AQA
Realising potential

A-LEVEL

A-LEVEL GEOGRAPHY
(7037)

EXAMPLE NEA INVESTIGATION

Marked investigation with commentary

An example investigation folder with completed proposal form and examiner commentary

To what extent are variations in heathland plant communities on a hill slope affected by soil moisture at Briantspuddle, Dorset?

Version 1.0 November 2017

Contents

2018 candidate record form

A-level Geography
NEA Independent fieldwork investigation (7037/C)

Please attach the form to your candidate's work and keep it at the centre or send it to the moderator as required. The declarations should be completed by the candidate and teacher as indicated.

Centre number

Click here to enter.

Centre name

Click here to enter text.

Candidate number

Click here to enter.

Candidate's full name

Click here to enter text.

Work submitted for assessment **must** be the candidate's own. If candidates copy work, allow candidates to copy from them, or cheat in any other way, they may be disqualified.

Candidate declaration

Have you received help/information from anyone **other than** subject teacher(s) to produce this work?

☐ No ☐ Yes *(give details below or on a separate sheet if necessary).*

Click here to enter text.

Please list below any books, leaflets or other materials (eg DVDs, software packages, internet information) used to complete this work **not** acknowledged in the work itself. Presenting materials copied from other sources **without acknowledgement** is regarded as deliberate deception.

Click here to enter text.

From time to time we use anonymous examples of candidates' work (in paper form and electronically) within our guidance materials to illustrate particular points. If your work appears in AQA materials in this context and you object to this, please contact us and we will remove it on reasonable notice.

I have read and understood the above. I confirm I produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate signature.

Date Click here to enter a date.

Teacher declaration

I confirm the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied (to the best of my knowledge) that the work produced is solely that of the candidate.

Teacher signature.

Date Click here to enter a date.

Candidate number	Candidate's full name
Click here to enter.	Click here to enter text.

NEA proposal

To be completed by the candidate

Investigation title	To what extent are variations in heathland plant communities on a hill slope affected by soil moisture at Briantspuddle, Dorset?

How the title links to the specification content

3.1.6.6 Local ecosystems: The main characteristics of a distinctive local ecosystem such as an area of heathland…

3.1.1.2 The water cycle: Global distribution and size of major stores of water – lithosphere, hydrosphere, cryosphere and atmosphere.

Processes driving change in the magnitude of these stores over time and space, including flows and transfers: … processes at hill slope…scale.

Comment: The word 'heathland' is meant to describe a particular type of ecosystem with small bushes of heather and few trees. However, are all heathlands the same? If there are changes in the water cycle on the scale of a single hill slope, meaning differences in soil moisture, could these local differences produce a change in heathland plant communities?

Understanding these local differences could be important to help heathland managers understand how they can manage and conserve lowland heath.

Planned investigation hypothesis or question/sub-questions

Research Question: To what extent are variations in heathland plant communities on a hill slope affected by soil moisture at Briantspuddle, Dorset?

Sub-Questions

1.To what extent are there differences in heather species at different places on a hill slope?

2. Does the study site have evidence for variation in the water cycle on a hill slope?

3.Can differences in the distribution of heather communities be related to soil moisture?

4.Are there any implications of the above when it comes to successful management and conservation of lowland heath?

Investigation focus – indication of how the enquiry will enable the candidate to address the investigation title and explore the theme in relation to the chosen geographical area

Lowland heath is a plagioclimax ecosystem. This means it was made by people and only exists because of the activities of people. It is an important ecosystem because many rare reptiles and birds are found on heath. There is a lot of lowland heath in Dorset although in the past there used to be a lot more.

Ecologists identify three types of heathland that they call dry heath, humid heath and wet heath. As these names seem to say, the plants are related to soil moisture or ground water. I wondered if this could be investigated at Briantspuddle?

The heath at Briantspuddle is on the edge of the Bovington tanks ranges and the land is owned by the Army. As the public are not allowed to enter this heathland it makes a good place to study because it is an example of heathland in its most natural state. (The tanks don't actually go near to Briantspuddle). I also know that it is on a slope. I know the person to ask to allow me to get permission to study this site.

I also know a warden of another heath nearer to Poole and I can find out what the management problems are affecting heaths in the area.

Planned methodology – indication of qualitative and/or quantitative techniques including primary and, if relevant, secondary data collection techniques. Indication of the planned sampling strategy or strategies

Sub-question 1: To what extent are there differences in heather species at different places on a hill slope?

I want to find out if the heath at Briantspuddle has dry, humid and wet heath. To do this I will carry out a quadrat survey on the heather species. I will concentrate on the three most common heathers as I will not have to learn how to identify many different types. The three I will look at are Common Heather, Cross-leaf heath and Bell heather.

I will use stratified sampling and divide the hill slope up into three sections. I will do a quadrat survey on the top, middle and bottom of the slope. I will present my data using dispersion graphs and line graphs. To see if there are any differences between the top, middle and bottom of the slope, I will calculate chi-square.

This will be a quantitative analysis.

Sub-question 2: Does the study site have evidence for variation in the water cycle on a hill slope?
I would expect the top of the slope to be drier than the bottom, so I will look for boggy conditions or evidence of plants that grow in boggy areas such as sphagnum moss. I will use a soil auger or look for trenches dug by the Army to see if the soil is the same over this hillslope. I will analyse this information using visual interpretation. I will present what I find on drawings and diagrams.
This will be a qualitative analysis.
Sub-question 3: Can differences in the distribution of heather communities be related to soil moisture?
I will carry out another quadrat survey but this time I will also take soil samples that I can take back to college and analyse for soil moisture content. I will use a systematic sample and collect data every 10m down the hill slope from top to bottom. I will then be able to present my data showing percentage soil moisture and percent heather cover on scatter graphs and use Spearman Rank to see if the two can be correlated.
This will be a quantitative analysis.
Sub-question 4: Are there any implications of the above when it comes to successful management and conservation of lowland heath?
I will carry out an interview with the manager of Upton Heath near Poole to find out what the problems are and how lowland heath is managed. I will also find out if the there are any differences in the way dry, humid and wet heath are managed. I will use grounded analysis to find out the main problems and management techniques on dry, humid and wet heath.
This will be a qualitative analysis.

Data collection: ☐ Individual ☐ Group

To be completed by the teacher

Teacher approval for the investigation or details of any necessary amendments that need to be made before approval can be given

This looks like an interesting investigation that could have useful conclusions for heathland managers.
Have you been to this site before?
What makes you confident you can transfer your knowledge of Hartland Moor to the heath at Briantspuddle, a site where the public do not normally have access?
I like the way you have stated your sampling techniques but have you considered the sample sizes?
Before you look at the soils in the Army trenches or use the soil auger, make sure you understand what you will be looking at. We are not going to study soils in College so make sure you have a looked at some of the books in the College library before you undertake your fieldwork.
You are a bit vague with the statement 'I will also take soil samples'. Have you thought in detail, just exactly how you will collect soil samples and how the moisture content will be determined?
You have not mentioned anything about secondary data, have you decided that secondary data is not relevant to your study?

☐ Approved ☐ Approved subject to the implementation of amendments above ☐ Resubmission required

Full name Click here to enter text.

Teacher signature.

Date Click here to enter a date.

To be completed by the teacher
Marks must be awarded in accordance with the instructions and criteria in the specification.

Area	Level	Overall level	Mark	Comment
Area 1. Introduction and preliminary research **10 marks** (a) To define the research questions which underpin field investigations (AO3)	3	3	7	No reference to the water cycle. No reference to the specification
(b) To research relevant literature sources and understand and write up the theoretical or comparative context for a research question (AO3)	2			
Area 2. Methods of field investigation **15 marks** (a) To observe and record phenomena in the field and devise and justify practical approaches taken in the field including frequency/timing of observation, sampling, and data collection approaches (AO3)	3	3	11	Both quantitative and qualitative methods are used but generally lacking justification of chosen methods, including justification of sample sizes.
(b) To demonstrate practical knowledge and understanding of field methodologies appropriate to the investigation of human and physical processes (AO3)	4			
(c) To implement chosen methodologies to collect data/information of good quality and relevant to the topic under investigation (AO3)	3			

Area	Level	Overall level	Mark	Comment
Area 3. Methods of critical analysis **20 marks** (a) To demonstrate knowledge and understanding of the techniques appropriate for analysing field data and information and for representing results, and show ability to select suitable quantitative or qualitative approaches and to apply them (AO3)	2	2	9	Imprecise knowledge and understanding of techniques, eg levels of significance. No comments on accuracy of data or statistical summaries.
(b) To demonstrate the ability to interrogate and critically examine field data in order to comment on its accuracy and/or the extent to which it is representative, and use the experience to extend geographical understanding (AO3)	2			
(c) To apply existing knowledge, theory and concepts to order and understand field observations (AO2)	3			
Area 4. Conclusions, evaluation and presentation **15 marks** (a) To show the ability to write up field results clearly and logically, using a range of presentation methods. (AO3)	3	3	10	Report is generally well written and has a good overall structure. Some graphs are incomplete and hard to read. The student does not understand how to graph discrete data. Ethical dimension is well understood. Conclusions are valid but limited reference made to the water cycle and certainly no reference to the soil water budget.
(b) To evaluate and reflect on fieldwork investigations, explain how the results relate to the wider context and show an understanding of the ethical dimensions of field research. (AO3)	3			
(c) To demonstrate the ability to write a coherent analysis of fieldwork findings in order to answer a specific geographical question and to do this drawing effectively on evidence and theory to make a well-argued case. (AO3)	3			
	Total (60 marks)		37	

Details of additional assistance given

Record here details of any assistance given to this candidate which is beyond that given to the class as a whole and beyond that described in the specification (*continue on a separate sheet if necessary*).

Click here to enter text.

Concluding comments

Click here to enter text.

To what extent are variations in heathland plant communities on a hill slope affected by the soil moisture stores at Briantspuddle, Dorset?

Introduction

On the DEFRA Joint Nature Conservation Committee website, lowland heath is defined as:

'A well-known habitat type in the lowlands of the UK. It occurs on acidic, impoverished, dry sandy or wet peaty soils, and is characterised by the presence of a range of dwarf-shrubs. These include various types of heather and gorse, as well as bilberry, cowberry and crowberry'.
jncc.defra.gov.uk/page-1432 (Accessed on 13/11/16)

The fact that heath can occur on both dry sandy soil which is probably well drained as well as wet peaty soil indicates that water cycle differences could be an important factor influencing heath ecology.

DEFRA also goes to describe the various types of lowland heath. Dry and humid heaths occur on free draining areas and are dominated by Common Heather, Bell Heather, Cross-leaf Heath and gorse amongst other species. Wet Heath on the other hand is found on soils with impeded drainage with and includes plants such as Cross-leaf Heath amongst others.
jncc.defra.gov.uk/page-5939 (accessed on 13/11/16)

It was confirmed by the First Nature website that Cross-leaf Heath prefers wetter soils than either Common Heather or Bell Heather.
first-nature.com/flowers/erica-tetralix.php (Accessed on 15/11/16).

The student has correctly called the heather species *Erica tetralix* by its common name – cross-leaf heath.

Figure 1 shows the general visual appearance of a lowland heath in the U.K. It is dominated by low growing shrubs and has very few trees.

Figure 1 Lowland Heath in Dorset

Nagle (2000) points out that many heaths are plagioclimax vegetation communities only maintained by the actions of people. These activities include: deforestation, overgrazing and the use of managed fire. Also, they are under threat from housing, unmanaged fires, too little grazing and dense scrub and bracken encroaching on them.

However, heaths do need to be managed to stop invasion by trees. In the past this was carried out by farmers who used heathland for grazing. As this has now mainly stopped, active management is necessary to preserve this habitat for endangered rare reptiles and birds.

This graphic from the RSPB shows some of the ways in which lowland heath is managed.

Figure 2 The Management of Lowland Heath

Source: Blincoe. K., (2017).

In the last 250 years, the amount of heathland in Dorset has declined immensely. The table below shows this decline.

Year	Hectares (000s)
1750	39.6
1896	22.67
1960	10.0
1992	5.6

Source: Nagle, G., 2000, *Advanced Geography*, Oxford University Press.

The study site is on the edge of the military training area near Briantspuddle in Dorset. The location is shown in Figure 3.

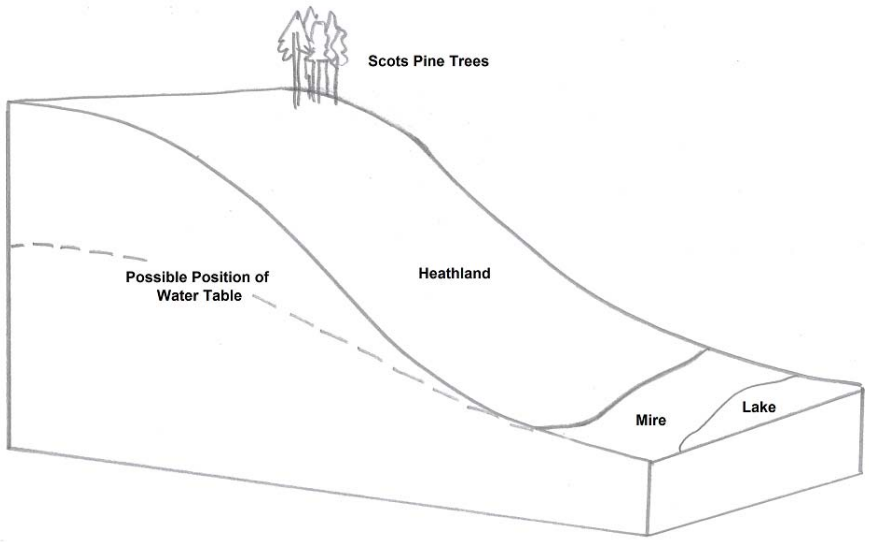
No scale on maps.

Figure 3 shows the location of the study site.

Source: Adapted from commons.wikimedia.org/wiki/File:Dorset_UK_district_map_(blank).svg
Licensed under the Creative Commons Attribution-Share Alike 3.0 Unported licence

The overall layout of the study site is shown in the block diagram, Figure 4.

Figure 4 Topography of the Study Site



The slope that was studied was near to Briantspuddle in Dorset and was chosen because it is on private land where the public cannot normally go. The land is owned by the Army and used for tank training. Hopefully, this site represented a good example of lowland heath in its most natural condition.

The student has provided a good justification for their choice of study site.

Sub-questions not developed or explained. For example, useful comments could make reference to the fact that when heathland develops on well-drained soil, the relevant components of the water cycle will be through-flow and percolation. But when heath develops on poorly drained soil (on the same hillside) the most important factors in the water cycle will be groundwater flow and groundwater storage.

Another comment could relate the references that Bell Heather and Common Heather might be found at the top of the slope, whereas Cross-leaf Heath should be more common on the lower slope nearer to the mire.

The area is on a slope leading down to a mire and then, to a lake and this should provide enough variation in soil moisture to allow different types of heath to develop. Although the area in the mire and towards the lake were not within the study area and were not investigated.

This investigation was divided into four parts, each one tackling one of the sub-questions which are listed below.

1. To what extent are there differences in heather species at different places on a hill slope?
2. Does the study site have evidence for variation in the water cycle on a hill slope?
3. Can differences in the distribution of heather communities be related to soil moisture?
4. Are there any implications of the above when it comes to successful management and conservation of lowland heath?

Methods

After arriving at the study I walked up and down the slope, to check where the heather stopped and the mire began. I also made of note of any trenches dug by the Army or military debris which could pose a health and safety risk.

My first survey was to determine to what extent there were variations in heather species at different places on a hill slope. I was hoping to confirm that this hill slope had dry, humid and wet heaths growing on it.

I decided to carry out a stratified survey and divided the slope into three sections – top, middle and bottom. I threw the quadrat 20 times in each section and noted the percentage cover of three common heather species, these were Common Heather, Bell Heather and Cross-leaf Heath. I ignored all other plants. This gave me a total sample of 60 data points on this slope. This survey is shown on Figure 5.

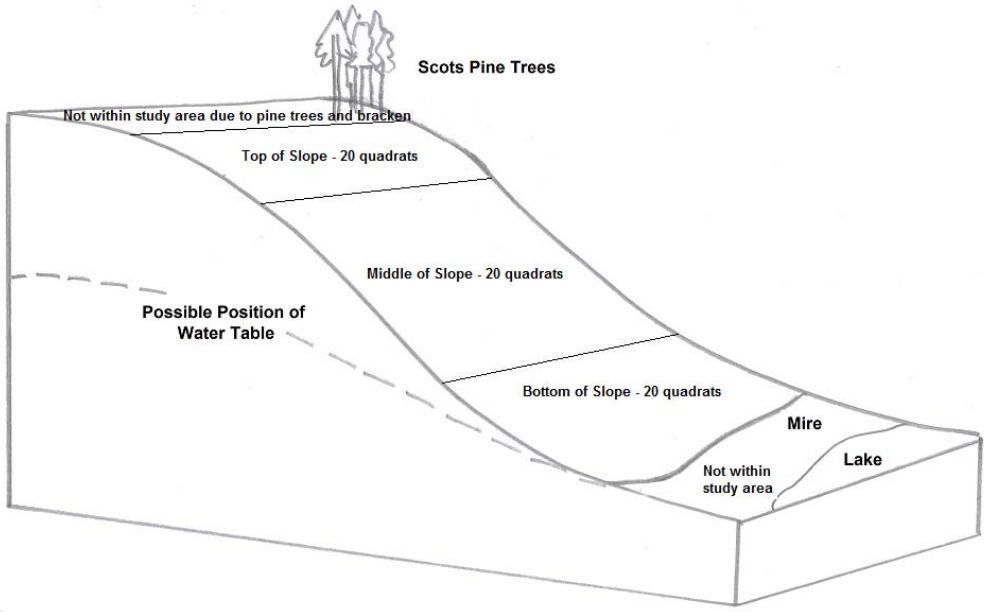
The student has not justified a sample size of 20 per slope segment, neither have they explained why it was necessary to divide the slope into three strata. For example, why not divide the slope into two segments and do 15 quadrats in each segment?

Fairly weak comment on accuracy. Human errors like this are usually random and therefore distributed normally about the mean. If the sample size is big enough, this type of error becomes irrelevant.

The student should have at least made a comment that by taking a large sample, the chance of error is reduced.

It would have been helpful if the student had explained what soil characteristics they were looking for and why they were important (ie how they related to soil moisture drainage and water storage).

Figure 5 Sampling Points for the Stratified Survey



There could be errors in my data because the percentage cover is only an estimate within the quadrat and I could have made mistakes.

My second survey was to look for evidence for variation in the water cycle on a hill slope. I expected that if the slope had different soil moisture and drainage this could be seen in the soils. I carried out a simple soil survey and inspected one of the Army trenches at the top of the slope to see what the soil was like and compared it with a sample from a soil auger at the bottom of the slope. If they were different it might be possible to draw some basic conclusions about the soil storage component of the water cycle.

I only have a basic knowledge about soils and can only look for obvious differences. I might therefore have missed something which a soil expert would see.

No justification of 5m spacing between samples. It would have been straightforward to have said that as the transect was 60m long, collecting samples at 5m intervals would produce a sample size of 13. As this is above the minimum sample size required for Spearman Rank, this spacing was acceptable.

No justification of the 10cm depth.

The antecedent rainfall will certainly inform the student if the preceding period has been wet or dry, but it does not necessarily follow that it will also predict soil moisture. Soil moisture will be affected by many other factors including PE, the field capacity and the soil moisture budget etc. The student has not considered that there is a more complex relationship between rainfall and the magnitude of soil moisture storage.

My third survey was to investigate the soil moisture in more detail and see if differences in the distribution of heather communities could be related to soil moisture. I laid out a tape measure in a straight line from the top of the slope to the near the bottom. I used systematic sampling to take a reading every 5m. At each place I did a quadrat survey to measure the percentage cover of heather species and also dug up a small sample of soil. The soil samples were collected from approximately 10cm below the surface and were wrapped in silver foil and put inside a freezer bag with a label. This soil was then taken back to college where I calculated the percentage moisture content. I did this by following the method below:

1. Weigh wet soil.
2. Dry soil in drying oven for 24 hours at 105°C.
3. Weigh dry soil
4. Calculate weight of water in the soil
   (weight of water = weight of wet soil – weight of dry soil)
5. Calculate the percentage moisture content.

% moisture = (Weight of water / Weight of dry soil) x 100

This technique for calculating soil moisture came from: Standards Association of Australia. *AS 1289 B1.1-1977. Determination of the Moisture Content of a Soil: Oven Drying Method (standard method).*

My data could be unreliable because I did not measure exactly where I collected the soil sample, it was from approximately 10cm depth but this could vary slightly. Also back in college, I made a mistake and did not weigh the empty beaker before I put the soil in. So I had to do this afterwards by emptying out the dry soil and then weighing the empty beaker. This could have made my data more inaccurate.

To help me interpret these results, I also collected secondary data of rainfall from the Southampton Weather website (southamptonweather.co.uk) for the 30 days leading up to my field visit. This would tell me if the soil would be wet or dry before I collected my data.

Although I used weather data from a station approximately 50 miles away from Briantspuddle, the rainfall may have been different in the two places. However, I'm hoping a rainy day in Dorset would also mean it was a rainy day in Hampshire. So I still think the secondary data will still be useful.

Finally, I wanted to find out if there were any implications of my findings when it comes to successful management and conservation of lowland heath. In order to do this, I carried out an interview with Mr Fale, the Urban Heaths Reserve Officer based at Upton Heath on the outskirts of Poole. This heath is approximately 15 miles away from my study site at Briantspuddle. It may have more management issues being near to an urban area than the Briantspuddle heath where the public are not allowed to go.

During the interview, I asked the following questions, which were often followed up with supplementary questions:

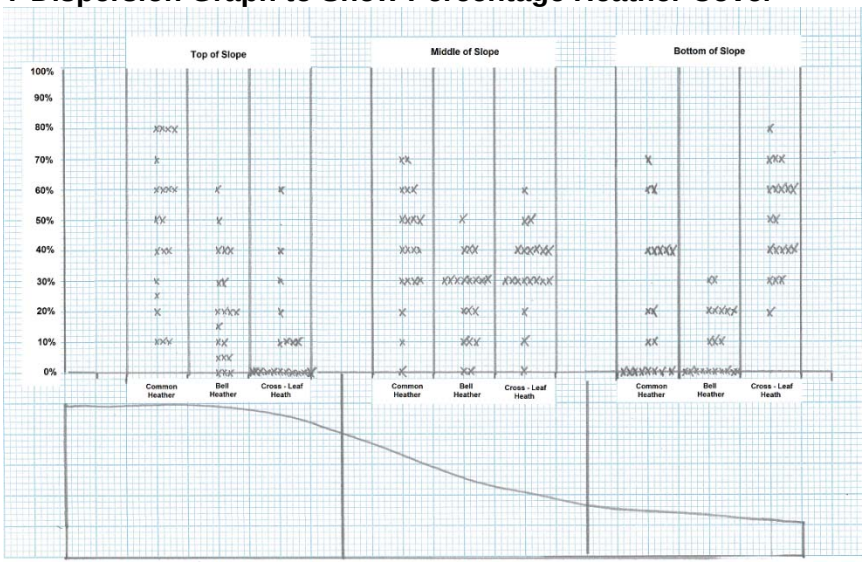
1. What are the natural threats to Upton Heath?
2. What are the human threats to Upton Heath?
3. Explain how you manage these threats.
4. Which takes up most of your time, managing the natural or the human threats?
5. Are all areas of the heathland reserve equally at risk from these threats?

Figure 6 Mr Fale, the Urban Heaths Reserve Officer for Dorset Wildlife Trust

Data presentation and analysis

In order to see if there were different heathland plant communities on the top, middle and bottom of the slope the data were first presented on dispersion graphs.

Figure 7 Dispersion Graph to Show Percentage Heather Cover



Difficult to read graph and the y-axis is not labelled.

However, it was a nice idea to present these graphs over a sketched hill profile, to communicate where the data had come from.

The dispersion graphs show that Common Heather occurs in all three sections of the slope, with a decrease towards the bottom. At the top of the slope, every quadrat had some Common Heather but at the bottom, eight out of the twenty quadrats did not have any Common Heather.

Analysis is too brief. No actual figures quoted from graph.

Only the very obvious trends identified. No calculation of mean or median values, interquartile range etc.

But the biggest differences are seen in the Bell Heather and Cross – leaf Heath. The amount of Bell Heather definitely decreases from the top to the bottom and the amount of Cross-leaf Heath definitely increases towards the bottom of the slope.

In order to see if these differences were significant a chi-square analysis was carried out.

After various attempts where too many of the expected frequencies came out as less than 5, it was decided that the following groups shown below should be used.

Some application of knowledge. (That no more than 20% of the expected frequencies should be less than 5).

No mention of degrees of freedom or how chi-square is calculated. No mention of levels of signicance.

Three chi-square tests were needed (one for each section of the slope) they are shown below. In each case the null hypothesis was:
There is no significant difference between the observed and expected frequencies.

The observed frequencies are the data I collected and the expected frequencies are what I could have expected to happen if the heather grew randomly on the hillslope.

Chi-square analysis for the top of the slope.

Top of slope				
Observed frequencies	Common h.	Bell h.	Cross leaf	Row total
Cover 0% to 10%	3	8	16	27
Cover 11% to 100%	17	12	4	33
Column total	20	20	20	**60**
Expected frequencies	Common h.	Bell h.	Cross leaf	Row total
Cover 0% to 10%	9	9	9	27
Cover 11% to 100%	11	11	11	33
Column total	20	20	20	**60**
Chi-square calculation	O	E	(O-E)^2	(O-E)^2/E
	3	9	36	4
	8	9	1	0.11111
	16	9	49	5.44444
	17	11	36	3.27273
	12	11	1	0.09091
	4	11	49	4.45455
			Chi sqr	**17.3737**

When the calculated value for chi-square of 17.3737 is compared with the critical value of 3.357, the null hypothesis can be rejected and it can be seen that a high percentage cover of Common Heather was observed 17 times against an expected frequency of only 11 and a high percentage cover of Cross-leaf Heath was only observed 4 times compared to an expected frequency of 11. The observed frequencies for Bell Heather are very close to what was expected.

From this, it can be seen that Common Heather prefers the growing conditions found at the top of the slope and Cross-leaf Heath does not grow well at the top of the slope.

No mention of degrees of freedom or how it is calculated. No mention of levels of signicance.

Just because H_0 had to be accepted, it doesn't mean there are 'no conclusions'.

Assuming this part of the slope is neither particularly well drained or excessively waterlogged, conditions could be suitable for all three types of heather to grow. This is what would be expected for a typical example of humid heath.

Chi-square analysis for the middle of the slope

Middle of slope				
Observed frequencies	Common h.	Bell h.	Cross leaf	Row total
Cover 0% to 10%	2	5	2	9
Cover 11% to 100%	18	15	18	51
Column total	20	20	20	**60**
Expected frequencies	Common h.	Bell h.	Cross leaf	Row total
Cover 0% to 10%	3	3	3	9
Cover 11% to 100%	17	17	17	51
Column total	20	20	20	**60**
Chi-square calculation	O	E	(O-E)^2	(O-E)^2/E
	2	3	1	0.33333333
	5	3	4	1.33333333
	2	3	1	0.33333333
	18	17	1	0.05882353
	15	17	4	0.23529412
	18	17	1	0.05882353
			Chi sqr	**2.35294118**

When the chi-square value of 2.353 is compared with the critical value of 3.357, it is less and so the null hypothesis cannot be rejected. This means that no conclusions can be reached about the middle of the slope.

No mention of degrees of freedom or how it is calculated. No mention of levels of signicance.

Chi-square analysis for the bottom of the slope

Bottom of slope				
Observed frequencies	Common h.	Bell h.	Cross leaf	Row total
Cover 0% to 10%	10	13	0	23
Cover 11% to 100%	10	7	20	37
Column total	20	20	20	**60**
Expected frequencies	Common h.	Bell h.	Cross leaf	Row total
Cover 0% to 10%	7.66666667	7.66666667	7.66666667	23.0000003
Cover 11% to 100%	12.3333333	12.3333333	12.3333333	37
Column total	20	20	20	**60.0000003**
Chi-square calculation	O	E	(O-E)^2	(O-E)^2/E
	10	7.666667	5.44444289	0.71014469
	13	7.666667	28.4444409	3.7101443
	0	7.666667	58.7777829	7.666667
	10	12.3333333	5.44444444	0.44144144
	7	12.3333333	28.4444444	2.30630631
	20	12.3333333	58.7777778	4.76576577
			Chi sqr	**19.6004695**

As the calculated value for chi-square was 19.6 and the critical value was 2.353, the null hypothesis can be rejected . The obvious conclusion from this analysis is that Cross-leaf Heath is much more common than expected in the lower section of the slope. Also, small quantities (less than 10%) of Bell Heather could have been expected 7.666667 times but was observed 13 times. This means that Bell Heather does not gow well in the lower slope.

I have therefore shown that in relation to sub-question 1, there are differences in the vegetation between the top of the slope and the bottom. Common Heather grows all over the slope but Bell Heather grows more at the top and Cross-Leaf Heath grows more at the bottom.

This supports the idea that there is dry heath at the top of the slope, humid heath in the middle of the slope and wet heath at the bottom of the slope.

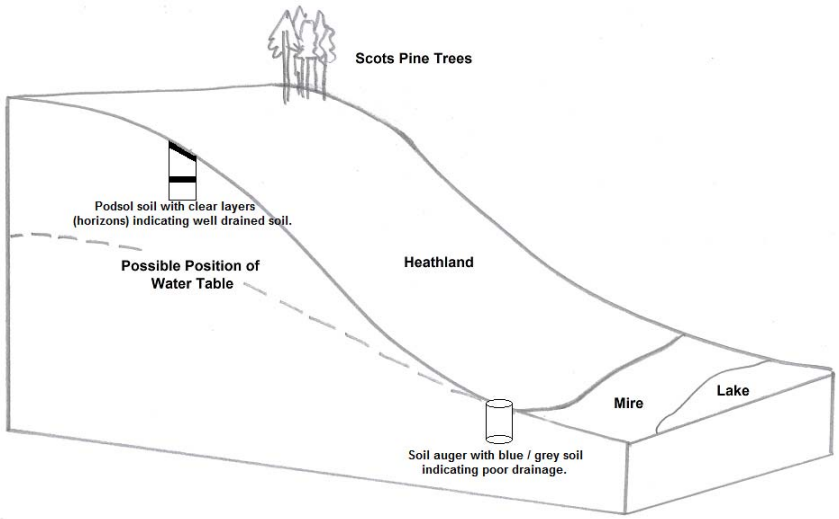
Although the student will not have studied soils, guidance from their teacher to look at the relevant sections in Waugh about soils has allowed the student to focus on the right ideas.

It is a shame they didn't draw or photograph the soils, the podsol would have been clear *in situ* and the gley would look blue/grey on the auger.

There is no way to check that the student has observed the soils accurately and confirm what they say saw does indeed tie up with the profiles shown in Waugh.

To answer the second sub-question - Does the study site have evidence for variation in the water cycle on a hill slope? I looked at the soils on this hill slope. My results are presented in Figure 8.

Figure 8 soil types on the hillslope at Briantspuddle



The Army had already dug a trench as the top of the slope and in this trench the soil was clearly visible. There were easily recognisable layers which were different colours. The overall pattern of these layers matched up with those described by Waugh (2009) on page 332 as a podsol. This type of soils only develops on well drained sites and so it can be concluded that the top of this hillslope is well drained.

As there were no trenches at the bottom of the slope a soil auger was used to take soil samples. After a few attempts a small sample of soil was observed that corresponded to the soil type described by Waugh (2009) on page 275 with the typical blue / grey colour of a gley soil that had developed in poorly drained conditions. This fitted in with my idea that the water table was probably just below the surface. It was beginning to look as if this natural heathland, which the public can rarely access was following the typical textbook description. At the top of the slope dry heath had developed on the well-drained soil, wet heath was growing on the lower slopes that had poor drainage and a humid heath vegetation community was growing in the middle of the slope.

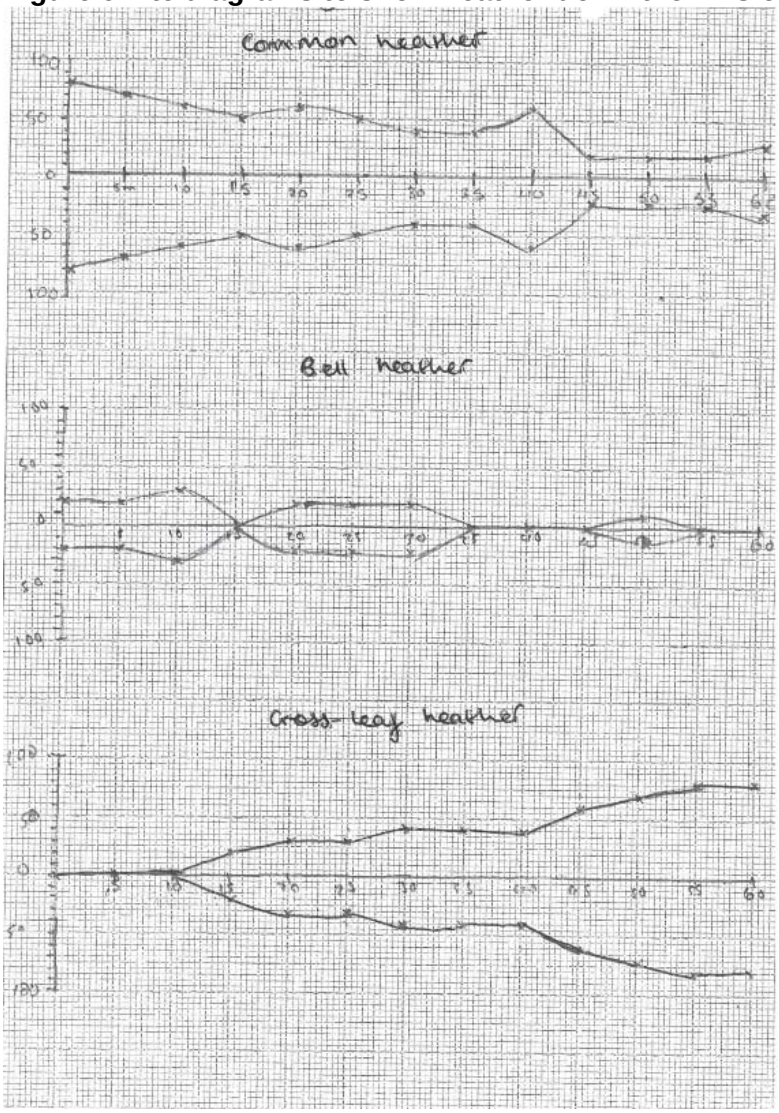
These kite diagrams are unclear. No horizontal scale. No label on y-axis.

No description provided to say what the kite diagrams show.

In order to check this idea, the third sub-question involved trying to relate the vegetation to the soil moisture directly and therefore information about both soil moisture and percentage heather cover were collected along a transect laid out down the hill slope.

The changes in percentage cover of heather down the slope is shown on these kite diagrams

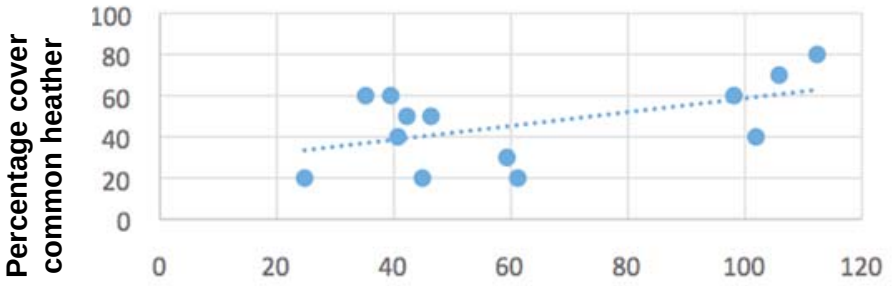
Figure 9 kite diagrams to show heather down the hillslope



To look for a relationship between the percentage cover of heather and soil moisture, scatter graphs were plotted using Excel. These are shown below.

Figure 10 scatter graph to show the relationship between % cover of common heather and soil moisture

Common heather



This graph that shows the relationship between Common Heather and soil moisture is positive. The trend line rises towards the wetter soils which is where the higher percentage cover of Common Heather is found.

Figure 11 scatter graph to show the relationship between % cover of bell heather and soil moisture

Bell heather

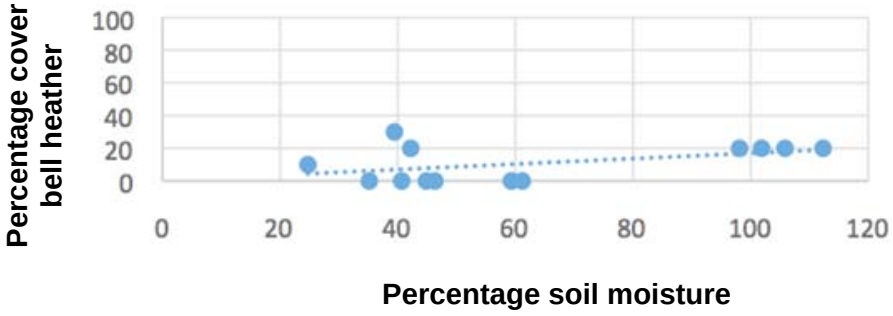


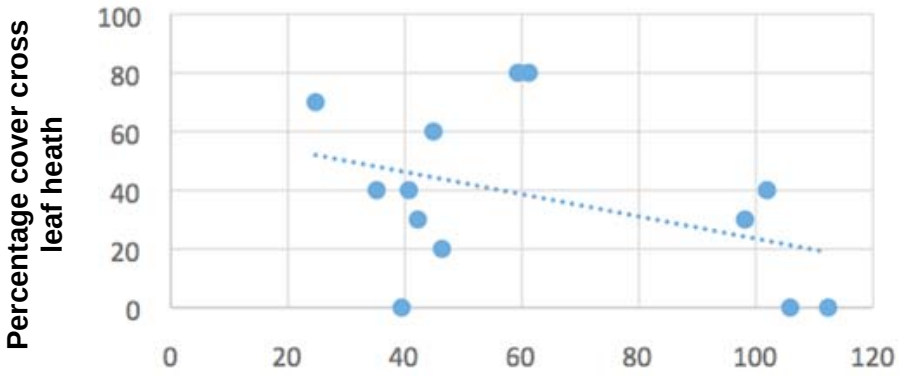
Figure 11 also shows a positive relationship with more Bell Heather occuring in the high soil moisture areas. This is not what would be expected acording to the theory, which says that Bell Heather should prefer the drier areas.

Limited description of all three scatter graphs. Only the overall trend commented on. No mention of how close the points are to the line or of any anomalies etc.

The student has failed to notice that the soil moisture seems to cluster around two values – around 40% and between 100% and 120%. Is this reasonable or does it indicate a problem with the data?

Figure 12 scatter graph to show the relationship between % cover of cross leaf heath and soil moisture

Cross leaf heath



This graph shows a negative relationship between percentage cover of Cross-leaf Heath and soil moisture. This is also not what was expected as the references say that Cross-leaf Heath grows better in the wetter areas and therefore the percentage cover should be higher where the soil moisture is greater.

In order to test the correlation between soil moisture and percentage heather cover three Spearman Rank tests were calculated. The null hypotheses were:

- There is no significant correlation between percentage soil moisture and percentage cover of Common Heather.
- There is no significant correlation between percentage soil moisture and percentage cover of Bell Heather.
- There is no significant correlation between percentage soil moisture and percentage cover of Cross-leaf Heath.

No worked example of calculation, no level of significance used.

No data are provided to support the phrase 'no similar trends in soil moisture'.

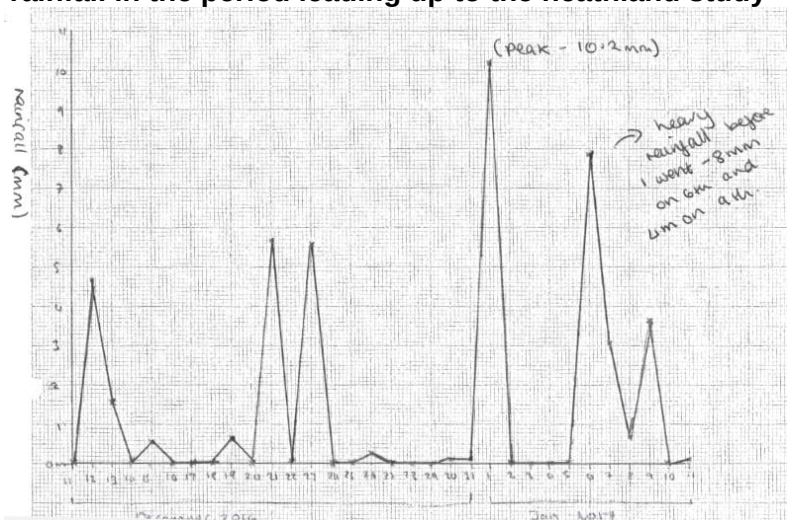
Rainfall data are discrete data and should be shown on a bar graph.

The results are shown in the table below.

Test	Calculated value for Spearman Rank	Critical Value for Spearman Rank	Conclusion
Common Heather	+ 0.348	0.560	Accept H_0
Bell Heather	+ 0.268	0.560	Accept H_0
Cross-leaf Heath	– 0.284	0.560	Accept H_0

Although the kite diagrams show there are clear vegetation trends down the hill slope there are no similar trends in the soil moisture and so this Spearman Rank analysis has failed to show any correlation between species cover and soil moisture.
The secondary rainfall data from the Southampton Weather website may help to explain this. The rainfall data for the days before the field visit are shown below.

Figure 13 rainfall in the period leading up to the heathland study



It can be seen that immediately prior to collecting the data, there were two days of quite heavy rainfall that may have affected my readings. This water would still have been in the soil, just below the surface, which is where I took my soil samples. Perhaps the best days for doing fieldwork like this would have been after a long dry spell?

This table and following paragraphs provide a good summary of the interview but fail to assess the scale or magnitude of these threats and the amount of time spent managing them.

It would have been useful if the student had found a way to compare the damage done by fire and dog walkers.

In order to understand the management conservation issues of lowland heath I carried out an interview with Mr Fale at Upton Heath.

Upton Heath is 500 hectares in size and has the urban area of Poole on two sides. The public has easy access 24 hours per day.

A summary of his answers are given in the table below.

What are the main threats to Upton Heath?	
Natural threats	**Human threats**
Plant succession that would, over time transform the heaths into oak – ash woodland	Fire is a severe threat. There are two sorts: - fire that is maliceous and fire that is carelless. Mr Fale thought that 75% of fires were due to carelessness and only 25% were deliberate and maliceous. At the time of my interview in July 2017, there had been three fires on Upton Heath since January.
Climate Change is extending the growing season. This leads to more biomass and faster succession as well as more fuel for fires, when they occur.	Dog waste enriches the soil and upsets the natural balance of a low nutrient soil. The dogs also disturb ground nesting birds such as the nightjar and meadow pippet.
Erosion human activitiy on the paths reduces the vegetation and exposes the soil. Rainfall is then able to erode the soil.	Erosion is caused mainly by mountain bikers and horse riders.
	Trampling and disturbance is caused by people not sticking to the footpaths People walking away from the paths can also disturb ground nesting birds.
	Some firms have mineral extraction rights to parts of Upton Heath
	Nitrate enhancement comes from car exhaust and enriches the soil. The areas affected are those closest to the main roads.

To manage these threats to Upton Heath, Dorset Wildlife Trust carry out rotational clearance of invading vegetation to maintain the plagioclimax vegetation and fence of the areas most at risk from erosion. As far as managing the human threats, they rely on education and information, urging people to follow the Heathland Code. There is a community group of local volunteers, called the Heathwatch Group, who keep an eye out for any threat to the heath and will telephone the relevant authority such as the fire brigade or the police if they see something.

There is also a seasonal difference in managing the threats to Upton Heath. Winter is spent managing the natural threats while in summer it's responding to the human threats that takes up most of the time.

Conclusion

The conclusion is a good summary of the points already made.

This investigation has successfully shown that heathers at the top of of slope are mainly Common Heather and Bell Heather with very little Cross-leaf Heath. The soil type, which is a podsol confirms this is a well drained sited and the heathland community is typical of a dry heath.

At the bottom of the slope, once again the observed vegetation was different from what could have been expected as there was very little Bell Heather but an abundance of Cross-leaf heath. The wet soil conditions were confirmed with the auger that found the blue/grey colour of a gleyed soil. At the bottom of the slope, which is only slightly higher than mire, the water table must be only just below the ground surface and this makes the bottom of the slope poorly drained

Heath type?

In the middle of the slope, the results are harder to conclude because the chi-square test showed that the observed frequencies were not significantly different from the expected frequencies. Instead all three main heather types were growing and this shows that the middle of the slope is neither well drained or poorly drained. As this part of the slope was below the dry heath but above the wet heath, it can be concluded it is humid heath.

The Spearman Rank tests for a correlation between percentage soil moisture and percentage heather cover showed that, in all three cases there was no correlation between the two. This result was surprising but can be explained by the secondary data from Southampton Weather that showed a number of wet days and high rainfall immediately preceeding the date of the field visit which was in January. During the winter months, the potential evaporation is low and therefore any rain that falls percolates slowly through this sandy soil until it reaches the water table. All that can be concluded is that at this time of year, the soil water store is not the important factor that determines the distribution of heathers.

When it comes to the management of heathlands, there are both natural and human factors to consider. The main natural factor is the invasion of the heath by other plants such as birch trees and gorse bushes, which occurs mainly in the dry heath areas. Human impact includes destruction of the vegetation by horse riders, mountain bikes and accidental or deliberate fires. Dog walkers can also cause a problem if they do not clear up after their pet. Once again human activity is mostly confined to the dry and humid heaths and these areas are more prone to fire than the wet heath.

The evaluation considers in some detail the ethical dimension of this investigation and recognises some of the limitations of this study.

Furthermore, there are comments relating to how it could be extended.

The weaknesses that have been apparent throughout such as the general lack of justification of methods and techniques as well as a lack of understanding about collecting good quality data limit the effectivenesss of the evaluation.

The student does try to question that perhaps 20 quadrats might not be enough and then appears to guess that 30 may be better, but without any secure reasoning.

The failure of the soil moisture survey to correlate with heather species percentage cover is explained as a data collection problem rather than questioning whether soil moisture on one day of the year is the correct variable to measure in the first place.

Overall, it can be concluded that there are variations in heathland plants and this habitat is under threat. It needs to be managed and conserved because it offers a rare habitat for reptiles and birds. Heath managers do not specifically differentiate between dry and wet heath for management purposes but aim to ensure that human impact stays at a minimum and the threat of fire is reduced.

Evaluation

Because this fieldwork was carried out in a threatened and vulnerable habitat it was important that ethical considerations were taken into account. The threat of fire can be an important factor when visiting heathlands at certain times of year. Although the threat of fire was less likley in the winter months it was still important to ensure that headlines in the local paper the next day didn't read 'Geography Student Causes Massive Heathland Fire'. Therefore, no naked flames were used at any time during the survey.

It was also important that the habitat was not disturbed, therefore no litter was dropped and the corrugated metal sheets left out by the Army for reptiles to nest under were not moved.

When collecting soil data, the ground was disturbed as little as possible. Trenches that already existed were used where possible to investigate the soil and where they did not exist only an auger hole was made in the ground. When collecting soil samples for moisture analysis, only a small sample was taken and from only just below the ground surface. This allowed the plants to be put back over the 10cm hole without them being killed.

The quadrat survey worked quite well but a sample size of 20 in each area might not have been enough as there was difficulty making the chi-square calculations work at first. Perhaps on another occasion 30 quadrats per slope section might overcome this problem?

The soil moisture survey did not work at all and this could be due to the time of year the data were collected and therefore extending data collection into all four seasons and repeating this survey might be useful. Looking back, it now seems a bit unlikely that one transect down the hill slope would provide enough data. Perhaps there were also issues collecting the soil sample from 10cm below the surface. Due to the rain that had fallen in the 7 days before this fieldwork, the soil surface would still be wet on the day of my fieldtrip.

The conclusions of this investigation only apply to one hillside and this study could be extended to include other hillsides and see if the same patterns apply. Also, a pedestrian count of people visiting heathlands on the edge of Poole and Bournemouth could be completed to see where people go when they walk their dog or ride their mountain bike. Such information could be useful by heathland managers and ecologists and help them to manage the human impact on these rare and valuable habitats.

Two references missing.

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Appendix

Field data

Heather survey on the top of the slope
Top of slope

Quadrat number	Common heather	Bell heather	Cross leaf heath
1	80	20	0
2	80	5	0
3	25	20	0
4	40	60	0
5	10	40	0
6	60	20	0
7	60	5	20
8	60	0	0
9	80	5	10
10	10	50	0
11	60	0	30
12	10	10	10
13	40	20	0
14	30	10	60
15	40	30	10
16	50	40	0
17	30	0	40
18	50	40	0
19	80	15	0
20	70	30	10

Heather survey on the middle of the slope
Mid slope

Quadrat number	Common heather	Bell heather	Cross leaf heath
1	50	30	30
2	40	40	20
3	40	30	30
4	10	30	60
5	40	0	30
6	70	20	30
7	40	0	40
8	60	30	40
9	30	10	50
10	60	30	30
11	70	50	0
12	30	40	40
13	20	20	40
14	50	10	40
15	0	30	50
16	60	10	40
17	30	40	10
18	60	30	30
19	30	20	30
20	50	30	30

Heather survey at the bottom of the slope
Bottom slope

Quadrat number	Common heather	Bell heather	Cross leaf heath
1	10	20	40
2	20	0	50
3	0	0	70
4	0	0	70
5	0	0	60
6	0	20	60
7	0	0	50
8	10	20	40
9	60	30	30
10	40	20	60
11	40	10	40
12	0	10	80
13	60	30	60
14	40	10	30
15	70	0	20
16	0	0	60
17	40	20	30
18	40	0	40
19	0	0	70
20	20	0	40

Soil moisture survey

Distance	Common heather	Bell heather	Cross leaf heath	Percentage moisture
0	80	20	0	112.33
5	70	20	0	105.85
10	60	30	0	39.44
15	50	0	20	46.33
20	60	20	30	98.12
25	50	20	30	42.21
30	40	20	40	101.88
35	40	0	40	40.67
40	60	0	40	35.16
45	20	0	60	44.87
50	20	10	70	24.73
55	20	0	80	61.17
60	30	0	80	59.31

Commentary

To what extent is there variation in urban microclimate across the city of Exeter?

The student has followed advice on how to layout the investigation report and provided a structure which follows the sections in the mark scheme. This makes marking the work more straightforward than when the student follows an alternative structure.

Overall they have a good understanding of the issues facing heathland and how to go about creating an investigation. They have undertaken a satisfactory literature review which has enabled them to gain a good understanding of their chosen local ecosystem, lowland heath but which omits any references to the water cycle.

This student certainly has the right idea but consistently gets let down by knowledge of the finer details and the understanding that allows them to justify the choices made. This is seen at the following points in their report:

1. good sub-questions, which are not fully explained
2. sampling frameworks that are not justified
3. an inability to explain how they ensured data were of a high quality
4. careless data presentation with graph items missing or illegible
5. not fully completing statistical tests by using a level of significance.

Area 1: Introduction and preliminary research (10 marks)

To define the research questions which underpin field investigations. (AO3)

Although the research question is securely identified it is not completely referenced to the specification (with section number and specification wording).

Level 3

To research relevant literature sources and understand and write up the theoretical or comparative context for a research question. (AO3)

Although the chosen site is well justified, there are no literature sources that relate back to the water cycle. Therefore Strand 2 is only Level 2. It is implied that without management seral succession will take place, however there is no specific reference to seral succession.

To reach Level 4, there should be well-understood and well-stated reference to the water cycle and soil moisture on the scale of a hillslope.

Level 2

Level 3

7 marks

Area 2: Methods of field investigation (15 marks)

To observe and record phenomena in the field and devise and justify practical approaches taken in the field including frequency/ timing of observation, sampling, and data collection approaches. (AO3)

The student has selected both quantitative and qualitative methods.

However, justification of these methods is not well developed, especially details such as sample size, depth of samples or spacing between samples. Also, there is no mention of the timing of data collection and especially its impact on the size of the soil moisture store.

The student could have used Google Satellite view to divide the slope into sections based on differences in vegetation colour or texture as seen in the satellite image rather than what appears to be the standard convex – straight – concave slope model. Another option would have been the walk the slope a few times and look for changes in the vegetation that justify dividing the slope into three, for example:

- area on slope where no cross-leaf heath is found
- area on slope where occasional cross-leaf heath is found
- area on slope where a lot of cross-leaf heath is found.

Although the student has made a good decision to divide the slope into three segments, they have not demonstrated and applied existing knowledge to demonstrate the best sampling framework.

One way to justify the sample size would have been to comment that the sample size needed to be large enough to ensure that the chi-square analysis could be carried out and that no more that 20% of the cells in the expected frequency contingency table contained values less than 5. When sampling the soil moisture along a 60m transect at intervals of 5m, they could have said that this produced a sample size of thirteen which was sufficient to carry out a Spearman Rank analysis.

To reach Level 4, the student should have provided a more detailed account with well-reasoned justification of their methods by covering the points above.

Although rainfall data has been used as secondary data, to say that it is only useful in determining soil moisture is an oversimplification. The antecedent rainfall will certainly inform the student if the preceding period has been wet or dry, but it does not necessarily follow that it will also predict soil moisture. Soil moisture will be affected by many other factors including PE, the field capacity and the soil moisture budget etc. The student has not considered that there is a more complex relationship between rainfall and the magnitude of soil moisture storage.

Level 3

To demonstrate practical knowledge and understanding of field methodologies appropriate to the investigation of human and physical processes. (AO3)

The methods are certainly replicable (however, we don't know the exact location of the site, only that it is 'somewhere near Briantspuddle'!). The student should have provided an OS grid reference.

Level 4 (low)

To implement chosen methodologies to collect data/ information of good quality and relevant to the topic under investigation. (AO3)

The student has clearly implemented their chosen methodologies and collected appropriate data. However, they have not always indicated to what extent it is good quality data.

For example, the student could have commented about the 10% level of precision used to record heather percentage cover. They have chosen (mainly) to use values such as 20%, 30% or 40%. However, a value of 30% could mean anything between a lower bound of 25% and the upper bound of 34%.

The reasons for choosing just one transect to relate soil moisture and heather species is weak and it would have been easier for the student to reach Level 4 if they had completed more transects, ie to obtain a representative sample of results. They could also have considered repeating measurements at intervals several weeks apart in order to obtain different soil moisture readings.

Level 3 (low)

Level 3

11 marks

Area 3: Methods of critical analysis (20 marks)

To demonstrate knowledge and understanding of the techniques appropriate for analysing field data and information and for representing results and show ability to select suitable quantitative or qualitative approaches and to apply them. (AO3)

Imprecise knowledge and understanding of techniques. Although the student can apply the correct inferential statistical tests and come to a correct conclusion, they fail to demonstrate understanding of levels of significance.

They failed to show understanding of how to graph discrete as opposed to continuous data and description of the scatter graphs was basic.

Level 2 (high)

To demonstrate the ability to interrogate and critically examine field data in order to comment on its accuracy and/or the extent to which it is representative, and use the experience to extend geographical understanding. (AO3)

The student has shown a partial ability to interrogate and critically examine field data.

They have not made any comments on its accuracy or the extent to which it is representative.

When using inferential statistical tests they have not referred to levels of significance.

They have not calculated or analysed any summary statistical information such a mean, range or standard deviation etc.

Level 2

To apply existing knowledge, theory and concepts to order and understand field observations. (AO2)

The student has been able to link their results back to their initial sub-questions. They understand the results that fit with the theory and those that do not. Therefore they have shown they can focus on the application of existing knowledge, theory and concepts in order to understand observations.

To reach Level 4, repeat surveys of soil moisture would have been helpful to show changes over three or four months. This could have been coupled with a simple measure of evapotranspiration using a flower pot with soil and *in situ* plants where daily water in and out is measured along with changes in water storage that is calculated from changes in weight of the flower pot. This would allow evapotranspiration to have been estimated over the period before each soil survey was carried out.

Level 3

Level 2

9 marks

Area 4: Conclusions, evaluation and presentation (15 marks)

To show the ability to write up field results clearly and logically, using a range of presentation methods (AO3 strand 3)

Overall presentation – the student has demonstrated a clear ability to write-up field results and would have shown a thorough ability if they had completed their write-up covering points made in all the previous comments.

- The text is generally fine.
- Figures and pages are numbered (but not the tables).
- Some graphs are incomplete and hard to read.
- The wrong type of graph is used to present the rainfall data.
- One DEFRA and the Australian Standards references are missing from the Bibliography.
- There is no Contents page.
- There is no executive summary.

Level 3

To evaluate and reflect on fieldwork investigations, explain how the results relate to the wider context and show an understanding of the ethical dimensions of field research (AO3 strand 2)

The evaluation is secure and shows a good understanding of the ethical dimensions of this study. The student recognises that although the spatial distribution of heath types follows a pattern that should be determined by soil moisture, the actual situation is more complicated than just a simple measure of percentage soil moisture and could also vary throughout the year.

To reach Level 4 a better understanding of temporal change as well spatial change might have been helpful. Another option might have been to compare this hillside with another to determine if the patterns are repeated or if there are significant differences between them.

Level 3

To demonstrate the ability to write a coherent analysis of fieldwork findings in order to answer a specific geographical question and to do this by drawing effectively on evidence and theory to make a well-argued case (AO3 strand 3).

The conclusions are valid.

The student is focused throughout, showing an ability to write a coherent analysis.

To reach Level 4, the student might have included reference to the importance of the water budget in affecting results. They might also have argued that if the soil moisture does not correlate with percentage heather what does? For example, a future study might like to investigate the number of days each year the soil was above field capacity or the number of days that soil moisture utilisation took place. Perhaps studies like these would show how the soil moisture store relates to the vegetation? It would have benefited the student if they had made comments about how the investigation could have been extended in ways such as these.

Level 3

Level 3

10 marks

Overall

Area 1: 7
Area 2: 11
Area 3: 9
Area 4: 10

Total: 37

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