Fieldwork Notebook

Rowan Moses, September 2022 - April 2023

3rd of October 2022 - Bee Survey - Swansea, SA1 Campus

The aim of this survey was to find and identify bee species found in the brownfield site next to the IQ building, using the Blooms for Bees citizen science app. This app was created with Coventry University with the goal to identify which plants are preferred by which bees. By using citizen science, getting non-scientists involved in the data collection, it is possible to gather far more data over a larger area than would otherwise be viable (Coventry University, 2018).

The survey was undertaken in the early afternoon, and the weather was slightly overcast, it wasn't raining but the ground was still damp. The temperature was 15 degrees celsius. Following the instructions of the Blooms for Bees app, a red clover (*Trifolium pratense*) was chosen to watch for five minutes, with the goal of identifying and recording any bee sightings. However, no bees were spotted by anyone surveying, and this could be due to the late season. Varela (2022) describes bumblebees hibernating over the cold season and solitary bees overwintering as grubs in nest cells.

Some students struggled to use the app, and there were limits identified to how specific the app would let you be about recording the plant species chosen for your survey, for example, no separation between white clover and red clover. A second survey session in the spring time could be useful for gathering more bee data.

10th of October 2022 - Tree Identification - Swansea, SA1 Campus and down by the riverside

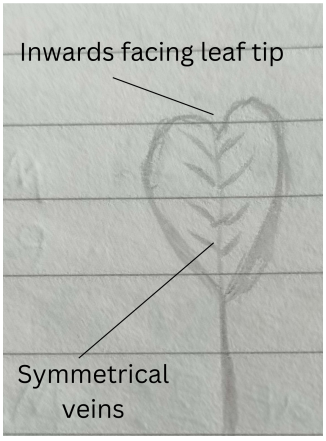


Figure 1: Drawing of an alder leaf.

The purpose of this trip was studying winter tree identification, using factors such as buds, twigs and bark, as deciduous trees were losing their leaves at this time of the year.

The weather was overcast with some sun. Many trees still had some or all leaves. The group particularly struggled to identify the alder tree (*Alnus glutinosa*), see figure 1. It tends to grow in wet areas like riversides, and has purple buds, and leaf tips that point inwards. The roots growing into water bodies provide shelter from fast currents or predators for fish as well. (The Wildlife Trusts, n.d).

Even though Swansea is an urban area, there were a wide range of tree species in the area investigated. However, a few of the specimens seen were dead or not looking especially healthy. This could be due to a number of reasons such as non-salt tolerant species being planted too close to the seafront, or compaction from nearby roads and buildings affecting their ability to grow.

26th of October 2022 - Green Infrastructure Trip - Llanelli

On this trip, we went to several locations to meet with different people for talks and question and answer sessions. The first place we visited was Machynys golf course, which was partially built on Machynys salt marsh, and is neighboured by Llanelli Wetland Centre. When the golf course was under construction, it was decided that a goal of the site was to try and maintain continuity of the wetland coastal ecosystems to encourage wildlife (see figure 2), meaning now there are many species in residence on the site.



Figure 2: Photos taken around the course.

Membership is expensive and limited, meaning this location is not very accessible, especially for low income people. Wildlife tours, designated walking routes and open access days could lessen this inequality while still preserving the ecosystem. It is a beautiful landscape, and especially as parts of Llanelli are in the top 10% of deprived areas in Wales when it comes to factors like employment, education and physical environment, access to a space like this could make a real difference in people's lives (The Carmarthenshire We Want, 2022).



Figure 3: Foothold Cymru Community Garden.

The next visit on this trip was to the community garden run by the charity Foothold Cymru in Trostre, outside Llanelli. Foothold Cymru works to alleviate poverty and provide people with practical skills, and their community garden has a lot of different features than Machynys golf course. It's small, in the middle of a very industry heavy area, and it's open to everyone, and they specifically try to engage young people and people with no other access to green spaces. They grow food in polytunnels and in raised beds, as shown in figure 3. Having far fewer resources such as time, space and money than somewhere like Machynys, they manage to engage the local

community more equitably than Machynys appears to. A site that could combine the strengths of both places could really benefit local communities, and both sites aid conservation on different scales.

27th of October 2022 - River Ilston Assessment - Gower

Our goal during this fieldwork was to assess how the characteristics of the river Ilston change at different points along the course of the river, and learn some basics of hydrological theory. This river has been the subject of other studies, such as Lawler's examination of the role that ice plays in erosion on its banks (1993), and is used by local communities for leisure and recreational purposes at varying points along its course.



Figure 4: The beginning of the route down to Ilston river.

The study began mid morning, almost at the source of the river, near Swansea Airfield (figure 4). Weather was cold and slightly overcast. A proper testing regime had been devised, but we had some issues accessing lab equipment on the day, so it was more of a mock up demonstration of how most of the tests would work.

We used kick sampling to study the macroinvertebrates, and depth sticks and tape measure to gather data about the width and depth of the river at different test points down the river. We also used the orange test to measure water surface velocity, by measuring how fast an orange floats downstream between two points. We didn't end up with any actual data at the end of it due to the equipment issues mentioned above, but it demonstrated how that kind of data gathering could work. Different parts of Ilston river are affected by different environmental conditions. In the village of Ilston, the riverbed has been edged with concrete to prevent the erosion of the road that runs next to it. This forces the river to run in a smaller area, making it faster flowing, and potentially more prone to flooding.

14th of November 2022 - Sand Dune Survey - Dunes Opposite SA1 Campus

The aim of this activity was to survey the sand dune flora, using transect lines and quadrat frames, and identify the plants found using identification keys. The weather was rainy and cold, so we had rain covers for the identification guides and our notebooks. The wind was coming off the sea.

In pairs, each pair measured out a 20m transect line, placing a quadrat every 5m, meaning 4 quadrat measurements were taken in total. The results recorded below are of a cover measure,

in which every square of the quadrat in which the plant is present is counted, rather than just every square in which it is rooted. Quadrat 1 was taken at the very front of the dune, working back up the dune (figure 5).



Figure 5: Transect line on sand dune.

Quadrat 1:

- Marram grass - 100/100 Squares.
- Ragwort - 1/100 Squares.

Quadrat 2:

- Marram grass - 41/100 Squares.
- Dewberry - 19/100 Squares.
- Dandelion species - 7/100 Squares.

Quadrat 3:

- Dewberry - 35/100 Squares.
- Dandelion species - 19/100 Squares.
- Wild carrot - 15/100 Squares.
- Marram grass - 10/100 Squares.
- Sea spurge - 1/100 Squares.
- Ragwort - 1/100 Squares.
- Vetch species - 1/100 Squares.

Quadrat 4:

- Sheep's fescue - 100/100 Squares.
- Dewberry - 35/100 Squares.
- Wild carrot - 12/100 Squares.
- Burnet saxifrage - 11/100 Squares.
- Marram grass - 5/100 Squares.
- Vetch species - 4/100 Squares.
- Ragwort - 1/100 Squares.

The further back from the sea that we got, the more different plants were present. We noticed that the wind coming off the sea was cold and brought salty spray up on the front of the dunes, potentially making it harder for plants to grow there. The wind is broken by the front of the dunes and so tapers off towards the back, so more plants can grow. Marram grass *(Ammophila arenaria)* is tough and salt tolerant, growing in nutrient poor, free draining soils, with its roots helping to stabilise dunes (Dynamic Dunescapes, n.d), and it was found in every square of the quadrat frame in the first quadrat measurement taken, closest to the sea. *A. arenaria* was discovered to have the strongest impact on erosion reduction when compared to *Cakile maritima* and *Salsola kali*, two annual plants commonly found on sand dunes (De Battisti and Griffin, 2020).

Despite the weather, there were multiple dog walkers walking on the paths through the dunes, and it is often much busier when the weather is good during the summer, so conservation efforts here would have to take the high use of the site into account.

16th January 2023 - Owl Pellet Dissection - Lab



Figure 6: Owl pellet material.

For this activity, we were in the lab to dissect owl pellets (figure 6). Pellets are the indigestible parts of prey that are regurgitated by many kinds of bird. They're often especially identifiable when produced by raptors, as undigested fur, feathers and bones are common and obvious to spot (BBC Wildlife, 2023). By identifying the bones found in owl pellets, a lot of information can be collected about the animals that the owl eats, including the habitat range and species distribution. Additionally, by analysing the presence of heavy metals in the pellets, they can even be used to track environmental contaminants such as pesticides, as due to biomagnification these contaminants will build up in predator animals (Nazneen *et al,* 2022).

The owl pellets used in this dissection were from Parc Le Breos, in Gower. The pellets were old, and had been stored together, and not been dried prior to storage, so it was hard to differentiate a singular pellet. Instead, we measured out 30g of the material to examine.

Identified Items:

- 2 upper jawbones, vole. One had teeth still intact, and one didn't.
- Small lower jaw (figure 7). Teeth were removed to examine root holes, and it was measured with callipers, 6mm in length. Potentially an unusual wood mouse, or a harvest mouse.
- 23 other unidentified bones, mostly vertebrae.



Figure 7: Jawbone being examined.

The owls at Parc Le Breos seemed to primarily eat rodents such as voles. However, as the material had not been stored correctly, more fragile evidence such as that of amphibians may have been damaged beyond easy recognition.

6th February 2023 - Bird Survey - Blackpill

Blackpill beach was classified as a Site of Special Scientific Interest in 1986, because of the number of bird species which are found in the area, both ones that live here year round and ones that stop off as part of migration (Swansea Council, 2021). On our trip here, our intention was to survey the birds present, using a British Trust for Ornithology Wetland Bird Survey sheet as an example of how bird species data can be recorded.



Figure 8: Blackpill beach.

The weather was cold but sunny, with mostly clear skies, and not much wind (figure 8). We began our survey at 11:30am, at grid code SS627903, and continued watching for approximately an hour.

Birds Seen:

- Crow = 7
- Seagull = 53
- Kittiwake = 1

The crows seen were all on the upper beach, furthest away from the sea. There was a large number of seagulls, but because of their distance it was hard to identify the species present, apart from the kittiwake. Adult kittiwakes (*Rissa tridactyla*) have black legs, compared to the common gulls which have yellow legs. They breed in the spring and summer, and spend winters at sea, and they eat fish, worms and shrimp (RSPB, n.d).

Blackpill beach was the site of the first recorded sighting of a ring billed gull *(Larus delawarensis)* in the United Kingdom. Native to North America, the ring billed gull is rare to see in the UK (British Trust for Ornithology, n.d; Vinicombe, 1985). Blackpill has also been the site of botanical study, Smith (2010) studied the morphological and physiological differences between Hoary Mustard (*Hirschfeldia incana*) in its native range in Crete, and the non-native specimens found in Blackpill and other sites in Swansea. He found that there appear to be morphological and physiological differences between the two populations that could indicate genetic differences also.

27th February 2023 - Analysis of Stream Quality Report - Singleton Park

1. Introduction

Water plays a vital role in both human society and in the functioning of ecosystems. The concept of water quality, or the characteristics of water, is thought to have originated with the beginning of what we would recognise now as civilisation, and humanity has been attempting to alter water quality since at least 4000 BCE (Li & Migliaccio, 2019).

Freshwater ecosystems support a wide range of both terrestrial and aquatic wildlife, and play a crucial role in the water cycle of the Earth. Fresh water is used for drinking, industry, recreation, in addition to providing vital habitats for wildlife, but it is a limited resource, with only a

comparatively small amount of the Earth's water being non-saline (United Nations, n.d). There are three primary characteristics water quality is measured by: chemical, biological, and physical. Each of these can be assessed in different ways (The Open University, 2023), depending what the aim of the study is.



Figure 9: The test site at Brynmill Stream.

The objective of this study was to analyse the water quality of Brynmill Stream, located in Singleton Park, Swansea (see figure 9). The focus was on determining biological quality by undertaking a species count, and then using a biotic index to gauge the pollution level of this stream.

2. Methodology

As the aim of this study was to survey the benthic macroinvertebrates present in Brynmill Stream, we used a technique called kick sampling to allow us to collect the macroinvertebrates for counting, as many would not be visible in the streambed as they live on the underside of rocks or in material such as leaves on the bottom of the stream. Many macroinvertebrates are considered bioindicator species, as different species can tolerate different levels of pollution. This means if pollution sensitive species are discovered in a test area, the pollution levels in that area are low (Tampo *et al,* 2021), and a biotic index helps to determine a numerical value for the quality this indicates.

Kick sampling is a common way to collect species for this type of study. It involves placing a kick net against the base of the river, and while standing just upstream, the assessor kicks to disturb the riverbed and wash organisms into the net (Field Studies Council, 2023). For this study, the duration of time that the assessors kicked for was 01:00 minute. Before undertaking this method of study, the body of water should be assessed for dangers such as deep water or unstable banks, and this survey method should not be conducted alone.



Figure 10: The initial sample container, before sorting takes place.

The organisms collected were then placed into a tray of water. From here, they could be sorted into a segmented container, using a pipette to pick up and release individuals, and placed in different compartments based on similar appearance to the naked eye (see figure 10). This allows the process of identification of the species present to begin, which then leads to being able to undertake the counting of each species present to collect the primary data. This method is mainly used to study either species diversity or to investigate the presence/absence of particular species (NHBS, 2019).

Identification was undertaken using a dichotomous key of freshwater species, which is a type of identification key based on observable physical characteristics (see figure 11). While using this key, the user is presented with a series of pairs of mutually exclusive choices which, via process of elimination, seek to identify the organism in question, at least in broad strokes (Martinez, 2020). All of the organisms collected during the kick sampling session were able to be identified using this method, and then were counted and the number of each organism present was recorded. After this, organisms were released back into the stream at the point at which they had been collected.

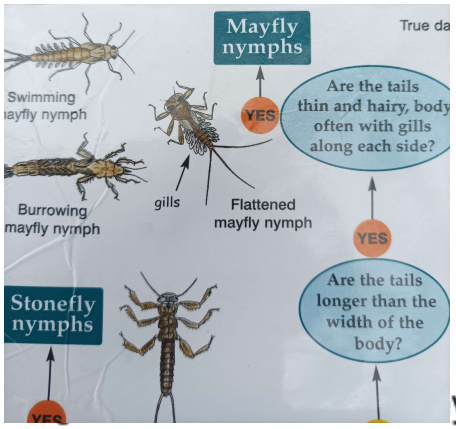


Figure 11: Dichotomous key.

3. Results and Analysis

3.1 Results of the Study

A variety of organisms were collected during the course of this study. Figure 12, as pictured below, is a graph showing both the different taxa found and the number of individuals in each of these groups.

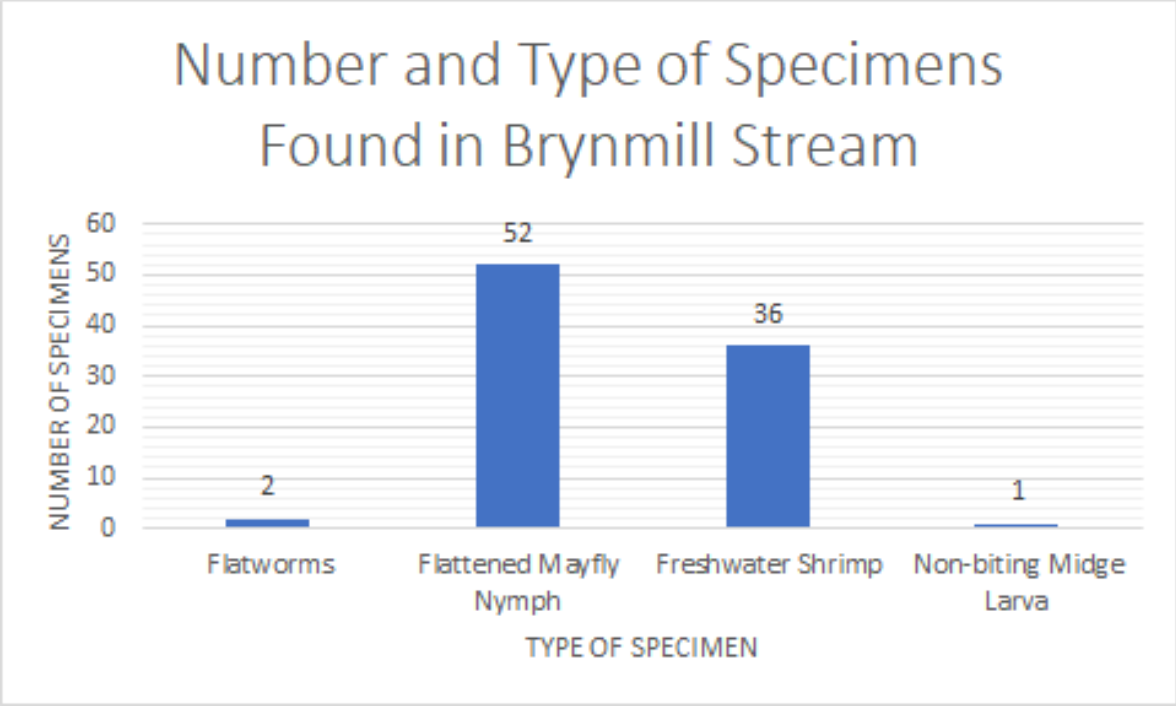


Figure 12: Graph showing results of study.

Specimens from a total of four different taxa were collected, with Flattened Mayfly Larva being the most common, followed by Freshwater Shrimp and Flatworms, with Non-biting Midge Larvae being the least common find in this dataset.

3.2 Analysis of Data

For this study, the Biological Monitoring Working Party (BMWP) Score will be used to analyse the results gathered. This is a biotic index that was developed in the 1970s-80s (Hawkes, 1998), that functions by assigning pollution tolerance scores to a range of families of benthic macroinvertebrates. These can then be added together, and the higher the overall score is, the better the water quality of the sample site. The table below (Table 1) shows the taxa found in this study with their corresponding BMWP score (Exmoor National Park, n.d).

TAXON	**BMWP SCORE**
Flatworm	5
Flattened Mayfly Nymph	10
Freshwater Shrimp	6
Non-biting Midge Larva	4

Table 1: Table of Taxa and BMWP scores.

Therefore using this ranking, the BMWP score of this site would be 25. This comes under the “poor” category, where the water body has been impacted by pollution (Bourne Stream Partnership, 2012). Scores of >100 are ranked as very good, unimpacted by pollution (Kucuk, 2008).

3.3 Taxon Analysis

The taxon with the most individuals collected was the Flattened Mayfly Nymph (see figure 12). They belong to the order *Ephemeroptera*, and are aquatic insects, with the juveniles living in freshwater and the adults living around the water body they were born into (Kondratieff, 2008). These juveniles, known as nymphs, are highly sensitive to pollution and deoxygenation, while being abundant in water bodies in good condition, and relatively easy to identify to their genera. Because of this, they are a bioindicator species used to gather information about water quality (Firmiano et al, 2017), and their high presence in these



Figure 12: Flattened Mayfly Nymphs in sample container.

test results implies an overall good water quality at the sample site.

Freshwater Shrimp also appeared frequently in sampling. They are not true shrimp, and are part of the order *Amphipoda*. They are common all year round, especially in flowing water (Forth Rivers Trust, n.d). As with mayflies, they are sensitive to low levels of dissolved oxygen in the water, but it is only prolonged exposure that is damaging to them, inhibiting growth and increasing disease levels (Food and Agriculture Organization of the United Nations, 1986). Precisely because they are common, and because they are highly affected by varying pesticides and other polluting chemicals which affect their metabolisms, they serve as a good bioindicator species (CEMAGREF, 2010).

3.4 Limitations of Study

Some potential weaknesses in the study methodology were identified. Primarily, the size of the sample and amount of samples taken limits the possibility and accuracy of statistical analysis. The sample taken was taken on one day, which does not provide information about the bigger picture of the water quality at Brynmill Stream. A better testing regime would involve sampling more sites along the stream, multiple times to provide accurate data, as in the study undertaken by Ariella & Moesriati (2017). This would ensure results reflected the whole reality of the water body being studied. Once data indicating water quality has been collected, more research would be required into the wider area around the stream and the history of the area to decide on the cause of any environmental degradation found and the best way to manage the site to enhance the area for conservation.

The sampling method, kick sampling, is based on individual actions that are hard to standardise. This means that results may be biased by the test performers. The “kick” in kick sampling can be timed, but the force of the kicking is not measured. It also may be difficult to sample across the whole stream habitat, and the taxa found in the margins may differ from those found in the centre of a stream bed. There is also suggestion that this method is flawed for sampling rare taxa, as more sampling sessions than usually undertaken would be required to accurately represent the numbers of such taxa, as discussed by Bradley & Ormerod (2002). This paper suggests more intensive testing regimes and the development of additional sampling programmes as a way to overcome this weakness.

Finally, limitations have been identified to the method used to analyse the data in this study. The BMWP scoring system takes into account the number of families, rather than number of species, which may result in bias, as there is the potential for a location that has a large number of low scoring taxa to score as highly as a location with a few high scoring taxa (Everall *et al,* 2017). This could be addressed in further studies by using additional scoring methods such as the Average Score Per Taxon to give a more accurate result.

4. Conclusion

This study aimed to assess the water quality of Brynmill Stream, by sampling the benthic macroinvertebrates and using the BMWP biotic index to analyse the data collected. A variety of taxa were collected, such as Flattened Mayfly larvae and Freshwater Shrimp. Each species found have their own requirements for water quality to live, and this combined with the results of the BMWP scoring system suggests that the biological water quality of the stream is poor, and has been impacted by pollution. Singleton Park is a well used park, in an urban area that has a history of heavy industry, and evidence of pollution in the stream would track with that pattern of usage. Information about the pollution present on a site, and its causes, can be used to inform management plans seeking to protect and enhance an area, and raising awareness of how to ensure further environmental damage does not take place. Without having this knowledge, environmental degradation may proceed unnoticed, and these issues will only become more intense as the climate crisis progresses.

However, this study was limited by the low number of samples and analysis methods used. There are many things still to learn about Brynmill Stream, and it would definitely benefit from further investigations into the site.

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