melampyrum pratense*								
45	*Digitalis purpurea*		5						
46	*Cytisus scoparius*								
47	*Mentha spp.*		40						
48	*Polygala serpyllifolia*								
49	*Lonicera spp.*								
50	*Sedum spp.*								
51	*Viola palustris*		40						
52	*Myrica gale*								
53	*Euphorium nemorosa*								
54	*Scirpus caespitosa*								
55	*Narthecium ossifragum*								
56	*Juncus squarrosus*								
57	*Andromeda polifolia*								
58	*Pinguicula vulgaris*	25							
59	*Hypericum elodes*		40						
60	*Lobelia dortmanna*	5							
61	*Potamogeton spp.*								
62	*Betula spp.*			10			5		
63	*Ilex aquifolium*								
64	*Quercus robur*								
65	*Sorbus aucuparia*								
66	*Malus sylvestris*								
67	*Pinus sylvestris*								2

	A	J	K	L	M	N	O	P	Q
1	**Quadrat**	**5,8**	**6,2**	**6,6**	**6,11**	**7,4**	**8,2**	**8,4**	**9,1**
68	***Fagus sylvatica***								
69	**Notes**								Shallow soil
70									
71									
72	***Calluna vulgaris***	78.86	19.72	108.43	59.15	167.58	98.58	39.43	177.44
73	***Erica tetralix***	38.59		115.78	15.44	77.19	115.78	154.38	231.57
74	***Erica cinerea***	98.65		98.65	19.73	295.95	19.73		147.97
75	***Agrostis spp.***	226.15	241.23	165.84	196.00	3.02	60.31	241.23	120.61
76	***Molina caerulea***	3.77		15.09	5.66	37.71	9.43		75.43
77	***Deschampsia flexuosa***								33.33
78	***Pteridium aquilinum***		108.32	151.65	324.95	4.33	26.00	6.50	
79	***Ulex europaeus***	148.22		123.52		148.22	222.33	370.55	24.70
80	***Rubus fruticosus***	8.06	32.22	60.42			24.17	8.06	
81	***Vaccinium myrtillus***						5.37		
82	***Vaccinium vitas-idaea***	41.77		27.84					
83	***Potentilla erecta***	244.93	97.97	244.93	244.93		14.70	195.95	
84	***Rumex acetosella***	12.50			124.96				
85	***Galium saxatile***						12.58	31.45	
86	***Hieracium umbellatum***	57.34			7.17			71.67	
87	***Melampyrum pratense***								
88	***Digitalis purpurea***		18.18						
89	***Cytisus scoparius***								
90	***Mentha spp.***		97.56						
91	***Polygala serpyllifolia***								
92	***Lonicera spp.***								
93	***Sedum spp.***								
94	***Viola palustris***		114.29						
95	***Myrica gale***								
96	***Euphorium nemorosa***								
97	***Scirpus caespitosa***								
98	***Narthecium ossifragum***								
99	***Juncus squarrosus***								
100	***Andromeda polifolia***								
101	***Pinguicula vulgaris***	93.75							
102	***Hypericum elodes***		96.00						
103	***Lobelia dortmanna***	100.00							
104	***Potamogeton spp.***								
105	***Betula spp.***			28.97			14.49		
106	***Ilex aquifolium***								
107	***Quercus robur***								
108	***Sorbus aucuparia***								
109	***Malus sylvestris***								
110	***Pinus sylvestris***								33.33
111	***Fagus sylvatica***								
112									
113	**Total Plants**	1153	825	1141	998	734	623	1119	844
114	**Species**	13	9	11	9	7	12	9	8
115	**Mean**	88.66	91.72	103.74	110.89	104.86	51.95	124.36	105.55
116	**Standard Deviation**	77.68	68.34	69.11	118.93	106.52	64.77	125.67	76.48
117	**Minimum**	3.77	18.18	15.09	5.66	3.02	5.37	6.50	24.70
118	**Lower Quartile**	38.59	32.22	44.69	15.44	21.02	14.01	31.45	33.33
119	**Median**	78.86	97.56	108.43	59.15	77.19	21.95	71.67	98.02
120	**Upper Quartile**	100.00	108.32	137.58	196.00	157.90	69.87	195.95	155.34
121	**Maximum**	244.93	241.23	244.93	324.95	295.95	222.33	370.55	231.57
122									

Appendix II - Soil

	A	R	S	T	U	V	W	X	Y
1	**Quadrat**	**9,7**	**10,2**	**10,10**	**11,4**	**11,9**	**11,14**	**12,3**	**13,1**
2	**Age (years)**	3.5	3.5	3.5	3.5	3.5	3.5	0.5	16.5
3	**Altitude (nearest 5m)**	110	100	95	110	110	105	90	100
4	**Date Sampled**	05/09/2007	22/09/2007	07/09/2007	15/08/2007	15/08/2007	15/08/2007	23/09/2007	17/08/2007
5	**Time Sampled**	11:50	12:20	16:05	10:30	15:45	18:10	14:35	15:40
6									
7	**Original Mass**	1.45	2.07	2.87	4.37	4.69	4.04	1.13	3.75
8	**Mass After Drying**	0.77	1.01	0.60	1.14	1.22	1.91	0.63	1.35
9	**Mass After Burning**	0.16	0.36	0.22	0.44	0.23	1.46	0.08	1.30
10									
11	**Moisture Content**	0.68	1.06	2.27	3.23	3.47	2.13	0.50	2.40
12	**Organic Content**	0.61	0.65	0.38	0.70	0.99	0.45	0.55	0.05
13									
14	**Anomaly?**								Anomaly
15									
16									3.81
17									1.30
18	**Procedure Repeated**								0.74
19									
20									2.51
21									0.56
22									
23	**% Moisture**	46.90	51.21	79.09	73.91	73.99	52.72	44.25	65.88
24	**% Organic**	42.07	31.40	13.24	16.02	21.11	11.14	48.67	14.70
25									
26	**Temperature/°C**	26.00	19.00	20.00	17.00	17.00	17.50	17.75	16.25
27	**pH**	4.0	4.0	4.0	4.0	4.5	5.0	4.5	4.0
28									
29	***Calluna vulgaris***	200	50	60	75	250	3	175	600
30	***Erica tetralix***	25	10	50	75	50		15	
31	***Erica cinerea***		5	25				15	
32	***Agrostis spp.***	85000	70000	10000	50000	2500	1000		
33	***Molina caerulea***	1250	2500	30000	10000	300		5000	
34	***Deschampsia flexuosa***								
35	***Pteridium aquilinum***		2000	5	3000	1500	2500	200	500
36	***Ulex europaeus***	15	35		15	5		10	
37	***Rubus fruticosus***	5	100	50	150		75		
38	***Vaccinium myrtillus***					2500			
39	***Vaccinium vitas-idaea***		25	20			75		
40	***Potentilla erecta***		25	20	100		35		
41	***Rumex acetosella***				250				
42	***Galium saxatile***				100				
43	***Hieracium umbellatum***				15		5		
44	***Melampyrum pratense***								
45	***Digitalis purpurea***								
46	***Cytisus scoparius***								
47	***Mentha spp.***								
48	***Polygala serpyllifolia***				2				
49	***Lonicera spp.***								
50	***Sedum spp.***								
51	***Viola palustris***								
52	***Myrica gale***			600					
53	***Euphorium nemorosa***								
54	***Scirpus caespitosa***								
55	***Narthecium ossifragum***								
56	***Juncus squarrosus***			200					
57	***Andromeda polifolia***								
58	***Pinguicula vulgaris***								
59	***Hypericum elodes***								
60	***Lobelia dortmanna***								
61	***Potamogeton spp.***								
62	***Betula spp.***					10			
63	***Ilex aquifolium***			5			15		
64	***Quercus robur***						1		
65	***Sorbus aucuparia***								
66	***Malus sylvestris***								
67	***Pinus sylvestris***								

	A	R	S	T	U	V	W	X	Y
1	**Quadrat**	**9,7**	**10,2**	**10,10**	**11,4**	**11,9**	**11,14**	**12,3**	**13,1**
68	***Fagus sylvatica***								
69	**Notes**	Shallow soil						Area still half dead, higher diversity in a sunken patch.	
70									
71									
72	***Calluna vulgaris***	78.86	19.72	23.66	29.57	98.58	1.18	69.00	236.58
73	***Erica tetralix***	38.59	15.44	77.19	115.78	77.19		23.16	
74	***Erica cinerea***		9.86	49.32				29.59	
75	***Agrostis spp.***	256.31	211.08	30.15	150.77	7.54	3.02		
76	***Molina caerulea***	9.43	18.86	226.28	75.43	2.26		37.71	
77	***Deschampsia flexuosa***								
78	***Pteridium aquilinum***		86.65	0.22	129.98	64.99	108.32	8.67	21.66
79	***Ulex europaeus***	74.11	172.92		74.11	24.70		49.41	
80	***Rubus fruticosus***	4.03	80.56	40.28	120.84		60.42		
81	***Vaccinium myrtillus***					383.63			
82	***Vaccinium vitas-idaea***		69.61	55.69			208.83		
83	***Potentilla erecta***		24.49	19.59	97.97		34.29		
84	***Rumex acetosella***				62.48				
85	***Galium saxatile***				62.89				
86	***Hieracium umbellatum***				21.50		7.17		
87	***Melampyrum pratense***								
88	***Digitalis purpurea***								
89	***Cytisus scoparius***								
90	***Mentha spp.***								
91	***Polygala serpyllifolia***				6.25				
92	***Lonicera spp.***								
93	***Sedum spp.***								
94	***Viola palustris***								
95	***Myrica gale***			244.07					
96	***Euphorium nemorosa***								
97	***Scirpus caespitosa***								
98	***Narthecium ossifragum***								
99	***Juncus squarrosus***			2.98					
100	***Andromeda polifolia***								
101	***Pinguicula vulgaris***								
102	***Hypericum elodes***								
103	***Lobelia dortmanna***								
104	***Potamogeton spp.***								
105	***Betula spp.***					28.97			
106	***Ilex aquifolium***			61.80			185.39		
107	***Quercus robur***						14.43		
108	***Sorbus aucuparia***								
109	***Malus sylvestris***								
110	***Pinus sylvestris***								
111	***Fagus sylvatica***								
112									
113	**Total Plants**	461	709	831	948	688	623	218	258
114	**Species**	6	10	12	12	8	9	6	2
115	**Mean**	76.89	70.92	69.27	78.96	85.98	69.23	36.26	129.12
116	**Standard Deviation**	93.30	70.46	80.90	45.55	125.04	80.37	21.09	151.97
117	**Minimum**	4.03	9.86	0.22	6.25	2.26	1.18	8.67	21.66
118	**Lower Quartile**	16.72	19.07	22.64	54.25	20.41	7.17	24.77	75.39
119	**Median**	56.35	47.05	44.80	74.77	46.98	34.29	33.65	129.12
120	**Upper Quartile**	77.67	85.13	65.65	117.05	82.54	108.32	46.48	182.85
121	**Maximum**	256.31	211.08	244.07	150.77	383.63	208.83	69.00	236.58
122									

Appendix II - Soil

	A	Z	AA	AB	AC	AD	AE	AF	AG
1	**Quadrat**	**13,7**	**14,5**	**15,3**	**15,6**	**16,2**	**17,4**	**18,2**	**18,10**
2	**Age (years)**	16.5	16.5	16.5	16.5	25.0	25.0	25.0	25.0
3	**Altitude (nearest 5m)**	80	110	75	80	95	105	110	95
4	**Date Sampled**	07/09/2007	17/08/2007	04/09/2007	04/09/2007	22/09/2007	22/09/2007	22/09/2007	07/09/2007
5	**Time Sampled**	16:35	11:00	15:30	17:00	14:55	13:50	09:25	10:15
6									
7	**Original Mass**	3.60	2.89	3.72	3.34	3.56	3.34	1.89	2.04
8	**Mass After Drying**	0.71	1.43	1.15	2.59	1.33	1.51	1.23	1.09
9	**Mass After Burning**	0.17	0.96	0.81	2.25	0.69	0.88	1.23	1.09
10									
11	**Moisture Content**	2.89	1.46	2.57	0.75	2.23	1.83	0.66	0.95
12	**Organic Content**	0.54	0.47	0.34	0.34	0.64	0.63	0.00	0.00
13									
14	**Anomaly?**							Anomaly	Anomaly
15									
16								1.92	2.03
17								1.20	1.00
18	**Procedure Repeated**							0.83	0.48
19									
20								0.72	1.03
21								0.37	0.52
22									
23	**% Moisture**	80.28	50.52	69.09	22.46	62.64	54.79	37.50	50.74
24	**% Organic**	15.00	16.26	9.14	10.18	17.98	18.86	19.27	25.62
25									
26	**Temperature/℃**	18.50	23.00	17.00	21.00	16.00	17.75	16.25	18.00
27	**pH**	4.0	4.5	7.0	5.0	4.0	5.0	4.0	4.0
28									
29	***Calluna vulgaris***	375	25	325	100	450	525	200	500
30	***Erica tetralix***	50		10	30	75	50		50
31	***Erica cinerea***	25		10	20	25			25
32	***Agrostis spp.***	5000	55000	10000	85000	7500		25000	
33	***Molina caerulea***	5000		10000		2500	8500		2000
34	***Deschampsia flexuosa***								
35	***Pteridium aquilinum***	10	5000	500	150	20	150	5000	1500
36	***Ulex europaeus***		5		10			15	25
37	***Rubus fruticosus***	35	100					20	
38	***Vaccinium myrtillus***		50	5		400		1500	
39	***Vaccinium vitas-idaea***	100	5						
40	***Potentilla erecta***	100		50	200				
41	***Rumex acetosella***		150						
42	***Galium saxatile***		50						
43	***Hieracium umbellatum***		10		100			20	
44	***Melampyrum pratense***								
45	***Digitalis purpurea***								
46	***Cytisus scoparius***								
47	***Mentha spp.***		125						
48	***Polygala serpyllifolia***								
49	***Lonicera spp.***								
50	***Sedum spp.***								
51	***Viola palustris***				35				
52	***Myrica gale***	450		20					
53	***Euphorium nemorosa***			10					
54	***Scirpus caespitosa***								
55	***Narthecium ossifragum***								
56	***Juncus squarrosus***								
57	***Andromeda polifolia***								
58	***Pinguicula vulgaris***								
59	***Hypericum elodes***								
60	***Lobelia dortmanna***								
61	***Potamogeton spp.***								
62	***Betula spp.***		20	5					
63	***Ilex aquifolium***			20					
64	***Quercus robur***		5	5					
65	***Sorbus aucuparia***								
66	***Malus sylvestris***				1				
67	***Pinus sylvestris***			5					

	A	Z	AA	AB	AC	AD	AE	AF	AG
1	Quadrat	13,7	14,5	15,3	15,6	16,2	17,4	18,2	18,10
68	***Fagus sylvatica***			1					
69	**Notes**		Definite boundary between bracken & grass	Large scots pine.	Large rowan				Large path running through quadrat
70									
71									
72	***Calluna vulgaris***	147.86	9.86	128.15	39.43	177.44	207.01	78.86	197.15
73	***Erica tetralix***	77.19		15.44	46.31	115.78	77.19		77.19
74	***Erica cinerea***	49.32		19.73	39.46	49.32			49.32
75	***Agrostis spp.***	15.08	165.84	30.15	256.31	22.62		75.38	
76	***Molina caerulea***	37.71		75.43		18.86	64.11		15.09
77	***Deschampsia flexuosa***								
78	***Pteridium aquilinum***	0.43	216.64	21.66	6.50	0.87	6.50	216.64	64.99
79	***Ulex europaeus***		24.70		49.41			74.11	123.52
80	***Rubus fruticosus***	28.20	80.56					16.11	
81	***Vaccinium myrtillus***		7.67	0.77		61.38		230.18	
82	***Vaccinium vitas-idaea***	278.44	13.92						
83	***Potentilla erecta***	97.97		48.99	195.95				
84	***Rumex acetosella***		37.49						
85	***Galium saxatile***		31.45						
86	***Hieracium umbellatum***		14.33		143.34			28.67	
87	***Melampyrum pratense***								
88	***Digitalis purpurea***								
89	***Cytisus scoparius***								
90	***Mentha spp.***		304.88						
91	***Polygala serpyllifolia***								
92	***Lonicera spp.***								
93	***Sedum spp.***								
94	***Viola palustris***				100.00				
95	***Myrica gale***	183.05		8.14					
96	***Euphorium nemorosa***			100.00					
97	***Scirpus caespitosa***								
98	***Narthecium ossifragum***								
99	***Juncus squarrosus***								
100	***Andromeda polifolia***								
101	***Pinguicula vulgaris***								
102	***Hypericum elodes***								
103	***Lobelia dortmanna***								
104	***Potamogeton spp.***								
105	***Betula spp.***		57.94	14.49					
106	***Ilex aquifolium***			247.19					
107	***Quercus robur***		72.16	72.16					
108	***Sorbus aucuparia***								
109	***Malus sylvestris***				66.67				
110	***Pinus sylvestris***			83.33					
111	***Fagus sylvatica***			18.75					
112									
113	**Total Plants**	915	1037	884	943	446	355	720	527
114	**Species**	10	13	15	10	7	4	7	6
115	**Mean**	91.53	79.80	58.96	94.34	63.75	88.70	102.85	87.88
116	**Standard Deviation**	87.92	92.74	64.51	80.16	62.59	84.64	85.97	64.24
117	**Minimum**	0.43	7.67	0.77	6.50	0.87	6.50	16.11	15.09
118	**Lower Quartile**	30.57	14.33	17.09	41.17	20.74	49.71	51.39	53.24
119	**Median**	63.26	37.49	30.15	58.04	49.32	70.65	75.38	71.09
120	**Upper Quartile**	135.39	80.56	79.38	132.51	88.58	109.64	147.75	111.94
121	**Maximum**	278.44	304.88	247.19	256.31	177.44	207.01	230.18	197.15
122									

	A	AH	AI	AJ	AK	AL
1	Quadrat					
2	Age (years)					
3	Altitude (nearest 5m)					
4	Date Sampled					
5	Time Sampled					
6		**Mean**		**Standard Deviation**	**Minimum**	**Lower Quartile**
7	**Original Mass**					
8	**Mass After Drying**					
9	**Mass After Burning**					
10						
11	**Moisture Content**					
12	**Organic Content**					
13						
14	**Anomaly?**					
15						
16						
17						
18	**Procedure Repeated**					
19						
20						
21						
22						
23	**% Moisture**	50.46		18.96	7.41	37.36
24	**% Organic**	20.59		13.86	4.40	12.53
25						
26	**Temperature/℃**	18.84		2.99	15.00	16.81
27	**pH**	4.39		0.64	4.00	4.00
28		**Mean**	**Frequency (/32)**			
29	***Calluna vulgaris***	230	32			
30	***Erica tetralix***	78	27			
31	***Erica cinerea***	57	18			
32	***Agrostis spp.***	37278	27			
33	***Molina caerulea***	9922	25			
34	***Deschampsia flexuosa***	20	1			
35	***Pteridium aquilinum***	2006	26			
36	***Ulex europaeus***	22	21			
37	***Rubus fruticosus***	51	15			
38	***Vaccinium myrtillus***	649	7			
39	***Vaccinium vitas-idaea***	27	11			
40	***Potentilla erecta***	106	16			
41	***Rumex acetosella***	330	6			
42	***Galium saxatile***	55	6			
43	***Hieracium umbellatum***	29	9			
44	***Melampyrum pratense***		0			
45	***Digitalis purpurea***	5	1			
46	***Cytisus scoparius***		0			
47	***Mentha spp.***	83	2			
48	***Polygala serpyllifolia***	2	1			
49	***Lonicera spp.***		0			
50	***Sedum spp.***		0			
51	***Viola palustris***	38	2			
52	***Myrica gale***	299	5			
53	***Euphorium nemorosa***	10	1			
54	***Scirpus caespitosa***		0			
55	***Narthecium ossifragum***	5	1			
56	***Juncus squarrosus***	150	2			
57	***Andromeda polifolia***		0			
58	***Pinguicula vulgaris***	25	1			
59	***Hypericum elodes***	40	1			
60	***Lobelia dortmanna***	5	1			
61	***Potamogeton spp.***		0			
62	***Betula spp.***	10	6			
63	***Ilex aquifolium***	13	4			
64	***Quercus robur***	4	3			
65	***Sorbus aucuparia***	1	1			
66	***Malus sylvestris***	1	1			
67	***Pinus sylvestris***	9	3			

	A	AH	AI	AJ	AK	AL
1	Quadrat					
68	***Fagus sylvatica***	1	1			
69	**Notes**					
70						
71		**Frequency (/32)**	**Standard Deviation**	**Minimum Value**	**Lower Quartile**	**Median**
72	***Calluna vulgaris***	32	74.16	1.18	28.59	78.86
73	***Erica tetralix***	27	162.44	15.44	34.74	77.19
74	***Erica cinerea***	18	193.92	9.86	32.06	49.32
75	***Agrostis spp.***	27	103.25	3.02	26.38	75.38
76	***Molina caerulea***	25	213.46	2.26	9.43	22.63
77	***Deschampsia flexuosa***	1	565.69	33.33	33.33	33.33
78	***Pteridium aquilinum***	26	150.22	0.22	6.50	23.83
79	***Ulex europaeus***	21	117.46	24.70	49.41	98.81
80	***Rubus fruticosus***	15	160.69	4.03	12.08	32.22
81	***Vaccinium myrtillus***	7	358.56	0.77	6.52	7.67
82	***Vaccinium vitas-idaea***	11	236.49	13.92	20.88	41.77
83	***Potentilla erecta***	16	157.77	14.70	28.17	73.48
84	***Rumex acetosella***	6	320.07	7.50	18.74	49.98
85	***Galium saxatile***	6	258.89	6.29	17.30	31.45
86	***Hieracium umbellatum***	9	251.92	7.17	14.33	21.50
87	***Melampyrum pratense***	0				
88	***Digitalis purpurea***	1	565.69	18.18	18.18	18.18
89	***Cytisus scoparius***	0				
90	***Mentha spp.***	2	445.72	97.56	149.39	201.22
91	***Polygala serpyllifolia***	1	565.69	6.25	6.25	6.25
92	***Lonicera spp.***	0				
93	***Sedum spp.***	0				
94	***Viola palustris***	2	394.43	100.00	103.57	107.14
95	***Myrica gale***	5	297.46	8.14	50.85	122.03
96	***Euphorium nemorosa***	1	565.69	100.00	100.00	100.00
97	***Scirpus caespitosa***	0				
98	***Narthecium ossifragum***	1	565.69	17.24	17.24	17.24
99	***Juncus squarrosus***	2	416.16	1.49	1.86	2.23
100	***Andromeda polifolia***	0				
101	***Pinguicula vulgaris***	1	565.69	93.75	93.75	93.75
102	***Hypericum elodes***	1	565.69	96.00	96.00	96.00
103	***Lobelia dortmanna***	1	565.69	100.00	100.00	100.00
104	***Potamogeton spp.***	0				
105	***Betula spp.***	6	241.86	14.49	18.11	28.97
106	***Ilex aquifolium***	4	297.95	61.80	108.15	154.49
107	***Quercus robur***	3	359.03	14.43	43.30	72.16
108	***Sorbus aucuparia***	1	565.69	100.00	100.00	100.00
109	***Malus sylvestris***	1	565.69	66.67	66.67	66.67
110	***Pinus sylvestris***	3	429.03	33.33	58.33	83.33
111	***Fagus sylvatica***	1	565.69	18.75	18.75	18.75
112						
113	**Total Plants**					
114	**Species**					
115	**Mean**					
116	**Standard Deviation**					
117	**Minimum**					
118	**Lower Quartile**					
119	**Median**					
120	**Upper Quartile**					
121	**Maximum**					
122						

	A	AM	AN	AO	AP	AQ
1	Quadrat					
2	Age (years)					
3	Altitude (nearest 5m)					
4	Date Sampled					
5	Time Sampled					
6		**Median**	**Upper Quartile**	**Maximum**	**Mode**	
7	**Original Mass**					
8	**Mass After Drying**					
9	**Mass After Burning**					
10						
11	**Moisture Content**					
12	**Organic Content**					
13						
14	**Anomaly?**					
15						
16						
17						
18	**Procedure Repeated**					
19						
20						
21						
22						
23	**% Moisture**	50.63	65.73	81.54		
24	**% Organic**	15.51	25.76	70.37		
25						
26	**Temperature/℃**	17.63	21.13	26.00	17.50	
27	**pH**	4.00	4.50	7.00	4.00	
28						
29	***Calluna vulgaris***					
30	***Erica tetralix***					
31	***Erica cinerea***					
32	***Agrostis spp.***					
33	***Molina caerulea***					
34	***Deschampsia flexuosa***					
35	***Pteridium aquilinum***					
36	***Ulex europaeus***					
37	***Rubus fruticosus***					
38	***Vaccinium myrtillus***					
39	***Vaccinium vitas-idaea***					
40	***Potentilla erecta***					
41	***Rumex acetosella***					
42	***Galium saxatile***					
43	***Hieracium umbellatum***					
44	***Melampyrum pratense***					
45	***Digitalis purpurea***					
46	***Cytisus scoparius***					
47	***Mentha spp.***					
48	***Polygala serpyllifolia***					
49	***Lonicera spp.***					
50	***Sedum spp.***					
51	***Viola palustris***					
52	***Myrica gale***					
53	***Euphorium nemorosa***					
54	***Scirpus caespitosa***					
55	***Narthecium ossifragum***					
56	***Juncus squarrosus***					
57	***Andromeda polifolia***					
58	***Pinguicula vulgaris***					
59	***Hypericum elodes***					
60	***Lobelia dortmanna***					
61	***Potamogeton spp.***					
62	***Betula spp.***					
63	***Ilex aquifolium***					
64	***Quercus robur***					
65	***Sorbus aucuparia***					
66	***Malus sylvestris***					
67	***Pinus sylvestris***					

	A	AM	AN	AO	AP	AQ
1	Quadrat					
68	***Fagus sylvatica***					
69	**Notes**					
70						
71		**Upper Quartile**	**Maximum Value**			
72	***Calluna vulgaris***	147.86	236.58			
73	***Erica tetralix***	115.78	887.68			
74	***Erica cinerea***	98.65	493.24			
75	***Agrostis spp.***	203.54	286.46			
76	***Molina caerulea***	75.43	603.41			
77	***Deschampsia flexuosa***	33.33	33.33			
78	***Pteridium aquilinum***	124.57	368.28			
79	***Ulex europaeus***	148.22	370.55			
80	***Rubus fruticosus***	60.42	120.84			
81	***Vaccinium myrtillus***	145.78	383.63			
82	***Vaccinium vitas-idaea***	76.57	278.44			
83	***Potentilla erecta***	195.95	244.93			
84	***Rumex acetosella***	109.34	249.91			
85	***Galium saxatile***	55.03	62.89			
86	***Hieracium umbellatum***	57.34	143.34			
87	***Melampyrum pratense***					
88	***Digitalis purpurea***	18.18	18.18			
89	***Cytisus scoparius***					
90	***Mentha spp.***	253.05	304.88			
91	***Polygala serpyllifolia***	6.25	6.25			
92	***Lonicera spp.***					
93	***Sedum spp.***					
94	***Viola palustris***	110.71	114.29			
95	***Myrica gale***	183.05	244.07			
96	***Euphorium nemorosa***	100.00	100.00			
97	***Scirpus caespitosa***					
98	***Narthecium ossifragum***	17.24	17.24			
99	***Juncus squarrosus***	2.60	2.98			
100	***Andromeda polifolia***					
101	***Pinguicula vulgaris***	93.75	93.75			
102	***Hypericum elodes***	96.00	96.00			
103	***Lobelia dortmanna***	100.00	100.00			
104	***Potamogeton spp.***					
105	***Betula spp.***	28.97	57.94			
106	***Ilex aquifolium***	200.84	247.19			
107	***Quercus robur***	72.16	72.16			
108	***Sorbus aucuparia***	100.00	100.00			
109	***Malus sylvestris***	66.67	66.67			
110	***Pinus sylvestris***	208.33	333.33			
111	***Fagus sylvatica***	18.75	18.75			
112						
113	**Total Plants**					
114	**Species**					
115	**Mean**					
116	**Standard Deviation**					
117	**Minimum**					
118	**Lower Quartile**					
119	**Median**					
120	**Upper Quartile**					
121	**Maximum**					
122						

Appendix III - Spearman's Rank

Temp-Moisture					
Soil Temperature	Rank	Soil Moisture	Rank	d	d^2
23	28.5	36.15	7	21.5	462.25
25.5	31	20.85	2	29	841
17.5	14	46.77	14	0	0
16	4	65.69	24	-20	400
17.5	14	81.54	32	-18	324
21.5	25.5	32.94	6	19.5	380.25
17.5	14	42.68	11	3	9
23.5	30	26.04	4	26	676
22.25	27	46.35	13	14	196
15.5	2	37.64	10	-8	64
15	1	59.69	21	-20	400
16	4	27.04	5	-1	1
17.5	14	64.21	23	-9	81
21.5	25.5	7.41	1	24.5	600.25
19	21.5	66.95	26	-4.5	20.25
16.25	7	36.92	8	-1	1
26	32	46.90	15	17	289
19	21.5	51.21	18	3.5	12.25
20	23	79.09	30	-7	49
17	10	73.91	28	-18	324
17	10	73.99	29	-19	361
17.5	14	52.72	19	-5	25
17.75	17.5	44.25	12	5.5	30.25
16.25	7	65.88	25	-18	324
18.5	20	80.28	31	-11	121
23	28.5	50.52	16	12.5	156.25
17	10	69.09	27	-17	289
21	24	22.46	3	21	441
16	4	62.64	22	-18	324
17.75	17.5	54.79	20	-2.5	6.25
16.25	7	37.50	9	-2	4
18	19	50.74	17	2	4
				Σd^2	7216
				$6\Sigma d^2$	43296
				n	32
				n^3	32768
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.323

pH-Moisture					
Soil pH	Rank	Soil Moisture	Rank	d	d^2
4	10	36.15	7	3	9
4	10	20.85	2	8	64
4	10	46.77	14	-4	16
4	10	65.69	24	-14	196
5	28	81.54	32	-4	16
4.5	22.5	32.94	6	16.5	272.25
4	10	42.68	11	-1	1
4	10	26.04	4	6	36
4.5	22.5	46.35	13	9.5	90.25
5	28	37.64	10	18	324
4	10	59.69	21	-11	121
4.5	22.5	27.04	5	17.5	306.25
4	10	64.21	23	-13	169
4	10	7.41	1	9	81
4	10	66.95	26	-16	256
5.5	31	36.92	8	23	529
4	10	46.90	15	-5	25
4	10	51.21	18	-8	64
4	10	79.09	30	-20	400
4	10	73.91	28	-18	324
4.5	22.5	73.99	29	-6.5	42.25
5	28	52.72	19	9	81
4.5	22.5	44.25	12	10.5	110.25
4	10	65.88	25	-15	225
4	10	80.28	31	-21	441
4.5	22.5	50.52	16	6.5	42.25
7	32	69.09	27	5	25
5	28	22.46	3	25	625
4	10	62.64	22	-12	144
5	28	54.79	20	8	64
4	10	37.50	9	1	1
4	10	50.74	17	-7	49
				Σd^2	5149.5
				$6\Sigma d^2$	30897
				n	32
				n^3	32768
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.056

pH-Organic Content					
Soil pH	Rank	Soil Organic Content	Rank	d	d^2
4	10	13.18	10	0	0
4	10	33.18	27	-17	289
4	10	35.48	29	-19	361
4	10	11.44	8	2	4
5	28	13.39	12	16	256
4.5	22.5	33.33	28	-5.5	30.25
4	10	14.63	14	-4	16
4	10	6.01	2	8	64
4.5	22.5	10.67	6	16.5	272.25
5	28	26.20	25	3	9
4	10	13.78	13	-3	9
4.5	22.5	4.40	1	21.5	462.25
4	10	12.89	9	1	1
4	10	70.37	32	-22	484
4	10	10.26	5	5	25
5.5	31	18.97	21	10	100
4	10	42.07	30	-20	400
4	10	31.40	26	-16	256
4	10	13.24	11	-1	1
4	10	16.02	17	-7	49
4.5	22.5	21.11	23	-0.5	0.25
5	28	11.14	7	21	441
4.5	22.5	48.67	31	-8.5	72.25
4	10	14.70	15	-5	25
4	10	15.00	16	-6	36
4.5	22.5	16.26	18	4.5	20.25
7	32	9.14	3	29	841
5	28	10.18	4	24	576
4	10	17.98	19	-9	81
5	28	18.86	20	8	64
4	10	19.27	22	-12	144
4	10	25.62	24	-14	196
				Σd^2	5585.5
				$6\Sigma d^2$	33513
				n	32
				n^3	32768
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.024

pH-# Calluna Vulgaris					
Soil pH	Rank	Calluna Vulgaris	Rank	d	d^2
4	10	39.43	11	-1	1
4	10	128.15	22	-12	144
4	10	9.86	2.5	7.5	56.25
4	10	78.86	16.5	-6.5	42.25
5	28	25.63	8	20	400
4.5	22.5	157.72	25	-2.5	6.25
4	10	147.86	23.5	-13.5	182.25
4	10	19.72	5	5	25
4.5	22.5	78.86	16.5	6	36
5	28	19.72	5	23	529
4	10	108.43	21	-11	121
4.5	22.5	59.15	13	9.5	90.25
4	10	167.58	26	-16	256
4	10	98.58	19.5	-9.5	90.25
4	10	39.43	11	-1	1
5.5	31	177.44	27.5	3.5	12.25
4	10	78.86	16.5	-6.5	42.25
4	10	19.72	5	5	25
4	10	23.66	7	3	9
4	10	29.57	9	1	1
4.5	22.5	98.58	19.5	3	9
5	28	1.18	1	27	729
4.5	22.5	69.00	14	8.5	72.25
4	10	236.58	31	-21	441
4	10	147.86	23.5	-13.5	182.25
4.5	22.5	9.86	2.5	20	400
5	28	39.43	11	17	289
4	10	177.44	27.5	-17.5	306.25
5	28	207.01	30	-2	4
4	10	78.86	16.5	-6.5	42.25
4	10	197.15	29	-19	361
				Σd^2	4906
				$6\Sigma d^2$	29436
				n	31
				n^3	29791
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.011

pH-# Agrostis spp.					
Soil pH	Rank	Agrostis spp.	Rank	d	d^2
4	10	286.46	31	-21	441
4	10	22.62	11.5	-1.5	2.25
4	10	60.31	16	-6	36
4	10	30.15	13.5	-3.5	12.25
5	28	6.03	8	20	400
4.5	22.5	90.46	19	3.5	12.25
4	10	60.31	16	-6	36
4	10	0.00	3	7	49
4.5	22.5	226.15	26	-3.5	12.25
5	28	241.23	27.5	0.5	0.25
4	10	165.84	22.5	-12.5	156.25
4.5	22.5	196.00	24	-1.5	2.25
4	10	3.02	6.5	3.5	12.25
4	10	60.31	16	-6	36
4	10	241.23	27.5	-17.5	306.25
5.5	31	120.61	20	11	121
4	10	256.31	29.5	-19.5	380.25
4	10	211.08	25	-15	225
4	10	30.15	13.5	-3.5	12.25
4	10	150.77	21	-11	121
4.5	22.5	7.54	9	13.5	182.25
5	28	3.02	6.5	21.5	462.25
4.5	22.5	0.00	3	19.5	380.25
4	10	0.00	3	7	49
4	10	15.08	10	0	0
4.5	22.5	165.84	22.5	0	0
5	28	256.31	29.5	-1.5	2.25
4	10	22.62	11.5	-1.5	2.25
5	28	0.00	3	25	625
4	10	75.38	18	-8	64
4	10	0.00	3	7	49
				Σd^2	4190
				$6\Sigma d^2$	25140
				n	31
				n^3	29791
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.155

pH-# Ulex Europaeus					
Soil pH	Rank	Ulex Europaeus	Rank	d	d^2
4	10	148.22	27	-17	289
4	10	123.52	24	-14	196
4	10	74.11	18.5	-8.5	72.25
4	10	0.00	5.5	4.5	20.25
5	28	24.70	12.5	15.5	240.25
4.5	22.5	98.81	21.5	1	1
4	10	98.81	21.5	-11.5	132.25
4	10	0.00	5.5	4.5	20.25
4.5	22.5	148.22	27	-4.5	20.25
5	28	0.00	5.5	22.5	506.25
4	10	123.52	24	-14	196
4.5	22.5	0.00	5.5	17	289
4	10	148.22	27	-17	289
4	10	222.33	30	-20	400
4	10	370.55	31	-21	441
5.5	31	24.70	12.5	18.5	342.25
4	10	74.11	18.5	-8.5	72.25
4	10	172.92	29	-19	361
4	10	0.00	5.5	4.5	20.25
4	10	74.11	18.5	-8.5	72.25
4.5	22.5	24.70	12.5	10	100
5	28	0.00	5.5	22.5	506.25
4.5	22.5	49.41	15.5	7	49
4	10	0.00	5.5	4.5	20.25
4	10	0.00	5.5	4.5	20.25
4.5	22.5	24.70	12.5	10	100
5	28	49.41	15.5	12.5	156.25
4	10	0.00	5.5	4.5	20.25
5	28	0.00	5.5	22.5	506.25
4	10	74.11	18.5	-8.5	72.25
4	10	123.52	24	-14	196
				Σd^2	5727.5
				$6\Sigma d^2$	34365
				n	31
				n^3	29791
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.155

Appendix III - Spearman's Rank

pH-# Myrica Gale					
Soil pH	Rank	Myrica Gale	Rank	d	d^2
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
4	10	122.03	29	-19	361
5	28	50.85	28	0	0
4.5	22.5	0.00	14	8.5	72.25
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
4.5	22.5	0.00	14	8.5	72.25
5	28	0.00	14	14	196
4	10	0.00	14	-4	16
4.5	22.5	0.00	14	8.5	72.25
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
5.5	31	0.00	14	17	289
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
4	10	244.07	31	-21	441
4	10	0.00	14	-4	16
4.5	22.5	0.00	14	8.5	72.25
5	28	0.00	14	14	196
4.5	22.5	0.00	14	8.5	72.25
4	10	0.00	14	-4	16
4	10	183.05	30	-20	400
4.5	22.5	0.00	14	8.5	72.25
5	28	0.00	14	14	196
4	10	0.00	14	-4	16
5	28	0.00	14	14	196
4	10	0.00	14	-4	16
4	10	0.00	14	-4	16
				Σd^2	2964.5
				$6\Sigma d^2$	17787
				n	31
				n^3	29791
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.402

pH-# Betula spp.					
Soil pH	Rank	Betula spp.	Rank	d	d^2
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
5	28	0.00	13.5	14.5	210.25
4.5	22.5	0.00	13.5	9	81
4	10	28.97	29	-19	361
4	10	0.00	13.5	-3.5	12.25
4.5	22.5	0.00	13.5	9	81
5	28	0.00	13.5	14.5	210.25
4	10	28.97	29	-19	361
4.5	22.5	0.00	13.5	9	81
4	10	0.00	13.5	-3.5	12.25
4	10	14.49	27	-17	289
4	10	0.00	13.5	-3.5	12.25
5.5	31	0.00	13.5	17.5	306.25
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
4.5	22.5	28.97	29	-6.5	42.25
5	28	0.00	13.5	14.5	210.25
4.5	22.5	0.00	13.5	9	81
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
4.5	22.5	57.94	31	-8.5	72.25
5	28	0.00	13.5	14.5	210.25
4	10	0.00	13.5	-3.5	12.25
5	28	0.00	13.5	14.5	210.25
4	10	0.00	13.5	-3.5	12.25
4	10	0.00	13.5	-3.5	12.25
				Σd^2	3003
				$6\Sigma d^2$	18018
				n	31
				n^3	29791
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.395

Soil Moisture-# Calluna Vulgaris					
Soil Moisture	Rank	Calluna Vulgaris	Rank	d	d^2
35.00	13	118.29	46.5	-33.5	1122.25
35.00	13	108.43	44.5	-31.5	992.25
36.15	15	39.43	25	-10	100
35.00	13	29.57	17.5	-4.5	20.25
20.00	5	147.86	53.5	-48.5	2352.25
20.00	5	177.44	65.5	-60.5	3660.25
20.85	7	128.15	48	-41	1681
20.00	5	157.72	57.5	-52.5	2756.25
45.00	25.5	39.43	25	0.5	0.25
46.77	30	9.86	5.5	24.5	600.25
45.00	25.5	0.00	1	24.5	600.25
65.00	57	59.15	30.5	26.5	702.25
65.69	65	78.86	36.5	28.5	812.25
65.00	57	29.57	17.5	39.5	1560.25
65.00	57	39.43	25	32	1024
45.00	25.5	167.58	61.5	-36	1296
45.00	25.5	167.58	61.5	-36	1296
42.68	21	147.86	53.5	-32.5	1056.25
25.00	9	29.57	17.5	-8.5	72.25
26.04	11	19.72	11	0	0
25.00	9	29.57	17.5	-8.5	72.25
25.00	9	59.15	30.5	-21.5	462.25
60.00	45.5	69.00	32.5	13	169
59.69	43	108.43	44.5	-1.5	2.25
60.00	45.5	78.86	36.5	9	81
60.00	45.5	29.57	17.5	28	784
65.00	57	226.73	73	-16	256
65.00	57	236.58	77.5	-20.5	420.25
65.00	57	197.15	69	-12	144
64.21	49	167.58	61.5	-12.5	156.25
5.00	1.5	88.72	40	-38.5	1482.25
7.41	3	98.58	42	-39	1521
5.00	1.5	3.94	2.5	-1	1
66.95	67	39.43	25	42	1764
65.00	57	98.58	42	15	225
65.00	57	147.86	53.5	3.5	12.25
65.00	57	13.80	9	48	2304
45.00	25.5	216.87	71	-45.5	2070.25
45.00	25.5	147.86	53.5	-28	784
46.90	31	78.86	36.5	-5.5	30.25
45.00	25.5	138.01	49.5	-24	576
45.00	25.5	167.58	61.5	-36	1296
50.00	36	3.94	2.5	33.5	1122.25
51.21	42	19.72	11	31	961
50.00	36	19.72	11	25	625
50.00	36	39.43	25	11	121
50.00	36	29.57	17.5	18.5	342.25
80.00	77.5	9.86	5.5	72	5184
50.00	36	9.86	5.5	30.5	930.25
80.00	77.5	98.58	42	35.5	1260.25
80.00	77.5	9.86	5.5	72	5184
79.09	74	23.66	13	61	3721
75.00	71	147.86	53.5	17.5	306.25

75.00	71	78.86	36.5	34.5	1190.25
75.00	71	197.15	69	2	4
73.91	68	29.57	17.5	50.5	2550.25
75.00	71	78.86	36.5	34.5	1190.25
75.00	71	11.83	8	63	3969
60.00	45.5	69.00	32.5	13	169
65.88	66	236.58	77.5	-11.5	132.25
65.00	57	246.44	81	-24	576
65.00	57	236.58	77.5	-20.5	420.25
65.00	57	187.29	67	-10	100
65.00	57	167.58	61.5	-4.5	20.25
65.00	57	157.72	57.5	-0.5	0.25
80.28	81	147.86	53.5	27.5	756.25
80.00	77.5	39.43	25	52.5	2756.25
80.00	77.5	29.57	17.5	60	3600
80.00	77.5	39.43	25	52.5	2756.25
65.00	57	236.58	77.5	-20.5	420.25
62.64	48	177.44	65.5	-17.5	306.25
40.00	18.5	138.01	49.5	-31	961
37.50	16	78.86	36.5	-20.5	420.25
40.00	18.5	118.29	46.5	-28	784
40.00	18.5	49.29	29	-10.5	110.25
40.00	18.5	226.73	73	-54.5	2970.25
50.00	36	167.58	61.5	-25.5	650.25
50.00	36	236.58	77.5	-41.5	1722.25
50.00	36	226.73	73	-37	1369
50.00	36	236.58	77.5	-41.5	1722.25
50.74	41	197.15	69	-28	784
				Σd^2	88485.5
				$6\Sigma d^2$	530913
				n	81
				n^3	531441
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.001

Soil Moisture-# Agrostis spp.					
Soil Moisture	Rank	Agrostis spp.	Rank	d	d^2
35.00	13	60.31	47.5	-34.5	1190.25
35.00	13	241.23	78	-65	4225
36.15	15	286.46	81	-66	4356
35.00	13	241.23	78	-65	4225
20.00	5	120.61	60	-55	3025
20.00	5	105.54	57.5	-52.5	2756.25
20.85	7	22.62	36	-29	841
20.00	5	165.84	69.5	-64.5	4160.25
45.00	25.5	150.77	65	-39.5	1560.25
46.77	30	60.31	47.5	-17.5	306.25
45.00	25.5	120.61	60	-34.5	1190.25
65.00	57	22.62	36	21	441
65.69	65	30.15	40	25	625
65.00	57	0.00	11.5	45.5	2070.25
65.00	57	105.54	57.5	-0.5	0.25
45.00	25.5	3.02	28	-2.5	6.25
45.00	25.5	150.77	65	-39.5	1560.25
42.68	21	60.31	47.5	-26.5	702.25
25.00	9	0.00	11.5	-2.5	6.25
26.04	11	0.00	11.5	-0.5	0.25
25.00	9	60.31	47.5	-38.5	1482.25
25.00	9	0.00	11.5	-2.5	6.25
60.00	45.5	75.38	52	-6.5	42.25
59.69	43	165.84	69.5	-26.5	702.25
60.00	45.5	150.77	65	-19.5	380.25
60.00	45.5	45.23	43	2.5	6.25
65.00	57	6.03	31	26	676
65.00	57	3.02	28	29	841
65.00	57	0.00	11.5	45.5	2070.25
64.21	49	3.02	28	21	441
5.00	1.5	180.92	71.5	-70	4900
7.41	3	60.31	47.5	-44.5	1980.25
5.00	1.5	3.02	28	-26.5	702.25
66.95	67	241.23	78	-11	121
65.00	57	60.31	47.5	9.5	90.25
65.00	57	30.15	40	17	289
65.00	57	180.92	71.5	-14.5	210.25
45.00	25.5	75.38	52	-26.5	702.25
45.00	25.5	150.77	65	-39.5	1560.25
46.90	31	256.31	80	-49	2401
45.00	25.5	211.08	74.5	-49	2401
45.00	25.5	90.46	55	-29.5	870.25
50.00	36	0.00	11.5	24.5	600.25
51.21	42	211.08	74.5	-32.5	1056.25
50.00	36	120.61	60	-24	576
50.00	36	150.77	65	-29	841
50.00	36	211.08	74.5	-38.5	1482.25
80.00	77.5	45.23	43	34.5	1190.25
50.00	36	90.46	55	-19	361
80.00	77.5	15.08	33	44.5	1980.25
80.00	77.5	0.00	11.5	66	4356
79.09	74	30.15	40	34	1156
75.00	71	0.75	24	47	2209

75.00	71	90.46	55	16	256
75.00	71	24.12	38	33	1089
73.91	68	150.77	65	3	9
75.00	71	211.08	74.5	-3.5	12.25
75.00	71	150.77	65	6	36
60.00	45.5	0.00	11.5	34	1156
65.88	66	0.00	11.5	54.5	2970.25
65.00	57	0.00	11.5	45.5	2070.25
65.00	57	0.00	11.5	45.5	2070.25
65.00	57	0.00	11.5	45.5	2070.25
65.00	57	0.00	11.5	45.5	2070.25
65.00	57	0.00	11.5	45.5	2070.25
80.28	81	15.08	33	48	2304
80.00	77.5	0.00	11.5	66	4356
80.00	77.5	0.00	11.5	66	4356
80.00	77.5	0.00	11.5	66	4356
65.00	57	0.00	11.5	45.5	2070.25
62.64	48	22.62	36	12	144
40.00	18.5	3.02	28	-9.5	90.25
37.50	16	75.38	52	-36	1296
40.00	18.5	15.08	33	-14.5	210.25
40.00	18.5	45.23	43	-24.5	600.25
40.00	18.5	1.51	25	-6.5	42.25
50.00	36	0.00	11.5	24.5	600.25
50.00	36	0.30	23	13	169
50.00	36	0.00	11.5	24.5	600.25
50.00	36	0.00	11.5	24.5	600.25
50.74	41	0.00	11.5	29.5	870.25
				Σd^2	110476
				$6\Sigma d^2$	662856
				n	81
				n^3	531441
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.247

Soil Moisture-# Ulex europaeus					
Soil Moisture	Rank	Ulex europaeus	Rank	d	d^2
35.00	13	197.63	78	-65	4225
35.00	13	24.70	41.5	-28.5	812.25
36.15	15	148.22	72.5	-57.5	3306.25
35.00	13	0.00	19.5	-6.5	42.25
20.00	5	247.04	80	-75	5625
20.00	5	74.11	52.5	-47.5	2256.25
20.85	7	123.52	65	-58	3364
20.00	5	74.11	52.5	-47.5	2256.25
45.00	25.5	123.52	65	-39.5	1560.25
46.77	30	74.11	52.5	-22.5	506.25
45.00	25.5	0.00	19.5	6	36
65.00	57	0.00	19.5	37.5	1406.25
65.69	65	0.00	19.5	45.5	2070.25
65.00	57	0.00	19.5	37.5	1406.25
65.00	57	0.00	19.5	37.5	1406.25
45.00	25.5	74.11	52.5	-27	729
45.00	25.5	24.70	41.5	-16	256
42.68	21	98.81	59	-38	1444
25.00	9	98.81	59	-50	2500
26.04	11	0.00	19.5	-8.5	72.25
25.00	9	24.70	41.5	-32.5	1056.25
25.00	9	0.00	19.5	-10.5	110.25
60.00	45.5	148.22	72.5	-27	729
59.69	43	123.52	65	-22	484
60.00	45.5	0.00	19.5	26	676
60.00	45.5	0.00	19.5	26	676
65.00	57	98.81	59	-2	4
65.00	57	0.00	19.5	37.5	1406.25
65.00	57	123.52	65	-8	64
64.21	49	148.22	72.5	-23.5	552.25
5.00	1.5	148.22	72.5	-71	5041
7.41	3	222.33	79	-76	5776
5.00	1.5	98.81	59	-57.5	3306.25
66.95	67	370.55	81	-14	196
65.00	57	123.52	65	-8	64
65.00	57	0.00	19.5	37.5	1406.25
65.00	57	49.41	46	11	121
45.00	25.5	0.00	19.5	6	36
45.00	25.5	123.52	65	-39.5	1560.25
46.90	31	74.11	52.5	-21.5	462.25
45.00	25.5	148.22	72.5	-47	2209
45.00	25.5	0.00	19.5	6	36
50.00	36	0.00	19.5	16.5	272.25
51.21	42	172.92	77	-35	1225
50.00	36	0.00	19.5	16.5	272.25
50.00	36	49.41	46	-10	100
50.00	36	0.00	19.5	16.5	272.25
80.00	77.5	0.00	19.5	58	3364
50.00	36	0.00	19.5	16.5	272.25
80.00	77.5	0.00	19.5	58	3364
80.00	77.5	0.00	19.5	58	3364
79.09	74	0.00	19.5	54.5	2970.25
75.00	71	74.11	52.5	18.5	342.25

75.00	71	148.22	72.5	-1.5	2.25
75.00	71	49.41	46	25	625
73.91	68	74.11	52.5	15.5	240.25
75.00	71	24.70	41.5	29.5	870.25
75.00	71	98.81	59	12	144
60.00	45.5	0.00	19.5	26	676
65.88	66	0.00	19.5	46.5	2162.25
65.00	57	0.00	19.5	37.5	1406.25
65.00	57	0.00	19.5	37.5	1406.25
65.00	57	148.22	72.5	-15.5	240.25
65.00	57	148.22	72.5	-15.5	240.25
65.00	57	0.00	19.5	37.5	1406.25
80.28	81	0.00	19.5	61.5	3782.25
80.00	77.5	0.00	19.5	58	3364
80.00	77.5	0.00	19.5	58	3364
80.00	77.5	0.00	19.5	58	3364
65.00	57	49.41	46	11	121
62.64	48	0.00	19.5	28.5	812.25
40.00	18.5	0.00	19.5	-1	1
37.50	16	74.11	52.5	-36.5	1332.25
40.00	18.5	49.41	46	-27.5	756.25
40.00	18.5	0.00	19.5	-1	1
40.00	18.5	0.00	19.5	-1	1
50.00	36	0.00	19.5	16.5	272.25
50.00	36	0.00	19.5	16.5	272.25
50.00	36	0.00	19.5	16.5	272.25
50.00	36	14.82	39	-3	9
50.74	41	123.52	65	-24	576
				Σd^2	104790.5
				$6\Sigma d^2$	628743
				n	81
				n^3	531441
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.183

Soil Moisture-# Myrica gale					
Soil Moisture	Rank	Myrica gale	Rank	d	d^2
35.00	13	0.00	34	-21	441
35.00	13	0.00	34	-21	441
36.15	15	0.00	34	-19	361
35.00	13	0.00	34	-21	441
20.00	5	0.00	34	-29	841
20.00	5	0.00	34	-29	841
20.85	7	0.00	34	-27	729
20.00	5	0.00	34	-29	841
45.00	25.5	0.00	34	-8.5	72.25
46.77	30	0.00	34	-4	16
45.00	25.5	0.00	34	-8.5	72.25
65.00	57	183.05	78.5	-21.5	462.25
65.69	65	122.03	75	-10	100
65.00	57	50.85	72	-15	225
65.00	57	142.37	76	-19	361
45.00	25.5	0.00	34	-8.5	72.25
45.00	25.5	0.00	34	-8.5	72.25
42.68	21	0.00	34	-13	169
25.00	9	0.00	34	-25	625
26.04	11	0.00	34	-23	529
25.00	9	0.00	34	-25	625
25.00	9	20.34	69	-60	3600
60.00	45.5	0.00	34	11.5	132.25
59.69	43	0.00	34	9	81
60.00	45.5	0.00	34	11.5	132.25
60.00	45.5	0.00	34	11.5	132.25
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
64.21	49	0.00	34	15	225
5.00	1.5	0.00	34	-32.5	1056.25
7.41	3	0.00	34	-31	961
5.00	1.5	0.00	34	-32.5	1056.25
66.95	67	0.00	34	33	1089
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
45.00	25.5	0.00	34	-8.5	72.25
45.00	25.5	0.00	34	-8.5	72.25
46.90	31	0.00	34	-3	9
45.00	25.5	0.00	34	-8.5	72.25
45.00	25.5	0.00	34	-8.5	72.25
50.00	36	0.00	34	2	4
51.21	42	0.00	34	8	64
50.00	36	0.00	34	2	4
50.00	36	12.20	68	-32	1024
50.00	36	0.00	34	2	4
80.00	77.5	203.39	80	-2.5	6.25
50.00	36	0.00	34	2	4
80.00	77.5	152.54	77	0.5	0.25
80.00	77.5	40.68	70.5	7	49
79.09	74	244.07	81	-7	49
75.00	71	0.00	34	37	1369

75.00	71	0.00	34	37	1369
75.00	71	0.00	34	37	1369
73.91	68	0.00	34	34	1156
75.00	71	0.00	34	37	1369
75.00	71	0.00	34	37	1369
60.00	45.5	0.00	34	11.5	132.25
65.88	66	0.00	34	32	1024
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
80.28	81	183.05	78.5	2.5	6.25
80.00	77.5	81.36	73	4.5	20.25
80.00	77.5	101.69	74	3.5	12.25
80.00	77.5	40.68	70.5	7	49
65.00	57	0.00	34	23	529
62.64	48	0.00	34	14	196
40.00	18.5	0.00	34	-15.5	240.25
37.50	16	0.00	34	-18	324
40.00	18.5	0.00	34	-15.5	240.25
40.00	18.5	0.00	34	-15.5	240.25
40.00	18.5	0.00	34	-15.5	240.25
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.74	41	0.00	34	7	49
				Σd^2	35448
				$6\Sigma d^2$	212688
				n	81
				n^3	531441
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.600

Soil Moisture-# Betula spp.					
Soil Moisture	Rank	Betula spp.	Rank	d	d^2
35.00	13	0.00	34	-21	441
35.00	13	0.00	34	-21	441
36.15	15	0.00	34	-19	361
35.00	13	0.00	34	-21	441
20.00	5	0.00	34	-29	841
20.00	5	0.00	34	-29	841
20.85	7	0.00	34	-27	729
20.00	5	0.00	34	-29	841
45.00	25.5	0.00	34	-8.5	72.25
46.77	30	0.00	34	-4	16
45.00	25.5	0.00	34	-8.5	72.25
65.00	57	0.00	34	23	529
65.69	65	0.00	34	31	961
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
45.00	25.5	0.00	34	-8.5	72.25
45.00	25.5	43.46	75	-49.5	2450.25
42.68	21	28.97	73	-52	2704
25.00	9	0.00	34	-25	625
26.04	11	0.00	34	-23	529
25.00	9	0.00	34	-25	625
25.00	9	101.40	78.5	-69.5	4830.25
60.00	45.5	0.00	34	11.5	132.25
59.69	43	28.97	73	-30	900
60.00	45.5	0.00	34	11.5	132.25
60.00	45.5	0.00	34	11.5	132.25
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
64.21	49	0.00	34	15	225
5.00	1.5	0.00	34	-32.5	1056.25
7.41	3	14.49	69.5	-66.5	4422.25
5.00	1.5	57.94	76	-74.5	5550.25
66.95	67	0.00	34	33	1089
65.00	57	115.88	80	-23	529
65.00	57	144.86	81	-24	576
65.00	57	86.91	77	-20	400
45.00	25.5	0.00	34	-8.5	72.25
45.00	25.5	0.00	34	-8.5	72.25
46.90	31	0.00	34	-3	9
45.00	25.5	0.00	34	-8.5	72.25
45.00	25.5	0.00	34	-8.5	72.25
50.00	36	101.40	78.5	-42.5	1806.25
51.21	42	0.00	34	8	64
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
80.00	77.5	0.00	34	43.5	1892.25
50.00	36	0.00	34	2	4
80.00	77.5	14.49	69.5	8	64
80.00	77.5	0.00	34	43.5	1892.25
79.09	74	0.00	34	40	1600
75.00	71	14.49	69.5	1.5	2.25

75.00	71	14.49	69.5	1.5	2.25
75.00	71	0.00	34	37	1369
73.91	68	0.00	34	34	1156
75.00	71	0.00	34	37	1369
75.00	71	0.00	34	37	1369
60.00	45.5	0.00	34	11.5	132.25
65.88	66	0.00	34	32	1024
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
65.00	57	0.00	34	23	529
80.28	81	0.00	34	47	2209
80.00	77.5	0.00	34	43.5	1892.25
80.00	77.5	0.00	34	43.5	1892.25
80.00	77.5	28.97	73	4.5	20.25
65.00	57	0.00	34	23	529
62.64	48	0.00	34	14	196
40.00	18.5	0.00	34	-15.5	240.25
37.50	16	0.00	34	-18	324
40.00	18.5	0.00	34	-15.5	240.25
40.00	18.5	0.00	34	-15.5	240.25
40.00	18.5	0.00	34	-15.5	240.25
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.00	36	0.00	34	2	4
50.74	41	0.00	34	7	49
				Σd^2	61002
				$6\Sigma d^2$	366012
				n	81
				n^3	531441
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.311

Based on values from sites of pH4

Appendix III - Spearman's Rank

Organic Content-# Calluna Vulgaris					
Soil Organic Content	Rank	Calluna Vulgaris	Rank	d	d^2
15.00	23	118.29	30.5	-7.5	56.25
15.00	23	108.43	28.5	-5.5	30.25
13.18	9	39.43	17	-8	64
15.00	23	29.57	12.5	10.5	110.25
35.00	55.5	147.86	37	18.5	342.25
35.00	55.5	177.44	48.5	7	49
33.18	52	128.15	32	20	400
35.00	55.5	157.72	40.5	15	225
35.00	55.5	39.43	17	38.5	1482.25
35.48	59	9.86	3.5	55.5	3080.25
35.00	55.5	0.00	1	54.5	2970.25
15.00	23	167.58	44.5	-21.5	462.25
15.00	23	167.58	44.5	-21.5	462.25
14.63	11	147.86	37	-26	676
5.00	1.5	29.57	12.5	-11	121
6.01	3	19.72	8	-5	25
5.00	1.5	29.57	12.5	-11	121
15.00	23	69.00	20.5	2.5	6.25
13.78	10	108.43	28.5	-18.5	342.25
15.00	23	78.86	24	-1	1
15.00	23	29.57	12.5	10.5	110.25
15.00	23	226.73	56	-33	1089
15.00	23	236.58	60.5	-37.5	1406.25
15.00	23	197.15	52	-29	841
12.89	8	167.58	44.5	-36.5	1332.25
10.26	7	39.43	17	-10	100
10.00	5	98.58	27	-22	484
10.00	5	147.86	37	-32	1024
10.00	5	13.80	6	-1	1
40.00	61.5	216.87	54	7.5	56.25
40.00	61.5	147.86	37	24.5	600.25
42.07	64	78.86	24	40	1600
40.00	61.5	138.01	33.5	28	784
40.00	61.5	167.58	44.5	17	289
30.00	48.5	3.94	2	46.5	2162.25
31.40	51	19.72	8	43	1849
30.00	48.5	19.72	8	40.5	1640.25
30.00	48.5	29.57	12.5	36	1296
30.00	48.5	9.86	3.5	45	2025
15.00	23	147.86	37	-14	196
15.00	23	78.86	24	-1	1
15.00	23	197.15	52	-29	841
16.02	34	29.57	12.5	21.5	462.25
15.00	23	78.86	24	-1	1
15.00	23	11.83	5	18	324
35.00	55.5	69.00	20.5	35	1225
14.70	12	236.58	60.5	-48.5	2352.25
15.00	23	246.44	64	-41	1681
15.00	23	236.58	60.5	-37.5	1406.25
15.00	23	187.29	50	-27	729
15.00	23	167.58	44.5	-21.5	462.25
15.00	23	157.72	40.5	-17.5	306.25
20.00	39	236.58	60.5	-21.5	462.25

Based on values from sites of pH4 and free of *M. gale*

17.98	35	177.44	48.5	-13.5	182.25
20.00	39	138.01	33.5	5.5	30.25
19.27	36	78.86	24	12	144
20.00	39	118.29	30.5	8.5	72.25
20.00	39	49.29	19	20	400
20.00	39	226.73	56	-17	289
25.00	43.5	167.58	44.5	-1	1
25.00	43.5	236.58	60.5	-17	289
25.00	43.5	226.73	56	-12.5	156.25
25.00	43.5	236.58	60.5	-17	289
25.62	46	197.15	52	-6	36
				Σd^2	42055
				$6\Sigma d^2$	252330
				n	64
				n^3	262144
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.037

Appendix III - Spearman's Rank

Organic Content-# Agrostis spp.					
Soil Organic Content	Rank	Agrostis spp.	Rank	d	d^2
15.00	23	60.31	21.5	1.5	2.25
15.00	23	241.23	61.5	-38.5	1482.25
13.18	9	286.46	64	-55	3025
15.00	23	241.23	61.5	-38.5	1482.25
35.00	55.5	120.61	33.5	22	484
35.00	55.5	105.54	31	24.5	600.25
33.18	52	22.62	14	38	1444
35.00	55.5	165.84	44.5	11	121
35.00	55.5	150.77	41	14.5	210.25
35.48	59	60.31	21.5	37.5	1406.25
35.00	55.5	120.61	33.5	22	484
15.00	23	3.02	5	18	324
15.00	23	150.77	41	-18	324
14.63	11	60.31	21.5	-10.5	110.25
5.00	1.5	0.00	2	-0.5	0.25
6.01	3	0.00	2	1	1
5.00	1.5	60.31	21.5	-20	400
15.00	23	75.38	25	-2	4
13.78	10	165.84	44.5	-34.5	1190.25
15.00	23	150.77	41	-18	324
15.00	23	45.23	18	5	25
15.00	23	6.03	8	15	225
15.00	23	3.02	5	18	324
15.00	23	0.00	2	21	441
12.89	8	3.02	5	3	9
10.26	7	39.43	17	-10	100
10.00	5	98.58	30	-25	625
10.00	5	147.86	38	-33	1089
10.00	5	13.80	11	-6	36
40.00	61.5	216.87	53	8.5	72.25
40.00	61.5	147.86	38	23.5	552.25
42.07	64	78.86	27.5	36.5	1332.25
40.00	61.5	138.01	35.5	26	676
40.00	61.5	167.58	47	14.5	210.25
30.00	48.5	3.94	7	41.5	1722.25
31.40	51	19.72	12.5	38.5	1482.25
30.00	48.5	19.72	12.5	36	1296
30.00	48.5	29.57	15.5	33	1089
30.00	48.5	9.86	9	39.5	1560.25
15.00	23	147.86	38	-15	225
15.00	23	78.86	27.5	-4.5	20.25
15.00	23	197.15	51.5	-28.5	812.25
16.02	34	29.57	15.5	18.5	342.25
15.00	23	78.86	27.5	-4.5	20.25
15.00	23	11.83	10	13	169
35.00	55.5	69.00	24	31.5	992.25
14.70	12	236.58	58	-46	2116
15.00	23	246.44	63	-40	1600
15.00	23	236.58	58	-35	1225
15.00	23	187.29	50	-27	729
15.00	23	167.58	47	-24	576
15.00	23	157.72	43	-20	400
20.00	39	236.58	58	-19	361

Based on values from sites of pH4 and free of *M. gale*

17.98	35	177.44	49	-14	196
20.00	39	138.01	35.5	3.5	12.25
19.27	36	78.86	27.5	8.5	72.25
20.00	39	118.29	32	7	49
20.00	39	49.29	19	20	400
20.00	39	226.73	54.5	-15.5	240.25
25.00	43.5	167.58	47	-3.5	12.25
25.00	43.5	236.58	58	-14.5	210.25
25.00	43.5	226.73	54.5	-11	121
25.00	43.5	236.58	58	-14.5	210.25
25.62	46	197.15	51.5	-5.5	30.25
				Σd^2	37428
				$6\Sigma d^2$	224568
				n	64
				n^3	262144
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.143

Appendix III - Spearman's Rank

Organic Content-# Ulex europaeus					
Soil Organic Content	Rank	Ulex europaeus	Rank	d	d^2
15.00	23	197.63	62	-39	1521
15.00	23	24.70	28.5	-5.5	30.25
13.18	9	148.22	57	-48	2304
15.00	23	0.00	13	10	100
35.00	55.5	247.04	63	-7.5	56.25
35.00	55.5	74.11	38.5	17	289
33.18	52	123.52	50	2	4
35.00	55.5	74.11	38.5	17	289
35.00	55.5	123.52	50	5.5	30.25
35.48	59	74.11	38.5	20.5	420.25
35.00	55.5	0.00	13	42.5	1806.25
15.00	23	74.11	38.5	-15.5	240.25
15.00	23	24.70	28.5	-5.5	30.25
14.63	11	98.81	44.5	-33.5	1122.25
5.00	1.5	98.81	44.5	-43	1849
6.01	3	0.00	13	-10	100
5.00	1.5	24.70	28.5	-27	729
15.00	23	148.22	57	-34	1156
13.78	10	123.52	50	-40	1600
15.00	23	0.00	13	10	100
15.00	23	0.00	13	10	100
15.00	23	98.81	44.5	-21.5	462.25
15.00	23	0.00	13	10	100
15.00	23	123.52	50	-27	729
12.89	8	148.22	57	-49	2401
10.26	7	370.55	64	-57	3249
10.00	5	123.52	50	-45	2025
10.00	5	0.00	13	-8	64
10.00	5	49.41	32.5	-27.5	756.25
40.00	61.5	0.00	13	48.5	2352.25
40.00	61.5	123.52	50	11.5	132.25
42.07	64	74.11	38.5	25.5	650.25
40.00	61.5	148.22	57	4.5	20.25
40.00	61.5	0.00	13	48.5	2352.25
30.00	48.5	0.00	13	35.5	1260.25
31.40	51	172.92	61	-10	100
30.00	48.5	0.00	13	35.5	1260.25
30.00	48.5	0.00	13	35.5	1260.25
30.00	48.5	0.00	13	35.5	1260.25
15.00	23	74.11	38.5	-15.5	240.25
15.00	23	148.22	57	-34	1156
15.00	23	49.41	32.5	-9.5	90.25
16.02	34	74.11	38.5	-4.5	20.25
15.00	23	24.70	28.5	-5.5	30.25
15.00	23	98.81	44.5	-21.5	462.25
35.00	55.5	0.00	13	42.5	1806.25
14.70	12	0.00	13	-1	1
15.00	23	0.00	13	10	100
15.00	23	0.00	13	10	100
15.00	23	148.22	57	-34	1156
15.00	23	148.22	57	-34	1156
15.00	23	0.00	13	10	100
20.00	39	49.41	32.5	6.5	42.25

Based on values from sites of pH4 and free of *M. gale*

17.98	35	0.00	13	22	484
20.00	39	0.00	13	26	676
19.27	36	74.11	38.5	-2.5	6.25
20.00	39	49.41	32.5	6.5	42.25
20.00	39	0.00	13	26	676
20.00	39	0.00	13	26	676
25.00	43.5	0.00	13	30.5	930.25
25.00	43.5	0.00	13	30.5	930.25
25.00	43.5	0.00	13	30.5	930.25
25.00	43.5	14.82	26	17.5	306.25
25.62	46	123.52	50	-4	16
				Σd^2	46446
				$6\Sigma d^2$	278676
				n	64
				n^3	262144
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.063

Organic Content-# Betula spp.					
Soil Organic Content	Rank	Betula spp.	Rank	d	d^2
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
13.18	9	0.00	28	-19	361
15.00	23	0.00	28	-5	25
35.00	55.5	0.00	28	27.5	756.25
35.00	55.5	0.00	28	27.5	756.25
33.18	52	0.00	28	24	576
35.00	55.5	0.00	28	27.5	756.25
35.00	55.5	0.00	28	27.5	756.25
35.48	59	0.00	28	31	961
35.00	55.5	0.00	28	27.5	756.25
15.00	23	0.00	28	-5	25
15.00	23	43.46	60	-37	1369
14.63	11	28.97	58.5	-47.5	2256.25
5.00	1.5	0.00	28	-26.5	702.25
6.01	3	0.00	28	-25	625
5.00	1.5	0.00	28	-26.5	702.25
15.00	23	0.00	28	-5	25
13.78	10	28.97	58.5	-48.5	2352.25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
12.89	8	0.00	28	-20	400
10.26	7	0.00	28	-21	441
10.00	5	115.88	63	-58	3364
10.00	5	144.86	64	-59	3481
10.00	5	86.91	61	-56	3136
40.00	61.5	0.00	28	33.5	1122.25
40.00	61.5	0.00	28	33.5	1122.25
42.07	64	0.00	28	36	1296
40.00	61.5	0.00	28	33.5	1122.25
40.00	61.5	0.00	28	33.5	1122.25
30.00	48.5	101.40	62	-13.5	182.25
31.40	51	0.00	28	23	529
30.00	48.5	0.00	28	20.5	420.25
30.00	48.5	0.00	28	20.5	420.25
30.00	48.5	0.00	28	20.5	420.25
15.00	23	14.49	56.5	-33.5	1122.25
15.00	23	14.49	56.5	-33.5	1122.25
15.00	23	0.00	28	-5	25
16.02	34	0.00	28	6	36
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
35.00	55.5	0.00	28	27.5	756.25
14.70	12	0.00	28	-16	256
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
15.00	23	0.00	28	-5	25
20.00	39	0.00	28	11	121

17.98	35	0.00	28	7	49
20.00	39	0.00	28	11	121
19.27	36	0.00	28	8	64
20.00	39	0.00	28	11	121
20.00	39	0.00	28	11	121
20.00	39	0.00	28	11	121
25.00	43.5	0.00	28	15.5	240.25
25.00	43.5	0.00	28	15.5	240.25
25.00	43.5	0.00	28	15.5	240.25
25.00	43.5	0.00	28	15.5	240.25
25.62	46	0.00	28	18	324
				Σd^2	38011
				$6\Sigma d^2$	228066
				n	64
				n^3	262144
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.130

Based on values from sites of pH4 and free of *M. gale*

Organic Content-# Molina caerulea					
Soil Organic Content	Rank	Molina caerulea	Rank	d	d^2
15.00	23	301.70	61	-38	1444
15.00	23	7.54	27.5	-4.5	20.25
13.18	9	7.54	27.5	-18.5	342.25
15.00	23	0.00	8.5	14.5	210.25
35.00	55.5	37.71	50.5	5	25
35.00	55.5	22.63	44	11.5	132.25
33.18	52	7.54	27.5	24.5	600.25
35.00	55.5	18.86	39.5	16	256
35.00	55.5	75.43	58	-2.5	6.25
35.48	59	75.43	58	1	1
35.00	55.5	0.00	8.5	47	2209
15.00	23	67.88	55	-32	1024
15.00	23	37.71	50.5	-27.5	756.25
14.63	11	22.63	44	-33	1089
5.00	1.5	754.26	64	-62.5	3906.25
6.01	3	377.13	62	-59	3481
5.00	1.5	3.77	23	-21.5	462.25
15.00	23	30.17	47.5	-24.5	600.25
13.78	10	15.09	34	-24	576
15.00	23	7.54	27.5	-4.5	20.25
15.00	23	0.00	8.5	14.5	210.25
15.00	23	18.86	39.5	-16.5	272.25
15.00	23	0.75	17	6	36
15.00	23	30.17	47.5	-24.5	600.25
12.89	8	37.71	50.5	-42.5	1806.25
10.26	7	0.00	8.5	-1.5	2.25
10.00	5	0.00	8.5	-3.5	12.25
10.00	5	0.00	8.5	-3.5	12.25
10.00	5	0.00	8.5	-3.5	12.25
40.00	61.5	7.54	27.5	34	1156
40.00	61.5	15.09	34	27.5	756.25
42.07	64	9.43	31	33	1089
40.00	61.5	18.86	39.5	22	484
40.00	61.5	24.51	46	15.5	240.25
30.00	48.5	0.00	8.5	40	1600
31.40	51	18.86	39.5	11.5	132.25
30.00	48.5	0.00	8.5	40	1600
30.00	48.5	1.89	21	27.5	756.25
30.00	48.5	0.00	8.5	40	1600
15.00	23	5.66	24	-1	1
15.00	23	75.43	58	-35	1225
15.00	23	1.51	18.5	4.5	20.25
16.02	34	75.43	58	-24	576
15.00	23	1.89	21	2	4
15.00	23	1.89	21	2	4
35.00	55.5	603.41	63	-7.5	56.25
14.70	12	0.00	8.5	3.5	12.25
15.00	23	0.00	8.5	14.5	210.25
15.00	23	0.00	8.5	14.5	210.25
15.00	23	45.26	53.5	-30.5	930.25
15.00	23	75.43	58	-35	1225
15.00	23	16.97	36	-13	169
20.00	39	45.26	53.5	-14.5	210.25

Based on values from sites of pH4 and free of *M. gale*

17.98	35	18.86	39.5	-4.5	20.25
20.00	39	0.00	8.5	30.5	930.25
19.27	36	0.00	8.5	27.5	756.25
20.00	39	7.54	27.5	11.5	132.25
20.00	39	11.31	32	7	49
20.00	39	0.00	8.5	30.5	930.25
25.00	43.5	22.63	44	-0.5	0.25
25.00	43.5	1.51	18.5	25	625
25.00	43.5	37.71	50.5	-7	49
25.00	43.5	18.86	39.5	4	16
25.62	46	15.09	34	12	144
				Σd^2	38046
				$6\Sigma d^2$	228276
				n	64
				n^3	262144
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.129

Appendix III - Spearman's Rank

Organic Content-Altitude					
Organic Content	Rank	Altitude	Rank	d	d^2
13.18	10	110	25.5	-15.5	240.25
33.18	27	110	25.5	1.5	2.25
35.48	29	115	30.5	-1.5	2.25
11.44	8	75	4	4	16
13.39	12	85	9	3	9
33.33	28	100	16.5	11.5	132.25
14.63	14	85	9	5	25
6.01	2	100	16.5	-14.5	210.25
10.67	6	85	9	-3	9
26.20	25	75	4	21	441
13.78	13	65	1.5	11.5	132.25
4.40	1	65	1.5	-0.5	0.25
12.89	9	105	20	-11	121
10.26	5	115	30.5	-25.5	650.25
18.97	21	110	25.5	-4.5	20.25
42.07	30	110	25.5	4.5	20.25
31.40	26	100	16.5	9.5	90.25
13.24	11	95	13	-2	4
16.02	17	110	25.5	-8.5	72.25
21.11	23	110	25.5	-2.5	6.25
11.14	7	105	20	-13	169
48.67	31	90	11	20	400
14.70	15	100	16.5	-1.5	2.25
15.00	16	80	6.5	9.5	90.25
16.26	18	110	25.5	-7.5	56.25
9.14	3	75	4	-1	1
10.18	4	80	6.5	-2.5	6.25
17.98	19	95	13	6	36
18.86	20	105	20	0	0
19.27	22	110	25.5	-3.5	12.25
25.62	24	95	13	11	121
				Σd^2	3098.5
				$6\Sigma d^2$	18591
				n	31
				n^3	29791
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.375

Altitude-# Agrostis spp.					
Altitude	Rank	Agrostis spp.	Rank	d	d^2
110	59	60.31	47.5	11.5	132.25
110	59	241.23	78	-19	361
110	59	286.46	81	-22	484
105	44.5	241.23	78	-33.5	1122.25
105	44.5	120.61	60	-15.5	240.25
105	44.5	105.54	57.5	-13	169
110	59	22.62	36	23	529
110	59	165.84	69.5	-10.5	110.25
115	75	150.77	65	10	100
115	75	60.31	47.5	27.5	756.25
115	75	120.61	60	15	225
80	10	22.62	36	-26	676
75	5.5	30.15	40	-34.5	1190.25
75	5.5	0.00	11.5	-6	36
80	10	105.54	57.5	-47.5	2256.25
95	24.5	3.02	28	-3.5	12.25
95	24.5	150.77	65	-40.5	1640.25
85	13.5	60.31	47.5	-34	1156
100	35	0.00	11.5	23.5	552.25
100	35	0.00	11.5	23.5	552.25
95	24.5	60.31	47.5	-23	529
95	24.5	0.00	11.5	13	169
70	2.5	75.38	52	-49.5	2450.25
65	1	165.84	69.5	-68.5	4692.25
75	5.5	150.77	65	-59.5	3540.25
70	2.5	45.23	43	-40.5	1640.25
115	75	6.03	31	44	1936
110	59	3.02	28	31	961
100	35	0.00	11.5	23.5	552.25
105	44.5	3.02	28	16.5	272.25
115	75	180.92	71.5	3.5	12.25
115	75	60.31	47.5	27.5	756.25
115	75	3.02	28	47	2209
115	75	241.23	78	-3	9
115	75	60.31	47.5	27.5	756.25
115	75	30.15	40	35	1225
115	75	180.92	71.5	3.5	12.25
110	59	75.38	52	7	49
110	59	150.77	65	-6	36
110	59	256.31	80	-21	441
110	59	211.08	74.5	-15.5	240.25
110	59	90.46	55	4	16
95	24.5	0.00	11.5	13	169
100	35	211.08	74.5	-39.5	1560.25
105	44.5	120.61	60	-15.5	240.25
105	44.5	150.77	65	-20.5	420.25
100	35	211.08	74.5	-39.5	1560.25
90	16.5	45.23	43	-26.5	702.25
90	16.5	90.46	55	-38.5	1482.25
95	24.5	15.08	33	-8.5	72.25
95	24.5	0.00	11.5	13	169
95	24.5	30.15	40	-15.5	240.25
115	75	0.75	24	51	2601

Based on values from sites of pH4

115	75	90.46	55	20	400
110	59	24.12	38	21	441
110	59	150.77	65	-6	36
105	44.5	211.08	74.5	-30	900
110	59	150.77	65	-6	36
95	24.5	0.00	11.5	13	169
100	35	0.00	11.5	23.5	552.25
100	35	0.00	11.5	23.5	552.25
100	35	0.00	11.5	23.5	552.25
85	13.5	0.00	11.5	2	4
90	16.5	0.00	11.5	5	25
90	16.5	0.00	11.5	5	25
80	10	15.08	33	-23	529
80	10	0.00	11.5	-1.5	2.25
80	10	0.00	11.5	-1.5	2.25
75	5.5	0.00	11.5	-6	36
95	24.5	0.00	11.5	13	169
95	24.5	22.62	36	-11.5	132.25
110	59	3.02	28	31	961
110	59	75.38	52	7	49
110	59	15.08	33	26	676
110	59	45.23	43	16	256
110	59	1.51	25	34	1156
105	44.5	0.00	11.5	33	1089
105	44.5	0.30	23	21.5	462.25
105	44.5	0.00	11.5	33	1089
100	35	0.00	11.5	23.5	552.25
95	24.5	0.00	11.5	13	169
				Σd^2	55045.5
				$6\Sigma d^2$	330273
				n	81
				n^3	531441
				$1-[(6\Sigma d^2)\div(n^3-n)]$	0.378

Organic Content-# Species					
Soil Organic Content	Rank	# Species	Rank	d	d^2
15.00	33	8	41.5	-8.5	72.25
15.00	33	9	49.5	-16.5	272.25
13.18	14	7	32	-18	324
15.00	33	3	3.5	29.5	870.25
35.00	69.5	6	20.5	49	2401
35.00	69.5	4	7	62.5	3906.25
33.18	66	5	12	54	2916
35.00	69.5	6	20.5	49	2401
35.00	69.5	10	59	10.5	110.25
35.48	73	13	75	-2	4
35.00	69.5	9	49.5	20	400
10.00	7.5	11	66.5	-59	3481
11.44	12	11	66.5	-54.5	2970.25
10.00	7.5	7	32	-24.5	600.25
10.00	7.5	8	41.5	-34	1156
15.00	33	7	32	1	1
15.00	33	12	71.5	-38.5	1482.25
14.63	17	10	59	-42	1764
5.00	2	10	59	-57	3249
6.01	4	4	7	-3	9
5.00	2	9	49.5	-47.5	2256.25
5.00	2	14	77.5	-75.5	5700.25
15.00	33	9	49.5	-16.5	272.25
13.78	16	11	66.5	-50.5	2550.25
15.00	33	9	49.5	-16.5	272.25
15.00	33	8	41.5	-8.5	72.25
15.00	33	9	49.5	-16.5	272.25
15.00	33	7	32	1	1
15.00	33	6	20.5	12.5	156.25
12.89	13	7	32	-19	361
10.26	11	9	49.5	-38.5	1482.25
10.00	7.5	11	66.5	-59	3481
10.00	7.5	8	41.5	-34	1156
10.00	7.5	14	77.5	-70	4900
40.00	75.5	6	20.5	55	3025
40.00	75.5	5	12	63.5	4032.25
42.07	78	6	20.5	57.5	3306.25
40.00	75.5	8	41.5	34	1156
40.00	75.5	6	20.5	55	3025
30.00	62	7	32	30	900
31.40	65	10	59	6	36
30.00	62	9	49.5	12.5	156.25
30.00	62	11	66.5	-4.5	20.25
30.00	62	10	59	3	9
15.00	33	9	49.5	-16.5	272.25
30.00	62	7	32	30	900
15.00	33	13	75	-42	1764
15.00	33	8	41.5	-8.5	72.25
13.24	15	12	71.5	-56.5	3192.25
15.00	33	10	59	-26	676
15.00	33	12	71.5	-38.5	1482.25
15.00	33	7	32	1	1
16.02	47	12	71.5	-24.5	600.25

15.00	33	11	66.5	-33.5	1122.25
15.00	33	13	75	-42	1764
35.00	69.5	5	12	57.5	3306.25
14.70	18	2	1	17	289
15.00	33	3	3.5	29.5	870.25
15.00	33	3	3.5	29.5	870.25
15.00	33	5	12	21	441
15.00	33	5	12	21	441
15.00	33	3	3.5	29.5	870.25
15.00	19	10	59	-40	1600
15.00	33	10	59	-26	676
15.00	33	9	49.5	-16.5	272.25
15.00	33	10	59	-26	676
20.00	52	6	20.5	31.5	992.25
17.98	48	7	32	16	256
20.00	52	5	12	40	1600
19.27	49	7	32	17	289
20.00	52	7	32	20	400
20.00	52	7	32	20	400
20.00	52	6	20.5	31.5	992.25
25.00	56.5	6	20.5	36	1296
25.00	56.5	5	12	44.5	1980.25
25.00	56.5	4	7	49.5	2450.25
25.00	56.5	7	32	24.5	600.25
25.62	59	6	20.5	38.5	1482.25
				Σd^2	101886.5
				$6\Sigma d^2$	611319
				n	78
				n^3	474552
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.288

Appendix III - Spearman's Rank

Age-# Species					
Site Age	Rank	# Species	Rank	d	d^2
7.5	34.5	8	38	-3.5	12.25
7.5	34.5	9	43	-8.5	72.25
7.5	34.5	7	30.5	4	16
7.5	34.5	3	3.5	31	961
7.5	34.5	6	19.5	15	225
7.5	34.5	4	7	27.5	756.25
7.5	34.5	5	11.5	23	529
7.5	34.5	6	19.5	15	225
7.5	34.5	10	49.5	-15	225
7.5	34.5	13	58.5	-24	576
7.5	34.5	9	43	-8.5	72.25
7.5	34.5	7	30.5	4	16
7.5	34.5	12	56	-21.5	462.25
7.5	34.5	10	49.5	-15	225
5.5	22	10	49.5	-27.5	756.25
5.5	22	4	7	15	225
5.5	22	9	43	-21	441
5.5	22	9	43	-21	441
5.5	22	11	53.5	-31.5	992.25
5.5	22	9	43	-21	441
5.5	22	8	38	-16	256
5.5	22	9	43	-21	441
5.5	22	7	30.5	-8.5	72.25
5.5	22	6	19.5	2.5	6.25
5.5	22	7	30.5	-8.5	72.25
3.5	8.5	6	19.5	-11	121
3.5	8.5	5	11.5	-3	9
3.5	8.5	6	19.5	-11	121
3.5	8.5	8	38	-29.5	870.25
3.5	8.5	6	19.5	-11	121
3.5	8.5	7	30.5	-22	484
3.5	8.5	10	49.5	-41	1681
3.5	8.5	9	43	-34.5	1190.25
3.5	8.5	10	49.5	-41	1681
3.5	8.5	7	30.5	-22	484
3.5	8.5	10	49.5	-41	1681
3.5	8.5	12	56	-47.5	2256.25
3.5	8.5	7	30.5	-22	484
3.5	8.5	12	56	-47.5	2256.25
3.5	8.5	11	53.5	-45	2025
3.5	8.5	13	58.5	-50	2500
16.5	44.5	2	1	43.5	1892.25
16.5	44.5	3	3.5	41	1681
16.5	44.5	3	3.5	41	1681
16.5	44.5	5	11.5	33	1089
16.5	44.5	5	11.5	33	1089
16.5	44.5	3	3.5	41	1681
25	53.5	6	19.5	34	1156
25	53.5	7	30.5	23	529
25	53.5	5	11.5	42	1764
25	53.5	7	30.5	23	529
25	53.5	7	30.5	23	529
25	53.5	7	30.5	23	529

Based on values from sites of pH4 and lacking *M. gale*

25	53.5	6	19.5	34	1156
25	53.5	6	19.5	34	1156
25	53.5	5	11.5	42	1764
25	53.5	4	7	46.5	2162.25
25	53.5	7	30.5	23	529
25	53.5	6	19.5	34	1156
				Σd^2	48555
				$6\Sigma d^2$	291330
				n	59
				n^3	205379
				$1-[(6\Sigma d^2)\div(n^3-n)]$	-0.419

Appendix IV - Data Collection Diary

Day 1 (13/08/2007) – Fine, dry weather during a dry spell.

Day 2 (15/08/2007) – Cool, damp weather following torrential rain the previous day.

Day 3 (17/08/2007) – Cool, dry weather during a time of occasional showers.

Day 4 (21/08/2007) – Cool, dry weather during a time of occasional showers.

Day 5 (02/09/2007) – Warm & windy during a dry period.

Day 6 (04/09/2007) – Hot, dry weather during a dry period.

Day 7 (05/09/2007) – Hot, dry weather during a dry period.

Day 8 (07/09/2007) – Hot, dry weather during a dry period.

Day 9 (22/09/2007) – Cool, humid weather during a dry period.

Day 10 (23/09/2007) – Humid weather just before a day of heavy rain.