

Biodiversity Assignment

Fieldwork techniques used in understanding woodland ecology and developing improvement plans.

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Introduction

This report investigates the variation of soil structure and soil chemistry across Kilvey Hill. The first section of the paper gives an overview of soil properties, pH and the purpose of chemicals namely, nitrogen, potassium and phosphorus. It will then determine the methodology to undertake the investigation. The remaining part of the report will analyse the results which will then be used to suggest site recommendations. Understanding the various soil types, how they are categorised, and which sort you are working with is essential for producing productive soils and determining the appropriate soil management plan for that region.

A baseline of the site

Before visiting a site, it is crucial to establish a baseline of what was previously present, what currently exists, and what is absent. Kilvey Hill has endured diverse land uses over time. Originally farmed for corn, it became a site for heavy metal production during the industrial revolution, which left soils in the area contaminated and unsuitable for local trees. Between 1830 and the early 1900s, the lower slopes of the hill served as a tip, posing potential environmental concerns (CADW, 2016). Nowadays, Kilvey Hill is a community woodland that serves various groups including volunteers, hikers, motocross riders, and families (GoWild!, 2023). However, the area needs to overcome recurring issues of fly-tipping, illegal motorist use, and fire damage (Channon, 2022). In the future, more people are likely to use the area when the proposed zipline running across the hill is operational. Owing to its proximity to populated areas, Kilvey Woodland is classified as an 'urban fringe' woodland (Forest Research, 2023).

Location of the study

Figure 1 depicts the study area. Kilvey Hill is in the city of Swansea, South Wales. The hill is located on the east bank of the River Tawe, North of the city centre, and can be seen and accessed from various places in the area. The hill reaches 193 meters above sea level (Mountain Days, 2011). Sample Location 1 is at Martins Pond on the southern part of Kilvey Hill. It is a relatively flat area

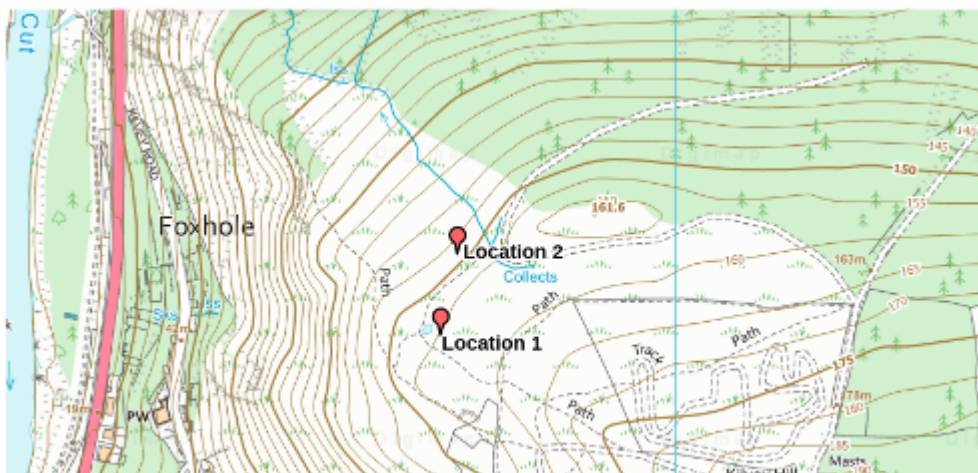


Figure 1, Digimaps, 2023, OS Map, Map of Kilvey Hill

surrounded by forests and flora. Its latitude and longitude are 51.63552N and 3.92630W. Location 2 lies a bit further north, on a steeper slope, with the coordinates 51.63738N, 3.92512W.

The Importance of Soils in Woodlands

Woodland trees relies heavily on nutrients that accumulate in the soil through natural processes. Many essential elements taken up during a tree's life cycle are returned to the soil when the tree

dies, creating a nutrient cycle (Woodland Trust, 2016). Soils in forests are critical to the ecosystem's growth and health. Plants require nitrogen, potassium, and phosphorus as important nutrients for growth and development (Khalofah et al., 2022). As a result, monitoring and developing management strategies for the woods based on soil NPK is an aspect of good woodland management.

Methodology

In this fieldwork, the chemical properties of soil were established on Kilvey Hill. Looking specifically at nitrogen, phosphorus and potassium in two different locations: the previously contaminated area and the non-contaminated area. The first step in this process was to arrive, sit and observe the site to take in the surroundings and get a feel for the functioning of biodiversity. As part of this, photos were taken which are shown in the photo collage in Figure 2. When walking up the hill, it was notable that there's lots of erosion on the footpath mainly from water running down this part, making it difficult and inaccessible for some users. Another observation was that the water had lots of silt and sediment which could result from poor soils. Additionally, when observing the water, Pleurodelinae (newts) were discovered, indicating the potential for improvements if it's managed correctly.



Figure 3, Charlotte Malpass, 2023, Photo Collage of Field Trip

The initial approach for this fieldwork was to use a soil auger to collect a column of dirt and examine how the pH changes with depth; but, due to the challenging digging conditions in both places, a sample large enough to test could not be gathered. As a consequence, the plan was changed, and samples were gathered from each location instead, to be taken back to the lab for chemical analysis. Figure 3 depicts the two soil samples with distinct variances in colour and texture.

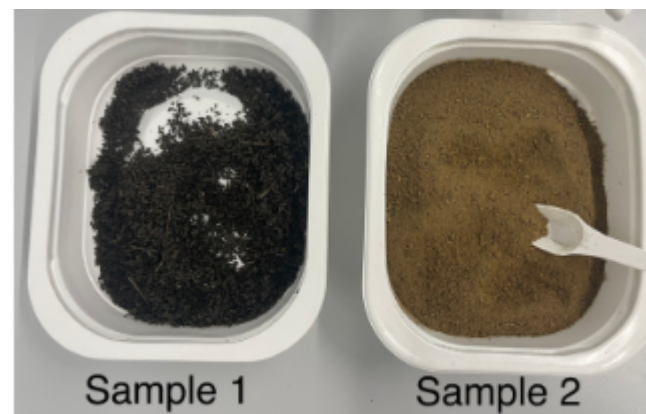


Figure 3, Charlotte Malpass, 2023, Image of dried soil samples

Laboratory analysis of soil

In the lab, the palintest kit was used to test for soil chemicals. To prepare the soil for testing, it was dried in the oven for 4 hours and then sieved to remove impurities like twigs and stones. The following method is followed from the palintest complete management soil test kit sk 500 (palintest, nd).

Potassium test:

- Fill sample container to 50 ml with deionised water
- Add one level blue scoop of extraction K powder, cap and shake
- Add one level 2 ml scoop of soil, cap and shake for 1 minute
- Filter and collect extract K in a clean container up to the 10ml mark
- Add one potassium K tablet, crush and mix to dissolve
- Stand for 2 minutes and wait for the solution to go cloudy (a cloudy solution is indicative of potassium presence)
- Select test K on the photometer and collect the reading.

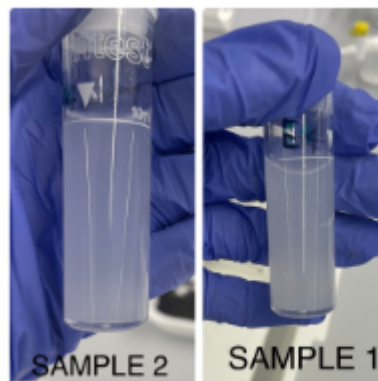


Figure 4- Charlotte Malpass, 2023, Image of potassium indicator.

Phosphate test:

- Fill sample container to 50 ml with deionised water
- Add 5 extraction P tablets, cap and shake
- Add one level 2 ml scoop of soil, cap and shake for 1 minute
- Filter and collect 2 ml of extract P in a new sample container
- Fill the up tp 10 ml with deionised water
- Add one acidifying S tablet, crush and dissolve
- Add one phosphate p tablet, crush and dissolve
- Stand for 10 minutes
- Select test P and take a reading on the photometer

Nitrate test:

- Fill sample container to 50 ml with dionised water
- Add one level blue scoop of extraction N powder, cap and shake
- Add one level 2 ml scoop of soil, cap and shake for 1 minute
- Add one level universal nitratest N powder, cap and shake for 1 minute
- Filter and collect in a clean container up to 10ml
- Add one nitrocel N tablet, crush and dissolve
- Stand for 10 minutes
- Select test N and take a reading on the photometer

These tests were completed for both soil samples and the results are displayed in the table figure 5 graphically in figure 6.

Results

Soil sample	Nitrogen concentration (mg/l)	Phosphate concentration (mg/l)	Potassium concentration (mg/l)	pH
1	0.8	25	350	4.25
2	1.5	13	250	4.83

Figure 5, Table of Results for NPK concentrations on Kilvey Hill

GRAPHS TO SHOW THE DIFFERENT CHEMICAL PROPERTIES ACROSS TWO SAMPLES

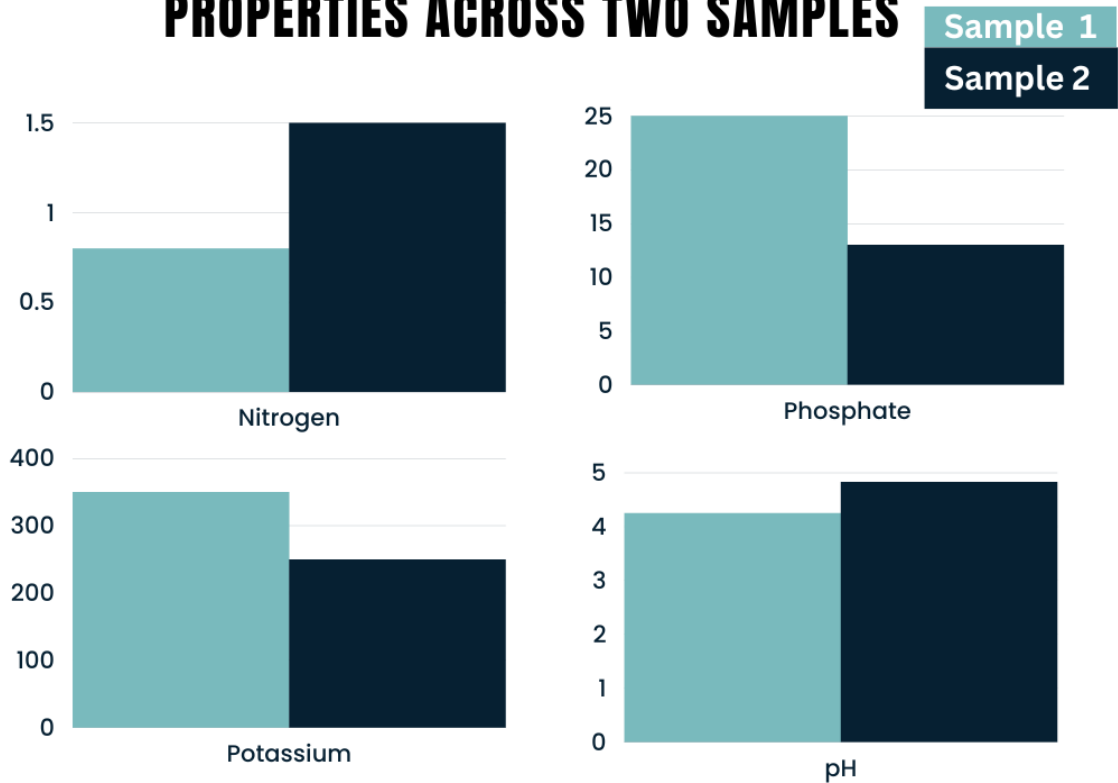


Figure 6, Charlotte, 2023, graph of NPK concentrations across both samples

Analysis

	Nitrogen	Phosphorus	Potassium
	Nutrient level range in ppm		
Low	0-15	0-25	0-60
Medium	15-30	25-50	60-100
High	30+	50+	100+

Figure 7- Look at table for Nitrogen, potassium and phosphorus, (Jove, 2023)

To understand the results, the table shown in Figure 7 was used to see what nutrient range the results were in. Since 1 mg/l is equal to 1 ppm, no conversion was needed. The nitrogen concentrations in both samples were low as they were in the range of 0-15ppm. Nitrogen is the most limiting nutrient for plant growth (Cleland and Harpole, 2010) which suggests plant growth is difficult in this area due to low nitrogen concentration. The phosphate concentration of both samples is low. Phosphorus helps to stimulate leaf and root growth (Plénet et al, 2000). Both samples' potassium concentrations are considered high because they are in the 100+ppm range. Potassium is important for plant nutrition. It is essential for photosynthesis, and enzyme reactions including metabolism, protein synthesis and solute transport (Tränkner, Tavakol and Jákli, 2018). The pH of both samples is very acidic which could be related to the high presence of conifer trees on the site. Soil pH is an indicator of the chemical qualities of soil which can influence plant development and nutrient uptake (Manzoor et al, 1999, pp.51–60). From this data, it suggests that the chemical properties of the soil on Kilvey Hill are of poor quality as no results fall in the medium category.

Limitations of the study

The Palintest soil sampling guide recommends taking between 10 and 25 individual soil samples in a W shape to ensure comprehensive soil analysis (Palintest, nd). Moreover, the soil sample wasn't taken from the recommended depth of 10 cm, so topsoil with impurities was included. Visiting the site only one time during a single season and time of day disregards diurnal and seasonal variations, requiring repeated observations and stakeholder engagement to identify long-term management strategies for Kilvey Hill. Further data collection is necessary to improve the validity and reliability of results due to methodological limitations. Repeated visits with observations would need to be completed to apply this and would help to increase knowledge of how management plans would impact the site long term as well as liaising with stakeholders to understand how it will affect the way that they use Kilvey Hill. Further data collection is required to increase the validity and reliability of the results as there are obvious problems with the method of collection.

Further improvements to this investigation would be to determine the soil texture of each soil sample by using the 'jar texture test' as soil types may influence the characteristics of soil (Foster, 2020). Furthermore, collecting and sharing data from the other students looking at water quality and plant diversity would have been useful to gain a broader insight into other aspects of Kilvey Hill. This would allow for a more comprehensive understanding of the woodland ecosystem and inform more effective management strategies.

Recommendations

Based on the study's findings, the following management recommendations for improving soil structure and nutrient levels, and hence plant development, in Kilvey Hill, can be considered.

1. Increase soil pH in location 1: coniferous Woodland soils should have a pH of less than 5 for optimal plant growth (4). As the soil pH in location 1 is significantly below the suggested pH, adding lime to the soil can help to raise the pH to an optimal level for plant growth and biogeochemical processes (Neina, 2019).

2. Footpath erosion: The main path up Kilvey Hill is heavily eroded due to water running down and people using the path. This makes it inaccessible to some users. Adopting some management solutions such as
 1. Terracing: Construct horizontal cuts in the slope and create steps/ terraces to trap water, reduce runoff and hold water back (Idaho.GOV, 2011).
 2. Revegetation: Increasing the amount of vegetation on the path to increase soil structure and stability (Food and Agriculture Organization of the United Nations, 1992).
 3. Channeling: redirecting the water flow so that it flows down the path with the least resistance and away from the path users are using (TCV, n.d). Reducing runoff and erosion will retain or optimise the phosphorus levels in the soil, increasing plant productivity (Bashagaluke et al., 2018). Improvements to this are especially important if the proposed zip line goes ahead as there will be a major increase in the amount of footfall.
3. Introduce nitrogen fixation: One area sampled has a low nitrogen concentration which can cause stunted plant growth. Legumes such as clover can be introduced to the woodland to help increase nitrogen levels (GOV.UK, n.d.). Introducing plants like this will help increase the nitrogen concentration in the soils.

When implementing the management plan it's important to consider how to minimise soil disturbance e.g. equipment used. Implementing these recommendations will help to increase biodiversity and ecosystem services in the woodland by increasing soil quality, and improving plant development.

Conclusion

Ultimately, the study of soil nutrient levels on Kilvey Hill provided some insights into the health and productivity of the woodland ecosystem through the testing of nitrogen, phosphorus and potassium. The samples were tested using the palintest kit, and the results indicated that soil nutrient levels varied significantly between sampling locations and were frequently inconsistent. The recommendations include increasing soil pH, increasing soil nitrogen levels, and reducing the amount of soil erosion caused by runoff. Due to the inconsistency of the results and the poor method of collection, it's hard to conclude whether the management plan would be effective in improving the soil nutrient levels as the data collected doesn't give an accurate reflection of the site's baseline. Considerably more fieldwork would need to be done to determine a more accurate picture of the soil quality. The study should be repeated obtaining more samples from a wider range of areas as recommended by the palintest guide (palintest, nd) and samples needed to be taken at a greater depth than this study did. Further improvements could be made by incorporating other people's findings and talking to users such as the community volunteer group would help to form a more comprehensive understanding and therefore a more effective long-term management plan.

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